

Approved

State of Idaho
DOPL

PA#: 1613316
Date: 10/30/2025

These documents are approved contingent on the compliance with the mark-ups and notes applied.

This approval shall not be construed to be an approval of any violation of, or variance from, Idaho's adopted codes, standards, laws or rules applicable to this project.

DIVISION OF OCCUPATIONAL &
PROFESSIONAL LICENSES

DOPL

Project Manual

for

UI: Replace Chiller, CNR

University of Idaho
Moscow, Idaho

October 3, 2025

DPW# 23251 | Coffman# 231760



221 N Wall St., Suite 500
Spokane, WA 99201
509-328-2994
www.coffman.com

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ADVERTISEMENT FOR BIDS

Sealed proposals will be received by Division of Public Works, State of Idaho at **875 Perimeter Drive. c/o Ken Cook, MS 2281, Moscow, Idaho 83844-2281** until **2:00 PM**, local time, **Tuesday December 16th, 2025**, for **DPW Project No. 23251, RE-BID Chiller Replacement in the College of Natural Resources (CNR) Building, University of Idaho, Moscow, Idaho.**

A description of the work of this project can be summarized to include replacement of the chilled water system and existing fisheries water distribution systems, water mixing stations, and chlorine analyzer at the College of Natural Resources fisheries lab at the University of Idaho. Alternate No. 1 includes installing automatic mixing stations throughout the laboratory.

Proposals will be opened and publicly read at the above hour and date.

Plans, specifications, proposal forms and other information are on file for examination at the following locations:

Division of Public Works, 502 N. 4th St., Boise, ID, 83702 (208) 332-1900
University of Idaho, Architectural and Engineering Services, 875 Perimeter Dr., Moscow, ID, 83844
Associated General Contractors, 1649 W Shoreline Dr., Ste. 100, Boise, ID 83702 (208) 344-2531

<https://www.idahoagc.org/plan-room>

Blueprint Specialties, 6205 W. Overland Rd., Boise, ID 83709 (208) 377-0294 www.docuproject.com

Spokane Regional Plan Center, 209 N. Havana St., Spokane, WA 99202 (509) 328-9600

Lewiston-Clarkston Plan Service, 2117 12th Ave., Lewiston, ID 83501 (208) 746-3591

Coffman Engineers, 221 N Wall St. Suite 500, Spokane WA. 99201 (509) 328-2994

A bid bond in the amount of 5% of the total bid amount, including any add alternates, is required.

One set of documents may be obtained by licensed general contractors and by licensed mechanical and electrical subcontractors from the Design Professional for a refundable deposit of \$350. Others may obtain documents at cost, non-refundable.

A pre-bid conference will be held on **Tuesday, December 2nd, 2025**, beginning at **10:00 AM**, prevailing local time, at the **University of Idaho, Facility Building, 875 Perimeter Drive, Moscow, Idaho then continuing to College of Natural Resources (CNR) 975 W 6th St, Moscow, Idaho 83844.** Bidders are encouraged to attend.

☐ A Public Works Contractors License for the State of Idaho is required to bid on this Work.

Estimated Cost: \$1,722,000

DATED: _____

Kelly Berard, Deputy Administrator
Division of Public Works

END OF ADVERTISEMENT FOR BIDS

ADVERTISEMENT FOR BIDS

BOILERPLT-2025 dbb.doc JUNE 2025

AB - 1

(DPW Project #23251)
(October, 2025)

INSTRUCTIONS TO BIDDERS

GENERAL PROVISIONS

DEFINITIONS: Capitalized terms used in these Instructions to Bidders ("Instructions") shall have the meaning given to them in the Division of Public Works' Fixed Price Construction Contract Between Owner and Contractor.

HEADINGS: Headings used in these Instructions are for convenience only.

REJECTION OF BIDS, WAIVER OF INFORMALITIES OR CANCELLATION: Prior to the effective date of a contract, the Administrator of the Division of Public Works shall have the right to accept or reject all bids, to waive any minor deviations/informalities or to cancel the bid.

ORAL INFORMATION: Questions concerning a bid must be directed in writing to the designated Design Professional (architect or engineer) no less than ten (10) calendar days before bids are due unless provided otherwise via an addendum. Oral information is not binding and any reliance by a bidder on any oral information or representation is at the bidder's sole risk. Any information given a prospective bidder in response to a written question will be provided to all prospective bidders by an addendum, if such information is necessary for purposes of submitting a bid or if failure to give such information would be prejudicial to uninformed bidders.

PUBLIC RECORDS: The Idaho Public Records Law, Title 74, Chapter 1, Idaho Code, allows the open inspection and copying of public records. Public records include any writing containing information relating to the conduct or administration of the public's business prepared, owned, used, or retained by a State or local agency regardless of the physical form or character. Unless exempted by the Public Records Law, your bid will be a public record subject to disclosure under the Public Records Law. Any questions regarding the applicability of the Public Records Law should be addressed to your legal counsel prior to submission.

FORM OF AGREEMENT: Unless otherwise specified in the bid documents, the agreement between the successful bidder and the Owner ("State of Idaho") shall be the Division of Public Works' Fixed Price Construction Contract Between Owner and Contractor.

PERFORMANCE AND PAYMENT BONDS: A performance bond and payment bond are required for this Project, each in an amount of not less than one hundred percent (100%) of the Contract Price. The performance and payment bonds shall be AIA Document A312, 1984 or the most recent Edition, or a standard surety form certified approved to be the same as the AIA A312 form and shall be executed by a surety or sureties reasonably acceptable to the Owner and authorized to do business in the State of Idaho. Bonds must be provided within ten (10) calendar days following receipt of a Notice of Intent to Award.

BID SUBMISSION PROCESS

BID DOCUMENTS: The bid documents are available from the Design Professional or as provided in the Invitation to Bid or advertisement for bids. The responsibility is on the bidder to use a complete set

of bid documents to prepare its bid and neither the Owner nor the Design Professional shall incur any liability for the bidder's failure to do so. Bidders obtain no ownership interest or any use rights, except to use in preparation of their bid, by issuance of the bid documents.

Bidders and Sub-bidders shall field verify all dimensions pertaining to the Work and shall be responsible for the determination of all quantities of materials required for the completion of the Work. The bidder shall not rely on the scale drawings of the Bidding Documents in its determination of required materials quantities. No allowance shall be made for Bidder's failure to field-verify dimensions.

If a deposit is required, the deposit will be returned to a bidder returning the complete bid documents in good condition no more than twenty (20) days after a Notice of Intent is issued and the amount of any deposit returned may be reduced if the bid documents returned are not complete or are damaged. A bidder awarded a Contract may also keep the bid documents and any deposit will be returned.

ADDENDA: In the event it becomes necessary to revise any part of the bid documents, addenda will be issued. Information given to one bidder will be available to all other bidders if such information is necessary for purposes of submitting a bid or if failure to give such information would be prejudicial to uninformed bidders. It is the bidder's responsibility to check for addenda prior to submitting a bid. A bidder is required to acknowledge receipt of all addenda by identifying the addenda numbers in the space provided on the bid proposal form. Failure to do so may result in the bid being declared non-responsive. No addenda will be issued less than four (4) calendar days before the closing date unless the bid closing date is extended.

REVIEW: It is the bidder's responsibility to review the bid documents and compare them as needed, including, with regard to, any other Work that is or may be under construction that might affect the bidder or its Work, to examine the site and local conditions and to report, in writing, any questions, errors, inconsistencies or ambiguities to the Design Professional.

PRODUCTS SPECIFIED AND PROPOSED SUBSTITUTIONS: Materials, products, or equipment, if specified by name or manufacturer, establish the standard of quality required and that must be met by any proposed substitution. Requests for substitutions must be made in writing to the Design Professional no less than ten (10) calendar days prior to the bid closing unless provided otherwise via an addenda. Such requests must provide detailed information to allow the Design Professional to determine if the proposed substitution is acceptable, including drawings or performance or test data and a detailed statement of how the substitution would change any other part of the Work. It is the bidder's obligation to satisfy this requirement and the Design Professional's decision shall be final. To be allowed, substitutions must be approved in an addendum to the bid documents.

BID FORM: Bids must be submitted on the bid proposal forms, or copies of forms, furnished by the Owner or the Design Professional. Bids submitted must contain all original signatures in ink on the following forms:

1. Bid Proposal Form;
2. Contractor's Affidavit Concerning Alcohol and Drug-Free Workplace;
3. Bidder's Acknowledgment Statement and;
4. Bid Bond (bid security).

The person signing the Bid Proposal Form must initial any and all changes appearing on any of the bid forms. If the bidder is a corporation or other legal entity, the bid forms must be signed by an authorized

designee. Oral, telephonic, telegraphic, facsimile, or other electronically transmitted bid forms and/or signatures will not be considered.

BID PRICES: The bid form may require bidders to submit bid prices for one (1) or more items on various bases, including lump sum base bid, lump sum bid alternate prices, unit prices or any combination thereof. Bid amounts shall be expressed in words and numbers. The amount in words shall prevail if there is a discrepancy.

ALTERNATES: If the solicitation/bid includes alternate bid items or unit prices, failure to bid on the alternates or unit prices may disqualify the bid. If bidding on an alternate does not change the base bid, indicate by "No Change." If bidding on all items is not required by the Contract Documents, bidders must affirmatively indicate that they are not bidding on those items.

TIME FOR SUBMISSION: Bids must be submitted on or before the time specified in the advertisement for bids. Any bid submitted late will be rejected.

SEALED ENVELOPE: Bids shall be submitted in a sealed envelope with the following clearly printed on the outside of the envelope: the Project number and Project name; the name and address of the bidder; and a statement, such as "BID ENCLOSED" to indicate that it is a bid.

MAILED BIDS: When bids are mailed or shipped, the sealed envelope containing the bid shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof. If mailed, the mailing envelope shall be addressed as follows:

Division of Public Works c/o Ken Cook, DPW-FR
UI Facilities Services Building
875 Perimeter Drive, MS2281 Moscow, ID 83844-2281

It is the bidder's responsibility to ensure that its bid is delivered to the place designated for receipt on or before the specified closing time. The Owner assumes no responsibility for delays in the delivery of mail by the U.S. Post Office or private couriers. Bidders should be advised the intra-state mail system may increase delivery time from arrival at Central Postal to the place designated for receipt and should plan accordingly. **LATE SUBMISSIONS WILL BE REJECTED, WILL NOT BE OPENED AND WILL BE RETURNED TO THE BIDDER. NO DEVIATIONS WILL BE ALLOWED.**

BID CLOSING DECLARED: Immediately prior to the bid opening, the Owner's representative will declare the official bid closing. Any part of a bid not received prior to the bid closing declared by the designated representative will not be considered and will be returned to the bidder unopened. All bids shall be taken under advisement.

DRUG-FREE WORKPLACE: Along with its bid, the bidder shall submit an affidavit certifying compliance with Title 72, Chapter 17, Idaho Code, requiring the Contractor and its subcontractors at the time of bid to provide a drug-free Workplace program and to maintain such program throughout the duration of the Contract. The form of affidavit is attached.

ILLEGAL ALIENS: Bidder shall warrant that the bidder does not knowingly hire or engage any illegal aliens or persons not authorized to Work in the United States; bidder shall take steps to verify that it does not hire or engage any illegal aliens or persons not authorized to Work in the United States; and that any misrepresentation in this regard or any employment of persons not authorized to Work in the

United States constitutes a material breach and shall be cause for the imposition of monetary penalties and/or termination of any Contract resulting from this bid.

LEGAL RESIDENCY REQUIREMENT: By submitting a bid, the bidder attests, under penalty of perjury, that it (the bidder) is a United States citizen or legal permanent resident or that it is otherwise lawfully present in the United States pursuant to federal law. Prior to being issued a contract, the bidder will be required to submit proof of lawful presence in the United States in accordance with §67-7903, Idaho Code.

BIDDER'S ACKNOWLEDGEMENT STATEMENT: The attached Bidder's Acknowledgement Statement must be completed and included, or the bid may be found non-responsive.

PUBLIC WORKS CONTRACTOR'S LICENSE: This Project is not financed in whole or in part by federal funds. Bids will be accepted from those Contractors only (prime contractors, subcontractors and/or specialty contractors) who, prior to the bid opening, hold current licenses as public Works contractors in the State of Idaho.

IDAHO LABOR REQUIREMENTS: This Project is subject to the provisions of Sections 44-1001 and 44-1002, Idaho Code, dealing with labor preference.

IDAHO PREFERENCE LAW: Section 67-2348, Idaho Code, requires the Division of Public Works to apply a preference in determining which Contractor submitted the lowest responsible bid. If the Contractor who submitted the lowest dollar bid is domiciled in a state with a preference law that penalizes Idaho domiciled contractors, the Division of Public Works must apply the preference law (percentage amount) of that domiciliary state to that Contractor's bid.

NAMING OF SUBCONTRACTORS: Section 67-2310, Idaho Code, requires general (prime) Contractors to include in their bid the name of the subcontractors who shall, in the event the Contractor secures the Contract, subcontract the plumbing, HVAC, and electrical Work under the general (prime) Contract. Failure to name subcontractors as required by this section shall render any bid submitted by a general (prime) Contractor nonresponsive and void. Subcontractors named in accordance with the provisions of this section must possess an appropriate license or certificate of competency issued by the State of Idaho covering the Contractor Work classification in which the subcontractor is named.

The Division of Public Works interprets Section 67-2310, Idaho Code, to mean three (3) separate areas of Work: plumbing Work, HVAC, and electrical Work. The Division of Public Works also requires that the general (prime) Contractor name the entity that will perform the Work, including if the entity is a subcontractor, a sub-subcontractor or the general (prime) Contractor submitting the bid. Failure to complete the Bid Proposal in full shall render a bid nonresponsive and void.

With regard to possessing an appropriate license or certificate of competency, all subcontractors listed by the general (prime) Contractor must have at the time of the bid opening a current license in the appropriate category (class, type and specialty category) as issued by the Public Works Contractors State License Board. In addition, plumbing, HVAC and electrical subcontractors shall have at the time of the bid opening a valid plumbing contractor's license, HVAC contractor's license or electrical contractor's license, respectively, as issued by the Idaho Division of Occupational and Professional Licenses.

In determining if the above listed subcontractors are required on the Project, the Division of Public Works will refer to the plans and specifications. If doubt exists prior to bid closing, potential bidders

should contact the Division of Public Works and the Design Professional who prepared the plans and specifications will be requested to make the determination. If plumbing, HVAC or electrical Work are not shown on the plans and specifications but are discovered by the bidder prior to the date of bid opening, then the bidder must request clarification from the Design Professional. Absent such clarification, Work will be considered incidental, and naming of a subcontractor will not be required.

BID SECURITY

AMOUNT AND FORM OF SECURITY: To be considered, bids must be accompanied by an acceptable bid security in an amount not less than five percent (5%) of the total amount of the bid, including additive alternates. The security may be in the form of a bond or a certified or cashier's check. A standard surety bid bond form meeting all the conditions of AIA Document A310 is acceptable and, if used, must include a certified and current copy of the power of attorney if the bond is executed by the attorney-in-fact on behalf of the surety.

FORFEITURE: A successful bidder who fails to sign the Contract for the Work or furnish the required bonds within ten (10) calendar days following the receipt of notice of intent to award a Contract is subject to forfeiture in accordance with Section 54-1904E, Idaho Code.

RETENTION OF SECURITY: Bid security shall be retained for no more than forty-five (45) calendar days after the opening of bids, so long as the bidder has not been notified of the acceptance of the bid.

BID WITHDRAWAL

PRIOR TO BID CLOSING: If a bid has been submitted, it may be withdrawn in person by a bidder's authorized representative before the opening of the bids. A bidder's representative will be required to show identification and sign on a bid summary sheet before it will be released. After bid closing, no bid may be withdrawn except in strict accordance with these Instructions or applicable law.

BID MODIFICATION

PRIOR TO BID CLOSING: If a bid has been submitted, it may be modified by the submission of a written document contained in a separate sealed envelope marked "Bid Modification from [Name of Bidder] for DPW Project No: 23251; UI: Replace Chiller, CNR." **THE DOCUMENT MODIFYING THE BID MUST BE SIGNED IN INK BY AN AUTHORIZED REPRESENTATIVE OF THE SUBMITTING BIDDER. THE DIVISION OF PUBLIC WORKS RESERVES THE RIGHT TO REQUIRE PRESENTATION OF EVIDENCE SATISFACTORY TO IT TO ESTABLISH THE AUTHORITY TO ACT ON BEHALF OF THE SUBMITTING BIDDER. NO OTHER FORM OF MODIFICATION (INCLUDING TELEPHONE, FACSIMILE OR ELECTRONIC MAIL) WILL BE ACCEPTED. AFTER BID CLOSING, NO BID MAY BE MODIFIED EXCEPT IN STRICT ACCORDANCE WITH THESE INSTRUCTIONS OR APPLICABLE LAW.**

RELIEF FROM BIDS

CONDITIONS FOR RELIEF: Relief from bids is subject to Sections 54-1904B through 54-1904E, Idaho Code. In the event a bidder discovers a mistake in its bid following the bid opening and wishes to withdraw its bid, the bidder shall establish to the satisfaction of the Owner, pursuant to Section 54-1904C, Idaho Code, that a clerical or mathematical mistake was made; the bidder gave the public entity (Owner) written notice within five (5) calendar days after the opening of the bid of the mistake, specifying in the notice in detail how the mistake occurred; and the mistake was material.

DETERMINATION: If the Owner determines that the bidder has satisfied the requirements of Section 54-1904C, Idaho Code, to entitle it to relief from a bid because of a mistake, it shall prepare a report in writing to document the facts establishing the existence of each required element. The report shall be available for inspection as a public record and shall be filed with the public entity soliciting bids. A bidder claiming a mistake and satisfying all the required conditions of Section 54-1904C, Idaho Code, shall be entitled to relief from the bid and have any bid security returned by the Owner. Bidders not satisfying the conditions of Section 54-1904C, Idaho Code shall be subject to forfeiture in accordance with Section 54-1904B, Idaho Code. A bidder who claims a mistake or who forfeits its bid security shall be prohibited from participating in any re-bidding of that project on which the mistake was claimed, or security forfeited, and the Owner may award the Contract to the next lowest responsive and responsible bidder.

BIDDER'S REPRESENTATIONS

REPRESENTATIONS UPON SUBMITTING A BID: By submitting its bid, a bidder represents and warrants the following:

1. The person signing the bid is authorized to bind the bidder;
2. It has all required licenses, permits or other authorizations necessary to submit its bid;
3. It has taken steps necessary to ascertain the nature and location of the Work and has investigated and satisfied itself as to the general and local conditions which can affect the Work or its cost, including but not limited to: (i) conditions bearing upon transportation, disposal, handling and storage of materials; (ii) the availability of labor, water, natural gas, electric power and roads; (iii) uncertainties of weather, river stages or similar physical conditions at the site; (iv) the conformation and conditions of the ground; and (v) the character of equipment and facilities needed preliminary to and during the Work;
4. It has satisfied itself as to character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including exploratory Work done by the Owner as well as from the drawings and specifications provided as part of the bid package, and that any failure of the bidder to take such actions will not relieve the bidder from responsibility for estimating properly the difficulty and cost of successfully performing the Work;
5. It has received, read and reviewed the Contract, has submitted any questions in writing regarding the same and has received an answer to such questions;
6. Its bid is based upon the requirements of the Contract without exception;
7. It is in compliance with Title 72, Chapter 17, Idaho Code, regarding a drug-free Workplace and has included the required affidavit regarding the same;
8. Its bid is in compliance with employment of persons authorized to Work in the United States;
9. It will retain bid security and hold and honor all base bid prices for forty-five (45) calendar days from the date of bid opening, and cannot be withdrawn after the bid opening;
10. Its bid prices shown for each item on the bid proposal form include all labor, material, equipment, overhead and compensation to complete all the Work for that item; and
11. It has included in its bid amount Idaho sales and/or use taxes on all materials and equipment and all other taxes imposed by law.

BID AWARD

AWARD METHOD: Public Works construction contracts for the State of Idaho are awarded to the "lowest responsible and responsive bidder." The low bidder, for purposes of award, shall be the responsible and responsive bidder offering the low aggregate amount for the base bid item, plus any additive or deductive bid alternates selected by the Owner, and within funds available as determined by the Owner. Bid Award is also subject to the requirements of Idaho Code, including without limitation: Title 67, Chapter 57; Title 67, Chapter 23; Title 54, Chapter 19; and Title 44, Chapter 10. It is the bidder's responsibility to conform to **ALL** applicable federal, state, and local statutes or other applicable legal requirements. The information provided herein is intended to assist bidders in meeting applicable requirements but is not exhaustive and the Owner will not be responsible for any failure by any bidder to meet applicable requirements.

DETERMINATION OF RESPONSIBILITY: The Owner reserves the right to make reasonable inquiry about or from the submitting bidder or from third parties to determine the responsibility of a submitting bidder. Such inquiry may include, but not be limited to, inquiry regarding experience and expertise related to the Project, manpower and other resources, financial stability, credit ratings, references, potential subcontractors, and past performance. The unreasonable failure of a submitting bidder to promptly supply any requested information may result in a finding of non-responsibility.

NOTICE OF EFFECTIVENESS: No Contract is effective until the authorized Owner's official has signed the Contract and the Notice to Proceed has been issued. The bidder shall not provide any goods or render services until the Contract has been signed by the Administrator of the Division of Public Works and the Contract has become effective. Furthermore, the Owner is in no way responsible for reimbursing the bidder for goods provided or services rendered prior to the signature of the authorized Division of Public Work's official and the arrival of the Notice to Proceed.

INCURRING COSTS: The Owner is not liable for any cost incurred by bidders prior to the Notice to Proceed.

PRIOR ACCEPTANCE OF DEFECTIVE BIDS OR PROPOSALS: The Owner generally will not completely review or analyze bids that appear to fail to comply with the requirements of the bid documents, nor will the Owner generally investigate the references or qualifications of those who submit such bids. Therefore, any acknowledgment that the selection is complete shall not operate as a representation by the Owner that an unsuccessful bid was responsive, complete, sufficient, or lawful in any respect.

POST-AWARD SUBMITTALS: Upon receipt of a Notice of Intent to Award, the apparent low responsive and responsible bidder shall provide documentation required in such Notice. Such Notice of Intent to Award shall generally require the bidder to return to the Owner, within ten (10) days of receipt, a signed Contract, all required bonds, proof of insurance and documentation required by the Idaho State Tax Commission (report and affidavit).

OWNER'S RIGHT TO REJECT: Prior to execution of the Contract, the Owner or Design Professional shall provide written notice of any reasonable objection to any person or entity proposed by the bidder. Upon receipt of such notice, the bidder may withdraw its bid, without forfeiture, or propose a substitute and identify any change in any bid amount caused by such substitution. The Owner may accept or reject the substitution or the adjusted price. If the Owner rejects the substitution or the adjusted price, it will return the bidder's bid guarantee.

END OF INSTRUCTIONS

BID PROPOSAL

TO: STATE OF IDAHO
DIVISION OF PUBLIC WORKS

To Whom it May Concern:

The Bidder, in compliance with your Invitation for Bids for the construction of **DPW Project No. 23251, UI: Replace Chiller, CNR**,, having examined the bidding and Contract Documents and the site of the proposed Work, and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of materials and labor, hereby proposes to furnish all labor, materials and supplies and to provide the service and insurance in accordance with the Contract Documents, within the time set forth therein, and at the prices stated below. These prices are to cover all expenses incurred in performing the Work required under the Contract Documents.

Bidder hereby agrees to commence Work under this Contract on a date to be specified in the written "Notice to Proceed" of the Owner and to substantially complete the Project within Three-Hundred-Sixty-Five (365) consecutive calendar days thereafter, as stipulated in the specifications. Bidder further agrees to pay as liquidated damages, the sum of One-Thousand Dollars (\$1,000) for each consecutive calendar day after the established substantial completion date or adjusted date as established by change order.

Bidder acknowledges receipt of Addenda No. _____.
(List all Addenda)

BASE PROPOSAL: Bidder agrees to perform all the base proposal Work described in the specifications and shown on the plans for the sum of:

_____ Dollars (\$_____)
(Amount shall be shown in both words and figures. In case of discrepancy, the amount shown in words will govern.)

Alternate No. 1: Install automatic mixing stations throughout laboratory

Add the sum of _____ Dollars (\$_____)

Alternate No. 2: _____

Add the sum of _____ Dollars (\$_____)

Alternate No. 3: _____

Add the sum of _____ Dollars (\$_____)

Alternate No. 4: _____

Add the sum of _____ Dollars (\$_____)

Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informality in the bidding.

The bidder agrees that this bid shall be good for a period of forty-five (45) calendar days after the scheduled opening time for receiving bids.

Upon receipt of written Notice of Intent to Award of this bid, Bidder will execute the formal Contract within ten (10) calendar days and deliver a Surety Bond or Bonds as required by paragraph "Performance and Payment Bonds" first page (ITB-1) of the Instructions to Bidders.

The bid security in the amount of five percent (5%) of the bid amount is to become the property of the Owner, in the event the Contract and bond are not executed within the time set forth, as liquidated damages for the delay and additional expense to the Owner caused thereby.

The names and addresses of the entities who will perform the Work identified below, subject to approval of Owner and Design Professional, if Undersigned is awarded the Contract, are as follows:

Plumbing (PWCL Category 15400)

(Name) _____

(Address) _____

Idaho Public Works Contractors License No. _____

Idaho Plumbing Contractors License No. _____

Heating, Ventilating & Air Conditioning (PWCL Category 15700-HVAC)

(Name) _____

(Address) _____

Idaho Public Works Contractors License No. _____

Idaho HVAC Contractors License No. _____

Electrical (PWCL Category 16000)

(Name) _____

(Address) _____

Idaho Public Works Contractors License No. _____

Idaho Electrical Contractors License No. _____

FAILURE TO NAME A PROPERLY LICENSED SUBCONTRACTOR IN EACH OF THE ABOVE CATEGORIES WILL RENDER THE BID UNRESPONSIVE AND VOID.

****INCLUDE THE FOLLOWING IF APPLICABLE****

Should the listing of subcontractors change due to selection of alternates or other similar circumstances, attach explanation.

Bidder warrants that bid has been prepared and that any contract resulting from acceptance of this bid is subject to the Fixed Price Construction Contract.

The undersigned notifies that it is of this date duly licensed as an Idaho Public Works Contractor and further that it possesses Idaho Public Works Contractor's License No. _____, and is domiciled in the State of _____.

Dated this _____ day of _____, 20____.

Respectfully submitted by:

Contractor's Name- Typed

Street or PO Address

City, State and zip code

Authorized Signature

Title

Telephone Number

Email Address

Have you remembered to include bid security (bid bond or a certified or cashier's check), Contractor's Affidavit Concerning Alcohol and Drug-Free Workplace and a signed copy of the Bidder's Acknowledgment Statement with your bid?

CONTRACTOR'S AFFIDAVIT
CONCERNING ALCOHOL AND DRUG-FREE WORKPLACE

STATE OF _____
:ss
COUNTY OF _____

Pursuant to the Section 72-1717, Idaho Code, I, the undersigned, being duly sworn, depose and certify that _____ is in compliance with the provisions of Section 72-1717, Idaho Code; that _____ provides a drug-free Workplace program that complies with the provisions of Title 72, Chapter 17, Idaho Code, and will maintain such program throughout the life of a state construction contract; and that _____ shall subcontract Work only to subcontractors meeting the requirements of Section 72-1717(1)(a), Idaho Code.

FAILURE TO EXECUTE THIS AFFIDAVIT AND SUBMIT IT ALONG WITH YOUR BID SHALL MAKE YOUR BID NON-RESPONSIVE.

Name of Contractor

Address or PO address

City, State, zip code

Signature

Title

Subscribed and sworn to before me this _____ day of _____, _____.

(SEAL)

NOTARY PUBLIC

Residing at: _____

Commission expires: _____

BIDDER'S ACKNOWLEDGMENT STATEMENT

NOTE: THE INFORMATION CONTAINED HEREIN IS A SUMMARY OF VITAL CONTRACT PROVISIONS AND DOES NOT CHANGE THE CONTRACT DOCUMENTS THAT WILL GOVERN THIS PROJECT.

Division of Public Works Project No. 23251 Chiller Replacement, CNR.

By submitting a bid for this Project, the undersigned bidder agrees that, if awarded the Contract for construction, Contractor will conform to all conditions and requirements of the Contract, including but not limited to:

- Contractor agrees to comply with conditions pertaining to Sections 44-1001 and 44-1002, Idaho Code, requiring the employment of ninety-five percent (95%) bona fide Idaho residents and providing for a preference in the employment of bona fide Idaho residents and regarding the employment of persons not authorized to Work in the United States.
- Contractor will substantially complete the Work within the time stated in the Contract Documents, or as modified by Change Order(s).
- If the Contractor fails to substantially complete the Project within the time stated in the Contract Documents, or as modified by Change Order, the Contractor agrees that the Owner may deduct from the Contract amount liquidated damages in the amount per calendar day, indicated in the Contract Documents, times the number of calendar days until the Project is Substantially Complete, as defined in the Contract Documents and as determined by the Design Professional.
 - The Contractor agrees that the amount allowed for overhead and profit on any Change Order is limited to the amounts indicated in subparagraph 16.3.(k) of the Fixed Price Construction Contract Between Owner and Contractor.
- 1. For total changes the amount allowed for overhead, profit, bonds and insurance for the Contractor and all subcontractors of any tier combined shall not exceed fifteen percent (15%) of direct costs; or
- 2. The Contractor will determine the amount of overhead and profit to be apportioned between the Contractor and its subcontractor of allowable amounts of overhead, profit, bonds and insurance.
- The Contractor agrees that Change Orders are governed by the Fixed Price Construction Contract Between Owner and Contractor General Conditions of the Contract for Construction including as follows:
 - 1. By the execution of a Change Order, the Contractor agrees and acknowledges that it has had sufficient time and opportunity to examine the change in Work which is the subject of the Change Order and that it has undertaken all reasonable efforts to discover and disclose any concealed or unknown conditions which may, to any extent, affect the Contractor's ability to perform in accordance with the Change Order. Aside from those matters specifically set forth in the Change Order, the Owner shall not be obligated to make any adjustments to either the Contract Sum or Contract Time by reason of any conditions affecting the change in Work addressed by the Change Order that could have reasonably been discovered or disclosed by the Contractor's examination.

2. Any Change Order fully executed by the Owner, Contractor and Design Professional, including but not limited to, a Change Order arising by reason of the parties' mutual agreement or by mediation, shall constitute a final and full settlement of all matters relating to or affected by the change in the Work, including but not limited to, all direct and consequential costs associated with such change and any and all adjustments to the Contract Price and Contract Time. In the event a Change Order increases the Contract Price, the Contractor shall include the Work covered by such Change Order in the Application for Payment as if such Work was originally part of the Project and Contract Documents.

- Certification Concerning Boycott of Israel. Pursuant to Idaho Code section 67-2346, if payments under the Contract exceed one hundred thousand dollars (\$100,000) and Contractor employs ten (10) or more persons, Contractor certifies that it is not currently engaged in, and will not for the duration of the Contract engage in, a boycott of goods or services from Israel or territories under its control. The terms in this section defined in Idaho Code section 67-2346 shall have the meaning defined therein.
- Ownership or Operation by China. Pursuant to Idaho Code section 67-2359, Contractor certifies that it is not currently owned or operated by the government of China and will not for the duration of the Contract be owned or operated by the government of China. The terms in this section defined in Idaho Code section 67-2359 shall have the meaning defined therein.
- Boycott of Various Industries. Pursuant to Idaho Code section 67-2347A (effective July 1, 2024), if payments under the Contract exceed one hundred thousand dollars (\$100,000) and Contractor employs ten (10) or more persons, Contractor certifies that it is not currently engaged in, and will not for the duration of the Contract engage in, a boycott of any individual or company because the individual or company: a) engages in or supports the exploration, production, utilization, transportation, sale, or manufacture of fossil fuel-based energy, timber, minerals, hydroelectric power, nuclear energy, or agriculture; or b) engages in or supports the manufacture, distribution, sale, or use of firearms. The terms in this section defined in Idaho Code section 67-2347A shall have the meaning defined therein, including through reference to another section of Idaho Code.

FAILURE TO EXECUTE THIS ACKNOWLEDGMENT MAY MAKE YOUR BID NON-RESPONSIVE.

I, _____, being duly authorized to bind
the (type or print name of individual)
bidder, _____, does hereby certify that I have fully read
(type or print name of company)
and understand this document and that it highlights certain parts of the Contract that will be entered
between the parties and that will govern this Project.

Authorized Signature: _____

Title: _____

Date: _____

END OF BIDDER'S ACKNOWLEDGMENT STATEMENT

DIVISION OF PUBLIC WORKS FIXED PRICE CONSTRUCTION CONTRACT BETWEEN OWNER AND CONTRACTOR

DPW PROJECT NO.: 23251

PROJECT NAME PER DPW: UI: Replace Chiller, CNR BLD. 055

NAME OF STATE AGENCY: University of Idaho

**PROJECT LOCATION: CNR BLD. 055, 975 W 6th Street,
Moscow, ID 83844**

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FIXED PRICE CONSTRUCTION CONTRACT
BETWEEN OWNER AND CONTRACTOR

THIS FIXED PRICE CONSTRUCTION CONTRACT BETWEEN OWNER AND CONTRACTOR (the "Contract") is by and between the State of Idaho, Department of Administration, Division of Public Works ("DPW" or the "Owner") and _____ (the "Contractor") and is for the construction of the project (the "Project") identified as DPW Project No. 23251, as more fully described in Exhibit A, and incorporated herein by reference. This Contract shall be effective on _____ (day) of _____ (month), 20__ (year), when executed by both parties.

In consideration of the mutual promises, covenants, and agreements stated herein, and for other good and valuable consideration, the sufficiency of which is hereby acknowledged, the Owner and the Contractor agree:

ARTICLE 1
CONTRACT DOCUMENTS

- 1.1** The Contract Documents consist of this Contract, the drawings and specifications for the Project (the "Drawings and Specifications") identified in Exhibit C and any Addenda thereto issued prior to execution of this Contract, written amendments signed by both the Owner and the Contractor, Change Orders signed by both the Owner and the Contractor, Construction Change Directives and any written orders by the Design Professional for minor changes in the Work (the "Contract Documents"). Documents not included or expressly contemplated in this Article 1 do not, and shall not, form any part of the Contract Documents.
- 1.2** The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations.

ARTICLE 2
REPRESENTATIONS AND WARRANTIES OF THE CONTRACTOR

To induce the Owner to execute this Contract and recognizing that the Owner is relying thereon, the Contractor, by executing this Contract, makes the following express representations to the Owner:

- 2.1** The Contractor is fully qualified to act as the Contractor for the Project and has, and shall maintain, any and all licenses, permits or other authorizations necessary to act as the Contractor for, and to construct, the Project.
- 2.2** The Contractor has become familiar with the Project site and the local conditions under which the Project is to be constructed and operated particularly in correlation to the requirements of the Contract.
- 2.3** The Contractor has received, reviewed, compared, studied, and carefully examined all of the documents which make up the Contract Documents, including the Drawings and Specifications, and any Addenda, and has found them in all respects to be complete, accurate, adequate, consistent, coordinated and sufficient for construction. Such review, comparison, study and examination shall be a warranty that the Contractor believes that the documents are complete and the Project is buildable as described except as reported.
- 2.4** The Contractor warrants that the Contract Time is a reasonable period for performing the Work.

2.5 The Contractor warrants to the Owner and Design Professional that all labor furnished on this Project shall be competent to perform the tasks undertaken; materials and equipment furnished under the Contract will be new and of high quality unless otherwise required or permitted by the Contract Documents; that the Work will be complete, of high quality and free from defects not inherent in the quality required or permitted; and that the Work will strictly conform to the requirements of the Contract Documents. Any Work not strictly conforming to these requirements, including substitutions not properly approved and authorized, shall be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse by Owner or its representatives, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. This warranty shall survive the completion of the Contract and final payment to the Contractor.

2.6 Required Certifications.

2.6.1 Certification Concerning Boycott of Israel. Pursuant to Idaho Code section 67-2346, if payments under the Contract exceed one hundred thousand dollars (\$100,000) and Contractor employs ten or more persons, Contractor certifies that it is not currently engaged in, and will not for the duration of the Contract engage in, a boycott of goods or services from Israel or territories under its control. The terms in this section defined in Idaho Code section 67-2346 shall have the meaning defined therein.

2.6.2 Ownership or Operation by China. Pursuant to Idaho Code section 67-2359, Contractor certifies that it is not currently owned or operated by the government of China and will not for the duration of the Contract be owned or operated by the government of China. The terms in this section defined in Idaho Code section 67-2359 shall have the meaning defined therein.

2.6.3 Disclosure of Abortion Related Matters. The State is subject to the No Public Funds for Abortion Act, Idaho Code title 18, chapter 87 (the "Act") and State employees who intentionally violate the provisions of the Act are subject to criminal prosecution. Contractor must disclose, unless Contractor is within one of the exemptions provided in the Act, if it or an affiliate is or becomes, during the term of the Agreement, an abortion provider and if it will use state facilities or public funds to provide, perform, participate in, promote or induce, assist, counsel in favor, refer or train a person for an abortion related activity. Please refer to the Act for definitions of the terms used in this section.

2.6.4 Boycott of Various Industries. Pursuant to Idaho Code section 67-2347A (effective July 1, 2024), if payments under the Contract exceed one hundred thousand dollars (\$100,000) and Contractor employs ten (10) or more persons, Contractor certifies that it is not currently engaged in, and will not for the duration of the Contract engage in, a boycott of any individual or company because the individual or company: a) engages in or supports the exploration, production, utilization, transportation, sale, or manufacture of fossil fuel-based energy, timber, minerals, hydroelectric power, nuclear energy, or agriculture; or b) engages in or supports the manufacture, distribution, sale, or use of firearms. The terms in this section defined in Idaho Code section 67-2347A shall have the meaning defined therein, including through reference to another section of Idaho Code.

ARTICLE 3 **INTENT AND INTERPRETATION**

With respect to the intent and interpretation of this Contract, the Owner and the Contractor agree as follows:

- 3.1** This Contract constitutes the entire and exclusive agreement between the parties with reference to the Project, and supersedes any and all prior discussions, communications, representations, understandings, negotiations or agreements. This Contract also supersedes any bid documents.
- 3.2** The intent of the Contract is to include all items necessary for the proper execution and completion of the Project and anything that may be required, implied or inferred by the documents which make up this Contract, or any one or more of them, shall be provided by the Contractor for the Fixed Price Contract Amount. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all.
- 3.3** Nothing contained in this Contract shall create, nor be interpreted to create privity or any other relationship whatsoever between the Owner and any person or entity except the Contractor; provided; however, that the Design Professional is entitled to performance and enforcement of obligations under the Contract intended or necessary to facilitate its duties. Any reference to the Owner, the Contractor, or the Design Professional shall be deemed to include authorized representatives.
- 3.4** When a word, term or phrase is used in this Contract, it shall be interpreted or construed first as defined herein; second, if not defined, according to its generally accepted meaning in the construction industry; and third, if there is no generally accepted meaning in the construction industry, according to its common and customary usage.
- 3.5** The words "include," "includes," or "including," as used in this Contract, shall be deemed to be followed by the phrase "without limitation."
- 3.6** The specification herein of any act, failure, refusal, omission, event, occurrence, or condition as constituting a material breach of this Contract shall not imply that any other, non-specified act, failure, refusal, omission, event, occurrence or condition shall be deemed not to constitute a material breach of this Contract.
- 3.7** The Contractor shall have a continuing duty to read, examine, review, compare and contrast each of the documents which make up this Contract, shop drawings and other submittals, and shall give timely written notice to the Owner and the Design Professional of any conflict, ambiguity, error or omission which the Contractor may find with respect to these documents before proceeding with the affected Work.
- 3.8** The express or implied approval by the Owner or the Design Professional of any shop drawings or other submittals shall not relieve the Contractor of the continuing duties imposed hereby, nor shall any such approval be evidence of the Contractor's compliance with this Contract. The Owner has requested that the Design Professional prepare documents for the Project, including the Drawings and Specifications for the Project Work, which are accurate, adequate, consistent, coordinated, and sufficient for construction. *HOWEVER, THE OWNER MAKES NO REPRESENTATION OR WARRANTY OF ANY NATURE WHATSOEVER TO THE CONTRACTOR CONCERNING SUCH DOCUMENTS.* The Contractor again hereby acknowledges and represents that it has received, reviewed, and carefully examined such documents; has found them to be complete, accurate, adequate, consistent, coordinated and sufficient for construction; and that the Contractor has not, does not and will not rely upon any representations or warranties by the Owner concerning such documents, as no such representations or warranties have been or are hereby made.
- 3.9** In the event of any conflict among any of the documents which make up this Contract, the Design Professional shall interpret the documents, and the interpretation shall be binding on both the Owner and Contractor; provided, however, that this does not change the Owner's right to make decisions regarding Objections in accordance with Article 13 and Article 14. If no interpretation is

provided by the Design Professional, the most stringent requirement in the Contract Documents will apply.

ARTICLE 4

OWNERSHIP OF DOCUMENTS

- 4.1** Unless otherwise agreed by the Design Professional and its consultants, the party that prepared the drawings, specifications and other documents is the author of such with all copyright, common law, statutory and other reserved rights. The Contractor may retain one (1) record set of the Drawings and Specifications and other documents but shall not own or claim any copyright in them.

The Drawings and Specifications and other documents, and any copies, are to be used solely for this project (the "Project"), and not on any other project, or additions to this Project outside this Contract, without written consent of the Owner, the Design Professional, and the Design Professional's consultants; provided, however, that copies may be made of applicable portions as necessary for completion of the Work. Such copies shall include any copyright notice on the Drawings and Specifications and other documents.

Submission to or use by a regulatory body related to this Project is an acceptable use.

ARTICLE 5

CONTRACTOR'S PERFORMANCE

The Contractor shall perform all the Work required, implied or reasonably inferable from this Contract, including the following:

- 5.1** Construction of the Project.
- 5.2** The furnishing of any required surety bonds and insurance.
- 5.3** The provision or furnishing, and prompt payment therefore, of labor, supervision, services, materials, supplies, equipment, fixtures, appliances, facilities, tools, transportation, storage, power, fuel, heat, light, cooling, or other utilities required for construction and all necessary permits, including any required elevator permits, required for the construction of the Project. Construction projects for the State of Idaho require a building permit issued by the Division of Occupational and Professional Licenses.
- 5.4** The creation and submission of a detailed and comprehensive set of marked up blue or black-lined record drawings. Said record drawings shall be submitted to and approved by the Design Professional as a condition precedent to final payment to the Contractor.
- 5.5** The Contractor is solely liable for theft or damage of materials and equipment stored on the Worksite but not yet installed in the facility. The Contractor shall protect and replace any loss of materials due to theft or damage, until final acceptance of the Project.

ARTICLE 6

TIME FOR CONTRACTOR'S PERFORMANCE

- 6.1** The Contractor shall commence the performance of this Contract in accordance with the "Notice to Proceed" (Exhibit F) issued by the Owner and shall diligently continue its performance to and until final completion of the Project. The Contractor shall accomplish Substantial Completion of the Project on or before the time indicated in Exhibit A. The period of time, including any adjustments

made under this Contract, for the Contractor to reach Substantial Completion is the "Contract Time."

- 6.2** The Contractor may be assessed by and be responsible to the Owner for the amount indicated in Exhibit A per day for each and every calendar day of unexcused delay in achieving Substantial Completion beyond the date set forth for Substantial Completion. Any sums owed hereunder by the Contractor shall be payable not as a penalty but as liquidated damages, representing an estimate of delay damages likely to be sustained by the Owner estimated at the time of this Contract. When the Owner reasonably believes that Substantial Completion will be inexcusably delayed, the Owner shall be entitled, but not required, to withhold from any amounts otherwise due the Contractor an amount then believed by the Owner to be adequate to recover liquidated damages applicable to such delays. If and when the Contractor overcomes the delay in achieving Substantial Completion, or any part thereof, for which the Owner has withheld payment, the Owner shall promptly release to the Contractor those funds withheld, but no longer applicable, as liquidated damages. The Owner's right to liquidated damages is not, and shall not be deemed to be, an exclusive remedy for delay and the Owner shall retain all remedies at law or in equity for delay or other breach.
- 6.3** The term "Substantial Completion," as used herein, shall mean that point at which, as certified in writing by the Design Professional, or if there is no Design Professional, as certified by the Owner, the entire Project is at a level of completion in strict compliance with the Contract Documents, such that the Owner or its designee can enjoy beneficial use or occupancy and can use or operate it in all respects for its intended purpose. If, in the reasonable determination of the Owner, receipt of operation and maintenance manuals or completion of training is necessary for such beneficial use or occupancy, then there shall be no Substantial Completion until such manuals are provided or such training is completed. Partial use or occupancy of the Project shall not result in the Project being deemed substantially complete, or accepted as substantially complete, and such partial use or occupancy shall not be evidence of Substantial Completion. The Project shall not be deemed accepted until it is finally complete.
- 6.5** Any request by the Contractor for an extension of the Contract Time must be made in accordance with, and is subject to, Article 13, Article 14 related to Objections, and Article 16.
- 6.6** The Owner shall have no liability of any kind to the Contractor if a schedule or other document submitted by the Contractor shows an intention to complete the Work prior to the scheduled completion date and for any reason other than Owner caused delay, the Contractor is not able to achieve such early completion.

ARTICLE 7

FIXED PRICE AND CONTRACT PAYMENTS

- 7.1** The Owner shall pay, and the Contractor shall accept, as full and complete payment for the Contractor's timely performance of its obligations hereunder, the Fixed Price Contract Amount indicated in Exhibit A. The Fixed Price Contract Amount shall not be modified except as provided in this Contract.
- 7.2** Prior to approval of the contract, the Contractor shall prepare and present to the Owner and the Design Professional the Contractor's Schedule of Values apportioning the Fixed Price Contract Amount among the different elements of the Project for purposes of periodic and final payment. The Contractor's Schedule of Values shall be presented in the Owner's web-based construction management software. The Contractor shall not imbalance its Schedule of Values nor artificially inflate any element thereof. The violation of this provision by the Contractor shall constitute a material breach of this Contract. The Contractor's Schedule of Values will be utilized for the

Contractor's requests for payment but shall only be utilized after it has been approved in writing by the Design Professional.

- 7.3** The Owner shall pay the Fixed Price Contract Amount to the Contractor in accordance with the procedures set forth in this Article. The Contractor shall submit a Contractor's Request for Payment, on or before the day of each month indicated in Exhibit A or otherwise agreed to, after commencement of performance, but no more frequently than once monthly. Said payment request shall be on made in the Owner's web-based construction management software and shall include whatever supporting information as may be required by the Design Professional, the Owner or both. Therein, the Contractor may request payment for one hundred percent (100%) of the Work satisfactorily completed to the date of the Contractor's Request for Payment, less five percent (5%) retainage, based on the Fixed Price Contract Amount allocated on the Schedule of Values. The Contractor's Request for Payment may include only: properly provided labor, materials or equipment properly incorporated into the Project, and time and materials or equipment necessary for the Project or that will be incorporated into the Project and are properly stored at the Project site (or elsewhere if off-site storage is approved in writing by the Owner). The Contractor's Request for Payment must exclude the total amount of previous payments received from the Owner. Any payment on account of stored materials or equipment will be subject to the Contractor providing written proof that the Owner has title to such materials or equipment and that they are fully insured against loss or damage. Each such Contractor's Request for Payment shall be signed by the Contractor and its submission shall constitute the Contractor's affirmative representation that the quantity of Work has reached the level for which payment is requested; that the Work has been properly installed or performed in strict compliance with the Contract; that all Work for which the Owner has previously paid is free and clear of any lien, claim or other encumbrance of any person whatsoever; and that the Contractor knows of no reason why payment should not be made as requested. As a condition precedent to payment, the Contractor shall, if required by the Owner, furnish to the Owner properly executed waivers or releases, in a form acceptable to the Owner, from all subcontractors, materialmen, suppliers or others having any claims or alleged claims, wherein said subcontractors, materialmen, suppliers or others shall acknowledge receipt of all sums due pursuant to all prior Contractor's Requests for Payment, and waive and relinquish any rights or other claims relating to the Project or Project site. The submission by the Contractor of the Contractor's Request for Payment also constitutes the Contractor's affirmative representation that, upon payment of the Contractor's Request for Payment submitted, title to all Work included in such payment shall be vested in the Owner.

Thereafter, the Design Professional shall review the Contractor's Request for Payment and may also review the Work at the Project site or elsewhere to determine whether the quantity and quality of the Work are as represented in the Contractor's Request for Payment and as required by this Contract. The Design Professional shall approve in writing the amount which, in the opinion of the Design Professional, is properly owing to the Contractor and such approval is required before the Owner shall have any payment obligation. The Design Professional may withhold such approval, in whole or in part, as necessary to protect the Owner if it reasonably believes that the quantity or quality of the Work is not as represented in the Contractor's Request for Payment or is not in strict conformance to the Contract Documents.

- 7.4** The Owner shall make payment to the Contractor no more than forty-five (45) days following receipt by the Owner of the Design Professional's written approval of each Contractor's Request for Payment. The amount of each such payment shall be the amount approved for payment by the Design Professional less such amounts, if any, otherwise owing by the Contractor to the Owner or which the Owner shall have the right to withhold as authorized by this Contract. The Design Professional's approval of the Contractor's Request for Payment shall not preclude the Owner from the exercise of any of its rights it may have in this Contract, at law or in equity, as set forth in Paragraph 7.8 hereinafter.

- 7.5** Off-site storage will not be approved at locations more than thirty (30) miles from the Project site or outside the State of Idaho and any payment for any off-site storage is subject to the following:
- (a) The Contractor must provide at least thirty (30) days' advance written notice of its request to store off-site. Such notice must include a description of the type, quantities, locations, and values of materials involved for the next billing cycle. All invoices must indicate the type, quantities and value of materials or equipment for which payment is requested;
 - (b) All materials stored off-site must be segregated and clearly marked with the DPW Project number and as being the "Property of the State of Idaho;"
 - (c) The Design Professional and/or the Owner's Field Representative must have unrestricted access to the stored materials during all business hours and may physically inventory all invoiced materials and equipment and may physically inspect the storage conditions;
 - (d) The Contractor must provide written Consent of Surety to off-site storage of materials and equipment and to payment for such materials and equipment prior to incorporation in the Work. Consent must be from the Surety. Consent of local broker or agent is not acceptable;
 - (e) The Contractor must maintain and must provide to the Design Professional, upon request, a current log of stored materials and equipment, which reflects when materials and equipment are used or added; and
 - (f) The Contractor must obtain and maintain all risk property insurance at replacement cost, with the State of Idaho listed as loss payee on all materials and equipment stored off-site and in transit.
- 7.6** When payment is received from the Owner, the Contractor shall immediately pay all subcontractors, materialmen, laborer(s), and suppliers the amounts they are due for the Work covered by such payment. The Contractor shall not withhold from a subcontractor or supplier more than the percentage withheld from a payment certificate for the subcontractor's or supplier's portion of the Work. In the event the Owner becomes informed that the Contractor has not paid a subcontractor, materialmen, laborer, or supplier as provided herein, the Owner shall have the right, but not the duty, to issue future checks and payment to the Contractor of amounts otherwise due hereunder naming the Contractor and any such subcontractor, materialmen, laborer or supplier as joint payees. Such joint check procedure, if employed by the Owner, shall create no rights in favor of any person or entity beyond the right of the named payees to payment of the check and shall not be deemed to commit the Owner to repeat the procedure in the future.
- 7.7** Payment to the Contractor, utilization of the Project for any purpose by the Owner, or any other act or omission by the Owner shall not be interpreted or construed as an acceptance of any Work of the Contractor not strictly in compliance with this Contract.
- 7.8** The Owner shall have and be entitled to the right to refuse to make any payment, including by reducing payment under any Contractor's Request for Payment, and, if necessary, may demand the return of a portion or all of an amount previously paid to the Contractor for reasons that include the following:
- (a) The quality of the Contractor's Work, in whole or part, is not in strict accordance with the requirements of this Contract or identified defective Work, including punch list Work, is not remedied as required by the Contract Documents;

- (b) The quantity of the Contractor's Work, in whole or in part, is not as represented in the Contractor's Request for Payment or otherwise;
- (c) The Contractor's rate of progress is such that, in the Owner's opinion, Substantial Completion or final completion, or both, may be inexcusably delayed or that the Owner will incur additional costs or expense related to repeated Substantial Completion or final completion inspections through no fault of the Owner;
- (d) The Owner reasonably believes that the Contractor has failed to use Contract funds, previously paid the Contractor by the Owner, to pay Contractor's project-related obligations, including subcontractors, laborers and material and equipment suppliers;
- (e) There are claims made or it seems reasonably likely that claims will be made, against the Owner;
- (f) The Contractor has caused a loss or damage to the Owner, the Design Professional or another contractor;
- (g) The Owner reasonably believes that the Project cannot be completed for the unpaid balance of the Fixed Price Contract Amount, or the Owner reasonably believes that the Project cannot be completed within the Contract Time and that the unpaid balance of the Fixed Price Contract Amount would be inadequate to cover the cost of actual or liquidated damages for the anticipated delay;
- (h) The Contractor fails or refuses to perform any of its obligations to the Owner; or
- (i) The Contractor fails to pay taxes as required by Title 63, Chapter 15, Idaho Code.

7.9 In the event that the Owner makes a written demand upon the Contractor for amounts previously paid by the Owner as contemplated in Paragraph 7.8, the Contractor shall promptly comply with such demand.

7.10 If the Owner, without cause, fails to pay the Contractor any amounts due and payable sixty (60) days after those amounts are due pursuant to Paragraph 7.4, the Contractor shall have the right to cease the Work until receipt of proper payment. Contractor must first provide written notice to the Owner of the Contractor's intent to cease the Work ten (10) days prior to stopping the Work under this Paragraph. If any amounts remain unpaid after sixty (60) days after the Design Professional approves the Contractor's Request for Payment under Paragraph 7.4, interest in accordance with Idaho Code § 67-2302 shall accrue on those unpaid amounts.

7.11 When the Contractor considers Substantial Completion has been achieved, the Contractor shall notify the Owner and the Design Professional in writing and shall furnish to the Design Professional a listing of those matters yet to be finished. The Design Professional will thereupon conduct an inspection to confirm that the Work is, in fact, substantially complete. Upon its confirmation that the Contractor's Work is substantially complete, the Design Professional will so notify the Owner and Contractor in writing and will therein set forth the date of Substantial Completion. The Owner and the Contractor must accept the date of Substantial Completion in writing. Guarantees and warranties required by this Contract shall commence on the date of Substantial Completion. At the Contractor's Request for Payment following Substantial Completion, the Owner shall pay the Contractor an amount sufficient to increase total payments to the Contractor to ninety-five percent (95%) of the Fixed Price Contract Amount, less any liquidated damages, less the reasonable costs as determined by the Design Professional for completing all incomplete Work, correcting and bringing into conformance all defective and nonconforming Work, and handling any outstanding or

potential claims. If the Design Professional determines that the Contractor has made or is making satisfactory progress on any uncompleted portions of the Work, the Owner may, at its discretion, release a portion of the retainage to the Contractor prior to the actual final completion of the conditions set forth in Paragraph 7.14. It is the intent of the parties that the Project will be accepted only in total (at Substantial Completion and final completion) and not in phases unless provided for in Exhibit A. Any acceptance other than in total shall require written agreement of Owner and Design Professional.

- 7.12** When the Contractor considers the Project is at final completion, it shall notify the Owner and the Design Professional thereof in writing. Thereupon, the Design Professional will perform a final inspection of the Project. If the Design Professional confirms that the Project is complete in full accordance with the Contract Documents and that the Contractor has performed all of its obligations to the Owner, the Design Professional will furnish a final approval for payment to the Owner certifying to the Owner that the Project is complete and the Contractor is entitled to the remainder of the unpaid Fixed Price Contract Amount, less any amount withheld pursuant to this Contract.
- 7.13** If the Contractor fails to achieve final completion within a reasonable number of days as established by the Design Professional from the date of Substantial Completion, the Contractor may be assessed and be responsible to the Owner for fifty percent (50%) of the daily amount of liquidated damages as established pursuant to Paragraph 6.2 and Exhibit A, per day for each and every calendar day of unexcused delay in achieving final completion beyond the date established for final completion of the Work. Any sums due and payable hereunder by the Contractor shall be payable not as a penalty but as liquidated damages representing an estimate of delay damages likely to be sustained by the Owner, estimated at or before the time of executing this Contract. When the Owner reasonably believes that final completion will be inexcusably delayed, the Owner may withhold from any amounts otherwise due the Contractor an amount then believed by the Owner to be adequate to recover liquidated damages applicable to such delays. If and when the Contractor overcomes the delay in achieving final completion, or any part thereof, for which the Owner has withheld payment, the Owner shall promptly release to the Contractor those funds withheld, but no longer applicable, as liquidated damages. The Owner's right to liquidated damages is not, and shall not be deemed to be, an exclusive remedy for delay and the Owner shall retain all remedies at law or in equity for delay or other breach.
- 7.14** As a condition precedent to final payment, the Contractor must furnish the Owner, in the form and manner required by Owner, and with a copy to the Design Professional of the following:
- (a) An affidavit that all of the Contractor's obligations to subcontractors, laborers, equipment or material suppliers or other third parties in connection with the Project have been paid or otherwise satisfied;
 - (b) A release by the Contractor of all Claims it has or might have against the Owner or the Owner's property (DPW's form, Exhibit H);
 - (c) Contractor's Affidavit of Debts and Claims (AIA Document G706);
 - (d) Consent of Surety to final payment (AIA Document G707);
 - (e) Confirmation of all required training, product warranties, operating manuals, instruction manuals and other record documents, drawings and things customarily required of the Contractor; and

- (f) A Public Works Contract Tax Release issued by the Idaho Tax Commission (See "Request for Tax Release" form, Exhibit G, to be submitted by Contractor to the Idaho Tax Commission).

- 7.15** The Owner shall, subject to its rights set forth in this Contract, make final payment of all sums due to the Contractor within forty-five (45) days of the Design Professional's execution of a final approval for payment and receipt of documentation required by Paragraph 7.14, whichever is received later.

ARTICLE 8

INFORMATION AND MATERIAL SUPPLIED BY THE OWNER

- 8.1** The Administrator of DPW or designee shall be the sole representative of the State of Idaho. The Design Professional shall have authority to bind Owner only as specifically set forth in this Contract.
- 8.2** The Owner will assign a Project Manager and a Field Representative to represent the Owner, identified in Exhibit B. The Owner's Field Representative's duties, responsibilities and limitations of authority are in accordance with DPW's policies and procedures.
- 8.3** The Owner shall furnish to the Contractor, prior to the execution of this Contract, any and all written and tangible material in its possession concerning conditions below ground at the site of the Project. Such written and tangible material is furnished to the Contractor only to make complete disclosure of such material as being in the possession of the Owner and for no other purpose. By furnishing such material, the Owner does not represent, warrant, or guarantee its accuracy, either in whole in part, implicitly or explicitly.
- 8.4** The Owner will secure and pay for all required easements, the plan check fee required by the Division of Occupational and Professional Licenses, conditional use permits and any other permits and fees specifically indicated in the Contract Documents to be secured and paid for by the Owner.
- 8.5** The Owner will provide the Contractor one (1) copy of this complete Contract and the number of sets of Drawings and Project Manuals (including Specifications) as indicated in Exhibit A. The Contractor may purchase additional copies, at its expense, from the Design Professional.

ARTICLE 9

STOP WORK ORDER

- 9.1** In the event the Contractor fails or refuses to perform the Work as required or fails or refuses to correct nonconforming Work, the Owner may instruct the Contractor to stop Work in whole or in part. Upon receipt of such instruction, the Contractor shall immediately stop as instructed by the Owner and shall not proceed further until the cause for the Owner's instructions has been corrected, no longer exists or the Owner instructs that the Work may resume. In the event the Owner issues such instructions to stop, and in the further event that the Contractor fails and refuses within seven (7) days of receipt of same to provide adequate assurance to the Owner that the cause of such instructions will be eliminated or corrected, then the Owner shall have the right, but not the obligation, to carry out the Work with its own forces or with the forces of another contractor, and the Contractor shall be fully responsible and liable for the costs of performing such Work by the Owner. Without limiting what else might constitute nonconforming Work, the existence of a gross safety violation or other situation or condition that creates, or could imminently create, a threat of serious harm to persons or property, shall constitute nonconforming Work and any order to stop the Work issued for such reason shall not be considered an interference with the Contractor's performance of the Work or its means and methods. The rights set forth herein are in addition to, and without prejudice to, any other rights or remedies the Owner may have against the Contractor.

- 9.2** Any order to stop the Work issued pursuant to Paragraph 9.1 shall not be used to justify any Claim by the Contractor for additional time or money.

ARTICLE 10
DUTIES, OBLIGATIONS AND RESPONSIBILITIES OF THE CONTRACTOR

In addition to any and all other duties, obligations and responsibilities of the Contractor set forth in this Contract, the Contractor shall have and perform the following duties, obligations and responsibilities to the Owner:

- 10.1** The Contractor's continuing duties set forth in Paragraph 3.7 are by reference hereby incorporated in this Paragraph 10.1. The Contractor shall not perform Work without adequate plans and specifications or, as appropriate, approved shop drawings or other submittals. If the Contractor performs Work knowing or believing it involves an error, inconsistency, or omission in the Contract without first providing written notice to the Design Professional and Owner, the Contractor shall be responsible for such Work and shall pay the cost of correcting same.
- 10.2** The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing Work. Errors, inconsistencies, or omissions discovered shall be reported to the Design Professional, the Owner and the Owner's Field Representative immediately. Such examination, review and comparison shall be a warranty that the Contract Documents are complete, and the Project is buildable as described except as reported. Reported errors, inconsistencies or omissions will constitute a request for an interpretation by the Design Professional and may constitute an objection pursuant to Article 14 hereof where appropriate.
- 10.3** The Contractor shall ensure that all Work shall strictly conform to the requirements of this Contract.
- 10.4** The Work shall be strictly supervised, the Contractor bearing full responsibility for any and all acts or omissions of those engaged in the Work on behalf of the Contractor.
- 10.5** All labor furnished on this Project shall be competent to perform the tasks undertaken; materials and equipment furnished under the Contract will be new and of high quality unless otherwise required or permitted by the Contract Documents; the Work will be complete, of high quality and free from defects not inherent in the quality required or permitted; and the Work will strictly conform to the requirements of the Contract Documents. Any Work not strictly conforming to these requirements, including substitutions not properly approved and authorized, shall be considered defective.
- 10.6** Except as provided in Paragraph 8.4, the Contractor shall secure or provide and pay for all licenses, permits required by the Idaho Division of Occupational and Professional Licenses, governmental approvals and inspections, connections for outside services for the use of municipal or private property for storage of materials, parking, utility services, temporary obstructions, enclosures or opening and patching of streets, and for all other facilities and services necessary for proper execution and completion of the Project.
- 10.7** The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on performance of the Work.
- 10.8** The Contractor shall employ and maintain at the Project site only competent supervisory personnel. Key supervisory personnel assigned by the Contractor to this Project are as listed in Exhibit B.

- 10.9** The Contractor shall employ a competent superintendent and necessary assistants, as needed, to oversee execution of the Work. The superintendent shall be in attendance at the Project site during the progress of the Work. The superintendent and any project manager, if the Contractor utilizes a project manager, shall be reviewed and must be approved by the Design Professional and Owner, and neither shall be changed except with the consent of the Design Professional and Owner, unless the superintendent and/or project manager cease to be employed by the Contractor. Under this circumstance, any new superintendent or new project manager must be satisfactory to the Design Professional and Owner. Such approval shall not be unreasonably withheld. The superintendent and any project manager shall represent the Contractor and all communications given to the superintendent or project manager are deemed given to the Contractor.
- 10.10** So long as the individuals named above remain actively employed or retained by the Contractor, they shall perform the functions indicated next to their names unless the Owner agrees to the contrary in writing. In the event one or more individuals not listed in Paragraph 10.9 subsequently assumes one or more of those functions listed in Paragraph 10.9, the Contractor shall be bound by the provisions of this paragraph as though such individuals had been listed in Paragraph 10.9.
- 10.11** The Contractor shall provide to the Owner and the Design Professional a milestone schedule for completing the Work within the Contract Time. Such schedule shall be in a form specified in Division 1 of the Specifications and be acceptable to the Owner and to the Design Professional. The schedule must be submitted to and accepted by the Design Professional prior to the first request for payment unless required earlier by Division 1 of the Specifications. The Contractor's milestone schedule must be updated as required by the Design Professional and/or the Owner to reflect conditions encountered and shall apply to the total Project. The Contractor's revisions to the schedule shall not constitute a waiver of the requirement to complete the Project in the time allowed by the Contract unless additional time for performance has been allowed pursuant to a Change Order. Any changes in milestone start or end dates must be furnished to the Owner and the Design Professional. Strict compliance with the requirements of this Paragraph shall be a condition precedent to the payment to the Contractor and failure by the Contractor to strictly comply with said requirements shall constitute a material breach of this Contract.
- 10.12** Unless otherwise provided in the Contract Documents, on all projects where the Fixed Price Contract Amount is over \$1,000,000, the Contractor shall schedule and perform the Work in accordance with a Critical Path Method ("CPM") to indicate the rate of progress and practical order of the Project. The purpose of this scheduling requirement is to ensure adequate planning, coordination, and execution of the Work. The schedule shall indicate the dates for starting and completing major Work activities, project events, major equipment, material and equipment submittals and delivery of major items. Project activities having critical time restraints on action, required by the Owner, shall be shown as scheduled milestones. The Contractor's schedule shall demonstrate the order, interdependence, and sequence of activities. Critical paths shall be highlighted or distinguished. The schedule shall include all the dates specified in the Contract for Substantial Completion and final completion of the Work. The time limit set forth in the Contract for Substantial Completion and final completion must govern; the schedule must be adjusted to meet these dates. Schedule float shall belong to the Project. The Contractor shall submit to the Owner and Design Professional a CPM schedule within three (3) weeks after award of the Contract and maintain such schedule on a current basis in accordance with the Contract Documents.
- 10.13** Once a month, or at intervals as required by the Design Professional, the Contractor shall advise the Owner and the Design Professional of the status of the Work (in duplicate) on the current milestone schedule. If any project milestone dates are not met on schedule, the Contractor shall immediately advise the Owner and Design Professional in writing of the proposed action to bring the Work on schedule. The Contractor shall also submit a detailed short-term schedule, as required

by Division 1 of the Specifications, each month. This short-term schedule shall include a description of current and anticipated problem areas, delaying factors and their impact, and explanation of corrective action taken or proposed. If the Work is behind schedule, the Contractor shall indicate what measures it will take to put the Work back on schedule.

- 10.14** If the Work is not progressing through no fault of the Owner or the Design Professional, as shown on the milestone schedule, as determined by the Design Professional, and the Owner and the Design Professional do not believe the Contractor's proposed action to bring the Work on schedule is adequate, then the Contractor shall be deemed in default under this Contract and the progress of the Work shall be deemed unsatisfactory. In such event, the Owner, at its discretion, may require the Contractor to Work such additional time over regular hours, including Saturdays, Sundays, and holidays, without additional cost to the Owner to bring the Work on schedule.
- 10.15** The Contractor shall keep an updated copy of the Drawings and Project Manual (including Specifications) and Addenda at the site. Additionally, the Contractor shall keep a current submittal schedule and a copy of approved shop drawings and other submittals. All these items shall be available to the Owner and the Design Professional at all regular business hours. Upon final completion of the Work, all these items must be updated by the Contractor and provided to the Design Professional and shall become the property of the Owner.
- 10.16** The Contractor shall carefully review and inspect for compliance with the Contract Documents, the shop drawings, and other submittals (including product data and samples) required by the Contract Documents and shall submit to the Design Professional only submittals approved in accordance with this section. Such review and submittal shall be done promptly and in a sequence that will not delay its Work under this Contract or the activities of the Owner or of separate contractors. Shop drawings and other submittals from the Contractor do not constitute a part of the Contract. The Contractor shall not do any Work requiring shop drawings or other submittals unless the Design Professional has verified compliance in writing. All Work requiring verified shop drawings or other submittals shall be done in strict compliance with such approved documents. However, verification of compliance by the Design Professional shall not be evidence that Work installed pursuant thereto conforms with the requirements of this Contract. The Design Professional shall have no duty to review submittals that are not Contractor approved, partial submittals or incomplete submittals. The Contractor shall maintain a submittal log which shall include, at a minimum, the date of each submittal, the date of any re-submittal, the date of any approval or rejection and the reason for any rejection.
- 10.17** The Contractor shall maintain the Project site in a reasonably clean condition during performance of the Work. Upon final completion, the Contractor shall thoroughly clean the Project site of all debris, trash and excess materials or equipment.
- 10.18** At all times relevant to this Contract, the Owner and the Design Professional shall have a right to enter the Project site and the Contractor shall allow the Owner and/or the Design Professional to review or inspect the Work without formality or other procedure.
- 10.19** The presence or duties of the Design Professional's or the Owner's personnel or representatives at the construction site, does not make any of them responsible for those duties that belong to the Contractor or other entities and does not relieve the Contractor or any other entities of their obligations, duties, and responsibilities, including any obligation or requirement to have or to implement any health or safety plans or precautions. Except as provided in Paragraph 10.9, Design Professional's and Owner's personnel have no authority to exercise any control over any Contractor or other entities or their employees in connection with their Work or any health or safety precautions and have no duty for inspecting, noting, observing, correcting, or reporting on health or safety deficiencies of the Contractor or other entities or any other persons at the site except their own

personnel. The presence of Design Professional's or Owner's personnel at a construction site is for the purpose of providing to Owner a greater degree of confidence that the completed Work will conform to the Contract Documents and that the integrity of the design concept as reflected in the Contract Documents has been implemented and preserved by the Contractor. Construction sites include places of manufacture for materials incorporated into the construction Work and Contractor includes manufacturers of materials incorporated into the construction Work.

ARTICLE 11

SAVE HARMLESS AND INDEMNIFICATION

- 11.1** The Contractor shall indemnify, defend and hold harmless the State of Idaho, Division of Public Works, its officers, agents, employees, from and against all liability, claims, damages, losses, expenses, actions, settlements, attorneys' fees, and suits whatsoever caused by, arising out of, or in connection with Contractor's acts or omissions under this Agreement or the Contractor's failure to comply with any State or federal statute, law, regulation, or rule.
- 11.2** Upon receipt of the State's tender of indemnity and defense, Contractor shall immediately take all reasonable actions necessary, including, but not limited to providing a legal defense for the State, to begin fulfilling its obligation to indemnify, defend, and save harmless the State. Contractor's indemnification and defense liabilities described herein shall apply regardless of any allegations that a claim or suit is attributable in whole or in part to any act or omission of the State under this Agreement. Contractor shall not be required to hold the State harmless for damages attributed to the State in a final order issued by a court of competent jurisdiction.
- 11.3** Any legal defense provided by the Contractor to the State under this Section must be free of any conflicts of interest, even if retention of separate legal counsel for the State is necessary. Any attorney appointed to represent the State must first qualify as and be appointed by the Attorney General of the State of Idaho as a Special Deputy Attorney General pursuant to Idaho Code sections 67-1401(13) and 67-1409(1). The State must approve all settlement offers and agreements made on its behalf and has the option to attend any settlement or alternative dispute resolution proceedings.

ARTICLE 12

THE DESIGN PROFESSIONAL

- 12.1** The Design Professional for this Project is identified in Exhibit B, incorporated herein by reference, along with any authorized representatives and any limitations of responsibility. For the purpose of this Contract, the "Design Professional" means the properly licensed architect, properly registered professional engineer or other professional licensed in the State of Idaho who prepared the Drawings and Specifications for this Project. If the employment of the Design Professional is terminated, the Owner may retain a replacement professional, and the role of the replacement professional shall be the same as the role of the Design Professional. Unless otherwise directed by the Owner in writing, the Design Professional will perform those duties and discharge those responsibilities allocated to the Design Professional in this Contract. The duties, obligations and responsibilities of the Design Professional shall be for contract administration and include the following:
- (a) Unless otherwise directed by the Owner in writing, the Design Professional shall not act as the Owner's agent.
 - (b) Unless otherwise directed by the Owner in writing, the Owner and the Contractor shall communicate with each other through the Design Professional.

- (c) When requested by the Owner or Contractor in writing, the Design Professional shall within seven (7) days render written interpretations necessary for the proper execution or progress of the Work or shall provide a written explanation as to why more time is needed and provide a date by which it will be provided.
- (d) The Design Professional shall draft proposed change authorization(s).
- (e) The Design Professional shall review and verify compliance or respond otherwise as necessary concerning shop drawings or other submittals received from the Contractor.
- (f) The Design Professional shall be authorized to refuse to accept Work that is defective or otherwise fails to comply with the requirements of this Contract. If the Design Professional deems it appropriate, the Design Professional may, with the Owner's consent, require extra inspections or testing of the Work for compliance with the requirements of this Contract.
- (g) The Design Professional shall review the Contractor's Request for Payment and shall verify in writing those amounts which, in the opinion of the Design Professional, are properly owing to the Contractor as provided in this Contract.
- (h) The Design Professional shall, upon written request from the Contractor, perform Substantial Completion and final completion inspections contemplated by Article 6.
- (i) The Design Professional may require the Contractor to make changes which do not involve a change in the Fixed Price Construction Contract Amount or time consistent with the intent of this Contract. Such changes shall be given to the Contractor in writing under signature of the Design Professional, with a copy to the Owner, and may be in the form of a supplemental instruction.
- (j) The Design Professional shall review and evaluate Objections and take other actions related to Claims in accordance with Articles 13, 14, and 16.
- (k) The duties, obligations and responsibilities of the Contractor under this Contract shall in no manner whatsoever be changed, altered, discharged, released, or satisfied by any duty, obligation or responsibility of the Design Professional. The Contractor is not a third-party beneficiary of any Contract by and between the Owner and the Design Professional. It is expressly acknowledged and agreed that the duties of the Contractor to the Owner are independent of, and are not diminished by, any duties of the Design Professional to the Owner.

ARTICLE 13

OWNER'S NOTIFICATION TO CONTRACTOR OF NON-CONFORMING WORK

- 13.1** The Owner, Owner's Representative, or the Design Professional shall notify the Contractor of non-conforming work, which shall include work that deviates from the Contract Documents ("Non-Conforming Work"). Non-Conforming Work shall be determined in the sole discretion of the Owner or Design Professional. The notice shall be in writing or verbally at the regular construction progress meetings as soon as reasonably practicable and documented in the minutes.
- 13.2** This section shall not limit the Owner's remedies under this Agreement.
- 13.3** Contractor shall fix Non-Conforming Work to Owner's satisfaction or the Contractor may file an Objection pursuant to the requirements in Article 14.
- 13.4** The Contractor must demonstrate to Owner, Owner's Representative or the Design Professional that Non-Conforming work has been corrected prior to covering or concealing the work.

ARTICLE 14 **CONTRACTOR'S OBJECTIONS**

- 14.1** For purposes of this Contract, an "Objection" means a demand by the Contractor to the Owner or Design Professional for a change in the Fixed Price Contract Amount, an extension of the Contract Time, an adjustment to or interpretation of the Contract terms, change to Contract Documents, or other relief with respect to the terms of the Contract, which demand the Contractor or Owner asserts is required or allowed under the Contract Documents and which the Contractor and the Owner, or Contractor and Design Professional have previously discussed and failed to agree upon.
- 14.2** For the Objection to be considered, it must meet the following requirements:
- (a) The Objection must be in writing;
 - (b) The Objection by the Contractor must be signed by an authorized representative of the Contractor;
 - (c) The Objection by the Contractor must be provided to the Owner and to the Design Professional;
 - (d) The Objection must be made no later than ten (10) days after the event or first appearance of the circumstance giving rise to the Objection;
 - (e) The Objection must describe in detail all known facts and circumstances that the Contractor asserts support the Objection;
 - (f) The Objection must refer to the provision(s) of the Contract Documents that the Contractor asserts support the Objection;
 - (g) The Contractor must provide all documentation or other information to substantiate the Objection; and
 - (h) The Contractor must continue its performance under this Contract pending the resolution of any Objection; provided, however, that the Contractor shall not perform any additional or changed work not otherwise authorized in accordance with the Contract Documents.

- 14.3** The failure by the Contractor to meet any of the requirements of Paragraph 14.2 shall constitute a complete waiver by the Contractor of any rights arising from or related to the Objection.
- 14.4** If the Objection is made based on concealed or unknown site conditions, the following shall apply in addition to all other provisions applicable to the Objection:
- (a) The condition must have been previously concealed and unknown or of a type not ordinarily encountered in the general geographic location of the Project and must not have been reasonably susceptible to discovery; and
 - (b) The Contractor shall notify the Design Professional and the Owner of the condition and shall not disturb the condition until the Design Professional and Owner have observed it or have waived in writing the right to observe it.
- 14.5** If the Objection by the Contractor is for an increase in the Fixed Price Contract Amount, the following shall apply in addition to all other provisions applicable to the Objection:
- (a) Any increase in the Fixed Price Contract Amount shall be strictly limited to the direct costs incurred by the Contractor and shall not include any other costs, indirect or other, including any costs for or related to lost productivity, profit, home office overhead and any other overhead, legal fees, Objection preparation, any matter previously resolved by a change order, equipment costs, costs related to the services of a project manager unless the project manager was required full time by the Owner or the Contract Documents, any costs associated with the failure to complete the Work early or in advance of the date required by the Contract Documents, it being specifically agreed to by the parties that there is no intention to have the Eichleay or other similar formula applicable to this Contract nor shall this Contract be deemed to be subject to any such formula; and
 - (b) The Owner shall have no liability for, and the Fixed Price Contract Amount shall not be increased related to, any Objections of third parties, including subcontractors, unless and until the liability of the Contractor for such has been established in a court of competent jurisdiction and any such liability of the Owner shall be limited in the same manner as described in subparagraph 14.5 (a).
- 14.6** If the Objection by the Contractor is for an extension of the Contract Time, the following shall apply in addition to all other provisions applicable to the Objection:
- (a) The Contractor has been delayed in its performance by an act or omission of the Owner and through no fault of the Contractor;
 - (b) The Contractor has been delayed in its performance by unusually severe weather that could not reasonably have been anticipated or by another event not within its reasonable control;
 - (c) At the time it occurs or during its occurrence, the delay will preclude completion of the Project in the time required by the Contract Documents; and
 - (d) Any extension of the Contract Time shall be the Contractor's sole and exclusive remedy for any delay except a delay caused by the active interference of the Owner with the Contractor's performance which active interference continues after written notice to the Owner. The Owner's exercise of any of its rights or remedies under this Contract, including ordering changes in the Work, directing suspension, rescheduling or correction of the Work, do not constitute active interference.

- 14.7** If an Objection is made based on an error, inconsistency or omission in the Contract that was reasonably susceptible to discovery by the Contractor and was not reported, then that Objection shall be denied.
- 14.8** All Objections made in accordance with this Article 14 shall be reviewed and evaluated by the Design Professional. If the Objection is not made in strict accordance with Article 14, it shall be rejected as waived. Any failure by the Design Professional to reject the Objection for failure to meet the requirements of Article 14 is not binding on the Owner and the Owner may reject the Objection for such failure.
- 14.9** No later than seven (7) days from receipt of the Objection by the Design Professional, they may either:
- (a) Make a written request to the Contractor or Owner for more data to support the Objection if desired;
 - (b) Attempt to facilitate resolution of the Objection through informal negotiations; or
 - (c) Make a written recommendation to the Owner, with a copy to the Contractor, that the Owner reject or approve all or part of the Objection and state the reasons for the Design Professional's recommendation.
- 14.10** If the Design Professional requests more data from the Contractor under subparagraph 14.9.(a), the Contractor shall respond no later than seven (7) days from receipt of such request, and provide additional data, provide a date certain by which additional data will be provided, or state that it will not provide additional data. Upon receipt of data, if any, in accordance with this section, the Design Professional will complete the evaluation of the Objection within seven days. Failure to respond at all or failure to provide data by the date specified in the response to the request shall result in the Objection being evaluated based on the information in the Design Professional's possession.
- 14.11** In evaluating the Objection, the Design Professional may consult with the Contractor, the Owner or other persons with knowledge or expertise that may assist the Design Professional in its evaluation.
- 14.12** No later than fourteen (14) days after receipt by the Owner of the Design Professional's recommendation regarding the Contractor's Objection, the Owner shall, in writing, notify the Contractor and the Design Professional of its decision regarding the Objection.
- 14.13** The Owner's decision regarding the Contractor's Objection is binding on final between the Owner and the Contractor but is subject to mediation in accordance with this Contract. The Contractor must proceed with the Work under the terms of this Agreement and any decision made by the Owner pursuant to this Section; provided, however, that Contractor but may concurrently pursue any remedies available at law or under this Contract.

ARTICLE 15

SUBCONTRACTORS

- 15.1** A document in the form of Exhibit E shall be completed and submitted upon execution of this Contract and those subcontractors named therein shall match those subcontractors named in the Contractor's bid unless otherwise agreed to in writing by the Owner. Also, upon execution of this Contract by the Contractor, the Contractor shall identify to the Owner and the Design Professional, in writing, those parties intended as subcontractors on the Project not otherwise named in Exhibit E. The Owner shall, in writing, state any objections the Owner may have to one or more of such subcontractors. The Contractor shall not enter into a subcontract with an intended subcontractor

with reference to whom the Owner objects. All subcontracts shall afford the Contractor rights against the subcontractor which correspond to those rights afforded to the Owner against the Contractor herein, including those rights of Contract Termination as set forth in this Contract. All subcontractors shall, throughout the duration of this Contract, be properly licensed as Idaho Public Works Contractors.

- 15.2** The Contractor conditionally assigns each of its subcontracts related to the Project to the Owner. All subcontracts between the Contractor and the subcontractors shall obligate the subcontractor to such conditional assignment. Upon a Termination by the Owner for cause under Paragraph 20.1, the Owner may accept such conditional assignment by written notification to the applicable subcontractor and to the Contractor. Such acceptance is subject to the rights of the Surety, if any, relating to the Contract.

ARTICLE 16

CHANGES IN THE WORK

16.1 General:

- (a) Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive, or order for a minor change in the Work, subject to the limitations stated in this Article and elsewhere in the Contract Documents; and
- (b) Changes in the Work shall be performed under applicable provisions of the Contract Documents and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

16.2 Change Orders:

- (a) "Change Order" is a written instrument prepared by the Design Professional and signed by the Owner, Contractor and Design Professional, stating their agreement upon: a change in the Work, any adjustment in the Fixed Price Contract Amount and any adjustment in the Contract Time;
- (b) Methods used in determining adjustments to the Fixed Price Contract Amount may include those listed in subparagraph 16.3.(d);
- (c) The amount allowed for overhead and profit on any Change Order is limited to the amounts indicated in subparagraph 16.3.(k);
- (d) Any Change Order prepared, including those arising by reason of the parties' mutual agreement or by mediation, shall constitute a final and full settlement of all matters relating to or affected by the change in the Work, including all direct, indirect, and consequential costs associated with such change and any and all adjustments to the Fixed Price Contract Amount and Contract Time. In the event a Change Order increases the Fixed Price Contract Amount, the Contractor shall include the Work covered by such Change Order in the Contractor's Request for Payment as if such Work were originally part of the Project and Contract Documents; and
- (e) By the execution of a Change Order, the Contractor agrees and acknowledges that it has had sufficient time and opportunity to examine the change in Work which is the subject of the Change Order and that it has undertaken all reasonable efforts to discover and disclose any concealed or unknown conditions which may to any extent affect the Contractor's ability

to perform in accordance with the Change Order. Aside from those matters specifically set forth in the Change Order, the Owner shall not be obligated to make any adjustments to either the Fixed Price Contract Amount or Contract Time by reason of any conditions affecting the change in Work addressed by the Change Order, which could have reasonably been discovered or disclosed by the Contractor's examination.

16.3 Construction Change Directive (CCD):

- (a) "Construction Change Directive" is a written order prepared by the Design Professional and signed by the Owner and Design Professional directing a change in the Work prior to agreement on adjustment, if any, in the Fixed Price Contract Amount or Contract Time or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract, consisting of additions, deletions or other revisions, the Fixed Price Contract Amount and Contract Time being adjusted accordingly;
- (b) A Construction Change Directive, within limitations, may also be used to incorporate minor changes in the Work agreed to by the Design Professional's representative, the Owner's Field Representative and the Contractor's superintendent or project manager. The limits of these representatives' authority with regard to Construction Change Directives shall be documented in writing by the Design Professional, Owner and Contractor;
- (c) A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order;
- (d) If the Construction Change Directive provides for an adjustment to the Fixed Price Contract Amount, the adjustment shall be based on one (1) of the following methods:
 - i. Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
 - ii. Unit prices stated in the Contract Documents or subsequently agreed upon;
 - iii. Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
 - iv. As provided in subparagraph 16.3.(g).
- (e) Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Design Professional in writing within forty-eight (48) hours of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Fixed Price Contract Amount or Contract Time;
- (f) A Construction Change Directive signed by the Contractor indicates the agreement of the Contractor therewith, including adjustment in Fixed Price Contract Amount and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be incorporated into a future Change Order;
- (g) If the Contractor does not respond promptly or disagrees with the method for adjustments in the Fixed Price Contract Amount or Contract Time, the method and the adjustment shall be determined by the Design Professional on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an

increase in the Fixed Price Contract Amount, an allowance for overhead and profit in accordance with subparagraph 16.3.(k). In such case of an increase in Fixed Price Contract Amount, and also under subparagraph 16.3.(d), the Contractor shall keep and present, in such form as the Design Professional may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this subsection shall be limited to the following:

- i. Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom and Workers' compensation insurance;
 - ii. Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
 - iii. Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
 - iv. Costs of permit fees and sales, use or similar taxes related to the Work; and
 - v. Additional costs of supervision and field office personnel directly attributable to the change.
- (h) The amount of credit to be allowed by the Contractor to the Owner for a deletion or change which results in a net decrease in the Fixed Price Contract Amount shall be for the actual net cost of the decrease, confirmed by the Design Professional. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change;
- (i) Pending final determination of the total cost of a Construction Change Directive to the Owner, amounts not in dispute for such changes in the Work shall be included in the Contractor's Request for Payment accompanied by a Change Order indicating the parties' agreement with part or all of such costs;
- (j) When the Owner and Contractor agree with the determination by the Design Professional concerning the adjustments in the Fixed Price Contract Amount and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order; and
- (k) For purposes of subparagraphs 16.2.(c) and 16.3.(g), the allowance for combined overhead, profit, bonds and insurance shall be limited as follows, unless otherwise provided in the Contract Documents:
- i. For changes, the amount allowed for overhead, profit, bonds and insurance for the Contractor and all subcontractors of any tier combined shall not exceed fifteen percent (15%) of direct costs; or
 - ii. The Contractor will determine the apportionment between the Contractor and its subcontractors of allowable amounts of overhead, profit, bonds, and insurance.

16.4 The Design Professional will have authority to order minor changes in the Work not involving adjustment in the Fixed Price Contract Amount or extension of the Contract Time and not

inconsistent with the intent of the Contract Documents. Such changes shall occur by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

ARTICLE 17

DISCOVERING AND CORRECTING DEFECTIVE OR INCOMPLETE WORK

- 17.1** If the Contractor covers, conceals, or obscures its Work in violation of this Contract or in violation of a directive or request from the Owner or the Design Professional, such Work shall be uncovered and displayed for the Owner's or Design Professional's inspection upon request and shall be reworked at no cost in time or money to the Owner.
- 17.2** If any of the Work is covered, concealed, or obscured in a manner not addressed by Paragraph 17.1, it shall, if directed by the Owner or the Design Professional, be uncovered and displayed for the Owner's or Design Professional's inspection. If the uncovered Work conforms strictly with this Contract, the costs incurred by the Contractor to uncover and subsequently replace such Work shall be borne by the Owner. Otherwise, such costs shall be borne by the Contractor.
- 17.3** The Contractor shall, at no cost in time or money to the Owner, promptly correct Work (fabricated, installed or completed) rejected by the Owner or by the Design Professional as defective or that fails to conform to this Contract whether discovered before or after Substantial Completion. Additionally, the Contractor shall reimburse the Owner for all testing, inspections and other expenses incurred as a result thereof.
- 17.4** In addition to any other warranty obligations in this Contract, the Contractor shall be specifically obligated to correct, upon written direction from the Owner, any and all defective or nonconforming Work for a period of twelve (12) months following Substantial Completion.
- 17.5** The Owner may, but shall in no event be required to, choose to accept defective or nonconforming Work. In such event, the Fixed Price Contract Amount shall be reduced by the lesser of:
- (a) the reasonable costs of removing and correcting the defective or nonconforming Work; or
 - (b) the difference between the fair market value of the Project as constructed and the fair market value of the Project had it not been constructed in such a manner as to include defective or nonconforming Work. If the remaining portion of the unpaid Fixed Price Contract Amount, if any, is insufficient to compensate the Owner for the acceptance of defective or nonconforming Work, the Contractor shall, upon written demand from the Owner, pay the Owner such remaining compensation for accepting defective or nonconforming Work.

ARTICLE 18

TERMINATION BY THE CONTRACTOR

- 18.1** The Contractor may terminate the Contract if the Work is stopped for a period of ninety (90) consecutive days through no act or fault of the Contractor or a subcontractor, sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:
- (a) Issuance of an order by a court or by another public authority having jurisdiction and authority which requires all Work to be stopped; or
 - (b) An act of government, such as a declaration of national emergency, which requires all Work to be stopped.

- 18.2** In such event, the Contractor shall be entitled to recover from the Owner as though the Owner had terminated the Contractor's performance under this Contract pursuant to Paragraph 20.3.

ARTICLE 19

OWNER'S RIGHT TO SUSPEND CONTRACTOR'S PERFORMANCE

- 19.1** The Owner may, at any time and without cause, order the Contractor, in writing, to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine. If the Owner directs any such suspension, the Contractor must immediately comply with same.
- 19.2** In the event the Owner directs a suspension of performance under this Article, and such suspension is through no fault of the Contractor, the Fixed Price Contract Amount and Contract Time shall be adjusted for increases in the cost and time caused by such suspension, delay, or interruption to cover the Contractor's reasonable costs, actually incurred and paid, of:
- (a) Demobilization and remobilization, including such costs paid to subcontractors;
 - (b) Preserving and protecting Work in place;
 - (c) Storage of materials or equipment purchased for the Project, including insurance thereon; and
 - (d) Performing in a later, or during a longer, time frame than that provided by this Contract.
- 19.3** The adjustment of the Fixed Price Contract Amount shall include an amount for a reasonable profit. The adjustment of the Fixed Price Contract Amount shall not include any amount not otherwise allowed under this Contract, including any limitations applicable to Claims. The Contractor shall provide supporting documentation related to any increase upon request of the Owner. No adjustment shall be made to the extent:
- (a) That performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
 - (b) That an equitable adjustment is made or denied under another provision of the Contract.

ARTICLE 20

TERMINATION BY THE OWNER

The Owner may terminate this Contract in accordance with the following terms and conditions:

- 20.1** If the Contractor does not perform the Work, or any part thereof, in accordance with the Contract Documents, or in a timely manner; does not supply adequate labor, supervisory personnel, or proper equipment or materials; fails to pay subcontractors; fails to timely discharge its obligations for labor, equipment, and materials; proceeds to disobey applicable law; or otherwise breaches this Contract, then the Owner, in addition to any other rights it may have against the Contractor, may terminate the Contract and assume control of the Project site and of all materials and equipment at the site and may complete the Work. In such case, the Contractor shall not be paid further until the Work is complete. Upon such Termination, the Owner may, subject to any superior rights of the Surety, take possession of the site and of all materials, equipment, tools and construction equipment and machinery thereon owned by the Contractor; accept assignment of those subcontracts conditionally assigned under Paragraph 15.2; and finish the Work by whatever reasonable method the Owner may deem expedient.

20.2 When the Owner terminates the Contract for cause as provided in Paragraph 20.1, the Contractor shall not be entitled to receive further payment until the Work is finished and shall only be entitled to payment for Work satisfactorily performed by the Contractor in accordance with the Contract Documents. If the costs of finishing the Work, including compensation for the Design Professional's services and expenses made necessary thereby, exceed the unpaid balance, the Contractor shall pay the difference to the Owner. This obligation for payment shall survive termination of the Contract. The Contractor shall also terminate outstanding orders and subcontracts. The Contractor shall settle the liabilities and claims arising out of the termination of subcontracts and orders. In the event the employment of the Contractor is terminated by the Owner for cause pursuant to Paragraph 20.1 and it is subsequently determined by a court of competent jurisdiction that such termination was without cause, such termination shall thereupon be deemed a Termination under Paragraph 20.3 and the provisions of Paragraph 20.3 shall apply.

20.3 The Owner may, at any time and for any reason, terminate this Contract. The Owner shall give no less than seven (7) days' written notice of such Termination to the Contractor specifying when termination becomes effective. The Contractor shall incur no further obligations in connection with the Work and the Contractor shall stop Work when such Termination becomes effective. The Contractor shall also terminate outstanding orders and subcontracts. The Contractor shall settle the liabilities and claims arising out of the termination of subcontracts and orders. The Owner may direct the Contractor to assign the Contractor's right, title and interest under termination orders or subcontracts to the Owner or its designee. The Contractor shall transfer title and deliver to the Owner such completed or partially completed Work and materials, equipment, parts, fixtures, information, and Contract rights as the Contractor has. When terminated pursuant to this section, the following shall apply:

- (a) The Contractor shall submit a Termination Claim to the Owner and the Design Professional specifying the amounts claimed due because of the Termination, together with costs, pricing or other supporting data required by the Owner or the Design Professional. Failure by the Contractor to file a Termination Claim within ninety (90) days from the effective date of termination shall be deemed a complete waiver by the Contractor of any right to any payment;
- (b) Before or after receipt of the Termination Claim, the Owner and the Contractor may agree to the compensation, if any, due to the Contractor hereunder; and
- (c) If the Contractor has filed the Termination Claim but the Contractor and the Owner do not agree on an amount due to the Contractor, the Owner shall pay the Contractor the following amounts:
 - i. Unpaid Contract prices for labor, materials, equipment and other services provided or perfected prior to termination and acceptable to or accepted by the Owner;
 - ii. Reasonable costs incurred in preparing to perform the terminated portion of the Work, and in terminating the Contractor's performance, plus a fair and reasonable allowance for direct job-site overhead and profit related to such preparation (such profit shall not include anticipated profit or consequential damages); provided, however, that if it appears that the Contractor would have not profited or would have sustained a loss if the entire Contract would have been completed, no profit shall be allowed or included and the amount of compensation shall be reduced to reflect the anticipated loss, if any; and
 - iii. Reasonable costs of settling and paying claims arising out of the Termination of subcontracts or orders pursuant to this Paragraph 20.3.

- 20.4** Costs described in subparagraphs 20.3.(c)(ii) or 20.3.(c)(iii) above shall not include amounts paid in accordance with other provisions hereof. In no event shall the total sum to be paid the Contractor under subparagraph 20.3.(c) exceed the total Fixed Price Contract Amount, as properly adjusted, reduced by the amount of payments previously or otherwise made and by any other deductions permitted under this Contract and shall in no event include duplication of payment.

ARTICLE 21

CONTRACTOR'S LIABILITY INSURANCE

- 21.1** All insurance carriers providing coverage under this Agreement, shall be rated an "A" or above by Best's Insurance Rating Service. Evidence of such insurance coverage or self-insurance shall be in the form of a certificate of insurance or statement of financial responsibility. The Contractor shall immediately notify the Owner of notice of knowledge of cancellation, refusal to renew, or change in any material way the nature or extent of the coverage provided by such policies. The Contractor will provide notification by written notice, by certified or registered mail, return receipt requested.
- 21.2** Contractor shall maintain such Commercial General Liability insurance with minimum limits of \$1,500,000/\$2,500,000 to protect its interest and that of the Owner. The State of Idaho, Division of Public Works will be named an Additional Insured on any general liability and property policies carried and required by this Agreement. The insurance afforded by the Contractor and Sub-Contractors shall be primary insurance. The State of Idaho's retained risk program coverage is only applicable to the acts or omissions of the State's officials, agents, or employees and shall not cover the acts or omissions of the Contractor or its Sub-Contractors.
- 21.3** Contractor shall carry Worker's Compensation Insurance to cover obligations imposed by federal and state statutes covering all employees and employers' liability insurance with a minimum limit of 1,000,000.
- 21.4** Business Auto and Umbrella Liability Insurance: Contractor shall maintain business, auto liability and, if necessary, commercial umbrella liability insurance with a limit of not less than \$1,000,000 each accident;
Such insurance shall cover liability arising out of any auto (including owned, hired, and non-owned autos);
Business auto coverage shall be written on ISO form CA 00 01, CA 00 05, CA 00 12, CA 00 20 or a substitute form providing equivalent liability coverage. If necessary, the policy shall be endorsed to provide contractual liability coverage equivalent to that provided in the 1990 and later editions of CA 00 01;
If hazardous waste will be hauled, Contractor shall obtain pollution liability coverage equivalent to that provided under the ISO pollution liability-broadened coverage for covered autos endorsement (CA 99 48) and the Motor Carrier Act endorsement (MCS 90) shall be attached.
- 21.5** If any of the insurance required under this Agreement is arranged on "claims made" basis, "tail" coverage will be required at the completion of this Agreement for duration of five (5) years thereafter. The Contractor shall be responsible for furnishing certification of "tail" coverage or continuous "claims made" liability coverage for five (5) years following the completion of this Agreement. Continuous "claims made" coverage will be acceptable in lieu of "tail" coverage provided its retroactive date is on or before the effective date of this Agreement.
- 21.6** The Contractor shall indemnify, defend and save harmless the State of Idaho, the Division of Public Works, (name of agency), their officers, agents and employees, from and against any liability, claims, damages, losses, expenses, actions and suits whatsoever, including injury or death of

others or any employees of the Contractor or the Contractor's Sub-Contractor caused by or arising out of acts or omissions, or negligent performance by the Contractor of any term of this contract.

- 21.7** All express representations, indemnifications or limitations of liability made in or given to this Agreement will survive the completion of all services of Contractor under this Agreement or the termination of this Agreement for any reason.

ARTICLE 22

BUILDER'S RISK INSURANCE

- 22.1** Unless otherwise provided in this Agreement, the General Contractor shall purchase or maintain property insurance written on a builder's risk "all-risk" policy (the "Builder's Risk Policy") in excess of \$2,000,000 to cover the Owner's property, the Project, and General Contractor's equipment, materials, and supplies.

(a) The Builder's Risk Policy shall:

- i. Include perils of fire with extended coverage and mischief, collapse, earthquake, flood, windstorm, temporary buildings and debris removal, demolition, and flood damage, if commercially available for similar operation in the region of the United States where the Project is located;
- ii. Be of an amount not less than the initial Contract Amount, plus value of subsequent Contract modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site, on a replacement cost basis without optional deductibles;
- iii. Cover resultant damage from errors in design, plans, specifications, faulty workmanship, materials, and construction;
- iv. Include reasonable compensation for Design Professional, Project Manager, Owner and its contractors' services and expenses required as a result of an insured loss, excluding any Liquidated Damages, extra expense, and expediting expense;
- v. Include the State of Idaho, Contractor and Sub-Contractors as Named Insureds under the policy.
- vi. Contain an express, full and complete, waiver of any right of subrogation by the insurer in favor of the Owner and State of Idaho for loss or damage occurring during the Work to the extent covered by the Builder's Risk Policy.

(b) The General Contractor shall purchase the Builder's Risk Policy from a company or companies lawfully authorized to do business and issues contracts of insurance in the State of Idaho.

(c) The General Contractor shall be responsible for the deductible, whether or not to the extent the loss is caused by the negligence or intentional misconduct of the General Contractor, any of its Subcontractors or sub-subcontractors or material suppliers or any other person for whom the General Contractor is responsible.

(d) The General Contractor shall submit to the Owner, or the Project Manager if designated by the Owner, for its approval, all items deemed by the Builder's Risk Policy carrier to be uninsurable.

(e) The General Contractor shall not commence Work under the Agreement until it has obtained all required insurance and until evidence of the required insurance has been

reviewed and accepted by the Owner. Owner review of the insurance shall not relieve nor decrease the liability of the General Contractor.

- (f) The Builder's Risk Policy shall be maintained in force, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final acceptance by the Owner and final payment to the General Contractor has been made.

22.2 The Contractor authorizes the Owner to negotiate and agree on the value and extent of, and to collect the proceeds payable with respect to, any loss under a policy of insurance where the Owner is the Insured or Additional Insured pursuant to any of the provisions of this Article. The Owner shall have full right and authority to compromise any claim, or to enforce any claim by legal action or otherwise, or to release and discharge any insurer, by and on behalf of the Owner and Contractor. The Owner shall provide written notice to Contractor of:

- (a) its having reached any such settlement or adjustment with an insurer; and
- (b) the receipt of any funds pursuant to this Article. Any objection by the Contractor to a settlement or adjustment made under this Article must be made in writing to the Owner within five (5) business days of the notice from the Owner. The Owner and the General Contractor agree to attempt to resolve the dispute by mutual agreement.

22.3 The General Contractor shall deposit proceeds received under the Builder's Risk Policy in a manner in which such proceeds can be separately accounted for. The General Contractor shall distribute the proceeds in accordance with an agreement as the parties may reach. If after such loss no other special agreement is made and unless the Owner terminates the Contract pursuant to Article 20, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 16.

ARTICLE 23

SOVEREIGN IMMUNITY

23.1 In no event shall this Agreement or any act by the STATE OF IDAHO, be a waiver of any form of defense or immunity, whether sovereign immunity, governmental immunity, immunity based on the Eleventh Amendment to the Constitution of the United States or otherwise, from any claim or from the jurisdiction of any court. If a claim must be brought in a federal forum, then it must be brought and adjudicated solely and exclusively within the United States District Court for the State of Idaho. This Section applies to a claim brought against the STATE OF IDAHO only to the extent Congress has appropriately abrogated the state's sovereign immunity, and is not consent by the STATE OF IDAHO, to be sued in federal court, or a waiver of any form of immunity, including, but not limited to, sovereign immunity, and immunity based on the Eleventh Amendment to the Constitution of the United States.

ARTICLE 24

PERFORMANCE AND PAYMENT BONDS

24.1 The Contractor shall furnish separate performance and payment bonds to the Owner. Each bond shall set forth a penal sum in an amount not less than the Fixed Price Contract Amount and shall include a power of attorney attached to each bond. The signature of both the Contractor's principal and the Surety are required. If the Surety is incorporated, both bonds must have the corporate seal. Each bond furnished by the Contractor shall incorporate by reference the terms of this Contract as fully as though they were set forth verbatim in such bonds. In the event the Fixed Price Contract Amount is adjusted by Change Order executed by the Contractor, the penal sum of both the

performance bond and the payment bond shall be deemed increased by like amount. The performance and payment bonds furnished by the Contractor shall be AIA Document A312, or a standard Surety form certified approved to be the same as the AIA Document A312, and shall be executed by a Surety, or Sureties, reasonably acceptable to the Owner and authorized to do business in the State of Idaho.

- 24.2** Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall permit a copy to be made.
- 24.3** It is the Contractor's obligation to notify the Surety in the event of changes in the Contract Documents, which in the absence of notification might serve to discharge the Surety's obligations, duties or liability under bonds or the Contract.

ARTICLE 25

PROJECT RECORDS

- 25.1** All documents relating in any manner whatsoever to the Project, or any designated portion thereof, which are in the possession of the Contractor or any Subcontractor of the Contractor, shall be made available to the Owner or the Design Professional for inspection and copying upon written request. Furthermore, said documents shall be made available, upon request by the Owner, to any state, federal or other regulatory authority and any such authority may review, inspect, and copy such records. Said records include all drawings, plans, specifications, submittals, correspondence, minutes, memoranda, tape recordings, videos or other writings or things which document the Project, its design, and its construction. Said records expressly include those documents reflecting the cost of construction to the Contractor. The Contractor shall maintain and protect these documents for no less than four (4) years after final completion or termination of the Contract or for any longer period of time as may be required by law or good construction practice.

ARTICLE 26

MISCELLANEOUS PROVISIONS

- 26.1** The law is hereby agreed to be the law of the State of Idaho. The parties further agree that venue for any proceeding related to this Contract shall be in Boise, Ada County, Idaho, unless otherwise mutually agreed by the parties.
- 26.2** Pursuant to Section 54-1904A, Idaho Code, within thirty (30) days after award of this Contract, the Contractor shall file with the Idaho State Tax Commission, with a copy to the Owner, a signed statement showing the date of Contract award, the names and addresses of the home offices of contracting parties, including all Subcontractors, the state of incorporation, the Project Number and a general description of the type and location of the Work, the amount of the prime contracts and all subcontracts and all other relevant information which may be required on forms which may be prescribed by the Idaho State Tax Commission.
- 26.3** The Contractor, in consideration of securing the business of erecting or constructing Public Works in the State of Idaho, recognizing that the business in which it is engaged is of a transitory character, and that in the pursuit thereof, its property used therein may be without the state when taxes, excises or license fees to which it is liable become payable, agrees:
- (a) To pay promptly when due all taxes (other than on real property), excises and license fees due to the State of Idaho, its sub-divisions, and municipal and quasi-municipal corporations therein, accrued or accruing during the term of this Contract, whether or not the same shall be payable at the end of such term;

- (b) That if the said taxes, excises, and license fees are not payable at the end of said term, but liability for the payment thereof exists even though the same constitute liens upon its property, to secure the same to the satisfaction of the respective officers charged with the collection thereof; and
- (c) That, in the event of its default in the payment or securing of such taxes, excises and license fees, to consent that the department, officer, board or taxing unit entering this Contract may withhold from any payment due it hereunder the estimated amount of such accrued and accruing taxes, excises and license fees for the benefit of all taxing units to which said Contractor is liable.

- 26.4** Before entering a Contract, the Contractor shall be authorized to do business in the State of Idaho and shall submit a properly executed Contractor's Affidavit Concerning Taxes (Exhibit D).
- 26.5** Pursuant to Section 44-1002, Idaho Code, it is provided that each Contractor "must employ ninety-five percent (95%) bona fide Idaho residents as employees on any job under any such contract except where under such contracts fifty (50) or less persons are employed the contractor may employ ten percent (10%) nonresidents, provided, however, in all cases employers must give preference to the employment of bona fide residents in the performance of said Work, and no contract shall be let to any person, firm, association, or corporation refusing to execute an agreement with the above mentioned provisions in it; provided, that, in contracts involving the expenditure of federal aid funds this act shall not be enforced in such a manner as to conflict with or be contrary to the federal statutes prescribing a labor preference to honorably discharged soldiers, sailors, and marines, prohibiting as unlawful any other preference or discrimination among citizens of the United States." (Ref. Section 44-1001, Idaho Code)
- 26.6** The Contractor shall maintain, in compliance with Title 72, Chapter 17, Idaho Code, a drug-free workplace program throughout the duration of this Contract and shall only subcontract work to subcontractors who have programs that comply with Title 72, Chapter 17, Idaho Code.
- 26.7** As between the Owner and Contractor as to acts or failures to act, any applicable statute of limitations shall commence to run, and any legal cause of action shall be deemed to have accrued in any and all events in accordance with Idaho law.
- 26.8** The Contractor and its subcontractors and sub-subcontractors shall comply with all applicable Idaho statutes with specific reference to Idaho Public Works Contractors' licensing laws in the State of Idaho, Title 54, Chapter 19, Idaho Code, as amended.
- 26.9** The Contractor shall not knowingly hire or engage any illegal aliens or persons not authorized to work in the United States and take steps to verify that it does not hire or engage any illegal aliens or persons not authorized to work in the United States. Any misrepresentation in this regard or any employment of persons not authorized to work in the United States constitutes a material breach and shall be cause for the imposition of monetary penalties not to exceed five percent (5%) of the Fixed Price Contract Amount per violation and/or Termination of this Contract. The Contractor also acknowledges that, if it is a natural person, it is subject to Title 67, Chapter 79, Idaho Code regarding verification of lawful presence in the United States.

ARTICLE 27

EQUAL OPPORTUNITY

The Contractor shall maintain policies of employment as follows:

- 27.1** The Contractor and the Contractor's subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, age or national origin. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, color, sex, age or national origin. Such action shall include the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.
- 27.2** The Contractor and the Contractor's subcontractors shall, in all solicitation or advertisements for employees placed by them or on their behalf; state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, age or national origin.

ARTICLE 28

SUCCESSORS AND ASSIGNS

- 28.1** Each party binds itself, its successors, assigns, executors, administrators or other representatives to the other party hereto and to successors, assigns, executors, administrators or other representatives of such other party in connection with all terms and conditions of this Contract. The Contractor shall not assign this Contract or any part of it or right or obligation pursuant to it without prior written consent of the Owner. If Contractor attempts to make assignment without consent of Owner, Contractor shall remain legally responsible for all obligations under this Contract.

ARTICLE 29

SEVERABILITY

- 29.1** In the event any provision or section of this Contract conflicts with applicable law or is otherwise held to be unenforceable, the remaining provisions shall nevertheless be enforceable and shall be carried into effect.

ARTICLE 30

MEDIATION

- 30.1** Contractor Objections for additional cost or time are subject to Article 14, shall be reviewed as provided in accordance with that Article and, as a condition precedent to litigation, are subject to dispute resolution attempts and mediation in accordance with this Article. All other issues and disputes arising from this contract are also subject to dispute resolution attempts & mediation in accordance with this Article, as a condition precedent to litigation.
- 30.2** The Parties agree that resolution of any dispute or disagreement without formal legal proceedings is to their mutual benefit and to the benefit of the Project.
- 30.3** The parties agree to make every reasonable attempt to resolve any issues or disputes informally. The parties further agree that prior to the institution by either of legal or equitable proceedings of any kind, and as a condition precedent thereto, any dispute between the Contractor and the Owner related to the Contract, including a dispute over the Owner's decision regarding a Claim, shall be subject to mediation as follows:
- (a) If the issue to be mediated involves only a dispute regarding the Contract Time, no request to mediate shall be made unless liquidated damages have been assessed by the Owner. If the issue to be mediated involves a Claim or other financial dispute, no request to mediate shall be made unless the amount is \$50,000 or more or until there are cumulative Claims or

disputes amounting to \$50,000 or more; provided, however, that a mediation request can be made as to any Claim or financial matter at any time after Substantial Completion;

- (b) The party seeking mediation shall notify the other party in writing of its mediation request. In such written request, the requesting party must clearly describe the issues it believes are subject to mediation;
- (c) Within fifteen (15) days of receipt of the mediation request, the non-requesting party shall respond in writing to the request;
- (d) Unless the Owner and the Contractor agree to other rules for mediation, mediation shall be in accordance with the Construction Industry Rules of Arbitration and Mediation Procedures in effect at the time of the mediation;
- (e) The parties shall share the mediator's fee and any filing fees equally; provided, however, that if a party makes a written request to the mediator without satisfying the requirements of this section and by doing so incurs any costs or fees, that party shall be solely responsible for the costs or fees;
- (f) Unless otherwise mutually agreed to by the parties, the mediation shall be in Boise, Ada County, Idaho;
- (g) The parties shall cooperate in arranging the other details of mediation, such as selection of the mediator, mediation dates and times;
- (h) The parties agree that all parties necessary to resolve the matter shall be parties to the same mediation proceeding; provided, however, that no Subcontractor or sub-subcontractor shall attend the mediation absent advance notice and consent from the Owner;
- (i) Agreements reached in mediation shall be enforceable as settlement agreements in any court having proper jurisdiction; and
- (j) Unless otherwise agreed in writing, the Contractor shall continue the work and maintain the approved schedules during any mediation proceedings. If the Contractor continues to perform, the Owner shall continue to make payments in accordance with the Contract Documents.

30.4 If mediation fails to resolve the dispute, either party may file an action in the courts of Idaho in accordance with the venue provision contained in this Contract.

ARTICLE 31

WAIVER OF CONSEQUENTIAL DAMAGES

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

- (a) Damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business, and reputation and for loss of management or employee productivity or of the services of such persons; and
- (b) Damages incurred by the Contractor for principal office expenses, including the compensation of personnel stationed there; for losses of income, financing, business, and

reputation; loss of management or employee productivity or of the services of such persons; and for loss of profit except profit arising directly from the Work.

- 31.2** This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Articles 18 and 20. Nothing contained in this paragraph shall be deemed to preclude an award of the assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

IN WITNESS WHEREOF, the parties have executed this Contract on the dates set forth below.

OWNER:

State of Idaho
Division of Public Works

Authorized Signature

Date

Dale Reynolds
Print Signature

Administrator
Title

CONTRACTOR:

Contractor's Name- Typed

Authorized Signature

Date

Print Signature

Title

EXHIBIT A

PROJECT IDENTIFICATION, ADDENDA, CONTRACT AMOUNT, CONTRACT TIME, ACCEPTED ALTERNATIVES, LIQUIDATED DAMAGES, AND SPECIAL CONDITIONS (IF ANY)

OWNER'S PROJECT IDENTIFICATION INFORMATION:

DPW Project No.23251
Project Title UI: Replace Chiller, CNR
Project Location 975 W 6th St, Moscow, ID 83844

General Project Description: A description of the work of this project can be summarized to include replacement of the chilled water system and existing fisheries water distribution systems, water mixing stations, and chlorine analyzer at the College of Natural Resources fisheries lab at the University of Idaho.

ADDENDA: Addenda applicable to the Contract and made a part of are as follows:

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

FIXED PRICE CONTRACT AMOUNT AND ACCEPTED ALTERNATES:

Base Bid Amount: _____ \$ _____
Alternate No. 1 (_____) add \$ _____

Total Fixed Price Contract Amount
(_____) Dollars \$ _____

Contractor's Requests for Payment are to be submitted for Work accomplished through the ____ day of each month as described in Paragraph 7.3.

TIME FOR PERFORMANCE AND LIQUIDATED DAMAGES:

A. The Contractor shall commence construction of its scope of the Work in accordance with the Notice to Proceed issued by the Owner, and which will become Exhibit F to this Contract.

B. The Contractor shall accomplish Substantial Completion as defined in Article 6 of the Contract within Three-Hundred-Sixty-Five (365) consecutive calendar days from the date authorized to proceed in the Notice to Proceed.

C. The amount of liquidated damages per day for each and every day of unexcused delay as outlined in Article 6 on the Contract is: One Thousand Dollars (\$1,000)

DRAWINGS AND SPECIFICATIONS:

The Owner shall furnish the Contractor 5 sets of Drawings and Project Manuals.

EXHIBIT B

ADDRESSES AND AUTHORIZED REPRESENTATIVES (INCLUDING LIMITATIONS)

The names, addresses and authorized representatives of the Owner, the Contractor and the Design Professional are:

OWNER: State of Idaho
Division of Public Works
502 N. 4th Street
P.O. Box 83720
Boise, ID 83720-0072
Dale Reynolds, Administrator

Project Manager: Scott Tucker
Telephone: (208) 332-1900
E-mail: scott.tucker@adm.idaho.gov
May sign for Owner: Yes [X] No []

Field Representative: Ken Cook
Telephone: (208) 885-6246
E-mail: ken.cook@adm.idaho.gov
May sign for Owner: Yes [X] No []

CONTRACTOR: _____ (company name)
_____ (address or PO address)
_____ (city, state, zip)
_____ (telephone)
_____ (email)
Public Works Contractors License No. _____

Officer: _____ (name and title)
_____ (telephone)
_____ (E-mail)

Contractor's
Project Manager: _____ (name)
_____ (telephone)
_____ (E-mail)
May sign for Contractor: Yes [] No []
Change Orders: up to: \$ _____ .00
Construction Change Authorizations: up to: \$ _____ .00
Contractor's Request for Payment

Contractor's
Superintendent: _____ (name)
_____ (telephone)
_____ (E-mail)
May sign for Contractor: Yes [] No []
Construction Change Authorizations: up to \$ _____ .00

**DESIGN
PROFESSIONAL:**

Coffman Engineers
221 N Wall St.
Spokane, WA. 99201
509-328-2994
509-328-2999

Professional's
Project Manager:

Traci Hanegan
Professional License No. 10249
509-328-2994
509-328-2999
traci.hanegan@coffman.com

Professional's
Field Representative:

Bob Koca
509-328-2994
509-321-6164
bob.koca@coffman.com

May sign for Design Professional:

Field Reports	Yes [x]	No []
Change Order Proposal Requests	Yes [x]	No []
Construction Change Authorization:	Yes [x]	No []
Construction Change Order	Yes [x]	No []
Design Professional's Supplemental Instructions	Yes [x]	No []
Interpretations of the Contract Documents	Yes [x]	No []
Contractor's Request for Payment	Yes [x]	No []
Acceptance of Substantial Completion	Yes [x]	No []
Acceptance of final completion	Yes [x]	No []

EXHIBIT C

LIST OF DRAWINGS AND SPECIFICATIONS

LIST OF DRAWINGS:

General

G-001 Cover Sheet

Civil

C-001 DEMOLITION AND EROSION AND SEDIMENT CONTROL PLAN

C-101 CIVIL SITE PLAN

C-201 CIVIL DETAILS

Structural

S-001 GENERAL STRUCTURAL NOTES AND SPECIAL INSPECTION TABLES

S-101 GROUND FLOOR PLAN

S-102 FIRST FLOOR PLAN

S-501 STRUCTURAL DETAILS

Mechanical

M-001 MECHANICAL LEGENDS AND ABBREVIATIONS

MD-101 MECHANICAL GROUND FLOOR DEMO

MD-102 MECHANICAL FIRST FLOOR PLAN DEMO

MD-103 MECHANICAL DEMOLITION REFERENCE PHOTOS

MD-104 MECHANICAL DEMOLITION REFERENCE PHOTOS

M-101 MECHANICAL GROUND FLOOR PLAN

M-102 MECHANICAL FIRST FLOOR PLAN

M-103 MECHANICAL ENLARGED FIRST FLOOR PLAN

M-401 MECHANICAL ENLARGED GROUND FLOOR PLAN

M-501 MECHANICAL DETAILS

M-502 MECHANICAL DETAILS

M-503 MECHANICAL DETAILS

M-601 MECHANICAL PIPING DIAGRAMS

M-602 MECHANICAL PIPING DIAGRAMS

M-603 MECHANICAL CONTROL DIAGRAMS

M-604 MECHANICAL CONTROL DIAGRAMS

M-701 MECHANICAL SCHEDULES

M-702 MECHANICAL SCHEDULES

Electrical

E-001 SYMBOLS LIST, GENERAL NOTES, AND SHEET INDEX

ED101 ELECTRICAL BASEMENT DEMO

ED102 ELECTRICAL FIRST FLOOR DEMO

ED601 ONE-LINE DIAGRAM DEMO

E-101 ELECTRICAL BASEMENT PLAN

E-102 ELECTRICAL FIRST FLOOR PLAN

E-601 ONE-LINE DIAGRAM

E-701 ELECTRICAL SCHEDULES

LIST OF SPECIFICATIONS:

DIVISION 1 - GENERAL REQUIREMENTS

01 10 00	SUMMARY
01 23 00	ALTERNATES
01 25 00	SUBSTITUTION PROCEDURES
01 25 01	SUBSTITUTION REQUEST FORM
01 26 00	CONTRACT MODIFICATION PROCEDURES
01 29 00	PAYMENT PROCEDURES
01 31 00	PROJECT MANAGEMENT AND COORDINATION
01 33 00	SUBMITTAL PROCEDURES
01 40 00	QUALITY REQUIREMENTS
01 50 00	TEMPORARY FACILITIES AND CONTROLS
01 60 00	PRODUCT REQUIREMENTS
01 73 30	EXECUTION
01 74 19	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
01 77 00	CLOSEOUT PROCEDURES
01 78 23	OPERATION AND MAINTENANCE DATA
01 78 39	PROJECT AS-BUILTS DOCUMENTS
01 79 00	DEMONSTRATION AND TRAINING
01 91 13	GENERAL COMMISSIONING REQUIREMENTS

DIVISION 22-23 - MECHANICAL

22 05 00	COMMON WORK FOR PLUMBING
22 07 00	PLUMBING INSULATION SYSTEMS
22 11 00	WATER DISTRIBUTION SYSTEMS
22 40 00	PLUMBING FIXTURES
23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 40	VIBRATION AND SEISMIC CONTROLS FOR PIPING, PLUMBING, AND HVAC
23 05 50	IDENTIFICATION FOR PIPING AND EQUIPMENT
23 05 90	TESTING ADJUSTING AND BALANCING
23 07 00	HVAC INSULATION SYSTEMS
23 08 00	COMMISSIONING
23 09 00	INSTRUMENTATION AND CONTROL SYSTEMS
23 21 00	HYDRONIC PIPING
23 21 23	HYDRONIC PUMPS
23 57 00	PLATE HEAT EXCHANGERS
23 64 23	AIR-COOLED SCROLL WATER CHILLERS

DIVISION 26-28 - ELECTRICAL

26 05 00	COMMON WORK RESULTS
26 05 19	LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26	GROUND AND BONDING
26 05 29	HANGERS AND SUPPORTS
26 05 33	RACEWAYS AND FITTINGS
26 05 40	OUTLET, JUNCTION AND PULL BOXES
26 05 53	IDENTIFICATION
26 24 16	PANELBOARDS
26 27 26	WIRING DEVICES
26 28 13	FUSES
26 28 16	ENCLOSED SWITCHES AND CIRCUIT BREAKERS

LIST OF UNIVERSITY OF IDAHO STANDARDS:

STRUCTURED CABLING STANDARD V2.3

EXHIBIT D

CONTRACTOR'S AFFIDAVIT CONCERNING TAXES

STATE OF _____)
COUNTY OF _____) :ss

Pursuant to the Title 63, Chapter 15, Idaho Code I, the undersigned, being duly sworn, depose and certify that all taxes, excises and license fees due to the State or its taxing units, for which I or my property is liable then due or delinquent, has been paid, or arrangements have been made, before entering into a Contract for construction of any public works in the State of Idaho.

Name of Contractor

Address or PO address

City, State, zip code

Signature

Title

Subscribed and sworn to before me this _____ day of _____, _____.

(SEAL)

NOTARY PUBLIC

Residing at: _____

Commission expires: _____

EXHIBIT E

NAMED SUBCONTRACTORS

Pursuant to Section 67-2310, Idaho Code, commonly known as the naming law, the names and addresses of the entities who will perform the plumbing, heating and air conditioning and electrical work were named in the bid and are as follows:

Concrete (PWCL Category 03300)

(Name) _____
(Address) _____

Idaho Public Works Contractors License No. _____

Idaho Plumbing Contractors License No. _____

Instrumentation and Controls (PWCL Category 13800)

(Name) _____
(Address) _____

Idaho Public Works Contractors License No. _____

Idaho Plumbing Contractors License No. _____

Plumbing (PWCL Category 15400)

(Name) _____
(Address) _____

Idaho Public Works Contractors License No. _____

Idaho Plumbing Contractors License No. _____

Heating Ventilating & Air Conditioning (PWCL Category 15700-HVAC)

(Name) _____
(Address) _____

Idaho Public Works Contractors License No. _____

Idaho HVAC Contractors License No. _____

Testing and Balancing (PWCL Category 15950)

(Name) _____
(Address) _____

Idaho Public Works Contractors License No. _____

Idaho HVAC Contractors License No. _____

Electrical (PWCL Category 1600)

(Name) _____
(Address) _____

APPENDIX

Idaho Public Works Contractors License No. _____

Idaho Electrical Contractors License No. ____

EXHIBIT F

NOTICE TO PROCEED

TO CONTRACTOR: _____ DPW NUMBER: _____

CONTRACT DATE: _____ ARCHITECT: _____

CONTRACT AMOUNT: \$ _____

DATE OF ISSUANCE: _____ OWNER: State of Idaho

You are hereby notified to commence work on the above referenced contract on/or before _____, _____ and are to substantially complete the work within _____ consecutive calendar days thereafter; therefore your contract completion date is _____.

The contract provides for the sum of \$ _____ as liquidated damages for each consecutive calendar day after the above established substantial completion date that the Work remains incomplete. Completion date will be established by "Certificate of Substantial Completion."

You are reminded that any changes to the original contract document regarding either cost or completion date must be affected by a change order approved by this department.

Your payment estimates must be submitted on Division of Public Works forms included herein. We will be most happy to assist you in preparing the payment estimate forms.

_____ has been appointed Field Representative for this project. Please contact him at (208) _____ prior to beginning Work. A pre-construction meeting will be held on _____, _____, at _____, _____, at _____ (location)

Sincerely,

Dale Reynolds
Administrator

DR: **

DISTRIBUTION: Tax Commission
Division of Occupational and Professional Licenses
Risk Management (w/ Builder's Risk Application, if applicable)
(Project Manager)
Fiscal Office TAX ID xx-xxxxxxx

EXHIBIT G
Idaho State Tax Commission
REQUEST FOR TAX RELEASE

Date: _____

PART I -- AWARDING AGENCY INFORMATION:

Name of agency	Mailing address	City, state, and ZIP Code
Contact name	Phone number	Email address

PART II -- CONTRACTOR INFORMATION:

Name of contractor	Mailing address	City, state, and ZIP Code
Federal EIN	Contact name	Phone number
		Email address

PART III -- CONSTRUCTION/CONTRACT MANAGER INFORMATION (if applicable):

Name of business	Mailing address	City, state, and ZIP Code
Federal EIN	Contact name	Phone number
		Email address

Send a copy of the approved Tax Release to: ☐ Awarding Agency ☐ Contractor ☐
Construction Manager

NOTE: We will email all copies unless otherwise requested

PART IV -- PROJECT INFORMATION:

Name of project	Location of project

Description of project

Project number assigned by awarding agency	Project start date	Project completion date	Final/closing contract amount (includes all change orders)

Did any government entities supply materials which were installed by this contractor or its subs?:
_____ Yes _____ No

If YES, list these materials and their dollar values. (Attach additional information if needed):

List Materials

List Dollar Values of Materials

	\$	
	\$	
	\$	

Send to: Contract Desk/Sales Tax Audit
Idaho State Tax Commission

APPENDIX

BOILERPLT-2025 dbb.doc JUNE 2025

AP - 48
(DPW Project #23251)
(October, 2025)

PO Box 36

Boise ID 83722-0410

Phone: (208) 334-7618 • Fax: (208) 332-6619 • Email: **contractdesk@tax.idaho.gov**

NOTE: Please allow 30 days to process a Tax Release Request. You must send a complete, signed Form WH-5 Public Works Contract Report to the Idaho State Tax Commission to complete this request.

EXHIBIT H

RELEASE OF CLAIMS

(TO BE COMPLETED FOR FINAL PAYMENT)

I, _____, do hereby release the State of Idaho from any and all claims of any character whatsoever arising under and by virtue of DPW contract number _____, dated _____, as amended, except as herein stated.

Dated: _____

Contractor: _____

EXHIBIT J

CONDITIONS PRECEDENT TO FINAL PAYMENT

Date: _____
DPW Project No. _____
Project Title: _____
Location: _____

Send to:
State of Idaho
Division of Public Works
502 N. Fourth Street
Boise, Idaho 83702

Copy to:
Design Professional

Contractor's Responsibilities:

Per Paragraph 7:14 of the Fixed Price Contract: As a condition precedent to final payment, the Contractor must furnish the owner, in the form and manner required by Owner, to be submitted to the Design Professional for approval, the following:

- ☐ Contractor's Final Request for Payment Form has been uploaded to OMS;
- ☐ Release of Claims form has been uploaded to OMS (DPW's form, Exhibit H);
- ☐ Contractor's Affidavit of Payment of Debts and Claims Form has been uploaded to OMS (AIA G706);
- ☐ Consent of Surety to Final Payment has been uploaded to OMS (AIA G707);
- ☐ Confirmation of all required training (DPW's Training Confirmation Exhibit K), product warranties, operating manuals, instruction manuals and other record documents, drawings and items customarily required of the Contractor has been uploaded to OMS.
- ☐ Public Works Contract Tax Release from the Idaho Tax Commission has been uploaded to OMS;
- ☐ Division of Occupational and Professional Licenses Letter of Completion/Final Inspection has been uploaded to OMS (as required); and
- ☐ Project Finalization and Start Up has been uploaded to OMS (as required, Exhibit L).

Contractor's Signature

Date

Design Professional's Approval for Payment:

- ☐ All Documents Required per Paragraph 7.14 of the Fixed Price Contract have been uploaded to OMS.
- ☐ All Warranties, Guarantees, etc. have been received, approved and have been uploaded to OMS.
- ☐ Contractor's As-Built Drawings, have been received, reviewed, approved, and uploaded to OMS in PDF format.
- ☐ Final punch list with AE's verification that all items have been completed, has been uploaded to OMS.

- ☐ Record Drawings have been completed by AE. All required copies of the Record Documents and electronic media are attached and uploaded to OMS in PDF, and DWG 2010 format. DWG files should be bound in zip folder, or “e-transmit” folder, containing all drawing files with relevant dependencies (i.e. x-refs, images, title blocks, and pen settings). *Record Drawings are a requirement for the AE’s final payment; not the Contractor’s.*

To the best of my knowledge, information, and belief, and on the basis of my observations and inspections, I certify the Work has been completed in accordance with the terms and conditions of the Contract Documents and that the required documentation required by Paragraph 7.14 of the fixed priced contract has been received. The entire balance, as shown on the attached Final Request for Payment, is due and payable.

Design Professional's Signature

Date

EXHIBIT K

STATE OF IDAHO
DIVISION OF PUBLIC WORKS

TRAINING CONFIRMATION SIGN-IN SHEET

DPW Project: _____
Project Name: _____
Field Representative: _____
Time: _____

Agency: _____
Project Location: _____
Date & _____

Name	Company	E-mail	Telephone	Signature

V:\Design and Construction\CONTRACT ADMINISTRATION\Close Out\Training Confirmation
Sign In Sheet.xlsx

EXHIBIT L

PROJECT FINALIZATION AND START-UP

Upon completion of the equipment and systems installation and connections, the contractor shall assemble all equipment factory representative and subcontractors together for system start-up.

These people shall assist in start-up and check out their system(s) and remain at the site until the total system operation is acceptable and understood by the agency's representative(s). The factory representative and system subcontractor shall also give instructions on operation and maintenance of their equipment to the agency's maintenance and/or operation personnel. To prove acceptance of operation and instruction by the agency's representative(s), this written statement of acceptance shall be signed below.

"I, the Contractor, associated factory representative and subcontractors, have started each system and the total system; and have proven their normal operation to the agency's representative(s) and maintenance/operation personnel and have instructed him/them in the operation and maintenance thereof."

Agency's Representative

Contractor

Signature

Signature

Date

Date

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Fixed Price Construction Contract and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work by Owner.
5. Work under separate contracts.
6. Future work.
7. Owner-furnished products.
8. Contractor-furnished, Owner-installed products.
9. Access to site.
10. Coordination with occupants.
11. Work restrictions.
12. Specification and drawing conventions.
13. Miscellaneous provisions.
14. General Security Requirements
15. Permits

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: DPW Project No.23251
- B. Project Title UI: Replace Chiller, CNR
- C. Project Location: 975 W 6th St, Moscow, ID 83844
- D. Owner:
 1. State of Idaho

University of Idaho

SUMMARY

State of Idaho Division of Public Works

Coffman Engineers, Inc.

Division of Public Works
502 N. 4th Street
P.O. Box 83720
Boise, ID 83720-0072
Pat Donaldson, Administrator

E. Owner's Representative:

1. Project Manager

Scott Tucker
Telephone: (208) 332-1908
E-mail: scott.tucker@adm.idaho.gov
Fax: (208) 334-4031

F. Field Representative

1. Ken Cook

Telephone: (208) 885-6246
E-mail: ken.cook@adm.idaho.gov
Fax: (208) 334-4031

G. Architect or Engineer (Design Professional):

1. Coffman Engineers

221 N Wall St.
Spokane, WA. 99201
509-328-2994
509-323-9627

H. Architect's or Engineer's (Design Professional's) Consultants: The Architect or Engineer has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Traci Hanegan

Professional License No. 10249
509-328-2994
509-323-9627
E-Mail: traci.hanegan@coffman.com

2. Kurt Niven- Electrical Engineer

Telephone: (509) 328-2994
E-Mail: Kurt.Niven@Coffman.Com
221 N Wall St #500, Spokane, Wa 99201

3. Carston Mortenson- Civil Engineer

Telephone: (509) 328-2994
E-Mail: Carston.Mortenson@Coffman.Com
221 N Wall St #500, Spokane, Wa 99201

4. Jeff Mitchell - Structural Engineer

Telephone: (509) 328-2994
E-Mail: Jeff.Mitchell@Coffman.Com
221 N Wall St #500, Spokane, Wa 99201

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Base bid: Demolition of existing chiller at building exterior. Demolition of chilled water pumps tanks and heat exchanger in building basement. Demolition of chilled water piping in basement and laboratory. Installation of fisheries chilled water system comprising of chiller, pumps, controls, heat exchangers, tanks, valves and piping in basement mechanical room. Installation of new laboratory fisheries water distribution piping, mixing valves and headboxes in laboratory space. Installation at buildings exterior of new air-cooled condensers serving chillers. Removal of exterior fencing around existing chiller during demolition and reinstallation of fencing after demolition. Connection of existing chlorine monitoring system to new controls system for alarming. Installation of all controls and power equipment for operation of new fisheries water system. Installation of all structural members and concrete pads for installation of fisheries water system and cistern supports. Installation of new chain-link fence around new air-cooled condenser. Base bid scope is specified on entirety of drawings and specifications.
2. Installation of exterior installation of new free-cooler (dc-1) at building exterior as bid alternate. Installation and piping of new free-cooler at building exterior to basement. Installation of all controls equipment, wiring and programming for integration of free-cooling unit into fisheries water system. Installation of all power equipment and wiring installation of free-cooling unit. Installation and programming of controls for dry-cooler operation and chiller interconnection. Installation of fence and gates around new free-cooling unit.

B. Type of Contract:

1. Project will be constructed under a single prime contract per the Division of Public Works Fixed Price Construction Contract between Owner and Contractor. (Check the latest version "BOILERPLT dbb.doc (rev. FEB 2024)

1.5 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Preceding Work: Owner will perform the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.
 1. University of Idaho CNR laboratory to remove all loose lab type equipment/items to be maintained /reused prior to construction mobilization. Items not permanently attached to building structure / equipment.
- C. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
 1. University of Idaho CNR laboratory personnel reserve the right to salvage equipment for demo. University of Idaho CNR laboratory personnel will coordinate salvage during construction.
- D. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.
 1. University of Idaho CNR laboratory to install experimentation and all loose lab equipment/items. Laboratory items will be integrated into new fisheries water system and tested.
- E. Items noted NIC (Not in Contract), will be furnished and installed by the Owner/Agency.

1.6 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated on design documents and specifications. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products.

1.7 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to

perform work or to retain other contractors on portions of Project, and by use of facility by building tenants in existing tenant improvement Projects.

- B. Use of Site: Limit use of Project site to work in areas indicated on plans. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to laboratory, basement mechanical rooms, connecting halls and stairs, parking area outlined on plans.
2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

- a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
- b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- c. Contractor parking shall be limited to those areas indicated on the Contract Document and as designed by the Owner.
- d. Maintain clear access to project at all times for firefighting equipment. Maintain exit ways from existing building required by authorities having jurisdiction.
- e. Signs: Provide signs adequate to direct visitors.

- 1) Do not install, or allow to be installed, signs other than specified sign(s) and signs identifying the principal entities involved in the project.

- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Any damage to the building, due to negligence on behalf of the contractor to not maintain a weather-tight condition, shall be the responsibility of contractors and they shall bear the burden for correction and/or repairs for any damage. Repair damage caused by construction operations.

- D. Security: The contractor shall maintain security of the building's roof areas and any staging areas throughout the project.

- E. Behavior and Dress: The Contractor and all Contractors representatives, to include subcontractors, consultants, vendors or other parties hired by the Contractor will maintain professional behavior and wear appropriate attire that always identifies their company while on the job site.

1.8 PROTECTION OF BUILDING, CONTENTS, AND GROUNDS.

- A. Construction Site Lay-down and Storage: As per plans.
- B. Verify with Agency any specific requirements.

1.9 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and adjacent building areas and buildings during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 2. Notify Owner not less than 36 hours in advance of activities that will affect Owner's operations.
 3. The Owner will take special care not to damage materials or work completed by the contractor prior to final acceptance. If the contractor occurs any damages, prior to final acceptance, they need to notify the Owner and Architect immediately for verification of damages. If the contractor fails to notify the Owner and Architect within 24 hours of the incident, the contractor shall be responsible for the performance and shall bear the cost of correction.

1.10 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 8 a.m. to 5 p.m., Monday through Friday, unless otherwise indicated.
1. Weekend Hours: Weekend working hours are permitted working hours of 8 a.m. to 5 p.m .
 2. Early Morning or Late Evening Hours: Work is not permitted
 3. Hours for Utility Shutdowns: Shall be coordinated with University of Idaho 14 days in advance of shutdown.
 4. Hours for noisy or hazardous activity shall be coordinated with University of Idaho 36 hours in advance of work.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
1. Notify University of Idaho CNR not less than 14 days in advance of proposed utility interruptions.
 2. Obtain University of Idaho CNR written permission before proceeding with utility interruptions.

- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify University of Idaho CNR not less than 14 days in advance of proposed disruptive operations.
 - 2. Obtain University of Idaho CNR written permission before proceeding with disruptive operations.
- E. Hazardous Materials: Notify the Design Professional and Owner immediately upon discovery of existing hazardous materials.
- F. Nonsmoking Building: Smoking is not permitted within the building or within 30 feet of entrances, operable windows, or outdoor-air intakes.
- G. Controlled Substances: Use of tobacco products and other controlled substances is not permitted per Section 72-1717, Idaho Code.
- H. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- I. Employee Screening: Comply with Owner's requirements for drug and criminal background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.
- A. Contractor Parking: Provide parking permits for all Contractor personnel working on Project site.
- B. Maintain cleanliness in areas adjacent to and surrounding the construction area to the satisfaction of the Owner at all times.
- C. Ensure deliveries and contractor work access are in accordance with previous agreement with Owner and/or as indicated in the Contract Documents.

1.11 PERMITS

- A. Furnish all necessary permits for construction of the Work.

1.12 WASTE DISPOSAL

- A. The contractor is responsible for any and all demolition and/or removal as necessary and required to fulfill the requirements of the Contract Documents.

1.13 TESTING AND INSPECTION

- A. Notify Owner/Engineer at least 24 hours prior to commencement of Work requiring special inspection.

1.14 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012300 – ADD ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

- A. Add Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost for each alternate is the net addition to the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other work of the Contract.
- C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS

- 2.1 See drawings for details of bid alternate #1.

PART 3 - EXECUTION

3.1 BASE BID

- A. Demolition of existing chiller at building exterior. Demolition of chilled water pumps tanks and heat exchanger in building basement. Demolition of chilled water piping in basement and laboratory. Installation of fisheries chilled water system comprising of chiller, pumps, controls, heat exchangers, tanks, valves and piping in basement mechanical room. Installation of new laboratory fisheries water distribution piping, manual valves and headboxes in laboratory space. Installation at buildings exterior of new air-cooled chillers. Removal of exterior fencing around existing chiller during demolition and reinstallation of fencing after demolition. Connection of existing chlorine monitoring system to new controls system for alarming. Installation of all controls and power equipment for operation of new fisheries water system. Installation of all structural members and concrete pads for installation of fisheries water system and cistern supports. Installation of new chain-link fence around new air-cooled chiller. Base bid scope is specified on entirety of drawings and specifications.

3.2 SCHEDULE OF ALTERNATES

- A. Alternate No. 1 Automatic mixing stations
1. Installation of base bid scope.
 2. Installation of automatic mixing stations including automatic mixing valves, controls wiring and display, and programming. Scope indicated on drawings M-503, M-601, M-602, M-603, M-702

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design

- characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SUBSTITUTION REQUEST

(To be completed by the contractor)

To: _____ Project Name: _____ Project
No.: _____

We hereby submit for your consideration the following product in lieu of the specified item.

Section	Paragraph	Specified Item

Proposed substitution: _____

- A. Does the requested substitution affect dimensions shown on drawings?.....

Yes No

- B. Will the undersigned pay the cost for the changes caused by the requested substitution?.....

Yes No

- C. Does the requested substitution have effect on other trades?

Yes No

- D. Is the manufacturer's guarantee the same for the requested substitution as the specified item? ...

Yes No

- E. What is the cost / savings to the contract?.....\$

(more/less)

[Requested Substitution \$ (+/-) Specified Item \$

J

- F. Explain the differences between the requested substitution and the specified item, including changes to the drawings and/or specification and why the requested substituted is necessary.

University of Idaho

SUBSTITUTION REQUEST

State of Idaho Division of Public Works

Coffman Engineers, Inc.

For Architects Only

- ☐ **Recommended**
- ☐ **Not Recommended**
- ☐ **Recommended as Noted**
- ☐ **No action**

By: _____

Title: _____ Date: _____

Remarks: _____

DPW Approval By: _____

Signature

Date

Contractor

Address

City

Phone

Fax

Email

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Fixed Price Construction Contract and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK

- A. Engineer will issue through Construction Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, through Owner's web-based management software (OMS). ASI may be completed on AIA Document G710, "Architect's Supplemental Instructions" and attached into OMS.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Construction Manager will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Construction Manager are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity

duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- e. Quotation Form: Use forms provided by Owner. Sample copies are included in Project Manual.

- B. Contractor-Initiated Work Change Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Construction Manager.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Work Change Proposal Request Form: Use form provided by Owner. Sample copy is included in Project Manual.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, the Architect will complete the Owner's Change Order Form and attach the Proposal Request and back-up. The Architect will then forward this documentation to the Owner's Project Manager who will create a Change Order through OMS for approval of the Owner and Contractor. Note approval is determined after Change Order is approved through OMS.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Work Change Directive: Construction Manager may issue a Work Change Directive on AIA Document G714. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment on DPW's Owners web-based management software (OMS).

1.2 SCHEDULE OF VALUES (SOV)

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Submit the schedule of values on Owner's or other approved "schedule of values" form to Division of Public Works seven days after contract is approved.
 - 2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts where needed.
 - 3. Provide a separate line item in the SOV for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 - 4. Allowances: Provide a separate line item in the SOV for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 - 5. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
 - 6. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
 - 7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling 2 percent of the Contract Sum and subcontract amount.
 - 8. Review and approval by the Architect and Owner (DPW's Project Manager and DPW's Field Representative) is required prior to the first payment application.

1.3 PAYMENT APPLICATIONS

- A. Each Pay Application or Invoice shall be submitted via the OMS under the 'Cost Tracking/Contract Mgmt.' module where they will be electronically approved by the Contractor, Architect, and Owner (DPW Field Representative, DPW Project Manager, and DPW Senior Field Representative). The Schedule of Value must be included and attached in OMS with the Invoice.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Payment Application is the period indicated in the Agreement.
- C. Payment Application Times: Create Pay Applications on the Owners web-based management software by the 7th of the month and electronically submit for approval. The period covered by each Payment Application is one month, ending on the last day of the month.
- D. Initial Payment Application: Administrative actions and submittals that must precede or coincide with submittal of first Payment Application include the following:
 - 1. List of subcontractors.
 - 2. Contractor's construction schedule (preliminary if not final).
 - 3. Products list (preliminary if not final).
 - 4. Schedule of unit prices.
 - 5. Submittal schedule (preliminary if not final).
 - 6. Copies of building permits.
 - 7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 8. Initial progress report.
 - 9. Data needed to acquire Owner's insurance. (or Builders Risk from the Contractor)
- E. Payment Application at Substantial Completion: After Architect issues the Certificate of Substantial Completion, upload a Payment Application showing 100 percent completion for portion of the Work claimed as substantially complete. Retainage will still be held by the Owner.
- F. Final Payment Application: After completing Project closeout requirements, submit final Payment Application with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Evidence of completion of Project closeout requirements per Conditions Precedent to Final Payment Form.
 - 2. Marked up Record Drawings and Specifications.
 - 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 4. Contractor's Affidavit of Payment of Debts and Claims Form. AIA Document G706.
 - 5. Consent of Surety to Final Payment. AIA Document G707.
 - 6. Release of Claims form, Exhibit H. Evidence that claims have been settled.

7. Confirmation of all required training, product warranties, operating manuals, instruction manuals and other record documents, drawings and items customarily required of the Contractor.
8. Public Works Contract Tax Release from the Idaho Tax Commission.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Authority Having Jurisdiction/Division of Building Safety (AHJ/DBS) inspection approval/occupancy permit.
12. Any and all other items required by the Owner (DPW) under the applicable contract requirements.

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Fixed Price Construction Contract and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 2. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Construction Manager, Design Professional, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Key Personnel Names: Within seven (7) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Processing of submittals.
 5. Progress meetings.
 6. Pre-installation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.

- b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
- c. Indicate functional and spatial relationships of components of Design Professional, structural, civil, mechanical, and electrical systems.
- d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
- e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
- f. Indicate required installation sequences.
- g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Design Professional indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

- 1. Floor Plans and Reflected Ceiling Plans: Show Design Professional and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
- 2. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
- 3. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
- 4. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
- 5. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
- 6. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.

- d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 7. Review: Design Professional will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Design Professional determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Design Professional will so inform Contractor, who shall make changes as directed and resubmit.
 8. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
 9. Review: Design Professional will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Preparation Format: DWG, Version 2018 operating in Microsoft Windows operating system.
 3. File Submittal Format: Submit or post coordination drawing files using PDF format.
 4. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
 5. Design Professional will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Design Professional makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in PDF format or DWG, Version 2018
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and upload an RFI in the Owners web-based management software (OMS).
1. Design Professional will approve RFIs with any comments through OMS.
 2. Design Professional shall notify DPW of the Design Professional's Representative who will receive and respond to RFIs.
 3. Contractor to upload RFIs in a prompt manner so as to avoid delays in the work or work of subcontractors.
 4. Contractor and Design Professional can copy any Team members the question and/or response within OMS.

- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Input information required by OMS.
 2. Specification Section number and title and related paragraphs, as appropriate.
 3. Drawing number and detail references, as appropriate.
 4. Field dimensions and conditions, as appropriate.
 5. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 6. Attachments: Upload sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. Design Professional's Action: Design Professional will review each RFI, determine action required, and respond. Allow seven (7) working days for Design Professional's response for each RFI. RFIs received by Design Professional after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Design Professional's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Design Professional's action may include a request for additional information, in which case Design Professional's time for response will date from time of receipt by Design Professional of additional information.
 3. Design Professional's action on RFIs that may result in a change to the Contract Time or the Contract Sum in which case the Contractor may submit a Proposal Request to the Design Professional.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Design Professional in writing within seven (7) days of receipt of the RFI response.
- D. On receipt of Design Professional's action, review response and notify Design Professional within seven (7) days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Design Professional's Data Files: Design Professional will provide Design Professional's CAD drawing digital data files for Contractor's use during construction.

- B. Use of Design Professional's Digital Data Files: Digital data files of Design Professional's CAD drawing will be provided by Design Professional for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
 2. Design Professional makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Digital Drawing Software Program: Contract Drawings are available in PDF format or DWG .
 4. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
 - a. Subcontractors, and other parties granted access by Contractor to Design Professional's digital data files shall execute a data licensing agreement in the form of Agreement included in this Project Manual.
 5. The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
 - b. Exterior plans.
- C. Web-Based Project Software: Use Owner's web-based management software site (OMS) for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project software site includes the following features for:
 - a. Compilation of Project data, including Contractor, subcontractors, Design Professional, Design Professional's consultants, Owner, and other entities involved in Project.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents. The 'My Team' module Includes names of individuals and contact information.
 - c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Tracking status of each Project communication in real time, and log time and date when responses are provided.
 - f. Handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.

- k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
- D. PDF Document Preparation: Where PDFs are required to be submitted to Design Professional, prepare as follows:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

- A. General: The Design Professional will schedule and conduct bi-monthly meetings at the Project site unless otherwise indicated.
- B. Preconstruction Conference: The Owner will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Design Professional.
 - 1. Attendees: Authorized representatives of Owner, Contractor and its superintendent, and major subcontractors shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Owner's standard preconstruction agenda will be used.
 - 3. Minutes: The Design Professional will be responsible for the meeting minutes and will record and distribute via the OMS.
- C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
 - 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Design Professional, Owner, and Owner's Commissioning Authority of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.

- f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Construction Progress Meetings: The Contractor will conduct construction progress meetings at biweekly intervals.
 1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Agency, Owner's Commissioning Authority and Design Professional, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required

to ensure that current and subsequent activities will be completed within the Contract Time.

- 1) Review schedule for next period.
- b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) As-Built Updates.
 - 20) Pending claims and disputes.
 - 21) Documentation of information for payment requests.
4. Minutes: Contractor is responsible for conducting any construction progress meeting and will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Contractor shall revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Design Professional's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Design Professional's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Design Professional and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Design Professional.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.

8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Options: Identify options requiring selection by Design Professional.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Design Professional on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Submittals:

1. Upload Submittals on Owners web-based management software (OMS). Contractor to initiate the process via "Construction Management", then "Submittal" tab within the website.

E. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Web-Based Project Software: Prepare submittals in PDF form, and upload to OMS. Enter required data in web-based software site to fully identify submittal.
2. Samples: Prepare submittals and deliver to Design Professional.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on [Design Professional's] receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 1. Initial Review: Allow seven (7) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Design Professional will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Resubmittal Review: Allow seven (7) days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Design Professional's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.

- c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Design Professional's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Transmittal: Upload PDF transmittal to the Owners web based management software under submittals. Include digital image file illustrating Sample characteristics, and identification information for record.
 - 4. Web-Based Project Software: Prepare submittals in PDF form, and upload to Owners web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 - 5. Paper Transmittal: Include paper transmittal including complete submittal information indicated for samples delivered to the Design Professional.
 - 6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample

sets may be used to determine final acceptance of construction associated with each set.

- a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit two (2) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Design Professional will return submittal with options selected.
8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three (3) sets of Samples. Design Professional will retain two Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Design Professionals and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable.

Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

- a. Name of evaluation organization.
- b. Date of evaluation.
- c. Time period when report is in effect.
- d. Product and manufacturers' names.
- e. Description of product.
- f. Test procedures and results.
- g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Design Professional.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, upload to the Owners web-based management software, shall be signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
 2. Confirm plan review requirements with Division of Building Safety.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before uploading to the Owners web based management software.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp that is indicated on the web-based submittal. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Design Professional will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 DESIGN PROFESSIONAL'S REVIEW

- A. Action Submittals: Design Professional will review each submittal, indicate corrections or revisions required , and return it within the “Comment” box on the web site.
 - 1. Submittals by Web-Based Project Software: Design Professional will indicate, on Project software website, the appropriate action.
 - a. Actions taken by indication on Project software website have the following meanings:
 - 1) Approved, No Exceptions Taken, Pending, Overdue, Complete, or Rejected.
- B. Informational Submittals: Design Professional will review each submittal and will not return it, or will return it if it does not comply with requirements. Design Professional will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Design Professional .
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be rejected for resubmittal without review.
- E. Submittals not required by the Contract Documents will be returned by Design Professional without action.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Fixed Price Construction Contract and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. 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-assurance and -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.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Design Professional, or Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by the Design Professional.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless

otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
 2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- 1.4 CONFLICTING REQUIREMENTS
- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that

are different, but apparently equal, to Design Professional for a decision before proceeding.

- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Design Professional for a decision before proceeding.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Design Professional.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Design Professional.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.

7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 30 days of Notice to Proceed and not less than 20 days prior to preconstruction conference. Submit in format acceptable to Design Professional. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Design Professional has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and re-inspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project unless authorized by the Design Professional.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Design Professional and Commissioning Authority with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Design Professional
 - 2. Notify Design Professional 20 days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.

5. Obtain Design Professional's approval of mockups before starting work, fabrication, or construction.
 - a. Allow 20 days for initial review and each re-review of each mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed unless otherwise indicated.
- L. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services. These services, or special inspections, provided to the Owner are for the express purpose of meeting the testing requirements required under the authorities having jurisdiction and shall not in any way be considered to replace the Contractor's responsibility for quality assurance and control for the project.
1. Contractor will coordinate and schedule all testing and special inspections with the Owner's testing agency.
 2. Under no circumstances will the Owner's testing agency perform quality control or quality assurance work for the Contractor.
 3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
 4. Initial reports (handwritten as a minimum) will be given to the Contractor by the Owner's testing Agency before leaving the site the day of the inspection.
 5. Final reports will be issued later to the Contractor, Design Professional, and Owner.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Owner, Design Professional, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Owner, Design Professional, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service to Owner, Design Professional, and Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner, Design Professional, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner as follows:
1. Schedule of Special Inspections by Owner:
 - a. Backup Generator Testing

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: 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 revisions as they occur. Provide access to test and inspection log for Owner and Design Professional's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- 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

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Design Professional, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.
- E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- E. Moisture-and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Refrigeration coil system isolation schematic drawing
 - 4. Location of proposed air-filtration system discharge.
 - 5. Waste-handling procedures.
 - 6. Other dust-control measures.
 - 7. Noise control measures.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and CC/ANSI A117.1.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS**2.1 TEMPORARY FACILITIES**

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Design Professional, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION**3.1 TEMPORARY FACILITIES, GENERAL**

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See Section 017419 Waste Management and Disposal for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Toilets: Use of Owner's existing toilet facilities may be permitted, if authorized, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead unless otherwise indicated.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel.

3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 2. Maintain support facilities until Design Professional schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
 3. Recondition base after temporary use, including removing contaminated material, regrading, proof-rolling, compacting, and testing.
 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 321216 "Asphalt Paving."
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touch up signs so they are legible at all times.
- F. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities

having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Temporary Elevator Use: Use of elevators is not permitted.

J. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

1. Do not load elevators beyond their rated weight capacity.
2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

L. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

M. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
- D. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- E. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- F. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
 - 1. Construct covered walkways using scaffold or shoring framing.
 - 2. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
 - 3. Paint and maintain appearance of walkway for duration of the Work.
- G. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- H. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 - 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 3. Provide walk-off mats at each entrance through temporary partition.

- I. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 3. Indicate methods to be used to avoid trapping water in finished work.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later

than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Design Professional through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Design Professional's Action: If necessary, Design Professional will request additional information or documentation for evaluation within seven (7) days of receipt of a comparable product request. Design Professional will notify Contractor of approval or rejection of proposed comparable product request within seven (7) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
 - a. Form of Design Professional's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Design Professional does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

- A.** Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B.** Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS**2.1 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Design Professional will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."
 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.

- a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
- 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
- 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
- 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Design Professional's sample," provide a product that complies with requirements and matches Design Professional's sample. Design Professional's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Design Professional from manufacturer's full range" or similar phrase, select a product that complies with requirements. Design Professional will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Design Professional will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Design Professional may return requests without action, except to record noncompliance with these requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 2. Evidence that proposed product provides specified warranty.
 3. List of similar installations for completed projects with project names and addresses and names and addresses of Design Professionals and owners, if requested.
 4. Samples, if requested.

END OF SECTION 016000

SECTION 017300 - EXECUTION**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for limits on use of Project site.
 - 2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.2 INFORMATIONAL SUBMITTALS

- A. Certificates: Upload certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.

1.3 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Design Professional of locations and details of cutting and await directions from Design Professional before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Design Professional's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
 6. Dates: Indicate on the contractor's schedule when cutting and patching will be performed.
- B. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.

- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Design Professional for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are

indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Design Professional according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Design Professional and Construction Manager promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Design Professional and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Design Professional and Construction Manager.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Design Professional. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Design Professional before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of in occupied spaces and in unoccupied spaces, or as required by authorities having jurisdiction.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Design Professional.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Remove and replace damaged, defective, or non-conforming Work.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.

- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 AGENCY-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's and Agency construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner and Agency construction personnel.
 1. Construction Schedule: Inform Owner/Agency of Contractor's preferred construction schedule for Owner/Agency portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner/Agency in a timely manner if changes to schedule are required due to differences in actual construction progress.
 2. Pre-installation Conferences: Include Owner/Agency construction personnel at pre-installation conferences covering portions of the Work that are to receive Owner/Agency work. Attend pre-installation conferences conducted by Owner/Agency construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. Facilitate recycling and salvage of materials including the following:
1. Refrigerant.
 2. Steel
 3. Aluminum
 4. Copper
 5. Plastic

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit/Upload plan to OMS within 30 days of date established for the Notice to Proceed.

1.5 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, upload report to OMS. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons
 - 4. Quantity of waste salvaged, both estimated and actual in tons
 - 5. Quantity of waste recycled, both estimated and actual in tons
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Qualification Data: For waste management coordinator.

1.6 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements.
- B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse and owner Salvaged Materials: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****3.1 PLAN IMPLEMENTATION**

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Permitted on Project site.
- C. Salvaged Items for Owner's Use:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area on-site.
 - 5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the following:
 - 1. Moscow Recycling Center, (208) 883-7131

- C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum 1-1/2-inch size.
- B. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Pulverize masonry to maximum 3/4-inch size.
 - 2. Clean and stack undamaged, whole masonry units on wood pallets.
- C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- D. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- E. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

- F. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- G. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

- 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
- 2. Polystyrene Packaging: Separate and bag materials.
- 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
- 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

- 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
- 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

- 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

- 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
- 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including Fixed Price Construction Contract and other Division 01 Specification Sections, apply to this Section.
- B. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- C. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at final completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Idaho Division of Public Works Close-Out requirements, including "Conditions Precedent to Final Payment" list. The "Project Finalization" form is required unless specifications indicate otherwise.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of seven (7) days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including as-built documents which indicate any field revisions made to the construction documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents. (Verify if hard and/or electronic copies are required from the Agency.)
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number.
 - 5. Submit sustainable design submittals not previously submitted.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 - 7. A final report of Special Inspections to be attached to the Substantial Completion. If no Special Inspections are required, Design Professional can initial as such on the Substantial Completion form.
 - 8. Submit O&M Manuals for compliance with the contract documents. (Verify if hard and/or electronic copies are required from the Agency)
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of seven (7) days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 - 6. Advise Owner of changeover in utility services.

7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of ten (10) days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Design Professional and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Design Professional will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Design Professional, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.5 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit final Application for Payment according to Section 012900 "Payment Procedures" via the OMS.
 2. Certified List of Incomplete Items: Submit certified copy of Design Professional's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Design Professional. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Idaho Division of Public Works Close-Out requirements.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Design Professional and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Design Professional will approve/initial punch list after inspection or will notify Contractor of construction that must be completed or corrected before final documents will be signed.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order
2. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Design Professional, through Construction Manager, will return annotated file.
 - b. PDF electronic file. Design Professional, through Construction Manager] will return annotated file.

1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Design Professional for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within ten (10) days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 1. Submit by uploading to web-based project software site.
- E. Warranties in Paper Form:
 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION**3.1 FINAL CLEANING**

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.

- j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations, as well as any damage to surrounding areas. Repair includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition before requesting inspection for determination of Substantial Completion.
- 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
- B. Repair, or remove and replace, defective construction.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Design Professional and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
 - 2. Submit three paper copies. Design Professional, through Construction Manager, will return two copies.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 7 (seven) days before commencing demonstration and training. Design Professional and Commissioning Authority will return copy with comments.
 - 1. Correct or revise each manual to comply with Design Professional's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Design Professional's and Commissioning Authority's comments and prior to commencing demonstration and training.
- D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 2. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.

4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Design Professional.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Design Professional that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.5 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.

- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds, as described below.
- C. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.

- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.
- H. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1.8 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

END OF SECTION 017823

SECTION 017839 – PROJECT AS-BUILT DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for as-built documents, including the following:
 - 1. As-Built Drawings.
 - 2. As-Built Specifications.
 - 3. As-Built Product Data.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for final property survey.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. As-Built Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up as-built prints.
 - 2. Number of Copies: Submit copies of as-built Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit one paper-copy set(s) of marked-up as-built prints.
 - 2) Upload PDF electronic files of scanned as-built prints and one of file prints onto DPW's Owners Web-based Management Software.
 - 3) Owner will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit one paper-copy set of marked-up as-built prints.
 - 2) Upload PDF electronic files of scanned as-built prints onto DPW's Owners Web-based Management Software.
 - 3) Architect will review for completeness.
- B. As-Built Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

- C. As-Built Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where As-Built Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

1.3 AS-BUILT DRAWINGS

- A. As-Built Prints: Maintain one set of marked-up paper or electronic copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark as-built prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained as-built data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up as-built prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference as-built prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up as-built prints.

4. Mark as-built sets with colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up as-built prints with design professional, and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 2. Format: DWG, Version 2018, Microsoft Windows operating system.
 3. Format: Annotated PDF electronic file with comment function enabled.
 4. Incorporate changes and additional information previously marked on as-built prints. Delete, redraw, and add details and notations where applicable.
 5. Refer instances of uncertainty to Design Professional through Construction Manager for resolution.
 6. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "AS-BUILT DRAWING" in a prominent location.
1. As-built Prints: Organize as-built prints into manageable sets. If required, bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. As-Built Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "AS-BUILT DRAWINGS."
 - d. Name of Design Professional and Construction Manager.
 - e. Name of Contractor.

1.4 AS-BUILT SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as As-Built Product Data.
 - 5. Note related Change Orders, as-built Product Data, and as-built Drawings where applicable.
- B. Format: Submit as-built Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

1.5 AS-BUILT PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project as-built document purposes. Post changes and revisions to project as-built documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and As-built Drawings where applicable.
- C. Format: Submit As-built Product Data as scanned PDF electronic file(s) of marked-up paper copy of Product Data.
 - 1. Include as-built Product Data directory organized by Specification Section number and title, electronically linked to each item of as-built Product Data.

1.6 MAINTENANCE OF AS-BUILT DOCUMENTS

- A. Maintenance of As-Built Documents: Store as-built documents in the field office apart from the Contract Documents used for construction. Do not use project as-built documents for construction purposes. Maintain as-built documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project as-built documents for Design Professional and Construction Manager's reference during normal working hours.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit one copy (1) within seven (7) days of end of each training module.
 - 1. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

- C. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Design Professional.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.

- g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.

- g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner through Construction Manager, with at least ten (10) days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Cleanup: Collect used and leftover educational materials and remove from Project. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video.
 1. Submit video recordings on USB thumb drive.
- C. Recording: Display continuous running time.
- D. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Related Sections:
 - 1. Division 01 Section "Facilities Exterior Enclosure Commissioning" for commissioning process activities for building exterior enclosure, roof, and foundation systems, assemblies, equipment, and components.
 - 2. Division 22 Section "Commissioning of Plumbing" for commissioning process activities for plumbing systems, assemblies, equipment, and components.
 - 3. Division 23 Section "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.
 - 4. Division 25 Section "Commissioning of Integrated Automation" for commissioning process activities for integrated automation systems, assemblies, equipment, and components.
 - 5. Division 26 Section "Commissioning of Electrical Systems" for commissioning process activities for electrical systems, assemblies, equipment, and components.
 - 6. Division 27 Section "Commissioning of Communications" for commissioning process activities for communications systems, assemblies, equipment, and components.

1.3 DEFINITIONS

- A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

- C. CxA: Commissioning Authority.
- D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
 - 1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
 - 2. Representatives of the facility user and operation and maintenance personnel.
 - 3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
3. Attend commissioning team meetings held on a biweekly basis.
4. Integrate and coordinate commissioning process activities with construction schedule.
5. Review and accept construction checklists provided by the CxA.
6. Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
8. Complete commissioning process test procedures.

1.7 CxA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan.
- C. Convene commissioning team meetings.
- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
- F. Prepare and maintain the Issues Log.
- G. Prepare and maintain completed construction checklist log.
- H. Witness systems, assemblies, equipment, and component startup.
- I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 019113

SECTION 220500 – COMMON WORK FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. 2017 Idaho State Plumbing Code.

1.2 SUMMARY

- A. Requirements under this section include required work that is common to multiple sections in Division 22 and shall be complied with by all suppliers and subcontractors.
- B. This Section includes the following:
 - 1. Joining materials.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Thermometers and pressure gauges.
 - 9. Test plugs.
 - 10. Equipment labels and piping identification.
 - 11. Expansion joints.
 - 12. Alignment guides.
 - 13. Steel pipe hangers and equipment supports.
 - 14. Trapeze pipe hangers.
 - 15. Metal framing systems.
 - 16. Fastener systems.
 - 17. Pipe positioning systems.
 - 18. Equipment supports.
 - 19. Motors
 - 20. Seismic controls.

1.3 DEFINITIONS

- A. A/E: Prime design consultant responsible for preparation of these specifications.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- G. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- H. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Provide submittals per Division 01, Section 013300, "Submittal Procedures."
- B. Product Data: Submit product data for each type of product indicated herein. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Provide for the following:
 - 1. Joining materials.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Thermometers and pressure gauges.
 - 9. Test plugs.
 - 10. Equipment Labels and piping identification.
 - 11. Valve Tags.
 - 12. Valve numbering scheme.
 - 13. Valve Schedules: For each piping system to include in maintenance manuals.

- D. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- E. Operation and Maintenance Data:
1. All valves and specialty valves (Valve tag list),
 2. Water piping system accessories, strainers, expansion tanks, meters, backflow preventers, gages, thermometers, trap primers, filters,
 3. Drainage specialties, back water valves, drains, interceptors.
 4. All equipment that includes an electrical connection and/or has recommended maintenance, along with all related accessories.
 5. All controls.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- E. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 PROJECT CONDITIONS

- A. Do not install products or materials that are wet, moisture damaged, or mold damaged.
- B. Field Measurements: Verify actual dimensions of site conditions by field measurements before fabrication.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping from end damage and to prevent debris from entering pipe. Maintain piping through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 TRANSITIONS AND OFFSETS BEYOND THE SCOPE OF WORK

- A. Check drawings of other trades to verify spaces in which work will be installed. Establish exact locations of piping and ducts in such a manner as to conform to structure, avoid obstructions, and keep openings and passageways clear. Lines that must pitch, or that must have a constant elevation, shall have the right-of-way over lines not so restricted. Maintain maximum headroom. If space conditions appear inadequate, notify the A/E before proceeding with the work. Make reasonable modifications in the work without extra cost as needed to prevent conflict with work of other trades and for proper execution of the work.
- B. If the total additional weight of sheet metal or piping materials (including associated fittings, hangers, seismic restraints and insulation) required for piping offsets which are not indicated or inferred on the contract documents exceeds six percent (6%) of the total weight of the piping system, the amount exceeding this percentage may be considered to be beyond the requirements of these documents.
- C. For additional compensation to be considered for transitions and offsets more than the amount stated in Paragraph B above, the Contractor shall submit to the A/E a detailed take-off of all materials indicated on the contract documents. The Contractor shall also submit a separate take-off along with coordination drawings or marked-up contract drawings with yellow highlighting indicating specifically the transitions and offsets considered to be "extra work." Additional compensation will only be considered if take-offs and drawings are received by the A/E four weeks in advance of the fabrication of conflicting work in the area of concern so that the A/E may be able to determine ways to minimize or eliminate the extra work.

1.9 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08, Section 083113, "Access Doors and Frames."
- D. Coordinate work with other trades including venting, electrical connections, food Service, gas service, equipment connections, controls, etc.
- E. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.
- F. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- G. Coordinate installation of identifying devices with locations of access panels and doors.
- H. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

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

2.2 COMPRESSED AIR PIPING

- A. Drawn-Temper Copper Tubing: **ASTM B 88, Type L.**
- B. Wrought-Copper Fittings: ASME B16.22.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide:

- a. Anvil International, Inc.
- b. S. P. Fittings; a division of Star Pipe Products.
- c. Victaulic Company of America.
- d. Stadler-Viega
- e. Bronze Flanges and Flanged Fittings: ANSI/ASME B16.24.

3. Copper or Bronze Pressure-Seal Fittings:

- a. Manufacturer: Subject to compliance with requirements, provide products manufactured by Stadler-Viega.
- b. Housing: Copper.
- c. O-Rings and Pipe Stops: EPDM.
- d. Tools: Manufacturer's special tools.
- e. Minimum 200-psig (1379-kPa) working-pressure rating at 250 degrees F (121 degree C.)

C. Wrought-Copper Unions: ASME B16.22.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

- a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
- b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 3. PVC to ABS Piping Transition: ASTM D 3138.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Waterway Fittings:
 - 1. Piping 2" Size and Smaller: Provide at each point of connection between copper and galvanized steel pipe, dielectric waterway design, threaded, lined with inert, non-corrosive thermoplastic.
 - 2. Basis of Design: Clearflow Series 19100.
 - 3. Manufacturers:

- a. Clearflow.
- b. Epco Sales, Inc.
- c. Watts

D. Dielectric Flanges:

1. Flanges in Copper Piping: Bronze or wrought-copper companion flange with tubing shoulder, 150-lb. or 300-lb. wsp rating, as required to suit system pressure, with 1/16-inch thick red rubber gasket per ANSI/ASME B16.21.
2. Basis of Design: Watts Model 3110.
3. Manufacturers:
 - a. Clearflow.
 - b. Epco Sales, Inc.
 - c. Watts

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

1. Separate companion flanges and steel bolts and nuts shall have 150 minimum working pressure where required to suit system pressures.
2. Basis of Design: PSI Pipeline Seal and Insulator, Inc. Dielectric Flange Kit.
3. Manufacturers:
 - a. Advance Products and Systems.
 - b. Calpico Inc.
 - c. PSI Pipeline Seal and Insulator, Inc.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 degree F. Calpico, Inc. or Lochinvar Corp "V-Line".

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

1. Basis of Design: Victaulic Dielectric Nipple.
2. Manufacturers:
 - a. Precision Plumbing Products, Inc.
 - b. Sioux Chief,
 - c. Victaulic Corporation

2.6 MECHANICAL SLEEVE SEALS

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

1. Manufacturers:

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

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Cast-in-place watertight device for protecting penetrating objects from expansion and contraction of concrete. Factory-assembled for use in cast-in-place concrete floors and walls and consisting of two outer sleeves and a one-piece radial extended-flange waterstop gasket, with mid-body seal for embedment and sealing to concrete slab and continuous water seal extending to the penetrating pipe.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbard Enterprises/HOLDRITE; Hydro Preseal, or a comparable product.
 2. Outer Sleeves: EPDM or NBR attached to the mid-body seal forming an area with which to attach the device to the structural reinforcing rod determining the position of sleeve in the wall.
 3. Water Stop Mid-body Seal: Flexible polymer seal with radial extended flange consisting of one to three concentric raised rings which lock into concrete, maintaining seal over time as concrete contracts from sleeve.

2.8 FIRE-RESISTANCE-RATED WATERTIGHT SLEEVE-SEAL SYSTEMS

- A. Add if needed after 95% submittal

2.9 ESCUTCHEONS

- A. General: Provide all steel manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening. All escutcheons shall have polished chrome plated finish. Provide deep pattern escutcheons where needed to conceal couplings and fittings that protrude beyond the wall surface. No split ring escutcheons, no plastic escutcheons.

2.10 GROUT

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

2.11 THERMOMETERS AND PRESSURE GAGES

- A. Thermometers: Adjustable angle, Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.200, or digital thermometer of equal quality.
1. Manufacturers:
 - a. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - b. Trerice, H. O. Co.
 - c. Weiss Instruments, Inc.
 - d. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - e. Miljoco.
 2. Case: Highly polished, hermetically sealed, stainless steel with five-inch diameter.
 3. Ring: Stainless steel.
 4. Element: Bimetal coil.
 5. Dial: Satin-faced, or highly polished, non-reflective aluminum with permanently etched scale markings.
 6. Pointer: Black metal.
 7. Window: Double strength Glass.
 8. Connector: Adjustable angle, ½" with ASME B1.1 screw threads.
 9. Stem: stainless steel, for thermo-well installation and of length to suit installation.
 10. Accuracy: Plus or minus one percent of range or plus or minus one scale division to maximum of 1.5 percent of range. Scale shall be degrees Fahrenheit, unless otherwise indicated, suitable for the media operating temperatures.
 11. Thermometers shall conform generally to the following:

SERVICE	RANGE – DEGREES F.	DEG. F/DIV.
Domestic hot water	0-250	2
Domestic cold water	30-130	1
Non-potable hot water	0-250	2
Non-potable cold water	30-130	1

- B. Thermowells: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer with extension necks of suitable length for insulated piping. Furnished by same manufacturer as thermometers.
- C. Pressure Gages: Indicating-dial type complying with ASME B40.100.
1. Manufacturers:
 - a. AMETEK, Inc.; U.S. Gauge Div.
 - b. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - c. Palmer - Wahl Instruments Inc.
 - d. Trerice, H. O. Co.
 - e. Weiss Instruments, Inc.
 - f. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - g. Miljoco.
 2. Case: Liquid-filled type, 4-1/2-inch diameter aluminum.
 3. Pressure-Element Assembly: Grade A Phosphor Bronze Bourdon tube, unless otherwise indicated.
 4. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 6. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 7. Ring: Stainless steel.
 8. Pointer: Black metal.
 9. Window: Glass.
 10. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 11. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 12. Range for Fluids under Pressure: Two times operating pressure.
 13. Scale: Scale shall be psig or inches mercury vacuum depending on the application.
- D. Shutoff Cocks for Gauges: 1/4" NPT lever handle ball valve with solid chrome-plated brass ball. Same manufacturer as gauge.
- E. Pressure Snubbers: Filter type snubbing element, brass housing. Same manufacturer as gauge.

2.12 TEST PLUGS

A. Manufacturers

1. MG Piping Products Co.
2. Peterson Equipment Co., Inc.
3. Sisco Manufacturing Co.
4. Terrice, H. O. Co.
5. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem beyond insulation for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing neoprene, valves gasketed orifice, suitable for inserting a 1/8" OD probe assembly.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish one test kit containing one pressure gage and adaptor, one thermometer, and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 3-inch diameter dial and probe. Dial range shall be 0 to 200 psig.
2. High-Range Thermometer: Small bimetallic insertion type with 2-inch diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
3. Carrying case shall have formed instrument padding.

2.13 EQUIPMENT LABELS AND PIPING IDENTIFICATION

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 degree F.
5. Minimum Label Size: Length and width vary for required label content, size labeling as appropriate for pipe size.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number.
- C. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.
- G. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass beaded chain; or S-hook.
- H. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses. Valve-tag schedule shall be included in operation and maintenance data.

2.14 EXPANSION JOINTS

- A. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.
 1. Manufacturers:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Metraflex, Inc.

2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder- joint end connections.
 - a. NPS 2 and Smaller: Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
3. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and flanged or weld end connections for NPS 2-1/2 and larger.
 - a. NPS 2 and Smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
 - b. NPS 2-1/2 to NPS 6: Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.

2.15 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
 1. Manufacturers:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Hyspan Precision Products, Inc.
 - d. Metraflex, Inc.
 - e. Senior Flexonics, Inc.; Pathway Division.

2.16 MATERIALS FOR ANCHORS

- A. Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 1. Stud: Threaded, zinc-coated carbon steel.
 2. Expansion Plug: Zinc-coated steel.
 3. Washer and Nut: Zinc-coated steel.
- E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.

1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
3. Washer and Nut: Zinc-coated steel.

2.17 STEEL PIPE HANGERS AND EQUIPMENT SUPPORTS

- A. Description: MSS SP-58-2009; "Pipe Hangers and support– Materials, Design, Manufacture, Selection, Application and Installation": Types 1 through 59, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

1. Manufacturers:
 - a. Anvil.
 - b. B-Line Systems, Inc.
 - c. ERICO/Michigan Hanger Co.
 - d. Hubbard Enterprises/HOLDRITE®
 - e. PHD Manufacturing, Inc.

- B. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.18 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts. For piping 2" and below, manufactured specialty products formed from pregalvanized commercial steel.

1. The total weight of piping and components upon each trapeze span shall not exceed the manufacturers load rating. Load ratings must include a minimum 2 X safety factor.

2.19 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - c. Hubbard Enterprises/HOLDRITE®

- d. PHD Manufacturing, Inc.
- e. Unistrut Corp.; Tyco International, Ltd.

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

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

2.20 FASTENER SYSTEMS

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

1. Manufacturers:

- a. Hilti, Inc.
- b. Hubbard Enterprises/HOLDRITE®
- c. ITW Ramset/Red Head.
- d. Powers Fasteners.

2.21 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

1. Manufacturers:

- a. C & S Mfg. Corp.
- b. HOLDRITE Corp.; Hubbard Enterprises.
- c. Samco Stamping, Inc.

2.22 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.23 MOTORS

A. GENERAL MOTOR REQUIREMENTS

- 1. Comply with NEMA MG 1 unless otherwise indicated.
- 2. Comply with IEEE 841 for severe-duty motors.

B. MOTOR CHARACTERISTICS

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. POLYPHASE MOTORS

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Energy efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Separate winding for each speed.
5. Rotor: Random-wound, squirrel cage.
6. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
7. Temperature Rise: Match insulation rating.
8. Insulation: Class F.
9. Code Letter Designation:
 - a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - b. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
10. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - b. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. SINGLE-PHASE MOTORS

1. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.24 SEISMIC CONTROLS

- A. Refer to Section 230540 – Vibration and Seismic Controls for HVAC and Plumbing.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 01, Section 017329, "Cutting and Patching" and Division 02, Section 024119, "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

5. Equipment and Fixtures to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated and/or code-required slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors where exposed to view from any location in a finished space and in stairways.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 1. Cut sleeves to length for mounting flush with both surfaces. Exception: Extend sleeves installed in floors of mechanical equipment areas or other potentially-wet

- areas two inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to two inches above finished floor level. Refer to Division 07, Section 076200, "Sheet Metal Flashing and Trim" for flashing. Basis of design: Link-Seal or equal.
 3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 for materials and installation.
- N. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for one-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.3 PIPING JOINT CONSTRUCTION**
- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
 - B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping one to two-inch in size, adjacent to each valve (unless valve construction facilitates disassembly) and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in wet piping systems.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

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

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05, Section 055000, "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 THERMOMETER APPLICATIONS

- A. Install thermometers in the outlet of each domestic, hot-water storage tank.

3.8 GAUGE APPLICATIONS

- A. Install pressure gauges at the inlet and discharge of each pressure-reducing valve.
- B. Install pressure gauges at suction and discharge of each pump.

3.9 THERMOMETER AND GAGE INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gage.
- E. Install test plugs in tees in piping.
- F. Install connection fittings for attachment to portable indicators in accessible locations.
- G. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.
- H. Adjust faces of thermometers and gages to proper angle for best visibility.

3.10 PIPE AND EQUIPMENT LABEL PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.11 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.12 PIPE LABEL INSTALLATION

- A. Pipe painting and label color-coding shall be ANSI standards.

- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 20 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.13 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.14 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

3.15 EXPANSION-JOINT INSTALLATION

- A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- B. Install expansion joints of sizes matching size of piping in which they are installed.
- C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.16 PIPE BEND AND LOOP INSTALLATION

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.

1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.17 ALIGNMENT-GUIDE INSTALLATION

- A. Install guides on piping adjoining pipe expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

3.18 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

3.19 HANGER AND SUPPORT INSTALLATION

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

- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- B. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Each equipment support in first paragraph below requires calculation and detail.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.
- O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- Q. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - d. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - e. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:
 - f. NPS 1/4 to NPS 3-1/2 12 inches long and 0.048 inch thick.
 - g. NPS 4 12 inches long and 0.06 inch thick.
 - h. NPS 5 and NPS 6 18 inches long and 0.06 inch thick.
 - i. NPS 8 to NPS 14 24 inches long and 0.075 inch thick.
 - j. NPS 16 to NPS 24 24 inches long and 0.105 inch thick.
 5. Pipes NPS 8 and Larger: Include wood inserts.
 6. Insert Material: Length at least as long as protective shield.
 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.20 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 - a. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 - b. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 - c. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - d. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - e. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - f. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 - g. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 - h. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - i. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.

- j. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 - k. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 - l. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
- L. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment.

Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

1. Horizontal (MSS Type 54): Mounted horizontally.
2. Vertical (MSS Type 55): Mounted vertically.
3. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
4. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
5. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
6. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
7. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.21 EQUIPMENT SUPPORTS

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

3.22 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.23 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.24 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 220500

SECTION 220700 – PLUMBING INSULATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Industrial (fisheries) ambient water piping.
 - 5. Industrial (fisheries) chilled water piping.
 - 6. Industrial (fisheries) hot water piping
- B. New Work: Completely insulate all new work as specified and scheduled.
- C. Existing piping: Completely insulate all existing piping as specified and indicated on drawings.

1.3 SUBMITTALS

- A. Product Data: Submit for each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 3. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 4. Detail application of field-applied jackets.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per

ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency. Insulation shall have a flame spread index of 25 or less and smoke developed rating index of 50 or less.

- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

- 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22, Section 220500.
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing before installation of insulation.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.2 PIPE INSULATION

- A. Thermal Requirements for all Pipe Insulation: Insulation thickness and/or R-value shall be as required by the local energy code or as indicated, whichever is greater.
- B. Glass Fiber Preformed Pipe Insulation: Glass fiber meeting ASTM C547, rigid molded. "K" value 0.23 at 75°F. Maximum service temperature shall not exceed 850°F. Jacket shall be high density, white Kraft bonded to aluminum foil for vapor barrier, reinforced with fiberglass yarn, permanently treated, secured with self-sealing longitudinal laps and butt strips or AP jacket with outward clinch expanding staples coated with vapor barrier mastic.
 - 1. For interior use only. Do not use on exterior piping.
 - 2. Approved Manufacturers:
 - a. Johns Manville "Micro-Lok HP."
 - b. Knauf Insulation "Earthwool 1000 Pipe Insulation."
 - c. Owens-Corning "Fiberglas SSLII-ASJ."
 - 3. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
- C. EPDM rubber, flexible, closed-cell elastomeric insulation in tubular or sheet form. The product will meet the requirements defined in ASTM C 534.
 - 1. Approved Manufacturers:
 - a. Aeroflex USA Inc.; Aerocel AC, Aerocel White/Gray, Aerocel-SSPT, Aerocel W/G-SSPT, or Aerocel SA.
 - b. Armacell LLC; AP Armaflex.
 - c. Industrial Thermo Polymers Limited; Tundra Seal.
 - 2. EPDM elastomeric insulation shall have a flame-spread index of 25 or less and a smoke-developed index of 50 or less when tested in accordance with ASTM E 84, for all products through 2" thickness.
 - 3. Product to be suitable for use from -297 F to 300 F continuous service temperature, per ASTM C 411.
 - 4. EPDM elastomeric insulation shall have a maximum thermal conductivity of 0.245 Btu-in./h-ft²F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518.
 - 5. Field-Applied Jacket: Requirements are specified in "Field-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.

2.3 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
- B. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
- C. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.4 FIELD APPLIED JACKETS

- A. Jacketing of Pipes Exposed to Weather: All piping exposed to weather shall be finished with an aluminum jacket over the insulation. Aluminum jacket material shall be embossed or corrugated sheet, 0.016" nominal thickness, conforming to ASTM B209, temper H-14. Jacketing shall be applied with joints lapped not less than 2", and shall be secured with 3/8" x 0.020" thick aluminum bands located at each circumferential lap and at not more than 9" intervals throughout. Horizontal joints shall lap downward to shed water. Vertical joints shall be sealed with weatherproof silicone sealant.

1. Approved Manufacturers:

- a. Childers Products, Division of ITW.
- b. Pabco Metals Corporation.
- c. RPR Products Inc, "Insul-Mate".

Be careful to consider jacketing requirements for piping that may be outdoors, but not exposed to weather. Such piping may include piping in parking garages, within covered loading docks, etc. Make sure documents adequately address different requirements for different situations.

- B. PVC Plastic: One-piece molded type fitting covers and jacketing material, gloss white. Connections, tacks, pressure sensitive color matching vinyl tape. PVC material shall be 25 flame spread and 50 smoke development rated per ASTM E-84.

1. Approved Manufacturers:

- a. Johns Manville "Zeston 2000 PVC".
- b. Proto Engineered Thermoplastics Corp. "Proto Fitting Cover System".
- c. P.I.C. Plastics, Inc.; FG Series.
- d. Speedline Corporation "Smoke-Safe".

2.5 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement 100 to 1200 degree: Comply with ASTM C 449/C 449M.

2.6 ADHESIVES AND MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated. Obtain insulation and/or jacket manufacturer approval for all adhesives and mastics used. Obtain A/E approval for all locations where mastics will be used.
 - 1. Adhesives shall not be considered an acceptable alternative to specified mechanical fastening methods without prior A/E approval.
 - 2. All adhesives and mastics shall be suitable for the moisture conditions and temperatures that will be encountered.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
- E. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 4. Color: White.
- F. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

2.7 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants: Materials shall be compatible with insulation materials, jackets, and substrates. Fire- and water-resistant, flexible, elastomeric sealant. Minus 40 to plus 200 degree F service temperature range. Color shall be aluminum or grey.
- B. ASJ Flashing Sealants and Vinyl, PVDC, and PVC Jacket Flashing Sealants: Materials shall be compatible with insulation materials, jackets, and substrates. Fire- and water-resistant, flexible, elastomeric sealant. Minus 40 to plus 200 degree F service temperature range. Color shall be white.

2.8 TAPES

- A. ASJ Tape: White, 3-inch wide, vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
- B. FSK Tape: Foil-face, three-inch wide, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
- C. PVC Tape: White, 2-inch wide, vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
- D. PVDC Tape: White, three-inch wide, vapor-retarder PVDC tape with acrylic adhesive. Manufacturer: Dow Chemical Company "Saran 560 Vapor Retarder Tape".

2.9 EQUIPMENT INSULATION

- A. Flexible Glass Fiber Blanket:
- B. Rigid Glass Fiber Board:
- C. Glass Fiber Tank Insulation:

PART 3 - EXECUTION

3.1 MINIMUM INSULATION SCHEDULE

- A. Fiberglass insulation shall not be used outdoors.
- B. Domestic water pipe insulation:

Fluid Operating Temperature Range and Usage (F°)	Insulation Conductivity		Nominal Pipe or Tube Size (Inches)				
	Conductivity Btu·in./(h·ft²·°F)	Mean Rating Temperature, °F	< 1	1 to < 1 ½	1 ½ to ≤ 4	4 to < 8	≥ 8
141 – 200	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
105 – 140	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5
40 – 60	0.21 – 0.27	75	0.5	0.5	1.0	1.0	1.0
<40	0.20 – 0.26	75	0.5	1.0	1.0	1.0	1.5

- 1. For piping smaller than 1 ½ inch and located in partitions within conditioned spaces, reduction of these thickness by 1 inch shall be permitted but not to a thickness less than 1 inch.

- C. Service Schedule:

System	Operating Temp. (°F)	Material
Domestic Cold Water Industrial (Fisheries) Ambient Water Industrial (Fisheries) Chilled Water	40-60	Glass-Fiber EPDM Elastomeric
Domestic Hot Water, Domestic Recirculating Hot Water Industrial (Fisheries) Hot Water	105-140	Glass-Fiber EPDM Elastomeric

D. Equipment insulation:

1. Water heaters and hot water storage tanks that are not factory insulated shall be insulated with flexible glass fiber blanket or rigid glass fiber board.

E. Valves and pipe fittings shall be insulated as indicated below.

3.2 INSULATION WORK IN GENERAL

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- E. Install insulation with least number of joints practical.
- F. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- G. Do not apply insulation until surfaces to be covered have been leak tested, have had rust and scale removed, and have been cleaned, dried and inspected.
- H. Insulation shall be kept dry and clean at all times.
- I. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
5. Continue insulation vapor barrier through penetrations except where prohibited by code.
6. Continue pipe insulation through gypsum and masonry walls only if fire stopping specified in Division 07 has a UL Listed assembly that includes a jacketed insulation. Coordinate with General Contractor.
7. Install insulation with factory-applied jackets as follows:
 - a. Draw jacket tight and smooth.
 - b. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - c. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - d. For below ambient services, apply vapor-barrier mastic over staples.
 - e. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - f. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
8. All work shall be performed at ambient and equivalent temperatures as recommended by the manufacturers.
9. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
10. Joints shall be staggered on multi-layer insulation.
11. Do not apply insulation until heat tracing specified elsewhere in other sections of this Specification is completed and tested.

3.3 INSULATION INSTALLATION, PIPING

- A. General: Pipe insulation shall be installed in strict conformance to the manufacturer's recommendations. Pipe insulation shall be continuous and installed on all fittings and appurtenances unless specified otherwise. Installation shall be with full-length units of insulation and using a single-cut piece to complete a run. Provide jackets for all pipe insulation.

B. Insulation Installation on Straight Pipes and Tubes:

1. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
2. Secure laps with outward clinched staples at six inches o.c, for insulation with factory-applied jackets on above ambient surfaces.
3. Do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant, for insulation with factory-applied jackets on below-ambient surfaces.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
3. Use minimum 1" wide PVC Tape to secure Insulation.

D. Unions, Flanges, Couplings, Strainers, and Valves:

1. Insulate all fittings, flanges, couplings, strainers, valves (and similar accessories) associated with an insulated piping system unless indicated otherwise.
2. Exposed Work: On exposed work, insulate to a diameter equal to insulation of adjacent piping provided a minimum of 0.75" of insulation is maintained around fittings, couplings, strainers and valves, otherwise, increase diameter.
3. Concealed Work: On concealed work, increase insulation diameter to maintain same insulation thickness as on adjacent piping. Use same material as specified for adjacent piping; fitting covers to be as specified hereinafter.
4. Adjustable and Serviceable Valves and Accessories: Where balancing valves, strainers and similar devices are adjustable or require servicing on less than a five-year cycle, provide removable insulation sections. Where valves with repackable glands and similar devices allow service, but manufacturer does not anticipate service frequency to be less than five years, make reasonable provisions to allow removal and reinstallation of the same materials with minimal effort and potential for damage.

E. Thermometer and Test Wells: Insulate test thermometer, industrial thermometer, and other test wells over their exterior length. Insulate thermometer wells protruding above finish pipe or equipment insulation. Neatly taper insulation away from top of well. Insulation on thermometer wells shall be 1-1/2" minimum thickness.**F. Insulation Support at Hangers:**

1. Provide support shield and 360 degree insert between support shield and piping on piping 1-1/2" diameter and larger. Fabricate insert from heavy density insulating material suitable for the temperature. Shield shall be fabricated of 14

gauge galvanized sheet metal. Insulation shields and inserts shall be not less than the following lengths:

1/2" to 2-1/2"	10"
3" to 6"	12"
8" to 10"	16"

2. Vapor-barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation with lagging adhesive for vapor seal. Where anchors are secured to insulated chilled piping, insulate anchors same as piping for a distance not less than four times insulation thickness to prevent condensation.

- G. Sleeves and Wall Chases: Insulation on pipes through walls and floors shall be full size and jacketed same as adjacent insulation.
- H. Allowances for Movement: At points where pipe will move during expansion and contraction (expansion joints, Z-bends, expansion loops, etc.), clearances between the pipe and encased insulation shall be sized to permit full pipe movement without cracking or damaging insulation and casing or jacket.
- I. Insulation Within Reach of Building Occupants: Where insulation is within reach of building occupants and visitors, insulation surfaces shall be protected by smooth sheet aluminum jacket material, 0.016" nominal thickness, lapped, banded, and installed same as above. The term "within reach" is defined as within ten feet of the floor, except for cases where there is reasonable protection (in the opinion of the A/E) offered by objects located between the insulation and the floor. This does not apply to insulation concealed within wall or ceiling construction and insulation located within equipment rooms that can be locked off from the normal building occupants.

3.4 SPECIAL PIPE INSULATION REQUIREMENTS:

- A. Cold Piping Insulation: Exposed ends of insulation shall be sealed with vapor retarding mastic installed per the manufacturer's recommendations. Vapor seals at butt joints shall be applied at every fourth pipe section and at each fitting to isolate any water incursion.
- B. Removable Insulation Sections: Installation shall conform to the following:
 1. Fabricate removable insulation sections from sections of pipe insulation or block insulation as follows. Removable flexible blankets will be allowed with prior approval if adequate covering is provided. Vapor barrier must be maintained for cold surfaces.
 2. When covers are made from sectional pipe insulation, extend insulation at least two times the insulation thickness over adjacent pipe insulation on each side of the component. Secure cover in place with stainless-steel hooks and wire.
 3. When covers are made from block insulation, make two halves, each consisting of mitered blocks. Extend insulation at least two inches over adjacent pipe

insulation on each side of the component. Fill space between the component and pipe insulation with insulating cement.

3.5 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. Terminate insulation above roof surface and seal with joint sealant for applications requiring only indoor insulation. Install insulation for outdoor applications tightly joined to indoor insulation ends for applications requiring indoor and outdoor insulation. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. Terminate insulation inside wall surface and seal with joint sealant for applications requiring only indoor insulation. Install insulation for outdoor applications tightly joined to indoor insulation ends for applications requiring indoor and outdoor insulation. Seal joint with joint sealant.
 - 3. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Floor, Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated floors, walls and partitions if firestop is rated for this approach. Obtain further direction from A/E if firestopping is not rated for insulated penetrations. Comply with requirements in Division 07 Section for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.6 FIELD-APPLIED JACKET INSTALLATION

- A. General: Where field-applied jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with two-inch overlap at seams and joints.
 - 2. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where metal jackets are indicated, install with two-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

END OF SECTION 220700

SECTION 22 11 00 – WATER DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. Section Includes:

1. Aboveground domestic and industrial water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Ball valves.
4. Butterfly valves.
5. Gate valves.
6. Check valves.
7. Strainers.
8. Mechanically coupled piping systems.
9. Backflow preventors.
10. Pressure reducing valves.
11. Combination balancing-shutoff valves.
12. Thermostatic mixing valves.
13. Flexible connectors.
14. Water Hammer Arrestors.

15.

- B. Related Sections:

1. Division 22, Section 220500, "Common Work for Plumbing."

1.3 PERFORMANCE REQUIREMENTS

1. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to SEI/ASCE 7.

1.4 SUBMITTALS

- A. Product Data: For the following products:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Ball valves.
4. Butterfly valves.
5. Gate valves.
6. Check valves.
7. Strainers.
8. Mechanically coupled piping systems.
9. Backflow preventors.
10. Pressure reducing valves.
11. Combination balancing-shutoff valves.
12. Thermostatic mixing valves.
13. Flexible connectors.
14. Water Hammer Arrestors.
15. Outlet Boxes.
16. Hose Bibbs.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.
- C. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 1. Ensure that valves are dry and internally protected against rust and corrosion.
 2. Protect valves against damage to threaded ends and flange faces.
 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
 - a. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
 2. Do not proceed with interruption of water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 WATER PIPE AND FITTINGS (POTABLE AND NON-POTABLE WATER)

- A. Industrial fisheries water piping is non-potable.
 1. Fisheries Cold and Ambient Water Piping: PVC Plastic Pipe, ASTM D 1785, Schedules 80.
 2. Fisheries Hot and Mixed Water Piping: CPVC Plastic Pipe, ASTM F 441/F 441M, Schedules 80.
- B. Fittings for PVC and CPVC Piping:
 1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2467 for Schedule 80 pipe.
 2. PVC Solvent Cement: ASTM D 2564.

3. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 439 for Schedule 80 pipe.
4. CPVC Solvent Cement: ASTM F 493.

C. Potable water piping (non-fisheries piping):

1. Pipe Above Ground: Seamless copper water tube, ASTM B88, Type L, hard-drawn.
2. Pipe Below Ground (3" Size and Smaller): Seamless copper water tube, ASTM B88, Type "K," annealed, ANSI/ASME B16.22 wrought copper fittings, joints made by soldering.

D. Fittings for Copper Tubing:

1. Wrought copper or bronze solder-joint pressure fittings conforming to ANSI/ASME B16.18 and ANSI/ASME B16.22.
2. Adapters may be used for connecting tubing to flanges and to threaded ends of valves and equipment.
3. Solder: Lead-free, silver bearing, NSF approved, for all joints in copper water tubing. Apply flux carefully and remove all excess.
4. Press Fittings: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.
5. Mechanically formed (T-Drill) TEE'S may be used above grade, have brazed connection and be in strict compliance with manufactures' recommendations.

E. Unions, Copper Piping: 125-lb. wrought copper or cast bronze, solder joint type; ANSI/ASME B16.22 or ANSI/ASME B16.18.

F. Dielectric Fittings: See section 220500.

2.2 VALVES

A. General: Provide valves on all water piping systems, 125-psi system working pressure and below, where shown or specified. Provide valve in water or drain connection to each removable or replaceable item of equipment.

1. Shut-Off Valves (fisheries lab water): Ball type, PVC. Shall be rated for 235 PSI at 70°F. Basis of Design: Hayward TBH Series

B. Shut-Off Valves 2" and Smaller: Ball type, bronze, lead free. Bronze shall be ASTM B584 Alloy C84400. Two-piece body style, threaded ends, full port, 316 stainless steel ball, teflon seats, adjustable packing, lever handle, blowout proof stem, 150 wsg, 600 wog.

1. Approved Manufacturers:

- a. Apollo No. 77CLF.
- b. Milwaukee BA-400.
- c. Nibco No. T-585-70

- d. Watts No. B-6080
- C. Shut-Off Valves 2-1/2" and Larger: Butterfly type, full lug, ductile iron body, 400 series stainless steel stem, aluminum bronze disc, EPDM liner and seals, upper and lower stem bearing, blowout proof stem, extended neck for minimum 2" insulation, manufacturer recommended for bi-directional dead end service at full rated pressure without a downstream flange, sizes 2-1/2" through 4" shall be lever operated and 200 psi cwp; 6" through 12" shall be gear operated and 200 psi cwp; 14" and larger shall be gear operated and 150 psi cwp.
 - 1. Approved Manufacturers:
 - a. Nibco No. LD-2000.
 - b. Milwaukee CL.
- D. Gate Valves 2-1/2" and Larger: Cast-iron body, bronze trim, OS & Y, bolted bonnet, flanged ends, 125 wsp, 200 wog.
 - 1. Approved Manufacturers:
 - a. Milwaukee No. F2885-A.
 - b. Nibco No. F-617-0.
 - c. Stockham No. G-623.
- E. Swing Check Valves 2" and Smaller: Bronze body, threaded ends, swing check, Teflon disc and seat, 125 wsp, 200 wog.
 - 1. Approved Manufacturers:
 - a. Milwaukee No. 509-T.
 - b. Nibco No. T-413-Y.
 - c. Stockham No. B-320-T.
- F. Swing Check Valves 2-1/2" and Larger: Cast iron body, horizontal swing check, bronze trim, with brass-faced disc, brass body seat ring, flanged pattern, 125 wsp, 200 wog.
 - 1. Approved Manufacturers:
 - a. Milwaukee No. F2974-A.
 - b. Nibco No. F-918-B.
 - c. Stockham No. G-931.
- G. Check Valves, Nonslam Type 2-1/2" and Larger: Wafer style, cast-iron body, bronze disc and seat, center guided, stainless steel spring and screws, 200 non-shock wog.
 - 1. Manufacturers:
 - a. Milwaukee No. 1400.
 - b. Nibco No. F-910-B.

- H. Check Valves in Copper Tubing: Bronze body and disc, soldered joint end connections, horizontal swing check, screwed cap, 125 wsp, 200 wog.

1. Approved Manufacturers:

- a. Milwaukee No. 1509.
- b. Nibco No. S-413-B.
- c. Stockham No. B-309.

- I. Drain Valves 1/2" to 3/4" Sizes: Bronze ball valve, two-piece body, standard port, 316 stainless steel ball, RPTFE seats, lever handle, blow out proof stem, threaded or soldered with hose end, cap and chain, 150 psi wsp, 600 psi wog.

1. Approved Manufacturers:

- a. Apollo 78/200 Series.
- b. Nibco S58
- c. Milwaukee No. BA-100H or BA-150H.

2.3 STRAINERS

- A. Strainers: Strainers shall be Y-pattern with cast-iron or bronze bodies.

- B. Domestic Water System Strainers 2" and Smaller: Threaded, 250 lb., wye-pattern. Monel or stainless steel screen with 20 mesh perforations.

1. Approved Manufacturers:

- a. Armstrong No. CA1SC-250.
- b. Conbraco 59 Series.
- c. Watts Series 77S.

- C. Domestic Water System Strainers 2-1/2" and Larger: Flanged, 125 lb. Y-pattern, Monel or stainless steel screens; 1/16 perforations for 2-1/2" to 5" size pipe; 1/8" perforations for 6" and larger pipe.

1. Approved Manufacturers:

- a. Armstrong No. A1FL-125.
- b. Conbraco 539 Series.
- c. Watts Series 77F-D.

- D. Strainers in Copper Tubing 2" and Smaller (Threaded Pattern): 200 lb., heavy-duty cast bronze body, Y-type, 20-mesh stainless steel screen, threaded blowdown end.

1. Approved Manufacturers:

- a. Armstrong No. CA1SC-250.
- b. Conbraco 59 Series.
- c. Watts Series S777S.

- E. Strainers in Copper Tubing 2" and Smaller (Solder Pattern): 200 lb., heavy-duty cast bronze body, Y-type, 20-mesh stainless steel screen, threaded blowdown end.

1. Approved Manufacturers:

- a. Armstrong No. CA1SC-250.
- b. Conbraco 59-300 Series.
- c. Watts Series S777S.

2.4 MECHANICALLY COUPLED PIPING SYSTEMS

- A. Systems: Mechanically coupled piping products are approved for use on the following systems only: Domestic Potable and Non-Potable Cold Water Systems, 4" size and larger.
- B. Mechanically grooved pipe couplings, fittings, valves and other grooved components may be used as an option to soldering, threading or flanged methods. All grooved components shall be of one manufacturer and shall conform to local codes and ordinances and ANSI/ASME B-31.1, B-31.9, UL/FM and IAPMO. The grooved end product manufacturer shall be ISO-9001 certified. Manufacturer: Victaulic Company, Tyco-Grinnell or Anvil International Gruitlok.
- C. Pipe and Fittings:
1. Copper tubing Type L, hard drawn, conforming to ASTM B88. The pipe shall be roll-grooved in accordance with the manufacturer's recommendations.
 2. Copper Piping Fittings: Fittings shall be constructed of copper, per ASTM B75, alloy C12200 or B152 alloy C11000 or bronze sand cast per ASTM B-584, copper alloy CDA 836.
 3. Fittings shall be grooved end fittings as designed in the manufacturer's catalog literature. Fittings shall be manufactured to copper tubing sizes, with grooves designed to accept grooved end couplings of the same manufacturer. Flaring of tube and fitting ends to IPS dimensions is not allowed.
- D. Couplings and Components:
1. Coupling housings shall be ductile iron conforming to ASTM A395 and A536; cast and ductile iron, and finished with copper alkyd enamel paint.
 2. Bolts and nuts shall be carbon steel track type conforming to ASTM A183, minimum tensile 110,000 psi.
 3. Gaskets in water piping system shall be Grade "E" EPDM, "FlushSeal®" style, with temperature range from -30°F to +230°F. (Gaskets UL classified in accordance with ANSI/NSF 61 for hot (+180°F) and cold (+80°F) potable water service.) Gasket selection for each system shall be in accordance with manufacturer's current recommendations to suit system pressure and temperature.

4. Adapters shall be used at flanged connections, engaging directly into roll grooved copper tube and fittings and bolting directly to ANSI/ASME Class 125 and Class 150 flanged components, complete with standard flange bolts.
- E. Dielectric Fittings: Dielectric fittings shall be used at piping connections between dissimilar metals and equipment to protect from local cell corrosion.
 1. Approved Manufacturers:
 - a. Anvil International Gruvlok "Di-Lok"
 - b. Clearflow "Dielectric Waterway."
 - c. Victaulic Corporation "Clearflow" Dielectric Waterway Style 47.

2.5 VALVES—MECHANICALLY COUPLED COPPER PIPING SYSTEMS

- A. Butterfly Valves 2" through 4" Bronze body per ASTM B584 with EPDM encapsulated ductile iron disc, ductile iron per ASTM A536, stainless steel Type 416 upper and lower shafts, lever operated with 10-position throttling plate, manufacturer recommended for bi-directional dead end service at full rated pressure without a downstream flange, 300 psi cwp. Basis of Design: Grinnell Model B680.
- B. Butterfly Valves 6" and Larger: Cast iron body, EPDM synthetic rubber encapsulated ductile iron disc with integrally cast stem, lever operated with 10-position throttling plate, manufacturer recommended for bi-directional dead end service at full rated pressure without a downstream flange, 300 psi cwp.
 1. Approved Manufacturers:
 - a. Anvil Gruvlok Series 7600 or Series 7700.
 - b. Nibco No. GD-4765-3.
 - c. Victaulic Series 608.

2.6 PRESSURE REDUCING VALVES

- A. Pressure Reducing Valves 2-1/2" and Smaller: Bronze body, 300 psi rated inlet high temperature rated diaphragm for hot or cold water, renewable stainless steel seat, spring cage and orifice, threaded pattern, with Y-strainer and steel perforated strainer screen.
 1. Approved Manufacturers:
 - a. Watts Series 223S or 223BS.
 - b. Wilkins 500YSBR Series.
- B. Accessory Connections: Install shut off valve on each side of reducing valve and full sized bypass with shut off valve. Install strainer on inlet side of, and the same size as pressure reducing valve. Install pressure gauge on low pressure side of line.

2.7 COMBINATION BALANCING-SHUTOFF VALVES

A. Combination Balancing-Shutoff Valves 2" and Smaller:

1. Valves shall have threaded or soldered pattern. All metal parts shall be nonferrous, pressure die-cast, nonporous copper alloy. Valves shall be capable of installation in any direction without affecting flow measurement; shall provide four functions:
 - a. Precise flow measurement,
 - b. Precision flow balancing,
 - c. Positive shut-off with no-drip seat and Teflon disc, and
 - d. Drain connection with protective cap.
2. Valves shall have hand wheel adjustment for vernier-type setting and shall include memory setting for a tamperproof balancing setting.
3. Approved Manufacturers:
 - a. Armstrong CBV.
 - b. Bell & Gossett CB.
 - c. Nibco No. T1710L or T1710.

2.8 **BID ALTERNATE #1** AUTOMATIC MIXING VALVES FOR FISHERIES WATER

A. Thermostatic Mixing Valve for Fisheries Water:

1. Approved Manufacturers:
 - a. Belimo
 - b. Hayward
 - c. Approved Equal

2.9 FLEXIBLE CONNECTORS

A. Approved Manufacturers:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex-Weld, Inc.
4. Hyspan Precision Products, Inc.
5. Metraflex, Inc.
6. Twin City Hose.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.

3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.10 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Approved Manufacturers:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.11 HOSE BIBBS

A. Hose Bibbs (HB-X):

1. Approved Manufacturers:
 - a. Woodford Manufacturing Company; a division of WCM Industries, Inc. Model 24.
 - b. Chicago 293-E27CP.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc. 5672.
 - d. Watts Drainage Products Model SC-8.
 - e. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products. Model Z1341.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Stainless Steel.
4. Seat: Stainless Steel, replaceable.
5. Supply Connections: NPS 3/4 threaded or solder-joint inlet.

6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough stainless steel.
10. Finish for Service Areas: Rough stainless steel bronze, or chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle or operating key.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.

PART 3 - EXECUTION

3.1 PIPING JOINT CONSTRUCTION

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

3.2 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 1. Install unions, in piping NPS 1" and larger and 2" and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in wet piping systems.

3.3 DOMESTIC AND INDUSTRIAL WATER PIPING INSTALLATION

A. Special Requirements:

1. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
2. Protect flanges, fittings, and piping specialties from moisture and dirt.

B. General Requirements:

1. Shutoff Valves: Install ball type shut-off valves at the base of each plumbing riser serving more than one fixture, in each branch line serving more than one fixture, and elsewhere as shown. Install valves in positions accessible for operation and repair.
2. Grading of Piping: Where possible, grade all lines to facilitate drainage. Provide drain valves at bottom of risers. All unnecessary traps in circulating lines shall be avoided. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.
3. Concealed Piping: Conceal all piping in finished areas of the building unless noted otherwise.
4. All piping shall be run parallel with building construction and 90° angles to same.
5. Provisions for Piping Covering: Allow sufficient space for the proper installation of the pipe covering. If piping is installed too close to other piping or equipment, the piping shall be moved to avoid such interferences.
6. Pipe in Shafts: Piping in vertical shafts which are accessible shall be arranged to prevent obstruction to the access openings.
7. Install no piping of any kind in electrical equipment rooms, telephone equipment rooms, or elevator machine rooms.
8. Unions: Install at connections to all equipment downstream of valves, at all equipment specialties, and wherever else required to permit easy connection and disconnection. Do not conceal unions in walls, partitions or inaccessible ceilings.
9. Where grooved piping systems are utilized, unions are not required. Couplings shall serve as unions.
10. Dielectric Fittings: Provide approved dielectric type waterways, fittings or flanges where pipe sections made of dissimilar metals are to be joined to prevent metal to metal contact. Do not use dielectric unions.

C. Connections to Fixtures:

1. General: Anchor supply connections at fixtures to steel straps secured to studs. Provide copper tubing stubs through wall for connection to compression type stops.
2. Contractor shall provide all necessary material and labor to connect to the plumbing system all fixtures and equipment having plumbing connections and

which are furnished by the Owner or specified in other sections of these specifications.

3. The supply line to each item of equipment or fixture, except control valves which are supplied with an integral stop, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to all fixtures shall be anchored to prevent movement.
4. Partition-Type Stops: Provide on water supply to all fixtures which are not connected through individual exposed stops, integral stops, or stops in pipe space.

D. Backflow Preventers:

1. Provide on service piping and other locations shown:
2. Install according to applicable requirements.
3. Locate backflow preventers in same room as connected equipment or system.
4. Do not install bypass piping around backflow preventers.
5. Backflow preventers shall be installed so as to be fully accessible for testing and maintenance by the water purveyor.
6. Provide funnel below each backflow preventer discharge. Funnel shall include approved air gap and drain line to funnel floor drain or other approved receptor. Drain line shall be sized for maximum backflow preventer discharge. Provide steel wall brackets for support of backflow preventers.

E. Pressure Piping Regulations: All piping work, except drainage, shall conform to the "ANSI/ASME Building Services Piping Code," B31.9, including latest amendments.

F. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

G. Install balancing valves in locations where they can easily be adjusted.

H. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

I. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

J. Install water-hammer arresters in water piping according to PDI-WH 201.

3.4 MECHANICALLY COUPLED PIPING JOINTS

A. Rolled grooved pipe for mechanically coupled joints shall be installed in accordance with the manufacturer's specifications contained in the latest published literature.

B. Fabrication techniques for all mechanical joints in accordance with manufacturer's recommendations contained in the latest published literature.

3.5 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Install horizontally mounted, in-line, centrifugal pumps with shaft(s) horizontal.
- D. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.
- E. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support pump weight.
- F. Install pressure switches in water supply piping.
- G. Install thermostats in hot-water return piping.
- H. Install timers on wall adjacent to pump.
- I. Install piping adjacent to pumps to allow service and maintenance.
- J. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
- K. Install flexible connectors adjacent to pumps in suction and discharge piping of the pumps:
- L. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping.
- M. Install pressure gage at suction and discharge of each pump. Install at integral pressure-gage tapings where provided or install pressure-gage connectors in suction and discharge piping around pumps.

3.6 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Double-check, backflow-prevention assemblies.
 - 3. Water pressure-reducing valves.
 - 4. Calibrated balancing valves.
 - 5. Thermostatic, water mixing valves.
 - 6. Outlet boxes.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220500.

3.7 STERILIZATION OF DOMESTIC WATER PIPING

- A. Provide disinfection and flushing of all new and altered or repaired potable water systems in accordance with "Disinfection of Potable Water System," Uniform Plumbing Code, 2006 Edition.
- B. Sterilization and Flushing: To conform with 2017 Idaho State Plumbing Code. All water piping, twenty-four (24) hour sterilization contact time, 50 parts per million chlorine concentration. Open all valves several times, following by flushing with clean water until residual chlorine is the same as that of potable water.

3.8 TESTING AND ADJUSTING

- A. Water Piping: To conform with 2017 Idaho State Plumbing Code. All domestic cold and hot water and non-potable water piping inside building shall be tested by hydrostatic pressure at 100 psi, for a minimum of 24 hours without any leaks. Provide a pressure gauge with a shutoff and bleeder valve at the highest point of the piping being tested. Only potable water shall be used for testing.
- B. Set field-adjustable pressure set points of water pressure-reducing valves.
- C. Set field-adjustable flow set points of balancing valves.
- D. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

3.9 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 221100

SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. Section includes:
 - 1. Fisheries head boxes.
 - 2. Fixture supports.
 - 3. Protective shielding guards.
 - 4. Supply fittings.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. **Product Data:** For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. **Operation and Maintenance Data:** For plumbing fixtures to include in emergency, operation, and maintenance manuals.

1.5 WATER EFFICIENCY STANDARDS

- A. All applicable plumbing fixtures shall conform to the water efficiency standards set forth in the Idaho State Plumbing Code, latest addition.

1.6 QUALITY ASSURANCE

- A. **Source Limitations:** Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. **NSF Standard:** Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
- E. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Flexible Water Connectors: ASME A112.18.6.
 - 2. Hose-Coupling Threads: ASME B1.20.7.
 - 3. Off-Floor Fixture Supports: ASME A112.6.1M.
 - 4. Pipe Threads: ASME B1.20.1.
 - 5. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.7 WARRANTY

- A. **Warranty Period for Commercial Applications:** One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CUSTOM HEAD BOX

- A. Provide custom insulated fiberglass head box from Reiff Manufacturing.
 - 1. Outside: width 12 3/4" x length 28 3/4" x height 30 7/8" (included 2" insulated walls and 3/4" FRP board floor all encapsulated in fiberglass)
 - 2. Inside: width 12" x length 24" x height 30".
 - 3. Construction Method:
 - a. 20 mils smooth inner isophthalic gelcoat (grey).
 - b. 0.150" inner fiberglass layer.
 - c. Coosa 26 lb density iso board framing wall framing and solid floor.
 - d. 2" thick 2-lb density polyiso board foam insulation in walls.
 - e. 0.150" outer fiberglass layer.
 - f. 20 mils textured outer isophthalic gelcoat.
 - g. 1 pvc fitting of choice up to 4".
 - h. 0.250" uninsulated FRP lid to match tank.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install fixtures level and plumb according to roughing-in drawings.
- C. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture.
- D. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

- E. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- F. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22, Section 220500, "Common Work Results for Plumbing."
- G. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07, Section 07920, "Joint Sealants."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26, Section 260526, "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26, Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.5 CLEANING

- A. Clean head boxes and other fittings with manufacturers' recommended cleaning methods and materials.

- B. After completing installation of head boxes, inspect exposed finishes and repair damaged finishes.

3.6 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.
- C. During renovation work, do not leave inactive water piping full of water for more than two days without flushing or draining to reduce the accumulation of biofilm. Provide valves as required to isolate and drain piping left inactive for more than two days.

3.7 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 224000

SECTION 230500 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. Requirements under this section includes required work that is common to multiple sections in Division 23 and shall be complied with by all suppliers and subcontractors

1.3 DEFINITIONS

- A. A/E: Prime design consultant responsible for preparation of these specifications.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- G. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- H. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Provide submittals per Division 01, Section 013300, "Submittal Procedures."
- B. Product Data: Submit product data for each type of product indicated herein. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Required in the following areas: Mechanical Rooms, Pump Rooms, shafts, and congested areas required for coordination. Include as a minimum all piping and ductwork.
 - 2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Wiring Diagrams: For power, signal, and control wiring.
- D. Operation and Maintenance Data:
 - 1. All valves and specialty valves (Valve tag list),
 - 2. Piping system accessories including, but not limited to; strainers, expansion tanks, meters, gages, thermometers, traps, filters, etc.
 - 3. Ductwork system accessories including, but not limited to; fire and smoke dampers, backdraft dampers, terminal units, etc.
 - 4. All equipment that includes an electrical connection and/or has recommended maintenance, along with all related accessories.
 - 5. All controls.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.

- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics (such as larger motor horsepower) may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 PROJECT CONDITIONS

- A. Do not install products or materials that are wet, moisture damaged, or mold damaged.
- B. Field Measurements: Verify actual dimensions of site conditions by field measurements before fabrication.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 Transitions and offsets beyond the scope of work

- A. Check drawings of other trades to verify spaces in which work will be installed. Establish exact locations of piping and ducts in such a manner as to conform to structure, avoid obstructions, and keep openings and passageways clear. Lines that must pitch, or that must have a constant elevation, shall have the right-of-way over lines not so restricted. Maintain maximum headroom. If space conditions appear inadequate, notify the A/E before proceeding with the work. Make reasonable modifications in the work without extra cost as needed to prevent conflict with work of other trades and for proper execution of the work.
- B. If the total additional weight of sheet metal or piping materials (including associated fittings, hangers, seismic restraints and insulation) required for piping offsets which are not indicated or inferred on the contract documents exceeds five percent (5%) of the total weight of the piping system, the amount exceeding this percentage may be considered to be beyond the requirements of these documents.
- C. In order for additional compensation to be considered for transitions and offsets in excess of the amount stated in Paragraph B above, the Contractor shall submit to the A/E a detailed take-off of all materials indicated on the contract documents. The Contractor shall also submit a separate take-off along with coordination drawings or

marked-up contract drawings with yellow highlighting indicating specifically the transitions and offsets considered to be "extra work." Additional compensation will only be considered if take-offs and drawings are received by the A/E four weeks in advance of the fabrication of conflicting work in the area of concern so that the A/E may be able to determine ways to minimize or eliminate the extra work.

1.9 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.

1.10 PROJECT FINALIZATION AND START-UP

- A. Upon completion of the equipment and systems installation and connections, the contractor shall assemble all equipment factory representative and subcontractors together for system start-up.
- B. These people shall assist in start-up and check out their system and remain at the site until the total system operation is acceptable and understood by the agency's representative. The factory representative and system subcontractor shall also give instructions on operation and maintenance of their equipment to the agency's maintenance and/or operation personnel. To prove acceptance of operation and instruction by the agency's representative, the contractor shall prepare a written statement of acceptance explaining same for his signature. The statement might read as follows:

I, the Contractor, associated factory representative and sub-contractors, have started each system and the total system; and have proven their normal operation to the agency's representative and have instructed him in the operation and maintenance thereof.

Agency's Representative

Contractor

Signature

Signature

Date

Date

PART 2 - PRODUCTS

2.1 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.
4. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.
 - a. For motors with 2:1 speed ratio, consequent pole, single winding.
 - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
5. Multispeed Motors, Two Winding: Separate winding for each speed.
6. Rotor: Random-wound, squirrel cage.
7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.
10. Code Letter Designation:
 - a. Motors 15 Hp and Larger: NEMA starting Code F or Code G.
 - b. Motors Smaller Than 15 Hp: Manufacturer's standard starting characteristic.
11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Additional Requirements for Polyphase Motors:

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
 - b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 hp and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

F. Electronically Commutated Motors:

1. Microprocessor-Based Electronic Control Module: Converts 120 V or 240 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
2. Three-phase power motor module with permanent magnet rotor.
3. Circuit board or digital speed controller/LED display.
4. Building Automation System Interface: Via AC voltage signal, DC voltage signal or Digital Serial Interface (DSI).

2.2 STEEL PIPE HANGERS AND EQUIPMENT SUPPORTS

- A. Description: MSS SP-58-2009; "Pipe Hangers and support– Materials, Design, Manufacture, Selection, Application and Installation": Types 1 through 59, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
 - 1. Basis of Design: Anvil.
 - 2. Manufacturers:
 - a. Anvil.
 - b. B-Line Systems, Inc.
 - c. ERICO/Michigan Hanger Co.
 - d. Hubbard Enterprises/HOLDRITE®
 - e. PHD Manufacturing, Inc.
- B. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts. For piping 2" and below, manufactured specialty products formed from pre-galvanized commercial steel.
 - 1. The total weight of piping and components upon each trapeze span shall not exceed the manufacturers load rating. Load ratings must include a minimum 2 X safety factor.
 - a. Hubbard Enterprises/HOLDRITE EZ-Strut™ or owner approved equivalent.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
 - 1. Basis of Design: Unistrut Corp.; Tyco International, Ltd.
 - 2. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - c. Hubbard Enterprises/HOLDRITE®
 - d. PHD Manufacturing, Inc.

- e. Unistrut Corp.; Tyco International, Ltd.
- B. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
 - 1. Basis of Design: Pipe Shields, Inc.
 - 2. Manufacturers:
 - a. Carpenter & Paterson, Inc.
 - b. ERICO/Michigan Hanger Co.
 - c. Pipe Shields, Inc.
- B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Basis of Design: Hilti, Inc.
 - 2. Manufacturers:
 - a. Hilti, Inc.
 - b. Hubbard Enterprises/HOLDRITE®
 - c. ITW Ramset/Red Head.
 - d. Powers Fasteners.

2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support piping.
 - 1. Approved manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.

2.8 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
 - 1. Approved manufacturers:
 - a. C & S Mfg. Corp.
 - b. HOLDRITE Corp.; Hubbard Enterprises.
 - c. Samco Stamping, Inc.

2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Plenum Rated Pipe Clamps: ASTM E-84 25/50 plastic clamps from Hubbard Enterprises/HOLDRITE.
- C. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi , 28-day compressive strength.

2.11 EXPANSION COMPENSATORS

- A. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.

1. Approved manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Metraflex Metraloop
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Flex-Pression, Ltd.
2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder joint end connections.
 - a. NPS 2 and Smaller: Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
3. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and flanged end connections for NPS 2-1/2 and larger.
 - a. NPS 2 and Smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
 - b. NPS 2-1/2 to NPS 6: Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.

2.12 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
 1. Approved Manufacturers:
 - a. Metraflex, Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Flex-Weld, Inc.
 - e. Hyspan Precision Products, Inc.

2.13 MATERIALS FOR ANCHORS

- A. Indicate alignment-guide length and maximum spider travel on Drawings.
- B. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
- C. Steel Shapes and Plates: ASTM A 36/A 36M.
- D. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

- E. Washers: ASTM F 844, steel, plain, flat washers.
- F. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Stainless-steel studs are available.
 - 2. Stud: Threaded, zinc-coated carbon steel.
 - 3. Expansion Plug: Zinc-coated steel.
 - 4. Washer and Nut: Zinc-coated steel.
- G. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - 2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - 3. Washer and Nut: Zinc-coated steel.
- H. Concrete: Portland cement mix, 3000 psi minimum. Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- I. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi , 28-day compressive strength.

2.14 THERMOMETERS

- A. Manufacturer:
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 2. Marsh Bellofram/Marshalltown.
 - 3. Terice, H. O. Co.
 - 4. Weiss Instruments, Inc.
 - 5. Miljoco.
- B. Thermometers: Adjustable angle, Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.200.
 - 1. Case: Highly polished, hermetically sealed, stainless steel with 5-inch diameter.
 - 2. Element: Bimetal coil.
 - 3. Dial: Satin-faced, or highly polished, non-reflective aluminum with permanently etched scale markings.
 - 4. Window: Double strength Glass.

5. Connector: Adjustable angle, ½" with ASME B1.1 screw threads.
6. Stem: stainless steel, for thermo-well installation and of length to suit installation.
7. Accuracy: Plus or minus one percent of range or plus or minus one scale to maximum of 1.5 percent of range. Scale shall be degrees Fahrenheit, unless otherwise indicated, suitable for the media operating temperatures.
8. Thermometers shall conform generally to the following:

SERVICE	RANGE – DEGREES F.	DEG. F/DIV.
Industrial (Fisheries) Hot Water	30-240	2
Domestic Cold Water Industrial Cold (Fisheries) Water	30-130	1
Chilled Water	0-100	1

- C. Thermowells: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer with extension necks of suitable length for insulated piping. Furnished by same manufacturer as thermometers.

1. Threaded Stainless Steel
2. Pressure Rating – not less than piping system design pressure.
3. Stem Length – Extend 2" into fluid or to extend to center of pipe
4. Extension for insulated piping – 2" nominal but not less than thickness of insulation
5. Threaded cap nut – With chain permanently fastened to well and cap.

2.15 PRESSURE GAUGES

- A. Manufacturers:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Marsh Bellofram/Marshalltown
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Miljoco

- B. Direct-Mounting, Dial-Type Pressure Gages:

1. Indicating-dial type complying with ASME B40.100.
2. Case: Liquid-filled type, 4-1/2-inch diameter Grade A phosphor Bronze.
3. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
4. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
7. Ring: Stainless steel.

8. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 9. Range for Fluids under Pressure: Two times operating pressure.
 10. Scale: Scale shall be psig.
- C. Shutoff Cocks for Gauges: 1/4" NPT lever handle ball valve with solid chrome-plated brass ball. Same manufacturer as gauge.
- D. Pressure Snubbers: Filter type snubbing element, brass housing. Same manufacturer as gauge.

2.16 TEST PLUGS

- A. Manufacturers
1. Peterson Equipment Co., Inc.
 2. Sisco Manufacturing Co.
 3. Or equal.
- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem beyond insulation for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200 degree F.
- D. Core Inserts: One or two self-sealing neoprene, valves gasketed orifice, suitable for inserting a 1/8" OD probe assembly.
1. Insert material for air, water, oil, or gas service at 20 to 200 degree F shall be CR.
 2. Insert material for air or water service at minus 30 to plus 275 degree F shall be EPDM.

2.17 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.
 4. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.

- d. Pipeline Seal and Insulator, Inc.

2.18 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing. Underdeck Clamp: Clamping ring with set screws.
- E. PVC Pipe: ASTM D 1785, Schedule 40.

2.19 ESCUTCHEONS

- A. General: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type (walls and ceilings): Deep-drawn, box-shaped brass with chrome-plated finish.
- C. One-Piece, Stamped-Steel Type (walls and ceilings): With set screw or spring clips and chrome-plated finish.
- D. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.20 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated or, if conflicts exist, as indicated on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated and/or code-required slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors where exposed to view from any location in a finished space and in stairways, according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Other Piping: One-piece, stamped-steel type with spring clips.
 - 2. Existing Piping: Same as for new piping.

- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other potentially-wet areas two inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to two inches above finished floor level. Refer to Division 07, Section 076200, "Sheet Metal Flashing and Trim" for flashing.
 - 3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 for materials and installation.
- N. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for one inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve (unless valve construction facilitates disassembly) and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in piping systems.

3.3 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

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

3.4 HANGER AND SUPPORT APPLICATIONS

- A. Comply with MSS SP-69 and 89 for pipe hanger selections and applications that are not specified otherwise in piping system Sections.
- B. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use padded hangers for piping that is subject to scratching.
- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 degrees F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes.

6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 and above, with steel pipe base stanchion support and cast-iron floor flange.
 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers if longer ends are required for riser clamps.
- G. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- H. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- I. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.

3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- J. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- K. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- L. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- M. Trapeze Pipe Hanger Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- N. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- O. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- P. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- Q. Select and locate hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- R. Install lateral bracing with pipe hangers and supports to prevent swaying.
- S. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- T. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- U. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- V. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to 14: 24 inches long and 0.075 inch thick.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09, Sections 099123, "Interior Painting" and 099113, "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

3.8 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 230500

SECTION 23 05 40 – VIBRATION AND SEISMIC CONTROLS FOR PIPING, PLUMBING, AND HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 EXTENT OF VIBRATION CONTROL WORK

- A. Vibration Isolation: All equipment, piping, plumbing, and ductwork as noted in the Seismic and Vibration Control Schedules on the project drawings shall be provided with vibration isolators to prevent the transmission of vibration and transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
- B. Pipe Riser Resilient Supports: Provide resilient support for all risers subject to significant expansion and/or contraction.

1.3 EXTENT OF SEISMIC CONTROL WORK

- A. Seismic Restraints for new construction: Provide seismic control of all new and relocated piping, plumbing, ductwork, and equipment specified in Division 22 and Division 23, as noted in the Seismic and Vibration Control Schedules on the project drawings. Provide all necessary seismic restraints to meet the requirements of the Code and referenced Standards.
- B. Omission of restraints for small components: Restraints may be omitted for smaller equipment, ductwork and piping only where specifically allowed by Code and referenced Standards, and where specifically allowed by the Qualified Professional Engineer (QPE) specified below. Restraints may only be omitted after the QPE has determined that adequate flexibility will be provided between restrained and non-restrained connected elements and determined that movement of unrestrained elements will not cause damage to adjacent elements.

1.4 DEFINITIONS

- A. Code: 2015 International Building Code (IBC).
- B. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.5 SEISMIC CONTROLS ENGINEERING REQUIREMENTS

- A. Qualified Professional Engineer: Contractor shall provide the services of a qualified professional structural engineer to engineer, design and/or select anchorage methods for all equipment, ductwork and piping specified in this Division of the Specifications. This requirement applies to equipment, ductwork, piping, and plumbing that is supported from above or below and that is supported with vibration isolation or not.
 - 1. Qualified Professional Engineer: ISAT-International Seismic Application Technology, La Mirada, California, or approved equal qualified firm.
 - 2. A qualified professional engineer (QPE) familiar with all of the applicable codes and design standards related to seismic protection of HVAC ductwork, piping and equipment and qualified in structural design of seismic protections and their interaction with building structures shall be responsible for execution of the work herein. Where applicable, the QPE shall also analyze wind forces and shall utilize these forces (if greater than seismic forces) when designing component anchorages. The tasks of the QPE are as follows:
 - a. Shall be responsible for the preparation of drawings, analysis, specifications, and inspection of the seismic protections required by Code and referenced Standards.
 - b. Shall coordinate with the Structural Engineer of Record of the building structure for the proper establishment of seismic values, applicable codes, and other requirements of the project related to seismic and wind design.
 - c. Shall verify the applicability of all codes and design standards with the Authority Having Jurisdiction and shall coordinate with the Authority where codes conflict or are open for interpretation for variances and clarifications.
 - d. Shall inform the Contractor where special provisions in other work, such as routine hanger hardware selection, are required to accommodate seismic restraint. Changes from specified hanger hardware will require A/E prior approval and shall be provided without change in Contract cost.
 - e. Shall analyze specified and/or Contractor-proposed ductwork and piping materials along with associated joining methods for seismic-related strength (flexibility and/or "toughness") and determine bracing spacing that will maintain appropriate integrity of the ductwork and piping during and after a design seismic event. If changes in construction are recommended in order to minimize the frequency of bracing, these shall be submitted for A/E review and will only be considered if a significant cost credit is offered.
 - f. Shall analyze specified and/or Contractor-proposed ductwork and piping materials along with associated joining methods for flexibility and determine the appropriate point bracing should stop along a specific run (when importance factor changes or when size reduces to a point where bracing may not be required).
 - g. Shall acquire equipment certifications for seismic worthiness from all equipment manufacturers where required by applicable codes or these specifications. These certifications shall be included in a final report to the Owner.
 - h. Shall perform calculations and select all required anchors and restraints.
 - i. Shall develop drawings (bearing QPE seal) of seismic controls that document the seismic anchors and restraints, their layout and the details

for their installation. Where design standards apply, the drawings shall note the locations and identify the standard details that apply.

3. The QPE shall be licensed to provide structural engineering in the state of Idaho.
- B. Seismic-Restraint Loading: Engineering, selection and placement of seismic restraints shall be determined by the QPE after reviewing the project with the Structural Engineer of Record (for the building structure). Obtain all needed parameters directly from that engineer and clearly document these parameters within the submittals. For the purpose of pricing only, use the following values:
 1. Site Class as Defined in the IBC: D.
 2. Seismic Design Category: C
 3. Risk Category: II
 4. SDs: 0.302
 5. SD1: 0.165
- C. Components with Importance Factor $I_p=1.5$: Engineering, selection and placement of seismic restraints shall be determined by the QPE based on the following components having an Importance Factor of $I_p=1.5$:
 1. Fisheries head boxes.
 2. Fisheries water piping mains as identified on the seismic and vibration drawing schedule.
 3. Major equipment as identified on the seismic and vibration drawing schedule, including pumps, chillers, heat exchangers, and tanks.
 4. All other components required by Code to have an importance factor of $I_p=1.5$.
- D. Components with Importance Factor $I_p=1.0$: All components not identified above as having an Importance Factor of $I_p=1.5$:

1.6 RELATED WORK

- A. Seismic Anchorage for Housekeeping Pads:
 1. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be provided as part of this work, if not already adequate as indicated in the documents of other Divisions. This requirement applies only to pads that receive seismic forces for equipment anchored under this Section.
 2. Housekeeping pads shall be coordinated by the seismic controls engineer to result in sizing such that a minimum edge distance of ten (10) bolt diameters is provided all around the outermost anchor bolts to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.
 3. Provide restraint attachment plates cast into housekeeping pads, concrete inserts, double-sided beam clamps, etc., in accordance with the requirements of the manufacturer's calculations.

1.7 VIBRATION ISOLATION AND RISER SUPPORT SUBMITTALS

A. Product Data: For the following:

1. Vibration Isolators: Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Construction Details and Calculations:

1. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
2. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

C. Operation and Maintenance Data.

1.8 SEISMIC CONTROL SUBMITTALS

A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
2. Annotate to indicate application of each product submitted and compliance with requirements.

B. Construction Details and Calculations: For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
2. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

- c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Layout Drawings: Show coordination of seismic bracing for ductwork, piping, plumbing and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints. Plans shall utilize copies of the contractor's coordination plans and shall show all locations and types for the following. The registered professional engineer must stamp plans.
 - 1. All seismic brace locations.
 - 2. All anchorage connections to the structure. Quantity and size
 - 3. Brace reactions at all connection points to the structure, for Structural Engineer of Record use in checking suitability of the building structure.
 - 4. Total vertical load at seismic brace locations.
 - 5. Type and size of brace member.
 - 6. Suspended utility max lbs per lineal foot or max pipe size at all seismic locations.
 - 7. Minimum rod size at all seismic locations.
 - 8. Vertical support anchors at non-seismic and seismic locations.
 - 9. Horizontal members of all trapeze assemblies.
- D. Operation and Maintenance Data.

1.9 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC and all local amendments unless requirements in this Section are more stringent.
- B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTIONS

- A. General: Flexible pipe connectors shall be provided at all piping connections to rotating equipment, isolated equipment and elsewhere as indicated.
 - 1. Basis of Design: Mason Industries, Inc.,
 - 2. Manufacturers:
 - a. Mason Industries, Inc.

University of Idaho
State of Idaho Division of Public Works
Coffman Engineers, Inc.

VIBRATION AND SEISMIC CONTROLS FOR
PIPING, PLUMBING, AND HVAC

- b. Metraflex
- c. Twin City Hose
- d. Unisource Manufacturing

- B. Flexible Stainless Steel Hose: Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples. Minimum lengths shall be as tabulated:

Flanged		Male Nipples	
3 x 14	10 x 26	1/2 x 9	1 1/2 x 13
4 x 15	12 x 28	3/4 x 10	2 x 14
5 x 19	14 x 30	1 x 11	2 1/2 x 18
6 x 20	16 x 32	1 1/4 x 12	
8 x 22			

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

- 1. Manufacturer: Mason Industries, Inc., Type "BSS."
- 2. Metraflex
- 3. Unisource Manufacturing

2.2 VIBRATION ISOLATORS

- A. General: Provide complete, engineered vibration-isolation systems. Engineering support shall be provided by a representative of the manufacturer, and shall be in full compliance with the manufacturer's recommendations and the following requirements.

- 1. Basis of Design: Mason Industries, Inc., utilizing the products specified in the following paragraphs.
- 2. Manufacturers:
 - a. California Dynamics Corporation.
 - b. Kinetics Noise Control.
 - c. Mason Industries, Inc.
 - d. Vibro-Acoustics.

- B. General Requirements:

- 1. Isolator Identification: All vibration isolators shall be clearly marked to show undeflected heights so that after installation and adjustment, deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being attained.
- 2. Provide a balanced set of isolators for each piece of equipment. Select isolators in accordance with equipment weight distribution to allow for no less than static deflection specified. All isolators for a single piece of equipment shall have approximately equal spring deflection. A minimum of four isolators per unit is required unless otherwise indicated.

3. Each isolator shall be numbered and color-coded to show location. Code number and color shall be marked on plans, on each equipment isolator, and on each base to ensure proper placement.
 4. Operating Limits: All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.
 5. The spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load.
 6. The theoretical vertical natural frequency for each support point, based upon the load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than $\pm 10\%$.
 7. Neoprene Mountings: All neoprene mountings shall have a shore hardness of 40–65 after minimum aging of 20 days, or corresponding oven-aging.
 8. Neoprene Isolator Formulation: Formulation of the neoprene shall conform to AASHTO specifications for neoprene or ASTM D4014 specification for elastomer:
 9. All vibration isolation hardware shall be designed or treated for corrosion resistance. Isolators exposed to the weather shall have steel parts zinc electroplated, PVC coated, plus a coating of neoprene or bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel. Nuts, bolts, and washers shall be zinc electroplated.
- C. Isolator Type 1: Two layers of $\frac{3}{4}$ " thick neoprene pad consisting of 2" square waffle modules separated horizontally by a 16-gauge galvanized shim. Load distribution plates shall be used as required. Basis of Design: Mason Industries, Inc., Type Super "W."
- D. Isolator Type 2: Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" and all directional seismic capability. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Preapproval "OPA" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Basis of Design: Mason Industries, Inc., Type Super "BR."
- E. Isolator Type 3: Spring isolators shall be freestanding and laterally stable without any housing and complete with a molded neoprene cup or $\frac{1}{4}$ " neoprene acoustical friction pad between the baseplate and the support. Basis of Design: Mason Industries, Inc. Type "SLF."
- F. Isolator Type 4: Restrained spring mountings shall have an SLF mounting as described in Type 3, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of $\frac{1}{2}$ " shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position, there must be an internal isolation pad. Housing shall

be designed to resist all seismic forces. Mountings shall have Anchorage Preapproval "OPA" Number from OSHPD in the State of California certifying the maximum certified horizontal and vertical load ratings. Basis of Design: Mason Industries, Inc., Type "SLR."

- G. Isolator Type 5: Spring mountings built into a ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of ¼" travel in all directions before contacting the resilient snubbing collars. Mountings shall have an Anchorage Preapproval "OPA" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Basis of Design: Mason Industries, Inc., Type "SSLFH."
- H. Isolator Type 6: Hangers shall consist of rigid steel frames containing minimum 1¼" thick neoprene elements at the top and a steel spring seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability, the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Basis of Design: Mason Industries, Inc., Type "30N."
- I. Isolator Type 7: Hangers to be pre-compressed and locked at the rated deflection by means of a resilient seismic up-stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30° capability. Basis of Design: Mason Industries, Inc., Type "PC30N."

2.3 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Provide complete, engineered equipment bases. Engineering support shall be provided by a representative of the manufacturer, and shall be in full compliance with the manufacturer's recommendations and the following requirements.
 - 1. Basis of Design: Factory-fabricated products by Mason Industries, Inc.
 - 2. Manufacturers:
 - a. California Dynamics Corporation.
 - b. Kinetics Noise Control.
 - c. Mason Industries, Inc.
 - d. Vibro-Acoustics.
- B. Type B-1 Base: Steel Base, factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-1/2-inches clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Cross members shall be provided where necessary to support the equipment or to prevent twisting of the main members. The section depth of any frame member shall be not less than 1/10th of the length of the longest frame member and not less than 1/10th of the greatest span between support points. All frame members shall have the same depth.
 4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Type B-2 Base: A welded structural steel base constructed of angle iron or channels, designed to spread base area of equipment to increase stability and permit suspension with hanger rods.
- D. Type B-3 Base: Inertia Base, factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 2. Base shall consist of a perimeter welded structural steel pouring form, 1/2" diameter reinforcing bars welded in place on 6" centers each way, pre-located equipment anchor bolts and pipe sleeves, and isolator brackets to reduce the mounting height of the equipment. The bottom edge of the steel reinforcing bars shall be 1-1/2" from bottom of the base. Drilled steel members shall have sleeves below the holes to receive anchor bolts. Thickness of the base shall be a minimum depth of 1/12th of the longest span, but not less than 6" deep. The base shall be sized a minimum overlap of 4" around the base of the equipment, and in the case of belt-driven equipment, 4" beyond the end of the drive shaft.
 3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 5. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.4 VERTICAL RISER SUPPORTS

- A. General: Provide complete engineered pipe riser support systems. Engineering support shall be provided by a representative of the manufacturer, and shall be in full compliance with the manufacturer's recommendations and the following requirements. Submittal must be stamped and signed by a licensed professional engineer in the employ of the manufacturer.
1. Basis of Design: Mason Industries, Inc., utilizing the following products:

- a. Support spring mountings; SLF
 - b. Anchors; ADA.
 - c. Telescoping guides; VSG
2. Manufacturers:
- a. California Dynamics Corporation.
 - b. Kinetics Noise Control.
 - c. Mason Industries, Inc.

2.5 SEISMIC-RESTRAINT COMPONENTS

- A. Manufacturers:
- 1. Basis of Design: Pre-approved products where available from Mason Industries, Inc., custom designed products where not available from Mason Industries, Inc.
 - 2. Manufacturers:
 - a. International Seismic Application Technology (ISAT).
 - b. Kinetics Noise Control.
 - c. Mason Industries, Inc.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or OSHPD.
- 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
 - 2. Even though the project may not be located in the State of California, all isolators that provide seismic restraint shall have an Anchorage Preapproval "OPA" Number from OSHPD (of the State of California) verifying the maximum certified load ratings.
 - 3. Seismic Cable Restraints consisting of galvanized steel aircraft cables shall be provided for vibration-isolated components.
 - 4. Seismic Solid Braces consisting of steel angles or channels shall be provided for all suspended components that are not vibration-isolated.
 - 5. Pipe clevis cross bolt braces are required in all restraint locations
 - 6. Provide hanger rod reinforcing to prevent buckling due to upward forces caused by restraints.
- C. Base-mounted equipment with vibration isolation: Where integral seismic restraints furnished with vibration isolators are not adequate, provide all-directional seismic snubbers consisting of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene.
- D. Restraint Anchors: Provide appropriate anchors to attach equipment, seismic restraints, and vibration isolation devices (if being used for seismic restraint), to the building structure. The method of connection to the structure shall be identified at each location on the Layout Drawings. All components shall meet the requirements of the

authorities having jurisdiction. Where available, anchors (such as wedge anchors) shall have an evaluation report number from the ICBO Evaluation Service, Inc. verifying its allowable loads

2.6 FACTORY FINISHES

- A. All vibration isolation and seismic restraint hardware shall be designed or treated for corrosion resistance.
- B. Items exposed to the weather shall have steel parts zinc electroplated, PVC coated, plus a coating of neoprene or bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial enamel.
- C. Nuts, bolts, and washers shall be zinc electroplated.
- D. Structural steel bases shall be thoroughly cleaned of welding slag, primed with zinc chromate and finished with two coats of industrial enamel.
- E. Field painting shall comply with requirements in Division 09. Verify compatibility of factory finishes with field-applied coats.

PART 3 - EXECUTION

3.1 VIBRATION ISOLATION INSTALLATION REQUIREMENTS

A. Vibration Isolation for Piping:

1. When piping connects to equipment is provided with vibration isolation and a flexible connection is not provided at the equipment, the first four pipe hangers shall be Type 7 with the same deflection as specified for the mountings under the connected equipment.
2. Floor supported piping shall be isolated with Type 4 isolators.
3. Do not support vibration isolated piping along with non-isolated piping on a common trapeze.
4. Steel spring hanger boxes shall be rigidly mounted to the supporting structure-not located in the middle of the hanger rod.
5. Hanger rods shall be aligned to clear the hanger box.
6. Load-transfer isolators, when utilized, shall temporarily maintain the piping in a rigid position until installation is complete and fully loaded.
7. Pipe anchors are not permitted in vibration isolated piping circuits.

B. General Requirements for Equipment Bases:

1. All bases shall be installed on housekeeping pads. All bases shall be sized to include equipment and motor without overhang.
2. Motor-driven equipment shall be mounted with motors on a common base of sufficient rigidity to maintain permanent alignment.
3. All bases shall have clearance of 1-1/2" between top of floor and underside of base.
4. Inertia bases shall have 1-1/2" clearance for first 50 sq.ft. of area.

3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION REQUIREMENTS

- A. Install seismic restraints for all equipment and all sizes of ductwork and piping except where omission of restraints for smaller sizes is specifically allowed by Code and specifically allowed by the QPE and seismic restraint manufacture's guidelines.
- B. Install cables so they do not bend across edges of adjacent equipment or building structure.
- C. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

- E. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- G. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.5 EQUIPMENT, PIPING, AND PLUMBING, SEISMIC RESTRAINT AND VIBRATION SCHEDULE:

- A. See schedule(s) on drawings.

3.6 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 230500

SECTION 230550 – IDENTIFICATION FOR PIPING AND EQUIPMENT GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUBMITTALS

- A. Product Data: Submit for each type of product indicated.
- B. Valve numbering scheme.
- C. Valve Schedules: For each piping system to include in maintenance manuals.

1.3 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 degree F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: As appropriate for pipe size.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.5 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 230550

SECTION 230590 – TESTING ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. Division 23, Section 230500 is directly related. Other sections are indirectly related and shall be reviewed.

1.2 SUMMARY

- A. Work under this section shall include furnishing all labor, materials, tools, and equipment necessary for testing, adjusting, and balancing (TAB) necessary to place all systems and items of equipment, specified in Division 23, in proper operating condition. All work shall be completely tested as required by this section and applicable city, county, and state codes and ordinances.
- B. Submit copies of all testing, adjusting, and balancing data to A/E.
- C. Leak and pressure testing of piping and duct systems and rotational testing of motors shall be performed by the installing contractor.
- D. TAB shall include the following:
 - 1. Hydronic systems:
 - a. Chilled water.
 - b. Fisheries water.
 - 2. Equipment quantitative-performance settings.
 - 3. Verifying that automatic control devices are functioning properly.
 - 4. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.
- E. Hydronic Systems: Includes chilled water, condenser water, heating hot water, and glycol-water systems, and heat recovery water systems.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- M. TAB: Testing, adjusting, and balancing.
- N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- O. Test: A procedure to determine quantitative performance of systems or equipment.
- P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit two copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

- C. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Contracting: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
- B. TAB Firm Qualifications:
1. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the A/E and submit another TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
 2. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the A/E and submit another TAB Specialist for approval.
 3. TAB Specialist Responsibilities:
 - a. The General Contractor, within 60 days after the notice to proceed, shall identify TAB specialist who would be responsible for supervising, coordinating, scheduling and reporting all TAB work and related activities and provide necessary information as required by the A/E.
 - b. All TAB work shall be performed under the direct supervision of the TAB specialist.
 - c. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC or NEBB. The reports shall be signed by the TAB specialist and shall bear the seal of the TAB standard.
 - d. The TAB Specialist would follow all TAB work through its satisfactory completion.
 - e. Final markings of settings of all HVAC adjustment devices.
 - f. Permanently mark location of duct test ports.
 4. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of three projects comparable in size and complexity of this project and must be certified so by the TAB agency in writing.

- C. Test Equipment Criteria: The basic instrumentation requirements and accuracy/calibration required by AABC, National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.
 - 1. Instrumentation Calibration: Calibrate instruments at least every year or more frequently if required by instrument manufacturer.
 - 2. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- D. Tab Criteria and Tolerances:
 - 1. One or more of the applicable AABC or NEBB publications, supplemented by ASHRAE Handbook "HVAC Applications" Chapter 36, and requirements stated herein shall be the basis for planning, procedures, and reports.
 - 2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36 as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 90 percent of final values for pre-filters and after-filters.
 - a. Air handling unit and all other fans, cubic feet per minute: Minus 5 percent to plus 10 percent.
 - b. Minimum outside air: 0 percent to plus 10 percent.
 - c. Individual rooms: air outlets and inlets, and air flow rates not mentioned above: Minus 10 percent to plus 10 percent.
 - d. Individual rooms where both supply and return/exhaust air volume is indicated: Unless the A/E confirms that room pressurization is not a requirement, the difference between the total supply to a room and the total exhaust/return from that same room shall be 0 percent to plus 10 percent. The required difference is determined by subtracting one total (sum of values indicated at terminals in the room) from the other.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 3. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 4. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- E. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- F. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning

Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
- B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

1.9 APPLICABLE PUBLICATIONS

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text, the publications are referenced to by the initials of the organization.

- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE): 2003 HVAC Applications ASHRAE Handbook, Chapter 37, Testing, Adjusting, and Balancing and Chapter 47
- C. Associated Air Balance Council (AABC): 2002 6th Edition AABC National Standards for Total System Balance
- D. National Environmental Balancing Bureau (NEBB):
 - 1. 2015 8th Edition Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): 2002 3rd Edition HVAC SYSTEMS-Testing, Adjusting and Balancing.

PART 2 - PRODUCTS

2.1 PLUGS

- A. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2 INSULATION REPAIR MATERIAL

- A. See Division 23, Section 23070, "Mechanical Insulation". Provide for repair of insulation removed or damaged for TAB work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, and balancing valves and fittings, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.

- C. Examine Project Record Documents described in Division 01,017839, Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems-Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, and balancing valves and fittings, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine system pumps to ensure absence of entrained air in the suction piping. Verify that start-up strainers have been removed from the pump suction diffusers.
- L. Examine equipment for installation and for properly operating safety interlocks and controls.
- M. Examine automatic temperature system components to verify the following:
 - 1. Valves, and other controlled devices are operated by the intended controller.
 - 2. Valves are in the position indicated by the controller.
 - 3. Integrity of valves for free and full operation and for tightness of fully closed and fully open positions.

4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 6. Spot-check thermostats to determine if they have been calibrated by the Control Contractor.
 7. Sensors are located to sense only the intended conditions.
 8. Sequence of operation for control modes is according to the Contract Documents.
 9. Controller set points are set at indicated values.
 10. Interlocked systems are operating.
 11. Changeover from heating to cooling mode occurs according to indicated values.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
 2. Hydronic systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Equipment and duct access doors are securely closed.
 5. Isolating and balancing valves are open and control valves are operational.
 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.
- B. Coordinate TAB procedures with any phased construction completion requirements for the project. Provide TAB reports for each phase of the project prior to partial final inspections of each phase of the project.

- C. Allow sufficient time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.
- D. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- E. Cut insulation , pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- F. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- G. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check for airflow blockages.
- G. Check condensate drains for proper connections and functioning.
- H. Check for proper sealing of air-handling unit components.

3.5 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.

2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.6 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Refrigerant Coils: Measure the following data for each coil:
1. Dry-bulb temperature of entering and leaving air.
 2. Wet-bulb temperature of entering and leaving air.
 3. Airflow.
 4. Air pressure drop.

3.7 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure outside-air, wet- and dry-bulb temperatures.

3.8 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.9 PROCEDURES FOR FISHERIES WATER MEASUREMENTS

- A. Balance recirculation lines to values shown on plans
- B. Record flow rates for reach circuit setter.

3.10 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

- A. General: Computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for pump performance forms including the following:
 - a. Conditions of filters.
 - b. Cooling coil, wet- and dry-bulb conditions.
 - c. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Water flow rates.
 2. Pipe and valve sizes and locations.
 3. Balancing stations.
 4. Position of balancing devices.
 5. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

- F. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Service.
- d. Make and size.
- e. Model and serial numbers.
- f. Water flow rate in gpm.
- g. Water pressure differential in feet of head or psig.
- h. Required net positive suction head in feet of head or psig.
- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.

2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

3.12 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:
 - a. Measure water flow of at least five percent of terminals.

- b. Measure water temperature at each temperature sensor. Compare the reading to the set point.
- c. Verify that balancing devices are marked with final balance position.
- d. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

- 1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner or Architect.
- 2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner or Architect.
- 3. Owner or Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal eight-hour business day.
- 4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- 6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
- 7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.13 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

3.14 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start of TAB.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.

- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 230590

SECTION 230700 – HVAC INSULATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. Section Includes: Insulation materials and accessories.
- B. New Work: Completely insulate all new work as specified and scheduled.
- C. Coordination:
 - 1. Coordinate size and location of supports, hangers, and insulation shields specified in other sections.
 - 2. Coordinate clearance requirements with piping installer for piping insulation application and equipment installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
 - 3. Coordinate installation and testing of heat tracing.

1.3 SUBMITTALS

- A. Product Data: Submit for each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23, Section 230500, "Common Work Results for HVAC."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing before installation of insulation.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Thermal Requirements for all Insulation: Insulation thickness, conductivity (k) value and/or R-value shall be as required by the local energy code or as indicated, whichever is greater.

2.2 PIPE INSULATION

- A. Glass Fiber Preformed Pipe Insulation: Glass fiber meeting ASTM C547, rigid molded. "K" value 0.23 at 75°F. Maximum service temperature shall not exceed 850°F. Jacket shall be high density, white Kraft bonded to aluminum foil for vapor barrier, reinforced with fiberglass yarn, permanently treated, secured with self-sealing longitudinal laps and butt strips or AP jacket with outward clinch expanding staples coated with vapor barrier mastic.
 - 1. For interior use only. Do not use on exterior piping.
 - 2. Manufacturers:
 - a. Johns Manville "Micro-Lok HP."

- b. Knauf Insulation "Earthwool 1000 Pipe Insulation."
 - c. Owens-Corning "Fiberglas SSLII-ASJ."
 - 3. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
- B. Polyisocyanurate Preformed Pipe Insulation: Rigid molded polyisocyanurate pipe insulation shall meet the requirements of ASTM C591 Type IV. Materials shall have a minimum thermal conductivity of 0.19 Btu-in. per sq.ft. per °F per hour at a mean temperature of 75°F when tested in accordance with ASTM C177 or ASTM C518, latest revisions. Maximum service temperature shall not exceed 300°F. The pipe insulation shall include a vapor retarder jacket with self-sealing longitudinal laps.
 - 1. Basis of Design: HiTherm HT-300.
 - 2. Manufacturers:
 - a. HiTherm HT-300.
 - b. Other Polyisocyanurate manufacturers shall be allowed only if they meet fire and smoke rating requirements for the specified thicknesses.
 - 3. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
- C. Phenolic: Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
 - 1. Basis of Design: Resolco; Insul-Phen.
 - 2. Manufacturers:
 - a. Dyplast Products; DyTherm.
 - b. ITW Insulation Systems; Trymer Supercel.
 - c. Resolco; Insul-Phen.
 - 3. Field-Applied Jacket: Requirements are specified in "Field-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
- D. Calcium Silicate Pipe Insulation (Use only for inserts for fiber glass insulation at pipe supports): Rigid molded pipe insulation, asbestos-free, meeting ASTM C533, color coded throughout, "K" value 0.40 at 300°F, maximum service temperature 1200°F, minimum compressive strength of block form not less than 200 psi with 5% compression at 1-1/2" thickness. Non-combustible tested per ASTM E-136. Secured with 16-gauge stainless steel tie wire with twisted ends on maximum 12-inch centers.
 - 1. Basis of Design: Johns Manville "Thermo-12 Gold."
 - 2. Manufacturers:

- a. Johns Manville "Thermo-12 Gold."
 - b. Industrial Insulation Group "Super Caltemp Gold."
3. Field-Applied Jacket: Requirements are specified in "Field-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
- E. EPDM rubber, flexible, closed-cell elastomeric insulation in tubular or sheet form. The product will meet the requirements defined in ASTM C 534.
 1. Basis of Design: Armacell LLC; AP Armaflex.
 2. Manufacturers:
 - a. Aeroflex USA Inc.; Aerocel AC, Aerocel White/Gray, Aerocel-SSPT, Aerocel W/G-SSPT, or Aerocel SA.
 - b. Armacell LLC; AP Armaflex.
 - c. Industrial Thermo Polymers Limited; Tundra Seal.
 3. EPDM elastomeric insulation shall have a flame-spread index of 25 or less and a smoke-developed index of 50 or less when tested in accordance with ASTM E 84, for all products through 2" thickness.
 4. Product to be suitable for use from -297 F to 300 F continuous service temperature, per ASTM C 411.
 5. EPDM elastomeric insulation shall have a maximum thermal conductivity of 0.245 Btu-in./h-ft²F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518.
 6. Field-Applied Jacket: Requirements are specified in "Field-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.

2.3 EQUIPMENT INSULATION

- A. Thermal Requirements for all Equipment Insulation: Insulation thickness and/or R-value shall be as required by the local energy code or as indicated, whichever is greater.
- B. Glass or Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Basis of Design: CertainTeed Corp.; SoftTouch Duct Wrap.
 2. Manufacturers:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite XG.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.

- e. Owens Corning; Softr Duct Wrap FRK.
- C. Glass or Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Basis of Design: CertainTeed Corp.; CertaPro Commercial Board.
 - 2. Manufacturers:
 - a. CertainTeed Corp.; CertaPro Commercial Board.
 - b. Johns Manville; 1000 Series Spin-Glas.
 - c. Knauf Insulation; Insulation Board.
 - d. Owens Corning; Fiberglas 700 Series.

2.4 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
- B. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
- C. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
- D. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
- E. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - 1. Manufacturers:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
- F. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - 1. Manufacturers:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

- G. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

1. Manufacturers:

- a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.5 FIELD APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

- C. Jacketing of Ducts and Pipes Exposed to Weather: All ductwork and piping exposed to weather shall be finished with an aluminum jacket over the insulation. Aluminum jacket material shall be embossed or corrugated sheet, 0.016" nominal thickness, conforming to ASTM B209, temper H-14. Jacketing shall be applied with joints lapped not less than 2", and shall be secured with 3/8" x 0.020" thick aluminum bands located at each circumferential lap and at not more than 9" intervals throughout. Horizontal joints shall lap downward to shed water. Vertical joints shall be sealed with weatherproof silicone sealant.

1. Basis of Design: Childers Products, Division of ITW "Metal Jacketing Systems."

2. Manufacturers:

- a. Childers Products, Division of ITW.
b. Pabco Metals Corporation.
c. RPR Products Inc, "Insul-Mate".

3. Be careful to consider jacketing requirements for piping that may be outdoors, but not exposed to weather. Such piping may include piping in parking garages, within covered loading docks, etc. Make sure documents adequately address different requirements for different situations.

- D. PVC Plastic: One-piece molded type fitting covers and jacketing material, gloss white. Connections, tacks, pressure sensitive color matching vinyl tape. PVC material shall be 25 flame spread and 50 smoke development rated per ASTM E-84.

1. Basis of Design: Johns Manville "Zeston 2000 PVC".

2. Manufacturers:

- a. Johns Manville "Zeston 2000 PVC".
b. Proto Engineered Thermoplastics Corp. "Proto Fitting Cover System".
c. P.I.C. Plastics, Inc.; FG Series.
d. Speedline Corporation "Smoke-Safe".

- E. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure sensitive, acrylic-bases adhesive covered by a removable protective strip.

1. Basis of Design: Dow Chemical Company Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder tape.
2. Manufacturers:
 - a. Dow Chemical Company Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder tape.
- F. Canvas Jacket: UL listed fabric, 6 oz./sq.yd. plain weave cotton treated with dilute fire retardant lagging adhesive. Manufacturer: Great Lakes Textiles Product Style 1979.
- G. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.
- H. Butt Straps: Materials shall be identical in all respects and appearance to the basic jacket material.

2.6 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 1. Basis of Design: P. K. Insulation Mfg. Co., Inc.; "Super-Stik".
 2. Manufacturers:
 - a. Insulco, Division of MFS, Inc.; "Triple I"
 - b. P. K. Insulation Mfg. Co., Inc.; "Super-Stik".
 - c. Ramco Insulation, Inc.; "Supertemp 1900".
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement 100 to 1200 degree: Comply with ASTM C 449/C 449M.
 1. Basis of Design: P. K. Insulation Mfg. Co., Inc. PK No. 127" and "Quik-Cote".
 2. Manufacturers:
 - a. Insulco, Division of MFS, Inc.; "SmoothKote".
 - b. P. K. Insulation Mfg. Co., Inc.; "Quik-Cote".
 - c. Ramco Insulation, Inc.; "Ramcote 1200".
 - d. Rock Wool Manufacturing Company; "Delta One Shot".

2.7 ADHESIVES AND MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated. Obtain insulation and/or jacket manufacturer approval for all adhesives and mastics used. Obtain A/E approval for all locations where mastics will be used.
 1. Adhesives shall not be considered an acceptable alternative to specified mechanical fastening methods without prior A/E approval.

2. All adhesives and mastics shall be suitable for the moisture conditions and temperatures that will be encountered.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Basis of Design: Armacell LCC; 520 Adhesive.
 2. Manufacturers:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Basis of Design: Childers Products, Division of ITW; CP-82.
 2. Manufacturers:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. Marathon Industries, Inc.; 225.
 - d. Mon-Eco Industries, Inc.; 22-25.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Basis of Design: Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 2. Manufacturers:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Solvent Weld Adhesive.
- E. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Basis of Design: Childers Products, Division of ITW; CP-35.
 2. Manufacturers:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. Marathon Industries, Inc.; 590.
 - d. Mon-Eco Industries, Inc.; 55-40.
 3. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 4. Service Temperature Range: Minus 20 to plus 180 deg F.
 5. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 6. Color: White.

- F. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Basis of Design: Childers Products, Division of ITW; CP-10 and CP-11.
2. Manufacturers:
 - a. Childers Products, Division of ITW; CP-10, CP-11.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. Marathon Industries, Inc.; 550.
 - d. Mon-Eco Industries, Inc.; 55-50.

2.8 SEALANTS

- A. Joint Sealants: Joint Sealants for Cellular-Glass, and Polyisocyanurate Products:

1. Basis of Design: Mon-Eco Industries, Inc. "44-05".
2. Manufacturers:
 - a. Childers Products, Division of ITW; "CP-76".
 - b. Foster Products Corporation "30-45N".
 - c. Mon-Eco Industries, Inc. "44-05".
 - d. Pittsburgh Corning Corporation Pittseal "444".

- B. FSK and Metal Jacket Flashing Sealants: Materials shall be compatible with insulation materials, jackets, and substrates. Fire- and water-resistant, flexible, elastomeric sealant. Minus 40 to plus 250 degree F service temperature range. Color shall be aluminum.

1. Basis of Design: Mon-Eco Industries, Inc. "44-05".
2. Manufacturers:
 - a. Childers Products, Division of ITW; "CP-76-8".
 - b. Foster Products Corporation "95-44".
 - c. Mon-Eco Industries, Inc. "44-05".

- C. ASJ Flashing Sealants, and PVDC, and PVC Jacket Flashing Sealants. Materials shall be compatible with insulation materials, jackets, and substrates. Fire- and water-resistant, flexible, elastomeric sealant. Minus 40 to plus 250 degree F service temperature range. Color shall be white.

1. Manufacturer:
 - a. Childers Products, Division of ITW; "CP-76".
 - b. Foster Products Corporation "95-44".
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc. "44-05".

2.9 TAPES

- A. ASJ Tape: White, 3-inch wide, vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Basis of Design: Compac Corp. "104 and 105".
 - 2. Manufacturers:
 - a. Avery Dennison Corporation, Specialty Tapes Division "FT 2150".
 - b. Compac Corp. "104 and 105".
 - c. Ideal Tape Co., Inc., an American Biltrite Company; "428 AWF ASJ".
 - d. Venture Tape; "1540 CW Plus, 1542 CW Plus", and "1542 CW Plus/SQ".
- B. FSK Tape: Foil-face, three-inch wide, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Basis of Design: Compac Corp. "110 and 111".
 - 2. Manufacturers:
 - a. Avery Dennison Corporation, Specialty Tapes Division "Fasson 0827".
 - b. Compac Corp. "110 and 111".
 - c. Ideal Tape Co., Inc., an American Biltrite Company; "491 AWF FSK".
 - d. Venture Tape; "1525 CW Plus, 1528 CW Plus", and "1542 CW Plus/SQ".
- C. PVC Tape: White, 2-inch wide, vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 - 1. Basis of Design: Compac Corp. "130".
 - 2. Manufacturers:
 - a. Avery Dennison Corporation, Specialty Tapes Division "Fasson 9200".
 - b. Compac Corp. "130".
 - c. Ideal Tape Co., Inc., an American Biltrite Company; "370 White Pvc".
 - d. Venture Tape; "1506 CW NS".
- D. PVDC Tape for Indoor Applications: White, three-inch wide, vapor-retarder PVDC tape with acrylic adhesive. Manufacturer: Dow Chemical Company "Saran 540 Vapor Retarder Tape".
- E. PVDC Tape for Outdoor Applications: White, three-inch wide, vapor-retarder PVDC tape with acrylic adhesive. Manufacturer: Dow Chemical Company "Saran 560 Vapor Retarder Tape".

2.10 SECUREMENTS

- A. Bands:
 - 1. Manufacturers:
 - a. Childers Products.

- b. Gerrard & Co.
- c. PABCO Metals Corporation.
- d. RPR Products, Inc.

PART 3 - EXECUTION

3.1 MINIMUM INSULATION SCHEDULE

- A. Fiberglass insulation shall not be used outdoors.
- B. Piping insulation:

Fluid Operating Temperature Range and Usage (°F)	Insulation Conductivity		Nominal Pipe or Tube Size in Inches (a)				
	Conductivity Btu·in./(h·ft ² ·°F)	Mean Rating Temperature, °F	< 1	1 to < 1 ½	1 ½ to ≤ 4	4 to < 8	≥ 8
> 350	0.32 – 0.34	250	4.5	5.0	5.0	5.0	5.0
251 – 350	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
201 – 250	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0
141 – 200	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
105 – 140	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5
40 – 60	0.21 – 0.27	75	0.5	0.5	1.0	1.0	1.0
<40	0.20 – 0.26	75	0.5	1.0	1.0	1.0	1.5

- a. For piping smaller than 1 ½ inch (38 mm) and located in partitions within conditioned spaces, reduction of these thickness by 1 inch shall be permitted but not to a thickness less than 1 inch.

- C. Service Schedule:

- 1. Use EPDM insulation for refrigerant gas piping.

- a. Refrigerant gas piping: 25 °F
- b. Refrigerant liquid piping: uninsulated

Notes:

- 2. Polyisocyanurate allowed only if it meets fire and smoke rating requirements at this thickness.
- 3. Use Calcium Silicate only for inserts at pipe saddles and hangers
- 4. Use polyisocyanurate insulation for chilled water and fisheries chilled water piping.

- D. Equipment; provide the following on any equipment that is not factory insulated:

- 1. Chillers: Insulate cold surfaces on chillers, including, but not limited to, evaporator bundles, condenser bundles, heat-recovery bundles, suction piping,

compressor inlets, tube sheets, water boxes, and nozzles with one of the following:

- a. Cellular Glass: 1-1/2 inches thick.
 - b. Mineral-fiber board, phenolic or polyisocyanurate: 1 inches thick.
 - c.
- E. Valves and pipe fittings shall be insulated as indicated below.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 INSULATION WORK IN GENERAL

- A. General: Except as specified, material shall be installed in accordance with the recommendations of the manufacturer.
1. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
 2. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
 3. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
 4. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
 5. Install insulation with least number of joints practical.
 6. Install insulation with longitudinal seams at top and bottom of horizontal runs.

7. Do not apply insulation until surfaces to be covered have been leak tested, have had rust and scale removed, and have been cleaned, dried and inspected.
8. Insulation shall be kept dry and clean at all times.
9. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
10. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - a. Install insulation continuously through hangers and around anchor attachments.
 - b. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - c. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - d. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
 - e. Continue insulation vapor barrier through penetrations except where prohibited by code.
11. Continue pipe insulation through gypsum and masonry walls only if fire stopping specified in Division 07 has a UL Listed assembly that includes a jacketed insulation. Coordinate with General Contractor.
12. Install insulation with factory-applied jackets as follows:
 - a. Draw jacket tight and smooth.
 - b. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - c. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - d. For below ambient services, apply vapor-barrier mastic over staples.
 - e. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - f. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
13. All work shall be performed at ambient and equivalent temperatures as recommended by the manufacturers.
14. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
15. Joints shall be staggered on multi-layer insulation.
16. Do not apply insulation until heat tracing specified elsewhere in other sections of this Specification is completed and tested.

17. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces.
18. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

3.4 INSULATION INSTALLATION, PIPING

- A. General: Pipe insulation shall be installed in strict conformance to the manufacturer's recommendations. Pipe insulation shall be continuous and installed on all fittings and appurtenances unless specified otherwise. Installation shall be with full-length units of insulation and using a single-cut piece to complete a run. Provide jackets for all pipe insulation.
- B. Insulation Installation on Straight Pipes and Tubes:
 1. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 2. Secure laps with outward clinched staples at six inches o.c, for insulation with factory-applied jackets on above ambient surfaces.
 3. Do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant, for insulation with factory-applied jackets on below-ambient surfaces.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Polyisocyanurate Insulation:
 1. All insulation shall be tightly butted and free of voids and gaps. Vapor retarder, if used, must be continuous. All fasteners and bands shall be neatly aligned.
 2. In below-ambient systems, staple, rivets, screws and other fasteners capable of penetrating the vapor retarder shall not be used.
 3. Install prefabricated insulation fittings on elbows, tees, and valves. Insulation at fittings shall be the same type and thickness as on straight pipe sections.
 4. Lap joints of vapor retarder jacket shall be sealed using SSL tape or manufacturer's vapor retarder tape.
 5. Elbows and fittings shall be wrapped with vapor retarder tape in a spiral fashion, using a 50% overlap between successive courses of tape.
- E. Unions, Flanges, Couplings, Strainers, and Valves:
 1. Insulate all fittings, flanges, couplings, strainers, valves (and similar accessories) associated with an insulated piping system unless indicated otherwise.

2. Exposed Work: On exposed work, insulate to a diameter equal to insulation of adjacent piping provided a minimum of 0.75" of insulation is maintained around fittings, couplings, strainers and valves, otherwise, increase diameter.
 3. Concealed Work: On concealed work, increase insulation diameter to maintain same insulation thickness as on adjacent piping. Use same material as specified for adjacent piping; fitting covers to be as specified hereinafter.
 4. Adjustable and Serviceable Valves and Accessories: Where balancing valves, strainers and similar devices are adjustable or require servicing on less than a five-year cycle, provide removable insulation sections. Where valves with repackable glands and similar devices allow service, but manufacturer does not anticipate service frequency to be less than five years, make reasonable provisions to allow removal and reinstallation of the same materials with minimal effort and potential for damage.
- F. Thermometer and Test Wells: Insulate test thermometer, industrial thermometer, and other test wells over their exterior length. Insulate thermometer wells protruding above finish pipe or equipment insulation. Neatly taper insulation away from top of well. Insulation on thermometer wells shall be 1-1/2" minimum thickness.
- G. Insulation Support at Hangers:
1. Provide support shield and 360 degree insert between support shield and piping on piping 1-1/2" diameter and larger. Fabricate insert from heavy density insulating material suitable for the temperature. Shield shall be fabricated of 14 gauge galvanized sheet metal. Insulation shields and inserts shall be not less than the following lengths:

1/2" to 2-1/2"	10"
3" to 6"	12"
8" to 10"	16"
 2. Vapor-barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation with lagging adhesive for vapor seal. Where anchors are secured to insulated chilled piping, insulate anchors same as piping for a distance not less than four times insulation thickness to prevent condensation.
- H. Sleeves and Wall Chases: Insulation on pipes through walls and floors shall be full size and jacketed same as adjacent insulation. Provide a metal jacket over the insulation on pipe passing through sleeves in non-fire rated walls where caulking is required.
1. Where penetrating interior walls, extend the metal jacket two inches out on either side of the wall and secure on each end with a band.
 2. Provide adequate support on vertical pipe to prevent slipping.
- I. Allowances for Movement: At points where pipe will move during expansion and contraction (expansion joints, Z-bends, expansion loops, etc.), clearances between the pipe and encased insulation shall be sized to permit full pipe movement without cracking or damaging insulation and casing or jacket.

- J. Insulation at Mechanical Pipe Couplings: PVC insulated fitting covers shall be applied after the installation is installed. Installation shall comply with the manufacturer's recommended procedures. Connection with the pipe insulation shall be done in a neat, finished appearance, and any required vapor barrier shall be maintained.
- K. Insulation Within Reach of Building Occupants: Where insulation is within reach of building occupants and visitors, insulation surfaces shall be protected by smooth sheet aluminum jacket material, 0.016" nominal thickness, lapped, banded, and installed same as above. The term "within reach" is defined as within ten feet of the floor, except for cases where there is reasonable protection (in the opinion of the A/E) offered by objects located between the insulation and the floor. This does not apply to insulation concealed within wall or ceiling construction and insulation located within equipment rooms that can be locked off from the normal building occupants.

3.5 SPECIAL PIPE INSULATION REQUIREMENTS:

- A. Sterilizers, Kitchen and Laundry Equipment Piping: Provide aluminum jackets over insulation on piping that connects to equipment (where exposed to view). Insulate steam filters and provide jackets, same as for piping. Provide escutcheons at wall, ceiling or floor penetrations.
- B. Cold Piping Insulation: Exposed ends of insulation shall be sealed with vapor retarding mastic installed per the manufacturer's recommendations. Vapor seals at butt joints shall be applied at every fourth pipe section and at each fitting to isolate any water incursion.
- C. Removable Insulation Sections: Installation shall conform to the following:
 - 1. Fabricate removable insulation sections from sections of pipe insulation or block insulation as follows. Removable flexible blankets will be allowed with prior approval if adequate covering is provided. Vapor barrier must be maintained for cold surfaces.
 - 2. When covers are made from sectional pipe insulation, extend insulation at least two times the insulation thickness over adjacent pipe insulation on each side of the component. Secure cover in place with stainless-steel hooks and wire.
 - 3. When covers are made from block insulation, make two halves, each consisting of mitered blocks. Extend insulation at least two inches over adjacent pipe insulation on each side of the component. Fill space between the component and pipe insulation with insulating cement.

3.6 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Glass Fiber Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
5. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
6. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

3.7 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. Terminate insulation above roof surface and seal with joint sealant for applications requiring only indoor insulation. Install insulation for outdoor applications tightly joined to indoor insulation ends for applications requiring indoor and outdoor insulation. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. Terminate insulation inside wall surface and seal with joint sealant for applications requiring only indoor insulation. Install insulation for outdoor applications tightly joined to indoor insulation ends for applications requiring indoor and outdoor insulation. Seal joint with joint sealant.
 3. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Floor, Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated floors, walls and partitions if firestop is rated for this approach. Obtain further direction from A/E if firestopping is not rated for insulated penetrations. Comply with requirements in Division 07 Section for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. General: Where field-applied jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with two-inch overlap at seams and joints.
 2. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where metal jackets are indicated, install with two-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 230700

SECTION ~~23-08-00~~230800 – COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for commissioning the HVAC system, its subsystems and equipment, and parts of the Plumbing and Electrical Systems. This includes the new construction and existing systems that will serve the new construction or are being renovated.
- B. The owner will hire a 3rd party independent CxA for this project. The contractor's responsibilities are defined in this specification.
- B.C. The owner is committed to commissioning the new fisheries water system to systematically optimize performance so that the College of Natural Resources can operate efficiently and effectively in accordance with the Owners Project Requirements, and that the facility staff has adequate system documentation, and training. It is the intent of the owner to ensure that the fundamental systems are calibrated and operating as required to deliver functional and efficient performance.
- C.D. The CxA will plan, manage, perform and report on the commissioning activities, utilizing the reporting formats and standardized forms provided by the CxA. The CxA will submit deliverable report according to a project schedule set by CxA and agreed upon by Owner. It is extremely important that all commissioning tasks be conducted in a transparent manner and involve the building engineer and operations staff to the greatest degree possible.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced.
 - 1. ASHRAE
 - a. ASHRAE Guideline 0-2013: The Commissioning Process
 - b. ASHRAE Guideline 1.1-2007: HVAC&R Technical Requirements for the Commissioning Process
 - 2. ANSI
 - a. ANSI/ASHRAE/IES Standard 202-2013: The Commissioning Process for Buildings and Systems

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COMMISSIONING Replace Chiller Plant to Building 2, Animal Research Building

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1.3 DEFINITIONS

- A. Acceptable Performance: A component or system being able to meet specified design parameters under actual load including satisfactory documented completion of functional performance tests, control system trending and resolution of outstanding issues.
- B. Acceptance Phase: The phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and operations & maintenance staff training occurs.
- C. Basis of Design (BOD): A document prepared by the Designer of Record that records concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements (OPR) and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- D. Building Envelope: Products, assemblies, equipment and systems that comprise the building exterior; including but not limited to foundations, floors, walls, doors, windows, openings, skylights, roof, and air barriers.
- E. Commissioning (Cx): Documented confirmation that building systems function in compliance with criteria set forth in the Contract Documents and OPR.
- F. Commissioning Authority (CxA): An independent entity designated by the Owner, not associated with the General Contractor. This entity oversees and recommends approval of the completion of all General Contractor commissioning activities.
- G. Commissioning Coordinator (CC): A representative responsible for coordinating commissioning activities on behalf of the subcontractor. Each CC will participate as a member of the project Commissioning Team.
- H. Commissioning Plan: A document prepared by the CxA that outlines the Cx team organization, communication paths, schedule, allocation of resources, matrix of responsibilities, installation/testing requirements, and documentation requirements of the commissioning process.
- I. Commissioning Report: A document prepared by the CxA at completion of the project.
- J. Commissioning Specialist (CxS): Individual designated by the Contractor as the construction team primary point of contact for coordination of commissioning activities with the subcontractors, Owner and CxA.
- K. Commissioning Team: Owner and Contractor entities/individuals that participate in the commissioning process.

- L. Contractor: The construction team including the prime contractor, subcontractors, vendors, suppliers and other construction entities associated with the General Contractor's contract.
- M. Functional Performance Test (FPT): A test used to verify and document the full range of components, systems, and assemblies function in accordance with the Contract Documents.
- N. Issue: A condition in the installation or function of a component, piece of equipment, or system that does not appear to be in compliance with the contract documents or Owner Project Requirements (OPR).
- O. Issues Log: A list of systems/equipment installation or performance issues that have been noted. The list is prepared by the CxA. It includes the current disposition of each issue and the date and description of final resolution.
- P. Owner: Entity with the highest level of responsibility for directing the project.
- Q. Owner Project Requirements (OPR): Non-technical document developed by the Owner. It is updated at regular intervals to state the intended concepts, goals, budget, performance, and other criteria to which the completed project must conform. It includes expectations of how the building will be used and operated. This document is the basis for building commissioning. It is used to develop the basis of design documentation.
- R. Pre-functional Checklist (PFC): Criteria used to verify that equipment/system/assembly installations, start-up, and operation comply with the Contract Documents, equipment submittals, and manufacturers' instructions.
- ~~S. Seasonal Performance Tests: Functional tests that are scheduled at such time when system design conditions can be replicated or simulated.~~
- ~~T.S.~~ Start-up: The initial start-up or activation of dynamic equipment.
- ~~U.T.~~ Subcontractor: Member of the Contractor construction team providing a service or product.
- ~~V.U.~~ Systems Manual: A manual that provides information needed to understand, operate, and maintain the equipment/systems/assemblies.
- ~~W.V.~~ Trending: Monitoring of equipment and sequences using the building control system or data loggers.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Each Contractor:

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1. Attend procedures meeting for TAB Work.
2. Perform commissioning tests at the direction of the CxA.
3. Attend controls coordination meeting.
4. Participate in systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
5. Perform commissioning tests at the direction of the CxA.
6. Provide information requested by the CxA for final commissioning documentation.

~~B. — Certify that TAB Work is complete.~~

~~C.B.~~ Mechanical Contractor:

~~1. — Attend TAB verification testing.~~

~~2.1.~~ Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period. The CxA shall provide any calibrated instruments, necessary for commissioning, which are not provided by the contractors.

~~3.2.~~ HVAC Instrumentation and Control Contractor: With the CxA, review control designs for controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

~~D.C.~~ TAB Contractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.
2. Verify the following:
 - a. Accessibility of equipment and components required for TAB Work.
 - b. Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
 - c. Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
 - d. Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
3. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."
4. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Instrumentation and Control for HVAC".

~~E.D.~~ Electrical Contractor:

1. With the Mechanical Contractor, coordinate installations and connections between and among electrical and HVAC systems.

~~2.1. Attend TAB verification testing of electrical equipment.~~

1.5 QUALITY CONTROL

- A. General Contractor Commissioning Specialist (CxS): The General Contractor shall designate a CxS to lead and coordinate all commissioning activities for the Contractor.

1. CxS shall possess the qualifications of an individual experienced with the commissioning of building systems of similar scope and complexity to those included under this contract. Experience as a construction project manager or superintendent is desirable.
2. Upon request, qualifications of the proposed CxS shall be submitted to the Owner for review and approval. The Owner will notify the Contractor if a change of CxS is required. If a change of CxS becomes necessary. The Contractor shall submit qualifications of the replacement CxS for review and approval.
3. CxS presence at all scheduled commissioning meetings is required.
4. CxS shall coordinate and supervise all commissioning related activities with the Subcontractors, Vendors, CxA and Owner.

- B. Subcontractor Commissioning Coordinators (CC) – Individual assigned as the lead on each subcontractor team and responsible to coordinate commissioning activities with the CxS.

1. Contractor is required to identify a CC on each subcontractor team and delegate all commissioning responsibilities through subcontracts.
2. CC presence at all scheduled commissioning meetings is required.
3. CC provides regular input on commissioning activities and issues resolution.
4. Alternates shall be identified during CC absences.

- C. Commissioning Meetings:

1. CxA will organize and lead regular commissioning meetings.
2. Meeting agendas typically include general status discussion, commissioning schedule updates, status of the electronic data management documentation progress, installation & testing progress, Issues Log review, and issues resolution.
3. CxA will provide meeting minutes to the Owner for distribution to the Contractor.
4. Contractor shall require CxS and CC attendance at the meetings to coordinate commissioning activities and resolve issues.

1.6 COMMISSIONING DOCUMENTATION

- A. Test Checklists: CxA, shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required.
1. Calibration of sensors and sensor function.
 2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
 3. Control sequences for HVAC systems.
 4. Strength of control signal for each set point at specified conditions.
 5. Responses to control signals at specified conditions.
 6. Sequence of response(s) to control signals at specified conditions.
 7. Electrical demand or power input at specified conditions.
 8. Power quality and related measurements.
 9. Expected performance of systems, subsystems, and equipment at each step of test.
 10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
 11. Interaction of auxiliary equipment.
 12. Issues log.

1.7 SUBMITTALS

- A. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.
- B. Certificate of Readiness: CxA shall compile certificates of readiness from each Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.
- C. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Contractor as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."
- D. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.
- E. Corrective Action Documents: CxA shall submit corrective action documents.

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- F. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

1.8 The systems to be commissioned are:

- A. Complete chilled water system.
- B. Portions of the fisheries water system installed by this project.
- C. Piping, cleaning and flushing
- D. Chemical treatment

~~E. Ductwork, including balancing dampers for mechanical room ventilation system.~~

F.E. Building automation system (controlled devices, control loops and system integration)

~~PART 2—Electrical system—Feeders and spot-check circuits for this project~~

~~PART 3—Emergency power system sequence of operation—Central Plant generator start on loss of power and automatic transfer switch operation.~~

~~PART 4—Lighting controls~~

~~PART 5—Fire alarm system~~

~~PART 6—~~PART 2 - PRODUCTS

6.42.1 TESTING EQUIPMENT

- A. The Contractor shall provide all equipment and tools to facilitate testing and access to commissioned equipment including lighting, safety equipment, lifts and ladders, two-way radios, etc. Equipment shall be maintained in good repair and operational condition throughout the duration of use on the project.

6.22.2 TESTING EQUIPMENT PROVIDED

- A. The Contractor shall provide all test equipment necessary to perform startup, initial checkout, and required functional performance tests. Special equipment, tools, and

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instruments available only from the vendor, specific to a piece of equipment, and required for testing shall be included in the base bid price and shall become the property of the Owner after testing has been completed, except for stand-alone data logging equipment. Data logging equipment and software required to test equipment shall not become the property of the Owner.

6.32.3 EQUIPMENT CALIBRATION

- A. The Contractor is responsible for testing equipment calibration. Prior to testing, the Contractor shall provide documentation that the equipment has current calibration which can be traced to National Institute of Standards and Technology (NIST) calibration. All testing equipment shall be of sufficient quality and accuracy to test and measure system performance within the tolerances specified. Unless otherwise noted, the following minimum requirements apply:
1. Temperature sensors and digital thermometers shall have a certified calibration within the past year to accuracy of 0.9 degrees F and resolution of plus or minus 0.2 degrees F.
 2. Pressure sensors shall have an accuracy of plus or minus 2.0 percent of the value range being measured (not the full range of the meter) and have been calibrated within the last year.
 3. All equipment shall be calibrated according to the manufacturer's recommended intervals and recalibrated when dropped or damaged. Calibration tags shall be affixed or certificates readily available during testing.
 4. Submit calibration documentation of all testing equipment with each testing episode. Serial numbers of equipment and standards used for Quality Control, zeroing, and calibration shall be included.

PART 7 - PART 3 - EXECUTION

7.13.1 GENERAL

- A. Commissioning is required as one quality measure of the construction of this building in order to assure that the final building meets the original intent of the owner's design. Following is a summary of the commissioning process and scope of work the owner requests for this project.
1. Testing Preparation
 - a. Certify that plumbing, electrical, chilled water system, fisheries water systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

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- b. Certify that instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- c. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- d. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- e. Inspect and verify the position of each device and interlock identified on checklists.
- f. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- g. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

2. Testing and Balancing Verification

- a. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- b. Notify the CxA at least 20 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- c. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1) The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2) The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3) Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4) Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3. General Testing Requirements

- a. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

- b. Scope of testing shall include all new work installed by this project. Testing shall include measuring capacities and effectiveness of operational and control functions.
- c. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- d. Electrical feeder testing shall include performing an insulation resistance test using a test voltage of 1000 VDC for 1 minute with a megohmmeter.
- e. The CxA along with the plumbing contractor, electrical contractor, mechanical Contractor, testing and balancing Contractor, and mechanical Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for systems, subsystems, and equipment.
- f. Tests will be performed using design conditions whenever possible.
- g. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- h. The CxA may direct that set points be altered when simulating conditions is not practical.
- i. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- j. If tests cannot be completed because of a deficiency outside the scope of the system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- k. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

7.23.2 Commissioning Process During the Construction Phase

- A. The commissioning process activities accomplished by the commissioning authority during the construction phase include:
 1. Organize the commissioning process components and conduct a pre-construction meeting where the commissioning process requirements are reviewed with the commissioning team.
 2. Coordinate and direct commissioning activities in a logical, sequential and efficient manner using consistent protocols, clear and regular communications and consultations with all necessary parties, frequently updated timelines, schedules, and technical expertise.
 3. Perform site visits, as necessary, but no fewer than one per month, to observe component and system installations. Accomplish a statistical review of construction focusing on the owner's design intent and the quality process.

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- Perform a static inspection of the installation to ensure that it is conforming to the drawings and specification. Submit checklists for these regular inspections as part of the commissioning plan.
4. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction-meeting minutes for revisions/substitutions relating to the owner's design intent. Assist in resolving any discrepancies.
5. With necessary assistance and review from the installing contractors, develop and write construction checklists. Submit to GC and owner for approval.
6. Organize and conduct periodic commissioning team meetings necessary to plan, develop the scope, coordinate, schedule activities and resolve problems.
7. Review submittals concurrent with the design professional's review.
8. Work with contractors in completing construction checklists and tracking of checklist completion.
9. Statistically sample completion of construction checklists on a periodic basis to verify that contractor's quality process is achieving the owner's project requirements.
10. Approve systems startup by reviewing start-up reports and by selected site observation.
11. With necessary assistance and review from installing contractors, write the test procedures. Submit to A/E and owner for review and approval.
12. Assist GC in direction of the contractor to execute the tests.
13. Coordinate witness and recommend approval of test procedure performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved.
14. Recommend approval of air and water systems balancing through statistical sampling of the report and separate field verification.
15. Maintain a master issues log and a separate testing record. Provide to the GC and owner written progress reports and test results with recommended actions.
16. Document the correction and retesting of non-compliance items by the contractor.
17. Reviews the systems manual for achieving the owner's project requirements.
18. Review, recommend pre-approval, and verify the training provided by the contractors.

7.33.3 Commissioning Process During the Occupancy and Operations Phase

- A. The commissioning process activities accomplished by the commissioning authority during the occupancy and operations phase include:
 1. Schedule and verify deferred and seasonal testing by the contractor.
 2. Verify continuing training.
 3. Complete the final Commissioning Process Report.
 4. Return to the site at 3 months and at 10 months into the 12-month warranty period. Review with facility staff the current building operation and the condition of

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outstanding issues related to the original and seasonal commissioning. Also interview facility staff and identify problems or concerns they have with operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports and documents and requests for services to remedy outstanding problems.

7.43.4 Commissioning Authority Responsibilities

- A. In addition to duties described above, the commissioning authority (CxA) will have the following responsibilities and authority:
1. Issue deficiency notices and verify that they have been corrected. An Issues Log will be maintained and reviewed at the commissioning meetings. Deficiencies that are not corrected in a timely manner will be reported to the owner.
 2. The commissioning authority (CxA) is not required to:
 - a. Establish design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving or resolving non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the design team. The CxA will report to the owner any deficiencies or discrepancies.
 - b. Issue change orders; they do review change orders for compliance with the construction documents. Non-compliances will be reported to the owner.

7.53.5 Observation and Testing Requirements

Equipment or Systems	Sampling Rate
<u>HVAC Systems</u>	
Chillers	100%
VFDs	100%
Heat exchangers	100%
Piping - chilled water system	40%
Temperature Control	100%
Pumps - chilled water system	100%
Glycol feeder	100%
Buffer tanks	
Cleaning/flushing	100%
Water treatment	100%

Fisheries Water Systems

VFDs	100%
Heat exchangers	100%
Piping	40%
Water temperature control	100%
Water valve control	100%
Pumps	100%
Buffer tank	100%

Building Automation Systems

All system inputs	100%
All system outputs	
Sequence of operation	100%
All alarms	100%

Electrical Systems

Emergency Power Sequence	100%
Feeders rated 200 Amps and above	100%

END OF SECTION ~~23-08-00~~230800

SECTION 230900 – INSTRUMENTATION AND CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Division 01 for submittal requirements and formats.
- B. Refer to University of Idaho published standards and specifications, including but not limited to:
 - 1. Structural Cabling Standards v2.3.

1.2 SCOPE OF WORK

- A. ATS Automation-Inland NW to be the sole source specified for the controls systems for the fisheries lab chilled water system, fish lab water mixing systems mixing/temperature control monitoring system. ATS Automation-Inland NW, 9507 E Sprague Ave, Spokane Valley, WA 99206. Project Contact: Chris Roberson, 509.842.0085, Chrisro@atsinlandnw.com.
- B. Automation system shall be an extension of the existing U of I Alerton Building Suite (ABS) 3.1. The new automation system shall utilize Alerton scalable system architecture to provide interoperability of the new facility through the existing Client/Server CAS network.
- C. The Building Automation System (automation system) manufacturer shall furnish and install a fully integrated automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities as herein specified.
- D. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with shop drawings, bill of materials, component designation or identification number and sequence of operation all bearing the name of the manufacturer.
- E. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.
- F. Automation system manufacturer shall be responsible for all automation system and Temperature Control wiring for a complete and operable system. All wiring shall be done in accordance with all local and national codes.
- G. The controls contractor shall be a direct sub to the General Contractor.

1.3 WORK BY OTHERS

- A. Mechanical contractor installs all wells, valves, taps, dampers, flow stations, etc. furnished by automation system manufacturer. Coordination of specific location for materials as described above will be provided by the controls contractor before field installation can be performed. Pipe transmitters shall be canted to fluid flow.
- B. Division 26 Electrical Contractor provides:
 - 1. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by automation system manufacturer.
 - 2. Wiring of all power feeds through all disconnects and or starters to electrical motor(s).
- C. Products furnished but not installed under this section
 - 1. Piping:
 - a. Control Valves
 - b. Flow Switches
 - c. Temperature Sensor Wells and Sockets
 - d. Flow Meters

1.4 Related Work

- A. Division 01 General Requirements
- B. Division 230500 Common Work Results for HVAC
- C. Section 230914 Variable Frequency Drives
- D. Section 237000 Central HVAC Equipment
- E. Section 230590 Testing Adjusting Balancing
- F. Division 26 Electrical

1.5 QUALITY ASSURANCE

- A. The automation system shall be designed and installed, commissioned and serviced by manufacturer employed, factory trained personnel. Manufacturer shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. Distributors or licensed installing contractors are not acceptable.
- B. The manufacturer shall provide an experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the automation system.

- C. The Bidder shall be regularly engaged in the design, installation and maintenance of automation system systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the manufacture, installation and maintenance of automation system systems similar in size and complexity to this project.
- D. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.
- E. All automation system peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX; Standard ULC C100, ; and under Standard UL 864, categories, UDTZ, and QVAX and be so listed at the time of bid. All floor level controllers shall comply, at a minimum, with UL Standard UL 91 6category PAZX; Standard UL 864, categories UDTZ, and QVAX and be so listed at the time of bid. (Note: No UL listed smoke control is required for this BMS system on this project).
- F. Pre-installation Conference: Contractor shall conduct a pre-installation conference in accordance with Division One requirements.

1.6 SUBMITTALS

- A. Submit documentation in the following phased delivery schedule:
 - 1. Equipment Submittals:
 - a. Valve and damper schedules
 - b. Equipment data cut sheets
 - 2. Shop Drawings:
 - a. System Schematics, Including:
 - 1) Sequence of operations
 - 2) Point names
 - 3) Point addresses
 - 4) Interface wiring diagrams
 - 5) Panel layouts
 - 6) System riser diagrams
 - b. Auto-CAD compatible system drawings
 - c. System Schematics, Schedule, Point Name, and Setpoint sign off sheet
- B. Upon project completion, submit operation and maintenance manuals, consisting of the following (submit both had and electronic copies):
 - 1. Index sheet, listing contents in alphabetical order
 - 2. Description of sequence of operations

3. As-Built interconnection wiring diagrams with manufacturer's equipment part list for all functional components of the system
4. List of connected data points, including panels to which they are connected and input device (ionization detector, sensors, etc.)
5. Current control programs
6. Valve schedule
7. Damper schedule
8. Manufacturer's equipment technical data

1.7 WARRANTY

- A. Provide all services, materials and equipment necessary for the successful operation of the new automation system for a period of one year after beneficial use. Provide an extended warranty option on all products for an additional 12 months for a total warranty of 24 months. Extended warranty applies to material components only; installation labor (if required) will be charged on an hourly basis.
- B. The adjustment, required testing, and repair of the system includes all computer equipment, transmission equipment and all sensors and control devices.
- C. If an emergency warranty call is placed, the automation system contractor shall return call within 4 hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekends and holidays.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Alerton, installed by ATS Inland NW branch. ATS Automation-Inland NW, 9507 E Sprague Ave, Spokane Valley, WA 99206. Project Contact: Chris Roberson, 509.842.0085, Chrisro@atsinlandnw.com.
 1. Automation system interface software shall be upgraded from the existing Alerton EBT 2.6 version to Alerton ABS 3.1 version.
 2. License shall be for a minimum of 10 workstations.

2.2 NETWORKING COMMUNICATIONS

- A. The design of the automation system shall network operator workstations and stand-alone DDC Controllers. The network architecture shall consist of three levels, a campus-wide (Management Level Network) Ethernet network based on TCP/IP protocol, high performance peer-to-peer building level network(s) and DDC Controller floor level local area networks with access being totally transparent to the user when accessing data or developing control programs.

- B. The design of automation system shall allow the co-existence of new DDC Controllers with existing DDC Controllers in the same network without the use of gateways or protocol converters.
- C. Peer-to-Peer Building Level Network:
 - 1. All operator devices either network resident or connected via dial-up modems shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the peer-to-peer network. No hardware or software limits shall be imposed on the number of devices with global access to the network data at any time.
 - 2. The peer-to-peer network shall support a minimum of 100 DDC controllers and PC workstations.
 - 3. Each PC workstation shall support a minimum of 4 peer-to-peer networks hardwired or dial up.
 - 4. The system shall support integration of third party systems (fire alarm, security, lighting, PCL, chiller, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for interprocess control. All exchange points shall have full system functionality as specified herein for hardwired points.
- D. Management Level Network
 - 1. All PCs shall simultaneously direct connect to the Ethernet and Building Level Network without the use of an interposing device.
 - 2. Operator Workstation shall be capable of simultaneous direct connection and communication with BACnet, and other required networks without the use of interposing devices.
 - 3. The Management Level Network shall not impose a maximum constraint on the number of operator workstations.
 - 4. When appropriate, any controller residing on the peer-to-peer building level networks shall connect to Ethernet network without the use of a PC or a gateway with a hard drive.
 - 5. Any PC on the Ethernet Management Level Network shall have transparent communication with controllers on the building level networks connected via Ethernet, as well as, directly connected building level networks. Any PC shall be able to interrogate any controller on the building level network.
 - 6. Any break in Ethernet communication from the PC to the controllers on the building level networks shall result in an alarm notification at the PC.
 - 7. The Management Level Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3.
 - 8. Access to the system database shall be available from any client workstation on the Management Level Network.
 - 9. All controllers on the Ethernet Management Level Network shall be connected to a virtual local area network as directed by UI personnel.

2.3 DDC CONTROLLER FLOOR LEVEL NETWORK:

- A. This level communication shall support a family of application specific controllers and shall communicate with the peer-to-peer network through DDC Controllers for transmission of global data.

2.4 DDC & HVAC MECHANICAL EQUIPMENT CONTROLLERS

- A. The DDC & HVAC Mechanical Equipment Controllers shall reside on the Building Level Network.
- B. DDC & HVAC Mechanical Equipment Controllers shall use the same programming language and tools. DDC & HVAC Mechanical Equipment Controllers, which require different programming language or tools on a network, are not acceptable.
- C. DDC & HVAC Mechanical Equipment Controllers, which do not meet the functions specified in Section 2.4.1 and Section 2.5 for DDC Controllers or Section 2.4.2 and Section 2.5 for HVAC Mechanical Equipment Controllers, are not acceptable.

2.5 DDC CONTROLLER

- A. DDC Controllers shall be a 16-bit stand-alone, multi-tasking, multi-user, and real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point I/O schedule. Each controller shall support a minimum of three (3) Floor Level Application Specific Controller Device Networks.
- B. Each DDC Controller shall have a minimum of 72 Mb memory to support its own operating system and databases, including:
 - 1. Control processes
 - 2. Energy management applications
 - 3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
 - 4. Historical/trend data for points specified
 - 5. Maintenance support applications
 - 6. Custom processes
 - 7. Operator I/O
 - 8. Dial-up communications
 - 9. Manual override monitoring
- C. Each DDC Controller shall support firmware upgrades without the need to replace hardware.
- D. Provide all processors, power supplies and communication controllers so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.

- E. DDC Controllers shall provide a minimum two RS-232C serial data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals. DDC Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or terminals. Ethernet I/O connections can be provided in lieu of two RS-232C serial ports and are a preferred method of communication.
- F. As indicated in the point I/O schedule, the operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
 - 1. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.
 - 2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.
- G. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.
- H. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components.
- I. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:
 - 1. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3 V
 - 2. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact
 - 3. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power
 - 4. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max)
- J. Isolation shall be provided at all peer-to-peer panel's AC input terminals to suppress induced voltage transients consistent with:
 - 5. IEEE Standard 587-1980
 - 6. UL 864 Supply Line Transients
 - 7. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11)
- K. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 60 days.

1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
2. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.
3. DDC controller program memory shall automatically reload from network CAS server upon power recovery if token check indicates memory loss.

2.6 HVAC MECHANICAL EQUIPMENT CONTROLLERS

- A. HVAC Mechanical Equipment Controllers shall be a 12-bit stand-alone, multi-tasking, multi-user; real-time digital control processors consisting of modular hardware with plug-in enclosed processors.
- B. Each HVAC Mechanical Controller shall have sufficient memory to support its own operating system and databases, including:
 1. Control processes
 2. Energy management applications
 3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
 4. Historical/trend data for points specified
 5. Maintenance support applications
 6. Custom processes
 7. Operator I/O
 8. Dial-up communications
- C. Each HVAC Mechanical Equipment Controller shall support firmware upgrades without the need to replace hardware.
- D. HVAC Mechanical Equipment Controllers shall provide a RS-232C serial data communication port for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals. Ethernet communications may be used in lieu of RS-232 serial ports.
- E. HVAC Mechanical Equipment Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.
- F. Each HVAC Mechanical Equipment Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all components. The HVAC Mechanical Equipment Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
- G. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:
 8. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3 V

9. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact
 10. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power
 11. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max)
- H. Isolation shall be provided at all peer-to-peer panel's AC input terminals to suppress induced voltage transients consistent with:
12. IEEE Standard 587-1980
 13. UL 864 Supply Line Transients
 14. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11)
- I. In the event of the loss of normal power, there shall be an orderly shutdown of all HVAC Mechanical Equipment Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
1. Upon restoration of normal power, the HVAC Mechanical Equipment Controller shall automatically resume full operation without manual intervention. Equipment shall return to normal operation based on a sequenced start-up restoration to allow sequential start-up of building systems and equipment. The FMO Representative will provide the timing sequence interval at submittal review based upon the Universities utilities loading and capability.
 2. Should HVAC Mechanical Equipment Controller memory be lost for any reason, the user shall have the capability of manually reloading the HVAC Mechanical Equipment Controller via the local RS-232C port or from a network workstation PC
 3. The network workstation PC shall also be capable of automatically downloading the HVAC Mechanical Equipment Controller through the Building Level Network
- 2.7 DDC & HVAC MECHANICAL EQUIPMENT CONTROLLER RESIDENT SOFTWARE FEATURES
- A. General:
1. The software programs specified in this Section shall be provided as an integral part of DDC and HVAC Mechanical Equipment Controllers and shall not be dependent upon any higher-level computer for execution
 2. All points shall be identified by up to 30-character point name and 16-character point descriptor. The same names shall be used at the PC workstation
 3. All digital points shall have user defined two-state status indication (descriptors with minimum of 8 characters allowed per state (i.e. summer/winter).
 4. The U OF I point naming scheme shall be supplied by the FMO Representative (F.O.R) in a joint meeting with the automation system Contractor, F.O. Dispatch Supervisor, and the F.O. Environmental Operations Supervisor where the plan for the automation system and CAS alarm response and monitor integration is decided.

B. Control Software Description

1. The DDC and HVAC Mechanical Equipment Controllers shall have the ability to perform the following pre-tested control algorithms:
 - a. Two-position control
 - b. Proportional control
 - c. Proportional plus integral control
 - d. Proportional, integral, plus derivative control
 - e. Automatic tuning of control loops

C. DDC and HVAC Mechanical Equipment Controllers shall provide the following energy management routines for the purpose of optimizing energy consumption while maintaining occupant comfort.

1. The system shall be capable of SSTO. Start-Stop Time Optimization (SSTO) shall automatically be coordinated with event scheduling. The SSTO program shall start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by time of occupancy. The SSTO program shall also shut down HVAC equipment at the earliest possible time before the end of the occupancy period, and still maintain desired comfort conditions.
 - a. The SSTO program shall operate in both the heating and cooling seasons.
 - b. It shall be possible to apply the SSTO program to individual fan systems.
 - c. The SSTO program shall operate on both outside weather conditions as well as inside zone conditions and empirical factors.
 - d. The SSTO program shall meet the local code requirements for minimum outside air while the building is occupied.
2. Event Scheduling: Provide a comprehensive menu driven program to automatically start and stop designated points or groups of points according to a stored time.
 - a. It shall be possible to individually command a point or group of points.
 - b. For points assigned to one common load group, it shall be possible to assign variable time delays between each successive start or stop within that group.
 - c. The operator shall be able to define the following information:
 - 1) Time, day
 - 2) Commands such as on, off, auto, and so forth.
 - 3) Time delays between successive commands.
 - 4) There shall be provisions for manual overriding of each schedule by an appropriate operator.
 - d. It shall be possible to schedule events up to one year in advance.
 - 1) Scheduling shall be calendar based.
 - 2) Holidays shall allow for different schedules.

3. Economizer Operation. The automation system will control the position of the air handler relief, return, and outside air dampers. If the outside air-dry bulb temperature falls below changeover set point the automation system will modulate the dampers to provide 100 percent outside air. The user will be able to quickly changeover to an economizer system based on dry bulb temperature and will be able to override the economizer cycle and return to minimum outside air operation at any time.
 4. Automatic Daylight Savings Time Switchover: The system shall provide automatic time adjustment for switching to/from Daylight Savings Time.
 5. Night setback control: The system shall provide the ability to automatically adjust setpoints for night control.
 6. System shall be capable of Peak Demand Limiting. The Peak Demand Limiting (PDL) program shall limit the consumption of electricity to prevent electrical peak demand charges.
 - a. PDL shall continuously track the amount of electricity being consumed, by monitoring one or more electrical kilowatt-hour/demand meters. These meters may measure the electrical consumption (kWh), electrical demand (kW), or both.
 - b. PDL shall sample the meter data to continuously forecast the demand likely to be used during successive time intervals.
 - c. If the PDL forecasted demand indicates that electricity usage is likely to exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads.
 - d. Once the demand peak has passed, loads that have been shed shall be restored and returned to normal control.
- D. DDC and HVAC Mechanical Equipment Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
1. A single process shall be able to incorporate measured or calculated data from any and all other DDC and HVAC Mechanical Equipment Controllers on the network. In addition, a single process shall be able to issue commands to points in any and all other DDC and HVAC Mechanical Equipment Controllers on the network. Database shall support 30 characters, English language point names, structured for searching and logs.
 2. Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.
 3. DDC and HVAC Mechanical Equipment Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task-orientated information from the user manual.
 4. DDC and HVAC Mechanical Equipment Controller shall be capable of comment lines for sequence of operation explanation.
- E. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DDC and HVAC Mechanical Equipment Controller shall perform

distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the DDC and HVAC Mechanical Equipment Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.

1. All alarm or point change reports shall include the point's English language description and the time and date of occurrence.
 2. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. Point priority levels shall be combined with user definable destination categories (PC, printer, DDC Controller, etc.) to provide full flexibility in defining the handling of system alarms. Each DDC and HVAC Mechanical Equipment Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
 3. Alarm reports and messages will be directed to a user-defined list of operator devices or PCs based on time (after hours destinations) or based on priority.
 4. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.
 5. In dial-up applications, operator-selected alarms shall initiate a call to a remote operator device.
- F. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified in the I/O summary.
1. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC and HVAC Mechanical Equipment Controllers point group. Two methods of collection shall be allowed: either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of 1 minute to 7 days shall be provided. Each DDC and HVAC Mechanical Equipment Controller shall have a dedicated RAM-based buffer for trend data and shall be capable of storing a minimum predetermined number of data samples. All trend data shall be available for transfer to a Workstation without manual intervention.
 2. DDC and HVAC Mechanical Equipment Controllers shall also provide high-resolution sampling capability for verification of control loop performance. Operator-initiated automatic and manual loop tuning algorithms shall be provided for operator-selected PID control loops as identified in the point I/O summary.
- G. DDC and HVAC Mechanical Equipment Controllers shall be capable of automatically accumulating and storing run-time hours for digital input and output points and automatically sample, calculate and store consumption totals for analog and digital pulse input type points, as specified in the point I/O schedule.

- H. The peer-to-peer network shall allow the DDC and HVAC Mechanical Equipment Controllers to access any data from or send control commands and alarm reports directly to any other DDC and HVAC Mechanical Equipment Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. DDC and HVAC Mechanical Equipment Controllers shall send alarm reports to multiple workstations without dependence upon a central or intermediate processing device. The peer-to-peer network shall also allow any DDC and HVAC Mechanical Equipment Controller to access, edit, modify, add, delete, back up, and restore all system point database and all programs.
- I. The peer-to-peer network shall allow the DDC and HVAC Mechanical Equipment Controllers to assign a minimum of 50 passwords access and control priorities to each point individually. The logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust and control the points that the operator is authorized for. All other points shall not be displayed on the PC workstation or portable terminal (e.g. all base building and all tenant points shall be accessible to any base building operators, but only tenant points shall be accessible to tenant building operators). Passwords and priorities for every point shall be fully programmable and adjustable.

2.8 FLOOR LEVEL NETWORK APPLICATION SPECIFIC CONTROLLERS (ASC)

- A. Each DDC Controller shall be able to extend its performance and capacity through the use of remote application specific controllers (ASC's) through Floor Level LAN Device Networks.
- B. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, and real-time digital control processor. Provide the following types of ASCs as a minimum:
 - 1. Central System Controllers
 - 2. Terminal Equipment Controllers
 - a. Each ASC shall be capable of control of the terminal device independent of the manufacturer of the terminal device.
- C. Central System Controllers:
 - 1. Provide for control of central HVAC systems and equipment including, but not limited to, the following:
 - a. Built-up air handling systems
 - b. Chilled and condenser water systems
 - c. Steam and hot water systems
 - 2. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences.
 - 3. Each controller shall support a standalone real-time operating system. Provide a time clock with battery backup to allow for stand-alone operation in the event

communication with its DDC Controller is lost and to insure protection during power outages.

4. All programs shall be field-customized to meet the user's exact control strategy requirements. Central System controllers utilizing pre-packaged or canned programs shall not be acceptable. As an alternative, provide DDC Controllers for all central equipment in order to meet custom control strategy requirements.
5. Programming of central system controllers shall utilize the same language and code as used by DDC Controllers to maximize system flexibility and ease of use. Should the system controller utilize a different control language, provide a DDC Controller to meet the specified functionality.

D. Terminal Equipment Controllers: (TEC)

1. Provide for control of each piece of equipment, including, but not limited to, the following:
2. Refrigeration systems (condensing units and evaporators) Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Analog outputs shall be industry standard signals such as 24V floating control, 3-15 psi pneumatic, 0-10VDC or 4-20 mA, allowing for interface to a variety of modulating actuators.
3. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the FLN, BLN or MLN is not acceptable.
4. The owner as a part of the submittal review process regarding which occupancy schedule(s) are applicable shall classify individual terminal equipment controllers. Siemens shall schedule the individual controllers accordingly.

2.9 PORTABLE OPERATOR'S TERMINAL (POT)

- A. Note: wired or wireless Ethernet capability can be employed in lieu of local thermostat connection.
- B. Automation system shall allow for use of industry standard, commercially available portable operator terminals with a LCD display and a full-featured keyboard or shall be a Personal Digital Assistant (PDA) compatible with the current Siemens customer tool set. The POT shall be handheld and plug directly into all DDC Controllers, HVAC & Mechanical Equipment Controllers, and Floor Level Network Controllers as described below. Provide a user-friendly, English language-prompted interface for quick access to system information, not codes requiring look-up charts.
- C. Functionality of the portable operator's terminal connected at any DDC Controller:
 1. Access all DDC Controllers and ASCs on the network.
 2. Backup and/or restore DDC Controller databases for all system panels, not just the DDC Controller connected to.
 3. Display all point, selected point and alarm point summaries.
 4. Display trending and totalization information.
 5. Add, modify and/or delete any existing or new system point.
 6. Command, change setpoint, enable/disable any system point.

7. Program and load custom control sequences as well as standard energy management programs.
 8. Acknowledge alarms.
- D. Functionality of the portable operator's terminal connected to any application specific controller:
1. Provide connection capability at either the Floor Level Network Controller or a related room sensor to access controller information.
 2. Provide status, setup and control reports.
 3. Modify, select and store controller database.
 4. Command, change setpoint, enable/disable any controller point.
- E. Connection of a POT to a DDC or HVAC & Mechanical Equipment Controller, or ASC Controller shall not interrupt nor interfere with normal network operation in any way, prevent alarms from being transmitted or preclude centrally initiated commands and system modification.
- F. Portable operator terminal access to controller shall be password-controlled. Password protection shall be configurable for each operator based on function, points (designating areas of the facility), and edit/view capability.

2.10 Automation system TO CAS CONNECTION

- A. Connect to the existing CAS/Client Server network to allow full access to all automation system controllers and equipment as described in the sequence of operation and Siemens Network Connectivity Standards.

2.11 WORKSTATION OPERATOR INTERFACE

A. Basic Interface Description

1. Operator workstation interface software shall minimize operator training through the use of English language prompting, 30-character English language point identification, on-line help, and industry standard PC application software. Interface software shall simultaneously communicate with up to 4 Building Level Networks and share data between any of the 4 networks. The software shall provide, as a minimum, the following functionality:
 - a. Real-time graphical viewing and control of environment
 - b. Scheduling and override of building operations
 - c. Collection and analysis of historical data
 - d. Point database editing, storage and downloading of controller databases.
 - e. Alarm reporting, routing, messaging, and acknowledgment
 - f. Display dynamic data trend plot.
 - g. Must be able to run multiple plots simultaneously
 - h. Each plot must be capable of supporting 10 pts/plot minimum
 - i. Must be able to command points directly off dynamic trend plot application.

- j. Definition and construction of dynamic color graphic displays.
 - k. Program editing
 - l. Transfer trend data to 3rd party software
 - m. Scheduling reports
 - n. Operator Activity Log
 - o. Open communications via OPC Server
 - p. Open communications via BACnet Client & Server
2. Use existing graphical user interface, which shall minimize the use of keyboard through the use of a mouse or similar pointing device and "point and click" approach to menu selection.
 3. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. Automation system software shall run on a Windows NT based 32 bit operating system. These Windows applications shall run simultaneously with the automation system software. The mouse or Alt-Tab keys shall be used to quickly select and switch between multiple applications. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line automation system alarms and monitoring information.
 4. Provide functionality such that any of the following may be performed simultaneously on-line, and in any combination, via user-sized windows. Operator shall be able to drag and drop information between applications, reducing the number of steps (i.e. Click on a point on the alarm screen and drag it to the dynamic trend graph application to initiate a dynamic trend).
 - a. Dynamic color graphics and graphic control
 - b. Alarm management, routing to designated locations, and customized messages
 - c. Year in advance event and report scheduling
 - d. Dynamic trend data definition and presentation
 - e. Graphic definition and construction
 - f. Program and point database editing on-line.
 5. Report and alarm printing shall be accomplished via Windows Print Manager, allowing use of network printers.
 6. Operator specific password access protection shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as deemed appropriate for each user, based upon an assigned password. Operator privileges shall "follow" the operator to any workstation logged onto (up to 999 user accounts shall be supported).
 7. Reports shall be generated on demand or via pre-defined schedule and directed to CRT displays, printers or disk. As a minimum, the system shall allow the user to easily obtain the following types of reports:
 - a. A general listing of all or selected points in the network
 - b. List of all points currently in alarm
 - c. List of all points currently in override status
 - d. List of all disabled points
 - e. List of all points currently locked out

- f. List of user accounts and access levels
 - g. List all weekly schedules
 - h. List of holiday programming
 - i. List of limits and dead bands
 - j. Custom reports from 3rd party software
 - k. System diagnostic reports including, list of DDC panels on line and communicating, status of all DDC terminal unit device points
 - l. List of programs
- 8. Scheduling and override. Provide a calendar type format for simplification of time-of-day scheduling and overrides of building operations. Schedules reside in the PC workstation, DDC Controller, and HVAC Mechanical Equipment Controller to ensure time equipment scheduling when PC is off-line; PC is not required to execute time scheduling. Provide override access through menu selection or function key. Provide the following spreadsheet graphic types as a minimum:
 - a. Weekly schedules
 - b. Zone schedules, minimum of 200 unique zones
 - c. Scheduling for up to 365 days in advance
 - d. Schedule reports to print at PC
- 9. Collection and Analysis of Historical Data
 - a. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or change of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.
 - b. Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or predefined groups of at least six points. Provide additional functionality to allow predefined groups of up to 250 trended points to be easily transferred on-line to Microsoft Excel. DDC contractor shall provide custom designed spreadsheet reports for use by the owner to track energy usage and cost, equipment run times, equipment efficiency, and/or building environmental conditions. DDC contractor shall provide setup of custom reports including creation of data format templates for monthly or weekly reports.

B. Dynamic Color Graphic Displays

- 1. Create color graphic floor plan displays and system schematics for each piece of mechanical equipment, including air handling units, chilled water systems and hot water boiler systems, and room level terminal units, shall be provided by the automation system contractor as indicated in the point I/O schedule of this specification to optimize system performance, analysis and speed alarm recognition. Color selection to be coordinated with FMO Representative to minimize color deficiency conflicts.

2. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands. Graphics software shall permit the importing of AutoCAD or scanned pictures for use in the system.
3. Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention and without pre-defined screen refresh rates.
 - a. Sizable analog bars shall be available for monitor and control of analog values; high and low alarm limit settings shall be displayed on the analog scale. The user shall be able to "click and drag" the pointer to change the setpoint.
 - b. Provide the user the ability to display blocks of point data by defined point groups; alarm conditions shall be displayed by flashing point blocks.
 - c. Equipment state can be changed by clicking on the point block or graphic symbol and then selecting the new state (on/off) or setpoint.
 - d. State text for digital points can be defined up to eight characters.
4. Colors shall be used to indicate status and change as the status of the equipment changes. The state colors shall be user definable.
5. The windowing environment of the PC operator workstation shall allow the user to simultaneously view several applications at a time to analyze total building operation and to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress

C. System Configuration & Definition

1. Network wide control strategies shall not be restricted to a single DDC Controller or HVAC Mechanical Equipment controller, but shall be able to include data from any and all other network panels to allow the development of Global control strategies.
2. Provide automatic backup and restore of all DDC controller and HVAC Mechanical Equipment controller databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DDC Controller or HVAC Mechanical Equipment Controller. Changes made at the DDC Controllers or HVAC Mechanical Equipment Controllers shall be automatically uploaded to the workstation, ensuring system continuity.

D. Alarm Management

1. Alarm Routing shall allow the user to send alarm notification to selected printers or PC location based on time of day, alarm severity, or point type.
2. Alarm Notification shall be provided via two alarm icons, to distinguish between routine, maintenance type alarms and critical alarms. These alarm icons shall be displayed when user is working in other Windows programs. The automation system alarm display screen shall be displayed when the user clicks on the alarm icon.

3. Alarm Display shall list the alarms with highest priority at the top of the display. The alarm display shall provide selector buttons for display of the associated point graphic and message. The alarm display shall provide a mechanism for the operator to sort alarms.
4. Alarm messages shall be customizable for each point to display detailed instructions to the user regarding actions to take in the event of an alarm.

E. Summary

1. In summary, following the basic intent of the specifications above, the Siemens Apogee system shall be supplied with all advertised standard features of that software package and the Alerton ABS 3.1 system shall be supplied with all advertised standard features of that software package. The intent of the specification is not construed to eliminate either operator interface based upon the unique features that can be claimed for the respective product.

2.12 FIELD DEVICES

- A. Provide instrumentation as required for monitoring, control or optimization functions.

B. Temperature Sensors

1. Liquid immersion temperature
 - a. Temperature monitoring range -40/240°F
 - b. Output signal Changing resistance
 - c. Accuracy at Calibration point $\pm 0.5^\circ\text{F}$ ($\pm 0.3^\circ\text{C}$)

C. Liquid Differential Pressure Transmitter

1. Ranges As Needed
2. Output 4 – 20 mA DC
3. Calibration Adjustments Calibration Adjustments
4. Accuracy $\pm 0.2\%$ of span
5. Linearity $\pm 0.1\%$ of span
6. Hysteresis $\pm 0.05\%$ of span

D. Differential Pressure:

1. Unit for fluid flow proof shall be Penn P74

Range	8 to 70 psi
Differential	3 psi
Maximum differential pressure	200 psi
Maximum pressure	325 psi
2. Unit for airflow shall be Siemens Building Technologies SW141.

Set point ranges:	0.5" WG to 1.0" WG (124.4 to 248.8 Pa)

1.0" WG to 12.0" WG (248.8 to 497.6 Pa)

E. Pressure to Current Transducer

1. Range	3 to 15 psig (21 to 103 kPa)
2. Output Signal	4 – 20 mA
3. Accuracy	± 1% of full scale (± 0.3 psig)

F. Damper Actuators

1. Electric control shall be Siemens Building Technologies OpenAir™ direct-coupled actuators direct-coupled actuators or Belimo equivalent.
2. Damper actuators shall be brushless DC Motor Technology with stall protection, bi-directional, fail safe spring return, all metal housing, manual override, independently adjustable dual auxiliary switch.
 - a. The actuator assembly shall include the necessary hardware and proper mounting and connection to a standard ½" diameter shaft or damper blade.
3. Actuators shall be designed for mounting directly to the damper shaft without the need for connecting linkages.
4. All actuators having more than 100 lb-in torque output shall have a self-centering damper shaft clamp that guarantees concentric alignment of the actuator's output coupling with the damper shaft. The self-centering clamp shall have a pair of opposed "v" shaped toothed cradles; each having two rows of teeth to maximize holding strength. A single clamping bolt shall simultaneously drive both cradles into contact with the damper shaft. Utilize friction-enhancing tape on shafts that do not provide flats for contact lock.
5. All actuators having more than a 100 in-lb torque output shall accept a 1" diameter shaft directly, without the need for auxiliary adapters.
6. All actuators shall be designed and manufactured using ISO900 registered procedures, and shall be listed under Standards UL873 and CSA22.2 No. 24-93 I.

2.13 MISCELLANEOUS DEVICES

A. Thermostats

1. Room thermostats shall be of the gradual acting type with adjustable sensitivity.
2. They shall have a bi-metal sensing element capable of responding to a temperature change of one-tenth of one degree. (Provide all thermostats with limit stops to limit adjustments as required.)
3. Thermostats shall be arranged for either horizontal or vertical mounting.
4. In the vertical position thermostat shall fit on a mullion of movable partitions without overlap.
5. Mount the thermostat covers with tamper-proof socket head screws.

B. Low Temperature Safeties: (Freezestats)

1. Install freezestats as indicated on the plans.
 - a. Upon detection of low temperature, the freezestats shall stop the associated supply fans and return the automatic dampers to their normal position. Provide manual reset.
 - 1) Primary contact on freezestat will control will control 120V power supplied to the AHU fan starters. Both the supply and return fans shall be disabled when the freezestat contact switch opens.
 - 2) The same 120V power shall energize a 24V transformer that provides low-voltage power to the OA, RA and EA, economizer dampers for that AHU. A separate 24V transformer must be provided for each AHU, which provides power only for these dampers. The OA, and EA economizer dampers shall be spring loaded Normally Closed, and RA damper shall be spring loaded Normally Open. The auxiliary contact from the freeze-stat shall be connected to the EMS DI point.
 - b. Provide input point to automation system for monitoring.
 - c. Installation to incorporate a serviceable testing loop that allows for insertion of element loop into a 4-inch throat vessel for calibration.

C. Smoke Detectors:

1. Provided and installed by others.
2. Sensor Probes
 - a. Sensor probes shall be constructed of gold anodized, 6063 aluminum alloy tube [insert 316 stainless steel tube in lieu of 6063 aluminum alloy tube, when required].
 - b. Sensor probe mounting brackets shall be constructed of 304 stainless steel.
 - c. Probe internal wiring between the connecting cable and sensor nodes shall be Kynar coated copper.
 - 1) PVC jacketed internal wiring is not acceptable.
 - d. Probe internal wiring connections shall consist of solder joints and spot welds.
 - 1) Connectors of any type within the probe are not acceptable.
 - 2) Printed circuit boards within the probe are not acceptable.
 - e. Probe internal wiring connections shall be sealed and protected from the elements and suitable for direct exposure to water.
 - f. Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/CL2P, UL/cUL Listed cable rated for exposures from -67°F to 392°F and continuous and direct UV exposure.
 - 1) Plenum rated PVC jacket cables are not acceptable.

- g. Each sensor probe cable shall be provided with a connector plug with gold plated pins for connection to the transmitter.
- h. Each sensor probe shall contain one or more independently wired sensing nodes.
- i. Sensor node airflow and temperature calibration data shall be stored in a serial memory chip in the cable connecting plug and not require matching or adjustments to the transmitter.
- j. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy.

- 1) Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.

- k. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
- l. Each sensor node shall be individually calibrated to NIST-traceable airflow standards at a minimum of 16 calibration points.
- m. The number of independent sensor nodes provided shall be as follows:

Area ft ²	# Sensor Nodes	Area ft ²	# Sensor Nodes
≤ 0.5	1	> 4 & ≤ 8	8
> 0.5 & ≤ 1	2	> 8 & ≤ 12	12
> 1 & ≤ 2	4	> 12 & ≤ 14	14
> 2 & ≤ 4	6	> 14	16

- 1) A total of 4 probes shall be required for openings with an aspect ratio ≤ 1.5 and with an area ≥ 25 ft².

3. Transmitter

- a. A remotely located microprocessor-based transmitter shall be provided for each measurement location.
- b. The transmitter shall be comprised of a main circuit board and interchangeable interface card.
- c. All printed circuit board interconnects, edge fingers, and test points shall be gold plated.
- d. All printed circuit boards shall be electroless nickel immersion gold (ENIG) plated.
- e. All receptacle plug pins shall be gold plated.
- f. The transmitter shall be capable of determining the average airflow rate and temperature of the sensor nodes.

- 1) Separate integration buffers shall be provided for display airflow output, airflow signal output (analog and network) and individual sensor output (IR-interface).

- g. The transmitter shall be capable of providing a high and/or low airflow alarm.
- h. The transmitter shall be capable of identifying an AMD malfunction via the system status alarm and ignore any sensor node that is in a fault condition.

- i. The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.
 - 1) The airflow rate, temperature, airflow alarm and system status alarm shall be visible on the display.
 - j. The transmitter shall be provided with two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals and [select one or both of the following]
 - 1) one isolated RS-485 (field selectable BACnet MS/TP or Modbus RTU) network connection; or
 - 2) one isolated Ethernet (simultaneously supported BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection.
 - k. Analog output signals shall provide the total airflow rate and be field configurable to output one of the following:
 - 1) temperature
 - 2) airflow alarm; or
 - 3) system status alarm
 - l. Network communications shall provide the average airflow rate, temperature, airflow alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures.
 - m. Provide an infra-red I/O card mounted on the transmitter PCB for communication to a handheld retrieval device that can download individual sensor node airflow and temperature data in real time.
 - n. The transmitter shall be powered by 24 VAC and use a switching power supply that is over-current and over-voltage protected.
 - o. The transmitter shall use a "watchdog" timer circuit to ensure continuous operation in the event of brown-out and/or power failure.
4. Performance
- a. Each sensing node shall have a temperature accuracy of $\pm 0.15^{\circ}$ F over an operating range of -20° F to 160° F.
 - 1) Listings and Certifications
 - b. The AMD shall be UL873 Listed as an assembly.
 - 1) Devices claiming compliance with the UL Listing based on individual UL component listing are not acceptable.
 - c. The AMD shall be BTL Listed.
 - d. The AMD shall carry the CE Mark for European Union Shipments.

D. Current Sensing Relay:

1. Provide solid-state, adjustable, current operated relay. Provide a relay, which changes switch contact state in response to an adjustable set point value of current in the monitored A/C circuit.
2. Adjust the relay switch point so that the relay responds to motor operation under load as an "on" state and so that the relay responds to an unloaded running motor as an "off" state. A motor with a broken belt is considered an unloaded motor.
3. Provide for status device for all fans and pumps.

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

- A. Provide a designated project manager who will be responsible for the following:
 1. Provide Input to the GC's project schedule.
 2. Construct and maintain project schedule.
 3. On-site coordination with all applicable trades, subcontractors, and other integration vendors as pertaining to the automation system installation.
 4. Authorized to accept and execute orders or instructions from owner/architect.
 5. Attend project meetings as necessary to avoid conflicts and delays.
 6. Make necessary field decisions relating to this scope of work.
 7. Coordination/Single point of contact.
 8. Make changes to submittal documents for the automation system system that representative of the building As-Built final documents.

3.2 SEQUENCE OF OPERATION

- A. Refer to plans.

3.3 START-UP OF Automation system

- A. When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. The manufacturer shall complete all testing, calibrating, adjusting and final field tests. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power.
- B. Provide any recommendation for system modification in writing to owner. Do not make any system modification, including operating parameters and control settings, without prior approval of owner.
- C. Automation system contractor shall follow the manufacturer's recommended startup and commissioning guidelines and provide a commissioning report initialed by the startup technician that the equipment was installed and operational. This checklist will be included in the O&M manuals.

- D. Contractor shall provide a "96 hour Guaranteed Run" of automation system. The "Guarantee Run" shall commence after all field equipment is installed, calibrated, commissioned and running under normal operating conditions – temporary installation(s) are not allowed to be considered as part of the "Guarantee Run". The "Guarantee Run" shall precede the testing, adjusting and balancing of the mechanical systems.
- E. The "Guarantee Run" shall include performance of all the associated software and hardware operations called for in these specifications. The "Guarantee Run" shall be for 96 continuous hour's duration, which no Contractor maintenance shall be required. All major setpoints, measured variables and equipment status will be trended during the "Guarantee Run". A list of the trended points shall be submitted to the Universities designated FMO Representative for approval in advance of the "Guarantee Run".

3.4 BALANCING COORDINATION

- A. Automation system contractor shall be available to assist the testing, adjusting and balancing contractor up a total of 12 hours.
- B. At the pre-balance conference the automation system contractor shall provide the TAB contractor software necessary to interface to and operate the control system. The automation system contractor shall provide a complete point list of controlled elements and list of Terminal Equipment Controllers. (TEC)
- C. The automation system contractor shall instruct the TAB contractor how to update daily balancing settings.
 - 1. Weekly the automation system contractor shall verify these updates, during the TAB process.

3.5 ELECTRICAL INSTALLATION WIRING AND MATERIALS

- A. Install, connect and wire the items included under this Section. This work includes providing required conduit, wire, fittings, and related wiring accessories. All wiring shall be installed in a minimum of ¾" conduit. Room Temperature Sensor wiring may be interconnected to respective ASC in a ½" conduit.
- B. Provide wiring between thermostats, aquastats and unit heater motors, all control and alarm wiring for all control and alarm devices for all Sections of Specifications.
- C. Provide status function conduit and wiring for equipment covered under this Section.
- D. Provide conduit and wiring between the automation system panels and the temperature, humidity, or pressure sensing elements, including low voltage control wiring in conduit.
- E. Provide conduit and control wiring for devices specified in this Section.
- F. All wiring to be compliant to local building code and the NEC.

- G. Provide conduit and wiring between metering instrumentation, indicating devices, miscellaneous alarm points, remotely operated contactors, and automation system panels, as shown on the drawings or as specified.
- H. All electrical installation wiring and methods must comply with Division 16000 specifications.

3.6 PERFORMANCE

- A. Unless stated otherwise, control temperatures within plus or minus 2°F of set point, humidity within plus or minus 3% of the set point and static pressure within 5% of set point.

3.7 TRAINING

- A. Refer to Section 017700 for demonstration and training requirements.
- B. The manufacturer shall provide training by a qualified control technician who is familiar with the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The manufacturer shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 P.M. weekdays.
- C. Provide (8) hours of training for Owner's designated operating personnel. Training deliverables shall be coordinated with the FMO Representative and will include a combination of the following:
 - 1. Explanation of drawings, operations and maintenance manuals
 - 2. Walk-through of the job to locate control components
 - 3. Operator workstation and peripherals
 - 4. DDC controller and ASC operation/function
 - 5. Operator control functions including graphic generation and field panel programming
 - 6. Operation of portable operator's terminal
 - 7. Explanation of adjustment, calibration and replacement procedures
 - 8. Student binder with training modules
- D. Since the Owner requires personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Manufacturer. Each Major Capitol Project will include training for one University technician at a factory-training center. The training will be for one week typically, at the level needed to successfully operate the automation system controls supplied. The Owner will bear the cost of transportation and lodging for this class.

END OF SECTION 230900

SECTION 232100- HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. This section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Chilled-water piping.
 - 2. Condensate-drain piping.
 - 3. Air-vent piping.
 - 4. Safety-valve-inlet and -outlet piping.
- B. Related Sections include the following: Division 23, Section 232123, "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Chilled-Water Piping: 150 psig at 200°F.
 - 2. Makeup-Water Piping: 80 psig at 150 degrees F.
 - 3. Condensate-Drain Piping: 80 psig at 100 degrees F.
 - 4. Air-Vent Piping: 150 psig at 200°F.
 - 5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.4 SUBMITTALS

- A. Submit product data for metal pipe and tubing, with specification, class or type, and schedule.
 - 1. Valves. Include material data, pressure/temperature ratings, flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

2. Air control devices.
 3. Chemical treatment.
 4. Hydronic specialties.
- B. Welding certificates.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
 3. Systems operating above 150 psi must comply with ASME B31.1 or B31.3
- C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.
- D. Coordinate inspection work with owner designated welding inspector.
- E. Piping shall have identification affixed at factory with proper ASTM identification. Piping specialties, including valves, shall have the manufacturer's trademark, name and/or model number and pressure rating, where applicable, affixed to permanently identify the manufacturer of product.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type K or L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. Wrought-Copper Fittings: ASME B16.22.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company of America.
 - d. Stadler-Viega
 - e. Bronze Flanges and Flanged Fittings: ANSI/ASME B16.24.
3. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
4. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting.
5. Copper or Bronze Pressure-Seal Fittings:
 - a. Manufacturer: Subject to compliance with requirements, provide products manufactured by Stadler-Viega.
 - b. Housing: Copper.
 - c. O-Rings and Pipe Stops: EPDM.
 - d. Tools: Manufacturer's special tools.
 - e. Minimum 200-psig (1379-kPa) working-pressure rating at 250 degrees F (121 degree C.)

D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53 Grade B seamless or ERW, Schedule 40, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- F. Wrought Steel Butt Weld Fittings: ANSI/ASME B16.9 with same wall thickness as connecting piping.

- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Standardization: All mechanically coupled piping products shall be of one manufacturer
 - 2. Basis-of-Design size 2-1/2" to 24":
 - a. Anvil International, Inc.
 - 3. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 4. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. Submit gasket compatability data for glycol service.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Dielectric Fittings Two-inch and Smaller: Threaded dielectric union, ANSI/ASME B16.39.
- C. Dielectric Fittings 2-1/2-inch and Larger: Flanged union with dielectric gasket and bolt sleeves, ANSI/ASME B16.42.
- D. Insulating Material: Suitable for system fluid, pressure, and temperature.
- E. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company
 - b. Central Plastics Company
 - c. Hart Industries International, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division
 - 2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 degrees F.
- F. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company
 - b. Central Plastics Company
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- G. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company
 - d. Pipeline Seal and Insulator, Inc.
2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

2.5 VALVES

A. General Requirements For Valves:

1. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
2. Valve Sizes: Same as upstream piping unless otherwise indicated.
3. Valve Actuator Types:
 - a. Gear Actuator: For quarter-turn valves NPS 6 and larger.
 - b. Handwheel: For valves other than quarter-turn types.
 - c. Handlever: For quarter-turn valves NPS 4 and smaller.
 - d. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
4. Valves in Insulated Piping: With two-inch stem extensions and the following features:
 - a. Ball Valves: With extended operating handle of nonthermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - b. Butterfly Valves: With extended neck.
5. Valve-End Connections:
 - a. Flanged: With flanges according to ASME B16.1 for iron valves.
 - b. Grooved: With grooves according to AWWA C606.
 - c. Threaded: With threads according to ASME B1.20.1.
 - d. Valve Bypass and Drain Connections: MSS SP-45.

B. HVAC Water System Valves (Not Grooved-End)

1. General: Utilize the following valves for water-based systems, such as chilled water and heating water.
2. Shut-Off Valves 2" and Smaller: Ball type, ASTM B-61, ASTM B-62. Bronze body shall be ASTM B584 Alloy C84400. Two-piece body style, threaded ends, full port, ASTM 276 Type 316 stainless steel ball and stem, Teflon seats, adjustable packing, lever handle, blowout proof stem, 150 wsp, 600 wog.
 - a. Manufacturer:
 - 1) Apollo No. 77C-140
 - 2) Crane 9303-S
 - 3) Nibco No. T-585-70-66
3. Shutoff Valves 2-1/2" through 12": Butterfly type, full lug, ductile iron body, 400 series stainless steel stem, aluminum bronze disc, EPDM liner and seals, upper and lower stem bearing, blowout proof stem, extended neck for minimum 2" insulation, manufacturer recommended for bi-directional dead end service at full rated pressure without a downstream flange, sizes 2-1/2" through 4" shall be lever operated and 200 psi cwp; 6" through 12" shall be gear operated and 200 psi cwp; 14" and larger shall be gear operated and 150 psi cwp.
 - a. Manufacturer:
 - 1) Demco No. NEC-511
 - 2) Keystone No. HS-2
 - 3) Milwaukee No. CL Series
 - 4) NIBCO No. LD-2000
4. Globe Valves 2" and Smaller: Bronze body, teflon disc, integral seat, union bonnet, malleable iron handwheel, 150 wsp, 300 wog.
 - a. Manufacturer:
 - 1) Crane 7TF
 - 2) Hammond IB413T
 - 3) Milwaukee No. 590T
 - 4) NIBCO No. T-235-Y
 - 5) Red-White No. 221
 - 6) Stockham No. B-22
5. Globe Valves 2-1/2" and Larger: Cast iron body, bronze trim, bolted bonnet, screwed-in brass body seat ring, solid brass disc, bronze stem, flanged ends, 125 wsp, 200wog.
 - a. Manufacturer:
 - 1) Crane 351
 - 2) Hammond IR116
 - 3) Milwaukee No. F2981A

- 4) NIBCO No. F-718-B
 - 5) Red-White No. 400
 - 6) Stockham No. G-512
6. Swing Check Valves 2" and Smaller: Bronze body, swing check, Teflon disc and seat, 125 wsp, 200 wog.
 - a. Manufacturer:
 - 1) Hammond IB940
 - 2) Milwaukee No. 509-T
 - 3) NIBCO No. T-413-Y
 - 4) Red-White No. 236T
 - 5) Stockham No. B-320-T
7. Swing Check Valves 2-1/2" and Larger: Cast-iron body, horizontal swing check, bronze trim, with brass-faced disc, brass body seat ring, flanged pattern, 125 wsp, 200 wog.
 - a. Manufacturer:
 - 1) Crane 373
 - 2) Hammond IR1124
 - 3) Milwaukee No. F2974-A
 - 4) NIBCO No. F-918-B
 - 5) Red-White No. 435
 - 6) Stockham No. G-93
8. Pump Check Valves, Non-slam Type 2" and Larger: Wafer style, cast-iron body, bronze disc and seat, center guided, stainless steel spring and screws, 200 nonshock wog.
 - a. Manufacturer:
 - 1) Hammond IR9253
 - 2) Metraflex Style 700
 - 3) Milwaukee No. 1400
 - 4) NIBCO No. W-910-B
9. Pump Check Valves, Non-slam Type 2-1/2" and Larger: Flanged, cast-iron body, stainless steel disc and seat, center guided, stainless steel spring and screws, 200 nonshock wog.
 - a. Manufacturer:
 - 1) Hammond IR9354
 - 2) Metraflex CVO900-125-10-ss
 - 3) Milwaukee No. 1800
 - 4) NIBCO F-910-LF

C. Grooved-End HVAC Water System Valves:

1. General: At Contractor's option, the following valves may also be used for 2-1/2" and larger water-based systems, such as chilled water and heating water.
2. Ball Valves 2-1/2" to 3" Sizes: Ductile iron, two-piece body, grooved ends, standard port, type 316 stainless steel ball and stem, TFE seats, lever handle, blow out proof stem, 740 psi cwp.
 - a. Manufacturer:
 - 1) Anvil Gruvlok Series 7500
 - 2) Victaulic Series 726
3. Butterfly Valves 2-1/2" to 4": Ductile iron body, EPDM synthetic rubber encapsulated ductile iron disc with integrally cast stem, lever operated with 10-position throttling plate, manufacturer recommended for bi-directional dead end service at full rated pressure without a downstream flange, 300 psi cwp.
 - a. Manufacturer:
 - 1) Anvil Gruvlok Series 7700
 - 2) Nibco No. GD-4765-3
 - 3) Victaulic Vic®-300
4. Butterfly Valves 6" through 12": Ductile iron body, EPDM synthetic rubber encapsulated ductile iron disc with integrally cast stem, gear operated, manufacturer recommended for bi-directional dead end service at full rated pressure without a downstream flange, 300 psi cwp.
 - a. Manufacturer:
 - 1) Anvil Gruvlok Series 7700
 - 2) Nibco No. GD-4765-5
 - 3) Victaulic Vic®-300
5. Check Valves 2-1/2" and Larger: Ductile iron body, horizontal or vertical spring-assisted check, stainless steel spring and shaft, grooved pattern, 300 psi cwp.
 - a. Manufacturer:
 - 1) Anvil Gruvlok Series 7800
 - 2) Victaulic Series 716
6. Pump Check Valves 2-1/2" and Larger: Ductile iron body, horizontal or vertical spring-assisted check, stainless steel spring and shaft, grooved pattern 300 psi cwp.
 - a. Manufacturer:
 - 1) Anvil Gruvlok Series 7800

2) Victaulic Series 716

2.6 SPECIALTY VALVES AND ACCESSORIES

A. Combination Balancing/Shut-Off Valves:

1. Provide balancing valves at coils, at circulating pumps and elsewhere as shown.
Manufacturer: Nibco 1710, Armstrong "CBV" Circuit Balancing Valves, Bell & Gossett "Circuit Setter Plus" or Tour-Anderson Model STAD/STAS and STAF/STAG.
2. Meter: Balancing valve manufacturer shall provide one portable meter for reading differential pressure in feet head. Each meter connection shall have positive shutoff valves. Meter shall have liquid-filled pressure gauge.
3. Valves shall be globe body, flanged pattern and all metal parts of nonferrous, pressure die-cast, flow measurement; shall provide four functions:
 - a. Precise flow measurement
 - b. Precision flow balancing
 - c. Positive shut-off with no-drip seat and Teflon disc
 - d. Drain connection with protective cap.
4. Valves shall have four 360-degree adjustment turns of handwheel for maximum Vernier-type setting with "Hidden Memory" feature to program the valve with precision tamperproof balancing setting.

B. Balance Valves (Larger pipe sizes, balancing only):

1. Valves shall be globe body, flanged pattern and all metal parts of nonferrous, pressure die-cast, nonporous copper alloy. Valves shall be capable of installation in any direction without affecting flow measurement; shall provide four functions:
 - a. Precise flow measurement.
 - b. Precision flow balancing.
 - c. Positive shut-off with no-drip seat and Teflon disc, and
 - d. Drain connection with protective cap.
2. Valves shall have four 360°-adjustment turns of handwheel for maximum Vernier-Type setting with "Hidden Memory" feature to program the valve with precision tamperproof balancing setting.
3. Provide hand-wheel protective cover to prevent accumulation of dirt and over-painting during construction.
4. Manufacturer: Armstrong "CBV" Circuit Balancing Valves, Tour-Andersson Model STAD/STAS and STAF/STAG or Mepco MBVS.

C. Drain Valves 1/2" to 3/4" Sizes: Bronze ball valve, two-piece body, standard port, chrome plated brass ball, RPTFE seats, lever handle, blow out proof stem, threaded or

soldered with hose end, cap and chain, 150 psi wsp, 600 psi wog. Manufacturer: Milwaukee No. BA-100H or BA-150H.

D. Diaphragm-Operated Safety Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Bell & Gossett Domestic Pump; a division of ITT Industries
 - b. Conbraco Industries, Inc.
 - c. Spence Engineering Company, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: 316 SS, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.7 AIR CONTROL DEVICES

- A. Manual Air Vents: Compression-type, screwdriver-operated air cocks shall be furnished and installed where shown and where required for venting. Cocks shall be 1/4" in size and shall be all bronze construction.
1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Screwdriver or thumbscrew.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/8.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 225 degrees F.
 8. Manual Air Vents Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump; a division of ITT Industries
 - d. Taco
- B. Automatic Air Vents (High Pressure): Single lever float type, 250 psi, 300°F cast iron body, 1/2" or 3/4" pipe connection as indicated. Float and internal mechanisms shall

be stainless steel. Manufacturer: Hoffman No. 792, Armstrong No. 21 or approved Taco.

- C. Automatic Air Vents (Low-Pressure): Built-in serviceable check valve, all construction either brass or stainless steel.
1. Body: Bronze or cast iron.
 2. Internal Parts: Nonferrous.
 3. Operator: Noncorrosive metal float.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/4.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 240 degrees F.
 8. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hoffman No. 79 Low Pressure
 - b. Approved Taco, Amtrol, Bell & Gossett
 - c.

2.8 AIR SEPARATORS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Spirotherm – Spirovent
- B. Full flow coalescing type combination air eliminator and dirt separator shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet / outlet nozzles.
- C. Selection shall be based upon system flow with pipe size as a minimum. In no case shall entering velocity exceed 10 feet per second.
- D. Unit shall include internal structured elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. The elements must be fabricated by the manufacturer and consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.
- E. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.
- F. Units shall include a side tap valve to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.

2.9 PRESSURE AND TEMPERATURE TEST STATIONS

- A. Test Plugs: Provide 1/2" size, pressure and temperature type fitting constructed of solid brass with two valve cores of Nordel, suitable for 275°F at 500 psi. Each fitting shall include cap with gasket. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Peterson Equipment Co., "Pete's Plugs" or approved Sisco.
 2. Test Plugs in Insulated Piping: Pete's Plug "XL" Series or approved Sisco or Flow Design.
- B. Test Kit: Provide test kit consisting of 0–100 psi, 0–230 feet of water pressure gauge with gauge adapter attached, a 25–125°F pocket testing thermometer, a 0–220°F pocket testing thermometer and gauge adapter.

2.10 CHEMICAL TREATMENT

- A. Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions. Contractor shall provide all propylene glycol refilling as required during one-year guarantee period. Provide four sample kits and testing for quarterly evaluation of the glycol solution. Testing to be done by the glycol manufacturer or certified lab capable of evaluating glycol samples for proper mix and corrosion inhibitor concentration. Charge the following systems to the glycol concentrations by weight indicated on drawings.
1. Provide all necessary inhibitors or other additives required and recommended by the glycol manufacturer for use with ferrous and nonferrous metals.
 2. Provide glycol manufacturer's premixed glycol/water solution, in the required concentration. Water in premix solution shall be distilled or demineralized water.
 3. Test equipment for glycol shall be furnished and approved by the glycol manufacturer.
 4. Manufacturer: Dow, Dowfrost or approved equal.
- B. Glycol System Make-Up Package:
1. Provide a factory-packaged system for make-up for the glycol system. Tank and pump assembly must be suitable for installation to resist Seismic forces as required by the International Building Code, with minimum of four legs and feet drilled for bolting to floor.
 2. The packaged unit shall be designed to operate on standard 110VAC, 60 Hz electrical circuits and shall maintain a fill pressure of 10 to 50 psig.
 3. Unit shall include cut-off and alarm arrangement that will stop the pump in case of excessive pressure, or a low solution level, and activate an alarm contact. A 110 VAC signal shall be provided for a remote alarm.
 4. A translucent polyethylene solution container, complete with lid, shall be mounted on the pumping assembly and shall include a strainer and a shut off valve. Glycol solution recovery lines shall be piped in from the system relief valves and

other points as indicated to the solution container, through its lid in such a way that the lid can be removed for filling and mixing.

5. The pumping assembly shall be mounted in a sturdy steel frame with legs to keep it off the floor. It shall include a 1.8 gpm at 50 psi pump, a 1/3 HP motor, a magnetic starter, a pressure tank with a pressure control, a priming valve, a PRV, a shut-off valve, and a pressure gauge. The pumping assembly shall be connected to the system with a 1/2" NPT connection.

2.11 HYDRONIC PIPING SPECIALTIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mueller Steam Company
2. Armstrong Pump
3. Watts
4. Metraflex
5. Armstrong International, Inc.
6. Hoffman Specialty; Division of ITT Industries
7. Spence Engineering Company, Inc.
8. Spirax Sarco, Inc.
9. Bell & Gossett
10. Taco

- B. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection for flanged end units.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger; soldered ends above suspended ceilings NPS 2 and smaller.
3. Start-up Strainer Screen: 40-mesh startup strainer,
4. Operational Strainer Screens: 20 mesh stainless steel strainer 2" and smaller; 1/16" perforated monel or stainless-steel basket with 50 percent free area for 2-1/2" to 5"; 1/16" perforated monel or stainless-steel basket with 50 percent free area 6" and larger.
5. CWP Rating: 250 psig 2" and Smaller, 200 psig soldered end bodies, 125 psig 2-1/2" and larger.

- C. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger; soldered ends above suspended ceilings NPS 2 and smaller.
3. Start-up Strainer Screen: 40-mesh startup strainer,

4. Operational Strainer Screens: 20 mesh stainless steel strainer 2" and smaller; 1/16" perforated monel or stainless-steel basket with 50 percent free area for 2-1/2" to 5"; 1/16" perforated monel or stainless-steel basket with 50 percent free area 6" and larger.
 5. CWP Rating: 250 psig 2" and Smaller, 200 psig soldered end bodies, 125 psig 2-1/2" and larger.
- D. Flexible connectors are specified in Division 23, Section 230540, "Vibration and Seismic Controls for HVAC."
- E. Expansion fittings are specified in Division 23, Section 230500, "Common Work Results for HVAC."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Chilled-water piping, NPS 2 and smaller, shall be any of the following:
1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.
 2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Chilled-water piping, -1/2 and larger, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- C. Makeup-water piping shall be the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- D. Condensate-Drain Piping (cooling coil): Type M DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- E. Air-Vent Piping:
1. Inlet: Same as service where installed.
 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.2 VALVE APPLICATIONS

- A. Install ball or butterfly type shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install balancing valves in the return pipe of each heating or cooling terminal.
- C. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- D. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.
- E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings. The drawings do not show all required fittings and offsets that may be necessary to connect pipes to equipment and to coordinate with other trades. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected.
- B. Install components furnished under other sections, such as: Control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls and column lines. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Space piping, including insulation, to provide one-inch minimum clearance between adjacent piping and other surfaces.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.

- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- N. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded hose adapter with cap, at low points in piping system mains and elsewhere as required for system drainage. Drains are generally not shown on the drawings.
 - 1. Where piping is located in heated space, provide drain valves at all low points where more than three gallons of water could be trapped.
 - 2. Where piping is located in unheated space, including insulated piping with heat tracing, provide drain valves at all low points where any water could be trapped. In general, piping should be arranged to minimize the need for drain valves.
 - 3. Where drain valves are indicated on the drawings, extend piping as noted.
- O. Provide manual air vents at all high points in the piping systems where air might accumulate. Manual air vents are generally not shown on the drawings. Air vent valves shall be located in an accessible location and shall be positioned with discharge down such that a container can be held under the valve to receive liquid discharge. Provide tubing (same size as vent valve) from the top of the pipe to be vented to the accessible vent valve.
- P. Provide automatic air vents where indicated on the drawings. Discharge from automatic air vents shall be field-piped to the nearest floor drain with a one inch air gap.
- Q. Glycol systems: In glycol systems, pipe drain and vent valves (that are located in the same mechanical room) back to glycol mix tank, or glycol catch tank, do not discharge glycol to floors, floor drains or to outside.
- R. Locate and orient valves to permit proper operation and access for maintenance. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- S. Install unions or flanges in piping adjacent to valves, at final connections of equipment, and elsewhere as indicated. Offset equipment connections and carefully locate unions and flanges to allow for equipment removal and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with three-elbow swing joints or as noted on the drawings.

- T. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Strainers shall be installed line size, which shall mean the size of the inlet pipe shown on the drawings, not the reduced size serving the valve or equipment. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- U. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23, Section 230500, "Common Work Results for HVAC."
- V. Identify piping as specified in Division 23, Section 230550, "Identification for Piping and Equipment."
- W. Test plugs in insulated piping shall have stem length as determined by insulation thickness.
- X. Tee water piping runouts or branches into the side of mains or other branches. Where possible, do not use bull-head tees, which are two lines flowing into opposite ends of a tee and exiting out the common side.
- Y. Dielectric fittings shall be used at piping connections between copper and dissimilar metals at equipment or piping to protect from galvanic corrosion. Where dissimilar piping materials are separated by dielectric fittings the separation shall include isolation of pipe hangers by insulation, plastic coated hangers or support from a nonconductive structure.

3.4 HANGERS AND SUPPORTS

- A. Seismic restraints are specified in Division 23, Section 230540, "Vibration and Seismic Controls for HVAC."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, seven feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, seven feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, nine feet; minimum rod size, 3/8 inch.

4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
 9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
 10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
 11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, five feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, six feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/2: Maximum span, eight feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, eight feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, nine feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 3. Make up joint so only three threads show.

- G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Tighten flange bolts in accordance with gasket manufacturer's recommendations. Use full face gaskets and flat face flanges when connecting to equipment or valves with cast iron flat face flanges.
- I. Pressure-Sealed Joint: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- J. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- K. Flexible Connectors: The piping gap shall be equal to the length of the expansion joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000 psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the expansion joint rating without them. All flexible connectors shall be installed on the equipment side of the shut off valves.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a two percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- E. Install tangential air separator in pump suction. Install blowdown piping with full-port ball valve; extend full size to nearest floor drain.
- F. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

3.8 SYSTEM CLEANING

- A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
- C. Fill systems indicated to have glycol solutions with the following concentrations indicated on drawings.
- D. Preparation of Piping Systems:
 - 1. System shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system. Record capacity and include in Operation and Maintenance manuals.
 - 2. Make temporary piping connections; furnish temporary pumps, and temporary bypass filter as required to properly accomplish all cleaning operations.
 - 3. Place all manual and control valves serving coil banks and terminal control units in open position during cleaning so that circulation through the mains and runouts is obtained during cleaning.
- E. Piping System Cleaning Sequence: The services of a chemical treatment specialist shall be used for procedure and chemical selection.
 - 1. Qualified Contractors: Ashland Specialty Chemical, Garratt Callahan and the Nalco Company.
 - a. Company shall only utilize qualified personnel active in the field of water treatment who are factory trained or authorized.
 - b. A single water treatment company for undivided responsibility shall perform startup, system check, water samples, analysis, cleaning, flushing, and testing.
 - 2. Initial Flush, All Systems:
 - a. Completely fill the system with fresh water and circulate (1st filling).

- b. Initial flushing shall be sufficient to remove all contaminants such as cuttings, filings, loose rust & scale, welding and soldering residue and debris.
 - c. Drain the entire system, including dead legs, and refill with fresh water (2nd filling).
3. Closed Systems:
 - a. Add the recommended dosage of cleaning solution to the system, circulate and bring up to the recommended temperature.
 - b. Test solution for proper concentration and document results.
 - c. Circulate the solution for the time recommended by the manufacturer (4 hours minimum and not to exceed the manufacturer's maximum limit).
 - d. Partially close and reopen all manual valves several times.
 - e. Operate all automatic valves through several cycles.
 - f. Completely drain the entire system.
 - g. Fresh Water Flush: Refill the system with fresh water (3rd filling). Then, with circulation pump running:
 - 1) Open one or more drains as far downstream from the fill point as is possible. Be sure the makeup is sufficient to keep up with the drain so as to maintain a full system.
 - 2) Partially close and reopen all manual valves several times.
 - 3) Blowdown all strainer, dead legs and low points in the system.
 - 4) Operate all automatic valves through several cycles.
 - 5) Continue to flush the system in this manner until the drain water is of the same clarity as the makeup water and testing reveals no further traces of cleaning solution (minimum one hour). Document the results.
 - h. Following the fresh water flush, drain the entire system:
 - 1) Clean all strainers.
 - 2) Remove all startup strainers.
 - 3) Drain all dead legs.
 - i. Fill System (Glycol Systems):
 - 1) Fill system with specified glycol, water and chemicals.
 - 2) Glycol solution MUST BE ADDED WITHIN TWO HOURS after final draining of the system.
 - 3) The cleaning firm shall, upon completion of filling system with glycol solution, tag each system so that tag is plainly visible as follows: "CAUTION THIS SYSTEM HAS BEEN "CHARGED" WITH GLYCOL. DO NOT DILUTE SYSTEM WITH WATER OR DRAIN SYSTEM WITHOUT AUTHORIZATION."

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Provide temporary valving or cap piping at connections to existing systems as required to confine testing to the new piping systems.
5. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
6. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks. System must be proven to hold pressure for two hours.
7. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.

6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

3.10 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start-up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 232100

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 236423 Air-Cooled Scroll Water Chillers includes the chiller specification that will also include these pumps as part of a combined skid package.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Separately coupled, vertical, in-line centrifugal pumps.

1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.
- D. Submittals shall be approved prior to shipping from factory.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer, same as the chiller manufacturer and provided together as one package.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store skid, including pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Mechanical Seals: One mechanical seal for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 GENERAL

- A. Motors shall be matched to pump for non-overloading service at the design impeller diameter and full speed in variable speed applications.
- B. Motor size shall be as scheduled.

2.3 SEPARATELY COUPLED, VERTICAL, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers:
 - 1. Armstrong Pumps Inc.
 - 2. Taco, Inc.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for 125-psig minimum working pressure and a continuous water temperature of 200 deg F.
- C. Pump Construction:
 - 1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and flanged connections.
 - 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance. Contractor shall provide pump impellor to supplier for re-trimming or replacement for system balancing.
 - 3. Pump Shaft: Stainless steel.
 - 4. Mechanical Seal: Non-potable, Type AT-70 outside balanced seal design and rated to 200°F maximum
 - 5. Pump Bearings: Permanently lubricated ball bearings.
 - 6. Each pump shall be guaranteed to circulate not less than the specified quantity of water against the specified circulating head when operating continuously without overheating the motor or bearings, etc. and without producing noise, audible anywhere in the building, outside of the space in which the pumps are installed. Quiet operation is mandatory.
- D. Shaft Coupling: Rigid spacer type, high tensile aluminum.

- E. Motor: Single speed, with ball bearings, unless otherwise indicated; rigidly mounted to pump casing with lifting eye and supporting lugs in motor enclosure. Comply with requirements in Division 23 Section "Common Work Results for HVAC".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Pumps shall be mounted on a steel factory skid with the chiller.

3.3 PUMP INSTALLATION

- A. Comply with applicable standard HI 1.4 or HI 2.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Support vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use heavy duty factory supplied baseplate feet to attached to the pump flanges to support the pump weight from the skid.
- E. Non-isolated Pumps: Mount pump and motor on heavy structural steel baseplate having a sufficient grout volume with adequately sized grout holes. Grout entire base with nonshrinking grout. Align pump and driver after grouting is completed. After alignment, pin pump and driver to base with taper pins, three pins minimum for each pump and driver. A flexible coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor, and it shall be equipped with a suitable coupling guard.

3.4 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.
- C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation and HI 2.1-2.5, "Vertical Pumps for Nomenclature, Definitions, Application and Operation."
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts and verify pump alignment.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install non-slam type spring check valve and shut-off valve on discharge side of pumps.
- F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- G. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.
- H. Install check valve and gate or ball valve on each condensate pump unit discharge.
- I. Install electrical connections for power, controls, and devices.
- J. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- K. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.6 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to startup of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 232123

SECTION 235700 -PLATE HEAT EXCHANGERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes plate heat exchangers.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Design Calculations: Calculate requirements for selecting seismic restraints and for designing bases.
 - 2. Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Manufacturer Seismic Qualification Certification: Submit certification that heat exchanger, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, performance, and dimensional requirements of heat exchangers and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."
- B. ASME Compliance: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 GASKETED PLATE HEAT EXCHANGERS

- A. Manufacturers:
1. Alfa Laval Thermal, Inc.
 2. Armstrong Pumps, Inc.
 3. Tranter PHE, Inc.
 4. TACO, Inc.
- B. Configuration: Freestanding assembly consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets.
- C. Frame:
1. Capacity to accommodate 32 percent additional plates.
 2. Painted SA 516 Gr. 70 carbon steel with provisions for anchoring to support.
- D. Top and Bottom Carrying and Guide Bars: Painted carbon steel, or stainless steel.

1. Fabricate attachment of heat-exchanger carrying and guide bars with reinforcement strong enough to resist heat-exchanger movement during a seismic event when heat-exchanger carrying and guide bars are anchored to building structure.
- E. End-Plate Material: Painted carbon steel.
- F. Tie Rods and Nuts: Steel or stainless steel.
- G. Plate Material: 0.5 mm thick, AISI 304 stainless steel.
- H. Gasket Material: NBR HT.
- I. Piping Connections:
 1. Threaded port for NPS 2 and smaller. For larger sizes, furnish end-plate port with threaded studs suitable for flanged connection.
- J. Enclose plates in a solid stainless-steel removable shroud.
- K. Capacity and Characteristics:
 1. Scheduled on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HEAT-EXCHANGER INSTALLATION

- A. Install heat exchangers on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC".
- B. Concrete Bases: Anchor heat exchanger to concrete base.
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections.
- B. Maintain manufacturer's recommended clearances for service and maintenance. Install piping connections to allow service and maintenance of heat exchangers.
- C. Install shutoff valves at heat-exchanger inlet and outlet connections.
- D. Install relief valves on heat-exchanger hot fluid connection and install pipe relief valves, full size of valve connection, to storage container.
- E. Install vacuum breaker at heat-exchanger steam inlet connection.
- F. Install hose end valve to drain shell.

3.4 FIELD QUALITY CONTROL

- A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain heat exchangers. Refer to Division 01 Section "Demonstration and Training."

3.7 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.

- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 235700

SECTION 236423- AIR-COOLED, SCROLL WATER CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 232123 Hydronic Pumps includes a specification for the pumps that are part of the chiller skid package.

1.2 SUMMARY

- A. Section includes packaged, air-cooled, electric-motor-driven, scroll water chillers.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- C. DDC: Direct digital control.
- D. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in Btu/h to the total power input given in watts at any given set of rating conditions.
- E. GFI: Ground fault interrupt.
- F. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.
- G. I/O: Input/output.
- H. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.
- I. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and intended for operating conditions other than the AHRI standard rating conditions.
- J. SCCR: Short-circuit current rating.

- K. TEAO: Totally enclosed air over.
- L. TENV: Totally enclosed nonventilating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include refrigerant, rated capacities, operating characteristics, and furnished specialties and accessories.
 - 2. Performance at AHRI standard conditions and at conditions indicated.
 - 3. Performance at AHRI standard unloading conditions.
 - 4. Minimum evaporator flow rate.
 - 5. Refrigerant capacity of water chiller.
 - 6. Oil capacity of water chiller.
 - 7. Fluid capacity of evaporator.
 - 8. Characteristics of safety relief valves.
 - 9. Force and moment capacity of each piping connection.
- B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:
 - 1. Assembled unit dimensions.
 - 2. Weight and load distribution.
 - 3. Required clearances for maintenance and operation.
 - 4. Size and location of piping and wiring connections.
 - 5. Diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings:
 - 1. Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - a. Structural supports.
 - b. Piping roughing-in requirements.
 - c. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
 - d. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.
 - 2. Coordination drawings showing plan, section and elevation views, drawn to scale.
 - 3. Each view to show screened background with the following:
 - a. Column grids, beams, columns, and concrete housekeeping pads.
 - b. Layout with walls, floors, and roofs, including each room name and number.

- c. Equipment and products of other trades that are located in vicinity of chillers and part of final installation, such as plumbing systems.
 - B. Certificates: For certification required in "Quality Assurance" Article.
 - C. Seismic Qualification Data: Certificates, for water chillers, accessories, and components, from manufacturers.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - D. Installation instructions.
 - E. Source quality-control reports.
 - F. Startup service reports.
 - G. Sample Warranty: For special warranty.
- 1.6 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.
 - B. Spare Parts List: Recommended spare parts list with quantity for each.
 - C. Touchup Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.
 - D. Instructional Videos: Including those that are prerecorded and those that are recorded during training.
- 1.7 MAINTENANCE MATERIAL SUBMITTALS
- A. Tool kit to include the following:
 - 1. A tool kit specially designed by chiller manufacturer for use in servicing chiller(s) furnished.
 - 2. Special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance.
 - 3. Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Chiller Tool Kit." Text size shall be at least 1 inch (25 mm) high.
 - 4. A list of each tool furnished. Permanently attach the list to underside of case cover. Text size shall be at least 1/2 inch (13 mm) high.

- B. Touchup Paint: 32 oz. (1 L) container of paint used for finish coat. Label outside of container with detailed description of paint to allow for procurement of a matching paint in the future.

1.8 QUALITY ASSURANCE

- A. AHRI Certification: Certify chiller according to AHRI 590 certification program.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.
- B. Package water chiller for export shipping.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified warranty period.
 - 1. Extended warranties include, but are not limited to, the following:
 - a. Complete chiller including refrigerant and oil charge.
 - b. Complete compressor and drive assembly including refrigerant and oil charge.
 - c. Refrigerant and oil charge.
 - 1) Loss of refrigerant charge for any reason due to manufacturer's product defect and product installation.
 - d. Parts and labor.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Scroll water chillers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Component Importance Factor: 1.0.

- B. Site Altitude: Chiller shall be suitable for altitude at which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.
- C. Performance Tolerance: Comply with the following in lieu of AHRI 550/590:
 - 1. Allowable Capacity Tolerance: Zero percent.
 - 2. Allowable Full-Load Energy Efficiency Tolerance: Zero percent.
 - 3. Allowable Part-Load Energy Efficiency Tolerance: Zero percent.
- D. AHRI Rating: Rate water chiller performance according to requirements in AHRI 550/590.
- E. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.
- F. IECC Compliance: Applicable requirements in IECC, Chapter 4 - "Commercial Energy Efficiency".
- G. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.
- H. Comply with NFPA 70.
- I. Comply with requirements of UL 1995, "Heating and Cooling Equipment," and include label by a qualified testing agency showing compliance.
- J. Operation Following Loss of Normal Power:
 - 1. Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to backup power system shall automatically return equipment and associated controls to the operating state occurring immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a backup power source, or through normal power if restored before backup power is brought on-line.
 - 2. See drawings for equipment served by backup power systems.
 - 3. Provide means and methods required to satisfy requirement even if not explicitly indicated.

2.2 MANUFACTURERS

- A. Daikin
- B. Modine-Jetson
- C. Trane

2.3 MANUFACTURED UNITS

- A. Description: Factory-assembled and run-tested split system water chiller complete with compressor(s), compressor motors and motor controllers, evaporator, electrical power, controls, and indicated accessories, suitable for installation inside the mechanical room. The condenser with fans assembly is to be provided for remote installation outside.
- B. Fabricate water chiller mounting base with reinforcement strong enough to resist water chiller movement during a seismic event when water chiller is anchored to field support structure.
- C. Sound-reduction package shall have the following:
 - 1. Acoustic enclosure around compressors.
 - 2. Reduced-speed fans with acoustic treatment.
 - 3. Designed to reduce sound level without affecting performance.
- D. Security Package: Security grilles with fasteners for additional protection of compressors, evaporator, and condenser coils. Grilles shall be coated for corrosion resistance and shall be removable for service access.

2.4 CABINET

- A. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
- B. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
- C. Casing: Galvanized steel.
- D. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B117.

2.5 COMPRESSOR-DRIVE ASSEMBLIES

- A. Compressors:
 - 1. Description: Positive-displacement direct drive with hermetically sealed casing.
 - 2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
 - a. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in lieu of each compressor.
 - 3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
 - 4. Capacity Control: On-off compressor cycling, plus hot-gas bypass.

- a. Digital compressor unloading is an acceptable alternative to achieve capacity control.
- 5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug or removable magnet in sump, and initial oil charge.
 - a. Manufacturer's other standard methods of providing positive lubrication are acceptable in lieu of an automatic pump.
- 6. Vibration Isolation: Mount individual compressors on vibration isolators.
 - a. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in lieu of each compressor.
- B. Compressor Motors:
 - 1. Hermetically sealed and cooled by refrigerant suction gas.
 - 2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.
- C. Compressor Motor Controllers:
 - 1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

2.6 REFRIGERATION

- A. Refrigerant: R-32 or R-454B. Classified as Safety Group A2L according to ASHRAE 34.
- B. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
- C. Refrigerant Circuit: Each circuit shall include an electronic-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
- D. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.
 - 1. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in each circuit in lieu of each compressor.
- E. Pressure Relief Device:
 - 1. Comply with requirements in ASHRAE 15, ASHRAE 147, and applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

2. Select and configure pressure relief devices to protect against corrosion and inadvertent release of refrigerant.
3. ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger.

2.7 EVAPORATOR

- A. Brazed-plate or shell-and-tube design, as indicated.
- B. Shell and Tube:
 1. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.
 2. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
 3. Shell Material: Carbon steel.
 4. Shell Heads: Removable carbon-steel heads with multipass baffles designed to ensure positive oil return and located at each end of the tube bundle.
 5. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping. Furnish flange adapters to mate to flanged piping.
 6. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
- C. Brazed Plate:
 1. Direct-expansion, single-pass, brazed-plate design.
 2. Type 316 stainless-steel construction.
 3. Code Compliance: Tested according to ASME Boiler and Pressure Vessel Code.
 4. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping. Furnish flange adapters to mate to flanged piping.
 5. Inlet Strainer: Factory-furnished, 20-mesh strainer for field installation in supply piping to evaporator. Manufacturer has option to factory install strainer.
- D. Flow Switch: Factory-furnished and installed, thermal-type flow switch wired to chiller operating controls.
- E. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F (minus 29 deg C).

2.8 AIR-COOLED CONDENSER

- A. Chiller to be provided with integral air cooled condenser.
- B. Description: Factory assembled and tested; consisting of casing, condenser coils, condenser fans and motors, and unit controls.
- C. Condenser Coil: Seamless copper-tube, finned coil; factory tested at 425 psig.

1. Coil Fin: Aluminum.
 2. Coil Coating: None.
 3. Circuit: To match compressors..
 4. Refrigerant Accessories: Provide receiver, pressure control, and solenoid valve for each circuit.
- D. Condenser Fans and Drives: Propeller fans with aluminum fan blades, for vertical air discharge; directly driven with permanently lubricated ball bearing motors with integral current- and thermal-overload protection.
- E. Operating and Safety Controls: Include condenser fan motor thermal and overload cutouts; 115-V control transformer, if required; magnetic contactors for condenser fan motors and a nonfused factory-mounted and -wired disconnect switch for single external electrical power connection.
- F. Unit Casings: Galvanized or zinc-coated steel treated and finished with manufacturer's standard paint coating, designed for outdoor installation with weather protection for components and controls, and with the following:
1. Removable panels for access to controls, condenser fans, motors, and drives.
 2. Plated-steel fan guards.
 3. Lifting eyes.
 4. Removable legs.
- G. Coil(s) with integral subcooling on each circuit.
- H. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- I. Fan Guards: Removable steel safety guards with corrosion-resistant PVC coating.

2.9 INSULATION

- A. Closed-cell, flexible, elastomeric thermal insulation complying with ASTM C534/C534M, Type I for tubular materials and Type II for sheet materials.
1. Thickness: 1-1/2 inches (38 mm).
- B. Adhesive: As recommended by insulation manufacturer.
- C. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.
1. Apply adhesive to 100 percent of insulation contact surface.
 2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
 3. Seal seams and joints to provide a vapor barrier.

4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.
5. Manufacturer has option to factory or field insulate chiller components to reduce potential for damage during installation.
6. Field-Applied Insulation:
 - a. Components that are not factory insulated shall be field insulated to comply with requirements indicated.
 - b. Manufacturer shall be responsible for chiller insulation whether factory or field installed to ensure that manufacturer is the single point of responsibility for chillers.
 - c. Manufacturer's factory-authorized service representative shall instruct and supervise installation of field-applied insulation.
 - d. After field-applied insulation is complete, paint insulation to match factory-applied finish.

2.10 ELECTRICAL

- A. Factory installed and wired, and functionally tested at factory before shipment.
- B. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
- C. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
- D. Wiring shall be numbered and color-coded to match wiring diagram.
- E. Factory wiring shall be located outside of an enclosure in a metal raceway. Terminal connections shall be made with not more than a 24-inch (610-mm) length of liquid tight or flexible metallic conduit.
- F. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch. Minimum SCCR according to UL 508 shall be as required by electrical power distribution system, but not less than 65,000 A.
- G. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:
 1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 2. NEMA KS 1, heavy-duty, nonfusible switch.
 3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- H. Each motor shall have overcurrent protection.

- I. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
- J. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
- K. Controls Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
- L. Control Relays: Auxiliary and adjustable time-delay relays, or an integral to water chiller microprocessor.
- M. Service Receptacle:
 - 1. Unit-mounted, 120-V GFI duplex receptacle.
 - 2. Power receptacle from chiller internal electrical power wiring.
- N. Indicate the following for water chiller electrical power supply:
 - 1. Current, phase to phase, for all three phases.
 - 2. Voltage, phase to phase and phase to neutral for all three phases.
 - 3. Three-phase real power (kilowatts).
 - 4. Three-phase reactive power (kilovolt amperes reactive).
 - 5. Power factor.
 - 6. Running log of total power versus time (kilowatt hours).
 - 7. Fault log, with time and date of each.

2.11 CONTROLS

- A. Factory installed and wired, and functionally tested at factory before shipment.
- B. Standalone, microprocessor based, with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.
- C. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
- D. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, digital display. Display the following:
 - 1. Date and time.
 - 2. Operating or alarm status.
 - 3. Operating hours.
 - 4. Outside-air temperature if required for chilled-water reset.
 - 5. Temperature and pressure of operating set points.
 - 6. Chilled-water entering and leaving temperatures.
 - 7. Refrigerant pressures in evaporator and condenser.
 - 8. Saturation temperature in evaporator and condenser.
 - 9. No cooling load condition.
 - 10. Elapsed time meter (compressor run status).
 - 11. Pump status.

12. Antirecycling timer status.
 13. Percent of maximum motor amperage.
 14. Current-limit set point.
 15. Number of compressor starts.
 16. Alarm history with retention of operational data before unit shutdown.
 17. Superheat.
- E. Control Functions:
1. Manual or automatic startup and shutdown time schedule.
 2. Capacity control based on evaporator leaving-fluid temperature.
 3. Capacity control compensated by rate of change of evaporator entering-fluid temperature.
 4. Chilled-water entering and leaving temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on return-water temperature.
 5. Pump enable/disable.
 6. Pump speed.
 7. Current limit and demand limit.
 8. Condenser-water temperature.
 9. External water chiller emergency stop.
 10. Antirecycling timer.
 11. Automatic lead-lag switching.
 12. Ice-building mode.
- F. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:
1. Low evaporator pressure or high condenser pressure.
 2. Low chilled-water temperature.
 3. Refrigerant high pressure.
 4. High or low oil pressure.
 5. High oil temperature.
 6. Loss of chilled-water flow.
 7. Loss of condenser-water flow.
 8. Control device failure.
- G. BAS System Interface: Factory-install hardware and software to enable system to monitor, control, and display chiller status and alarms.
1. Hardwired I/O Points:
 - a. Monitoring: On/off status, common trouble.
 - b. Control: On/off operation, chilled-water discharge temperature set-point adjustment.
 2. Communication Interface: ASHRAE 135 (BACnet) communication interface shall enable control system operator to remotely control and monitor the water chiller from an operator workstation. Control features and monitoring points displayed

locally at water chiller control panel shall be available through DDC system for HVAC.

- H. Factory-installed wiring outside of enclosures shall be in NFPA 70-complaint raceway. Make terminal connections with liquid tight or flexible metallic conduit.

2.12 ACCESSORIES

- A. Factory-furnished spring isolators with seismic restraints for field installation.
 - 1. Spring Deflection: 2 inches (50 mm).

2.13 CAPACITIES AND CHARACTERISTICS

- A. Capacity: per equipment schedule on drawings.
- B. Full-Load Efficiency:
 - 1. COP: per equipment schedule on drawings.
 - 2. EER: per equipment schedule on drawings.
 - 3. Power Input/Cooling Output, kW/Ton: per equipment schedule on drawings.
- C. Part-Load Efficiency:
 - 1. IPLV: per equipment schedule on drawings.
 - 2. NPLV: per equipment schedule on drawings.
- D. Low Ambient Operation: Chiller designed for operation as per equipment schedule on drawings.
- E. High Ambient Operation: Chiller designed for operation as per equipment schedule on drawings.
- F. Evaporator:
 - 1. Type: per equipment schedule on drawings.
 - 2. Pressure Rating: per equipment schedule on drawings.
 - 3. Fluid Type: per equipment schedule on drawings.
 - 4. Design Fluid Flow Rate: per equipment schedule on drawings.
 - 5. Minimum Fluid Flow Rate: per equipment schedule on drawings.
 - 6. Entering-Fluid Temperature: per equipment schedule on drawings.
 - 7. Leaving-Fluid Temperature: per equipment schedule on drawings.
 - 8. Fluid Pressure Drop: per equipment schedule on drawings.
 - 9. Fouling Factor: per equipment schedule on drawings.
- G. Condenser Entering-Air Temperature: per equipment schedule on drawings.
- H. Site Altitude: per equipment schedule on drawings.

- I. Number of Refrigeration Circuits: Two.
- J. Compressor Rated Load Amperes: per equipment schedule on drawings.
- K. Compressor Locked-Rotor Amperes: per equipment schedule on drawings.
- L. Controls Power Connection: Fed through integral transformer.
- M. Chiller Power Input: per equipment schedule on drawings.
- N. Chiller Minimum Circuit Ampacity: per equipment schedule on drawings.
- O. Chiller Maximum Overcurrent Protection Device: per equipment schedule on drawings.
- P. Chiller Electrical Characteristics: per equipment schedule on drawings.
- Q. Noise Rating: per equipment schedule on drawings when measured according to AHRI 370.

2.14 MATERIALS

- A. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
 - 1. Manufacturer's standard grade for casing.
 - 2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.

2.15 SOURCE QUALITY CONTROL

- A. Perform functional test of water chillers before shipping.
- B. Factory performance test water chillers, before shipping, according to AHRI 550/590.
 - 1. Test the following conditions:
 - a. Design conditions indicated.
 - b. AHRI 550/590 part-load points.

2. Allow Owner or owner's representative access to place where water chillers are being tested. Notify Owner or owner's representative 14 days in advance of testing.
- C. Factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.
- D. For water chillers located outdoors, rate sound power level according to AHRI 370 procedure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.
 1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

Commented [TH1]: Pump skid comment

3.2 WATER CHILLER INSTALLATION

- A. Coordinate sizes and locations of bases with actual equipment provided. Cast anchor-bolt inserts into concrete bases.
- B. Equipment Mounting:
 1. Install water chillers on existing concrete pad.
 2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230540 "Vibration and Seismic Controls for HVAC."
- C. Install pump skid in between chillers that contains both integral pumps. Install skid per manufacturer's specifications.
- D. Maintain manufacturer's recommended clearances for service and maintenance.
- E. Maintain clearances required by governing code.
- F. Chiller manufacturer's factory-trained service personnel shall charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.
- G. Install separate devices furnished by manufacturer and not factory installed.

1. Chillers shipped in multiple major assemblies shall be field assembled by chiller manufacturer's factory-trained service personnel.

3.3 PIPING CONNECTIONS

- A. Comply with requirements in Section 232100 "Hydronic Piping" Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to chillers, allow space for service and maintenance.
- C. Evaporator Fluid Connections:
 1. Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage.
 2. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve.
 3. Make connections to water chiller with a flange or mechanical coupling.
- D. Connect each drain connection with a drain valve, full size of drain connection. Connect drain pipe to drain valve with union and extend drain pipe to terminate over floor drain.
- E. Connect each chiller vent connection with an automatic vent, full size of vent connection.

3.4 ELECTRICAL POWER CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch (13 mm) high. Locate nameplate where easily visible.
- D. Chiller will be supplied with single point power connection for chiller and pump.

3.5 CONTROLS CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Chiller will control integral pump.

- C. Connect control wiring between chillers and other equipment to interlock operation as required to provide a complete and functioning system.
- D. Connect control wiring between chiller control interface and automation system for remote monitoring and control of chillers. Comply with requirements in Section 230900 "Instrumentation and Control Systems".
- E. Provide nameplate on face of chiller control panel indicating control equipment designation serving chiller and the I/O point designation for each control connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch (13 mm) high.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
 - 2. Verify that pumps are installed and functional.
 - 3. Verify that thermometers and gages are installed.
 - 4. Operate water chiller for run-in period.
 - 5. Check bearing lubrication and oil levels.
 - 6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
 - 7. Verify proper motor rotation.
 - 8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
 - 9. Verify and record performance of chilled water flow and low-temperature interlocks.
 - 10. ~~Verify and record performance of water chiller protection devices.~~
 - 11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- D. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.
- E. Prepare a written startup report that records results of tests and inspections.

Commented [TH2]: Flow switch

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers.

1. Instructor shall be factory trained and certified.
2. Provide not less than eight hours of training.
3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
5. Obtain Owner sign-off that training is complete.
6. Owner training shall be held at Project site.

END OF SECTION 236423.13

SECTION 260500 - COMMON WORK RESULTS**PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. Refer to Division 01 for submittal requirements and formats.
- B. Refer to University of Idaho published standards and specifications, including but not limited to:
 - 1. Structured Cabling Standard v2.3

1.2 OUTLINE OF WORK

- A. Scope: The work under this division includes furnishing all materials, equipment, labor, supervision, tools and items necessary for the construction, installation, connection, testing and operation of all electrical work for this project as shown on the Electrical Drawings and/or defined in Division 26 of the specifications.
- B. Contract Requirements: Comply with the requirements of the General Conditions, the Supplementary Conditions, and Division 01 as they apply to the work in this section. Comply with the requirements of the other specification divisions that have additional requirements for this work as referenced under Division 26 sections. Comply with requirements of the Buy American Act.
- C. Related Work Described Elsewhere: Where other divisions require electrical materials or installations under this division of the specifications, comply with all applicable requirements herein. Provide all electrical materials and installation work required to connect, test and operate equipment described in other divisions of these specifications as shown on the Electrical Drawings or specified hereinafter. Electrical installations required by other divisions but not shown on the Electrical Drawings or specifically called out in this division of the specifications shall be provided by the trade requiring the electrical work.
- D. Itemized Schedule of Costs: Furnish a contract cost breakdown by specification section to the Architect with a copy to the Engineer to allow evaluation of partial payment requests. Refer to Division 01 for requirements.
- E. Warranty: The Contractor shall guarantee all work installed under this specification and make good, repair or replace at his own expense, any defective work, materials or parts within the warranty period, if, in the opinion of the Architect, said defect is due to imperfection in material, design or workmanship. The warranty period shall be in accordance with Division 01 but not less than one year. Lamps are not warranted but all shall be operating at time of final acceptance. Warranty shall be submitted in writing as required in Division 01.

1.3 REGULATIONS

- A. Federal Regulations & Requirements: Federal procurement and construction materials standards will apply including compliance with the Buy American Act. Contractor shall verify all proposed materials and equipment meet Buy American requirements prior to submitting for engineer approval.
- B. Codes and Ordinances: Comply with all applicable codes, ordinances and regulations including the National Electrical Code, the Washington Administrative Code, National Electrical Safety Code, WISHA, NFPA, and all other national, state and local codes and ordinances. Notify the Architect of any non-compliance in contract documents to applicable codes and regulations prior to installation of the work. Changes in the work after initial installation due to requirements of code enforcing agencies shall be at no additional cost to the Owner.
- C. Permits: Provide and pay for all permits and fees required for this project. In addition to paying for all permits and fees, the Contractor shall be responsible for contacting the various Approving Authorities, arranging for review of shop drawings where appropriate, scheduling inspections in a timely manner, and making necessary corrections as required by the Approving Authorities.
- D. Approving Authority: It is the Contractor's responsibility to ascertain and contact the appropriate "Approving Authorities" for this project. Approving Authorities will include, but not be limited to the local Fire Marshal and the local authority having jurisdiction.
- E. Certificate of Inspection: Obtain a Certificate of Electrical Inspection from the local inspecting authority indicating final acceptance. Submit to the Owner upon completion of the project as part of project closeout.
- F. Safety Measures to be Taken: The Architect and Engineer have not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the Contractor to perform his work. The Contractor will be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. The duty of the Architect and Engineer to conduct construction observations of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures, in, on or near the construction site. It shall be the Contractor's responsibility to comply with "Safety and Health Regulations for Construction," Volume 36, No. 75, Part II of the Federal Register by the U.S. Department of Labor. Contractor shall be responsible for providing all such safety measures and shall consult with the state or federal safety inspector for interpretation whenever in doubt as to whether safe conditions do or do not exist or whether he is or is not in compliance all with state or federal regulations.

1.4 DRAWINGS AND SPECIFICATIONS

- A. Intent: The Electrical Drawings and specifications are intended to include all labor and materials necessary to provide a complete and operating facility. Any materials shown and called for on the drawings but not mentioned in the specifications, or vice versa, which are necessary for the proper completion of the installation or operation of the equipment, shall be furnished the same as if specifically called for in both. By submitting a bid, the Contractor is acknowledging that he has made a thorough examination of the contract documents, existing site conditions, and has determined that these documents and conditions do sufficiently describe the scope of construction work required under this contract. Any questions regarding interpretation of the contract documents shall be made in writing in a timely manner prior to the bid date to allow reasonable time for resolution of the questions.
- B. Diagrammatic Drawings: The Electrical Drawings are diagrammatic and do not show exact or complete raceway and wiring configurations, routing, rating or the necessary number and types of raceway fittings, junction boxes and pull boxes. Provide all labor and materials required to execute the work specified herein or described on the Electrical Drawings.
- C. Any minor changes (less than 6'-6" horizontal or vertical) in the location of the raceways, outlets, boxes, devices, wiring, etc., from those shown on the drawings shall be made without extra charge, where coordination requires or if so directed by the Architect prior to rough-in.

1.5 SUBMITTALS AND SHOP DRAWINGS

- A. Submittals, General: All equipment must be submitted for review prior to installation. Provide submittals in accordance with Division 01. The remaining instructions in this paragraph are intended to supplement and amplify the requirements of Division 01. Bind submittals in three-ring binder. Open catalog sheets will not be accepted. Shop drawings shall consist of one reproducible drawing and a maximum of four blueprint sets. Index to the applicable specification section with a transmittal letter bound as the first sheet. Provide an index with each section of equipment indicating exact catalog numbers of products provided. In addition, identify the specific products by catalog number within the submittal documents. Submittals will not be accepted unless they conform to these requirements.

- B. Shop Drawings: Provide shop drawings, descriptive bulletins, data sheets, diagrams, catalog cuts or other additional information as required for all specified materials including the following:

	Submittal Number	Date Reviewed
Raceways and Fittings	_____	_____
600-Volt Wire and Cable	_____	_____
Outlet, Junction and Pullboxes	_____	_____
Wiring Devices	_____	_____
Electrical Identification	_____	_____
Lighting Controls	_____	_____
Motor Controls & Misc. Equipment Connections	_____	_____
Disconnect Switches	_____	_____
Fuses	_____	_____
Grounding	_____	_____
Panelboards	_____	_____
Transient Voltage Surge Suppressors	_____	_____
Lighting	_____	_____
Telecommunications System	_____	_____

- C. Submittal Format: Submittals must be sent in complete "sets," including all specified material. Submission of individual materials will not be accepted.
- D. Review: The review of a manufacturer's name or product by the Architect does not relieve the Contractor of the responsibility for providing materials and equipment which comply in all details with the requirements of the contract documents. Contractor shall be solely responsible for submitting materials at such a time to allow a minimum of two weeks for Engineer's review.
- E. It is the Contractor's responsibility to thoroughly review vendor-assembled shop drawings, catalog cuts, etc. to ensure that these documents are complete and comply with the specifications. If this coordination effort is not done, the Architect reserves the right to reject the complete submittal without review. To ensure compliance with the Architect's review comments and communication of these comments through the Contractor and supplier to the manufacturer, all corrections to shop drawings shall be done by the manufacturer and resubmitted as requested by the Architect. "Local" mark-ups of the manufacturer's shop drawings will not be accepted.

1.6 OPERATIONS AND MAINTENANCE MANUALS

- A. Provide operations and maintenance manuals for all electrical equipment installed on this project in accordance with Division 01.
- B. Items described shall include, but not be limited to, the equipment listed under "Shop Drawings" in this division of the specifications. Provide table of contents at front of manual indicating general content of each section. Provide index for each section of the manual with complete equipment catalog item or identification.

- C. The information and diagrams included must be on the specific equipment installed for this project. General "product line" information is not acceptable. The equipment model and catalog numbers with appropriate prefixes and suffixes must be clearly indicated on the data sheets. Manuals shall contain shop drawings, schematic and wiring diagrams (showing all external connections), parts lists, operating and maintenance information. Any modifications to equipment in the field shall be updated on the drawings, diagrams, etc., to reflect the "as-built" conditions.
- D. Binding: Bind with three-screw post-type binder with heavy-duty hardboard cover and cloth backing. Imprint edge of volume with name of the building, year of completion and the words "Electrical Equipment." Front of manual shall be imprinted with the words "Electrical Equipment" the name of the project, the name of the Owner, year completed, name of the Architect, Engineer and Contractor. All printing in gold lettering. If the thickness of the manual exceeds approximately 2", provide separate volumes, each approximately 2" thick with each volume imprinted as described above and with the addition of the volume number. The back edge shall be imprinted with the name of the project, name of the Owner and year of completion.
- E. Provide one preliminary copy to the Commissioning Authority for review 30 days prior to scheduled training or project completion, whichever is first. One preliminary copy shall be submitted to the Engineer for review 30 days prior to completion of the project. Placeholders are to be used for information that is not available at the time of draft manual submission. Preliminary copy shall include proposed wording for cover and back edge of the manual. Submit final bound copies for distribution as required by Division 01.

1.7 RECORD DRAWINGS

- A. Maintained on Site: A record shall be made during the progress of the project indicating the work as actually installed. Corrections and changes shall be kept up to date at all times on a separate set of record drawings kept at the job site for review by the Architect. Mark-ups may be schematic as related to interior raceway systems, however, all raceways shall be shown in proper relationship with junction boxes, panelboards, devices, and equipment. Raceways installed below grade shall be shown with both horizontal and vertical dimensions at an accuracy of ± 6 inches.
- B. Project Closeout: Provide one set of prints indicating work as revised, detailed and actually installed, and submit to the Architect as part of the Project Closeout documentation. Panel schedules and fixture/equipment schedules shall also be updated.
- C. Additional Record Drawings: Refer to Signal and Communication Systems section for additional record drawing requirements. AutoCAD production requirements also apply to all signal and communications system drawings.

1.8 CONSTRUCTION SCHEDULING AND SEQUENCING

- A. Construction will occur in numerous phases. At the completion of each phase the electrical systems shall be tested and the Owner trained in the use of the systems. Refer to Architectural Drawings and the specifications for construction schedules and sequencing requirements.

1.9 ABBREVIATIONS AND DEFINITIONS

- A. Provide: To furnish and install.
- B. Wiring: Raceway, conductors and connections.
- C. Exposed: Visible from occupied areas.
- D. Install: To set in position and make fully operational.
- E. Furnish: Purchase and deliver to the job site.
- F. Required: As required by code, authority having jurisdiction or contract documents for the system and/or installation to be fully operational.

PART 2 – PRODUCTS

2.1 STANDARD OF QUALITY

- A. General: Whenever any material or equipment is specified by patent or proprietary name or by the name of the manufacturer, such specification shall establish the standard of quality in that particular field of manufacture. The Architect shall be the sole and final judge as to quality and acceptability of substitutions, no exceptions.
- B. Substitutions:
 - 1. Unless otherwise noted on the drawings or other sections of the specifications, the Contractor may offer material or equipment with equal or better qualities than those specified. Reference is made particularly to Instructions to Bidders related to prior approval requirements.
 - 2. When the substitute equipment or material necessitates revisions to the plans or involves other trades, the Contractor shall include drawings and details showing all such changes, and coordinate and assume any liability and costs from the affected trades. Also, if a change required engineering or mechanical services or other equipment modifications, these services shall be billable to the Contractor.

2.2 PRODUCT LISTING OR LABELING

- A. All electrical equipment and materials shall have Underwriters' Laboratories, Inc., or other approved testing facility label whenever published standards exist. Equipment in compliance with UL standards but not bearing their label is not acceptable. If the manufacturer cannot arrange for labeling of an assembled unit at the factory, the necessary inspection and acceptance by the testing facility shall be performed in the field at no additional cost to the Owner, and be acceptable to the authority having jurisdiction.

PART 3 – EXECUTION

3.1 GENERAL

- A. All materials shall be new, free from defects and arrive at the job site in original unopened containers.

3.2 MATERIAL STORAGE

- A. Make all necessary provisions for storing materials and equipment at site so as to insure the quality and fitness of the items to be incorporated in the work. Equipment shall be stored to prevent damage and corrosion.

3.3 WORKMANSHIP AND COORDINATION

- A. General: Workmanship shall be the best quality as recognized by the electrical construction industry and satisfactory to the Owner and Architect. Remove and replace lesser quality work as directed at no additional cost to the Owner. The Architect, or his designated representative, shall be the judge of the required quality of workmanship.
- B. Work of Other Trades: The Electrical Drawings do not show complete details of the building construction. Refer to the Architectural, Structural, Civil Landscape and Mechanical Drawings for those details which may affect the execution of this work. Specific locations of construction features shall be obtained from the reference drawings, field measurements, or the trade providing the material or equipment. No extra payments will be allowed for failure to obtain this information.
- C. The Contractor will not be paid for work requiring reinstallation due to lack of coordination prior to installation i.e., removing, replacing, relocating, cutting, patching or finishing. Special attention is called to the following items and all conflicts shall be coordinated prior to installation:

1. Light switches will be located on the "strike" side of the door.
 2. All electrical outlets, lighting fixtures, signal and communications devices, and other electrical devices and equipment are installed to avoid conflict with grilles, pipes, sprinkler heads, ducts and other mechanical equipment.
 3. Electrical outlets, lighting fixtures, signal and communications devices and equipment are to be installed in proper relation to cabinets, counters, doors and other Architectural appurtenances.
 4. Electrical characteristics (HP, KVA, voltage, phase, fusing, overload protection) of actual equipment furnished under other divisions being different from that shown on the electrical drawings.
- D. Cooperation: Plan and execute work in cooperation with all other trades and utility companies. Every reasonable effort shall be made to provide all concerned with timely notice of work affecting other trades, and to prevent conflicts or interference as to space requirements, dimensions, openings, block-outs, sleeving or other matters which will cause delays or necessitate work-around methods.
- E. General Construction:
1. Cutting and Patching: Provide all cutting, demolition and patching required for the installation of the electrical work on this project. Patching shall be accomplished by utilizing the general construction trades normally providing materials and labor needed for restoration of floor, ceiling or walls. Penetrations through existing structural walls, ceiling or floor slabs shall be core drilled. Spillage from core drilling shall be contained by diking, vacuuming and covering with protective plastic sheeting as required. In no case shall structural members be penetrated without prior approval of the Architect. After installation of raceways, provide approved fire sealing materials to close spaces around raceways.
 2. Sleeves and openings required through floors and walls for electrical work shall be the responsibility of the Contractor. This work shall be carefully coordinated with the General Contractor and other trades involved. All openings around conduits in sleeves shall be sealed with a material of equal fire rating as the material penetrated.
 3. Painting: Touch up electrical equipment with factory finished surfaces as required using factory furnished paint. Coordinate field painting requirements with the Architect prior to final trim and cover installation. Do not paint screw heads, hinges, nameplates, hardware, etc. All surface-mounted raceways in finished areas will be painted as directed under the "Painting" division of the specifications. Coordinate timing of installation to minimize conflicts with painting requirements.
 4. Cleaning: Promptly remove waste material and rubbish resulting from electrical work. Prior to energizing equipment, remove all chipping materials, construction dirt and debris, vacuum and wipe-down all internal areas. At completion of the project, clean all equipment and fixtures installed under this Contract.
 5. All penetrations through building roofing shall be flashed by a qualified roofing contractor normally in the business of commercial roofing. Flashing shall be in accordance with NRCA standard practices.

6. No penetrations shall occur in beams with internal pre-stressed cable design or concrete floor slabs with pre-stressed cabling will be allowed without prior written analysis by a structural engineer.
7. Prevent spillage during hauling operations. In case of spills (including trenching materials) clean streets, walkways, courtyards, etc. by means of proper sweepers or other approved methods.
8. Owner dumpsters shall not be used by the contractor.

F. Existing Conditions:

1. General: Specific scope of demolition work and operating conditions to be encountered shall be verified by on-site review prior to submitting bid. Demolition work in general is noted or shown on the documents based upon available "drawings of record" and may not show the actual conditions as they presently exist. The Contractor shall be responsible for removing or modifying the existing electrical installation as required by the building alterations. The Contractor shall be responsible for protection of existing equipment and wiring to be retained or reinstalled and shall replace any equipment damaged during the process of removal and reinstallation.
2. Owner Retained Equipment: The Owner may wish to retain certain specific items scheduled for demolition. The Contractor shall carefully remove these items, provide protection and packaging as may be required to protect the equipment and turn over said equipment to the Owner at a place designated on the jobsite. Any equipment that the Owner does not desire to retain shall become the property of the Contractor and be removed from the site.
3. Existing Conduit and Wiring: No existing conduit or wiring shall be reused.
4. Unused Conduit and Wiring: All unused conductors in existing buildings shall be removed. All unused conduit shall be removed except where located in or above existing construction which is not being altered and would require removal and replacement of the existing construction.

G. Continuity of Service to and In Existing Building:

1. Continuity of Service: The Contractor shall temporarily reroute or relocate existing wiring and/or equipment which is in conflict with existing building alterations and which is required to be maintained in use during construction. The Contractor's bid shall include intercepting and relocating existing raceways in 20 different locations throughout the facility. Each location shall be assumed to have four ¾" EMT raceways (100 L.F. each), each containing seven AWG conductors which must be intercepted and relocated.
2. Premium Pay: Any overtime work required by this project to maintain the facility in continuous service without reducing its efficiency shall be included as a part of this contract. No additional payments will be authorized for work performed on weekends, holidays or other-than-normal working hours.

3.4 REMOVAL AND REPLACEMENT OF EXISTING MATERIAL:

1. Ceiling Panels: Remove and reinstall all necessary panels in existing accessible ceilings, as required for the installation of electrical work. Where existing ceiling panels are damaged, they shall be replaced with new units. After ceiling removal and reinstallation is complete, the ceiling system appearance shall match adjacent similar ceilings that have not been removed.
2. Work Caused by Removal and Reinstallation of Existing Material: Existing electrical work which is to be removed and reinstalled as a result of the installation of work by other trades shall be performed by the Electrical Contractor at no additional expense to the Owner.
3. Existing fluorescent fixture ballasts to be removed may contain PCB's and are to be treated as hazard materials. Removal and disposal of these fixtures are to comply with all local, state, and federal agency requirements. Provide documentation as required by the regulating agency as proof of proper disposal.
4. Openings in walls and floors resulting from removal of conduits and/or devices are to be patched with materials equivalent to adjacent surfaces. Materials used for patching shall maintain the fire rating of the existing area.

3.5 MISCELLANEOUS

A. Equipment Anchorage, Support and Bracing:

1. General: Provide complete seismic anchorage and bracing for the lateral and vertical support of conduit and electrical equipment, as required by the Uniform Building Code.
2. Conduit Crossing Structural Separations: Conduit that crosses structural or seismic separations between building units shall be installed with flexible connections, suitable to accommodate longitudinal and transverse displacements. Secure raceways each side of joint and provide minimum of 36" length flexible conduit between building units.

B. Phase Relationship: Maintain consistent phase relationship and rotation throughout the project. Check and identify proper rotation of equipment prior to energizing said equipment.

C. Housekeeping Pads: Coordinate size and location of housekeeping pads for all floor-mounted electrical equipment. Pads shall be 4 inches thick (nominal) x 2 inches larger than plan view dimensions of equipment. Provide 1-inch x 1-inch chamfer at top edges of pads.

3.6 CONSTRUCTION OBSERVATION AND FINAL ACCEPTANCE

- A. Site Review: On-site meetings or reviews of construction by the Architect, Engineer or Owner shall not be construed as acceptance by these parties as related to quantities, rough-in locations, and compliance with code enforcing authorities unless specific exceptions have been brought to the attention of the Architect or Engineer and have been accepted in writing.
- B. Testing: The Contractor shall test all wiring and all electrical equipment to verify absence of grounds and short circuits and verify proper operation, rotation, and phase relationship. Contractor will be responsible for scheduling of tests and demonstrations at times mutually acceptable to the Owner. All equipment shall be demonstrated to operate in accordance with the requirements of this specification and the manufacturer's recommendations. Operate every device manually and automatically in accordance with its purpose. Tests shall be performed in the presence of the Owner or his designated representative. All instruments and personnel required to conduct the test shall be provided by the Contractor. Any test not witnessed by the Owner shall be waived by written document. All such documents must become the property of the Owner upon completion of construction.
- C. Commissioning:
 - 1. Selected equipment and systems are to be commissioned per Section 019100 "General Commissioning Requirements" and Section 260816 "Commissioning for Electrical Systems." The contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.
 - 2. Provide copies of all start up documents for systems being commissioned to the Commissioning Authority prior to start of commissioning testing.
 - 3. Provide assistance to the Mechanical Contractor and Commissioning Agent as specified in Section 019113 "General Commissioning and Section 230816 "Commissioning of Mechanical Support Sections."
- D. Instruction for Owner's Personnel:
 - 1. Scope: Following initial operation of all electrical equipment and prior to acceptance of the electrical work, conduct demonstrations of equipment operation and instruction periods for the Owner's representatives.
 - 2. Initial Instruction Periods: Shall include preliminary discussion and presentation of information from maintenance manuals with appropriate references to drawings, followed by tours of equipment spaces explaining maintenance requirements, access methods, servicing and maintenance procedures, settings and available system and equipment adjustments.
 - 3. Final Instruction Periods: 30 days after the initial instruction, a second instruction period shall be scheduled. The format and duration of the instruction periods shall be identical to the initial instruction periods.

4. Contractor's representatives, in general, who conduct these instructions and demonstrations shall be qualified foremen or superintendents acquainted with this project and from the trade involved. For major equipment, the representative shall be the manufacturer's representatives with operating experience and substantial design experience on this project. Their qualifications shall be submitted to the Architect and Engineer before conducting the instruction period.
5. Minimum Duration of Instruction Periods:
 - a. Electrical Distribution System: 4 Hours
 - b. Lighting System: 4 hours
 - c. Signal and Communications Systems: 4 Hours each
 - d. Refer to other section of the specification for additional testing requirements.
6. Scheduling of Instruction Periods: Provide notice of Contractor's readiness to conduct such instruction and demonstration periods to the Owner at least two weeks prior to each instruction period and reach agreement on the date of each instruction period.
7. Attendance sheets shall be filled out for each training session listing all participants. Copies of the attendance sheets shall be provided to the Commissioning Authority.
8. Prepare a written statement of acceptance for the Owner's signature. The statement shall be substantially as follows:
 "I (the Contractor), the associated factory representatives and the subcontractor, have thoroughly tested each of the following systems and have proved their normal operation to the Owner's representative and have instructed him in the operation and maintenance thereof."

<u>Owner's System</u>	<u>Demonstrator</u>	<u>Representative</u>	<u>Date</u>
Electrical Distribution	_____	_____	
Lighting	_____	_____	_____
_____	_____	_____	
_____	_____	_____	
Representatives	Date	_____	Owner's
_____	_____	_____	
Date		_____	Contractor

9. Send copies of this acceptance to the Architect and the Engineer and place one copy in each maintenance manual.

- E. Completion of Work: When requesting final inspection, provide ten-day notice. Submit written certifications that the work has been fully completed in strict accordance with the plans and specifications.
- F. Final Documentation: See STA General Conditions. All manuals, test results, and acceptances by the inspecting authorities shall be included in this final documentation.

END OF SECTION 260500

SECTION 260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Division 01 and Division 26 General Requirements for submittal requirements and formats.

1.2 SCOPE

- A. Provide all wire and cable required for electrical systems being installed.
- B. Federal procurement and construction materials standards will apply including compliance with the Buy American Act.

1.3 SUBMITTALS

- A. Product Data: Submit for each of the products provided. Contractor shall verify Buy American compliance prior to submitting for engineer approval.

PART 2 – PRODUCTS

2.1 PROHIBITED MATERIALS:

- A. Type MC cable, similar to Armor Cable and like material.

2.2 MATERIALS

- A. All wiring shall be Copper and be rated at 600 volts. Aluminum is acceptable for feeders rated 100 amps or larger.
- B. Wire sizes 12 and 10 shall be solid, Type THHN, Wire sizes 8 and larger shall be stranded, type THW, THHN/THWN. Minimum wire size shall be 12 AWG, unless noted otherwise.
- C. Pre-manufactured fixture whips may be used to connect recessed light fixtures in accessible ceilings.
- D. Minimum Conductor Size:

1. Neutral: #10 AWG (#12 AWG minimum for dedicated neutrals and lighting circuits).
2. Ground: #12 AWG.

E. Molded connectors with metal thread-on core shall be used for splicing 12 and 10 wire.

F. Stranded cable shall be connected to lugs using mechanical connectors and shall be wrapped with electrical tape to a thickness equal to the wire insulation connecting block.

G. Splices: For #8 and larger conductors, use molded insulated connector splice block.

2.3 MANUFACTURER

A. American Insulated Wire Corp, General Cable, Rome, Southwire, or approved equal.

2.4 TERMINATIONS AND SPLICES

A. Provide insulated screw-on type connectors on lighting and receptacle branch circuit splices; Ideal Wingnut or equal. Self-stripping crimp-pressure-type connectors such as Scotchlock 500 series are not approved. Insulated ring-tongue compression-type terminals (Burndy or T&B) for motor and equipment terminations; hydraulically set compression lugs for terminations at panel and switchboard busses; and Cadweld exothermic type for grounding systems.

B. Below-grade splices shall be made in handholes and shall be made watertight with epoxy resin type splicing kits. Scotchcast or equal.

2.5 SIGNAL AND COMMUNICATIONS WIRING

A. All signal and communications wiring is included in the appropriate signal and communications system specification sections.

2.6 CABLE TIES

A. Shall be Thomas & Betts "Ty-Rap." Provide in switchboards, wireways, panelboards, relay panels and other enclosures to neatly group and lace electrical conductors.

2.7 WIRE PULLING COMPOUND

A. Manufacturer: Ideal "Aqua-Gel II" or equal.

PART 3 – EXECUTION

3.1 BRANCH CIRCUITS

- A. Branch circuits shall be no. 12 AWG minimum, color-coded as listed below. Homeruns greater than 100 feet to first outlet shall be No. 10 minimum. Use no mechanical means for pulling wire. Make no splices in home runs. Wiring from separate raceway systems shall not be intermixed in common junction boxes. Wiring shown in separate raceway systems shall not be combined unless specifically approved by the engineer.
- B. All circuits shall have separate neutrals. No shared neutrals will be allowed.
- C. Provide separate ground bonding conductor full length inside all conduit.
- D. Where more than three current carrying conductor are installed in a single raceway, the minmum wire size shall be increased to comply with NEC 310-16, Note 8.

3.2 FEEDERS

- A. Feeders shall be sized as shown on the drawings and color-coded in accordance with list below. Make no splices unless shown on the plans or specifically approved by the Architect's representative.
- B. Provide separate ground bonding conductor full length inside all conduit.

3.3 COLOR CODING REQUIREMENTS

- A. 120/208-volt, 3-phase, 4-wire systems or 120/240-volt, 3-phase, 4-wire systems:

Phase A	black
Phase B	red
Phase C	blue
Neutral	white
Ground	green
Isolated ground	green with yellow stripe
Travelers	yellow (for 3- and 4-way switching)

- B. 277/480-volt, 3-phase, 4-wire systems:

Phase A	brown
Phase B	orange
Phase C	yellow
Neutral	grey
Ground	green
Travelers	lavender

- C. Color-coded tape may be used in lieu of color-coded insulation for conductors No. 6 AWG and larger. However, when color-coded tape is used, the conductor insulation shall be black only, and shall be taped at all terminations and junction boxes with color scheme shown above for entire length of exposed conductor. All control wiring shall be black with wire numbers on each conductor at each termination point. Wiring diagrams shall have corresponding wire numbers indicated thereon.

- D. System Cabling Type and Color Standards

System	Type	Color
EMS System	Plenum	White
Lighting Controls and Occupancy Sensor	As Required	Orange
Security System	As Secified in Section 280500	Yellow
Data Cat 5e	Non-Plenum Plenum	Blue White
Intercom System	Non-Plenum Plenum	Gray Gray

- E. Color coding shall be approved by the inspecting authority.

3.4 SPLICES AND TERMINATIONS

- A. Lighting and receptacle branch circuit conductors up to No. 10 AWG shall be spliced with wing nut type connectors. Motor connections using wiring No. 8 AWG and larger shall be made with crimp-type sleeves or lugs insulated with heat shrink tubing. Feeders shall not be spliced, except in special situations after engineer approval.

3.5 PHASE BALANCING

- A. Contractor shall check load on each phase at each panel and service equipment, and make the necessary circuit adjustment to ensure proper balance of load on all three phases.

3.6 HOME RUNS

- A. Branch circuit conductors shall be home run to panelboards as shown on the drawings. Combining branch circuit home run conductors in single conduits is allowed up to three current carrying conductors per conduit.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Division 01 and Division 26 General Requirements for submittal requirements and formats.

1.2 SCOPE

- A. Federal procurement and construction materials standards will apply including compliance with the Buy American Act.
- B. Provide power grounding system and equipment grounding system in accordance with the applicable codes and ordinances and as further defined on the plans.

1.3 GROUND CONTINUITY

- A. Provide through the entire electrical system. A separate green equipment grounding conductor shall be provided in all branch circuits.

1.4 BONDING

- A. Insulated grounding bushings shall be installed to bond all feeder conduits to the switchboard ground bus or panel ground bus at both ends of feeder raceways. Insulated grounding bushings shall also be installed in all feeder pull boxes to bond all conduits together. Jumpers or bonds shall be copper and sized in accordance with Table 250-95 of the National Electrical Code.

1.5 NEUTRAL GROUNDING

- A. The neutral point of all radically operated transformers shall be solidly grounded to the grounding system and transformer enclosure with code size ground conductors. The neutral bus in each panelboard shall be isolated from ground. The neutral shall be grounded only at a single point at the main switchboard or at separately derived system transformers.

1.6 SIZE OF GROUND WIRE

- A. In all cases, shall not be less than that required under National Electrical Code requirements.

1.7 RECEPTACLE GROUNDING

- A. Connect the ground terminal of all receptacles by utilizing a separate grounding conductor between the receptacle grounding screw and the ground conductor provided in the branch circuit. Integral mounting straps within the receptacle connected to the device mounting straps are not approved as a grounding method.

1.8 FLEXIBLE CONDUIT GROUNDING

- A. Provide a separate grounding conductor in all flexible conduit runs including watertight flexible conduit with integral grounding straps. Install ground conductor inside conduit with ungrounded conductors.

1.9 PVC CONDUIT GROUNDING

- A. Provide a code size green grounding conductor the full length of the feeder or branch circuit when PVC is used in whole or in part.

1.10 GROUND CONNECTIONS

- A. Ground connections to building steel, ground rods and cable taps shall utilize an exothermic welding process.

PART 2 – PRODUCTS

2.1 GROUND CONDUCTORS:

- A. Copper conductors in accordance with Section 260526 "Grounding and Bonding."

2.2 EXOTHERMIC CONNECTIONS

- A. "Cadweld Exolon," Erico Products, Inc., Burndy "Thermoweld" or approved equal.

2.3 INSULATED GROUND BUSHINGS

- A. Malleable iron with insulated ring and ground clamp. Steel City or equal.

2.4 COMPRESSION CONNECTIONS

- A. Non reversible comperssions – listed hydraulically-crimped fittings

2.5 GROUND RODS

- A. 3/4" x 10'-0" long. Copper clad steel.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Provide main grounding busbar for telephone/data, intercom, television system head end equipment. Grounding conductor for telephone/data, intercom, television system main grounding busbar shall be #6 AWG, 600 volt, insulated copper conductor.
- B. Bond all telecommunication equipment chassis, ladder racks, cable trays, conduits, equipment frames, cabinets, and all other telecommunications room and equipment room metallic components to the main grounding busbar.
- C. Install ground rod vertically, with top flush with ground level unless physically protected. Connect to water service on street side of main shutoff valve, building structural steel, and service transformer ground rod.
- D. Install ground rod at each transformer and make connection to all exposed metal parts.
- E. Provide exothermic or braze all concealed or below grade connections. Provide exothermic connections to building steel.
- F. Compression connections shall be made using a hydraulic 4-way compression die. All compression connections shall be exposed.
- G. Provide separate ground conductor the full length of all raceways.

3.2 GENERAL TERMINATIONS

- A. Burnish to bare metal under all grounding and bonding terminations to assure good ground continuity. Terminations are to be attached with separate screw and nut. When more than one termination is required, provide a separate ground terminal strip.

3.3 DEVICE OUTLET BOX

- A. Provide separate grounding conductor between the outlet box containing the device and the branch circuit grounding conductor.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Division 01 and Division 26 General Requirements for submittal requirements and formats.

1.2 SCOPE

- A. Federal procurement and construction materials standards will apply including compliance with the Buy American Act.
- B. Provide all hangers and supports required for electrical systems being installed.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

PART 2 – PRODUCTS

2.1 SUPPORT, ANCHORAGE AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line
 - 2. Thomas & Betts
 - 3. Unistrut
- C. Metallic Coatings: Hot-dip galvanized after fabrication.

- D. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating.
- E. Painted Coatings: Manufacturer's standard painted coating.
- F. Channel Dimensions: Selected for applicable load criteria.
- G. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- H. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- I. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used. Subject to compliance with requirements, provide products by one of the following manufacturers:
 - a. Hilti
 - b. ITW Ramset/Red Head
 - c. Simpson Strong-Tie
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used. Subject to compliance with requirements, provide products by one of the following manufacturers:
 - a. Cooper B-Line
 - b. Hilti
 - c. ITW Ramset/Red Head
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

PART 3 – EXECUTION

3.1 APPLICATION

- A. Conduit Crossing Structural Separation: Conduit that crosses structural or seismic separations between building units shall be installed with flexible connections, suitable to accommodate longitudinal and transverse displacements. Secure raceways each side of joint and provide minimum of 36 inches length flexible conduit between building units.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 3/8 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and low-voltage systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- B. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners. In lieu of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete four inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than four inches thick.
 5. To Steel: Beam clamps.
 6. To Light Steel: Sheet metal screws.
- C. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 CONCRETE BASES

- A. Provide four-inch high concrete pads with chamfered edges for all floor-mounted equipment including switchboards, distribution panels, transformers, motor control centers and unit substations.
- B. Construct concrete bases of dimensions indicated but not less than four inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- C. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section.
- D. Anchor equipment to concrete bases.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND FITTINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Division 01 and Division 26 General Requirements for submittal requirements and formats.

1.2 SCOPE

- A. Federal procurement and construction materials standards will apply including compliance with the Buy American Act.
- B. Provide complete raceway systems as shown on the drawings and/or as required for proper installation of the various electrical systems being installed under this project. Minimum raceway size shall be $\frac{1}{2}$ " for power and $\frac{3}{4}$ " for systems and data unless noted otherwise.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Raceways: Allied, Carlon, Western or equal.
- B. Fittings: Appleton, Carlon, T&B, Steel City, O-Z/Gedney or equal.
- C. Conduit Straps: Appleton, Carlon, T&B, Steel City, O-Z/Gedney or equal.
- D. Low-Voltage Cable Supports: Caddy or equal.

2.2 RACEWAYS

- A. Rigid Aluminum Conduit: Not Permitted.
- B. Rigid Metallic Conduit: Zinc-coated steel with full threaded connections.
- C. Electrical Metallic Tubing (EMT): Zinc-coated steel.
- D. Rigid Nonmetallic Conduit: Rigid PVC, Schedule 40, UL listed for direct burial or concrete encasement.
- E. Flexible Metallic Conduit: Galvanized steel, securely interlocked.

- F. Liquidtight Flexible Metallic Conduit: Galvanized steel, interlocked, with integral ground conductor and PVC jacket overall.

2.3 FITTINGS

A. Rigid Metallic Conduit:

1. Couplings: Threaded metallic type of the same material as the conduit.
2. Locknuts: Steel up to 2 inches, malleable iron for 2-1/2 inches and larger.
3. Bushings: Bakelite or plastic up to 2 inches, malleable iron with insulating collar for 2-1/2 inches and larger.
4. Unions: Zinc plated malleable iron, 3 piece conduit coupling. Running threads are not acceptable.

- B. Electrical Metallic Tubing (EMT): Fittings shall be raintight type steel set screw type containing dual setscrews on each side of coupling. Set screws shall be steel. Cast metal will not be accepted.

- C. Rigid Nonmetallic Conduit: Slip-on, nonthreaded type of same material as conduit. Provide rigid steel bends in conduit runs.

- D. Flexible Metallic Conduit: Galvanized steel, one- or two-screw clamp type. All fittings shall be steel.

- E. Liquidtight Flexible Metallic Conduit: PVC waterproof cover over steel conduit, steel compression type. PVC waterproof flex without steel core is prohibited.

- F. Expansion Fittings: Provide expansion fittings for all rigidly fastened conduits spanning a building expansion joint, and for all runs 1-1/2" or larger exceeding 150 feet in length. Fittings shall be hot-dipped galvanized malleable iron with a packing ring to exclude water, a pressure ring, and a separate external copper bonding jumper.

2.4 CONDUIT STRAPS

- A. Heavy-duty one- or two-hole pressed steel straps. "Nail-in" style straps shall not be used.

2.5 SURFACE RACEWAY ANCHORS

- A. 2-hole strips shall utilize Powers Poly-Toggle Cat #2305.

2.6 LOW VOLTAGE OPEN CABLING SUPPORTS

- A. J-Hooks: Shall comply with TIA requirements for structured cabling system. Galvanized finish. Caddy #CAT21 with CATHBA angled hanger bracket. Provide all hardware necessary for secure mounting to the structure. Follow manufacturer's recommendations for quantity of cables supported.
- B. Adjustable Cable Support: Shall comply with TIA requirements for structured cabling system. Caddy #CAT425. Follow manufacturer's recommendations for quantity of cables supported.
- C. Provide all accessories and mounting hardware required for a complete and working installation of open cabling supports.

PART 3 – EXECUTION

3.1 COORDINATION

- A. The Contractor shall review all drawings, details and elevations and coordinate with the Architect prior to rough-in, all installations of wiring devices and equipment. Where equipment is furnished by others, the Contractor shall ascertain the proper voltage, load and connection requirements prior to rough-in.

3.2 MATERIALS

- A. All materials of a specific type shall be provided by the same manufacturer throughout the project. These products shall be identical to those submitted for review.

3.3 RACEWAY INSTALLATION

- A. Raceway Types: Install raceway types and sizes as listed below:
 - 1. Rigid Metallic Conduit: In concrete, masonry, exposed exteriors and exposed interiors where subject to physical damage and as required by code enforcing agencies.
 - 2. Electrical Metallic Conduit (EMT): All areas other than above. May be used for feeders with integral green ground conductor.
 - 3. Flexible Metallic Conduit: Recessed fixture connections, interior concealed equipment connections, expansion and seismic joints and sound control. Not to be used for exposed installations within the building.
 - 4. Liquidtight Flexible Metallic Conduit: Exterior equipment connections and exposed installation within the building.
 - 5. Rigid Nonmetallic Conduit: Exterior underground installations; direct buried for lighting raceways,. 90° elbows to be rigid galvanized steel. Service raceways are to be concrete encased. Underground feeders; concrete encased with rigid steel conduit elbows.

6. Surface mounted raceway: Shall be used only where other routes are unavailable and where it is mutually agreed to be desirable by the contractor and owner.
7. See referenced Signal and Communications specification sections for raceways associated with these systems.

B. Installation:

1. Planning: The layout of all raceways shall be carefully planned by the Contractor to ensure an installation which is neatly done and workmanlike. Any work showing improper care in planning will be ordered removed by the Architect, and shall be replaced in a neat and proper manner, without any additional cost to the Owner.
2. Concealment: All raceways shall be concealed in finished areas unless approved otherwise by the Architect. Where existing wall surfaces are inaccessible, surface metal raceways for these exceptions may be provided when approved by the Architect. Raceways may be surface mounted in unfinished equipment spaces such as mechanical rooms, electrical rooms, elevator machine rooms, and attic spaces.
3. Cutting and Bending: Raceways shall have smooth interior, ends cut square and reamed. Bends shall be carefully made to avoid injuring or flattening raceways (no "Hickey" bends).
4. Exposed Raceways: Install exposed raceways as high as possible, above ductwork, parallel or at right angles to building lines.
5. Expansion and Earthquake Joints:
 - a. Raceways shall not be installed in concrete slab or wall construction when passing through an expansion or earthquake joint.
 - b. Raceways shall be installed in furred or suspended ceiling spaces with a minimum of 36 inches of flexible conduit crossing the expansion or earthquake joints. Secure raceways each side of joint.
6. Routing: All raceways shall be installed parallel or at right angles to the building construction unless prohibited by a physical obstruction. This applies to all exposed raceways as well as all raceways above suspended ceiling.
7. Raceway Supports: Raceways shall be supported with heavy-duty, one- or two-hole, pressed steel straps on interior surfaces. Support pendant-mounted raceways on 3/8-inch rod with pear-shaped hanger or trapeze-type hanger with 3/8-inch rod (minimum) and 1-5/8-inch square preformed channel and pipe clamps. Parallel, surface-mounted raceways shall be supported from 1-5/8-inch square preformed channel and pipe clamps. All fittings and supports shall be hot-dip galvanized in exterior areas. Preformed channel in areas above suspended ceilings may be standard painted finish. Multiple conduit runs shall be grouped and neatly racked on trapeze hangers.
8. Anchorage: Anchor to metal stud structures by means of sheet metal screws or manufactured spring steel clips. Fasten individual raceways supports to structural walls or slabs with steel expansion shells and bolts. Provide flush concrete insert for multiple raceway support system. Fasten to structural steel

- with heavy-duty beam clamps. Fasten to architectural or masonry walls with toggle bolts or molley screws.
9. Independent Support: Conduits shall not be supported from the ceiling suspension system, ducts, pipes or other systems foreign to the electrical installation. The entire electrical installation shall be kept independent from any other trade.
 10. Suspended Ceiling: Branch circuit raceways and outlet boxes installed above suspended ceilings may be secured to No. 9 AWG or larger support wires that are independent of the ceiling suspension system under the following conditions:
 - a. Raceways and cables are not larger than 3/4" trade size.
 - b. No more than two raceways or cables are supported by a support wire.
 - c. Raceways and cables are secured to the support wires by fittings designed and manufactured for the purpose.
 - d. The support wires are securely fastened to the structural ceiling and to the ceiling grid system.
 - e. The raceways or cables serve equipment that is located within the ceiling cavity or is mounted on or supported by the ceiling grid system.
 - f. Where not prohibited by the building code officials.
 11. Conduit Location: Conduit shall not be run under heavy equipment, footings or other structural elements that might adversely affect the integrity of the raceways system or building footing. All raceways installed above suspended ceilings must be kept a minimum of 6" clear above top of ceiling system.
 12. Floor Slabs and Columns: Conduits installed in structural floor slabs shall be coordinated with structural steel and shall be routed to provide a maximum concrete cover. In general, conduit shall not be installed in structural columns, unless special permission is granted by the Architect.
 13. Pullboxes with Covers: Shall be provided as shown on the drawings or as required by Code. All pullboxes shall be located so as to be accessible.
 14. Flexible Conduit: Shall be used only for lighting fixture pigtails in accessible ceilings, flush-mounted speaker pigtails in accessible ceilings, sound control, motor connections and at building expansion joints as specified. Installations shall not exceed 6'0" in length. Any other proposed use of flexible conduit must be approved by the Architect's representative.
 15. Metallic raceway shall be continuous and bonded/grounded. Transitions to ceiling, crawl or tunnel spaces are to be made from a junction box on the "concealed space" side of the penetration.
 16. Conduit Stubs: Conduit which stub-up through the floor shall be installed at such a depth that none of the curved section of the elbow is visible.
 17. Sealing: All conduit, sleeves, blockouts or openings around raceway and cable systems that penetrate building walls, floors and ceilings shall be sealed. Sealing materials shall be fire-rated, non-combustible type, specifically designed for this type of installation and shall be approved by the authority having jurisdiction.
 18. Penetrations: Raceways which pass through building roof, exterior walls of building above or below grade and floor slabs on grade shall be sealed on the interior side of the building using non-hardening sealing compound after all

- conductors have been installed in the raceway. Sealing material shall be specifically designed for electrical wiring systems.
19. Conduit Passing Through Building Roof: Provide a 4 lb. lead plumbing vent flashing with a counterflashing attached above using a galvanized steel clamp. Flashing shall be in accordance with NRCA standards practices.
 20. Conduit Penetrating Membranes: All conduits penetrating walls or slabs with membranes shall be installed with approved membrane clamping devices in order to provide necessary seal.
 21. Exterior Walls: Conduits passing through exterior walls below grade and/or bridging an area which was previously excavated and backfilled shall be rigidly supported by a structurally reinforced concrete duct bank spanning between the building wall and a bearing surface on undisturbed earth.
 22. Cleaning of Raceways: The interior and exterior of all conduits and other raceways shall be thoroughly cleaned of all material. All conduits shall be capped or plugged after installation to ensure that they remain clean.
 23. No section of conduit shall be longer than 100 feet or contain more than three (3) 90 degree bends between pull points or pull boxes.
 24. Rigid non-metallic conduit shall not be used in above grade floor slabs, or in wall or open spaces of any type.
 25. Electrical metallic tubing (EMT): EMT shall be used in concealed spaces. EMT may not be used in finished areas unless indicated on the drawings. EMT may be used for exposed work in unfinished areas where not exposed to physical damage. Raceways in traffic areas shall be considered exposed to physical damage where within 10 feet of floor. If used in finished areas, must be painted to match existing wall/surface color.
 26. Multiple rows of suspended conduits shall be supported from Trapeze style hangers, providing 20% spare room for future raceways.
 27. Rigid non-metallic conduit installed underground shall be buried a minimum of 24" and a maximum of 30" under grade.
 28. Utilize rigid steel conduit below all roadways. Installed at depths less than 24" conduit shall be encased in conduit. Over 24" depth, wrap with scotch insulation tape, or utilize conduit with factory applied PVC coating.
 29. Raceway shall be installed with a minimum separation of 12 inches of free air from steam and hot water piping and a minimum separation of 3 inches of free air space from all other mechanical piping.
- C. Dissimilar Materials: Keep electrical conduits free from contact with all other piping runs of different systems or of dissimilar metals.

3.4 RACEWAYS AND CABLE INSTALLATION PATHWAYS FOR LOW VOLTAGE SYSTEMS

- A. Installation of Raceways/Pathways for intercom, clock, telecommunications and CATV systems shall be in accordance with the applicable portions of ANSI/TIA/EIA-569-A, Commercial Building Standards for Telecommunications Pathways and Spaces.

- B. Conduits above lay-in ceilings: Do not install cables in conduits that are supported from the ceiling suspension system. All conduits shall be supported independently of the ceiling support system.
- C. Minimum size is $\frac{3}{4}$ " for systems and data, unless noted otherwise. Conduit fill shall not exceed 40%.
- D. Bend radii for conduits shall meet the following requirements:
 - 1. If the conduit has an internal diameter of 2 inches or less, the bend radius must be at least 6 times the internal conduit diameter.
 - 2. If the conduit has an internal diameter of more than 2 inches, the bend radius must be at least 10 times the internal conduit diameter.
- E. There shall be no more than two 90 degree bends between pull points in telecommunications conduit, without derating of the conduit capacity. For each additional 90 degree bend the conduit capacity shall be derated by 15 percent. Increase conduit size as required to meet conduit fill requirements of this section with the derated capacity accounted for. Or, provide pull boxes to eliminate 90 degree bends as necessary to avoid having to derate conduit. Offsets shall be considered as equivalent to a 90 degree bend. Pull boxes added to conduit runs as of result of this requirement shall be in accordance with this section.
- F. Conduits which are terminated at cable trays shall be supported from structure with a maximum distance of 24" from the tray. Conduits terminated at cable trays shall be bonded to the tray.
- G. Exterior conduit shall be Schedule 40 PVC for Service Entrances. Interior conduit for vertical riser cable shall be GRC, sized per ANSI/TIA/EIA-568-A-5 or as indicated on the Contract Drawings. Interior conduit for horizontal cable shall be EMT, sized per ANSI/TIA/EIA-568-A-5 standards or as indicated on the Contract Drawings.
- H. Use of flexible conduit for telecommunications shall be kept to a minimum and shall be at the discretion of the Contracting Agency. Obtain prior written approval for the use of flexible conduit. Where required due to physical considerations, flexible metal conduit may be allowed in lengths not exceeding 4 feet. If used, flexible metal conduit shall be increased by one trade size for the application used.
- I. Conduits entering the MDF room through the floor shall be terminated 4 inches above finished floor. Conduits entering the MDF room from above shall be terminated 4 inches below the finished ceiling, but in no case shall the conduits terminate greater than 12 inches above the cable tray or distribution frame.
- J. Conduits and cut-out openings between floors shall be sealed with firestopping material which is removable and reusable, to accommodate adds, moves and changes in the cabling system.
- K. All conduits used for routing of low voltage cables shall have bushings at all stubouts.

3.5 OPEN CABLE SUPPORT AND INSTALLATION PATHWAYS

- A. Where cables are indicated to be installed as "Open Cabling", cable supports (D-rings, J-hooks, adjustable straps, and saddles as appropriate) shall be installed to allow cabling to be grouped and run along a common path. Cables shall be run parallel or at right angles to the building structure, and shall not be looped diagonally across the ceiling space. Cables shall be loosely bundled with cable ties at minimum every 30 inches on center. Provide cable ties at closer intervals where called for on drawings. Provide plenum rated Teflon cable ties in spaces used to handle environmental air.
- B. Do not support cables from ductwork, sprinkler piping, water piping, waste piping or electrical conduit.
- C. Fire seal around all cables running through rated floors and walls in accordance with Section 260500 "Common Work Results."

END OF SECTION 260533

SECTION 260540 - OUTLET, JUNCTION, AND PULL BOXES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Division 01 and Division 26 General Requirements for submittal requirements and formats.

1.2 SCOPE

- A. Federal procurement and construction materials standards will apply including compliance with the Buy American Act.
- B. Provide all outlet, junction and pull boxes required for proper installation of electrical equipment being installed under this work.

1.3 COORDINATION

- A. The Contractor shall review all drawings, details and elevations and coordinate with the Architect and equipment supplier prior to rough-in, all installations of wiring devices and equipment. Where equipment is furnished by others, the Contractor shall ascertain the proper voltage, load and connection requirements prior to rough-in.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Boxes: Appleton, Circle AW, Crouse-Hinds, Racor, Steel City, Wiremold or equal.
- B. Fittings: Appleton, Circle AW, Crouse-Hinds or equal.
- C. Floor Boxes: Wiremold, FSR, or equal.

2.2 OUTLET AND DEVICE BOXES

- A. Interior Surface-Mounted in Unfinished Areas: One-piece pressed steel, electro-galvanized, size and depth required by Code, except 4-inch square or 4-inch octagonal minimum. Minimum 14 U.S. gauge, with return flange and screw retained cover.

- B. Interior Flush-Mounted: Galvanized pressed steel, knockout type, not less the 4" square, 2-1/8" deep, minimum 14 U.S. gauge, with return flange and screw retained cover. Provide extension rings for all flush boxes. Boxes which occur in concrete block walls shall be equipped with 1 1/2" square cornered tile extensions.
- C. Interior Surface-Mounted, Finished Areas: Wiremold No. 5700 Series sized to fit standard wiring device, covers specified below.
- D. Outlet boxes installed in surface metallic raceway systems shall be shallow boxes manufactured as part of the system.
- E. Exterior Mounted: Cast, non-ferrous metal with threaded hubs required. Manufacturers as listed above.
- F. Prohibited Materials: Sectional outlet boxes shall not be utilized.

2.3 JUNCTION AND PULL BOXES

- A. 100 cubic inches or smaller: Standard outlet box with stamped knockouts.
- B. 150 cubic inches or larger: Code gauge steel with sides formed and welded, with screw covers unless shown to have hinged doors. Hinged doors shall have locking device same as furnished for panelboards.
- C. Knockouts shall be factory stamped, or formed in the field with a cutting tool to provide a clean symmetrically-cut hole.
- D. Interior Areas: Steel, screw cover, Code gauge and size, baked enamel finish.
- E. Exterior or Wet areas: Weatherproofed galvanized steel construction with proper gaskets and corrosion resistant fasteners.
- F. Device outlets shall be a minimum of 2-1/8" inches deep, minimum 4 inches square.
- G. For existing walls, use 2 1/2" deep min. cut in box.
- H. Prohibited materials: "Handy Boxes"

2.4 FITTINGS

- A. Junction boxes or elbows may be cast conduit fittings at Contractor's option. Provide one size larger than raceway for feeders - "mogul-type." Openings accessible at all times. Exterior areas to be cast aluminum with gasketed non-ferrous covers.

PART 3 – EXECUTION

3.1 GENERAL

- A. Boxes shall be supported securely and independently. Mount boxes on building surfaces or support with trapeze hanger as described in Raceway Installation. Junction boxes shall not be used unless the number of bends, pulling length, or circuit requirements necessitate their installation. Junction or pullbox openings must be accessible. All boxes must be supported independently of any other building system.
- B. Coordinate and locate boxes to ensure accessibility of electrical wiring.

3.2 DEVICE BOXES

- A. Outlet and device boxes mounted in stud walls shall be attached to two adjacent wall studs using blocking material behind the box to ensure that the box will remain square to the finished wall surface.
- B. Outlet and device boxes mounted in masonry walls shall be set at the bottom or top of a masonry unit course.
- C. Plaster rings shall be provided for all devices in walls with finished materials such as gypsum wallboard, plaster, etc. Plaster ring shall extend outlet box to within 1/8-inch of finished wall surface including all wall coverings. Coordinate with Architectural finishes prior to rough-in.
- D. Grout around all outlet boxes to seal space between box and wall or ceiling materials.
- E. Exterior Wall Outlets: Conduit shall not enter the bottom of exterior wall outlet boxes. Conduit shall enter the sides and top only.
- F. Multiple Gang Outlet: Install two or more wiring devices shown in one location under a common plate except when outlets are of a different voltages such as telephone and duplex receptacles. Install plates with all edges in continuous contact with finished wall surfaces. Install plates vertically with alignment tolerance of 1/16-inch. Sectional plates are not permitted. No more than one device shall be installed in a single-gang position.
- G. Device Locations: Locate switches 6 inches from door casing unless otherwise shown. Outlets mounted above one another shall be on the same centerline. Coordinate exact locations of any special devices with Architect. All outlet heights must comply with all handicap accessibility requirements. Heights to center of outlet mounted vertically shall be as follows unless otherwise shown:
 - 1. Convenience Outlets: +18"
 - 2. Above Counter Outlets: Verify height. Minimum clearance one inch above backsplash or counter as applicable.
 - 3. Switches: 4'-0"

4. Electric Water Coolers: Conceal outlet behind equipment housing.
5. Where different type devices occur adjacent to each other, space outlet boxes so that finish plates will be spaced a minimum of one inch apart at same height.

3.3 BLANK COVERS

- A. Provide blank covers or plates over all boxes that do not contain devices or are not part of an equipment connection.

3.4 LABELING

- A. All junction and pull boxes in accessible ceiling spaces and exposed in unfinished areas shall be identified to indicate the branch circuit numbers, feeders, or signal and communication system contained within. Use permanent label. Fire Alarm System shall be red color. Refer to Section 270500 "Common Work Results for Communications" for requirements pertaining to Signal and Communication System.

3.5 JUNCTION OR PULL BOXES

- A. No box shall be secured to the ceiling system, HVAC ductwork, or mechanical piping.
- B. Pull and junction boxes shall be installed as shown or as necessary to facilitate pulling of wire and to limit the number of bends within code requirements. Boxes shall be permanently accessible and shall be placed only at locations approved by the Architect. Secure boxes rigidly to the building element on which they are mounted, or solidly embed boxes in concrete or masonry. Identify all pull and junction boxes with a permanent label, neatly showing the individual feeder or electrical system. Installations shall only be above accessible ceiling, crawl spaces, tunnels and in unfinished areas only.

3.6 EXTENSION RINGS

- A. A maximum of one extension ring shall be provided on each junction box.

END OF SECTION 260540

SECTION 260553 - IDENTIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Division 01 and Division 26 General Requirements for submittal requirements and formats.

1.2 SCOPE

- A. Federal procurement and construction materials standards will apply including compliance with the Buy American Act.
- B. Provide proper identification of all electrical work specified. This shall include but not be limited to the following items: service and distribution equipment, starters, disconnects, cabinets, terminal boxes, device junction boxes, danger signs, maintenance access points, and fused switches including fuse size and type.
- C. Install nameplates on all main and distribution switchboards, panelboards, disconnect switches, and miscellaneous systems junction boxes and cabinets installed under this contract.
- D. Install bakelite nameplates at each protective device in switchboard and distribution centers, showing circuit service.
- E. Install circuit directory cards in all panelboards. Cards shall be typed or computer printed.
- F. All wiring in all outlet and junction boxes shall be properly identified as to circuit number. Type of marker shall be made with Brady ID Pro printer/labeler with 3/4" labels, or approved equal. Locate label on inside of device box. Label shall be black letters on white background using Brady #42019 tape and #42011 ribbon.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Prohibited Materials
 - 1. Dymo (or equivalent) labels shall not be utilized, unless specifically noted.
- B. Schedules – provide typewritten directory for each panel, on heavy card stock, showing all circuit numbers.

2.2 EQUIPMENT NAMEPLATES

- A. Nameplates shall be fabricated from white bakelite, with 3/8" engraved black letters.
- B. Mounting: Nameplates shall be attached with a minimum of two 6-32 roundhead screws, lockwasher and nuts in exterior locations and contact-type permanent self-adhesive in indoor locations.

2.3 SWITCHBOARDS AND DISTRIBUTION PANELBOARDS

- A. General: Provide nameplate which identifies the switchboard/distribution panel and the source panel. (Example: Distribution Panel No. 1/Fed from Main Service Switchboard - Bkr. No. 1.)
- B. Overcurrent Devices: Provide nameplate at each overcurrent device that identifies the device number and the load served. (Example: Bkr. No. 1/Panel A.)

2.4 PANELBOARDS

- A. Provide nameplate on the front of the panel room which identifies the panel. (Example: Panel A.) Provide a nameplate concealed behind the door which identifies the panel, and the source panel. (Example: Panel A, Fed from Distribution Panel 1-Bkr. No. 2)

2.5 DISCONNECT SWITCHES AND MOTOR STARTERS

- A. Provide nameplate which identifies the source panel, load served and the fuse size where applicable. (Example: Panel A-1,3,5/Exhaust Fan No. 1/10 amp, RK1 fuses.)

2.6 JUNCTION AND PULL BOX IDENTIFICATION

- A. Mark the cover of all junction boxes and pull boxes to identify the system, circuits, or feeders contained within the box. Use red color for fire alarm. Circuits shall be identified by panelboards and specific circuit numbers contained within the junction box. Refer to specification Section 260540 "Outlet, Junction and Pull Boxes" and Section 270500 "Common Work Results for Communications."

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Clean all surfaces prior to installing labels. Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
- B. Nameplates

1. Panelboards: Mount inside door, on dead frount, above circuit breakers, unless panelboard is located in a utility-type room, then install nameplate on outside of panelboard above door.
2. Disconnect switches: Mount nameplate on outside of cabinet, near top. Omit nameplate from disconnect switches if located adjacent to equipment.

C. Schedules

1. Panelboards: Mount in frame under plastic cover, on back side of door. Schedule shall be typed or printed and show circuit service for each circuit breaker, using room numbers. Spares and spaces shall be written in pencil.

3.2 REGULATIONS

- A. Comply with governing regulations and requests of governing authorities for identification of electrical work.

3.3 DANGER AND WARNING SIGNS

- A. General: In addition to installation of danger signs required by governing regulations and authorities, Contractor shall be responsible for installing appropriate danger signs at locations constituting danger for persons in or about project.
- B. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power.

END OF SECTION 260553

SECTION 262416 - PANELBOARDS

PART 1 – GENERAL

1.1 SCOPE

- A. Provide all required panelboard equipment as shown on the drawings and specified herein.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. General Electric, Square D, Eaton and Siemens. All catalog numbers refer to Square D to establish minimum standards for quality and performance.

2.2 DISTRIBUTION PANELS

- A. 120/208 volt and 277/480 volt, 3 phase, 4 wire. Provide bolt-on circuit breakers and spaces as indicated on the drawings. Circuit breakers shall have a minimum interrupting rating of 22,000 amperes symmetrical. Square D "I-Line" series.

2.3 277/480-VOLT PANELS

- A. 277/480-volt, 3-phase, 4-wire. Provide bolt-on circuit breakers and spaces as indicated on the drawings. Minimum cabinet size: 20 inches wide x 5-3/4 inches deep. Circuit breakers shall have a minimum interrupting rating of 14,000 amperes symmetrical. Square D NF series.

2.4 120/208-VOLT PANELS

- A. 120/208-volt, 3-phase, 4-wire. Provide bolt-on circuit breakers and spaces as indicated on the drawings. Minimum cabinet size: 20 inches wide x 5-3/4 inches deep. Circuit breakers shall have a minimum interrupting rating of 10,000 amperes symmetrical. Square D NQOD series.

2.5 BUSSING

- A. Panelboard bussing shall be copper or tin-plated aluminum.

2.6 SPACE FOR FUTURE CIRCUIT BREAKERS OR FUSED SWITCHES

- A. Provide as indicated on the drawings. Spaces shall be completely equipped for the future addition of a circuit breaker or fused switch, including all mounting hardware and buss connections. Unless otherwise noted, spaces shall be sized to accommodate the following future circuit breaker or fused switch:

<u>Panel Rating</u>	<u>Minimum Space Ampacity</u>
100 amps	70 Amps
225 Amps	125 Amps
400 Amps	250 Amps
600 Amps	400 Amps
800 Amps	600 Amps
1200 Amps	800 Amps

2.7 MULTIPLE-POLE BREAKERS

- A. Shall have common trip with single handle.

2.8 BREAKER LOCK-OFF DEVICES

- A. Lock-off device shall mount on breaker handle to allow pad locking breaker in off position. Provide for breakers noted on drawings or required by Code.

2.9 PANELBOARD CIRCUIT NUMBERING

- A. Odd numbers on left side of panel, even numbers on right.

2.10 IDENTIFICATION

- A. Provide nameplates to identify all cabinets and index cards to identify each circuit in the panelboards.
- B. Label all conductors in panels with circuit number adjacent to the circuit breaker. Utilize plastic sleeve markers. T&B SM series or equal.
- C. Panel designations shall be laminated phenolic plastic with white letters. Provide black background for normal service panelboards and red background for panelboards automatically served by the emergency generator. Refer to Section 26 05 53.
- D. Circuit indexes shall be typewritten and identify locations using the final room numbers established by the Owner, not the room numbers shown on the Architect's floor plan. Indexes are to be located on the inside of each panel door in the space provided. Include a copy of all indexes in the Operations and Maintenance Manual.

2.11 GROUND BUS

- A. Provide one in each panelboard for terminating branch circuit ground conductors and feeder ground conductors. Multiple ground busses utilizing panelboard enclosures for continuity will not be accepted. Burnish area where ground connection is made to panelboard enclosure.

2.12 SPACE ONLY

- A. Means that complete provisions have been made so that only the adding and connection of the circuit breaker will complete the installation.

2.13 CABINETS

- A. All panelboards shall be provided with hinged door construction.
- B. Size of cabinets shall be in accordance with National Electrical Code, minimum size 20 inches wide x 5-3/4 inches deep, or as sized on drawings, sufficiently large to accommodate all equipment and conduit entering the top and bottom. No conduit shall enter sides or back.
- C. Cabinet fronts in finished areas shall be flush type, with smooth face and concealed trim clamps and hinges. Finish shall be ANSI 61 light gray. There shall be no monograms or trademarks visible on the face of the cabinet.
- D. Cabinet doors shall be tight closing without play when latched. Cabinet doors shall have flush retractable latch mechanisms. All cabinets shall be keyed alike.

2.14 METERING

- A. Meters monitoring the whole panel shall be integral to the panel, Square D Powerlogic Series or equal. Meter shall have an RS-485 Modbus output with conversion to BACnet protocol.
- B. Meters monitoring panel feeders shall be stand-alone type in it's own enclosure, Square D Powerlogic E4800 or equal. Meter shall have capacity to separately monitor seven or more individual feeders. Meter shall have an RS-485 Modbus output for each monitored load. Meter shall include current transformers, terminal blocks, and other parts required for the metering function.
- C. Meters shall monitor the following values:
 - 1. Line-to-neutral voltage for all phases
 - 2. Line-to-neutral average voltage
 - 3. Line-to-line voltage for all phases
 - 4. Line-to-line average voltage
 - 5. Current on each phase

6. Average current
7. Neutral current
8. kVA, kW for all phases, kWh for all phases
9. kW Demand
10. kVAR, kVARh for all phases
11. Power Factor
12. Thd
13. Frequency

- D. Instantaneous values for these parameters shall be accessible via local indications, and through the remote I/O link, equipped with smart communications card.

PART 3 – EXECUTION

3.1 MOUNTING

- A. Where panelboards are to be installed against plasterboard walls, provide separate support channels secured to blocking between steel studs. Coordinate blocking work with the Gypsum Wallboard Contractor. Panels shall not be secured directly to gypsum wallboard material. Unless noted otherwise, mount top of panel at 6' 0" above finished floor.

3.2 CLEAN-UP

- A. After construction is complete, vacuum the interior of all new and existing panel enclosures and provide touch-up paint on factory finished surfaces.

3.3 SPARE CONDUIT

- A. Provide six $\frac{3}{4}$ " spare conduits stubbed into ceiling space from each flush-mounted panelboard.

3.4 TESTING

- A. After all wiring is complete, all feeder and branch circuit terminations shall be checked with a torque wrench. Torque levels shall be in accordance with NETA Standard ATS unless otherwise specified by the Manufacturer. A test report which gives the following information for each panelboard shall be submitted to the Engineer two weeks prior to final inspection:
1. Size and insulation type of the phase, neutral and ground conductors.
 2. Phase-to-Phase and Phase-to-Neutral operating load voltage.
 3. Operating load current (each phase, neutral and ground).

4. Phase-to-Phase and Phase-to-Neutral conductor insulation resistance. Test shall be made with a DC "Megger" (500V minimum) type tester. If tests indicate faulty insulation (less than 8 megohms) the conductors shall be replaced and retested.
5. A copy of the test report shall be included in the Commissioning Field Notebook and the Operations and Maintenance Manual.
6. Lace all conductors within panelboards utilizing tie-wraps

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Division 01 and Division 26 General Requirements for submittal requirements and formats.

1.2 SCOPE

- A. Federal procurement and construction materials standards will apply including compliance with the Buy American Act.
- B. Provide all wiring devices complete with device plates shown on the drawings or specified within the specifications.

1.3 SUBMITTALS

- A. Product Data: Submit for each of the products provided. Contractor shall verify Buy American compliance prior to submitting for engineer approval.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Bryant, Cooper Wiring Devices, Hubbell, P & S, or Leviton. All part numbers refer to Hubbell to establish minimum standards for quality and performance.

2.2 GENERAL

- A. All devices shall be specification grade. Color shall be ivory for normal services and red for all services automatically fed from the emergency generator.

2.3 SWITCHES

- A. Single-Pole: 20-ampere, 120/277-volt, Hubbell No. 1221 Series.
- B. Three-Way: 20-ampere, 120/277-volt, Hubbell No. 1223 Series.

- C. Locking: 20-ampere, 120/277-volt, Hubbell No. 1221L (1-pole) series or No. 1223L (3-way) series. Provide two keys with each switch. Cover plate shall be stainless steel with on/off labels.

2.4 RECEPTACLES

- A. Duplex Receptacles, Specification-Grade: 20-ampere, 125-volt, 2-pole, 3-wire grounding, NEMA Type 5-20R Hubbell No. CR5362I (Ivory Color).
- B. Duplex Receptacles originating from emergency panels, Specification-Grade: 20-ampere, 125-volts, 3-wire grounding. NEMA Type 5-20R Hubbell No. CR5362R (Red Color).
- C. Duplex Receptacles originating from surge protected panels, Specification-Grade: 20-ampere, 125-volts, 3-wire grounding. NEMA Type 5-20R Hubbell No. CR5362GY (Gray Color).
- D. Duplex Receptacles, Safety Type, Specification-Grade: Safety-type, specification-grade device, rated at 20-ampere, 125-volt, grounded type, NEMA Type 5-20R; Hubbell No. SG-63 or approved equal. Receptacles must be capable of accepting double bladed plugs without ground pin.
- E. Ground Fault Circuit Interrupter (GFCI) Receptacles: Specification grade, weather resistant, 20-ampere, 125-volt, Class A, 5-milliampere sensitivity, standard or feed-through model and as shown on the drawings. Hubbell No. GF 5262 or approved equal.
- F. Faceless GFI Module: Specification-grade, 20 ampere, 125 volt, Class A, 5 milliampere sensitivity. Hubbell No. GF53501A or approved equal.
- G. Weatherproof Receptacles: Weather-resistant, GFCI-type receptacle with in-use, weatherproof, low-profile, lockable, diecast metallic alloy cover. Greenfield No. WIUVPS or equal.
- H. Special Receptacles: For other special receptacles, see drawings.
- I. Cord Caps: Cord caps on all cords shall be plastic insulated type.

2.5 SURFACE RACEWAY ASSEMBLIES

- A. Assemblies shall be as manufactured by Wiremold, of type 700, 2000 or 4000 series (including devices) as noted on the drawings. Color shall be ivory.
- B. Provide all required mounting hardware, miscellaneous fittings, end caps, etc. and manufactured by Wiremold.

- C. One gang device boxes for use with Wiremold 700 product shall be Wiremold part #V5748. Two gang device boxes for use with Wiremold 700 product shall be Wiremold part #V5748-2.
- D. One gang device boxes for use with Wiremold 2000 product shall be Wiremold part #V2048. Two gang device boxes for use with Wiremold 2000 product shall be Wiremold part #V2048-2.
- E. One gang device boxes for use with Wiremold 4000 product shall be Wiremold part #V4007C-1. One gang GFCI receptacle mounting cover for Wiremold 4000 product shall be Wiremold part #V4007C-1R.

2.6 VERITCAL MULTI-OULETS

- A. Free-standing multi-outlet assemblies shall be Walkerduct#5PA 10-4, equipped with single grounded type receptacles.
- B. Each unit shall be equipped with T-bar hangers, carpet or tile pad as required, power fed junction box, and ceiling trim plate.
- C. All receptacles shall be pre-wired (with ground wire) to power fed junction box.
- D. Length of each unit shall be selected to match ceiling height.
- E. Color of unit shall be ivory.
- F. Acceptable Manufacturers
- G. Wiremold equipment which is the approved equal of the equipment specified above is considered acceptable.
- H. Substitutions may be considered only when submitted in conformance with Section 260500 "Common Work Results."

2.7 DEVICE PLATES

- A. Prohibited materials
- B. Sectional plates shall not be utilized.
- C. All devices shall be equipped with stainless steel 0.04" thick with #302 satin finish, except for audiovisual devices which may be plastic.
- D. All junction boxes in finished areas shall be provided with stainless steel plates.

2.8 INSTALLATION

- A. Install two or more wiring devices shown in one location under a common plate except when outlets are of a different voltages such as telephone and duplex receptacles. Install plates with all edges in continuous contact with finished wall surfaces. Install plates vertically with alignment tolerance of 1/16 inch. Sectional plates are not permitted. No more than one device shall be installed in a single-gang position.
- B. Wiring: Branch circuit conductors shall be terminated either in side of or in back of specification-grade devices with screw clamped terminations. Spring-type pressure connections not approved. Wiring devices are not to be used for maintaining circuit continuity. Wiring devices are not to be used for maintaining circuit continuity. Removal of wiring device shall not effect downstream devices.
- C. Barrel type key switch shall be used to control lighting in corridors, gyms, cafeterias and restrooms (not required for single occupant restrooms).
- D. Orient receptacles so that ground pin is at bottom or to the right.
- E. Outlet height to meet ADA requirements or 16 inches minimum above floor.
- F. Attach surface raceway assemblies to wall surface by method recommended by manufacturer for the particular wall construction. Use anchors similar to Powers Poly-toggle, catalog #2305 with 1-1/2" screw minimum.
- G. Wiremold raceway shall be ivory factory color and shall not be painted. Any raceway attached to the Wiremold product in an unconcealed area which does not come pre-painted from the manufacturer shall properly be prepared for painting and shall be Wiremold #IWE-S ivory spray enamel.

PART 3 – EXECUTION (NOT USED)**END OF SECTION 262726**

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Division 01 and Division 26 General Requirements for submittal requirements and formats.

1.1 SCOPE

- A. Provide all fuses shown on drawings and specified herein including spare fuses mounted in a fuse cabinet.

1.2 DESCRIPTION

- A. Provide fuses as indicated on the drawings, sized per NEC, and as required for a fully operational system.
- B. All fuses shall be of the same manufacturer.
- C. All fuses shall be installed by the Electrical Contractor at jobsite and only when equipment is to be energized. Fuses shall not be installed during shipment.
- D. Spare Fuse Cabinet: Provide a surface mounted spare fuse cabinet with locking door and shelves. Install within the Main Electrical Room. Provide three spare fuses of each type used on the project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Bussman, Ferraz Shawmut or Littlefuse.

2.2 FUSES

- A. Provide 200,000 AIC, current limiting, UL, time delay fuses.
- B. Feeders 601-6000 Amps: Class L, KRP-C Time Delay.
- C. Feeders 600 Amps and Less:
 - 1. Class RK-1, LPN-RK for 250-volt, dual element

- 2. Class RK-1, LPS-RK for 600-volt, dual element.
- D. For motor circuit 600 volts and below: Class RK-1 or Class J sized at 125% FLC of motor.

PART 3 - EXECUTION

3.1 SPARE FUSES

- A. At the completion of the project, provide (1) spare fuse of each different type and size used on the project. Any spare fuses utilized during testing must be replaced in order to leave the Owner with the proper amount of spare fuses at completion of the project.
- B. Install fuses in fuse holder with fuse rating visible
- C. Provide typewritten directory card indicating all fusible devices, together with associated fuse size and type.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Division 01 and Division 26 General Requirements for submittal requirements and formats.

1.2 SCOPE

- A. Federal procurement and construction materials standards will apply including compliance with the Buy American Act.

1.3 SUBMITTALS

- A. Product Data: Submit for each of the products provided. Contractor shall verify Buy American compliance prior to submitting for engineer approval.

1.4 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:
 - 1. Square D
 - 2. General Electric
 - 3. Siemens
 - 4. Eaton

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Fusible Switch-600A and Smaller: NEMA KS 1, Type HD with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- B. Nonfusible Switch-600A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

- A. Molded-Case Circuit Breaker: NEMA AB 1 with interrupting capacity to meet available fault currents. Provide with the following features and accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
- B. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating. Provide with the following features and accessories:
 - 1. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.

2.4 ENCLOSURES

- A. Rated for environmental conditions at installed locations.
 - 1. Outdoor, wet or damp locations; NEMA 250, Type 3R.
 - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 3. Other wet or damp indoor locations; NEMA 250, Type 4.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Control Equipment Mounted to Walls: Mount adjacent units at uniform height. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. Provide freestanding racks complying with Section 260529 "Hangers and Supports," for controllers not located on walls.

- B. Floor-Mounted Control Equipment: Anchor to concrete base.
- C. Install fuses in each fusible switch.

3.2 IDENTIFICATION DEVICES

- A. Label each switch and circuit breaker on engraved laminated plastic as specified in Section 260553 "Identification."

3.3 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.4 TESTING

- A. After all wiring to each unit is complete, the Electrical Contractor shall cooperate with the Mechanical Contractor in testing equipment for proper operation and correct wiring as required for proper operation. All connections shall be checked with a torque wrench. Torque levels shall be in accordance with NETA Standard ATS unless otherwise specified by the manufacturer. A test report which gives the following information for each motor shall be submitted to the Engineer two weeks prior to final inspection:
 - 1. All nameplate data (voltage, phase, full-load current, locked motor current, NEMA design, code letter, RPM, etc.)
 - 2. Measured no-load voltage at motor terminals (all phases)
 - 3. Measured full-load voltage at motor terminals (all phases)
 - 4. Full load operating current (all phases)
 - 5. Motor starter manufacturer and overload heater number (attach the manufacturer's table of overload heater numbers and corresponding motor nameplate ranges)
 - 6. Fuse size and type
 - 7. Motor phase-to-phase and phase-to-ground winding resistance (motors five-HP and larger)
- B. A copy of the test report shall be included in the Operations and Maintenance Manuals.

END OF SECTION 262816

UNIVERSITY OF IDAHO
STRUCTURED CABLING STANDARD
VERSION 2.3



University of Idaho
Information Technology Services

Information Technology Services

Network Team

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UI Structured Cabling Standard

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1. INTRODUCTION

1.1. PURPOSE

The purpose of these requirements is to assist Departments, Engineers, Architects and Contractors in creating a robust infrastructure to support present technologies and to ensure the future addition of emerging technologies in education.

Product specifications, general design considerations, and installation guidelines are provided in this document. Any cabling contractor ("Contractor") performing structured cabling work for the University of Idaho must meet or exceed all requirements for the cabling system described in this document.

Communication technologies are a critical element in the design of virtually all new and renovation building projects. Whether it be voice, data and video transmission, security and fire alarm systems, audio/visual systems, multimedia, or other communication technologies, it is important that a team of experienced professionals are involved in the design to ensure that University of Idaho (UI) has a technology infrastructure that provides users with reliable, high-speed connectivity to internal and external network-based resources.

In addition to technical assistance, the Guidelines also recognize the important educational and fiscal implications of "future proofing." That is, careful planning of the technology infrastructure will extend the life of the investment and prevent premature obsolescence. For example, there is an ever-growing demand for bandwidth for telecommunications/network systems in educational environments. Typically, when departments start to use networks, the 10Mbps range is found satisfactory for text-based uses such as e-mail. Digital Imaging, Multimedia and Internet graphic files are now prevalent so the 100 Mbps range is required. Increasingly necessary, however, is full motion video, which may require up to 1 Gbps, depending upon video compression technology. This upward trend in higher bandwidths will continue as computer assisted medical imaging, education and research become more sophisticated and will require speeds of 10Gbps. Planning for future technological evolution is therefore essential and needs to be part of every construction/ renovation project.

Finally, a Structured Cabling Plant is a key concept in enabling Information Technology Services for UI. For future projections, the Guidelines have provided more detail that respond to the needs of renovation and modernization. They also apply, however, to new construction projects as well.

1.2. GENERAL SPECIFICATIONS

This specification may impact other trades. When there is a conflict in the construction document between trades, this Structured Cabling System Technical Minimum Specification prevails. As an example, the construction document may instruct the electrical contractor to provide telecommunications grounding/bonding and conduit runs in the electrical section of the construction document. If there is a conflict between the electrical specification and the telecommunications specification, the telecommunications specification prevails.

These specifications provide a minimum configuration that must be used for new construction or major remodeling of an existing facility. All manufacturers and part numbers are for performance standards only. Other manufacturers meeting the same performance standards as well as a minimum 20-year warranty will be considered with prior approval in writing. Contractor must receive written approval from the UI ITS Representative to use a different manufacturer than specified in this document.

1.3. PROJECT MANAGEMENT

Contractor must establish a single point of contact with the General Contractor who will be responsible for reporting progress and updating the UI ITS Representative with issues that UI must address to facilitate the cabling system installation. Contractor's point of contact (POC) must provide regular written reports to the UI ITS Representative detailing progress. Requests for access to limited access or restricted areas must be made at a minimum (1 week prior to the required access).

UI must designate, in writing, an ITS Representative for each project. Contractor will work with the ITS Representative for the entire project. If not specified, the UI ITS Network Manager will be the UI ITS Representative. Information critical to the completion of the task or project must be communicated to the UI ITS Representative as the requirement becomes known. Casual information must be passed during the scheduled progress report.

Contractor must maintain UI's facility in a neat and orderly manner during the installation of the communications cabling system. At the completion of work in each area, Contractor will perform a final cleaning of debris prior to moving the installation crew to the next work area. Some areas of the facility will require additional precautions to prevent the spread of dust and debris. Prior to commencing work, consult with the designated UI ITS Representative for specifics.

Note: If debris not directly related to the current installation is encountered within the ceiling plenum/telecom areas, Contractor must notify the UI ITS Representative and provide pricing for clean-up necessary to remedy.

1.4. APPLICABLE STANDARDS & CODES

All work must conform to the latest edition of the National Electrical Code®, the Building Code, and all local codes and ordinances, as applicable.

- *This Technical Specification and Associated Drawings*
- *ANSI/TIA/EIA-568-B.1 and addenda*
"Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements"
- *ANSI/TIA/EIA-568-B.2 and addenda*
"Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted-Pair"
- *ANSI/TIA/EIA-568-B.3 and addenda*
"Commercial Building Telecommunications Cabling Standard - Part 3: Optical Fiber Cabling and Components Standard"

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- *ANSI/TIA/EIA-569-A and addenda*
"Commercial Building Standard for Telecommunications Pathways and Spaces"
- *ANSI/TIA/EIA-606 and addenda*
"Administration Standard for the Telecommunications Infrastructure of Commercial Buildings"
- *ANSI/TIA/EIA-607 and addenda*
"Commercial Building Grounding and Bonding Requirements for Telecommunications"
- *Building Industries Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM) – latest edition*
- *National Fire Protection Agency (NFPA) – NFPA 70, National Electrical Code (NEC) - 2008*
- *Leviton Premier Network Design and Installation Contractor Agreement (current)*

If a conflict exists between applicable documents, then the order in the list above shall dictate the order of precedence in resolving conflicts. This order of precedence must be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state or federal inspection agency.

If this document and any of the documents listed above are in conflict, then the more stringent requirement must apply. All documents listed are believed to be the most current releases of the documents; Contractor is responsible to determine and adhere to the most recent release when developing the proposal for installation.

1.5. **CONTRACTOR QUALIFICATIONS**

Contractor must be fully capable of installing cabling of low voltage infrastructure to support applications such as, but not limited to data, voice and imaging network systems. Contractor must at a minimum possess the following qualifications:

Possess those licenses/permits required to perform telecommunications installations in the specified jurisdiction.

Personnel trained and certified to design and install BERK-TEK/LEVITON Products.

Provide proof of all LEVITON Installer Certificates and have at minimum of (4) current LEVITON Certified Installer Technicians in the local area within (100 miles) of where work is to be performed.

Provide references of the type of installation provided in this specification.

Personnel trained in the LEVITON Certified Installer course and be competent in Termination, Splicing, Testing, Trouble Shooting Fiber and Copper Products.

Personnel knowledgeable in Idaho local, state, province and national codes, and regulations. All work must comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.

Be in business a minimum of five (5) years and successfully engaged in the routine installation of structured cabling systems (i.e. voice, data, fiber, video, etc.) of similar size and complexity.

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Must have personnel fluent in the use of Computer Aided Design and possess and operate CAD software using .DWG or .DXF format and Microsoft Visio.

Must possess current liability insurance certificates.

Must be a LEVITON PREMIER NETWORK CONTRATOR current and in good standing thru the completion of any project with UI.

Must have a BICSI certified RCDD review and meet with the UI ITS representative to discuss the project and to ensure that a structured cabling system is installed that provides a comprehensive telecommunications infrastructure.

1.6. **PRODUCT GUARANTEE AND WARRANTY**

All BERK-TEK/LEVITON non-consumable products have a minimum 20-year guarantee. In order to qualify, the structured cabling system must be installed per the following:

Meet all TIA/EIA commercial building wiring standards

Use BERK-TEK/LEVITON products purchased from BERK-TEK/LEVITON Authorized Distributors

Products must be installed per BERK-TEK/LEVITON instructions and BERK-TEK/LEVITON Certified Installer training.

Materials and workmanship hereinafter specified and furnished must be fully guaranteed by Leviton for 20 years from transfer of title against any defects. Contractor must correct defects that may occur as the result of faulty materials or workmanship within 20 Years after installation and acceptance by the Customer, at no additional cost to The Customer. Contractor must promptly, at no cost to The Customer, correct or re-perform (including modifications or additions as necessary) any nonconforming or defective work within 20 Years after completion of the project of which the work is a part. The period of Contractor's warranty for any items herein are not exclusive remedies, and The Customer has recourse to any warranties of additional scope given by The Manufacturer to The Customer and all other remedies available at law or in equity. Contractor and Manufacturer warranties must commence with acceptance of/or payment for the work in full.

All Contractor procured equipment, or materials, must warrantied against defects in materials and workmanship to the extent such warranties are reasonably obtainable.

Contractor must pass along to The Customer any additional warranties offered by the manufacturers, at no additional costs to The Customer, should said warranties extend beyond the 20-year period specified herein.

This warranty shall in no manner cover equipment that has been damaged or rendered unserviceable due to negligence, misuse, acts of vandalism, or tampering by The Customer or anyone other than employees or agents of Contractor. Contractor's obligation under its warranty is limited to the cost of repair of the warranted item or replacement thereof. Insurance covering said equipment from damage or loss is to be borne by Contractor until full acceptance of equipment and services.

Approved equal must be made available only upon request by following the formal process of RFI.

1.7. **EXCEPTION PROCESS**

Any exceptions to the requirements in this document must be approved in writing by the UI ITS Representative.

2. SCOPE OF PROJECT / SCOPE OF WORK

2.1. HORIZONTAL CABLING

2.1.1. GENERAL INFORMATION

The Horizontal Structured Cabling System shall consist of Category 6 and Category 6 Augmented cables placed from the Telecommunications Room (TR) designated to the outlets as shown on drawings. All horizontal cables must terminate in the designated TR on 48-port patch panels having the capability to house Category 6 and Category 6A cabling. Wire management must be black in color and used to provide cable management above, below and to each side of the patch panel (2RU double-sided horizontal wire managers with cable radius guides and 8' high, double-sided vertical managers). A detailed parts list with quantities, part numbers of selected manufacturers components, and unit pricing per item must be submitted with each quote, or the quote will not be evaluated. Quotes without this information shall be considered incomplete.

The standard outlet configuration is (3) cables. Refer to drawings, if applicable, for category and quantity for any discrepancies from the minimum acceptable cables.

The pin-out for all horizontal cabling is to be 568A.

The horizontal cable run from the TR to the Work Area Outlet (WAO) must not exceed 295 feet and contain no splices. These cables are to provide service for voice, data, and multimedia as an integrated communications system. Horizontal cabling runs not meeting these criteria will not be accepted except in unusual cases whereby Contractor must inform UI of the situation and request approval in writing by the UI ITS Representative prior to installation.

All horizontal cabling must be blue, white, or yellow in color (for both voice and data).

For all Moves, Adds, and Changes (MAC) work, horizontal cabling must be rated for installation within a plenum (CMP) unless otherwise stated. If, by local codes, CMP is not required Contractor may request written approval from UI for an exception to use riser-rated (CMR) cable. For each project, UI will specify whether CMP or CMR cabling is to be used.

A 40% maximum fill-ratio must be maintained where cables enter a conduit (sleeve, stub-up, conduit run, etc.). 1" conduit is the minimum required size for structured cabling.

Unacceptable Installation: *Twisted pair cable can easily be damaged preventing CERTIFICATION. Twisting, jacket tearing, and kinks in the cable are not allowed and must be replaced. This damage is easily prevented by installers using proper pulling procedures. Remember the maximum tension allowed for the cable being used. Above that amount and the cable has BEEN DAMAGED.*

Contractor must provide all materials to place and terminate all outlet types.

Category 6 modules must match the faceplate color as well as accept icon designators.

2.1.2. OUTLET TYPES / CABLE QUANTITY

- Devices

Wall Phones: must have a minimum of one WAO with one Category 6 cable per location; (refer to drawings for project specification).

Wireless Access Points: must have a minimum of one WAO with two category 6 cable per location. (refer to drawings for project specifications).

Cameras: must have a minimum of one WAO with one Category 6 cable per location; (refer to drawings for project specifications).

Projectors: must have a minimum of one WAO with two Category 6 cable per location; (refer to drawings for project specifications).

Digital Displays: must have a minimum of one WAO with two Category 6 cable per location; (refer to drawings for project specifications).

- Rooms

Offices: must have a minimum of one WAO with three Category 6 cables and a second WAO with conduit raceway and pull string for future; (refer to drawings for project specifications).

Conference Rooms: must have a minimum of one WAO with three Category 6 cables and a second WAO with conduit raceway and pull string for future; (refer to drawings for project specifications).

Classrooms: must have a minimum of one WAO with three Category 6 cables and a second WAO with conduit raceway and pull string for future; (refer to drawings for project specifications).

Unless specified, height to match typical electrical receptacle for designated outlet.

2.2. BACKBONE-FIBER

The Backbone Fiber Riser System must consist of fiber cables with minimal 12-strand 8.3/9-um single mode placed from the telecommunications room on each floor to the inter-building telecom room (usually the "A" closet). All fiber terminations must terminate with LC connectors. All fiber enclosures will be managed with jumper trays below the enclosure. There will also be a required OSP minimum 24 strand single mode fiber from the fiber core building closets (Admin, Gibb, Library and/or McClure) to the inter-building telecom room (usually the "A" closet) of any new building. Note: A building may have more than one inter-building telecom room.

2.3. "SADDLE BAGS OR J HOOKS"

The cabling from the cable tray pathway must be routed to their respective outlets utilizing “saddle bags” (Caddy CableCat or similar) above ceiling. Cables must be bundled in groups of less than 50 and placed no more than 5’ apart following the pathway from the cable tray to WAO. “Saddle bags” and all mounting hardware as well as any placement of these devices are the responsibility Contractor. Horizontal cabling shall be routed through “saddle bags” placed above ceiling as needed to accomplish proper cable routing to work areas. “Saddle bags” and all cable pathways they create must follow building lines and allow access to cabling from hallway and open area locations and not be placed over other end user offices.

2.4. **RACK HARDWARE**

Rack Hardware must be utilized in the Telecommunications Room on each floor and Main Cross-Connect facility to house terminated Category 6 patch panels, fiber termination hardware, and network switch equipment. Each closet contains, typically, three (3) racks with vertical and horizontal wire management. All Rack hardware must be black in color and secured to the floor with appropriate hardware and overhead by cable tray. All racks will be 7 feet in height and 19 inches wide with 3-inch channels.

Vertical cable management must be utilized between each rack and at the end of each rack to manage vertical patch cables (in front) and horizontal cable runs (in back). Full height, front and rear, 6”-8” wide vertical managers must be used in between and at the sides of each 2-post or 4-post rack to provide cable management.

Horizontal wire management must be provided so there is wire management above and below each copper patch panel.

All rack hardware must be grounded to an approved building ground as described in TIA-942.

2.5. CABLE TRAY

2.5.1. HORIZONTAL DISTRIBUTION

Main corridors shall utilize wire basket-type cable tray, minimum 18" width and 6" depth. Any change in direction or elevation of tray or cable must have factory-recommended hardware (Tee's, 90's, waterfalls, proper fastening hardware, etc.). The only exception will be where cable exits tray for another distribution method (i.e. saddle bag (see Section 2.3) pathway, conduit, conduit stub-up, etc.) **AND** no pinch points exist from doing so. All cable trays must be grounded to an approved building ground as described in TIA-942.

2.5.2. TELECOMMUNICATIONS ROOMS

Cable tray (ladder type) must be black in color and placed inside the Telecommunications Rooms to provide a pathway into the room from corridor cable tray and routing the cables to the rack mounted termination hardware. Cable tray will be 18" wide and mounted to walls and racks as shown on drawings. Tray must be mounted above racks and doors to allow a natural cable drop from the tray to the rack. Cable tray must also act as a vertical brace for racks (i.e. secured to the wall with wall angle brackets to prevent any movement in top of rack). All cable trays must be grounded to an approved building ground as described in TIA-942.

2.6. FIRE-STOPPING SYSTEMS DIV 26

Suitable fire-stopping must be used to prevent the spread of smoke and fire throughout the building. Contractor must be responsible for installing fire-stopping system for every wall or floor penetration as required by code. Contractor shall use Hilti CP firestop sleeve or STI's EZ-Path (44 Series for Telecom Rooms and 33 Series for Corridor Firewalls). Contractor to install size and appropriate quantity as to maintain a 40% fill ratio.

2.7. FLOOR BOX/POKE-THRU DIV 26

Floor box/poke-thru devices must be provided for floor locations within Conference Rooms. These devices must include box/poke-thru and frames to allow an outlet to be placed into them. Coordinate with UI's ITS Representative to ensure plate will accept UI-selected manufacturer's connectors.

Poke-thru devices may be provided for access into modular furniture. These devices must offer a 2" pathway to route cables into modular furniture. Contractor must be responsible for any additional protection required to route cables into modular furniture.

2.8. **GROUNDING DIV 26**

Contractor must provide a ground bar at each termination location (Telecommunications Rooms) Contractor shall provide a #6 AWG stranded copper wire cable between ground bars located at each TR and ER to the building main service ground point. This ground conductor must be utilized for grounding termination equipment, equipment rack and cable tray. Grounding system components must be installed as described in TIA-942.

2.9. **CONDUITS, TRENCHING AND DIRECTIONAL BORING DIV 26**

Contractor option – Directional Bore or Trench to install conduit between locations identified on prints. Trenching may not be used through asphalt / concrete locations unless indicated on prints.

Minimum of 24" cover required along length of directional bore / trenching

Place 3" HDPE Communication Duct in trench / bore hole

- JM Eagle Schedule 80 or UI ITS approved equal

Provide Tracer Wire full length of directional bore. Terminate in each handhole using triple nut anchorage.

- 12 gauge solid copper with thermoplastic insulation

Provide Handhole (24"x36" minimum) at each end of bore within 5' of building foundation

- Hubbell Power Systems PG2436BA24 – LABEL = "COMMUNICATION" or approved equal

Coordinate location for building entry with the UI ITS Representative

- If entry is below grade, use watertight seal
- Link Seal Modular Seal or UI ITS approved equal
- If entry is above grade, transition to 3" Rigid Metal Conduit with long-sweep elbows. Provide weathertight seal at entry to building using all weather polyurethane sealant, color to match surrounding finishes.

If entry is through slab on grade, handhole may be eliminated, and HDPE Communication duct may be swept up to grade (near vertical) and cut off approximately 2" above slab. Contractor is responsible for calling for all utility locates and shall pothole all critical crossings prior to boring.

Contractor shall protect all open trenches.

Site Restoration

- Repair all damage to existing systems prior to closing trench.
- Backfill all trenches and borehole openings using "jumping jack" / Plate Compactor type

compaction equipment. Add water to achieve adequate compaction to prevent future settling.

- SOD AREAS
 - Scrape / Retain topsoil (+/- 6" deep) separate from trench spoils. Replace topsoil over well compacted soil. Grade to match existing.
 - Place new sod (New sod shall be equivalent of a ninety-nine percent improved variety blue grass sod).
 - Coordinate sod placement / maintenance with UI Facilities Management.
- PAVED AREAS
 - Replace pavement (concrete / asphalt) to match existing thickness
 - Minimum of 4" thick
 - Protect new pavement from damage until cured

3. WORK AREA OUTLETS

All work area outlets must be Category 6 at a minimum and mounted in extra deep double gang electrical boxes. The WAO must consist of either three (3) RJ-45 or six (6) RJ-45 ports (these are outlet standards but refer to drawings for exact requirements for every location). If surface-mounted raceway is utilized, then raceway manufacturer's extra deep double gang box solution must be required.

Unless specified, height to match typical electrical receptacle for designated outlet.

Where work area outlets are installed above acoustical tile, they shall be within 8" of ceiling tile for access.

3.1. RENOVATION CONCEALED OR FLUSH-MOUNTED

Work area outlets must be capable of reconfiguring, replacing or repairing the connector interface without re-terminating or recertifying the horizontal cabling.

Terminate all jacks according to manufacturer and latest amendment of EIA/TIA 568B guidelines.

Concealed drops should be restricted to hollow wall spaces that are made up of sheet rock on at least one side with no fire blocks. Wall openings shall have a wall-box eliminator (to be Caddy NPLS or NPLS2) installed for the purpose of mounting the faceplate. The wall-box eliminator must be securely fastened to the opening by mechanical means, top and bottom of bracket to ensure snug fit.

Electronic stud finders must be used at all times and before holes are cut in walls. This will eliminate hitting wall studs or in wall cross bracing.

Each cable must be uniquely identified and must have the same I.D. at the jack and telecommunication closet. All numbering must begin with a number provided by the UI ITS Representative and must continue sequentially in the MDF and IDF(s). Any out of sequence terminations must be corrected by Contractor. All jacks must be numbered with the same number as attached cable.

3.2. **RENOVATION EXPOSED OR SURFACE-MOUNTED DIV 26**

Exposed pathways down walls or columns must be installed with metallic latching ducts of the appropriate size that must sufficiently accommodate the cables being routed.

If AC power is run in the same pathway there must be physical separation between the power channel and the data channel of at least ½" and it must contain a metallic barrier (i.e. channeled raceway).

Care should be taken to ensure that cables are not exposed anywhere along the pathway. This means that proper fittings are required for all transition points. (i.e. splice covers and drop ceiling fittings.)

Double-sided tape alone is not sufficient to hold the duct and should only be used in conjunction with anchoring devices mounted a minimum of every (6) six feet. Failure to comply must be corrected at Contractor's expense.

A Minimum of Two (2) - 1/4" anchors must also be used at every device and/or junction box. Failure to comply must be corrected at Contractor's expense.

If surface mount- raceway is utilized, then raceway Manufacturer extra deep solution will be required to house any required amount of cables while still maintaining fill ratios and bend radii.

Each cable must be uniquely identified and must have the same I.D. at the jack and telecommunication closet and within 6" of termination; both workstation and cross connect sides.

3.3. **NEW CONSTRUCTION DIV 26**

Coax cable outlets must be double gang outlet boxes with 1" conduit to the nearest cable tray or saddle bag system (see Section 2.3) used to carry other low voltage cable that is not Category 6 data or telephone cable.

Conduit must have a pull-box after every cumulative 180-degree changes in direction. Pull-boxes must be in readily accessible locations.

No LB type fittings of any size are to be used for communication conduit.

Exposed conduit/surface-mount is not allowed in new construction and can only be used with written permission from the project manager.

No PVC conduit or PVC sleeves are to be used for communications cabling.

Minimum radii for bends shall be 9 ½" for ¾" conduit, 10 ½" for 1" conduit, and the equivalent of long radius bends for larger sizes.

Label all pull and junction boxes.

A nylon pull string must be run in every communication conduit prior to cable installation. A follow string must be left in conduits after cable is installed for future use if the fill does not exceed 40%. In the cable tray it is required to leave a clean unwrapped mule tape for future cabling.

Any conduit pull box, or junction box that is not accessible or does not provide a clear and workable pathway must be replaced at Contractor's expense.

3.4. **ADDITIONAL COPPER CABLING MODULES**

Additional Adapter Modules for copper must include the following:

- F-Type coax coupler module, male-male threaded
- Blank module to reserve space for future additions

The connectors must snap into all LEVITON outlets and modular patch panels.

3.5. **FACEPLATE CONFIGURATION**

W.A.O.'s that require a three (3) port faceplate; jacks must be placed in the faceplate to follow the sequential labeling from top to bottom.

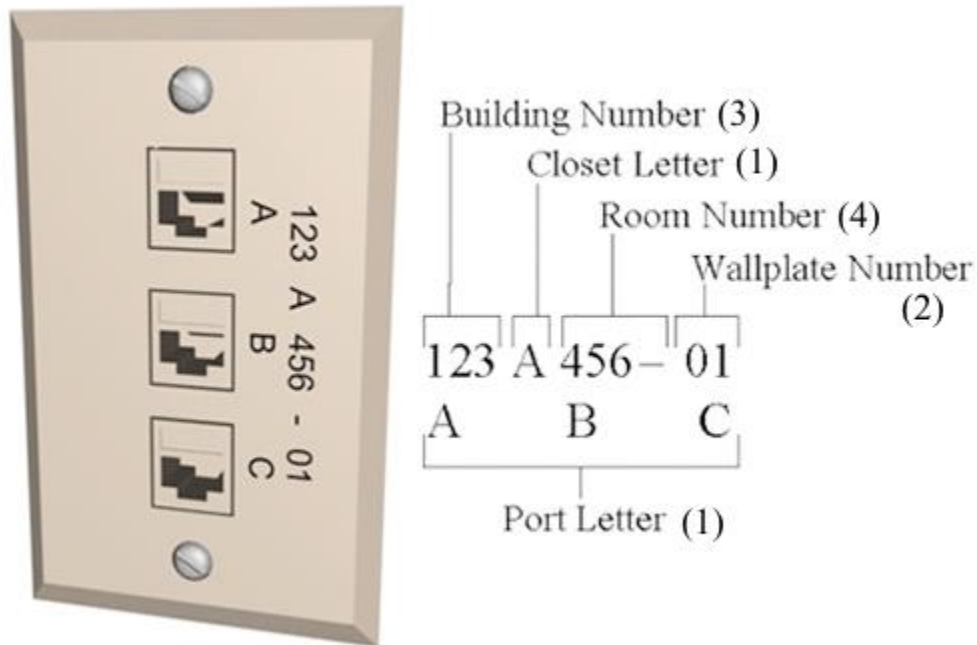
Each cable must be uniquely identified and will have the same I.D. at the jack and telecommunication closet.

3.6. **FACEPLATE LABELING**

Labels follow practices set forth in ANSI/TIA/EIA -606 ADMINISTRATION

Labels and numbering format for both the W.A.O and Telecommunications Rooms (TR) will be assigned by UI's ITS Representative. See below.

First WAO Example: 123 A 456- 01 A,B,C or Information Outlet designation can be on Line 2 at WAO location face plate. Second WAO Example with windows: 123 A 456- on top window and alphanumeric port letter next to each outlet jack.



All labels must be computer generated, wrap-around, self-laminating, and must be permanent. No permanent markers are to be used for final labeling.

Double gang outlets must be numbered left top to bottom, right top to bottom.

Single gang outlets must be numbered top to bottom.

Jack labels must be numbered with the same number as attached cable.

Each end of the Category 6 cable must be labeled at approximately 6" from the Network Data Jack / point of termination.

TR labels must be machine printed on appropriate label holders.

3.7. WALL PHONE FACEPLATES

Wall phone faceplates must be mounted per ADA forward reach specifications. Wall phone faceplates must be required as shown on the communications drawings. Wall phone locations must have only one (1) Category 6 cable pulled to each location.

3.8. MODULAR JACK COLORS

Category 6 jacks must match faceplate in color. Unless otherwise stated to visually indicate Cat6 1 GIG or Cat6A 10 GIG capability.

Blank Inserts must match faceplate in color.

BNC Coaxial bulkheads must match faceplate in color.

Blank covers for empty outlet boxes must match faceplate in color.

4. HORIZONTAL CABLING SUBSYSTEM

4.1. GENERAL GUIDELINES

UI does not pull separate cable for telephone. Telephone connections are included as one of the Category 6 cables at every location. Maximum cable length is 90 meters (295').

All cable must be installed according to BERK-TEK/LEVITON and the EIA/TIA cable installation specifications included by reference within this document. Cable must have a non-coiled slack loop in the TR by taking the longest usable route to terminate and a 3' coiled service loop at stub-up/out location.

Care must be taken to ensure that during the installation nicks, abrasions, burning, and scuffing of cable is prevented. Cables found to be damaged must be replaced at Contractor's expense regardless of whether the cable passes Category 6 testing standards.

All workstation cables must terminate on Category 6/6A, 48-port patch panels that allow the insertion of a disconnect device for independent testing of each side of the circuit for fault isolation without re-termination or re-certification of the installed cable. All labeling must be approved by UI's ITS Representative prior to labeling commencing.

The patch panel layout must be in this format: faceplate1 ports A, B, C, followed by faceplate 2, ports A, B C. Here are additional guidelines for patch panel port organization:

- Patch panel cable terminations should be sorted (top to bottom and left to right) by room number starting with lowest number first.
- Three-port faceplate must start with the A port in either
 - The leftmost position of a six-port group in a patch panel, or
 - The forth position from the left of a six-port group in a patch panel.
- Two-port and one-ports faceplates may be grouped as three or six cables by
 - Combining three two-port faceplate in a six-port group, or
 - Combining a two-port with a one-port in three-port group.
 - In addition, it is acceptable to group all the one-port and two-port faceplates into their own dedicated patch panel(s) and group placed at the end of the patch panels.
- It is required that an empty space be left, so that
 - The leftmost position in each six-port block of the patch panel always with an A port
 - In addition, place black electrician's tape over the unused port.

Patch panel labels should:

- Prepend with one, or two, zeros for rooms with 2 and 1 digit room numbers
 - 006-
 - 020-
- Room number should be followed by a “-”, or a sub-room letter
 - 006-
 - 007A
 - 100B
- Where label space is tight due to
 - Two-port label, the first 4 characters (building and closet) should be omitted.
 - One-port label, the extra white spacing may be removed in addition to the first 4 characters

Here are several examples patch panel label scenarios described above:

844 A	306 – 11		844 A	306 – 12		844 A	306 – 13		306 – 14		306 – 15
A	B	C	A	B	C	A	B	C	A	B	A
											
309 – 01		309 – 02		309 – 03		309 – 04	(No Label)		844 A	309 – 15	
A	B	A	B	A	B	A	B		A	B	C
											

See Appendix A for products and part number examples.

5. TELECOMMUNICATIONS ROOM

The telecommunication rooms (TR) shall house racks, voice termination fields and required cable routing hardware. Racks must be placed in a manner that must allow a minimum of 3’ of clearance from the front and rear mounting surfaces. If the rack is to have electronic equipment in it, then the 3’ measurement must be between the back end of the electronic device and the wall. If one mounting rail of the rack is placed against a wall, the mounting rail must be no closer than 6” to the wall to allow room for vertical management. Where there is more than one rack, the racks must be ganged with vertical management hardware to provide inter-bay

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management. Ganged rack frames must be placed in a manner that must allow a minimum of 3' of clearance from the front and rear mounting surfaces and on one side of the ganged assembly.

The number of TRs will depend on the number of end user locations and the distance from any given location to the TR. The maximum distance between the faceplate and the TR termination is 295 feet.

The TR includes those products that connect the networking equipment to the horizontal and backbone cabling subsystems. These products include termination hardware (connectors and patch cords), racks, cable management products and cable routing products.

Minimum of two 4" sleeves from the communications room to the horizontal infrastructure must be installed (more as required by NEC fill requirements).

Tie into building fire detection / prevention system.

Cross connecting all Telephone and Data services shall be the responsibility of UI.

Location: TR shall be located such that no single horizontal workstation cable shall exceed 90 meters from the Work Area Outlet to the TR/ER termination.

Floor Size: Minimum communications room size is 8' x 10'.

Floor Surface: Non-static asphalt tile floor or 2 coats Non-static concrete floor seal is to be used in TR's.

Ceiling Height: No ceiling is to be installed in the TR unless at a minimum of 8' 6" above finished floor.

Door Size: 3' wide and 6' 7" tall with 180-degree swing away from backboards and racks.

Wall Lining (backboard): AC-grade 3/4" x 4' x 8' sheets plywood, with no voids, covered on all sides with two coats flat black fire-retardant paint.

Lighting: 2-bulb LED light fixtures will be provided. Minimum 500 lux measured at 3' above finished floor.

Power: Minimum Two (2) 20-amp, 110-volt circuits with isolated grounds shall be installed above each equipment rack, one for each rail (due to probability of no ceiling, the outlet box will need to be affixed with uni-strut, work to be coordinated with electrical contractor). Each circuit will be on a dedicated circuit, isolated, non-switched, 4 way.

If the building has an emergency generator, two (2) 20-amp, 110-volt circuits shall be connected to it with 3-prong standard outlets.

Grounding and Bonding: Install a contiguous Intra-building grounding and bonding system in compliance with TIA/EIA-607 using a minimum conductor size of 6 AWG to be located on each plywood backboard with Grounding Bus Bar as directed.

HVAC: Environmentally conditioned (air conditioning) air must be provided to each TR. Maintain constant temperature of 64 - 75 F with minimum of one air change per hour. Networking/Telecommunications equipment heat dissipation is estimated at 3000 Watts per hour. $3.7 \times 3000 = 11,100$ BTU per hour.

Fire Protection: As required by applicable codes. Both vertical and horizontal penetrations are to be fire stopped.

Equipment Rack: 7' x 19" equipment rack with wire management (as specified in materials list) and ladder rack shall be provided and installed as directed.

Racks must be securely attached to the concrete floor using 3/8" hardware.

All racks must be grounded to the telecommunications grounding bus bar.

6. BACKBONE CABLING SYSTEM

6.1. COPPER BACKBONE

Backbone cross-connects for voice connectivity shall be wall-mount 110-type frames. Wiring blocks, connecting blocks and horizontal troughs shall be constructed of polycarbonate molding compound. Wiring blocks shall be marked black every fifth pair. Connecting block terminals shall be constructed of phosphor bronze, plated with a minimum of 150µin of tin-lead over a 50µin minimum nickel underplate. 25-pair frames shall be used as required by the backbone pair counts to be terminated in a given closet. Backbone frames must employ 5-pair connecting blocks on each 25-pair row.

Cables of 25-pair or greater must be a minimum of 24-AWG Category 3, solid conductor cables. Cables must be riser/plenum rated and in standard increments to the size of the project (one pair per ten pair installed horizontal cable fed from respective telecommunications room). Punch-down order should follow traditional USOC color code order for Multi-pair telephone cables.

Each cable must have four labels, specifically a label at each end of the cable and a label on each termination block, or WAO. All termination blocks must utilize a label holder, all labels must be machine printed on one side and have laminate protective cover and adhere well to cable or label holder. Each cable label must be located within 6" of the termination block, or WAO. Each cable label must be machine printed and adhere well to the cable.

6.2. FIBER BACKBONE

6.2.1. FIBER OPTIC RISER CABLES

Riser cables are intra-building cables running between telecom rooms. These cables are run inside innerduct that is attached to a cable tray, J hook system or inside a separate 1" conduit connecting telecom rooms.

Riser/plenum rated cable must be used for all interior installations.

A minimum of 12 single mode fibers must be installed between telecom rooms.

Fiber optic riser cables must be run without splices.

Single mode fibers must be terminated on blue LC connectors.

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Single mode cable fiber optic cable must be 8.3µm/125µm.

Use of EIA/TIA-598 color-coding is required.

Fiber riser cable must be tight buffered, 900µm, mechanically strippable.

It is preferred that fiber be pulled through the cable tray/conduit system by hand power. The use of tension limiting devices is required when power winches or similar devices are utilized to pull cable.

A service loop of 50' minimum is required at each telecom room location when entering or leaving the building.

Fiber cables are to be terminated in 19" rack-mounted enclosures.

All enclosures must have covers that can be closed.

Each enclosure must be labeled with source, destination, and strand count. Each label must be machine printed with permanent ink.

Example: Admin to Library 001C032A024SM

(3-character building number with 1-character TR identifier to 3-character building number with 1-character TR identifier and 3-character fiber count with 2-character fiber type)

Only use 4-character building numbers when building is assigned a 4-character identification number.

If there is no conduit system or inner duct raceway for installation of any fiber, Armored fiber must be installed.

6.2.2. OUTSIDE PLANT FIBER OPTIC CABLE (SINGLE-MODE ONLY)

Outside plant, cable must be used for all applications where cable is run in underground conduits.

Outside plant, fiber cable must be loose tube construction.

Each tube must contain up to 12 fibers.

Single mode fibers must be terminated on LC Connectors.

Outside cable run underground must be run in conduit.

- If an exception is approved to direct bury fiber, then a locate must be installed. See Section 2.9

Outside cable must be loose tube; gel filled utilizing non-hygroscopic, non-conductive, flooded core, homogenous gel.

Use of EIA/TIA-598 color-coding is required.

Buffer tubes requiring stripes must have co-extrusion inlaid stripes of contrasting color.

Pulling tension must not exceed 400 pounds. If mechanical assistance is required to pull cable through conduit system, then the use of a tension limiting device and a force gauge is required.

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Cable must be labeled at each end point. Label must identify cable origination and termination, strand/pair count, and cable type. Label must be UV-resistant.

Example: 001A032A024SM

(3-character building number with 1-character TR identifier to 3-character building number with 1-character TR identifier and 3-character fiber count with 2-character fiber type)

Only use 4-character building numbers when building is assigned a 4-character identification number.

6.2.3. TESTING – RISER, AERIAL, AND UNDERGROUND FIBER OPTIC CABLE

All fibers must be tested after the termination process is complete.

It is the responsibility of Contractor to supply all equipment necessary to test and document all dark and terminated fiber.

All fiber must be tested to EIA/TIA specifications and standards.

All fiber must be tested on the spool before it is pulled to ensure delivery of fiber that is not damaged.

All fiber must be tested in one direction with an OTDR.

All fiber must be tested in both directions with a power meter and source.

All multimode fiber must be tested at 850nm and 1300nm.

All single mode fiber must be tested at 1310nm and 1550nm.

As built drawings for all fiber optic cable are required.

After testing, any fiber that is determined to have excessive attenuation due to broken fiber, excessive bending, bad splices, or defective connectors must be replaced by Contractor at their own expense.

6.3. COAX BACKBONE

(1) Hard-line .500 coax riser cable, or other approved coax riser cable, shall be used to connect building IDF's (Intermediate Distribution Frame / Horizontal cross-connect) to the MDF (Main Distribution Frame / Main cross-connect). One (1) minimal 2" EMT conduit must be installed between termination points. No open cabling shall be installed from IDF to MDF. The above cable runs must be terminated with F type modular connectors these connectors shall be mounted into 19" modular jack patch panel.

7. PATHWAYS AND SPACES

7.1. PATHWAY GUIDELINES

Communications pathways are the single most critical component of structured cable system. In general, UI requires 1" conduit from the wall box to the cable tray. In renovations where cable tray cannot be installed the use of J-hooks or saddlebags are required, however, saddlebags are preferred over J-hooks.

Specifications for conduit runs must be included in Architect's design and drawings.

Cables must follow pre-designed pathways approved by the UI ITS Representative. Design of Pathway must follow the standards set forth in the TIA/EIA 569-A Commercial Building Standard for Telecommunications Pathways and Spaces document. These pathways must be constructed from saddlebags, J-hooks, or properly sized cable tray hung from ceiling but above drop ceiling.

Saddlebags or other cable routing/hanging devices must be attached to independent grid wire and not attached to the existing drop ceiling grid wiring. REASON: The added weight from the cables can cause distortion to the existing grid system.

Conduit must not run through areas in which flammable materials may be stored or over or adjacent to boilers, incinerators, hot water lines, or steam lines.

No cable shall be pulled until complete raceway has been inspected and accepted by the UI ITS Representative.

Conduit runs must be designed to follow the most direct route possible with no more than 180-degree bends between pull boxes and contain no continuous sections longer than 100 feet. Pull boxes must be accessible (after all mechanical systems are in place) and used for runs that exceed 100 feet in length. Conduit must be bonded to ground on one or both ends. All pull boxes must have the insulated bushing installed before cable is pulled.

When multiple conduits are pulled to one box, the minimum box size should be 24"x24"x6". All conduits must maintain run direction through the pull box (i.e. no changing of direction inside the box). The size of pull boxes is determined by the size of conduit leaving the pull box going to the IDF and size of conduit entering the pull box (refer to latest version of BICSI TDMM for sizing).

Cable racks or trays must be used on horizontal cable runs where there is sufficient cable to warrant it. Where possible, directional changes of 90-degree should be made by combining two 45-degree turns or utilizing "T" sections with rounded corners.

Cable trays must be secured using angled wall supports or a standard trapeze type support system. Center-hung supports are unacceptable. They must be secured to the ceiling by either all thread or to I-beams. Grid wire cannot be used with Cable Tray due to cable's weight.

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Cable tray must be supported per manufactures recommendations for appropriate load rating of cable to be installed plus 50%. Example: If a cable tray is to be placed in a corridor supporting 300 cables, install structural support hardware and spacing sufficient to support a load rating of 450 cables.

Cable trays must be used only over areas with ceiling access and must transition to a minimum of three 3-inch conduits when routed over fixed ceiling spaces larger than 10 feet.

Cable trays must be bonded end-to-end.

Cable trays must extend to within 24" of EZ-Path sleeves in corridors and outside the TR.

Primary cable trays must be basket/ snake or aluminum ladder trays. They must be 18 inches wide and at least 6 inches deep. Secondary tray sections may utilize a 12-inch-wide tray. Cable tray must be installed to manufactures recommendations using proper junctions, corners or elevation changes.

After all of the building systems i.e. HVAC, sprinkler, electrical are installed the cable tray must be accessible for the entire length. "Accessible" is the ability to install cable rigging / pulling attachments and be able to retrofit the cable tray with cable isolation devices and attachments. For cable tray sections where a minimum of 12" clearance above and on at least one side (assuming no obstructions below tray exists, preventing access to tray) cannot be maintained, a cable pulley system may need to be installed by Contractor (coordinate with the UI ITS Representative). Failure to comply with this requirement will result in the correction performed at Contractor's expense. No material must penetrate or abstract the pathway. All supports must be from the outside of rail not from center support inside tray.

A pull string for all directional pulls must be installed. Pull a new pull string separate of the cabling. Replacing the string frequently will prevent burning or damaging of cable. Cable pathway must be inspected throughout the project for cleanliness and consistency of following the standard separations. A pull string must be left in place whenever new cables are being pulled.

Ceiling support must be at four to five-foot intervals maximum. Cable pathways must be designed to avoid EMF and RFI interference. Common causes of this interference are fluorescent lighting fixtures, air handling motors and many kinds of electrical controls including starters and power distribution panels. All cable runs must follow BICSI recommendations for distances to be maintained between all voltages from all florescent lights and EMF sources. Any violations of this rule must be corrected at Contractor's expense.

Always follow cable manufactures recommendation and procedures to assure the bend radius is not exceeded when branching off to other areas along a pathway.

Only run parallel with electrical conduits if within cable manufactures recommendations. Route must exceed cable manufactures recommendations for cable distances dependent on the voltage of the devices or conduit in close proximity. Never strap cable runs to electrical conduits.

Properly-rated Velcro cable ties are to be used. Plastic cable ties are not to be used.

Every cable, whether an individual or many grouped together, must be supported. This means shooting grid wire and installing all "saddle bags" on an independent cable pathway system. Remember NEVER use the ceiling grid wire system. Install a separate grid wire. A Saddle bag (see Section 2.3) must be used, DO NOT wrap bare grid wire around the cable bundle for support. Plastic cable ties are NOT to be used as fasteners.

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Using the ceiling grid system is a violation of TIA/ EIA 569 and NEC requirements.

All cable pathways must keep the cable bundle at least six (6) inches off of the ceiling grid system. UI's ITS Representative must approve exceptions.

Never attach cables directly to grid wire with tie straps; always use a Saddle bag (see Section 2.3).

Cables should be properly supported and not sag between Saddle bag (see Section 2.3). If the cable does sag it means you need another Saddle bag (see Section 2.3).

Other low voltage trades (i.e. HVAC controls, security/access control, nurse call, etc.) except fire alarm will be allowed, with prior coordination only, to share tray space, where allowed by code. Those contractors must be required to place physical separators for each system so as to avoid any interference. A minimum of 3" of separation must be maintained throughout. If this is not possible, the voice/data contractor has priority. This does not apply to saddle bags/j-hooks.

Cable tray must be installed to be accessible. 12" of space above, 3" below, and 12" on one side must be free of other ceiling-mounted systems (i.e. mechanical, electrical, and plumbing). Contractor installing tray must coordinate with those trades prior to tray installation for best routing.

Cable may also be installed using raised floor in an approved pathway (no cables to be placed directly on floor) and architecturally designed soffit systems that permit ease of reentrance for future additions.

It is required that proper distances be maintained between cable routes and sources of heat, electromagnetic producing devices such as lighting ballasts, electric motors, and electronic controls.

Entire length of cable pathways must be cleaned by the end of the project. No debris such as clipped cable ties, junk pull string, wall penetration packaging or pieces or other trash is to be left in the ceiling. UI's ITS Representative will perform an inspection of the pathway with Contractor before closing of the ceiling or walls.

Note: If debris not directly related to the current installation is encountered within the pathway, Contractor must notify UI's ITS Representative and provide pricing for clean-up necessary to remedy.

7.2. FIRESTOP GUIDELINES

A firestop system is comprised of: the item or items penetrating the fire rated structure; the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, heat, vapor and pressurized water stream.

All penetrations through fire rated building structures (walls and floors) must be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating items i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. must be properly fire stopped. When penetrating fire-rated corridor/chase walls, a minimum of (2) engineered firestop devices (STI's EZ-Path Series 33) shall be used. Contractor responsible for the final quantity of sleeves based on cable quantity.

If Contractor penetrates a wall or uses an existing penetration for a cable pass-through, he/she must seal the penetration regardless of who punched initial hole.

Note: If improper/inadequate firestopping not directly related to the current installation is encountered within the ceiling plenum/between floors, Contractor must notify UI's ITS Representative and provide pricing for firestopping necessary to remedy.

7.3. FLOOR BOXES/POKE-THRU DEVICES

When installing poke-thru and floor boxes a complete manufacturer/Leviton solution will be required to permit installation and termination of all Category 6 cables (usually 3 cables per location) this solution must take into account the size, length, position, and number of bends to the supply conduit. A separate metal channel or conduit must be supplied for electrical and communication cables. The installer of floor boxes and poke-thru devices will be responsible to provide University of Idaho with a complete solution including all covers, top plates, carpet rings, angle connectors, conduit, flex tube, jacks, and hinged covers which must provide a complete and useable cabling system. The floor box/poke-thru must not pinch patch cables exiting the box. If the box does not permit installation of selected manufacturer's jacks, a 3-port decora quick port type bracket must be used.

- Legrand 8AT Evolution Series or Approved Equal by the UI ITS Representative.

NOTE: Designers of systems, which use floor devices that will be installed in tile floors, must consider and take into account UI's use of floor buffers and liquid floor wax and design accordingly.

8. GROUNDING

The facility must be equipped with a Telecommunications Bonding Backbone (TBB). This backbone must be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential for acting as a current carrying conductor. The TBB must be installed independent of the buildings electrical and building ground and must be designed in accordance with the recommendations contained in the ANSI/TIA/EIA-607-A Telecommunications Bonding and Grounding Standard.

The TBB must be designed and/or approved by a qualified PE, licensed (actual or reciprocal). Installation and termination of the main bonding conductor to the building service entrance ground, at a minimum, must be performed by a licensed electrical contractor.

The ground bar must be no less than 3"x12" in size. Grounding conductors entering IDF's or MDF's must be no less than 4-AWG and labeled "TMGB - Do not disconnect".

All vaults must be grounded back to the main telecom closets ground. Each IDF must tie to the main grounding buss in the MDF. All grounding of racks must be installed by the telecom installer within the IDF or MDF. Grounding must meet EIA/TIA, factory recommendations and all local electrical codes.

All grounding and bonding (racks, cables, cable tray, etc.) must meet the National Electrical Code (NEC®) and be installed as described in TIA-942 as well as local codes, which specify additional grounding and/or bonding requirements.

9. AS-BUILT DRAWINGS

Contractor will be provided with 2 sets of D or E-size drawings at the start of the project. One set will be designated as the central location to document all as-built information as it occurs throughout the project. The central set must be maintained by Contractor's Foreman on a daily basis and must be available to UI's ITS Representative upon request during the course of the project. Anticipated variations from the build-to drawings may be for such things as cable routing and actual outlet placement. No variations will be allowed to the planned termination positions of horizontal and backbone cables, and grounding conductors unless approved in writing by UI's ITS Representative.

Contractor must provide the central drawing set to UI's ITS Representative at the conclusion of the project. The marked-up drawing set must accurately depict the as-built status of the system including termination locations, cable routing, and all administration labeling for the cabling system. In addition, a narrative must be provided that describes any areas of difficulty encountered during the installation that could potentially cause problems to the communications system. A separate and complete set of as-built drawings in digitized (current Visio and AutoCAD) format on USB Thumb drive must be supplied to the ITS Representative.

10. CABLE SYSTEM TESTING

All cables and termination hardware must be 100% tested for defects in installation and to verify cable performance under installed conditions. All conductors and fibers of each installed cable must be verified useable by Contractor prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks must be repaired or replaced in order to ensure 100% useable conductors in all installed cables.

All cables must be tested in accordance with this document, the BERK-TEK/LEVITON PREMEIR Contract agreement, and best industry practices. If any of these are in conflict, Contractor must bring any discrepancies to the attention of the ITS Representative for clarification and/or resolution.

Each cable must be tested for continuity on all pairs and/or conductors. Twisted-pair cables must be tested for continuity, pair reversals, shorts, and opens plus tests that indicate installed cable performance.

Test documentation must be provided in the original electronic format (Linkware) as well as a PDF document via an email attachment or USB Thumb drive. The UI ITS Representative must review and approve the test documentation before final payment is approved. Scanner test results (Category 3, 5e or 6), fiber optic attenuation test results, OTDR traces, and power meter test results must be included. Test data must be presented in the sequence listed in the administration records. The test equipment by name, manufacturer, model number and last calibration date must also be provided at the end of the document. Unless a more frequent calibration cycle is specified by the manufacturer, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document must detail the test method used and the specific settings of the equipment during the test.

Handwritten or excel or word typed test results will not be accepted.

When repairs and re-tests are performed, the problem found, and corrective action taken must be noted. Only "Pass" results and not Marginal Pass* will be accepted unless prior approval is received in writing from UI's ITS Representative due to excessive length.

10.1. **COPPER TESTING**

10.1.1. CONTINUITY

Each twisted pair of every installed cable must be tested using a "green light" test set that shows opens, shorts, polarity and pair-reversals. The test must be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring must be corrected and the cable re-tested prior to final acceptance.

10.1.2. LENGTH

Each installed cable must be tested for installed length using a TDR type device. The cables must be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length must conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B Standard. Cable lengths must be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the longest pair length must be recorded as the length for the cable.

10.1.3. PERFORMANCE VERIFICATION

Category 6 cable must be performance verified using a Fluke DTX Level IV tester at minimum. The tester must have been factory-calibrated within the last 12 months (submit copy of calibration when requested). Test reports generated from a tester without a valid calibration certificate will not be accepted. The test set must be capable of testing for the continuity and length parameters defined above, and provide results for the following tests:

Insertion Loss

Pair-to-Pair Near End Crosstalk (NEXT)

Power Sum Near End Crosstalk (PSNEXT)

Equal Level Far End Crosstalk (ELFEXT)

Power Sum Equal Level Far End Crosstalk (PSELFEXT)

Return Loss (RL)

All Category 6 cable runs must be tested in accordance with the field test specifications defined in the "Commercial Building Telecommunications Cabling Standard" TIA/EIA-568-B.1. The test equipment must

comply with the accuracy levels defined in TIA/EIA 568-B.1 Section 11 “Cabling Transmission Performance and Test Requirements”.

Test results must be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA Standard, and the result shown as pass/fail. Test results must be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results must include all tests performed, the expected test result and the actual test result achieved.

All Category 6 cable runs must be tested in accordance with the field test specifications defined in the “Transmission Performance Specifications for 4-pair 100 Ω Category 6 Cabling” by the Telecommunications Industry Association (TIA); ANSI/TIA/EIA-568-B.2.1. This document must be referred to as the Cat 6 Standard. The test equipment must comply with the accuracy requirements for the level III field testers as defined in the TIA Cat 6 Document. Level IV testers as specified in Draft IEC61935-1 are also permitted.

The Pass or Fail condition for the cabling run under test is determined by the results of the required individual tests. Any Fail or Fail* result yields a Fail for the cabling run under test. In order to achieve an overall Pass condition, the results for each individual test parameter must be a Pass.

A Pass* or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter must be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. Not acceptable as a Pass.

10.2. FIBER OPTIC TESTING

Each fiber strand must be tested for attenuation with an optical power meter and light source. Cable length must be verified using sheath markings. If splices are used, splice attenuation must be verified with an OTDR. The guidelines and procedures established for Tier 1 testing in TIA/TSB-140 must apply.

10.2.1. ATTENUATION

Horizontal distribution single-mode optical fiber attenuation must be measured in one direction at either 1310 nanometers (nm) or 1550 nm using an LED light source and power meter. This measurement is consistent with the loss which network equipment will see under normal installation and use. Backbone single-mode fiber must be tested at both 1310 nm and 1550 nm in one direction. Test set-up and performance must be conducted in accordance with ANSI/TIA/EIA-526-7 Standard, Method B. Test results evaluation for the panel to panel (backbone) or panel to outlet (horizontal) must be based on the values set forth in ANSI/TIA/EIA-568-B.3.

Attenuation testing must be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source must be left in place after calibration and the power meter moved to the far end to take measurements. Maximum attenuation for installed cables must be evaluated based on the following formula: manufacturer's maximum attenuation per kilometer divided by 1000 and then multiplied by the installed cable length in meters (the length based on cable length measurements marked on the jacket is suitable, but if OTDR testing is performed in accordance with 8.2.2, then the actual measured length must be used). Conversion from metric to US Standard measurement must use 3.2808 as a constant with the result rounded to the next highest whole number.

The adjusted cable attenuation value must be added to the manufacturers mean loss per mated pair of connectors multiplied by the number of mated pairs under test (the testing for this project measures the loss over the installed cable plus two jumpers which accounts for three mated pairs of connectors - subtract one mated pair for the equipment interface to arrive at a total of two mated pairs under test).

The expected results for each cable (or group of cables of the same nominal length) must be calculated before the start of testing and recorded in a space provided on Contractor's test matrix. Each strand of fiber in the respective cable must be evaluated against this target number. Any fibers that exceed this value must be repaired or replaced at no cost to The Customer.

10.2.2. LENGTH AND SPLICE LOSS

Each cable must be verified for length using sheath markings, a length-capable power meter or an Optical Time Domain Reflectometer (OTDR). Splices, if used, must be verified for loss using an OTDR. The OTDR measurements for length, if taken, must be performed in accordance with ANSI/TIA/EIA-455-60 (FOTP-60). The measurements to determine splice loss must be performed in accordance with manufacturer's recommendations and best industry practices. Refer to TIA/TSB-140 for additional guidelines. OTDR traces must be taken if one or more of the following conditions exist.

OTDR testing is specifically requested by UI (refer to Tier 2 testing in TIA/TSB-140)

Each strand of all outside plant cables

Each optical fiber splice (fusion or mechanical)

A representative strand of each fiber cable over 300m in length

Where abnormal or unexpected results are obtained during attenuation testing

Where the cable has been subjected to extreme conditions or stresses during installation

11. SYSTEMS ACCEPTANCE

UI's ITS Representative will make periodic inspections of the project in progress and will approve each step of the project to include raceway, roughing in of cable, all terminations before faceplates are secured to wall, labeling, etc. One inspection will be performed at the conclusion of cable pathway installation, prior to closing the ceiling, to inspect the method of cable routing and support, and the fire stopping of penetrations. A second inspection will be performed at the completion of cable termination to validate that cables were dressed and terminated in accordance with ANSI/TIA/EIA specifications for jacket removal and pair untwist, compliance with manufacturer's minimum bend radius, and that cable ends are labeled, and dressed neatly and orderly to UI's satisfaction. Any variance from this will be corrected at Contractor's expense.

All test results and As-Builts must be submitted electronically to the UI ITS Representative before the job or system will be considered complete.

APPENDIX A

APPROVED PRODCUT LIST

The Berk-Tek/Leviton approved product list must consist of the following:

Cat6 Unshielded Twisted Pair Plenum: White- 10136265 or 10136230

Cat6 Unshielded Twisted Pair Non-Plenum: White- 10136343 or 10136340

Cat6A Unshielded Twisted Pair Plenum: White- 10137384 or 11089901

Cat6A Unshielded Twisted Pair Non-Plenum: White- 10137703 or 11084689

48-Port QuickPort Patch Panel: 49255-H48

Cat6 8P8C Modular/QuickPort Jacks: Black- 61110-RB6

Cat6A 8P8C Modular/QuickPort Jacks: Black- 6110G-RE6

Cat6 8P8C Modular/QuickPort Jacks: Ivory- 61110-RIB

Cat6A 8P8C Modular/QuickPort Jacks: Ivory- 6110G-RI6

Compression F Connector: 40985-CPF

F Connector Modular/QuickPort Insert: Ivory- 40831-BI

2 port QuickPort Faceplates with Identification Windows: Ivory- 42080-2IS

4 port QuickPort Faceplates with Identification Windows: Ivory- 42080-4IS

Blank Inserts: Ivory- 41084-BI

Surface Mount 1 Port Box to be used for non-Flush mount locations: Ivory- 41089-1IP

Surface Mount 2 Port Box to be used for non-Flush mount locations: Ivory- 4109-2IP

Surface Mount 4 Port Box to be used for non-Flush mount locations: Ivory- 4109-4IP

Premise Distribution Indoor/Outdoor 12 Strand Single Mode Plenum: PDP012AB0707

Premise Distribution Indoor/Outdoor 12 Strand Single Mode Non-Plenum: PDR012AB0707

Premise Distribution Indoor/Outdoor 24 Strand Single Mode Plenum: PDP024AB0707

Premise Distribution Indoor/Outdoor 24 Strand Single Mode Non-Plenum: PDR024AB0707

OSP 12 Strand Loose Tube gel filled Single Mode Fiber Cable: OPD012AB0403

OSP 24 Strand Loose Tube gel filled Single Mode Fiber Cable: OPD024AB0403

1U Fiber Optic Patch Panel: 5R1UM-S03

2U Fiber Optic Patch Panel: 5R2UM-S06

3U Fiber Optic Patch Panel: 5R3UM-F12

4U Fiber Optic Patch Panel: 5R4UM-F12

Single Mode 12 Port LC Optical Adapter Panels: 5F100-2LL

Single Mode 24 Port LC Optical Adapter Panels: 5F100-4LL

Blank Adapter Panels: Black- 5F100-PLT

Anaerobic Field Polish Fast-Cure Type LC Single Mode Connectors: 49990-SDL

APPENDIX B

BERK-TEK/LEVITON APPROVED EQUAL REQUIREMENTS

Any exceptions to the requirements in this document must be approved in writing by the UI ITS Representative.

To request an alternate manufacturer solution, provide the following supporting documents:

- *Alternate Equal Premier Network Design and Installation Contractor Agreement (current)*
- *Personnel trained and certified to design and install Alternate Equal Products.*
- *Provide proof of all Alternate Equal Installer Certificates and have at minimum of (4) current Alternate Equal Certified Installer Technicians in the local area within (100 miles) of where work is to be performed.*
- *Provide references of the type of installation provided in this specification.*
- *Personnel trained in the Alternate Equal Certified Installer course and be competent in Termination, Splicing, Testing, Trouble Shooting Fiber and Copper Products.*
- *Must be an Alternate Equal Contractor current and in good standing thru the completion of any project with UI.*
- *Alternate Equal non-consumable products must have a minimum 20-year guarantee.*
- *Alternate Equal Appendix A Product List for review.*

APPENDIX C

DIVISION 27 STRUCTURED CABLING CONSTRUCTION VERIFICATION CHECKLIST

Contractor to ensure all drawings, pathways, cables, installation, labels, as-builts, and testing comply with the requirements listed in this document prior to having the UI ITS Representative verify adherence and craftsmanship. Any substandard or improper installation practices will need to be corrected and reviewed once remediation is complete.

UI Structured Cabling Standard

Equipment Identification/Tag: _____

Location: _____

A) Labeling

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)									
				1)	2)	3)	4)	5)	6)	7)	8)	9)	10)
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
☐ CHECKLIST GROUP COMPLETE				INITIALS: _____		DATE: _____							

Question Details

- 1) Equipment Outlet faceplates labeled as specified.
- 2) Cabling at Equipment Outlet labeled as specified.
- 3) Modular Patch Panels for Horizontal Copper Cable labeled as specified.
- 4) Termination Blocks for Horizontal Copper Cable (if applicable) labeled using correct color-coded (BLUE) Designation Strips.
- 5) Termination Blocks for Backbone Copper Cable (if applicable) labeled using correct color-coded (WH, GR, BRN) Designation Strips.
- 6) Fiber Optic Patch Panels for backbone fiber optic cabling labeled as specified.
- 7) Copper Cabling at Modular Patch Panels and Termination Blocks at Main Telecom Room(s) labeled in accordance with specification requirements.
- 8) Fiber Optic Cabling at Patch Panels at Main Telecom Room(s) labeled in accordance with specification requirements.
- 9) Innerduct for backbone fiber optic cabling (if applicable) labeled as specified.
- 10) Backboard, Equipment Racks and Cabinets, and Enclosures labeled as specified.

Negative Responses

Group /Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

UI Structured Cabling Standard

Equipment Identification/Tag: _____

Location: _____

B) Horizontal Cabling – Installation Checks

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)									
				1)	2)	3)	4)	5)	6)	7)	8)	9)	10)
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO

☐ CHECKLIST GROUP COMPLETE
INITIALS: _____
DATE: _____

Question Details

- 1) Exposed cabling has been visually inspected for physical damage and any damaged cabling has been replaced. Cabling jacket and insulation are in good condition.
- 2) Cable color(s) matches specification requirements for given cable type.
- 3) Cable listing (e.g. General Purpose, Riser, Plenum) as specified and appropriate for installation environments.
- 4) Cabling is splice free.
- 5) Bend radii conforms to manufacturer recommendations for each cable type.
- 6) Appropriate slack provided in length required by specifications for given cabling type and termination point.
- 7) Cabling supported via “J-hook” supports at spacing defined within specifications. Supports are independent of piping, ductwork, equipment, cable tray or other conduit.
- 8) Minimum separations provided for cabling per specifications to minimize EMI.
- 9) Penetrations through floor, non-rated walls, or rated walls are sealed as specified for the wall or floor penetrated.
- 10) Communications Cabling pulled in separate conduits from normal power, emergency power, security and control systems.

Negative Responses

Group /Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

UI Structured Cabling Standard

Equipment Identification/Tag: _____

Location: _____

C) Horizontal & Backbone Cabling in Telecom Room– Installation Checks

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)									
				1)	2)	3)	4)	5)	6)	7)	8)	9)	10)
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
☐ CHECKLIST GROUP COMPLETE				INITIALS: _____		DATE: _____							

- 1) Modular Patch Panels and Termination Blocks provided as specified.
- 2) Cable is supported at rear of Patch Panels and at entry to Termination Blocks.
- 3) Copper Twisted Pair terminated as specified. Cable jacket is removed, and Cable pairs untwisted only to the extent required for termination and within manufacturers recommended limits.
- 4) Fiber Optic Patch Panels and Termination Blocks provided as specified.
- 5) Unused Fiber Optic Patch Panel positions fitted with blanks or cover plates as applicable.
- 6) Cable color(s) matches specification requirements for given cable type.
- 7) Cable listing (e.g. General Purpose, Riser, Plenum) as specified and appropriate for installation environments.
- 8) Cabling supported within telecom rooms and in vertical chases as specified. Supports are independent of piping, ductwork, equipment, cable tray or other conduit. Wire-mesh-type support grips or other approved means used where cable must bear stress.
- 9) Appropriate slack provided in length required by specifications for given cabling type and termination point.
- 10) Cabling is splice free.

Negative Responses

Group /Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

UI Structured Cabling Standard

Equipment Identification/Tag: _____

Location: _____

D) Testing Checks

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)									
				1)	2)	3)	4)	5)	6)	7)	8)	9)	10)
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
☐ CHECKLIST GROUP COMPLETE				INITIALS: _____		DATE: _____							

- 1) Maximum Horizontal Copper Cable (Voice/Data) length is less than 295' for all cables installed.
- 2) Copper Horizontal Twisted-pair Cabling Tested as specified.
- 3) Copper Backbone Twisted-pair Cabling Tested as specified.
- 4) Copper Horizontal Coax Cabling Tested as specified.
- 5) Copper Backbone Coax Cabling Tested as specified.
- 6) Fiber Optic Backbone Cabling Tested as specified.
- 7) Fiber Optic Horizontal Cabling Tested as specified.
- 8) Test Results are documented as specified and submitted for review.
- 9) Copper Category Cable Test Results Pass EIA/TIA Parameters.
- 10) Fiber Cable Test Results Pass EIA/TIA Parameters.

Negative Responses

Group /Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

UI Structured Cabling Standard

Equipment Identification/Tag: _____

Location: _____

E) Design Review & As-Built

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)									
				1)	2)	3)	4)	5)	6)	7)	8)	9)	10)
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
☐ CHECKLIST GROUP COMPLETE				INITIALS: _____		DATE: _____							

- 1) Equipment Rack(s) and/or Cabinet(s) Designed as specified, including clearances, anchoring to floor and side bracing.
- 2) Equipment Rack(s) configured with vertical management per specification.
- 3) Cable Runway designed per specification.
- 4) Conduit Raceways designed with minimal 40% fill ratio.
- 5) Power Circuits Verified in TR for Equipment Needs.
- 6) Schematic Design Review. Site Plan, Floor Designations, MDF/IDF/TR Requirements, Exterior Elevations, Square Footage.
- 7) Design Development Review. Fully Dimensional Floor Plan with Designated Rooms, Developed Building Sections, Developed Elevations, Specs.
- 8) Custom Specifications per Project Review. Specifications provided to Design team and applied accordingly to project.
- 9) Construction Documents Review. Completed Drawings for Construction Pricing and Installation.
- 10) As-builts Review. Labeled Correctly, Red Lined Changes, Verified Accurate Quantities and Locations.

Negative Responses

Group /Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		