



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

**Division of Facilities Construction and Management**

**DFCM**

# **STANDARD LOW BID PROJECT Project Budgets Over \$100,000**

**January 12, 2009**

# **HEAT EXCHANGER REPLACEMENT WEBER STATE UNIVERSITY OGDEN, UTAH**

DFCM Project Number: 08059810

Colvin Engineering (Brett Christensen)  
244 West 300 North, Suite 200  
Salt Lake City, Utah 84103

# TABLE OF CONTENTS

	<u>Page Numbers</u>
Title Sheet	1
Table of Contents	2
Notice to Contractors	3
Project Description	4
Project Schedule	5
Bid Form	6
Instructions to Bidders	8
Bid Bond	12
Instructions and Subcontractors List Form	13
Contractor's Agreement	16
Performance Bond	21
Payment Bond	22
Certificate of Substantial Completion	23
General Contractor Past Performance Rating	

Current copies of the following documents are hereby made part of these contract documents by reference. These documents are available on the DFCM web site at <http://dfcm.utah.gov> or are available upon request from DFCM.

DFCM Supplemental General Conditions dated July 15, 2008  
DFCM General Conditions dated May 25, 2005.  
DFCM Application and Certification for Payment dated May 25, 2005.

Technical Specifications :  
Drawings:

**The Agreement and General Conditions dated May 25, 2005 have been updated from versions that were formally adopted and in use prior to this date. The changes made to the General Conditions are identified in a document entitled Revisions to General Conditions that is available on DFCM's web site at <http://dfcm.utah.gov>**

# NOTICE TO CONTRACTORS

Sealed bids will be received by the Division of Facilities Construction and Management (DFCM) for:

**HEAT EXCHANGER REPLACEMENT**  
**WEBER STATE UNIVERSITY – OGDEN, UTAH**  
**DFCM PROJECT NO: 08059810**

Bids will be in accordance with the Contract Documents that will be available on **Monday, January 12, 2009**, and distributed in electronic format only on CDs from DFCM, 4110 State Office Building, Salt Lake City, Utah and on the DFCM web page at <http://dfcm.utah.gov>. For questions regarding this project, please contact Tim K. Parkinson, DFCM, at 801-450-2478. No others are to be contacted regarding this bidding process. The construction estimate for this project is \$230,000.00.

A **mandatory** pre-bid meeting will be held at **9:00 a.m. on Thursday, January 15, 2009** at Weber State University Facilities Management Office. All bidders wishing to bid on this project are required to attend this meeting.

Bids will be received until the hour of **2:00 PM on Wednesday, January 28, 2009** at DFCM, 4110 State Office Building, Salt Lake City, Utah 84114. Bids will be opened and read aloud in the DFCM Conference Room, 4110 State Office Building, Salt Lake City, Utah. NOTE: Bids must be received at 4110 State Office Building by the specified time.

A bid bond in the amount of five percent (5%) of the bid amount, made payable to the Division of Facilities Construction and Management on DFCM's bid bond form, shall accompany the bid.

The Division of Facilities Construction and Management reserves the right to reject any or all bids or to waive any formality or technicality in any bid in the interest of DFCM.

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT  
Joanna Reese, Contract Coordinator  
4110 State Office Building, Salt Lake City, Utah 84114

## **PROJECT DESCRIPTION**

Work includes the replacement of existing tube in shell type heat exchangers. Replace with Plate in Frame type heat exchangers in the following Buildings:

Education  
Science Lab  
Social Science  
South Library  
Allied Health South and North  
Student Services  
Administration  
Stadium Building

Provide all materials and labor necessary for complete finished and operational mechanical systems described in contract drawings and specifications.

**PROJECT SCHEDULE****PROJECT NAME: HEAT EXCHANGER REPLACEMENT – WEBER STATE UNIVERSITY  
OGDEN, UTAH****DFCM PROJECT NO. 08059810**

Event	Day	Date	Time	Place
Bidding Documents Available	Monday	January 12, 2009	1:00 PM	DFCM 4110 State Office Bldg SLC, UT and the DFCM web site *
<b>Mandatory</b> Pre-bid Site Meeting	Thursday	January 15, 2009	9:00 AM	Weber State University Facilities Management Facility
Last Day to Submit Questions	Wednesday	January 21, 2009	8:00 AM	Tim K. Parkinson– DFCM E-mail:tparkins@utah.gov Fax 801-538-3267
Addendum Deadline (exception for bid delays)	Tuesday	January 27, 2009	2:00 PM	DFCM web site *
Prime Contractors Turn In Bid and Bid Bond	Wednesday	January 28, 2009	2:00 PM	DFCM 4110 State Office Bldg SLC, UT
Sub-contractor List Due	Thursday	January 29, 2009	2:00 PM	DFCM 4110 State Office Bldg SLC, UT Fax 801-538-3677
Substantial Completion Date	Thursday	April 30, 2009	5:00 PM	

\* NOTE: DFCM's web site address is <http://dfcm.utah.gov>



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

**Division of Facilities Construction and Management**

**DFCM**

## BID FORM

NAME OF BIDDER \_\_\_\_\_ DATE \_\_\_\_\_

To the Division of Facilities Construction and Management  
4110 State Office Building  
Salt Lake City, Utah 84114

The undersigned, responsive to the "Notice to Contractors" and in accordance with the "Instructions to Bidders", in compliance with your invitation for bids for the **Heat Exchanger Replacement – Weber State University – Ogden, Utah – DFCM Project No. 08059810** and having examined the 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 labor, hereby proposes to furnish all labor, materials and supplies as required for the Work in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the Work required under the Contract Documents of which this bid is a part:

I/We acknowledge receipt of the following Addenda: \_\_\_\_\_

For all work shown on the Drawings and described in the Specifications and Contract Documents, I/we agree to perform for the sum of:

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

(In case of discrepancy, written amount shall govern)

I/We guarantee that the Work will be Substantially Complete by April 30, 2009, should I/we be the successful bidder, and agree to pay liquidated damages in the amount of **\$500.00** per day for each day after expiration of the Contract Time as stated in Article 3 of the Contractor's Agreement.

This bid shall be good for 45 days after bid opening.

Enclosed is a 5% bid bond, as required, in the sum of \_\_\_\_\_

The undersigned Contractor's License Number for Utah is \_\_\_\_\_.

Upon receipt of notice of award of this bid, the undersigned agrees to execute the contract within ten (10) days, unless a shorter time is specified in the Contract Documents, and deliver acceptable Performance and Payment bonds in the prescribed form in the amount of 100% of the Contract Sum for faithful performance of the contract.

The Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the Division of Facilities Construction and Management as liquidated damages for delay and additional expense caused thereby in the event that the contract is not executed and/or acceptable 100% Performance and Payment bonds are not delivered within the time set forth.

Type of Organization:

\_\_\_\_\_  
(Corporation, Partnership, Individual, etc.)

Any request and information related to Utah Preference Laws:

\_\_\_\_\_

Respectfully submitted,

\_\_\_\_\_  
Name of Bidder

ADDRESS:

\_\_\_\_\_

\_\_\_\_\_

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

# INSTRUCTIONS TO BIDDERS

## 1. Drawings and Specifications, Other Contract Documents

Drawings and Specifications, as well as other available Contract Documents, may be obtained as stated in the Invitation to Bid.

## 2. Bids

Before submitting a bid, each contractor shall carefully examine the Contract Documents, shall visit the site of the Work; shall fully inform themselves as to all existing conditions and limitations; and shall include in the bid the cost of all items required by the Contract Documents. If the bidder observes that portions of the Contract Documents are at variance with applicable laws, building codes, rules, regulations or contain obvious erroneous or uncoordinated information, the bidder shall promptly notify the DFCM Representative and the necessary changes shall be accomplished by Addendum.

The bid, bearing original signatures, must be typed or handwritten in ink on the Bid Form provided in the procurement documents and submitted in a sealed envelope at the location specified by the Invitation to Bid prior to the deadline for submission of bids.

Bid bond security, in the amount of five percent (5%) of the bid, made payable to the Division of Facilities Construction and Management, shall accompany bid. **THE BID BOND MUST BE ON THE BID BOND FORM PROVIDED IN THE PROCUREMENT DOCUMENTS IN ORDER TO BE CONSIDERED AN ACCEPTABLE BID.**

If the bid bond security is submitted on a bid bond form other than DFCM's required bid bond form, and the bid security meets all other legal requirements, the bidder will be allowed to provide an acceptable bid bond by the close of business on the next business day following notification by DFCM of submission of a defective bid bond security. **NOTE: A cashier's check cannot be used as a substitute for a bid bond.**

## 3. Contract and Bond

The Contractor's Agreement will be in the form found in the specifications. The Contract Time will be as indicated in the bid. The successful bidder, simultaneously with the execution of the Contract Agreement, will be required to furnish a performance bond and a payment bond, both bearing original signatures, upon the forms provided in the procurement documents. The performance and payment bonds shall be for an amount equal to one hundred percent (100%) of the contract sum and secured from a company that meets the requirements specified in the requisite forms. Any bonding requirements for subcontractors will be specified in the Supplementary General Conditions.

**4. Listing of Subcontractors**

Listing of Subcontractors shall be as summarized in the “Instructions and Subcontractor’s List Form”, which are included as part of these Contract Documents. The Subcontractors List shall be delivered to DFCM or faxed to DFCM at (801)538-3677 within 24 hours of the bid opening. Requirements for listing additional subcontractors will be listed in the Contract Documents.

DFCM retains the right to audit or take other steps necessary to confirm compliance with requirements for the listing and changing of subcontractors. Any contractor who is found to not be in compliance with these requirements is subject to a debarment hearing and may be debarred from consideration for award of contracts for a period of up to three years.

**5. Interpretation of Drawings and Specifications**

If any person or entity contemplating submitting a bid is in doubt as to the meaning of any part of the drawings, specifications or other Contract Documents, such person shall submit to the DFCM Project Manager a request for an interpretation thereof. The person or entity submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by addenda posted on DFCM’s web site at <http://dfcm.utah.gov>. Neither the DFCM nor A/E will be responsible for any other explanations or interpretations of the proposed documents. A/E shall be deemed to refer to the architect or engineer hired by DFCM as the A/E or Consultant for the Project.

**6. Addenda**

Addenda will be posted on DFCM’s web site at <http://dfcm.utah.gov>. Contractors are responsible for obtaining information contained in each addendum from the web site. Addenda issued prior to the submittal deadline shall become part of the bidding process and must be acknowledged on the bid form. Failure to acknowledge addenda may result in disqualification from bidding.

**7. Award of Contract**

The Contract will be awarded as soon as possible to the lowest, responsive and responsible bidder, based on the lowest combination of base bid and acceptable prioritized alternates, provided the bid is reasonable, is in the interests of the State of Utah to accept and after applying the Utah Preference Laws in U.C.A. Title 63, Chapter 56. DFCM reserves the right to waive any technicalities or formalities in any bid or in the bidding. Alternates will be accepted on a prioritized basis with Alternate 1 being highest priority, Alternate 2 having second priority, etc.

**8. DFCM Contractor Performance Rating**

As a contractor completes each DFCM project, DFCM, the architect/engineer and the using agency will evaluate project performance based on the enclosed “DFCM Contractor Performance Rating” form. The ratings issued on this project will not affect this project but may affect the award on future projects.

**9. Licensure**

The Contractor shall comply with and require all of its subcontractors to comply with the license laws as required by the State of Utah.

**10. Permits**

In concurrence with the requirements for permitting in the General Conditions, it is the responsibility of the Contractor to obtain the fugitive dust plan requirements from the Utah Division of Air Quality and the SWPPP requirements from the Utah Department of Environmental Quality and submit the completed forms and pay any permit fee that may be required for this specific project. Failure to obtain the required permit may result in work stoppage and/or fines from the regulating authority that will be the sole responsibility of the Contractor. Any delay to the project as a result of any such failure to obtain the permit or noncompliance with the permit shall not be eligible for any extension in the Contract Time.

**11. Right to Reject Bids**

DFCM reserves the right to reject any or all Bids.

**12. Time is of the Essence**

Time is of the essence in regard to all the requirements of the Contract Documents.

**13. Withdrawal of Bids**

Bids may be withdrawn on written request received from bidder prior to the time fixed for opening. Negligence on the part of the bidder in preparing the bid confers no right for the withdrawal of the bid after it has been opened.

**14. Product Approvals**

Where reference is made to one or more proprietary products in the Contract Documents, but restrictive descriptive materials of one or more manufacturer(s) is referred to in the Contract Documents, the products of other manufacturers will be accepted, provided they equal or exceed the standards set forth in the drawings and specifications and are compatible with the intent and purpose of

the design, subject to the written approval of the A/E. Such written approval must occur prior to the deadline established for the last scheduled addenda to be issued. The A/E's written approval will be in an issued addendum. If the descriptive material is not restrictive, the products of other manufacturers specified will be accepted without prior approval provided they are compatible with the intent and purpose of the design as determined by the A/E.

**15. Financial Responsibility of Contractors, Subcontractors and Sub-subcontractors**

Contractors shall respond promptly to any inquiry in writing by DFCM to any concern of financial responsibility of the contractor, subcontractor or sub-subcontractor.

**16. Debarment**

By submitting a bid, the Contractor certifies that neither it nor its principals, including project and site managers, have been, or are under consideration for, debarment or suspension, or any action that would exclude such from participation in a construction contract by any governmental department or agency. If the Contractor cannot certify this statement, attach to the bid a detailed written explanation which must be reviewed and approved by DFCM as part of the requirements for award of the Project.

**BID BOND**

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

**KNOW ALL PERSONS BY THESE PRESENTS:**

That \_\_\_\_\_ hereinafter referred to as the "Principal," and \_\_\_\_\_, a corporation organized and existing under the laws of the State of \_\_\_\_\_, with its principal office in the City of \_\_\_\_\_ and authorized to transact business in this State and U. S. Department of the Treasury Listed, (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the STATE OF UTAH, hereinafter referred to as the "Obligee," in the amount of \$ \_\_\_\_\_ (5% of the accompanying bid), being the sum of this Bond to which payment the Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

**THE CONDITION OF THIS OBLIGATION IS SUCH** that whereas the Principal has submitted to Obligee the accompanying bid incorporated by reference herein, dated as shown, to enter into a contract in writing for the \_\_\_\_\_ Project.

**NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION IS SUCH**, that if the said principal does not execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the principal, then the sum of the amount stated above will be forfeited to the State of Utah as liquidated damages and not as a penalty; if the said principal shall execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the Principal, then this obligation shall be null and void. It is expressly understood and agreed that the liability of the Surety for any and all defaults of the Principal hereunder shall be the full penal sum of this Bond. The Surety, for value received, hereby stipulates and agrees that obligations of the Surety under this Bond shall be for a term of sixty (60) days from actual date of the bid opening.

**PROVIDED, HOWEVER**, that this Bond is executed pursuant to provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to same extent as if it were copied at length herein.

**IN WITNESS WHEREOF**, the above bounden parties have executed this instrument under their several seals on the date indicated below, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

**DATED** this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

**Principal's name and address (if other than a corporation):**

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

By: \_\_\_\_\_

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

**Principal's name and address (if a corporation):**

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

By: \_\_\_\_\_

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

(Affix Corporate Seal)

**Surety's name and address:**

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

By: \_\_\_\_\_

Attorney-in-Fact (Affix Corporate Seal)

STATE OF \_\_\_\_\_ )  
 ) ss.  
COUNTY OF \_\_\_\_\_ )

On this \_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, personally appeared before me \_\_\_\_\_, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

My Commission Expires: \_\_\_\_\_

Resides at: \_\_\_\_\_

NOTARY PUBLIC

Agency: \_\_\_\_\_  
Agent: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_

Approved As To Form: May 25, 2005  
By Alan S. Bachman, Asst Attorney General

**Division of Facilities Construction and****INSTRUCTIONS AND SUBCONTRACTORS LIST FORM**

The three low bidders, as well as all other bidders that desire to be considered, are required by law to submit to DFCM within 24 hours of bid opening a list of **ALL** first-tier subcontractors, including the subcontractor's name, bid amount and other information required by Building Board Rule and as stated in these Contract Documents, based on the following:

**DOLLAR AMOUNTS FOR LISTING**

**PROJECTS UNDER \$500,000: ALL FIRST-TIER SUBS \$20,000 OR OVER MUST BE LISTED**  
**PROJECTS \$500,000 OR MORE: ALL FIRST-TIER SUBS \$35,000 OR OVER MUST BE LISTED**

- Any additional subcontractors identified in the bid documents shall also be listed.
- The DFCM Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law.
- List subcontractors for base bid as well as the impact on the list that the selection of any alternate may have.
- Bidder may not list more than one subcontractor to perform the same work.
- If there are no subcontractors for the job that are required to be reported by State law (either because there are no subcontractors that will be used on the project or because there are no first-tier subcontractors over the dollar amounts referred to above), then you do not need to submit a sublist. If you do not submit a sublist, it will be deemed to be a representation by you that there are no subcontractors on the job that are required to be reported under State law. At any time, DFCM reserves the right to inquire, for security purposes, as to the identification of the subcontractors at any tier that will be on the worksite.

**LICENSURE:**

The subcontractor's name, the type of work, the subcontractor's bid amount, and the subcontractor's license number as issued by DOPL, if such license is required under Utah Law, shall be listed. Bidder shall certify that all subcontractors, required to be licensed, are licensed as required by State law. A subcontractor includes a trade contractor or specialty contractor and does not include suppliers who provide only materials, equipment, or supplies to a contractor or subcontractor.

**'SPECIAL EXCEPTION':**

A bidder may list 'Special Exception' in place of a subcontractor when the bidder intends to obtain a subcontractor to perform the work at a later date because the bidder was unable to obtain a qualified or reasonable bid under the provisions of U.C.A. Section 63A-5-208(4). The bidder shall insert the term 'Special Exception' for that category of work, and shall provide documentation with the subcontractor list describing the bidder's efforts to obtain a bid of a qualified subcontractor at a reasonable cost and why the bidder was unable to obtain a qualified subcontractor bid. The Director must find that the bidder complied in good faith with State law requirements for any 'Special Exception' designation, in order for the bid to be considered. If awarded the contract, the Director shall supervise the bidder's efforts to obtain a qualified subcontractor bid. The amount of the awarded contract may not be adjusted to reflect the actual amount of the subcontractor's bid. Any listing of 'Special Exception' on the sublist form shall also include amount allocated for that work.

**GROUNDS FOR DISQUALIFICATION:**

The Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law. Director may withhold awarding the contract to a particular bidder if one or more of the proposed subcontractors are considered by the Director to be unqualified to do the Work or for

**INSTRUCTIONS AND SUBCONTRACTORS LIST FORM**  
**Page No. 2**

such other reason in the best interest of the State of Utah. Notwithstanding any other provision in these instructions, if there is a good faith error on the sublist form, at the sole discretion of the Director, the Director may provide notice to the contractor and the contractor shall have 24 hours to submit the correction to the Director. If such correction is submitted timely, then the sublist requirements shall be considered met.

**CHANGES OF SUBCONTRACTORS SPECIFICALLY IDENTIFIED ON SUBLIST FORM:**

Subsequent to twenty-four hours after the bid opening, the contractor may change its listed subcontractors only after receiving written permission from the Director based on complying with all of the following criteria.

- (1) The contractor has established in writing that the change is in the best interest of the State and that the contractor establishes an appropriate reason for the change, which may include, but not is not limited to, the following reasons: the original subcontractor has failed to perform, or is not qualified or capable of performing, and/or the subcontractor has requested in writing to be released.
- (2) The circumstances related to the request for the change do not indicate any bad faith in the original listing of the subcontractors.
- (3) Any requirement set forth by the Director to ensure that the process used to select a new subcontractor does not give rise to bid shopping.
- (4) Any increase in the cost of the subject subcontractor work is borne by the contractor.
- (5) Any decrease in the cost of the subject subcontractor work shall result in a deductive change order being issued for the contract for such decreased amount.
- (6) The Director will give substantial weight to whether the subcontractor has consented in writing to being removed unless the Contractor establishes that the subcontractor is not qualified for the work.

**EXAMPLE:**

Example of a list where there are only four subcontractors:

TYPE OF WORK	SUBCONTRACTOR, "SELF" OR "SPECIAL EXCEPTION"	SUBCONTRACTOR BID AMOUNT	CONTRACTOR LICENSE #
ELECTRICAL	ABCD Electric Inc.	\$350,000.00	123456789000
LANDSCAPING	"Self" *	\$300,000.00	123456789000
CONCRETE (ALTERNATE #1)	XYZ Concrete Inc	\$298,000.00	987654321000
MECHANICAL	"Special Exception" (attach documentation)	Fixed at: \$350,000.00	(TO BE PROVIDED AFTER OBTAINING SUBCONTRACTOR)

\* Bidders may list "self", but it is not required.

**PURSUANT TO STATE LAW - SUBCONTRACTOR BID AMOUNTS CONTAINED IN THIS SUBCONTRACTOR LIST SHALL NOT BE DISCLOSED UNTIL THE CONTRACT HAS BEEN AWARDED.**



SUBCONTRACTORS LIST
FAX TO 801-538-3677

PROJECT TITLE: \_\_\_\_\_

Caution: You must read and comply fully with instructions.

Table with 4 columns: TYPE OF WORK, SUBCONTRACTOR, 'SELF' OR 'SPECIAL EXCEPTION', SUBCONTRACTOR BID AMOUNT, CONT. LICENSE #. The table contains 15 empty rows for data entry.

We certify that:

- 1. This list includes all subcontractors as required by the instructions, including those related to the base bid as well as any alternates.
2. We have listed 'Self' or 'Special Exception' in accordance with the instructions.
3. All subcontractors are appropriately licensed as required by State law.

FIRM: \_\_\_\_\_

DATE: \_\_\_\_\_

SIGNED BY: \_\_\_\_\_

NOTICE: FAILURE TO SUBMIT THIS FORM, PROPERLY COMPLETED AND SIGNED, AS REQUIRED IN THESE CONTRACT DOCUMENTS, SHALL BE GROUNDS FOR OWNER'S REFUSAL TO ENTER INTO A WRITTEN CONTRACT WITH BIDDER. ACTION MAY BE TAKEN AGAINST BIDDERS BID BOND AS DEEMED APPROPRIATE BY OWNER. ATTACH A SECOND PAGE IF NECESSARY.

**CONTRACTOR'S AGREEMENT**

FOR:

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

THIS CONTRACTOR'S AGREEMENT, made and entered into this \_\_\_\_ day of \_\_\_\_\_, 20\_\_, by and between the DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT, hereinafter referred to as "DFCM", and \_\_\_\_\_, incorporated in the State of \_\_\_\_\_ and authorized to do business in the State of Utah, hereinafter referred to as "Contractor", whose address is \_\_\_\_\_.

WITNESSETH: WHEREAS, DFCM intends to have Work performed at \_\_\_\_\_.

WHEREAS, Contractor agrees to perform the Work for the sum stated herein.

NOW, THEREFORE, DFCM and Contractor for the consideration provided in this Contractor's Agreement, agree as follows:

**ARTICLE 1. SCOPE OF WORK.** The Work to be performed shall be in accordance with the Contract Documents prepared by \_\_\_\_\_ and entitled "\_\_\_\_\_."

The DFCM General Conditions ("General Conditions") dated May 25, 2005 and Supplemental General Conditions dated July 15, 2008 ("also referred to as General Conditions") on file at the office of DFCM and available on the DFCM website, are hereby incorporated by reference as part of this Agreement and are included in the specifications for this Project. All terms used in this Contractor's Agreement shall be as defined in the Contract Documents, and in particular, the General Conditions.

The Contractor Agrees to furnish labor, materials and equipment to complete the Work as required in the Contract Documents which are hereby incorporated by reference. It is understood and agreed by the parties hereto that all Work shall be performed as required in the Contract Documents and shall be subject to inspection and approval of DFCM or its authorized representative. The relationship of the Contractor to the DFCM hereunder is that of an independent Contractor.

**ARTICLE 2. CONTRACT SUM.** The DFCM agrees to pay and the Contractor agrees to accept in full performance of this Contractor's Agreement, the sum of \_\_\_\_\_ DOLLARS AND NO CENTS (\$\_\_\_\_\_.00), which is the base bid, and which sum also includes the cost of a 100% Performance Bond and a 100%

CONTRACTOR'S AGREEMENT  
PAGE NO. 2

Payment Bond as well as all insurance requirements of the Contractor. Said bonds have already been posted by the Contractor pursuant to State law. The required proof of insurance certificates have been delivered to DFCM in accordance with the General Conditions before the execution of this Contractor's Agreement.

**ARTICLE 3. TIME OF COMPLETION AND DELAY REMEDY.** The Work shall be Substantially Complete by \_\_\_\_\_. Contractor agrees to pay liquidated damages in the amount of \$\_\_\_\_\_ per day for each day after expiration of the Contract Time until the Contractor achieves Substantial Completion in accordance with the Contract Documents, if Contractor's delay makes the damages applicable. The provision for liquidated damages is: (a) to compensate the DFCM for delay only; (b) is provided for herein because actual damages can not be readily ascertained at the time of execution of this Contractor's Agreement; (c) is not a penalty; and (d) shall not prevent the DFCM from maintaining Claims for other non-delay damages, such as costs to complete or remedy defective Work.

No action shall be maintained by the Contractor, including its or Subcontractor or suppliers at any tier, against the DFCM or State of Utah for damages or other claims due to losses attributable to hindrances or delays from any cause whatsoever, including acts and omissions of the DFCM or its officers, employees or agents, except as expressly provided in the General Conditions. The Contractor may receive a written extension of time, signed by the DFCM, in which to complete the Work under this Contractor's Agreement in accordance with the General Conditions.

**ARTICLE 4. CONTRACT DOCUMENTS.** The Contract Documents consist of this Contractor's Agreement, the Conditions of the Contract (DFCM General Conditions, Supplementary and other Conditions), the Drawings, Specifications, Addenda and Modifications. The Contract Documents shall also include the bidding documents, including the Invitation to Bid, Instructions to Bidders/ Proposers and the Bid/Proposal, to the extent not in conflict therewith and other documents and oral presentations that are documented as an attachment to the contract.

All such documents are hereby incorporated by reference herein. Any reference in this Contractor's Agreement to certain provisions of the Contract Documents shall in no way be construed as to lessen the importance or applicability of any other provisions of the Contract Documents.

**ARTICLE 5. PAYMENT.** The DFCM agrees to pay the Contractor from time to time as the Work progresses, but not more than once each month after the date of Notice to Proceed, and only upon Certificate of the A/E for Work performed during the preceding calendar month, ninety-five percent (95%) of the value of the labor performed and ninety-five percent (95%) of the value of materials furnished in place or on the site. The Contractor agrees to furnish to the DFCM invoices for materials purchased and on the site but not installed, for which the Contractor requests payment and agrees to

safeguard and protect such equipment or materials and is responsible for safekeeping thereof and if such be stolen, lost or destroyed, to replace same.

Such evidence of labor performed and materials furnished as the DFCM may reasonably require shall be supplied by the Contractor at the time of request for Certificate of Payment on account. Materials for which payment has been made cannot be removed from the job site without DFCM's written approval. Five percent (5%) of the earned amount shall be retained from each monthly payment. The retainage, including any additional retainage imposed and the release of any retainage, shall be in accordance with UCA 13-8-5 as amended. Contractor shall also comply with the requirements of UCA 13-8-5, including restrictions of retainage regarding subcontractors and the distribution of interest earned on the retention proceeds. The DFCM shall not be responsible for enforcing the Contractor's obligations under State law in fulfilling the retention law requirements with subcontractors at any tier.

**ARTICLE 6. INDEBTEDNESS.** Before final payment is made, the Contractor must submit evidence satisfactory to the DFCM that all payrolls, materials bills, subcontracts at any tier and outstanding indebtedness in connection with the Work have been properly paid. Final Payment will be made after receipt of said evidence, final acceptance of the Work by the DFCM as well as compliance with the applicable provisions of the General Conditions.

Contractor shall respond immediately to any inquiry in writing by DFCM as to any concern of financial responsibility and DFCM reserves the right to request any waivers, releases or bonds from Contractor in regard to any rights of Subcontractors (including suppliers) at any tier or any third parties prior to any payment by DFCM to Contractor.

**ARTICLE 7. ADDITIONAL WORK.** It is understood and agreed by the parties hereto that no money will be paid to the Contractor for additional labor or materials furnished unless a new contract in writing or a Modification hereof in accordance with the General Conditions and the Contract Documents for such additional labor or materials has been executed. The DFCM specifically reserves the right to modify or amend this Contractor's Agreement and the total sum due hereunder either by enlarging or restricting the scope of the Work.

**ARTICLE 8. INSPECTIONS.** The Work shall be inspected for acceptance in accordance with the General Conditions.

**ARTICLE 9. DISPUTES.** Any dispute, PRE or Claim between the parties shall be subject to the provisions of Article 7 of the General Conditions. DFCM reserves all rights to pursue its rights and remedies as provided in the General Conditions.

**ARTICLE 10. TERMINATION, SUSPENSION OR ABANDONMENT.** This Contractor's Agreement may be terminated, suspended or abandoned in accordance with the General Conditions.

**ARTICLE 11. DFCM'S RIGHT TO WITHHOLD CERTAIN AMOUNT AND MAKE USE THEREOF.** The DFCM may withhold from payment to the Contractor such amount as, in DFCM's judgment, may be necessary to pay just claims against the Contractor or Subcontractor at any tier for labor and services rendered and materials furnished in and about the Work. The DFCM may apply such withheld amounts for the payment of such claims in DFCM's discretion. In so doing, the DFCM shall be deemed the agent of Contractor and payment so made by the DFCM shall be considered as payment made under this Contractor's Agreement by the DFCM to the Contractor. DFCM shall not be liable to the Contractor for any such payment made in good faith. Such withholdings and payments may be made without prior approval of the Contractor and may be also be prior to any determination as a result of any dispute, PRE, Claim or litigation.

**ARTICLE 12. INDEMNIFICATION.** The Contractor shall comply with the indemnification provisions of the General Conditions.

**ARTICLE 13. SUCCESSORS AND ASSIGNMENT OF CONTRACT.** The DFCM and Contractor, respectively bind themselves, their partners, successors, assigns and legal representatives to the other party to this Agreement, and to partners, successors, assigns and legal representatives of such other party with respect to all covenants, provisions, rights and responsibilities of this Contractor's Agreement. The Contractor shall not assign this Contractor's Agreement without the prior written consent of the DFCM, nor shall the Contractor assign any moneys due or to become due as well as any rights under this Contractor's Agreement, without prior written consent of the DFCM.

**ARTICLE 14. RELATIONSHIP OF THE PARTIES.** The Contractor accepts the relationship of trust and confidence established by this Contractor's Agreement and covenants with the DFCM to cooperate with the DFCM and A/E and use the Contractor's best skill, efforts and judgment in furthering the interest of the DFCM; to furnish efficient business administration and supervision; to make best efforts to furnish at all times an adequate supply of workers and materials; and to perform the Work in the best and most expeditious and economic manner consistent with the interests of the DFCM.

**ARTICLE 15. AUTHORITY TO EXECUTE AND PERFORM AGREEMENT.** Contractor and DFCM each represent that the execution of this Contractor's Agreement and the performance thereunder is within their respective duly authorized powers.

**ARTICLE 16. ATTORNEY FEES AND COSTS.** Except as otherwise provided in the dispute resolution provisions of the General Conditions, the prevailing party shall be entitled to reasonable attorney fees and costs incurred in any action in the District Court and/or appellate body to enforce this Contractor's Agreement or recover damages or any other action as a result of a breach thereof.



**PERFORMANCE BOND**  
(Title 63, Chapter 56, U. C. A. 1953, as Amended)

That \_\_\_\_\_ hereinafter referred to as the "Principal" and \_\_\_\_\_, a corporation organized and existing under the laws of the State of \_\_\_\_\_, with its principal office in the City of \_\_\_\_\_ and authorized to transact business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah, hereinafter referred to as the "Obligee," in the amount of \_\_\_\_\_ DOLLARS (\$) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS**, the Principal has entered into a certain written Contract with the Obligee, dated the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, to construct \_\_\_\_\_ in the County of \_\_\_\_\_, State of Utah, Project No. \_\_\_\_\_, for the approximate sum of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_), which Contract is hereby incorporated by reference herein.

**NOW, THEREFORE**, the condition of this obligation is such that if the said Principal shall faithfully perform the Contract in accordance with the Contract Documents including, but not limited to, the Plans, Specifications and conditions thereof, the one year performance warranty, and the terms of the Contract as said Contract may be subject to Modifications or changes, then this obligation shall be void; otherwise it shall remain in full force and effect.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the state named herein or the heirs, executors, administrators or successors of the Owner.

The parties agree that the dispute provisions provided in the Contract Documents apply and shall constitute the sole dispute procedures of the parties.

**PROVIDED, HOWEVER**, that this Bond is executed pursuant to the Provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

**IN WITNESS WHEREOF**, the said Principal and Surety have signed and sealed this instrument this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

**WITNESS OR ATTESTATION:**

\_\_\_\_\_

**PRINCIPAL:**

\_\_\_\_\_

By: \_\_\_\_\_ (Seal)

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

**WITNESS OR ATTESTATION:**

\_\_\_\_\_

**SURETY:**

\_\_\_\_\_

By: \_\_\_\_\_ (Seal)  
Attorney-in-Fact

STATE OF \_\_\_\_\_ )  
 ) ss.  
COUNTY OF \_\_\_\_\_ )

On this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, personally appeared before me \_\_\_\_\_, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney in-fact of the above-named Surety Company and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

My commission expires: \_\_\_\_\_

Resides at: \_\_\_\_\_

\_\_\_\_\_  
NOTARY PUBLIC

<b>Agency:</b> _____
<b>Agent:</b> _____
<b>Address:</b> _____
<b>Phone:</b> _____

Approved As To Form: May 25, 2005  
By Alan S. Bachman, Asst Attorney General

**PAYMENT BOND**

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

**KNOW ALL PERSONS BY THESE PRESENTS:**

That \_\_\_\_\_ hereinafter referred to as the "Principal," and \_\_\_\_\_, a corporation organized and existing under the laws of the State of \_\_\_\_\_ authorized to do business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); with its principal office in the City of \_\_\_\_\_, hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah hereinafter referred to as the "Obligee," in the amount of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS**, the Principal has entered into a certain written Contract with the Obligee, dated the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, to construct \_\_\_\_\_ in the County of \_\_\_\_\_, State of Utah, Project No. \_\_\_\_\_ for the approximate sum of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_), which contract is hereby incorporated by reference herein.

**NOW, THEREFORE**, the condition of this obligation is such that if the said Principal shall pay all claimants supplying labor or materials to Principal or Principal's Subcontractors in compliance with the provisions of Title 63, Chapter 56, of Utah Code Annotated, 1953, as amended, and in the prosecution of the Work provided for in said Contract, then, this obligation shall be void; otherwise it shall remain in full force and effect.

That said Surety to this Bond, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any way affect its obligation on this Bond, and does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of the Contract or to the Work or to the specifications or drawings and agrees that they shall become part of the Contract Documents.

**PROVIDED, HOWEVER**, that this Bond is executed pursuant to the provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

**IN WITNESS WHEREOF**, the said Principal and Surety have signed and sealed this instrument this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

**WITNESS OR ATTESTATION:**

\_\_\_\_\_

**PRINCIPAL:**

\_\_\_\_\_

By: \_\_\_\_\_ (Seal)

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

**WITNESS OR ATTESTATION:**

\_\_\_\_\_

**SURETY:**

\_\_\_\_\_

By: \_\_\_\_\_ Attorney-in-Fact (Seal)

STATE OF \_\_\_\_\_ )  
 ) ss.  
COUNTY OF \_\_\_\_\_ )

On this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, personally appeared before me \_\_\_\_\_, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

My commission expires: \_\_\_\_\_  
Resides at: \_\_\_\_\_

NOTARY PUBLIC

**Agency:** \_\_\_\_\_  
**Agent:** \_\_\_\_\_  
**Address:** \_\_\_\_\_  
**Phone:** \_\_\_\_\_

Approved As To Form: May 25, 2005  
By Alan S. Bachman, Asst Attorney General



CERTIFICATE OF SUBSTANTIAL COMPLETION

PROJECT \_\_\_\_\_ PROJECT NO: \_\_\_\_\_

AGENCY/INSTITUTION \_\_\_\_\_

AREA ACCEPTED \_\_\_\_\_

The Work performed under the subject Contract has been reviewed on this date and found to be Substantially Completed as defined in the General Conditions; including that the construction is sufficiently completed in accordance with the Contract Documents, as modified by any change orders agreed to by the parties, so that the State of Utah can occupy the Project or specified area of the Project for the use for which it is intended.

The DFCM - (Owner) accepts the Project or specified area of the Project as Substantially Complete and will assume full possession of the Project or specified area of the Project at \_\_\_\_\_ (time) on \_\_\_\_\_ (date).

The DFCM accepts the Project for occupancy and agrees to assume full responsibility for maintenance and operation, including utilities and insurance, of the Project subject to the itemized responsibilities and/or exceptions noted below:

\_\_\_\_\_

The Owner acknowledges receipt of the following closeout and transition materials:

- As-built Drawings
- O & M Manuals
- Warranty Documents
- Completion of Training Requirements

A list of items to be completed or corrected (Punch List) is attached hereto. The failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents, including authorized changes thereof. The amount of \_\_\_\_\_(Twice the value of the punch list work) shall be retained to assure the completion of the punch list work.

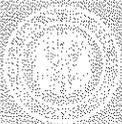
The Contractor shall complete or correct the Work on the list of (Punch List) items appended hereto within \_\_\_\_\_ calendar days from the above date of issuance of this Certificate. The amount withheld pending completion of the list of items noted and agreed to shall be: \$\_\_\_\_\_. If the list of items is not completed within the time allotted the Owner has the right to be compensated for the delays and/or complete the work with the help of independent contractor at the expense of the retained project funds. If the retained project funds are insufficient to cover the delay/completion damages, the Owner shall be promptly reimbursed for the balance of the funds needed to compensate the Owner.

\_\_\_\_\_ by: \_\_\_\_\_  
CONTRACTOR (include name of firm) (Signature) DATE

\_\_\_\_\_ by: \_\_\_\_\_  
A/E (include name of firm) (Signature) DATE

\_\_\_\_\_ by: \_\_\_\_\_  
USING INSTITUTION OR AGENCY (Signature) DATE

\_\_\_\_\_ by: \_\_\_\_\_  
DFCM (Owner) (Signature) DATE

**General Contractor Performance Rating Form**

Project Name:		DFCM Project#	
Contractor:  (ABC Construction, John Doe, 111-111-1111)	A/E:  (ABC Architects, Jane Doe, 222-222-2222)	Original Contract Amount:	Final Contract Amount:
DFCM Project Manager:		Contract Date:	
Completion Date:		Date of Rating:	

Rating Guideline	QUALITY OF PRODUCT OR SERVICES	COST CONTROL	TIMELINESS OF PERFORMANCE	BUSINESS RELATIONS
<b>5-Exceptional</b>	Contractor has demonstrated an exceptional performance level in any of the above four categories that justifies adding a point to the score. Contractor performance clearly exceeds the performance levels described as "Very Good"			
<b>4-Very Good</b>	Contractor is in compliance with contract requirements and/or delivers quality product/service.	Contractor is effective in managing costs and submits current, accurate, and complete billings	Contractor is effective in meeting milestones and delivery schedule	Response to inquiries, technical/service/administrative issues is effective
<b>3-Satisfactory</b>	Minor inefficiencies/errors have been identified	Contractor is usually effective in managing cost	Contractor is usually effective in meeting milestones and delivery schedules	Response to inquires technical/service/administrative issues is somewhat effective
<b>2-Marginal</b>	Major problems have been encountered	Contractor is having major difficulty managing cost effectively	Contractor is having major difficulty meeting milestones and delivery schedule	Response to inquiries, technical/service/administrative issues is marginally effective
<b>1-Unsatisfactory</b>	Contractor is not in compliance and is jeopardizing achievement of contract objectives	Contractor is unable to manage costs effectively	Contractor delays are jeopardizing performance of contract objectives	Response to inquiries, technical/service/administrative issues is not effective

<b>1. Rate Contractors quality of workmanship, management of sub contractor performance, project cleanliness, organization and safety requirement.</b>	<b>Score</b>
<u>Agency Comments:</u>	
<u>A &amp; E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

<b>2. Rate Contractor administration of project costs, change orders and financial management of the project budget.</b>	<b>Score</b>
<u>Agency Comments:</u>	
<u>A &amp; E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

<b>3. Rate Contractor's performance and adherence to Project Schedule, delay procedures and requirements of substantial completion, inspection and punch-list performance.</b>	<b>Score</b>
<u>Agency Comments:</u>	
<u>A &amp; E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

<b>4. Evaluate performance of contractor management team including project manager, engineer and superintendent also include in the rating team's ability to work well with owner, user agency and consultants.</b>	<b>Score</b>
<u>Agency Comments:</u>	
<u>A &amp; E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

5. Rate success of Contractor's management plan, completion of the plans mitigation of project risks and performance of value engineering concepts.	Score
<u>Agency Comments:</u>	
<u>A &amp; E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

<b>Signed by:</b>	<b>Date:</b>	<b>Mean Score</b>
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**Additional Comments:**



# **PROJECT MANUAL**

**WEBER STATE UNIVERSITY HEAT EXCHANGER  
REPLACEMENT IN: EDUCATION, SCIENCE LAB,  
SOCIAL SCIENCE, LIBRARY SUTH, ALLIED HEALTH  
SOUTH/NORTH, STUDENT SERVICES,  
ADMINISTRATION AND STADIUM BUILDINGS**

**WEBER STATE UNIVERSITY  
OGDEN, UTAH**

**Prepared By:**

**Colvin Engineering Associates, Inc.  
244 West 300 North, Suite 200  
Salt Lake City, Utah 84103  
(801) 322-2400**

**December 9, 2008**

WEBER STATE UNIVERSITY HEAT EXCHANGER REPLACEMENT IN:  
EDUCATION, SCIENCE LAB, SOCIAL SCIENCE, LIBRARY SOUTH,  
ALLIED HEALTH SOUTH AND NORTH, STUDENT SERVICES,  
ADMINISTRATION, AND STADIUM BLDGS.

DFCM PROJECT NO. 08059810  
12/09/2008

## TABLE OF CONTENTS

SECTION NUMBER	TITLE
15010	Basic Mechanical Requirements
15050	Basic Mechanical Materials and Methods
15240	Mechanical Sound and Vibration Control
15241	Mechanical Seismic Control
15250	Mechanical Insulation
15410	Plumbing Piping
15411	Disinfecting Water Supply System
15450	Plumbing Equipment
15511	HVAC Piping & Specialties
15548	HVAC Water Treatment

## **MECHANICAL**

SECTION NUMBER	TITLE
15010	Basic Mechanical Requirements
15050	Basic Mechanical Materials and Methods
15240	Mechanical Sound and Vibration Control
15241	Mechanical Seismic Control
15250	Mechanical Insulation
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15411	Disinfecting Water Supply System
15450	Plumbing Equipment
15511	HVAC Piping & Specialties
15548	HVAC Water Treatment

## **ELECTRICAL**

SECTION NUMBER	TITLE
16050	Basic Electrical Materials and Methods
16060	Grounding and Bonding
16071	Electrical Supports and Seismic Restraints
16075	Electrical Identification
16120	Conductors and Cables
16130	Raceways and Boxes

## SECTION 15010 - BASIC MECHANICAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Basic requirements common to the work in general of Division 15 and other Divisions and Sections of the Specification where referenced.
- B. Provide, unless specified otherwise, all labor, materials and equipment necessary for completely finished and operational mechanical systems described and specified under other Sections of this Division 15.
- C. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the work even though not specified or indicated.
- D. Inspection: Inspect work preceding or interfacing with work of Division 15 and report any known or observed defects that affect the Work to the Construction Manager/General Contractor. Do not proceed with the work until defects are corrected.
- E. Existing Utilities: Are indicated as accurately as possible on the Drawings. Close openings and repair damage in acceptable manner to utilities encountered. This Contractor shall be responsible for field surveying all aspects of existing conditions prior to bid date. Change orders will not be issued for a failure to review existing conditions which affect Division 15000 work.
- F. Commissioning is required on this project. Reference sections 15950, 15995, 15997, 15991, 17100.

#### 1.2 GENERAL PROVISIONS

- A. Division 15 will be responsible to carry out the commissioning requirements specified in Section 15995, 15997 and other sections referenced in 17100.

#### 1.3 RELATED WORK

- A. Requirements: Provide Basic Requirements in accordance with the Contract Documents.
- B. Division 1 Commissioning, coordinate as required.

#### 1.4 BID ALTERNATE AND LINE ITEM FORMS

- A. Bid alternates forms and/or line items for Division 15 work. All forms must be filled out in their entirety – no exceptions.

#### 1.5 UTILITIES, EXTENSIONS, CONNECTIONS AND FEES FOR WATER AND SEWER

- A. Provide all building services extensions and connections to off-site and on-site utilities.

- B. Sewer connection charges, typically based on fixture units, that in principle allow the right to obtain the sewer services from the utility will be arranged and paid for by the Division 15 Contractor.
- C. Water system development fees, typically based on meter size, that in principle allow the right to obtain the water services from the utility will be arranged and paid for by the Site Utilities Contractor.
- D. Sewer tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities Contractor.
- E. Water tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities Contractor.
- F. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the Division 15 Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the Division 15 Contractor.
- G. Be responsible for all pads, vaults, manholes, manhole covers, meter enclosures, valves, services boxes, and the like, all in conformance with requirements of the serving utility company.
- H. In the event that the water service to the building is a combination domestic and fire protection service, the responsibility of said "combination service" to the point of domestic connection shall be that of a licensed Fire Protection Contractor, including tap, valves, excavation, backfill, compaction and meters, if any. After point of domestic connection, responsibility for separate fire and domestic services is with appropriate trades including all labor and materials as herein before mentioned.
  - 1. Contractor shall coordinate with other trades all interface piping and types of connections to be provided for interface.
  - 2. Provide fire hydrant, auxiliary gate valve, tapping sleeve and valve or tee, service boxes, and anchor or swivel couplings, thrust blocks, deadmen, rods, and the like, all in conformance with the requirements of serving utility company.

## 1.6 REFERENCES

- A. General:
  - 1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
  - 2. The date of the standard is that in effect as the date of the Contract Documents, except when a specific date is specified.
  - 3. When required by individual Specifications section, obtain copy of standard. Maintain copy at job site during work until substantial completion.
  - 4. Coordinate and reference with Division 01650.

B. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

ADC	Air Diffusion Council 1000 E. Woodfield Rd. Schaumburg, IL 60173 <a href="http://www.flexibleduct.org">www.flexibleduct.org</a>
AGA	American Gas Association 400 No. Capitol St. N.W. Washington, DC 20001 <a href="http://www.aga.org">www.aga.org</a>
AMCA	Air Movement and Control Association 30 West University Drive Arlington Heights, IL 60004 <a href="http://www.amca.org">www.amca.org</a>
ANSI	American National Standards Institute 1819 L Street N.W. Washington, DC 20036 <a href="http://www.ansi.org">www.ansi.org</a>
ARI	Air Conditioning and Refrigeration Institute 4301 No. Fairfax Drive. Arlington, VA 22203 <a href="http://www.ari.org">www.ari.org</a>
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329 <a href="http://www.ashrae.org">www.ashrae.org</a>
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016 <a href="http://www.asme.org">www.asme.org</a>
ASPE	American Society of Plumbing Engineers 8614 W. Catalpa Ave. Chicago, IL 60656 <a href="http://www.aspe.org">www.aspe.org</a>
ASSE	American Society of Sanitary Engineering 901 Canterbury Westlake, OH 44145 <a href="http://www.asse-plumbing.org">www.asse-plumbing.org</a>
ASTM	American Society for Testing and Materials 100 Barr Harbor Dr. West Conshohocken, PA 19428 <a href="http://www.astm.org">www.astm.org</a>

AWS	American Welding Society 550 N.W. LeJeune Rd. Miami, FL 33126 <a href="http://www.aws.org">www.aws.org</a>
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235 <a href="http://www.awwa.org">www.awwa.org</a>
CDA	Copper Development Association 260 Madison Avenue New York, NY 10016 <a href="http://www.copper.org">www.copper.org</a>
CISPI	Cast Iron Soil Pipe Institute 5959 Shallow Ford Rd., Suite 419 Chattanooga, TN 37421 <a href="http://www.cispi.org">www.cispi.org</a>
CS	Commercial Standard of NBS (U.S. Dept. of Commerce, National Institute of Standards and Technology) Government Printing Office Washington, D.C. 20402
CTI	Cooling Technology Institute 530 Wells Fargo Drive Houston, TX 77090 <a href="http://www.cti.org">www.cti.org</a>
ICC	International Code Council 5203 Leesburg Pike, Suite 600 Falls Church, VA 22041 <a href="http://www.intlcode.org">www.intlcode.org</a>
IAPMO	International Association of Plumbing and Mechanical Officials 20001 E. Walnut Drive South Walnut, CA 91789 <a href="http://www.iapmo.org">www.iapmo.org</a>
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 <a href="http://www.nebb.org">www.nebb.org</a>
NEC	National Electric Code (of NFPA)
NEMA	National Electric Manufacturer's Association 1300 N. 17 <sup>th</sup> Street Rosslyn, VA 22209 <a href="http://www.nema.org">www.nema.org</a>

NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincey, MA 02269 <a href="http://www.nfpa.org">www.nfpa.org</a>
NSF	NSF International 789 No. Dixboro Rd. Ann Arbor, MI 48113 <a href="http://www.nsf.gov">www.nsf.gov</a>
OSHA	Occupational Safety Health Administration (U.S. Dept. of Labor) Government Printing Office Washington, D.C. 20402 <a href="http://www.osha.gov">www.osha.gov</a>
PDI	Plumbing and Drainage Institute 45 Brystal Drive South Easton, MA 02375 <a href="http://www.pdionline.org">www.pdionline.org</a>
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association 4201 Lafayette Center Drive Chantilly, VA 20151 <a href="http://www.smacna.org">www.smacna.org</a>
UL	Underwriters Laboratories, Inc. 333 Pfingston Rd. Northbrook, IL 60062 <a href="http://www.ul.com">www.ul.com</a>

## 1.7 DEFINITIONS

- A. Specification Language Explanation: These Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the drawings", "a", "the", are intentional. Supply when "NOTE" occurs on Drawings. Supply words "shall be" or "shall" by inference when colon is used with sentences or phrases. Supply words "on the Drawings" by inference when "as indicated" is used with sentences or phrases. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.
- B. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
- C. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

- D. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.
- E. Indicated: The term "Indicated" is a cross-reference to graphics, notes or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.
- F. General Contractor: The term "General Contractor" used in Division 15 and elsewhere in the Contract Documents means the party with whom the Owner has executed the Owner-Contractor Agreement.
- G. Approved Equal: Except as otherwise defined in greater detail, term "approved equal" means that any materials, equipment, work procedures and techniques shall be either addressed on the drawing, specifications or addendum by manufacturer or by detailed material description. When brand names are referenced it implies that only the manufacturers listed are approved. All approved material, equipment, work procedures, and techniques will be noted in the specifications, drawings, or by addendum prior to bid date. Items not approved in this manner will not be considered.

## 1.8 QUALITY ASSURANCE

- A. Quality Control:
  - 1. Materials and apparatus required for the work to be new and of first-class quality; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article shall be furnished.
  - 2. Furnish the services of an experienced superintendent, who will be constantly in charge of the installation of the work, together with all skilled workmen, fitters, metal workers, certified welders, plumbers, millwrights, sprinkler fitters, drain layers, helpers, and labor required to unload, transfer, erect, connect, adjust, start, operate and test for each system.
  - 3. Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the manufacturer. This includes the performance of tests as recommended by the manufacturer.
- B. Proof of Performance:
  - 1. Division 15 Contractor shall provide proof of performance certification of all Mechanical Equipment and Systems to demonstrate that all Mechanical Equipment and Systems are operating to the intent of the design. This proof of performance shall include, but shall not be limited to, actual demonstration of all temperature/pressure control loops, operation of all heating/cooling equipment and other required tests upon request by the Engineer or Owner. A signed certificate from the piping, sheet metal, control, and balancing subcontractors stating that they have personally checked the operation of all equipment and control loops and that everything under their subcontract is operating as specified. These certificates shall be furnished to the 15990 Contractor for inclusion in the Operation and Maintenance Manual.

- C. All system components, controllers, host computers, portable terminals, and similar equipment, all hardware and software (including third party products) furnished by this contractor shall conform to the following:
  - 1. General Integrity: No value for current date (minimum range from 1980 to 2036) will cause any interruption in operation.
  - 2. Date Integrity: Date-based functions shall behave consistently for dates prior to, during, and after Year 2000 (minimum range from 1980 to 2036).
  - 3. Explicit/Implicit Century: The century in any date shall be specified either explicitly or by unambiguous algorithms or inferencing functions.

## 1.9 REGULATORY REQUIREMENTS

- A. Execute work per Underwriters, Public Utility, Local and State Codes, Ordinances and applicable regulations. Obtain and pay for required permits, inspections, and certificates. Notify Architect of items not meeting said requirements.
- B. Comply with editions of all applicable codes, ordinances and regulations in effect at the time of bid opening including but not necessarily limited to the following:

International Mechanical Code.  
International Plumbing Code.  
International Fuel Gas Code.  
State Department of Health Requirements.  
State Energy Code.  
National Fire Protection Association Standards.  
International Fire Code.  
International Building Code.  
National Electrical Code NFPA-70.  
State Boiler Code.  
Jurisdictional County Health Department.  
Jurisdictional City Wastewater Management Division or District.  
Jurisdictional City Water Department.  
Jurisdictional Water Conservation Standards.  
Code and Manual for the Design and Installation of Mechanical Warm Air Heating Systems – Nation Warm Air Heat and Air Conditioning Association (NWAH and ACA) Manual #9, 4<sup>th</sup> Edition.  
ASME Boiler Construction Code for Low Pressure Heating Boilers.  
ASME Boiler and Pressure Vessel Code.  
Unfired Pressure Vessels – ASME Boiler and Pressure Vessels Codes, including Sec. VIII  
Code of Minimum Requirements for Comfort Air Conditioning (ASHRAE).  
Building Materials and Structures (BMS).  
Uniform Plumbing Code as adopted by the I.A.P.M.O.  
American Standard Plumbing Code ASA A40.  
Utah Plumbing Code.  
Uniform Building Code of the Pacific Coast Building Officials Conference.  
Utah Code for Energy Conservation in New Building Construction.  
Ogden City Codes and Regulations as applicable.  
State of Utah Boiler and Pressure Vessel Compliance Manual.  
Standards of Tubular Exchanger Manufacturers Association – TEMA Standards for Class “C” Heat Exchangers.  
Standards for the Installation for Air Conditioning and Ventilating Systems other than Residence Type – National Board of Underwriters (NBFU) and National Fire Protection Association (NFPA) Pamphlet No. 90A.

NBFU Sprinkler Equipment Standards.  
American Society of Heating, Refrigerating and Air Conditioning Engineers Standards.  
American Welding Society Standards.  
DFCM Design Manual.  
Weber State University Design and Construction Standards.

- C. If discrepancies occur between the Contract Documents and any applicable codes, ordinances, acts, or standards, the most stringent requirements shall apply.
- D. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the IBC, and listed by Underwriters Laboratories, Inc.

#### 1.10 SUBMITTALS

- A. Contractors are required to submit Mechanical Cost Breakdown to Engineer when submitting shop drawings. Shop drawings will not be accepted without a complete Mechanical Cost Breakdown. See last page of this Section for requested breakdown. If your standard compilation of bids is different than our requested breakdown, please send it in your format. We need the data to keep our cost estimating files up to date. Just fill-in blanks with a pencil, typing is not required.
- B. Submit Samples, Shop Drawings and Product Data as required by various Sections of Division 15 in accordance with The General Conditions of the Contract. The Contractor agrees that these Submittals processed by the Engineer are not Change Orders; that the purpose of these Submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. Contractor further agrees that if deviations, discrepancies, or conflicts between these Submittals and the Contract Documents in the form of design drawings and specifications are discovered either prior to or after these Submittals are processed by the Engineer, the Design Drawings and Specifications shall control and shall be followed.
- C. The submittals shall be submitted in a single package with all mechanical equipment for the project enclosed. The submittals shall be both electronic (Adobe Acrobat .pdf format) and hard copies enclosed in a stiff back, 3-ring binder. All mechanical equipment shall be separated with tabbed index cards with an indexed legend provided in the front of the binder.
- D. Test Reports: Submit certified test reports as required by various Sections of Division 15 showing compliance in accordance with General Conditions of the Contract. Signed copies shall be included in the Operation and Maintenance Manual.
- E. Operating Instructions and Maintenance Data: Prepare and submit printed operating instructions and maintenance data in accordance with Operating and Maintenance Data paragraph in this Section.
- F. Submittals will be reviewed and marked as follows:
  - 1. Approved: No action required. Submittals are accepted as submitted.
  - 2. Approved as Noted: Correct the submittals per notes by Engineer and submit new copies of submittal to Contractor for project records. Do not resubmit to Engineer.

3. Revise as Noted: Correct the submittals per notes by Engineer and resubmit to Engineer for approval.
  4. Rejected: Equipment as submitted does not meet requirements of Contract Documents. Revise and/or clarify per comments and resubmit to Engineer.
  5. Submittal not Requested: Submittal not required per specification. Submittal returned with no review.
- G. Note that Engineer's approval does not relieve Contractor from being ultimately responsible for ensuring that submitted items satisfy all requirements of the Contract Documents.
- H. Site Condition and Coordination:
1. Before any equipment is installed and before running and/or fabricating any lines of piping, the Contractor shall provide Engineer 1/4" scale drawings of all mechanical rooms with submitted equipment and verify all other areas to assure himself that they can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the existing Structural and Architectural Work.

#### 1.11 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Substitutions and Prior Approvals: Substitutions and prior approvals will be acceptable only when the proposed substitute has been submitted to the Engineer and approved through an addendum or change order. Request for prior approval shall be submitted a minimum of 10 calendar days prior to bid.
- B. Some materials and equipment are specified by manufacturer and catalog numbers. The manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.
- C. NOTE: When alternate or substitute materials and equipment are used Division 15 Contractor shall be responsible for engineering/redesign costs, space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use. Notification of General Contractor and other affected subcontractors shall be the responsibility of the Division 15 Contractor.

#### 1.12 PROJECT RECORD DOCUMENTS

- A. General: Comply with Division 1.
- B. Job Site Documents: Maintain at the job site, one record copy of the following:
1. Drawings, including mechanical, plumbing and fire sprinkler.
  2. Specifications
  3. Addenda
  4. Reviewed Shop Drawings
  5. Field Test Records

Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.

- C. Record Information: Label each document "Record Document". Mark information with red ink. Keep each record current. Do not permanently conceal any work until required information is recorded.
- D. Record following information on Drawings:
  - 1. Horizontal and vertical location of underground utilities to be dimensioned from column lines.
  - 2. Dimensioned location of internal utilities and appurtenances concealed in construction.
  - 3. Field changes of dimension and detail.
  - 4. Changes by change order or field order.
  - 5. Details not on original contract drawings.
  - 6. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed shall be indicated on equipment schedules.
- E. Record the following information on Specifications:
  - 1. Changes by change order or field order.
  - 2. Other matters not originally specified.
- F. Contractor redlines due to architect/engineer by "Certificate of Occupancy" issued to Owner.
- G. Shop Drawings: Maintain shop drawings as record documents recording changes made after review as specified for drawings above.
- H. Submittal: At completion of project, deliver record documents to Owner's representative and transmit a copy of signed receipt from Owner to the Engineer.

#### 1.13 OPERATING AND MAINTENANCE DATA

- A. Division 15 Contractor shall submit all information in electronic (Adobe Acrobat) format (CD) in addition to five (5) typed and bound copies of the maintenance manual, 8-1/2" x 11" in size, to the Mechanical Consulting Engineer for approval before substantial completion. These approved copies will be returned to the Contractor and shall then be transmitted to the Owner.
- B. Organization of the manuals shall follow the recommendations in ASHRAE Guideline 4-1993.
- C. The manual shall be both electronic (Adobe Acrobat .pdf format) and hard copy enclosed in a stiff-back, three-ring binder and shall have:
  - 1. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
  - 2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/shutdown and long-term shutdown. Note that these instructions are for entire systems. Simply providing manufacturer's shutdown procedures for individual components is unacceptable.
  - 3. Maintenance instructions, including valves, valve tag and other identified equipment lists, proper lubricants and lubricating instructions for each piece of

- equipment and complete systems and necessary cleaning/replacing/adjusting schedules.
4. All test reports and proof of performance certificates.
  5. Manufacturer's data on each piece of equipment, including the following. Provide original printed material in each book, faxes and photocopies are NOT acceptable.
    - a. Installation instructions.
    - b. Drawings and specifications (final shop drawings).
    - c. Parts lists.
    - d. Complete "as-built" wiring and temperature control diagrams. (Shop drawings are not acceptable.)
    - e. Lubrication and other preventative maintenance data.
    - f. Equipment warranties.
    - g. Design intent document furnished by Engineer.
- D. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified on drawings. Insert a copy of the Equipment List or Equipment Schedules in manual.
1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches. Label with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
  2. Tag all manual operating valves per requirements in Section 15050.
  3. Provide a typed tag list or schedule laminated or mounted under plexiglass in the equipment room stating number, location, and function of each tagged item. Insert a copy of tag list in each "Maintenance Manual".
  4. Provide a reduced scale drawing of each floor indicating the location of each manual and automatic valve in every HVAC and plumbing piping system and include valve position number and normal valve position (normally open/normally closed) as per Specification Section 15050. Mount all drawings under plexiglass or laminate and mount on equipment room wall.
- E. Division 15990 Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all mechanical systems, using the maintenance manual as a guide. This individual will be knowledgeable of all systems and manufacturers maintenance and operation recommendations. These meetings must be scheduled through the Architect, Construction Manager/General Contractor and far enough in advance so that all necessary personnel can be adequately notified. These meetings to be video-taped.
1. Submit training certificate and copy of video to Owner's Representatives at end of training and have certificate signed to indicate adequate training has been received.

#### 1.14 OPERATING AND MAINTENANCE MANUALS

- A. The "Operating and Maintenance Manual" (O & M) is a bound compilation of both electronic (Adobe Acrobat .pdf format) and hard copy descriptive drawings and data which identify equipment installed at the project site and detail the procedures and parts required to maintain and repair the equipment. Also, provide a CD-ROM that includes all O & M information included in hard copy. Copies of approved submittals shall be included for all equipment items.

- B. Four sets will be required for each project. These are to be submitted for approval to the Project Manager.
- C. All data and instruction sheets shall be marked to indicate the plan symbol, model, number, and options installed for each item of equipment furnished and installed. These data sheets shall either be reviewed and approved submittals or shall be accompanied by such.
- D. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.
- E. Pages are to be standard 8-1/2" x 11" sheets, or 11" x 17" folded to fit the 8-1/2" x 11" sizes.
- F. Additionally, the following information is to be included:
  - 1. A complete parts list(s) and source of supply for each piece of equipment, marked with model, size, and plan symbol.
  - 2. A copy of the approved submittals for each piece of equipment.
  - 3. The balance report.
  - 4. Performance curves and capacity data, marked with model & size and plan symbol.
  - 5. Wiring diagrams and control sequences marked with model, size and plan symbol in hard copy and AutoCAD format.
  - 6. Control sequences and point schedules from Control Contractor.
- G. Enclose the material in rigid 3-ring binders and submit to the Project Manager at the completion of the project. Binders shall be Buckram binders or prior approved equal with block lettering. Sheet size shall be 8-1/2" x 11" with expandable metal capacity as required for the project. The number of binders forming one O & M Manual shall be based on a maximum limit of 4 inches.
- H. The following information shall appear on the front cover and backbone:
  - 1. "Operation and Maintenance Manual"
  - 2. Project Name (and volume number if more than one volume)
  - 3. Project number
  - 4. University name, Building name, number, and street address
  - 5. \* Architect's name
  - 6. \* Engineer's name
  - 7. \* General Contractor's name
  - 8. \* Mechanical Contractor's name

\* Items "5" through "8" need not be printed on the backbone.
- I. Include a Table of Contents and tabbed index dividers.

#### 1.15 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver and store materials and equipment in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.

- B. Protection: Store materials and equipment off the ground and under cover, protected from damage. Maintain caution labels on hazardous materials.
- C. Large Items: Make arrangements with other contractors on the job for introduction into the building of equipment too large to pass through finished openings.
- D. Handling of Materials: Materials shall be handled, sorted and distributed using appropriate handling methods to protect all materials from damage. Dented, rusted, corroded or otherwise damaged materials shall be removed from the project site. Determination of materials deemed unusable or inappropriate for installation shall be made by the Architect/Engineer.

#### 1.16 PROJECT CONDITIONS AND ASBESTOS HAZARD

##### A. Accessibility and Coordination:

1. Division 15 Contractor shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for proper installation of his work. He shall hold coordination meetings with all trades and Contractors of other Divisions of the Work whose work is in the same space and shall provide coordination drawings showing mechanical, sheet metal, electrical, data, plumbing, fire sprinkler, and indicate pinch points and verify all items will fit before any fabrication is begun or equipment is ordered. Keep one (1) set of these drawings on site at all times. Provide a set of these drawings to the Construction Manager/General Contractor, Commissioning Agent, Architect, and Engineers for review. Such spaces and clearances shall, however, be kept to the minimum size required.
2. Division 15 Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include (but not be limited to) valves, shock absorbers, traps, cleanouts, motors, controllers, switchgear, filters, VAV boxes, control valves, balancing valves, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the Architect/Construction Manager/General Contractor prior to making the change.
3. Division 15 Contractor shall provide the Construction Manager/General Contractor with the exact locations of access doors for each concealed valve, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.
4. Division 15 Contractor to coordinate all utility shutdowns with campus project manager at least 7 days prior to the proposed shutdown.

##### B. Fabrication:

1. Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the Contractor shall provide Architect and Engineer 1/4" scale drawings of all mechanical rooms with submitted equipment and verify all other areas to assure himself that they can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

- C. Freeze Protection:
  - 1. Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection.
- D. Scaffolding, Rigging and Hoisting:
  - 1. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required.
- E. If Contractor during the course of work observes or suspects the existence of asbestos in the structure or building, Contractor shall promptly notify Owner and Architect/Engineer. Owner shall consult with Architect/Engineer regarding removal or encapsulation of the asbestos material and Contractor shall not perform any work pertinent to the asbestos material prior to receipt of special instructions from Owner through the Architect/Engineer.

#### 1.17 COORDINATION

- A. General: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.
- B. Coordination with Electrical Work: Section 15050.
- C. Utility Interruptions: Coordinate mechanical utility interruptions with the Owner and the Utility Company. Plan work so that duration of the interruption is kept to a minimum.
- D. Cutting and Patching: Section 15050.
- E. Drawings and Specifications: The Mechanical Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown is diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Take dimensions, measurements, locations, levels, etc., from the Architectural Drawings and equipment to be furnished.
- F. Each Division 15 subcontractor shall coordinate with other contractors to make certain that any of his equipment, piping or ductwork which is mounted on isolators or flexibly connected does not become "grounded" by another contractors work (e.g. walls, ceiling, etc.).
- G. Discrepancies: Examine Drawings and Specifications for other parts of the work, and if any discrepancies occur between the plans for the work of this Division and the plans for the work of others, report such discrepancies to the Construction Manager/General Contractor and obtain written instructions for any changes necessary.
- H. Order of Precedence: The precedence of mechanical construction documents are as follows:
  - 1. Addenda and modifications to the Drawings and Specifications take precedence over the original Drawings and Specifications.

2. Should there be a conflict within the Specifications or within Drawings of the same scale, the more stringent or higher quality requirements shall apply.
  3. In the Drawings, the precedence shall be Drawings of larger scale over those of smaller scale, figured dimensions over scaled dimensions and noted materials over graphic indications.
  4. Should there be a conflict in dimensions or locations between Mechanical Drawings and Architectural Drawings, the Architectural Drawings shall have precedence.
- I. Schedule all shutdowns of utilities 2 weeks prior to shutdown with Weber State University Campus Design Office.

#### 1.18 START-UP PROCEDURES

- A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, proper control sequence, and any other condition which may cause damage to equipment or endanger personnel.
- B. Insure that all control systems are fully operational in automatic mode. Individually test each control loop to make certain it is operating as intended and is communicating properly with other devices.
- C. If systems are not to continue in use following the start-up procedures, steps should be taken to insure against accidental operation or operation by unauthorized personnel. Provide padlocks on disconnect switches where applicable.
- D. Factory personnel shall be notified as appropriate to start systems requiring their services.
- E. Notify engineer at least 2 weeks prior to the scheduled start-up date of all major mechanical equipment and systems.

#### 1.19 SCHEDULE OF TESTING

- A. Provide testing in accordance with the General Conditions of the Contract.
- B. A schedule of testing shall be drawn up by the Division 15 Contractor in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.
- C. All testing must be performed in the presence of the Architect's/Construction Manager's/General Contractor's representative; his signature for verification of the test must appear on the schedule.
- D. All testing must be performed in accord with the procedures set forth in Division 15 and other Sections of the Specifications where referenced. At completion of testing, the completed schedule shall then be submitted in triplicate to the Architect and a copy shall be forwarded to the 15990 Contractor for inclusion in Operation and Maintenance Manual.
- E. Make all specified tests on piping, ductwork and related systems as specified in this specification.
- F. Make sure operational and performance tests are made on seasonal equipment.

- G. Complete all tests required by Code Authorities, such as smoke detection, life safety, fire protection and health codes.
- H. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters cleaned or replaced, settings on pressure relief valves properly adjusted, valve and pump packings properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required.

#### 1.20 CLEANING AND FINISHING

- A. Provide cleaning in accordance with the General Conditions of the Contract and Division 1.
- B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints and other foreign materials from sight-exposed piping, ductwork, equipment, fixtures and other such items installed under Division 15 of the work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.
- C. Section 15511 Contractor shall be responsible to certify that all HVAC Piping Systems have been cleaned in accordance with Section 15548 - HVAC Water Treatment whether actually done by the Section 15511 Contractor or by the 15548 Contractor.

#### 1.21 WARRANTIES

- A. Warranty: Provide a written warranty to the Owner covering the entire mechanical work to be free from defective materials, equipment and workmanship for a period of one year after Date of Acceptance. During this period provide labor and materials as required to repair or replace defects. Provide certificates for such items of equipment which have warranties in excess of one year. Submit to the Construction Manager/General Contractor for delivery to the Architect. Include a copy of all warranties in the Operation and Maintenance Manual.
- B. This warranty will be superseded by the terms of any specific equipment warranties or warranty modifications resulting from use of equipment for construction heat or ventilation.
- C. All refrigeration compressors shall have a (4) four year extended warranty from the manufacturer of the equipment in addition to the standard one-year warranty.

#### 1.22 PROJECT CLOSEOUT

- A. Project Observation Reports:

At or near the completion of the construction phase of this project, the Engineer will generate one or more Project Observation Reports for the owner. These reports will list the items of construction observed by the Engineer which are not in compliance with the Contract Documents.

The Mechanical Contractor and/or subcontractors shall certify completion of each listed item in writing and forward copies to the Architect, Engineer and General Contractor. The

Engineer will not recommend the payment of retainage until this compliance certification has been received.

Each item on the Project Observation Report shall have a signature/date in the margin of the report indicating completion of that item.

#### 1.23 CERTIFICATES AND KEYS

- A. Certificates: Upon completion of the work, deliver to the Construction Manager/General Contractor one copy of Certificate of Final Inspection.
- B. Keys: Upon completion of work, submit keys for mechanical equipment, panels, etc. to the Construction Manager/General Contractor.

#### 1.24 UNIT PRICES

- A. Refer to Section 01151 - Unit Prices where scope and description of unit prices are given.

END OF SECTION 15010

WEBER STATE UNIVERSITY HEAT EXCHANGER REPLACEMENT IN:  
EDUCATION, SCIENCE LAB, SOCIAL SCIENCE, LIBRARY SOUTH,  
ALLIED HEALTH SOUTH AND NORTH, STUDENT SERVICES,  
ADMINISTRATION, AND STADIUM BLDGS.

DFCM PROJECT NO. 08059810  
12/09/2008

**CONFIDENTIAL**  
(For CEA Use Only)

MECHANICAL COST BREAKDOWN  
(Rounding off to the nearest \$500 is acceptable)

PROJECT NAME: WSU HOT WATER HEAT EXCHANGER REPLACEMENT

BID DATE: (Month/Year) \_\_\_\_\_ CEA PROJECT NO.: 2008-082.00

SUBCONTRACTOR NAME: \_\_\_\_\_

HVAC Equipment:	\$
HVAC Piping Material and Labor:	\$
Sheet Metal Equipment:	\$
Sheet Metal Material and Labor:	\$
Insulation:	\$
Plumbing Equipment and Fixtures:	\$
Plumbing Piping Materials and Labor:	\$
Automatic Temperature Control:	\$
Testing, Adjusting and Balancing:	\$
Fire Protection:	\$

**A completed copy of this form MUST be forwarded to the Engineer before any shop drawings/submittal will be reviewed. See Section 15010, 1.8, A.**

Fax or mail completed form to:

Colvin Engineering Associates, Inc.  
244 West 300 North, Suite 200  
Salt Lake City, Utah 84103  
(801) 322-2400 - Phone  
(801) 322-2416 - Fax

## SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Work furnished but not installed by this Contractor:
  - 1. Access doors in accordance with paragraph 2.3 in this Section 15050.

#### 1.2 SYSTEM DESCRIPTION

- A. The work includes, but is not limited to the following:

Materials and methods common to the work in general of Division 15 and other Divisions and Sections of the Specifications where referenced.

#### 1.3 QUALITY ASSURANCE

- A. Welder Qualifications:
  - a. Each welder shall have passed a qualification test within the past 6 months.
  - b. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications", ASME Section VIII, and ANSI 313.
  - c. The test report shall certify that the welder is qualified to weld the material to be used at the job site.
  - d. The Contractor shall submit three copies of each welder's qualification test report to the Project Manager for approval prior to commencing the work. No welder shall be used on the project until so certified.

#### 1.4 REFERENCES

- A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
  - 1. For electrical equipment and products, comply with applicable National Electrical Manufacturers Association (NEMA) Standards, and refer to NEMA Standards for definitions of terminology herein.
  - 2. Comply with National Electrical Code (NEC) NFPA-70 for electrical installation requirements.
  - 3. Certified Pipe Welding Bureau (NCPWB) and American National Standards Institute (ANSI) Code Numbers B31.2, & B31.9 as applicable for welding requirements.
  - 4. Comply with American National Standards Institute (ANSI A13) for identification of piping systems.

5. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.
6. State of Utah, Division of Facilities Construction and Management Design Criteria.
7. Weber State University Design and Construction Standards for Architects, Engineers and Contractors, revised August 2004.
8. Use all applicable inspection, testing and turnover forms by DFCM Design Criteria dated March 10, 1995, Mechanical Appendix 1, Attached in Part 3 of this section.

## 1.5 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:
  1. Legend and color of piping and equipment identification.
  2. Freeze Protection Systems for Piping and Equipment (Heat Tracing).
  3. Domestic Hot Water Heat Maintenance System.
- B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data Paragraph in Section 15010.
  1. Motors.
  2. Starters.
- C. Certificates: Before proceeding with the Work, submit to the Architect/Construction Manager/General Contractor, two copies of Certification that the welding work will be done according to ANSI B31.1 by welders who have been tested and whose qualification test sheets are available, attesting to their ability to weld in accordance with the Standard Procedure Specifications as established by the National Certified Pipe Welding Bureau.

## PART 2 - PRODUCTS

### 2.1 MOTORS

- A. General: Furnish motors necessary to operate mechanical equipment.
- B. Motor Characteristics: Comply with the following requirements:
  1. Variable Speed Drive Compatibility: All motors which are powered through a variable frequency drive shall conform to NEMA MG-1, Part 31 for inverter duty and shall be capable of continuous operation at 20% of nominal speed and shall meet the requirements of the Variable Frequency Drive specification in Section 15910 or Division 16 as applicable.
  2. Altitude Deration: Motors to be furnished to maintain specified rated service factor at altitude of project.
  3. NEMA Temperature Rating: Rated for 40 deg.C environment for continuous duty at full load, Class B motor temperature rise. Motors for use with variable frequency drives shall be Class F Insulated.
  4. Starting Capability: Provide each motor capable of making starts as frequently as indicated by the automatic control system.

5. Phases and Current Characteristics: Provide squirrel-cage induction polyphase motors for 3/4 horsepower and larger, and provide capacitor-start single-phase motors for 1/2 horsepower and smaller. One-sixth horsepower and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 16 and with individual equipment requirements specified in other Sections of Division 15. Provide two separate windings on polyphase two speed motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
6. Power Factor: All motors rated greater than 1000 watts shall have a Power Factor of not less than 85% under rated load conditions. The 85% PF may be obtained by design of the motor or by providing a capacitor. Capacitors, if provided to obtain the 85% PF, must be switched with the motor. If the motor draws less than 1000 watts at full load, it is excluded from the 85% power factor requirement.
7. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors. Motors shall be selected such that the brake horsepower requirement is not within the service factor at design load.
8. Efficiency: All motors shall be energy efficient type in accordance with the current State Energy Code, except where a higher efficiency is noted on drawings.
9. Motor Construction: Provide Design "B" motors for general purpose continuous duty and Design "C" motors where required for high starting torque such as the low speed motor on fans with a two-motor drive arrangement. Small motors that are part of packaged equipment may be manufacturer's standard motors meeting Energy Code requirements for efficiency.
  - a. Bearings: Ball or roller bearings with inner and outer shaft seals: regreasable; except permanently sealed where motor is normally inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in the motor, provide bearings designed to resist the thrust loading. Refer to individual sections of Division 15 for fractional horsepower light-duty motorized equipment where sleeve-type bearings are permitted.
  - b. Enclosure Type: Except as otherwise indicated, provide open drip-proof motors for indoor use where satisfactorily housed during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual Sections of Division 15 for other enclosure requirements.
  - c. Overload Protection: Provide built-in thermal overload protection for each leg of each phase and, where indicated, provide internal sensing device suitable for signaling and stopping the motor at the starter. Thermal overload protectors shall be sized to accommodate the altitude of installation.
  - d. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, NEMA efficiency, power factor, special features and similar information.
  - e. Motor Connections: Provide conduit connection boxes.
  - f. Motors shall not exceed 80dbA rating when running their full speed and power range.

## 2.2 STARTERS

- A. General: Furnish starters and contactors necessary to operate mechanical equipment motors. **Starter manufacturer shall be the same brand for ALL motors furnished under Division 15.** Approved manufacturers shall be those listed in Division 16 or this specification.
- B. Motor Starter Characteristics: Comply with NEMA standards and NEC. Furnish Type I general purpose enclosures with padlock ears, and with frames and supports for mounting on wall, floor or panel as required. Furnish the type and size of starter recommended by the motor manufacturer and equipment manufacturer for the applicable protection and start-up condition; refer to individual equipment sections for basic load requirements. All starters shall be by the same manufacturer. Only manufacturers approved by Division 16000 will be accepted. All starters shall comply with Division 16000 requirements.
- C. Manual Control:
  - 1. Furnish maintained-contact push buttons and L.E.D. pilot lights, properly arranged for single-speed or multi-speed operation as indicated.
  - 2. Furnish manual switch and L.E.D. pilot light for motors 1/3 horsepower and smaller, except where interlock or automatic operation is indicated.
- D. Automatic Control:
  - 1. Furnish magnetic starters for motors 1/2 horsepower and larger and for smaller motors where interlock or automatic operation is indicated. Include the following:
    - a. Maximum number of auxiliary contacts available: three or more.
    - b. "Hand-Off-Automatic" switches in starter cover.
    - c. Interlocks, pneumatic switches and similar devices as required for coordination with the control requirement specified in Section 15955-Electronic Controls.
    - d. Built-in 120 volt control circuit transformer, fused from line side, where service exceeds 240 volts.
      - 1) Control circuit conductors to be protected in accord with the National Electrical Code.
    - e. Trip-free thermal overload relays, each phase.
    - f. Externally operated manual reset except on refrigeration compressors which shall have automatic reset. Automatic reset shall be limited to three attempts. If motor fails to start after three attempts, manual reset shall be required.
    - g. Undervoltage release or protection.
    - h. Phase failure/phase reversal protection on all legs.
- E. Weather Protection: Provide weather-proof mounting of magnetic starters for equipment outside of the building.
- F. Note that some starters are furnished and installed under Division 16.

## 2.3 ACCESS DOORS

- A. Furnish steel access doors, minimum size required 24"x24" for normal service use or as sized on drawings as manufactured by Inryco/Milcor, Walsh, Hannan, or Gladwin Co., where shown on mechanical or architectural drawings, and where required for access to valves, shock absorbers, dampers, mechanical equipment or appurtenances.
- B. Standard Doors:
  - 1. Frames: 16 ga. steel.
  - 2. Panels: 14 ga. steel.
  - 3. Finish: Chemically bonded prime coat of baked enamel.
  - 4. Hinge: Concealed spring hinges openable to 175 degree; removable pins. Provide number of hinges as recommended by manufacturer for size of door.
  - 5. Locking Devices: Flush steel, screwdriver operated, cam type locks. All access doors below 8'-0" in public areas shall be key-operated cylinder lock with two keys. Same key shall open all access doors.
  - 6. Style of doors shall be appropriate for architectural finish at door location. Furnish masonry anchors where required.
- B. Fire Rated Doors:
  - 1. Frames: 16 ga. steel.
  - 2. Panels: Sandwich type, 20 ga. steel sheets, manufacturer's standard insulated core.
  - 3. Finish: Chemically bonded prime coat of baked enamel.
  - 4. Hinge: Continuous type, steel with stainless steel pin.
  - 5. Closer: Automatic closing mechanism.
  - 6. Locking Devices: Self-latching, key-operated cylinder lock with two keys; interior, latch release mechanism.
  - 7. Style of doors shall be appropriate for architectural finish at door location.
  - 8. Fire rated doors shall have components and assemblies meeting requirements of the American Insurance Association, Factory Mutual Insurance Association and listed by Underwriters Laboratories, Inc.
- C. Exact location of access doors shall be as directed by Mechanical Contractor and approved by the Architect.
- D. Doors shall be installed by the General Contractor.
- E. Access doors are to be lockable in public places.

## 2.4 VALVES

- A. General:
  - 1. Provide valves as specified herein and as indicated on the Drawings complete with accessories and attachments as required and appropriate for the pressure/temperature of system.
  - 2. Supply valves for proper pressure ratings determined by the system working pressures at point of use and of proper types for systems and functions indicated.

3. Steam and Condensate System Isolation Valves: Use steam rated ball valves on pipe sizes 2" and smaller. Use gate valves on pipes larger than 2". Use globe valves on manual bypass lines.
4. Provide like type valves of one manufacturer only unless specified otherwise.
5. Plainly and permanently mark valves with manufacturer's name or trademark, pressure rating, both Cold Working Pressure (CWP) and Steam Working Pressure (SWP), as applicable and flow direction when required to prevent improper installation.
6. Mark valves requiring approval by Underwriter's Laboratories (UL) or Factory Mutual Engineering Division (FM) with appropriate markings cast into the valve body.
7. Provide extended necks as appropriate for insulation.

B. Manufacturers:

1. The following manufacturers are acceptable providing the product to be considered is equivalent in every respect to the nomenclature provided by the specified make and model.
  - a. Bronze Valves: Powell, Milwaukee, Crane, Hammond, Nibco.
  - b. Iron Body Valves: Powell, Milwaukee, Traverse City, Kennedy, Iowa, American, Nibco.
  - c. U.L., F.M. Approved or Listed Valves: Nibco, Demco, Pratt, Kennedy, Mission, Milwaukee, Hammond.
  - d. Ball Valves: Hammond, Watts, Jamesbury, Worcester, Milwaukee, Apollo, Powell, Dynaquip, Nibco, Spirax Sarco.
  - e. Butterfly Valves: Milwaukee, Hammond, Centerline, DeZurik, Fisher, Victaulic, Keystone, Posi-Seal, TEC, Flowseal, Nibco.
  - f. Lubricated Plug Valves: Homestead, Nordstrom, Powell.
  - g. Non-Lubricated Eccentric Plug Valves: DeZurik.
  - h. Stop and Drain and Drain Valves: Milwaukee, Hammond, Prier, Nibco or United Brass.
  - i. Gas Cock: Peter Healy or Crane.

C. Valve Schedule:

1. Standard Bronze Valves - 150 SWP/300 CWP. Per ASTM B61/B62. No brass materials will be accepted.
  - a. Check, Gate, and globe with union bonnet and rising stem.
  - b. Sizes 1/8 through 2 inches.
  - c. Schedule:

Plan Code:	G.V.	GL.V.	C.V.	L.C.V.
Valve Type:	Gate	Globe	Swing	Lift
Make:	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-134	T-235Y	T-433Y	365.5
Straight Soldered:	S-134	S-235Y	S-433Y	--
Angle Threaded:	--	T-335Y	--	--
Angle Soldered:	--	--	--	--

2. Standard Iron Body Valves - 125 SWP/200 CWP.

- a. Gate, globe and check.
- b. Sizes 2-1/2 through 12 inches.
- c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	W.C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Weighted	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-619	T-617-0	T-718B	T-918Y	T-918YBLW	--
Straight Flanged:	F-619	F-617-0	F-718B	F-918Y	F-918YBLW	23
Angle Threaded:	----	----	T-818B		----	----
Angle Threaded:	----	----	F-818B	----	----	----

3. Standard Iron Body Valves - 150 SWP/300 CWP.

- a. Gate, globe and check.
- b. Sizes 2 through 12 inches.
- c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Crane (Chapman)
Straight Threaded:	T-669	T-667-0	--	--	--
Straight Flanged:	F-669	F-667-0	F-768B	F-968B	223
Angle Threaded:	--	--	--	--	--
Angle Flanged:	--	--	F-868B	--	

4. UL and FM Approved Valves.

- a. Gate, check and butterfly.
- b. Sizes all.
- c. Schedule:

Plan Code:	OS&Y	C.V.	W.V.C.	BF.V	D.V.
Valve Type:	Gate	Swing	Wafer	BTFY	Drain
Make:	Nibco	Nibco	Nibco	Demco	Nibco
Straight Threaded:	T-104-0	T-413W	--	--	T-211Y
Straight Flanged:	F-607-0	F-908-W	--	--	--
Wafer:	--	--	W-900-W	NE-H	--

5. UL and FM Approved Valves - 175 Pound Water.

- a. Post indicator with indicator post.
- b. Sizes 4 through 12 inches.

c. Schedule:

Plan Code:	P.I.V.	P.I.V.B.F.
Valve Type:	Gate	BTFY
Make:	Nibco	Demco
Straight Flanged:	F-609	NE-H (Wafer)
Mechanical Joint:	M-609	--
Indicator Post Vertical:	NIP-1	Stem extension and gear operator with post indicator U.L. Listed only.
Indicator Post through Wall:	NIP-2	--

6. Underground Valves - 175 Pound Water, American Water Works Association (AWWA).

- a. Gate valves with service boxes.
- b. Sizes (see schedule).
- c. Schedule:

Plan Code:	GV & SB	GV & SB
Size/Inches:	3/4 thru 2	2 thru 16
Valve Type:	Oriseal	Gate
Make:	Mueller	Mueller
Model:	H-15201	A-2380-22 or 2380-18
Service Box:	H-10396-86	H-10357
Base:	H-10396-7-8-9 or H-10400	No. 6 Oval
Key:	Stationary rod attached.	A-24610 Furnish one each box.

7. Ball Valve:

- a. Blowout proof stem.
- b. Ball port type with appropriate seals and seat, as specified.
- c. Bronze bodies per ASTM B61/B62 or ASTM B-584, no brass material will be accepted.
- d. Stainless steel bodies per ASTM A-351, Grade CF3M.
- e. Schedule:

Plan Code:	B.V.	B.V.	H.V.	S.B.V.
Service:	Balancing	In line control and isolation	Refrigeration	Steam and Steam Condensate
Pressure:	150 SWP/300 CWP	150 SWP/300 CWP	500 CWP	150 SWP
Sizes/Inches:	1/4 thru 2-1/2	1/4 thru 3"	3/8" thru 2 1/8"	1/2" thru 2"
Make:	Nibco	Nibco	Nibco	Nibco
Straight Threaded:	T-580-70-66	T-585-70-66	--	T-595-Y-S6R-66
Straight Solder End:	S580-70	S585-70	S595-Y-66	--

Actuator:	Lever with memory stop	Lever	Lever	Lever
Port:	Standard	Full	Full	full

\* Steam ball valve includes a three-piece body, seals rated for steam operating temperatures up to 400°F.

8. Butterfly Valves:

- a. Schedule; standard 150 psi with 150 psi ANSI companion flanges for use where system pressures cannot exceed 200 psig shut off (static) pressure.

Plan Code:	BFV		
Style:	Semi-lug wafer body		
Pressure Rating ANSI Class:	150 minimum		
Body:	Cast Iron		
Disc:	Aluminum Bronze		
Stem:	316 stainless 18-8 stainless 17-4 PH stainless		
Seat:	EPDM (-40 deg.F to 250 deg.F)		
Actuator:	2" thru 5" Infinite position lever with memory stop. 6" thru 24" Self-locking worm gear with adjustable limit stops, and position indicator. Provide chain wheel and chain where indicated by contract documents or where valve is located more than 8' above floor.		
Make:	Keystone		
Size:	2"-12"	14"-20"	24"-36"
Model:	228	122	AR1

9. Stop Check Valve:

- a. Schedule:

Plan Code:	S.C.V.
Pressure:	250 SWP/500 CWP
Size/Inches:	2-1/2 thru 10"
Make:	Crane
Straight Flanged:	28E
Angle Flanged:	30E

10. Eccentric Plug Valve:

a. Schedule:

Plan Code:	E.P.V.	E.P.V.
Pressure:	175 lb. CWP	175 lb. CWP
Size/Inches:	1/2 thru 3	4 thru 8
Make:	DeZurik	DeZurik
Model:	400	100
Actuator:	483-487	159 w/Memory Stop
Ends:	Threaded	Flanged

11. Gas Valves:

a. Gas cock and lubricated plug.

b. Schedule:

Plan Code:	G.C.K.	L.P.V.	L.P.V.	G.B.V.
Pressure:	100 PSI Air	200 lb. CWP	200 lb. CWP	250 PSI LP-Gas
Size/Inches:	1/2 thru 1	1/2 thru 3	4 thru 12	1/4" thru 3"
Make:	Peter Healy	Walworth	Walworth	Apollo
Model:	1500-F	1700	1707-F	80-100
Actuator:	None	E-2	Wrench as required	1/4 turn
Ends:	Threaded	Threaded	Flanged	Threaded

12. Specialty Valves:

a. Petcock, stop and drain, drain, needle.

b. Schedule:

Plan Code:	PTK	S&D.V.	D.V.	N.V.
Type:	Petcock	Gate	Ball	Needle
Pressure:	250 LB.	125 LB.	125 LB.	200 LB.
Size/Inches:	1/8	1/2 and 3/4	3/4	1/8 thru 3/4
Make:	Powell	Nibco	Apollo	Jenkins
Model:	922	76 or 726	78-104	743G
Ends:	Threaded	Threaded or Soldered	Threaded and Hose End Adaptor	Threaded

2.5 PIPE HANGERS, SUPPORTS, AND ACCESSORIES PROTECTION

A. General:

1. Provide hangers, rods, clamps, brackets, attachments, inserts, bracing, nuts, coach screws, eye bolts, clips, plates, and washers as required for appropriate installation for building structure provided.
2. All hangers and accessories shall be manufactured by one manufacturer for compatibility of all components.
3. All hangers, attachments, and accessories shall be provided with a certified manufacturers safety factor of five (5).
4. All hangers, attachments and accessories shall comply with the following:
  - a. Safety factor of 5 (actual load vs. ultimate load).
  - b. National Fire Protection Association (NFPA) (except as amended by provisions of this Specification for minimums) and as applicable.
  - c. Factory Mutual Engineering Division (FM) as applicable.
  - d. Manufacturers Standardization Society (MSS).

B. Material:

1. Hangers in contact with steel, iron, cast or ductile iron shall be hot dipped galvanized or cold galvanized with "ZRC" cold galvanized compound only to a thickness of not less than 3.0 mil (.003 inches). "ZRC" cold galvanizing compound is manufactured by ZRC Chemical Products Co., Quincy Mass.
2. Hangers in contact with copper piping shall be copper clad or provided with heavy density felt (20 oz.) pad permanently attached to the hanger and placed so as to prevent direct contact between pipe and hanger. Felt shall be mildew and moisture rot proof. Heavy polyvinyl chloride coating on hanger, 5 mil thickness minimum will be acceptable in lieu of felt.
3. Hangers in contact with "plastic" or "glass" piping shall be galvanized in accordance with Sub-paragraph B-1, above and padded in accordance with Sub-paragraph B-2, above.
4. Hangers for insulated piping shall be provided on all piping of this size with insulation shields or insulation saddles\* as applicable and appropriate and in accordance with the following schedule:

Nominal Pipe or Tubing Size	Shield Length	Shield Gauge Thickness	Material
½" thru 3"	12"	18	Galvanized
4"	12"	16	Galvanized
5"	15"	16	Galvanized
6"	18"	16	Galvanized
8"	24"	--	B-line (B3160-3165)
over 8"	36"	--	B-line (B3160-3165)

\* Insulation inserts between piping and shield shall be furnished by 15250 Contractor for appropriate pipe size and insulation thickness for all insulated piping requiring a vapor barrier.

5. Provide swivel ring hangers similar and equivalent to B-Line B-3170, 3170CT, and 3170C for pipe sizes 1/2" thru 8".
6. Clevis type hangers may, at the Contractors option, be provided when similar and equivalent to B-Line B-3100, and 3100C.
7. Roller type hangers shall be used on all steam piping 4" and larger and when appropriate shall be equivalent to B-Line B-3110 black steel with cast iron roller. Provide insulation saddles for all roll-type hangers, B-Line B3160-3165. Calcium silicate inserts, in conjunction with insulation saddles shall be provided on all steam piping.
8. Beam and bar joist clamps shall be appropriate for attachment locations, top beam, bottom beam, etc., and provided with retainer rods, clips or straps as required.
9. Hanger spacing and minimum rod sizes in the following schedule are based on combined bending and shear stress of 1500 psi when the pipe is filled with water and 1/10-inch deflection allowance between supports, all valves, heavy fittings and changes in direction of piping shall be additionally supported with hangers each side of valves and heavy fittings, and one additional support within one foot of the directional change. Where more stringent hanger spacing and rod sizes are required by jurisdictional authority, the more stringent requirements shall supercede the following schedule.

Nominal Pipe or Tubing Size	Maximum Support Spacing Center to Center (ft)	Minimum ATR or MTR rod dia (in)
1/2" thru 1"	6	3/8"
1-1/4" thru 2"	7	3/8"
2-1/2" thru 3"	10	1/2"
4"	14	5/8"
5"	16	5/8"
6"	17	3/4"
8"	19	7/8"
over 8"	20	1"

10. Riser clamps shall be provided on all vertical risers at each floor and shall conform to materials and protective coatings or pads as specified in Paragraph B of this Article 2.05. Clamps shall be similar and equivalent to B-Line B-3131 and B-3148.
11. Provide concrete inserts where required in flat slab construction similar and equivalent to B-Line B-22-1 Series 2000 lbs. per foot load capacity and spaced per hanger spacing schedule (sub-paragraph B-9 above) provide all accessories and nuts required.
12. Trapeze hangers shall be constructed of channel similar and equivalent to B-Line Series B-11 thru B-72 as appropriate complete with pipe clamps, nuts, rollers etc., as required. Channel to bear 5 times actual weight of all piping on trapeze system with minimum deflection. (.01 inch maximum).
13. Wall brackets shall be fabricated "knee" brackets conforming to requirements of sub-paragraph B-12 above and made up with B-Line Series B-11 thru B-72

- channel. Angle clips may be used in wood joist construction when similar and equivalent to B-Line B-3060 or 3061.
14. Hangers attached to wood construction shall be attached by use of eye bolts, coach screws or lag bolts when load bearing ratings maintain a safety factor of 5.
  15. All other means of support i.e., special construction, pipe stands, earthquake bracing, sway bracing, etc., shall be provided as required and in conformance with jurisdictional authority and these Contract Documents, submit all special or required support and bracing systems for review by the Architect/Engineer prior to installing any item.
  16. All vertical refrigeration suction and hot gas, and all steam piping shall be provided with insulation shields and calcium silicate inserts at each support location.
  17. All piping systems exposed to motorized traffic shall be fully protected by installation of concrete-filled pipe bollards. Bollards shall be cleaned and painted as directed by the Architect.

C. Acceptable Manufacturers:

1. Manufacturers acceptable to this Specification are as follows, all other manufacturers must submit for acceptance.
  - a. B-Line
  - b. Fee & Mason
  - c. Grinnell
  - d. P.H.D.
  - e. Michigan
  - f. Tolco

2.6 IDENTIFICATION MATERIALS FOR PIPING AND EQUIPMENT

A. Materials for identification shall be as follows:

1. Metal Tags: Round brass discs, minimum 1-1/2" diameter with edges ground smooth. Each tag shall be punched and provided with brass chains for installation.
2. Engraved Nameplates: Fabricate from plastic sheet stock of sufficient thickness to allow engraved lettering in contrasting color. Attach nameplates to equipment with screws.
3. Painted Stencils: Of size and color per ANSI A13.1 using clean cut letters and oil base paint. Paint material shall comply with Architectural Painting Specifications. See Part 3 for legend and size for Stencils.

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
3/4" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
over 10"	32"	3-1/2"
Ductwork and Equipment	NA	2-1/2"

\*\*\* OR \*\*\*

3. Pressure Sensitive Markers: Brady Type 350 flexible vinyl film identification markers and tape, with legend, size and color coding per ANSI A13.1. or approved equal.

2.7 DIELECTRIC PIPE FITTINGS AND ISOLATORS

- A. Manufacturer: Epco Sales Inc., Victaulic.  
 B. Schedule: (complete unions)

Model:	FX	GX
Sizes:	1/2" thru 2"	2" thru 12"
Maximum Pressure:	250 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F
Epconite Gasket:	#2	#2
Ends:	FPT x Solder	FPT x Solder
Type:	Union	Flanged Union

- C. Schedule: (companion flanges)

Model:	X	W	H
Sizes:	1-1/2" - 10"	1-1/2" - 12"	1-1/2" - 12"
Maximum Pressure:	175 psi	175 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F	210 deg. F
Epconite Isolators:	#2	#2	#2
End Style:	Solder (Brass)	Weld neck	Iron Pipe Thread
Type:	Companion	Companion	Companion
Face Gasket:	Same as Isolators		

- D. Dielectric fittings shall conform to ASA B16.8, and shall be plated as applicable a minimum of .0005" and have no flow restriction when assembled.

## 2.8 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tubing: ASTM B88, Type M, hard drawn.
  - 1. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.29 solder wrought copper.
  - 2. Joints: ASTM B32, solder, Grade 95TA.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION

- A. General: Unless otherwise specifically indicated on Drawings or in Specifications, install equipment and materials in accordance with recommendations of manufacturer, including performance of tests as manufacturer recommends. Install all equipment, valves, etc. to be accessible and maintainable without any extreme or unusual effort such as removing duct, air handlers, structure, etc.
- B. Protection:
  - 1. Close ends of pipe and ductwork during construction to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Cover floor drains and protect fixtures and equipment against damage during concrete pours and mechanical work.
- C. Quiet Operation and Vibration:
  - 1. All work shall operate in accordance with Section 15240 - Mechanical Sound and Vibration Control under all conditions of load.
  - 2. Sound or vibration conditions not in accordance with Section 15240 and considered objectionable shall be corrected in a manner approved by the Architect under the Work of Division 15.

### 3.2 WELDING

- A. Joints between sections of pipe, between pipe and fittings, shall be fusion welded. Use only certified welders. Strength of finished welded joints to be equal to strength of pipe. Width of finished weld to be at least 2-1/2 times the thickness of the part joined. Thickness of weld to be at least 25% greater than the thickness of pipe or fittings. Finished welded joints to present neat and workmanlike appearance.
- B. Make no direct welded connections to valves, strainers, apparatus, and related equipment. Make connections to flanged valves, and flanged equipment with welded pipe connection flanges.
- C. Radii of weld ells to be 1-1/2 times nominal diameter of fittings. Fittings used for all branch connections, whether full-size or reducing, to have interior surfaces smoothly contoured. Wall thickness of welded fittings equal to adjacent piping.

### 3.3 ELECTRIC WIRING

- A. Furnish equipment requiring electrical connections to operate properly and to deliver full capacity at electrical service available.
- B. All control wiring to be in accordance with manufacturer's recommendations; all wiring shall be color coded to facilitate checking.
- C. Unless otherwise indicated, all mechanical equipment motors, starters, and controls shall be furnished, set in place, and wired in accordance with the Electrical Equipment/Wiring Responsibility Matrix on the drawings. Contractor should note that the intent of this electric wiring matrix is to have the Division 15 Contractor responsible for coordinating all control wiring as outlined, whether or not specifically called for by the mechanical or electrical drawings and specifications. Mechanical Contractor shall comply with the applicable requirements of Division 16 for electrical work of this Division 15 which is not otherwise specified. No extras will be allowed for Contractor's failure to provide for these required items. The Division 15 Contractor shall also refer to the Division 16 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

ELECTRICAL EQUIPMENT/WIRING RESPONSIBILITY MATRIX

Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Equipment Motors	MC	MC	EC	MC
Motor Starters & Overload Heaters & Variable Speed Drives	MC – Except when shown on MCC	EC	EC	MC
Fused & Unfused Disconnect Switches, Thermal Overload & Heaters	EC	EC	EC	--
Manual Switches & Speed Control Switches carrying full load currents.	MC	EC	EC	EC
Fire/Smoke and Smoke Dampers	MC	MC	EC – Requires emergency power circuit if air system served is on emergency power..	EC
Control Relays & Transformer (See Note 2)	MC	MC	EC	MC
Thermostats (Line Voltage)	MC	EC	EC	EC
Temperature Control Panels	MC	MC	EC	MC
Building Fire Alarm System Fire & Smoke Detectors, including Relays in Starters for Fan Shutdown.	EC	EC	EC	EC
DDC Interface to Fire Alarm System	MC	MC	EC	MC

Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Electric Plumbing Fixtures, Sensor Faucets, Sensor Flush Valves, Electric Water Coolers, and required Transformers.	MC	MC	EC	MC
Motor & Solenoid Valves, Damper Motors, PE & EP Switches, Control Valves, Low Voltage Thermostats	MC	MC	MC	MC
Pushbutton Stations & Pilot Lights (manually operated switches not carrying load currents).	MC	MC	N/A	MC
Pushbutton Stations & Pilot Lights carrying fully load current.	MC	EC	EC	N/A
Exhaust fans for kitchen hoods or fume hoods where interlocked with make-up air fans.	MC	MC	EC	EC
Exhaust fans when switched with room lights.	MC	MC	EC	EC
Timers, Lock-out Devices, Wheatstone Bridges and Meters	MC	MC	EC	MC
Temporary Heating Connections	MC	MC	EC	MC
Variable Speed Drives	MC	MC	EC	MC

- \* MC = Mechanical Contractor under Division 15 of the work.
- \* FM = Mechanical Contractor under Section 15365 - FM-200 Fire Suppression System.
- \* FPC = Fire Protection Contractor.
- \* EC = Electrical Contractor under Division 16 of the work.

D. All temperature control conduit and wiring shall be furnished and installed under Section 15955. All motorized damper and motorized valve wiring shall be furnished and installed under Section 15955.

### 3.4 SLEEVES, PLATES AND CLOSURES

- A. Division 15 Contractor shall provide and locate pipe sleeves and inserts 1" larger, clear dimension, than the outside of the pipe, required before new floors and walls are built or shall be responsible for the cost of cutting and patching required where sleeves and inserts were not installed or where incorrectly located. Sleeves for insulated piping shall be large enough to allow the covering to pass through the sleeve. Caulk or seal as required to make sure water does not penetrate through sleeve.
- B. Provide sleeves for mechanical piping passing through concrete floor slabs and through concrete, masonry, tile, and gypsum wall construction. Provide metal collars to close and protect openings.
- C. Where sleeves are placed in exterior walls below grade, pack spaces between the pipe or conduit and the sleeves with Hornflex Thiokol L-32 Sealant or Link Seal and make water-tight. Provide metal rodent collars securely fastened to structure.

- D. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe only and the insulation shall be made to butt against the construction, except for pipes requiring insulation having a vapor barrier, in which case, the sleeves shall be large enough to pass the pipe and insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations, make actual lengths to suit the following:
1. Terminate sleeves flush with walls, partitions, and ceilings.
  2. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor.
  3. In all areas where pipes are exposed, extend sleeves 1/4" above finished floor, except in rooms having floor drains, where sleeves shall be extended 2" above floor and in Kitchens and Mechanical Equipment Rooms, where sleeves shall be extended 4" above floor.
- E. Sleeves shall be constructed of 24 gauge galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated on the drawings. "Crete Sleeve" (plastic type) sleeves are acceptable for concrete construction as manufactured by Sperzel Division, Shamrock Industries.
- F. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is placed or when other construction is built around them.
- G. Provide tight fitting floor and ceiling plates on pipes passing thru walls, ceilings, and floors. Nickel or chrome plated in finished areas, galvanized cast iron in unfinished areas. Provide wall and ceiling flanges for ducts in finished areas.
- H. Provide all cutting, patching of holes, openings, notches. Obtain written approval for notching, boring, chipping, burning, drilling, welding to structural members in accordance with the General Conditions of the Contract and paragraph 3.7 of this Section.
- I. Where pipe sleeves penetrate fire rated walls and floors, this contractor shall use fire safing to seal openings.

### 3.5 FOUNDATIONS, PADS AND CURBS

- A. Provide dowels, anchor bolts, groutings, concrete foundations and pads for pumps, plumbing, heating and ventilating or air conditioning equipment in accordance with Concrete Specifications.
- B. Dimensions and exact locations for foundations and concrete curbs for mechanical equipment to be field verified and located accurately by Division 15 Contractor.

### 3.6 EXCAVATING AND BACKFILLING

- A. Excavate for all mechanical equipment such as fuel tanks, ductwork, sump pumps, manholes and trenches for underground pipelines to required depths. Compact bottoms of excavations. Slope to obtain required grade. Remove rocks, trash and debris before installation of equipment and backfilling. Backfill by hand tamping earth under the haunch of the pipe to specified compaction. Backfill and compact in thin layers until top of pipe is

covered. Complete backfill by methods required or directed for soil characteristics to comply with the Architectural section of these specifications.

- B. Excavations near footings shall be such that, when nearing building footings, or bearing foundation walls, the excavation bottom shall not be nearer the footing than a normal 45 degree bearing line from edge of footing bottom to bottom of excavation. When it is necessary to perpendicularly cross under a continuous foundation wall, care shall be taken to insure that crossing is clear of the structural foundation and of minimal width.
- C. Do not place backfill over pipe lines until lines are properly tested.
- D. When trenching through specially tested areas, such as paving, asphalt, etc., Contractor shall be responsible for restoring the surface to its original condition, and in a manner approved by the Architect. Repair trenches where settlement occurs, and restore the surface for the period of one year after final acceptance of the project. All cutting of paving, asphalt, etc. shall be by saw cutting.

### 3.7 CUTTING AND PATCHING

- A. Openings in New Construction:
  - 1. Provisions for New Openings: The Division 15 Contractor shall verify all openings required in the new construction in connection with the work under Division 15 with the Architectural and Structural Drawings and shall then meet with and verify same with the General Contractor/Construction Manager who will assign the work to the appropriate contractor to provide all openings in the new construction of the correct size and location in walls, floors or through roofs required for the installation of the mechanical work.
- B. Cutting in New Construction:
  - 1. Failure on the part of the Division 15 Contractor to make the above arrangements for required openings shall cause the cost of cutting and patching for the necessary openings for the installation of his work to be borne by him, either by being assigned to the General Contractor/Construction Manager or in the form of performing the required cutting himself. In either case, all patching shall be done by the appropriate finishing contractor as determined by the General Contractor/Construction Manager. No cutting or drilling of holes shall be done without approval of the Architect/Engineer.
- C. Patching in New Construction:
  - 1. The appropriate finishing contractor as determined by the General Contractor/Construction Manager shall patch all openings in the new structure. All openings made in fire rated walls, floors, or ceilings, shall be patched and made tight to conform to the fire rating for the enclosure. All materials used in patching shall match the materials specified in the Architectural Specifications and all patched areas shall be restored to the specified finish surface to the satisfaction of the Architect.
  - 2. The Division 15 Contractor shall pay the appropriate Finishing Contractor as determined by the General Contractor/Construction Manager for all patching resulting from cutting to accommodate mechanical work.

D. Cutting in Existing Building:

1. The Construction Manager/General Contractor shall make arrangements for required openings in the existing building to facilitate the passage of ductwork, piping, etc. thru existing floors, walls, and beams. Division 15 Contractor to coordinate all requirements.

E. Patching in Existing Building:

1. The General Contractor shall patch all existing walls and floors to match existing.

3.8 PIPE HANGERS/SUPPORTS

- A. Use inserts, anchors, expansion bolts or other approved and acceptable means of attachment to concrete construction. Set inserts in advance of concrete installation, provide required reinforcement rod for all inserts carrying loading equivalent of one 4" pipe or more. All inserts shall be flush with face of slab or wall containing insert.
- B. Provide flat square washers for rods thru metal decking with nut above washer, when acceptable and approved.
- C. Cinch hangers to carry appropriate share of loading and slope piping without sags or "pocketing" as appropriate and required.
- D. Rod offsets, or angle installation, plumber tape or wire will not be accepted. Hanger rods shall be true and plumb.
- E. Piping shall not be hung from other piping or equipment items. Provide attachments to building structure only. Use trapeze, wall brackets, knee brackets, etc., where hanger rods cannot be attached within spacing plumb to structures.
- F. Provide sway and earthquake bracing where required in accordance with Section 15241 - Mechanical Seismic Control.

3.9 INSTALLATION OF VALVES

A. General:

1. Provide valves as shown on Contract Documents and as required for pressure relief, balancing and/or control of flow.
2. Provide isolation valves for maintenance and service on each piece of equipment regardless of whether or not shown on Contract Drawings.
3. Provide isolation valves for all branch line take-offs that serve more than two items of fixtures or equipment.
4. Provide balancing valves for each leg of domestic hot water return piping of two branches or more, all heating/cooling water returns and/or supplies to equipment as shown on Contract Documents.
5. Provide access means for each valve or group of valves either by access panels or utilization of inherent access provided by building methods i.e., lift out ceiling construction or exposed valve installations in non critical areas such as janitors closets, storage rooms, etc.

6. Install all valves with valve bonnets or operating stems in vertical (upright) position when possible, valves may be installed with bonnets or stems not less than 35 degrees downward from vertical plane except valves on vertical piping may be 90 degrees from vertical plane. Swing type check valves shall be installed on horizontal piping no more than 45 degrees upward slope from horizontal plane, using lift checks on vertical piping. Lift check valves shall not be used on sewage or sump pump discharge piping.
  7. Inspect and tighten all bonnet nuts, bolts, packing glands, lubricate all valves requiring lubrication, secure all hand wheels and identification plates, be responsible for all valves having manufacturers name, trade name, working pressure and size stamped or cast into the body of the valve. Perform all maintenance, repacking and inspection prior to installation of valve.
- B. Proper Installation of Valves:
1. Provide valves in accordance with the following schedule unless specified otherwise in Contract Documents.
    - a. Dead-end shut off: Gate, ball, butterfly, plug, stop and drain.
    - b. Throttling: Ball, plug, globe, diaphragm, needle, butterfly (when using butterfly valves for throttling, additional valves must be provided for service shutoff.)
    - c. Backflow prevention: Check.
    - d. Water hammer prevention: Silent or pilot operated non slam check.
    - e. Gas piping: Lubricated plug (or ground joint cock up to 1" only), or UL-Listed ball valve.
- C. Removal and Repair Provisions:
1. Provide all valves which are not accessible for repair without removal from piping with union connection immediately adjacent to valve outlet.
- D. Access to Valves:
1. Install all valves, balancing valves and meters in clear open accessible position so valve information and position can easily be read and maintained. Valve position to be reviewed by Campus Project Manager and/or maintenance personnel. If valve is installed without review and valve is determined to be non-accessible by Campus Project Manager, valve to be removed and relocated to new location by this contractor at no additional charge.

### 3.10 PAINTING

- A. Surfaces of equipment and materials to be thoroughly cleaned and left ready for painting in accordance with Architectural Painting Specifications.
- B. Duct interiors visible through registers, grilles and diffusers shall be painted flat black.
- C. All other painting of mechanical equipment and piping, unless otherwise noted, shall be performed under other divisions of the work with the exception of identification of piping and equipment which will be the responsibility of the Division 15 Contractor.

### 3.11 IDENTIFICATION OF PIPING AND EQUIPMENT

- A. General: Provide pipe identification, valve tags, stencils, or engraved nameplates to clearly identify the mechanical equipment, piping and controls of the various mechanical systems and direction of flow in piping.

B. Methods for identification shall be as follows:

1. Metal Tags: Stamp tags with letter prefixes to indicate service, followed by a number for location in system.
2. Engraved Nameplates: Attach nameplates with brass screws. Pressure-sensitive embossed labels are not acceptable. Nameplates shall bear the same identifying legend used on the Contract Documents.
3. Painted Stencils: Stenciled markings shall be neatly performed with no overspray, drips, or other imperfections. Pipes and equipment to be stenciled shall first be wiped clean of dirt, dust, rust, grease and moisture. Pipes and smooth, hard surface in the area the stencil is to be applied. Paint application shall comply with Architectural Painting Specifications.

Size of Legend and Letters for Stencils:

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
3/4" to 1-1/4"	8"	3/4"
1-1/2" to 2"	8"	1"
2-1/2" to 6"	12"	2"
8" to 10"	24"	2-1/2"
over 10"	32"	3-1/2"
Ductwork and Equipment	NA	2-1/2"

4. Piping Legend and Color (Contractor shall obtain written approval of colors from Owner's representative prior to starting work). Match existing Campus Standards.

Legend	Background Color	Direction Arrow	Pressure
Steam	Yellow	Arrow	PSI
Condensate	Yellow	Arrow	PSI
Feed Water	Light Green		
Blow Down	Yellow		
Domestic Cold Water	Light Green		
Domestic Hot Water	Light Green		

5. Pressure Sensitive Markers: Apply pressure sensitive markers in accordance with manufacturer's recommendations with complete wrap around may be used at Contractor's option. Marker adhesion will be tested for permanence. Any markers showing dog ears, bubbles, or other failings shall be replaced.

- C. Identification of Piping: Identify all piping adjacent to each valve, passing through walls or floor, each riser or junction, maximum 50 feet apart, connection to equipment, adjacent to each fitting, accessible for maintenance in crawl spaces, tunnels, above ceilings, and

access spaces as well as exposed to view utilizing stenciled markings according to the following procedures:

1. Use an arrow marker for each pipe-content legend. The arrow shall always point away from the pipe legend and in the direction of flow: color and height of arrow to be same as content legend lettering.
  2. If flow can be in both directions, use a double-headed arrow indication.
  3. Apply pipe legend and arrow indication at every point of pipe entry or exit where line goes thru wall or ceiling cut.
  4. Apply pipe legend and arrow indication within 3" of each valve to show proper identification of pipe contents and direction of flow.
  5. The legend shall be applied to the pipe so that lettering is in the most legible position. For overhead piping, apply legend on the lower half of the pipe where view is unobstructed, so that legend can be read at a glance from floor level.
  6. For pipes under 3/4" O.D., fasten brass tags securely at specified legend locations.
  7. Legend on steam piping, condensate return, compressed air, medical air, gas, and vacuum systems shall include working pressure or vacuum.
  8. Insulated piping equipped with electric heat trace shall additionally be labeled "Electric Traced" with label of same size and color as the pipe legend.
- D. Valves: All valves, including but not limited to domestic hot and cold water, hot water recirculation, heating water, chilled water, condenser water, steam, steam condensate return, fire protection, gas, medical gas, vacuum and special service valves located inside the building, shall be tagged and identified as to type of service, location number, and normal valve position (normally open or normally closed).
- E. Controls: All magnetic starters and relays, shall have nameplates or be stenciled to identify connecting or controlled equipment. All manual operating switches, fused disconnect switches and thermal over-load switches which have not been specified as furnished with indexed faceplates shall also have nameplates or be stenciled as to "connected" or "controlled" equipment. All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays, and starters shall be clearly identified.
- F. Pumps: All pumps shall be identified as to service and zones served. Base mounted pumps shall be stenciled or have system served nameplates. Brass tags secured by brass chains may be used on small in-line pumps.
- G. Storage Tanks, Water Treatment Equipment and Heaters: All tanks and heaters shall be stenciled as to service. The connecting pipes to each shall be identified and the service temperature entering and leaving the tank or heater shall be indicated.
- H. Fans: All supply and exhaust fans and air handling units and connecting ductwork supplying one or more areas from an equipment room or isolated crawl or furred space shall have nameplate or be stenciled as to plan code number, service and areas of zones served.
- I. Air Conditioning Equipment: Air conditioning equipment such as chillers, pumps, condensers, or roof-top equipment shall be identified by stencils, or system nameplates.
- J. Access Doors: Provide engraved nameplates or painted stencils to identify concealed valves, controls, dampers or other similar concealed mechanical equipment. Obtain Architect approval before installation on all access doors in finished areas.

- K. Lift Out Ceilings: Provide engraved nameplates on ceiling tee stem to identify concealed valves, controls dampers or similar concealed mechanical equipment which is directly above nameplate in ceiling space. Obtain Architect approval before installation.
- L. Expansion tanks shall be labeled to indicate system served and precharge pressure.
- M. Access Flooring: Provide thin engraved nameplate on access panel to indicate location of underfloor fan coils and smoke/fire dampers.
- N. Meters to be labeled.
- O. Duct at equipment to be labeled with area served.

### 3.12 DRIP PANS

- A. Provide drip pans under all fluid conducting piping which runs over electric switchgear, busway, or electric motor starters, and under all point-of-use water heaters.
- B. Pans: 18 gauge galvanized iron. Pans shall be two inch deep, with rolled top edges, and shall extend six inches each side of the pipe or group of pipes and six inches beyond the equipment below. Keep pans as close to the underside of the pipes as practicable. All seams shall be soldered, and pans shall be crossbraced as required to prevent sagging and warping.
- C. Pitch each pan to a drain connection, and pipe a 1-1/2 inch or larger copper tube drain to discharge over nearest available open drain.

### 3.13 FIRE SAFING

- A. Mechanical Contractor shall provide fire safing for his work as follows: Where fire rated separations are penetrated by pipes, conduit or ductwork, the annular space around the pipe, conduit or ductwork shall be filled with a U.L. Rated fire safing material. Refer to Division 7 for materials and application specifications.

### 3.14 DIELECTRIC PIPE FITTINGS AND ISOLATORS

- A. Provide dielectric pipe fittings and isolators at all connections between dissimilar metals in the domestic water, and fire protection systems to control corrosion potential caused by galvanic or electrolytic action.
- B. Typical locations for dielectric isolation are; water heaters, storage and pressure tanks, water conditioning equipment, pumps, changes in service piping materials, make-up connections to boilers and chilled water systems, valves, deaerators, flexible connectors and the like where materials of different electrode potential are joined.
- C. Hangers for piping shall be isolated per Section 15050 when hanger and piping materials are dissimilar and subject to production of electrolysis or galvanic action.
- D. Storage tanks shall be isolated from piping and tank stands by use of anti-electrolytic and galvanic isolators.

### 3.15 DRAIN LINES

- A. Provide condensate drain lines from each cooling coil and evaporative media sump drain pan to drain or to termination indicated. Drain lines to be galvanized pipe or Type M hard copper.

### 3.16 HEATING SYSTEM USED FOR TEMPORARY HEAT DURING CONSTRUCTION

- A. Permanent heating system shall not be used until building is totally and permanently enclosed (no temporary barriers for weather protection), and source of heat supply is permanently installed.
- B. Once the heating system has been placed into operation, it shall not be shut down except for moderate weather, and all heated areas shall be maintained at a minimum temperature of 50 deg. F 24 hours a day.
- C. When any air-handling equipment is used for temporary heat, the filters shall be installed and maintained. Before building acceptance by Owner, these units shall be thoroughly cleaned and new filters shall be installed. This is over and above the extra set of filters to be provided the Owner as called for in the specifications. Coils shall be cleaned if necessary, as determined by the Engineer.
- D. Any and all systems being used for temporary heat shall become the Contractor's responsibility to maintain, and be put into first class working order before acceptance by the Owner.
- E. Any manufacturer's guarantees that start with the use of equipment for temporary heat shall be extended by the contracting firm holding the prime contract for construction, so that the Owner will have his one-year guarantee from date of acceptance.

### 3.17 EXISTING PIPES AND MECHANICAL EQUIPMENT TO BE REMOVED

- A. Where existing mechanical equipment, fixtures and/or piping is to be removed and/or relocated, all piping shall be disconnected and capped. All existing piping and hangers not to remain in use shall be removed completely to an existing main that is to remain in use, and capped at the main. General Contractor shall do all cutting, patching, and restoring that may be required for the removal of this piping and equipment. Where it is not possible to remove branch piping not remaining in use, due to its being concealed in the structure, the Division 15 Contractor shall cap the piping concealed at both ends in these areas as approved by the Architect.
- B. All mechanical equipment, fixtures, and piping to be removed and not re-used shall remain the property of the Division 15 Contractor for credit to the contract price except as noted otherwise.

END OF SECTION 15050

## SECTION 15240 - MECHANICAL SOUND AND VIBRATION CONTROL

### PART 1 - GENERAL

#### 1.1 RELATED WORK

- A. Requirements: Provide Mechanical Sound and Vibration Control in accordance with the Contract Documents.
- B. Related work specified in other Sections:
  - Section 15010 - Basic Mechanical Requirements
  - Section 15050 - Basic Mechanical Materials and Methods
  - Section 15511 - HVAC Piping & Specialties
  - Section 15900 - Ductwork and Accessories - Flexible Ductwork Connections

#### 1.2 SYSTEM DESCRIPTION

- A. The work includes, but is not limited to the following:
  - 1. Support isolation for motor/driven mechanical equipment.
  - 2. Rails or beams for distribution of equipment loading to isolation units.
  - 3. Fabricated bases for distribution of equipment loading to isolation units.
  - 4. Inertia base frames in conjunction with equipment isolation.
  - 5. Isolation of pipes and ductwork.
  - 6. Sound attenuating units.
  - 7. Sound-linings.
  - 8. Sound proofing of construction.
  - 9. External sound proofing.

#### 1.3 QUALITY ASSURANCE

- A. The Division 15 Contractor shall be responsible for assuring that all the following sound pressure level criteria are met. Sound pressure level tests shall be carried out by the Section 15990 Contractor in compliance with the Section 15990 specifications.
- B. Acoustical Criteria:
  - 1. Noise levels due to equipment and ductwork to permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC curves:
    - All occupied spaces ----- RC-35
    - except
    - Occupied spaces within 15 foot radius from main  
supply and return duct shafts ----- RC-40
    - Lobbies, Toilets, Commons Area ----- RC-40

- Mechanical Rooms ----- RC-60-80
- Office ----- NC-30
- Conference ----- NC-30
- Classrooms ----- NC-30
- Vending Room ----- NC-30
- Telecommunications Room (24-hour cooling req'd) --

C. Mechanical Acoustical Performance:

1. Air Distribution system equipment terminal device noise:

Maximum permissible discharge sound-power levels in octave bands of airborne transmission through the terminal units or related pressure reducing devices, when operated in installed condition per Drawings and Specifications shall be as per Table 1, following:

TABLE 1 - Maximum PWL (dB re 10-12 Watt)				
Octave Band	RC-30	RC-35	RC-40	RC-45
1	54	59	64	69
2	68	73	78	83
3	61	66	71	76
4	59	64	69	74
5	51	56	61	66
6	48	53	58	63
7	39	44	49	54

2. Pressure reducing variable air volume boxes radiated noise:

Maximum permissible radiated sound-power levels in octave bands when operated in an installed condition over occupied spaces, shall be as per Table 2 following:

TABLE 2 - Maximum PWL (dB re 10-12 Watt)				
Octave Band	RC-30	RC-35	RC-40	RC-45
1	54	59	64	69
2	62	67	72	77
3	58	63	68	73
4	55	60	65	70
5	53	58	63	68
6	50	55	60	65
7	46	51	56	61

3. Motor Acoustical Performance:

Motor drives for pumps when installed per Drawings and Specifications shall operate with noise levels not exceeding 90dbA.

Noise levels shall be determined in accordance with IEEE Standard #85 Test "Procedure for Air-Borne Noise Measurements on Rotating Electric Equipment.

4. Refrigeration Machine Cooler, Condenser, Compressor and Compressor Piping Acoustical Performance:

The maximum permissible noise levels under design operating conditions, when measured in accordance with the methods and qualifications specified herein shall not exceed 90 dbA.

1.4 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract.
1. Each type of isolator including spring diameters, deflections, compressed spring height and solid spring height.
  2. Sound Attenuators.
  3. Sound Lining.
  4. Inertia Bases.
- B. Test Reports: Submit certified test reports showing compliance in accordance with General Conditions of the Contract of the following items:
1. Pressure drop and insertion loss ratings for sound attenuators.
  2. Certification that sound lining meets erosion test method described in UL Publication No. 181.

PART 2 - PRODUCTS

2.1 PIPING AND EQUIPMENT ISOLATION

- A. Manufacturer: Mason Industries, Inc.
- B. Other acceptable manufacturers offering equivalent products: Korfund, Amber/Booth Co., Vibration Mountings and Control Co., Kinetics.
- C. Double Deflection Neoprene Mountings (Specification Schedule Type 2)
1. Mason Industries Type ND Mounting, Type DNR Rails.
  2. Minimum static deflection 0.35 inch.
  3. Bolt holes where required.
  4. Steel rails above mountings to compensate for overhang where required.

- D. Spring Isolator Mountings (Specification Schedule Type 3)
1. Mason Industries Type SLF.
  2. Free-standing, laterally stable without housing, complete with 1/4 inch neoprene acoustical friction pads between base plate and support and with leveling bolts that must be rigidly bolted to equipment.
  3. Spring diameters no less than 0.8 of the compressed height of the spring at rated load.
  4. Springs with minimum additional travel to solid equal to 50 percent rated deflection.
- E. Restrained Spring Isolator Mountings (Specification Schedule Type 4)
1. Mason Industries Type SLR.
  2. Spring isolator mounting equal to Type SLF but with housing that includes vertical resilient limit stops to prevent spring extension when weight is removed from equipment.
  3. Provide hot dipped galvanized mountings exposed to weather.
- F. Vibration Hangers (Specification Schedule Type 6)
1. Mason Industries Type DNH.
  2. Spring and double deflection neoprene element in series.
  3. Neoprene element minimum deflection 0.35 inch.
  4. Spring diameters no less than 0.8 of compressed height of spring at rated load.
  5. Springs with minimum additional travel to solid equal to 50 percent rated deflection.
- G. Integral Structural Steel Base (Specification Schedule Type B)
1. Mason Industries Type WF.
  2. Rectangular for equipment other than "T" or "L" shaped pump bases.
  3. Pump bases for split case pumps to include supports for suction and discharge base ells.
  4. Beams for perimeter members minimum depth equal to one tenth of the longest dimension of the base. Depth need not exceed 14 inches if deflection and misalignment is kept within acceptable limits by manufacturer.
  5. Provide height saving brackets to provide a clearance of one inch.
- H. Steel Rail Base (Specification Schedule Type B)
1. Mason Industries Type ICS.
  2. Steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base.
  3. Provide members sufficiently rigid to prevent strains in the equipment.
- I. Concrete Inertia Bases (Specification Schedule C)
1. Mason Industries Type K.
  2. Rectangular structural beam or channel concrete forms for floating foundations.
  3. Provide bases for split case pumps large enough for suction and discharge base ells supports.

4. In general, unless shown otherwise on the Drawings, provide bases with a minimum depth of one twelfth of the longest dimension of the base, but not less than 6 inches.
5. Forms to include minimum concrete reinforcement consisting of 1/2 inch bars or angles welded in place on 6 inch centers running both ways in a layer 1-1/2 inches above the bottom, or additional steel as is required by the structural conditions.
6. Forms furnished with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts.
7. Provide height saving brackets to maintain a 1 inch clearance below base.

J. Flexible Butyl Hose Pipe Connectors (Up to 2")

1. Mason Industries Type RMM.
2. Flexible Butyl 150 lb. hose with brass screw type ends attached by expansion or swedging methods. Clamps are unacceptable.
3. Duty up to: 100 psi and 220 deg. F.
4. Hoses up to 1-1/4 inches shall be 12 inches in length and 1-1/2 inches to 2 inches shall be 18 inches in length.

K. Flexible Neoprene Sphere Pipe Connectors (2" to 12")

1. Mason Industries Type MFNC and Type MFTNC.
2. Neoprene single-sphere type with 150 lb. ASA steel floating flanges.
3. Duty up to: 150 psi and 230 deg. F.
4. Movement limits: minimal 3/8 inch axial compression, 1/4 inch axial elongation, 3/8 inch lateral movement and 15 deg. angular movement.

L. Braided Flexible Connectors (Drawing Code "FC")

1. Manufacturer: Thermo Tech, Inc., Metraflex, Flex-Hose Co., Flexicraft Industries, Flex-Pression Ltd.
2. Flexible connectors manufactured of 150 series stainless steel convoluted metal bellows and braid, 300 psig ASA drilled flanges. Maximum permanent offset from centerline = 3/4". Maximum intermittent offset from centerline = 3/8".
3. Pressure test to be certified for 300 psi at 250 deg. F.
4. Schedule:

Make:	Metraflex								
Model:	SLP								
Size:	1-1/2"	2"	2-1/2"	3"	4"	6"	8"	10"	12"
Connector Length:	6"	6"	10-1/4"	10-5/8"	11-3/4"	14-1/8"	15-3/8"	12-3/4"	18-3/8"
Max Pressure:	300 psig								
Max Temperature:	250 deg. F								

2.2 ADHESIVE AND SEALER

- A. Acceptable Products: Adhesive, Benjamin Foster "81-99", or accepted equal, Sealer, Benjamin Foster "82-07" or accepted equal.

- B. In conformance with NFPA 90A.
- C. Flamespread: Maximum 25.
- D. Fuel contributed and smoke developed: Maximum 50.

2.3 NON-HARDENING CAULKING

- A. Acceptable Products: Tremco "Polybutene", Schuller or accepted equal.
- B. Guaranteed to be permanently elastic.

2.4 VIBRATION DAMPERING COMPOUND

- A. Acceptable Manufacturers: Soundcoat GP-1 Vibration Damping Compound, Korfund Dynamics Corporation Vibro-damp 80A.
- B. Non burning.
- C. Compound shall effectively damp vibrations for a broad frequency range between 10 Hz to 20 kHz.
- D. Decay rate Geiger plate 45 dB/sec. at 72 deg. F.

2.5 EXTERNAL SOUND BARRIER INSULATION

- A. Acceptable Manufacturers: Kinetics.
- B. Model: KC-5-50
- C. Sound barrier shall be a foam composite type consisting of 1/2 lb. per ft<sup>2</sup> mass barrier bonded to 1/2" urethane absorption foam. Provide with adhesive transfer tape for direct attachment to a finished metal surface.
- D. Sound Transmission Loss:

- 1. Transmission loss when attached to an 18 gauge metal surface shall be as per the following table:

Band No.	Band Center Freq. (Hz)	Transmission Loss (dB)
1	125	17
2	250	25
3	500	40
4	1000	53
5	2000	54
6	4000	53

- E. Flamespread: Maximum 25
- F. Fuel contributed and smoke developed: Maximum 50.

### PART 3 - EXECUTION

#### 3.1 GENERAL - PIPING AND EQUIPMENT ISOLATION

- A. Unless otherwise noted on the Equipment Mounting Schedule, provide mechanical equipment mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators to be selected in accordance with the weight distribution so as to produce reasonable uniform deflection. Deflections to be as noted on the Equipment Mounting Schedule included at the end of this section.
- B. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following the isolation work, to avoid any contact which would reduce the vibration isolation.
- C. The installation or use of vibration isolators must not cause any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, maintain equipment and piping in a rigid position during installation. Do not transfer the load to the isolator until the installation is complete and under full operational load.
- D. Support the machine to be isolated with a structural steel frame.
- E. Provide brackets to accommodate the isolator and provide a mechanical stop. The vertical position and size of the bracket to be recommended by the isolator manufacturer.
- F. For restrained spring isolators, use housing as blocking during erection so that installed and operating heights can be the same. Maintain a minimum clearance of 1/2 inch around restraining bolts between housing and spring to avoid interference with spring action. Limit stops to be out of contact during normal operation.

#### 3.2 HANGERS

- A. Install type 2 or 3 vibration isolation piping hangers where indicated in Equipment Mounting Schedule at the end of this section and within 20 feet (measured along piping) upstream and downstream of all pumps 3 HP or larger.
- B. Install the isolators with the isolator hanger box attached to or hung as close as possible to the structure.
- C. Suspend the isolators from substantial structural members, not from slab diaphragm unless specifically accepted.
- D. Align hanger rods to clear hanger box.

#### 3.3 EQUIPMENT BASES

- A. Provide minimum operating clearance between the equipment frame or rigid steel base frame and the housekeeping pad or floor of 1 inch. Provide minimum operating clearance between concrete inertia base and the housekeeping pad or floor of 1 inch.

### 3.4 FLEXIBLE PIPING CONNECTORS

- A. Provide flexible connectors for equipment that is supported by or mounted on vibration isolators except when connected piping is made up with a Victaulic Flex coupling system. Connectors to be installed under Section 15511.
- B. Hoses shall be installed on the equipment side of the shut-off valves and horizontally wherever possible.
- C. Provide connectors at pump suction and discharge, and elsewhere as required to accommodate thermal expansion, vibration and misalignment.
- D. Provide flexible connectors on all suction and discharge connections to all base mounted centrifugal pumps, vertical turbine pumps, air compressors, dryers, vacuum pumps or other equipment items producing vibration, shock, noise, or thermal motion of piping.
- E. Provide 300 psi companion flanges for connector for threaded, welded, soldered, or brazed piping as appropriate.
- F. Connectors to be aligned, centered, and shall not bear weight of pipe, fittings, or pipeline accessories such as valves. Piping shall be supported both sides of horizontal or vertical connectors.

### 3.5 PIPE FLOOR SUPPORTS

- A. Provide type 3 mountings with a minimum static deflection of 1.5 inches on horizontal pipe floor supported at slab in equipment rooms above grade.

### 3.6 SOUND PROOFING OF CONSTRUCTION

- A. Required for opening between ductwork and piping and following construction:
  - 1. Equipment room walls.
  - 2. Floors, except in shafts.
  - 3. Roofs, specifically inside roof curbs for mechanical equipment and where ductwork penetrates roof deck.
- B. Sound proofing:
  - 1. Fill openings with tightly packed fibrous glass blanket or board for full depth of penetration.
  - 2. Caulk each side of opening with non-hardening, non-aging caulking compound.

### 3.7 EXTERNAL VIBRATION DAMPENING

- A. For typical floor supply duct take-offs from main supply riser when required to meet specified sound levels, provide 1/8 inch thick duct exterior coating of vibration dampening compound. These treatments to be provided over the rectangular portion (flat sides) of the floor take-off ducts.

### 3.8 EXTERNAL SOUND BARRIER INSULATION

- A. Provide foam composite, applied over the vane axial fan casings (both supply and return) extending from the inlet side of the intake sound traps, to the leaving side of the discharge sound traps, inclusive of all flexible connectors.
- B. Provide a duct enclosure of 2 layers of 5/8" gypsum board with staggered seams extending from the point that the ducts leave the rooftop unit or fan plenum to the leaving side of the discharge sound trap(s). A minimum clearance of 1" shall be maintained between the ductwork and the enclosure walls; all voids between the enclosure and the ductwork to be filled with loose batt fiberglass insulation. The points at which the ductwork penetrates the enclosure; the sheetrock is to be cut away from the ductwork by 1/4" to 1/2" and the void is to be filled with non-hardening caulk. Caulk shall be fire-rated if enclosure is required to be fire-rated.

### 3.9 EQUIPMENT MOUNTING SCHEDULE

- A. Manufacturer: Mason Industries, Inc.
- B. Schedule: See the following pages.

WEBER STATE UNIVERSITY HEAT EXCHANGER REPLACEMENT IN:  
 EDUCATION, SCIENCE LAB, SOCIAL SCIENCE, LIBRARY SOUTH,  
 ALLIED HEALTH SOUTH AND NORTH, STUDENT SERVICES,  
 ADMINISTRATION, AND STADIUM BLDGS.

DFCM PROJECT NO. 08059810  
 12/09/2008

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PUMPS						
A. Close Coupled						
1. Up to 7 1/2 HP	B/C	2	.25	C	3	.75
2. 10 HP & Over	C	3	.75	C	3	.75

WEBER STATE UNIVERSITY HEAT EXCHANGER REPLACEMENT IN:  
 EDUCATION, SCIENCE LAB, SOCIAL SCIENCE, LIBRARY SOUTH,  
 ALLIED HEALTH SOUTH AND NORTH, STUDENT SERVICES,  
 ADMINISTRATION, AND STADIUM BLDGS.

DFCM PROJECT NO. 08059810  
 12/09/2008

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PUMPS						
A. Flexible Coupled						
1. Up to 40 HP	C	3	.75	C	3	.75
2. 50 to 125 HP	C	3	.75	C	3	.75
3. 150 HP & Over	(See Note 1)			(See Note 1)		

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
<p><u>BASE TYPES:</u></p> <p>A = NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT                      B = STRUCTURAL STEEL RAILS OR BASE                      C = CONCRETE INERTIA BASE                      D = CURB-MOUNTED BASE</p> <p><u>ISOLATOR TYPES</u></p> <p>1 = RUBBER OR GLASS FIBER PAD                      2 = RUBBER FLOOR ISOLATOR OR HANGER                      3 = SPRING FLOOR ISOLATOR OR HANGER                      4 = RESTRAINED SPRING ISOLATOR                      6 = SPRING AND RUBBER IN SERIES HANGER</p> <p><u>NOTES:</u></p> <ol style="list-style-type: none"> <li>CONTRACTOR SHALL PROVIDE VIBRATION ISOLATION AND CALCULATIONS STAMPED BY A LICENSED PROFESSIONAL ENGINEER.</li> <li>TO AVOID ISOLATOR RESONANCE PROBLEMS, SELECT ISOLATOR DEFLECTION SO THAT NATURAL FREQUENCY IS 40% OR LESS THAN LOWEST OPERATING SPEED OF EQUIPMENT (SEE ASHRAE HVAC APPLICATIONS HANDBOOK, 1999 EDITION).</li> </ol>						

WEBER STATE UNIVERSITY HEAT EXCHANGER REPLACEMENT IN:  
 EDUCATION, SCIENCE LAB, SOCIAL SCIENCE, LIBRARY SOUTH,  
 ALLIED HEALTH SOUTH AND NORTH, STUDENT SERVICES,  
 ADMINISTRATION, AND STADIUM BLDGS.

DFCM PROJECT NO. 08059810  
 12/09/2008

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	30 FT. FLOOR SPAN			40 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PUMPS						
A. Close Coupled						
1. Up to 7 1/2 HP	C	3	.75	C	3	.75
2. 10 HP & Over	C	3	1.5	C	3	1.5

WEBER STATE UNIVERSITY HEAT EXCHANGER REPLACEMENT IN:  
 EDUCATION, SCIENCE LAB, SOCIAL SCIENCE, LIBRARY SOUTH,  
 ALLIED HEALTH SOUTH AND NORTH, STUDENT SERVICES,  
 ADMINISTRATION, AND STADIUM BLDGS.

DFCM PROJECT NO. 08059810  
 12/09/2008

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	30 FT. FLOOR SPAN			40 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PUMPS						
A. Flexible Coupled						
1. Up to 40 HP	C	3	1.5	C	3	1.5
2. 50 to 125 HP	C	3	1.5	C	3	2.5
3. 150 HP & Over	(See Note 1)			(See Note 1)		

EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	30 FT. FLOOR SPAN			40 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
<p><u>BASE TYPES:</u></p> <p>A = NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT                      B = STRUCTURAL STEEL RAILS OR BASE                      C = CONCRETE INERTIA BASE                      D = CURB-MOUNTED BASE</p> <p><u>ISOLATOR TYPES</u></p> <p>1 = RUBBER OR GLASS FIBER PAD                      2 = RUBBER FLOOR ISOLATOR OR HANGER                      3 = SPRING FLOOR ISOLATOR OR HANGER                      4 = RESTRAINED SPRING ISOLATOR                      6 = SPRING AND RUBBER IN SERIES HANGER</p> <p><u>NOTES:</u></p> <p>1. CONTRACTOR SHALL PROVIDE VIBRATION ISOLATION AND CALCULATIONS STAMPED BY A LICENSED PROFESSIONAL ENGINEER.</p> <p>2. TO AVOID ISOLATOR RESONANCE PROBLEMS, SELECT ISOLATOR DEFLECTION SO THAT NATURAL FREQUENCY IS 40% OR LESS THAN LOWEST OPERATING SPEED OF EQUIPMENT (SEE ASHRAE HVAC APPLICATIONS HANDBOOK, 1999 EDITION).</p>						

END OF SECTION 15240

## SECTION 15241 - MECHANICAL SEISMIC CONTROL

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Anchorage and seismic restraint systems for all Division 15 isolated and non-isolated equipment, ductwork and piping systems.
- B. Equipment/piping/ductwork to be isolated and/or seismically supported shall include but not be limited to the following:
  - 1. Piping
  - 2. Air Separators
  - 3. Expansion Tanks
  - 4. Pumps
  - 5. Heat Exchangers

#### 1.2 RELATED WORK

- A. Requirements: Provide Mechanical Seismic Control in accordance with the Contract Documents.
- B. Section 15010 - Basic Mechanical Requirements.
- C. Section 15050 - Basic Mechanical Materials and Methods.
- D. Section 15240 - Mechanical Sound and Vibration Control.

#### 1.3 REFERENCES

- A. International Building Code, Current Edition in use by Jurisdictional Authority.
- B. NFPA Bulletin 90A, Current Edition.
- C. UL Standard 181.
- D. Tri-Services Manual, Fagel Et Al, 1973.
- E. SMACNA Seismic Restraint Manual: Guidelines for mechanical systems.

#### 1.4 SYSTEM DESCRIPTION

- A. The Division 15 Contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachments, supports, seismic snubbers and bracing to comply with the following:
  - 1. Seismic Use Group II.
  - 2. Short period design spectral response acceleration coefficient  $S_{DS}$ = 1.2.

3. One-second period design spectral response acceleration coefficient  $S_{D1} = 0.78$ .
  4. Site Class D.
  5. Seismic Design Category E.
- B. The following components have a component importance factor  $I_p$  of 1.5:
1. Fire Sprinkler Protection System.
- All other components have an importance factor of 1.0.

#### 1.5 QUALITY ASSURANCE

- A. All supports, hangers, bases, anchorage and bracing for all isolated equipment and non-isolated equipment shall be designed by a professional engineer employed by the restraint manufacturer, qualified with seismic experience in bracing for mechanical equipment. Shop drawings submitted for earthquake bracing and anchors shall bear the Engineer's signed professional seal.
- B. The above qualified seismic engineer shall determine specific requirements for equipment anchorage and restraints, locations and sizes based on shop drawings for the mechanical equipment which have been submitted, reviewed and accepted by the Architect/Engineer for this project.
- C. Seismic Engineer or the Engineer's Representative shall field inspect final installation and certify that bracing and anchorage are in conformance with the Seismic Engineer's design. A certificate of compliance bearing the Seismic Engineer's signed Professional Engineer's seal shall be submitted and shall be included in each copy of the Operation and Maintenance Manuals.
- D. The Division 15 Contractor shall require all equipment suppliers to furnish equipment that meets the seismic code, with bases designed to receive seismic bracing and/or anchorage. All isolated and non-isolated mechanical equipment bracing to be used in the project shall be designed from the Equipment Shop Drawings and certified correct by the equipment manufacturer for seismic description listed in section 1.04 above, with direct anchorage capability.

#### 1.6 SUBMITTALS

- A. Submit shop drawings, calculations, and printed data for the following items under provisions of the General Conditions of the Contract:
  1. Complete engineering calculations and shop drawings for all seismic requirements for all equipment to be restrained as outlined in 15241-1.1 and as detailed on drawings.
  2. The professional seal of the engineer who is responsible for the design of the Seismic Restraint System.
  3. Details for all seismic bracing.
  4. Details for steel frames, concrete inertia bases, and housekeeping pads. Include dimensions, embed depths, dowelling details, and concrete reinforcing requirements.
  5. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors, snubbers, cables, and bolt connections.

6. Floor plan noting the locations, size, and type of anchorage and restraint to be used.
7. Certificate of Compliance.

## PART 2 - PRODUCTS

### 2.1 RESTRAINT EQUIPMENT AND SYSTEMS

- A. Acceptable Manufacturers and Suppliers for Non-Isolated Systems:
  1. Mason Industries, Inc.
  2. Korfund
  3. Amber/Booth Company
  4. Vibration Mountings and Control Company
  5. Kinetics
  6. International Seismic Application Technology
- B. Manufacture and design of restraints and anchors for isolated equipment shall be by the manufacturer of the vibration isolators furnished for the equipment in accordance with Section 15240.

### 2.2 SNUBBERS

- A. Snubbers shall be all-directional and consist of interlocking steel members restrained by replaceable shock absorbent elastomeric materials a minimum of 3/4 inch thick.
- B. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch or more than 1/4 inch.
- C. Snubbers shall be Mason Industries Z - 1011 or accepted equivalent.

## PART 3 - EXECUTION

### 3.1 DESIGN AND INSTALLATION

- A. General:
  1. All mechanical equipment, piping and ductwork shall be braced, anchored, snubbed or supported to withstand seismic disturbances in accordance with the criteria of this specification. Provide all engineering, labor, materials and equipment for protection against seismic disturbances as specified herein. The following mechanical components are exempt from seismic restraint requirements:
    - a. Components in Seismic Design Categories A and B (see 1.4-A-5 above).
    - b. Components in Seismic Design Category C (see 1.4-A-5 above) that have an importance factor  $I_p$  of 1.0 (see 1.4-B above).
    - c. Components that have an importance factor  $I_p$  of 1.0 (see 1.4-B above), that are mounted less than four feet above the floor, that weigh less than

- 400 pounds, and that have flexible ductwork, piping, and conduit connections.
- d. Components that have an importance factor  $I_p$  of 1.0 (see 1.4-B above), that weigh 20 pounds or less, and that have flexible ductwork, piping, and conduit connections.
2. Powder-actuated fasteners (shot pins) shall not be used for component anchorage in tension applications in Seismic Design Category D, E, or F.
- B. Spring Isolated Equipment:
1. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases as described in the vibration control specifications unless the equipment manufacturer certified direct attachment capability. Each spring mounted base shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. Snubbers shall be installed with factory set clearances.
- C. Non-Isolated Equipment:
1. The Division 15241 Contractor shall be responsible for thoroughly reviewing all drawings and specifications to determine all equipment to be restrained. This Contractor shall be responsible for certifying that this equipment is mounted and braced such that it adheres to the system description criteria in part 1.04 of this specification section.
- D. Piping:
1. Seismic braces for piping may be omitted when the distance from the top of the pipe to the supporting structure is 12" or less.
  2. A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
  3. Unbraced piping attached to in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.
  4. At the interface of adjacent structures or portions of the same structure that may move independently, utility lines shall be provided with adequate flexibility to accommodate the anticipated differential movement between the ground and the structure.
  5. Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.

END OF SECTION 15241

## SECTION 15250 - MECHANICAL INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED WORK

- A. Requirements: Provide insulation in accordance with the Contract Documents.
- B. Related work specified in other Sections:
  - Section 15010 - Basic Mechanical Requirements
  - Section 15050 - Basic Mechanical Materials and Methods
  - Section 15240 - Mechanical Sound and Vibration Control
  - Section 15450 - Plumbing Equipment
  - Section 15511 - HVAC Piping and Specialties
  - Section 15650 - Refrigeration
  - Section 15750 - Heat Transfer
  - Section 15880 - Air Distribution
  - Section 15900 - Ductwork and Accessories

#### 1.2 SYSTEM DESCRIPTION

- A. The mechanical insulation work required by this Section shall include materials and methods as described herein and on the Drawings and as required by applicable energy codes.
- B. The work includes, but is not limited to providing insulation on the following:
  - 1. Plumbing Systems:
    - Domestic Hot Water-Supply, Recirculating, Hot Water Converters, and Storage Tanks
    - Tempered Domestic Water-Supply, Recirculating and Storage Tanks
    - Domestic Cold Water
  - 2. Heating Systems:
    - Heat Exchangers, Converters and Air Separators
    - Steam Piping
    - Gravity Steam Condensate
    - Pumped Steam Condensate
    - Steam Condensate Receivers

#### 1.3 QUALITY ASSURANCE

- A. Qualifications: The firm executing the work of this Section shall have at least 3 years successful installation experience on projects with mechanical insulations similar in scope and nature to that required for this Project.

- B. Requirements of Regulatory Agencies: All insulation shall be in accordance with Jurisdictional Building Code and State and Federal Energy Conservation Standards.

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions for each type of mechanical insulation in accordance with the General Conditions of the Contract. Include schedule showing manufacturer's product number, thickness and furnished accessories for each mechanical system requiring insulation.
- B. Provide schedule of pipe sizes with insulation thickness at corresponding fluid temperatures.

#### 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Deliver insulation, coverings, adhesives, and coatings to site in containers with manufacturer's stamp or label affixed showing fire hazard ratings of products.
- B. Storage of Materials: Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged insulation; remove from project site.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers of insulation materials shall be as follows:

- Certain-teed
- Owens-Corning
- Johns Manville
- Armstrong
- Knauf
- Dow Chemical
- 3M/Thermal Ceramics (FireMaster)
- Unifrax (Fyrewrap)
- SpecSeal (Claymac)
- Renler (Pyroscat FastR Wrap)

#### 2.2 MATERIALS

- A. Conductivity:

TYPE OF INSULATION	MAXIMUM THERMAL CONDUCTIVITY/INCH
Calcium Silicate	0.47 at 600 degrees Fahrenheit
Glass Fiber Pipe Insulation	0.25 at 75 degrees Fahrenheit
Glass Fiber Rigid Equipment Insulation	0.25 at 75 degrees Fahrenheit
Glass Fiber Rigid Duct Insulation	0.24 at 75 degrees Fahrenheit
Glass Fiber Blanket Duct Insulation	0.29 at 75 degrees Fahrenheit
Expanded Polystyrene	0.24 at 75 degrees Fahrenheit
Ceramic Fiber Grease Duct Wrap	0.25 at 70 degrees Fahrenheit

- B. Vapor Barrier Coatings: To have a perm rating not more than 0.25 when tested in accordance with ASTM E96, procedure A.
- C. Adhesives, Sealers, Facings and Vapor Barrier Coatings: To be compatible with materials to which applied, and shall not corrode, soften, or otherwise attack the pipe or insulation materials in either the wet or dry state. Use only adhesives, sealers, facings, and vapor barrier coatings as recommended by the manufacturer of insulation materials.
- D. Chemicals for Treating Paper: Non-soluble.

### 2.3 PERFORMANCE CRITERIA

- A. Insulation and accessory materials to meet the following criteria:
  - 1. Insulation Materials: To be noncombustible as defined in National Fire Protection Association Pamphlet 220 and to be Underwriter's Laboratory listed.
  - 2. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM E 84 (NFPA 255) method.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Testing of piping and ductwork to be completed prior to application of insulation.
- B. Apply insulation tightly over clean, dry surfaces with sections or edges firmly butted together.
- C. Make insulation continuous through sleeves or openings in walls and floors.
- D. Run seal vapor barriers continuous throughout all cold surface insulation systems.
- E. Avoid the use of staples on vapor barrier jackets. Seal all vapor barrier penetrations with white vapor barrier sealant.

- F. Apply adhesives so as not to exceed the coverages recommended by the manufacturers.
- G. Leave surfaces clean and ready for painting.
- H. Do not insulate cleanouts, access openings or identification plates. Neatly bevel insulation and finishes up to the edges of such openings and stop with sheet metal rings.
- I. Provide non-collapsing inserts between pipe and all shields/saddles on all insulated piping 2-1/2" and larger.

### 3.2 SPECIFIC INSTALLATION REQUIREMENTS

#### A. Minimum Pipe Insulation Schedule:

2006 International Energy Conservation Code

PIPE INSULATION THICKNESS IN INCHES*			
Fluid	Nominal Pipe Diameter		
	≤ 1.5"	> 1.5"	>10"
Steam	1.5	3.0	3.0

\*Based on insulation having a conductivity not exceeding 0.27 BTU per inch/h-ft<sup>2</sup>·°F.

Exceptions:

1. Factory installed piping within HVAC equipment tested and rated in accordance with 2006 IECC referenced procedures.
2. Piping that conveys fluids that have a design operating temperature range between 55°F and 105°F, unless noted to be insulated on drawings or in specifications.
3. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power, unless noted to be insulated on drawings or in specifications.
4. Runout piping not exceeding 4 feet in length and 1 inch in diameter between the control valve and HVAC coil.

#### B. Plumbing System:

##### 1. Domestic Cold Water:

Insulate entire system. Thickness per Table of Section 15250-3.2.A.

##### 2. Domestic Hot and Tempered Supply and Circulating Water:

Insulate entire system.  
 Thicknesses per table of 15250-3.2.A.

##### 3. Domestic Hot Water Heaters, Storage Tanks, and Accumulators (not factory insulated):

Two inch thick fiberglass board, foil faced or faced with Du-All tank wrap or equal. Finish with six-ounce canvas or fiberglass reinforcing mesh and fire retardant lagging adhesive.

##### 4. Fittings:

Premolded PVC fitting covers with Fiberglass insert. PVC covers shall be rated for such use.

##### 5. Valves:

All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas and heavy coat of vapor barrier mastic coating.

C. Heating System:

1. Steam Piping Systems:

- a. Fiberglass covering with aluminum all-service jacket and self-seal lap.
- b. Thicknesses per Minimum Pipe Insulation Schedule.
- c. Steam Condensate: Thickness per Steam Piping System of 15250-3.2A.

2. Fittings:

- a. Premolded PVC fitting covers with Fiberglass insert.

3. Valves:

- a. All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas or fiberglass reinforcing mesh and heavy coat of vapor barrier mastic coating.

END OF SECTION 15250

## SECTION 15410 - PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Water Piping.
- B. Testing.

#### 1.2 RELATED REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Section 15010 - Basic Mechanical Requirements.

#### 1.3 RELATED SECTIONS

- A. Section 15050 - Basic Mechanical Materials and Methods.
- B. Section 15240 - Mechanical Sound and Vibration Control.
- C. Section 15241 - Mechanical Seismic Control.
- D. Section 15250 - Mechanical Insulation.
- E. Section 15411 - Disinfecting Water Supply System.
- F. Section 15450 – Plumbing Equipment.

#### 1.4 SUBMITTALS

- A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:  
  
Water Piping, Fittings, and Joints.

#### 1.5 SEQUENCING/SCHEDULING

- A. Coordinate any system shutdown with Campus Project Manager not less than 7 days prior to proposed shutdown.

## PART 2 - PRODUCTS

### 2.1 WATER PIPE, TUBE, FITTINGS AND JOINTS

#### A. Exterior Buried:

1. Copper Tube, Fittings, and Joint Material:
  - a. Copper tube ASTM B88 Type K shall be soldered to wrought or cast fittings using AWS class BCuP brazing filler metal.
  - b. Wrought copper and bronze solder joint fittings shall conform to ANSI B16.22.
  - c. Cast bronze solder joint fittings shall conform to ANSI B16.18.
2. Cast Iron Pipe Fittings and Joints:
  - a. Gray cast iron pipe, centrifugally cast, 18/40 physicals, cement lined, mechanical joint, thickness class 23 minimum. 300 psi minimum working pressure "laying condition A" as designated by USA Standard A21.1 and 8 foot bury.
  - b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.
  - c. Mechanical joint fittings shall be Ductile Iron, 350 psi working pressure up to 24" size.
3. Ductile Iron Pipe Fittings and Joints:
  - a. Class 150, ductile iron pipe centrifugally cast, thickness class 2, cement lined, mechanical joint, 350 psi minimum working pressure "laying condition A" as designated by USA Standard A21.51 and 8 foot bury.
  - b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.

#### B. Interior Buried:

1. Provide type K annealed (soft) copper water tube conforming to ASTM B-88 with 95% tin 5% antimony solder joints using wrought fittings. No joints below grade. Provide continuous tube for all buried tubing using tube bends in lieu of fittings. Exterior tube may be coupled where requirements are in excess of standard mill lengths by using wrought pressure couplings with stops and silver solder brazed joints. Lengths coupled in this manner, where necessary and acceptable to the Engineer, will meet the intent of the no fitting requirement of this Specification. Interior buried tube shall meet the same criteria and requirements.

#### C. Interior Tube Supported by Hangers and Clamps:

1. Provide ASTM B88 Type L hard drawn copper tube for all water distribution piping inside building/structure, with wrought copper fittings and couplers up to 6", cast brass or bronze fittings and couplers for sizes 6" and larger. Joints shall be made with 95-5 Class SnSb solder or Victaulic CTS roll-grooved couplers and fittings for 3" and larger tube.

PART 3 - EXECUTION

3.1 WATER TUBE, FITTINGS AND JOINTS

A. General:

1. All copper tube and fittings shall be reamed and buffed prior to soldering or brazing.
2. The use of lead solder of any class, for joint make-up or back-up for finishing is prohibited.
3. Refer and conform to the Copper Development Association instructions for proper preparation and actual installation practice for all soldered and brazed joints.
4. Support water tube in accordance with Section 15050.
5. Bury exterior water line at 48" to 60" below finished grade.

3.2 PROHIBITED PIPE ROUTING

A. Plumbing piping, regardless of contents (water, sewer, vent, etc.) shall not be routed through or above the following locations:

1. Electrical panel rooms
2. Electrical switch gear rooms
3. Electrical transformer rooms
4. Elevator shafts
5. Elevator equipment rooms
6. Data Centers
7. File Server Rooms / MDF / IDF

B. Should there be a conflict with the plans and the above paragraph, notify the Engineer immediately for corrective action prior to starting work.

3.3 TESTING

A. Schedule of Testing:

Service	**Allowable Test Methods				Minimum Test Pressure (psig)	Minimum Test Period (minutes)	Allowable Pressure Variance (psig)
	H <sub>2</sub> O	CA	N <sub>2</sub>	V			
1. Potable Water Pipe Valves & Fittings	X	X			125 100	60 60	-0- +1/2
2. Sanitary, Storm & Acid Waste and Vent System:							
*Stack Height:							
0-23 FT.	X				10	30	-0-
24-34 FT.	X				15	30	-0-
35-46 FT.	X				20	20	-0-
47-57 FT.	X				25	20	-0-
58-69 FT.	X				30	10	-0-
70-80 FT.	X				35	10	-0-

Service	**Allowable Test Methods				Minimum Test Pressure (psig)	Minimum Test Period (minutes)	Allowable Pressure Variance (psig)
	H <sub>2</sub> O	CA	N <sub>2</sub>	V			
81-92 FT.	X				40	10	-0-
93-103 FT.	X				45	10	-0-
Over 104 FT.	X				50	10	-0-
5. Distilled and Deionized			X		60	30	-0-

- B. Testing connections for hydrostatic tests shall be made at the base of the system, CA, N2 and vacuum testing can be made from connections anywhere in the system tested.
- C. In the event that tests fail, use a standard soap and brush inspection using "Trouble Bubble" Liquid high density soap as manufactured by Jersey Meter Co., Patterson N.J. Formula ST-1. After source of failure is discovered, correct and retest system. Repeat procedure until system sustains required testing successfully.
- D. Testing contractor shall give at least 16 working hours notice to the General Contractor/Construction Manager so that arrangements for witnessing tests can be made. The General Contractor/Construction Manager shall witness and SIGN the required test form.
- E. All joints, valves, fittings and piping accessory items shall be exposed to view during tests whether pipe is above or below ground. "Closed in" or "Buried" piping shall be re-exposed during testing.
- F. Proper restraining of piping and test plugs shall be accomplished prior to test.

END OF SECTION 15410

## SECTION 15411 - DISINFECTING WATER SUPPLY SYSTEM

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Disinfection of Domestic Water Supply System.

#### 1.2 RELATED WORK

- A. Requirements: Provide Disinfecting Water Supply System in accordance with the Contract Documents.
- B. Section 15010 - Basic Mechanical Requirements.
- C. Section 15410 - Plumbing Piping.

#### 1.3 DEFINITIONS

- A. Disinfectant residual means the quantity of disinfectant in treated water.
- B. pH factor means the measure of alkalinity and acidity in water.
- C. ppm means parts per million.

#### 1.4 CONTRACTOR'S QUALIFICATIONS

- A. Water Treatment Contractor: At least three years experience performing work specified herein.
- B. Bacteriological Laboratory: Certified by Serving Water Board or District and be in compliance with the State and U.S. Safe Drinking Water Act.

#### 1.5 REGULATORY AGENCY REQUIREMENTS

- A. Comply with requirements of Local and State Regulations.

#### 1.6 SUBMITTALS

- A. Submit for review and acceptance the following items under provisions of the General Conditions of the Contract:
  - 1. Water treatment contractor's evidence of experience.
  - 2. Bacteriological laboratory's evidence of certification.

B. Submit printed data for the following items under provisions of Operating and Maintenance Data paragraph in Section 15010:

1. Disinfection Report:

a. Include the following:

Date issued.  
Project name and location.  
Treatment Contractor's name, address, and phone number.  
Type and form of disinfectant used.  
Time and date of disinfectant injection start.  
Time and date of disinfectant injection completion.  
Test locations.  
Initial and 24 hour disinfectant residuals in ppm for each outlet tested.  
Time and date of flushing start.  
Time and date of flushing completion.  
Disinfectant residual after flushing in ppm for each outlet tested.

2. Bacteriological Report:

a. Include the following:

Date issued.  
Project name and location.  
Laboratory's name, certification number, address and phone number.  
Time and date of water sample collection.  
Name of person collecting samples.  
Test locations.  
Time and date of laboratory test start.  
Coliform bacteria test results for each Outlet tested. Certification that water conforms or fails to conform to bacterial standards of State and Federal Safe Drinking Water Act.  
Bacteriologist's signature.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protect against damage and discoloration.
- B. Maintain caution labels on hazardous materials.
- C. Maintain storage room dry and with temperatures as uniform as possible between 60 deg.F and 80 deg.F.
- D. Do not store Caustic Soda directly on floor colder than 55 deg.F.

1.8 PROTECTING WORK OF OTHER TRADES

- A. Provide necessary signs, barricades, and notices to prevent any person from accidentally consuming water or disturbing system being treated.
- B. Protect against damage and discoloration caused by work of this Section.

## PART 2 - PRODUCTS

### 2.1 DISINFECTANT

- A. Free chlorine; liquid, powder, tablet, or gas.

### 2.2 ALKALI

- A. Caustic Soda or Soda Ash.

### 2.3 ACID

- A. Hydrochloric type.

## PART 3 - EXECUTION

### 3.1 EXISTING CONDITIONS

- A. Prior to starting work, verify that Domestic Water System is completed, flushed and clean.
- B. Prior to starting work, notify Construction Manager/General Contractor of any defects requiring correction.
- C. Do not start work until conditions are satisfactory.

### 3.2 PREPARATION OF WATER FOR TREATMENT

- A. Verify pH factor of water to be treated.
- B. If pH factor is less than 7.4, introduce sufficient alkali during disinfectant injection to produce 7.4 to 7.6 pH level.
- C. If pH factor is greater than 7.6, introduce sufficient acid during disinfectant injection to lower pH to 7.4 to 7.6 level.

### 3.3 SYSTEM TREATMENT

- A. Inject disinfectant throughout system to obtain 50 to 80 ppm residual.
- B. Starting at outlet closest to water sources, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.
- C. Test for disinfectant residual at each of the following locations:
  - 1. Ends of piping runs.

2. Remote outlets. (Ends of each multiple fixture branch line)
  3. Tanks and domestic water heaters.
  4. At least 15% of outlets on each floor as directed by Architect/Engineer.
- D. Maintain disinfectant in system for 24 hours.
- E. If resultant disinfectant residual test is less than 25 ppm, repeat System Treatment.

### 3.4 FLUSHING

- A. Flush disinfectant from entire system; permit no more than residual rate of supplied incoming water.

### 3.5 BACTERIOLOGICAL TEST

- A. Instruct Bacteriological Laboratory to take water samples no sooner than 24 hours after flushing system.
- B. Take water samples at each of the following locations:
1. Where water enters system.
  2. Ends of piping runs.
  3. Remote outlets.
  4. Tanks.
  5. At least 10% of outlets on each floor other than those used for testing disinfectant residual, where directed by Architect/Engineer, but in no case less than 2 outlets per floor.
- C. Analyze Water Samples in accordance with Standard Methods for the examination of Water & Waste Water, published by American Water Works Assoc., 6666 W. Quincy Ave., Denver, CO 80235.
- D. If Bacteriological Test proves water quality to be unacceptable, repeat System Treatment.

### 3.6 PRODUCT CLEANING & REPAIRING

- A. Including work of other trades, clean, repair and touch-up, or replace when directed, products which have been soiled, discolored, or damaged by work of this Section.
- B. Remove debris from Project Site upon work completion or sooner, if directed.

END OF SECTION 15411

## SECTION 15450 - PLUMBING EQUIPMENT

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Steam Water Heater

#### 1.2 RELATED WORK

- A. Requirements: Provide Plumbing Equipment in accordance with the Contract Documents.

- Section 15010 - Basic Mechanical Requirements.
  - Section 15050 - Basic Mechanical Materials and Methods.
  - Section 15240 - Mechanical Sound and Vibration Control.
  - Section 15241 - Mechanical Seismic Control.
  - Section 15410 - Plumbing Piping.
  - Section 15430 - Plumbing Specialties.
  - Section 15485 - Natural Gas Systems.

#### 1.3 SUBMITTALS

- A. Submit product specification data for the following items under provision of The General Conditions of the Contract:
  - 1. Steam Water Heater.
- B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 15010:
  - 1. Steam Water Heater.

#### 1.4 WARRANTIES

- A. Provide original warranties for specific equipment of term specified and in accordance with Section 15010.

### PART 2 - PRODUCTS

#### 2.1 PRODUCT ACCEPTANCE

- A. Acceptable Manufacturers are listed for each product, and manufacturers shall submit products that are in fact equivalent in all respects of material, design, function, size, and appearance to the manufacturer specified. Deviations of any type will not be acceptable.

- B. Where acceptable manufacturers are not listed, only the manufacturer specified will be accepted.
- C. All equipment of like use and nomenclature shall be supplied by one manufacturer only.

## 2.2 PLATE AND FRAME WATER HEATERS

- A. Furnish and install as shown on the plans packaged double wall SS 316 instantaneous steam water heater(s) as manufactured by Spirax Sarco, Tiger Flow / Bell & Gossett, Alfa Laval, Tranter, Polaris, .
- B. Each heater shall be a complete factory assembled package as shown on drawings rated to heat water from steam to the control valve. Heater will deliver a constant outlet temperature  $\pm 2-3^{\circ}\text{F}$  under stable load conditions. Heater will provide outlet temperatures within  $\pm 9^{\circ}\text{F}$  of set point when subject to sudden changes in demand. Buffer tank or mixing valve shall not be permitted. Heater to have 1/3 , 2/3 control valve with UNT controller tied into the Metasys system.
- C. Each heater shall have an integrally mounted stainless steel recirculation pump to maintain continuous flow through the heat exchanger. The heat exchanger shall be the bolted plate and frame type so the unit can be serviced without having to disturb any connection on the steam or waterside. Heat exchanger shall have the capacity to be expanded by 20% the addition of plates without removal of the heater from its installed position.
- D. All heat transfer surfaces in contact with potable water shall be 316L stainless steel. Copper or non-metallic liners shall not be acceptable. Potable water piping on the package shall be 316L stainless steel.
- E. System shall be designed, manufactured and stamped in accordance with ASME Section VIII on the primary and secondary side for 150 PSIG @ 350°F.
- F. Each packaged water heater shall consist of the following components, which are factory-assembled and ready for connection to services. All steam and condensate control components must be supported by the supplier of the package.

### Steam Control Valve:

- 1. Electronic with single loop PID and smart positioner (optional air kit).  
Electric linear actuator and single loop PID control.
  - 2. Stainless steel circulator pump 1/25 HP pre-wired to NEMA 1 control box.
  - 3. Automatic pump trap.
  - 4. 4" dial pressure gauge.
  - 5. Bronze P&T relief valve set @ 150 psig @ 210°F.
  - 6. Carbon steel support stand.
  - 7. Integrate steam control valve into building automation system.
- G. Warranty: The heater shall be warranted for one year from date of shipment against failure due to defects in material or workmanship.

## PART 3 - EXECUTION (NOT USED)

WEBER STATE UNIVERSITY HEAT EXCHANGER REPLACEMENT IN:  
EDUCATION, SCIENCE LAB, SOCIAL SCIENCE, LIBRARY SOUTH,  
ALLIED HEALTH SOUTH AND NORTH, STUDENT SERVICES,  
ADMINISTRATION, AND STADIUM BLDGS.

DFCM PROJECT NO. 08059810  
12/09/2008

END OF SECTION 15450

## SECTION 15511 - HVAC PIPING AND SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Related work specified in other Sections:
  - Section 15010 - Basic Mechanical Requirements
  - Section 15050 - Basic Mechanical Materials and Methods
  - Section 15240 - Mechanical Sound and Vibration Control
  - Section 15241 - Mechanical Seismic Control
  - Section 15250 - Mechanical Insulation
- C. Work installed but furnished under other Sections:
  - 1. Pot Feeders, Water Meters, Solenoid Water Valves with Strainers and Manifolds furnished under Section 15548 - HVAC Water Treatment.
  - 2. Flexible pipe connectors - Section 15240.
  - 3. Automatic steam control valves.
  - 4. Temperature sensing wells.

#### 1.2 SYSTEM DESCRIPTION

- A. The work includes, but is not limited to the following:
  - 1. Steam piping system and specialties.
  - 2. Relief Valves.
  - 3. Expansion Tanks
  - 4. Diaphragm - Type Compression Tanks.
  - 5. Air Vents.
  - 6. Strainers
  - 7. Valves in accordance with Section 15050.
  - 8. Pipe hangers and supports, saddles and shield in accordance with Section 15050.
  - 9. Expansion joints, anchors and guides.
  - 10. Mechanical sound and vibration control in accordance with Section 15240.
  - 11. Installation of automatic control valves.
  - 12. Tests.

#### 1.3 QUALITY ASSURANCE

- A. Welder Qualifications: Welding shall be performed by an NCPWB Certified Welder with current certificate in accordance with ANSI B31.9 for shop and project site welding of piping work.

#### 1.4 REFERENCES

- A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
1. Comply with American Welding Society (AWS) National Certified Pipe Welding Bureau (NCPWB) and American National Standards Institute (ANSI) Code Numbers B31.2, B31.9 as applicable for welding requirements.
  2. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.
  3. ANSI/ASME B31.9 - Building Services Piping.
  4. ANSI/AWS D1.1 - Structural Welding Code.
  5. ANSI/ASME Sec. 9 - Welding and Brazing Qualifications.
  6. ASTM B32 - Solder Metal.
  7. ANSI/AWS A5.8 - Brazing Filler Metal.

#### 1.5 SUBMITTALS

- A. Submit Product Data for the following items under provisions of The General Conditions of the Contract.
1. Diaphragm-Type Compression Tanks.
  2. Air Separators.
  3. Strainers.
  4. Balancing Valves.
  5. Thermometers.
  6. Pressure Gauges.
  7. Steam Traps.
  8. Expansion Joints and Guides.
- B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 15010.
1. Diaphragm-Type Compression Tanks.
  2. Air Separators.
  3. Strainers.
  4. Balancing Valves.
  5. Steam Traps.
  6. Expansion Joints and Guides.
- C. Test Reports: Submit certified test reports for the following showing compliance in accordance with the General Conditions of the Contract:
1. Piping pressure tests.
  2. Piping systems cleaning and flushing per Section 15548.
  3. Certificates: Before proceeding with the Work, submit to the Architect/Engineer/Construction Manager/General Contractor, two copies of Certification that the welding work will be done according to ANSI B31.1 by welders who have been tested and whose qualification test sheets are available, attesting to their ability to weld in accordance with Standard Procedure Specifications as established by the National Certified Pipe Welding Bureau.



- F. Flanges:
- |           |  |
|-----------|--|
| All Sizes | ASTM A181, Grade 1, Class 300 slip-on or weld neck flat faced. |
|-----------|--|

## 2.2 LOW AND MEDIUM PRESSURE STEAM, PIPING (LESS THAN 16 PSIG)

- A. Steel Pipe:
- Pipe:

2 Inch & Smaller	ASTM A120, Grade A, Schedule 40 black buttweld or continuous welded steel or screwed.
2-1/2 Inch & Larger	ASTM A120, Grade B, Schedule 40 black buttweld or continuous welded steel.
  - Fittings:

2 Inch & Smaller	ASTM A197, Class 200 black malleable iron screwed, Schedule 40.
2-1/2 Inch & Larger	ASTM A234, Steel butt weld standard weight forged fittings, Schedule 40.
  - Unions:

2 Inch & Smaller	Class 200, Schedule 40 black malleable iron screwed bronze to iron, ground joint.
2-1/2 Inch & Larger	Use Schedule 40 flanges or grooved couplings.
  - Gaskets:

All Sizes	Class 200 1/16 inch full faced - punched.
-----------	---
  - Bolting:

	ASTM A307, Grade B, regular square head machine bolts with heavy hex nuts.
--	--
  - Flanges:

All Sizes	ASTM A181, Grade 1, Class 200 slip-on or weld neck flat faced.
-----------	--

## 2.3 STEAM CONDENSATE RETURN PIPING

- A. Steam condensate return piping shall be the same as steel low pressure steam piping specification except that all piping shall be Schedule 80 with extra heavy fittings.
- |                   |   |
|-------------------|---|
| 2 Inch or Smaller | Schedule 80, screwed malleable iron fittings. |
|-------------------|---|

2-1/2 Inch or Larger Schedule 80, ASTM-72 black buttweld or continuous welded steel.

2.4 STATIONARY PRESSURE GAUGES

- A. Acceptable manufacturers: Trerice 600C Series, Weksler Regal Series, Weiss Instruments, Miljoco.
- B. Schedule: All gauges will be liquid filled.

Plan Code	PG-1	PG-2
Type	4-1/2" Dial	4-1/2" Dial
Bourdon tube/socket	Phosphor bronze tube brass socket	Stainless steel tube 316 stainless steel socket
Accuracy	ANSI B40.1 Grade 1A 1% FS over middle half of range	ANSI B40.1 Grade 1A 1% F.S. over middle half of range
Case	Cast aluminum	Cast aluminum
Window	Clear glass	Clear glass
Snubber	Yes	Yes
Coil siphon	For steam service	For steam service
Gauge cock	Yes	Yes
Set hand	No	No
Silicone filled	No	No
Weatherproof	No	No

- C. Range: Select gauges for the following standard ranges unless otherwise indicated on drawings, or as required for special systems:
  1. Domestic Water 0 to +160 psi
  2. Low Pressure Steam -30 in Hg to +60 psi
  3. Steam -30 in Hg to +150 psi
  4. Pump Gauges -30 in Hg to +100 psi
- D. Include a syphon tube and gauge cock on all pressure gauges used on steam systems. Syphon must be filled with water.

2.5 STATIONARY THERMOMETERS

- A. Acceptable manufacturers: Trerice Industrial Series, Ametek Industrial Series, Weiss Instruments, Miljoco.
- B. Schedule:

Plan Code:	T-1
Type	Self Powered Digital Adjustable angle
Case	9" cast aluminum
Window	Clear acrylic

Tube	Thermistor
Stem	Aluminum, insertable
Separable Socket	Brass

C. Range: Select thermometers, for the following standard ranges unless otherwise indicated on Drawings, or as required for special systems.

- |    |                    |              |
|----|--------------------|--------------|
| 1. | Steam              | 50 to 400 °F |
| 2. | Low pressure steam | 30 to 300 °F |
| 3. | Steam condensate   | 30 to 240 °F |

## 2.6 STEAM TRAPS

A. Acceptable Manufacturers: Armstrong, Hoffman/ITT, Spirax Sarco, Watson McDaniel.

B. Float and Thermostatic Traps:

1. Cast iron body; carbon steel cover screws, stainless steel ball float, float arm, valve mechanism assembly, valve seat, and air vent assembly. All components must be capable of being repaired/replaced without disturbing piping.
2. Thermostatic air vent shall be of balanced pressure type and shall be adequately sturdy to withstand waterhammer shock without sustaining damage.
3. Unit capable of maximum operating pressure of 35 psig.

C. Thermodynamic Traps:

1. ASTM stainless steel body and insulated cap with hardened stainless steel disk and seat, capable of maximum operating pressure of 450 psig and maximum operating temperature of 750°F.
2. Include stainless steel Universal Swivel pipeline connector with integral "Y" strainer, blowdown valve, and hose fitting. "Y" strainer to be equipped with stainless steel screen with 1/32" perforations. Trap is fastened to pipeline connector with two steel bolts, allowing trap to be removed/replaced without disturbing any piping. Contractor is responsible for ordering pipeline connectors with correct hand so trap is accessible and not located between piping and wall.

## 2.7 EXPANSION JOINTS, ANCHORS AND GUIDES

A. Approved Manufacturers: Barco, Flex-Hose, Metraflex.

B. Provide expansion joints where called for on drawings or otherwise necessary to prevent noise or damage.

C. Exposed Bellows Expansion Compensator: Stainless steel bellows with internal stainless steel liner, carbon steel ANSI flanges or Schedule 80 beveled weld ends as indicated in schedules. Include tie rods with spacers to prevent over-elongation and over-compression of the unit. Expansion compensator must be rated for operating temperatures up to 600°F and operating temperatures up to 150 psi.

D. Externally Pressurized Expansion Compensators: Stainless steel multi-ply bellows with internal guides, internal stainless steel liner, and a heavy wall outer housing designed for

line pressure. Operating fluid pressure inside compensator is transferred to the outside of the bellows through a gap between internal guide flange and the outer housing. Entire assembly to be sealed to contain fluids and pressure, and shall include a drain port in the outer housing. Unit to be rated for operating pressure of 150 psi and operating temperature up to 700°F. Unit to be a packless design, maintenance free design. Guarantee a minimum of 10,000 full travel cycles without failure. Use Metraflex Metragator, Flex-Hose Flexpress, or equal from list of approved manufacturers.

- E. Braided Pipe Seismic Connectors: Two or three equal lengths of annular corrugated flexible stainless steel hose with stainless steel overbraid and four stainless 90° elbows, resulting in a device that absorbs/compensates for pipe motion in all 6 degrees of freedom simultaneously. Device shall allow for  $\pm 4$ " of pipe motion in any direction. Unit to be rated for operating pressures of 150 psi and operating temperatures of 600°F. Include support lugs on elbows and fitting on distant elbow for drain plug or air relief valve. Use Flex-Hose, Tri-Flex Loop or equal from list of approved manufacturers.
- F. Pipe Guides: Provide pipe guides and anchors as shown on drawings or as recommended by expansion joint manufacturer. Pipe guides must allow axial movement of pipe while eliminating lateral pipe movement. Guides to be constructed of painted carbon steel, and consist of a two-piece split spider clamp that bolts around the pipe, and a two-piece bolted split housing with integral base that anchors the unit to the structure. Pipe anchors shall be made of carbon steel, are to be welded to the pipe they serve, and are to be painted to protect the anchor and welds from corrosion. Anchors to include an integral base that bolts to the structure.

## 2.8 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; 1/16 inch thick preformed neoprene bonded to asbestos.

## 2.9 RELIEF VALVES

- A. Acceptable Manufacturers: Kunkle, Watts, McDonnell and Miller, Lonegren, Conbraco, Spirax Sarco.
- B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.
- C. Size as required for maximum operating pressure and heat transfer capacity of the equipment. Provide relief valve in each system to protect piping, tanks and equipment.
- D. Include a drip pan elbow on all steam system relief valves. Pipe drip pan drain to nearest floor sink.
- E. Pipe steam relief valves serving pressure reducing valve on low pressure side and pipe to outside.

## 2.10 STRAINERS

- A. Acceptable Manufacturers: Armstrong, Boylston, AW Cash, ITT, Hoffman, Keckley, Mueller, Trane, Metraflex, Victaulic, Gustin-Bacon, Conbraco.
- B. Size 2 inch and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. Size 2-1/2 inch to 4 inch: Flanged or grooved iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- D. Size 5 inch and Larger: Flanged or grooved iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

## 2.11 DIAPHRAGM-TYPE BLADDER TANKS

- A. Acceptable Manufacturers: Bell and Gossett, Amtrol, Wessels, Woods, Taco, Wheatley.
- B. Provide tanks of size and capacity shown on Drawings.
- C. Construction: Welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM bladder sealed into tank, and steel legs or saddles.
- D. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

## 2.12 AIR VENTS

- A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/4 inch copper tubing to a floor drain or sink with petcock at working level, ground.
- B. Balanced Pressure Thermostatic Air Vents for Steam Systems: Self-adjusting balanced pressure thermostatic type with stainless steel bellows. Stainless steel head and seat, cast iron body. All internals must be accessible for maintenance.

## 2.13 DIAPHRAGM-TYPE EXPANSION TANKS

- A. Acceptable Manufacturers: Bell and Gossett, Amtrol, Wessels, Woods, Taco, Wheatley, Armstrong, Flexcon.
- B. Provide tanks of size and capacity shown on Drawings.
- C. Construction: Welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- D. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

### PART 3 - EXECUTION

#### 3.1 PIPE WORKMANSHIP

- A. Piping shown on the drawings shall be installed complete, and shall be of the size shown on the drawings. When a size is not indicated, the sub-contractor shall request the pipe size from the Architect/Engineer thru the General Contractor. All piping shall be installed parallel or perpendicular to the building construction. All piping shall be installed so as to allow for expansion. Install saddles and shields per Section 15050.

#### 3.2 PIPE JOINTS

- A. All pipe shall be reamed to full pipe diameter before joining. Screwed joints shall be made with standard pipe thread, and an approved compound applied to the male thread only. Welded joints shall be made in accord with the procedure outlined in National Certified Pipe Welding Bureau, or by other reputable testing laboratory or agency. Subcontractor shall use only "Threadolet" or "Weldolet" fittings for intersection welding of branches to mains. Valves and specialties shall have screwed or flanged joints. No bushings allowed.

#### 3.3 PIPE SLOPE

- A. Slope all domestic water, chilled water, heating water, and condenser water piping at 1"/40' toward drains.

#### 3.4 STEAM AND CONDENSATE SLOPE

- A. Shall be 1" in 15 feet in direction of flow.

#### 3.5 RELIEF VALVES

- A. Provide a pressure relief valve in each closed loop system set at 1.2 times the maximum operating pressure.

#### 3.6 EXPANSION JOINTS, ANCHORS AND GUIDES

- A. Pipe anchors shall be installed as shown and at the closest feasible point to all changes in pipe direction and elevation and at main branch take-offs, except at expansion loops. All piping shall be supported, anchored, braced and guided to control expansion-contraction and pipe movement due to pressure or shock, and to result in quiet operation.

#### 3.7 BALL JOINTS

- A. Install ball joints and anchoring for piping where it crosses expansion joints of building.

### 3.8 AIR VENTS

- A. At all changes in elevation downward in direction of flow, and where shown, provide a manual air vent as follows: install a full size air chamber and pipe down with 1/4 inch copper tubing to a petcock. If the vent is above a ceiling, install the petcock just above the ceiling. Provide air vent fittings (manual) on hydronic coils.
- B. Install thermostatic air vents at the ends of all steam mains and headers at all high points, on all steam heat exchangers, and on all steam coils. Make connection at high point of pipe or device, and pipe air vent discharge to nearby floor sink. Install a swing check valve in horizontal discharge piping off units that do not include an integral check device. Install a swing check-valve downstream of air vent if unit has no internal check.

### 3.9 PIPING CONNECTORS

- A. Install flexible pipe connectors at equipment coils and pumps and elsewhere as required to accommodate thermal expansion, misalignment and vibration in accordance with Section 15240 - Mechanical Sound and Vibration Control.

### 3.10 AIR SEPARATOR

- A. Contractor shall remove and clean strainer after 24 hours operation and after 30 days.

### 3.11 STEAM SYSTEM STRAINERS

- A. Install steam strainers on side so branch of "Y" lies on horizontal plane, not down.
- B. Strainers in condensate drip legs will primarily see condensate and are to be installed with the branch of the "Y" in the vertical plane, pointing down.

### 3.12 THERMOMETERS AND PRESSURE GAUGES FOR HEAT EXCHANGER INSTALLATION

- A. Contractor shall furnish and install a set of four adjustable, indicating type, self powered digital thermometers of the separable socket adjustable type in glass faced metal cases. They shall be placed in the piping adjacent to the machine or heat exchanger as indicated in details.:
- B. Thermometer bulb shall project sufficiently into pipe to accurately measure water temperature. Cases shall clear insulation.
- C. Provide and install gauge valves and gauges so that water pressure difference across these vessels is indicated.
- D. Mount thermometers and gauges in a readily accessible location and easily read in a standing position from the equipment room floor.
- E. Provide a shut-off valve on the branch line to each pressure gauge located in the system.

### 3.13 TESTS

- A. General: Provide test pump, gauges, meters, other instruments, materials, and labor, in connection with tests.
- B. Pressure Tests: Before testing piping systems, remove or otherwise protect from damage, control devices, air vents and other parts which are not designed to stand pressure used in testing piping.
- C. Hydrostatic Pressure: Test hydronically, piping for all services (except pneumatic system compressed air) to 125 psi or 1.5 times the maximum working pressure, whichever is greater, for at least six consecutive hours, during which time pressure shall remain constant without pumping. Subject welded joints to the hammer test, and copper joints to soap suds while under hydrostatic pressure.
- D. Coordinate testing dates and times with Owner's representative. Owner's representative must witness all test and sign all test result forms as required.

### 3.14 CLEANING OF PIPING SYSTEMS

- A. Provide for the cleaning of the HVAC Water Piping Systems after hydrostatic tests have been completed and prior to the operating tests in accordance with Section 15548 - HVAC Water Treatment.
- B. 15511 Contractor is to provide bypasses and isolation valves as required by 15548 Contractor to allow circulation of cleaning solution in new piping system without allowing system cleaning solution to circulate through existing piping system. Division 15511 Contractor is responsible for removing and cleaning strainers in existing system plugged by cleaning of new system. Simply blowing down strainers is unacceptable.

### 3.15 HVAC WATER TREATMENT

- A. Provide valved tees and piping and 3/4 inch threadlets for water treatment apparatus in accordance with Section 15548 HVAC Water Treatment Contractor instructions.

END OF SECTION 15511

## SECTION 15548 - HVAC WATER TREATMENT

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Pre-Startup cleaning of HVAC Piping Systems.
- B. Pre-Startup cleaning of Steam and Condensate Piping Systems.
- C. Treatment for Steam System.

#### 1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish only the following items to Section 15511 - HVAC Piping Contractor for installation:
  - Manifolds
  - Solenoid Water Valves with Strainers
  - Motorized Ball Valves for solids separator blowdown/bleed

#### 1.3 RELATED WORK

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.
- B. Section 15010 - Basic Mechanical Requirements.
- C. Section 15050 - Basic Mechanical Materials and Methods.
- D. Section 15411 - Disinfecting Water Supply System.
- E. Section 15511 - HVAC Piping and Specialties.

#### 1.4 QUALITY ASSURANCE

- A. The Water Treatment, Chemical and Service Company shall be a recognized specialist, active in the field of industrial water treatment for at least ten years, whose major business is in the field of water treatment, and shall have regional water analysis laboratories, development facilities and service department, plus full-time service personnel within the locale of the job site.
- B. All products shall be provided by a single Contractor to ensure there being a single source of responsibility.
- C. While it is recognized that there are, for most items, several equal brands and manufacturers, the bidders will for the purpose of this bid, offer only specified equipment and chemicals.

- D. Acceptable Water Treatment, Chemical and Service Suppliers meeting the above requirements for this project are as follows:
1. West, Inc.
  2. Nalco
  3. Hi-Valley Chemical
  4. Alpine Technical Services
  5. Power Engineering Co.
- E. Campus treatment is currently West, Inc. Water Treatment Company providing service for this project will use compatible treatment service and follow West, Inc. standards and recommendations.
- F. Firms not listed above must submit a list of satisfied customer service references and evidence of qualifications and experience for acceptance to execute the work on this project under provisions of the General Conditions of the Contract.

#### 1.5 SUBMITTALS

- A. Technical Data: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:
1. Water Treatment Materials and Equipment.
  2. Control Diagrams.
  3. Chemicals and quantity provided.
- B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data Paragraph in Section 15010.
1. All Water Treatment Equipment and Procedures.
  2. Water Treatment Program Control Chart.

#### 1.6 MAINTENANCE SERVICE

- A. Provide the services of a fully qualified Field Engineer and laboratory and technical assistance from a fully qualified laboratory staff for one year warranty period. Services and assistance shall include the following:
1. A two hour training course for the Owner's operating personnel instructing them clearly and fully on the installation, care, maintenance, testing, and operation of the water treatment systems. The training course shall be arranged by the Division 15 Contractor at the startup of the system.
  2. A monthly technical service visit to the jobsite of the installation to perform field inspections and to make water analysis on site, both of such complexity as to evaluate the water systems operations. The Field Engineer shall detail findings with the proper personnel in writing on proper practices, chemical treating requirements, and any corrective actions needed to protect the water systems from scale, corrosion, and fouling. Two copies of the written field service report shall be forwarded to the Owner and the Division 15 Contractor and the Engineer after each visit.
  3. Be on call at no additional cost increase to the Contract Sum to make on-site inspections of equipment during scheduled or emergency outages in order to

properly evaluate the success of the water treatment program, and to make recommendations in writing based upon these inspections.

#### 1.7 EXTRA STOCK

- A. Provide sufficient chemicals for treatment and testing during one year warranty period. If any system loses the chemicals due to pipe leaks or any other system malfunction, the Division 15000 Contractor shall replace the chemicals at no expense to the Owner. Chemicals shall not be harmful to the system in which they are used, and shall comply with Jurisdictional Codes governing the use and discharge of chemical formulations.

### PART 2 - PRODUCTS

#### 2.1 STARTUP CLEANING OF STEAM PIPING SYSTEM

- A. Provide chemicals for startup cleaning of steam and condensate piping systems. Assist installing contractor during startup to conduct once-through cleaning of piping systems.

#### 2.2 STEAM SYSTEMS

- A. Provide Chemical Feed Equipment, Control Equipment, and Chemicals for Heating Steam Systems.
- B. Acceptable Manufacturers:  
  
Chemical Pump Package Unit: Neptune, Milton Roy, LMI.  
Manual Throttling Valve: Claypool, Tasco, Packer.
- C. Provide a chemical pump package unit for each boiler consisting of the following.
  - 1. One (1) DEI ½" motorized ball valve.
  - 2. One (1) Parker continuous blowdown valve.
  - 3. One (1) LMI A51-257 Chemical Metering Pump including two spring loaded stainless steel check valves. Provide foot valve and suction tubing for pump. Provide all hardware to mount pump to the flat on the top of the tank. All mounting and associated hardware shall be stainless steel.
  - 4. One (1) Aquatrac Model CPT1FL2RMAD Automatic Blowdown Controller. Provide all required surge protection and interlocks for proper operation of the controller. (One controller to monitor blowdown and chemical feed for both boilers).
  - 5. One (1) Chemical Pump Control Panel. Panel shall be NEMA 12X Construction and shall include hand/off/auto switches and annunciator light for each pump. Pump control shall be provided by the blowdown controller through the Pump Control Panel (one chemical pump control panel to control chemical feed for both boilers).
  - 6. One (1) Water Meter sized for boiler feed water line with a pulse signal.
  - 7. One (1) Neptune QC-50 Injection Quills.
  - 8. One (1) 65 gallon bulk treatment tank with secondary containment basin. Tanks shall be cross-linked HDPE. Tank shall be Snyder MST style tank within a tank. Tank shall include mounting flat for pump and Camlock connection for filling the tank. A visual level indicator shall be supplied with the tank.

9. One (1) Madden sample cooler model SC0001.
  10. One (1) Keckley blowdown strainer style 1.
- D. The controller shall be mounted at a height appropriate for convenient visual inspection. Controller shall incorporate the latest in solid state/microprocessor technology. Controller enclosure shall be NEMA 12X.
- E. The Automatic Blowdown Controller shall include not less than 12 analog inputs, and 12 Digital inputs for system monitoring. Inputs for water meter connections shall be separate from the initial 12 digital inputs. Water meter from the make-up line of the deaerator and the boiler feed water lines shall be connected and monitored by the controller. All analog inputs shall be 4-20 mA loops. The Automatic Blowdown Controller shall be provided with two (2) sensing probes. One sensor shall be installed on the surface blowdown line of each boiler.
- F. Controller shall include digital display and shall be programmed through a remote infrared programmer. Infrared programmer shall be supplied with the controller and will allow programming of the controller without opening the enclosure. Data storage shall include all measured parameters and shall be stored at a minimum of 15 minute increments. Total data storage shall be held for not less than 30 days.
- G. Software and hardware shall be provided with the controller to allow computerized monitoring.
- H. Water treatment chemicals shall be fed on a percentage of makeup water and feed water to each of the boilers. Liquid sulfite shall be fed directly to the deaerator. Boiler treatment shall be fed into the boiler feed water line, downstream of the boiler feed water pumps and water meter.
- I. All treatment materials will be delivered to the facility in portable containers which will be used only to transport treatment to the bulk storage tanks and then removed. No portable containers will be allowed to remain onsite.
- J. Monthly reports will be provided to the engineer and to the owner showing all monitored treatment parameters.
- K. Blowdown sensor, metering valve, and motorized ball valve shall be mounted with a three valve bypass to isolate sensor and valves for servicing.
- L. Provide a second separate chemical pump package unit consisting of the following for the deaerator storage tank:
1. One (1) LMI A151-257 Chemical Metering Pump.
  2. One (1) Water meter sized for makeup water line with a pulse signal.
  3. One (1) Neptune QC-50 Injection Quills.
  4. One (1) 65 gallon bulk treatment tank with secondary containment basin. Tanks shall be cross-linked HDPE. Tank shall be Snyder MST style tank within a tank. Tank shall include mounting flat for pump and Camlock connection for filling the tank. A visual level indicator shall be supplied with the tank.
- M. Provide a separate chemical pump package unit consisting of the following for the condensate return line treatment station indicated on drawings:
1. One (1) LMI A151-257 Chemical Metering Pump.

2. One (1) programmable timer for 7 day operation with a minimum of 8 operation times per day. Timers shall be mounted in a NEMA 12X enclosure. The timer enclosure shall provide at least one outlet for the chemical metering pump. All electrical connections for the pump and the timer shall be made inside the timer enclosure.
3. One (1) pump support stand. The stand shall support the pump at a height to accommodate a 5 gallon pail underneath. The stand shall provide for mounting the timer above the pump. Stand shall be stainless steel or mild steel with an epoxy coating. Steel with enamel paint coatings will not be acceptable.

### 2.3 STEAM SYSTEM CHEMICALS

- A. Provide chemicals for use in the steam system, to include scale inhibitor, Alkalinity Builder, Sludge Conditioner, Oxygen Scavenger, Condensate Line Treatment, and Corrosion Inhibitor.

### 2.4 WATER TREATMENT CONTROL TESTING EQUIPMENT

- A. Provide testing chemicals to properly analyze the condenser water for organic phosphonate and closed system water for nitrite. Furnish the necessary test kits for these tests.
- B. Provide a Myron L "DS" meter, single range, 0-5000 MICROMHOS/CM auto-temp compensation 50-160 deg.F, 9-volt transistor batteries, and built in cell cup.
- C. Furnish a supply of log sheets on which to record the test results and bound copy of full test instructions.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Coordinate where installation of equipment in piping systems is required with the Section 15511 - HVAC Piping Contractor and Electrical requirements per Section 15050 - Basic Mechanical Materials and Methods and provide installation instructions to those firms providing installation.

### 3.2 CLEANING OF PIPING SYSTEMS

- A. Thoroughly clean the HVAC water piping systems after hydrostatic tests have been completed and prior to the operating tests with liquid alkaline dispersant cleaner per instructions specified in Part 2 dictating the quantities of the cleaner to use, methods, and duration of the operation. Systems shall then be drained and thoroughly flushed out with fresh water. Thoroughly clean the steam and condensate piping system and equipment.
- B. Contractor shall notify Architect/Engineer prior to cleaning operation, and shall verify in writing to the Architect/Engineer after the system has been cleaned.
- C. Failure of any part of the system due to improper cleaning or inadequate chemical feed shall be the responsibility of the Division 15 Contractor.

- D. Division 15511 Contractor is to provide bypasses and isolation valves as required to allow circulation of cleaning solution in new piping system without allowing system cleaning solution to circulate through existing piping system. Coordinate proper bypass and isolation valve locations with Division 15511 Contractor to ensure proper cleaning of entire new HVAC piping systems.

### 3.3 SYSTEM START-UP

- A. The Water Treatment Supplier shall put the treatment equipment into operation, and make adjustments necessary for proper operation.
- B. The Water Treatment Supplier shall provide a written report to the Division 15 Contractor indicating that the start-up has been completed and that all equipment is operating properly.

### 3.4 OPERATOR TRAINING AND SERVICE

- A. The Water Treatment Supplier shall instruct the Owner's operating personnel so as to familiarize them with all treatment equipment and procedures per Maintenance Service specified in Part 1 of this Section. Minimum of 2 hours/system type.
- B. The Water Treatment Supplier shall obtain a signed receipt from the Owner's operating personnel to confirm that adequate training has been received to operate the systems properly.

END OF SECTION 15548

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DFCM PROJECT NO. 08059810  
12/09/2008

## TABLE OF CONTENTS

SECTION NUMBER	TITLE
16050	Basic Electrical Materials and Methods
16060	Grounding and Bonding
16071	Electrical Supports and Seismic Restraints
16075	Electrical Identification
16120	Conductors and Cables
16130	Raceways and Boxes

## SECTION 16050 – BASIC ELECTRICAL MATERIAL AND METHODS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Raceways.
  - 2. Building wire and connectors.
  - 3. Supporting devices for electrical components.
  - 4. Electrical identification.
  - 5. Electricity-metering components.
  - 6. Concrete equipment bases.
  - 7. Electrical demolition.
  - 8. Cutting and patching for electrical construction.
  - 9. Touchup painting.
  - 10. Submittals.
  - 11. Workmanship.
  - 12. Coordination drawings.
  - 13. Record documents.
  - 14. Drawings and Specifications.
  - 15. Maintenance manuals.
  - 16. Rough-ins.
  - 17. Electrical installations.
  - 18. Cutting and patching.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

#### 1.4 SUBMITTALS

- A. Product Data: Follow the procedure specified in Division 1 Section "Submittals".

- B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
- C. hField Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. Additional copies may be required by individual sections of these Specifications.

#### 1.5 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70.

#### 1.6 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work.
- C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.
- D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- E. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.
- F. Prepare coordination drawings in accordance with Division 1 Section "Project Coordination", to a scale of  $\frac{1}{4}"=1'-0"$ , or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installation, and building components. Indicate locations where spaces is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including but not limited to the following:
- G. Indicate the proposed locations of the major raceway systems, equipment and materials. Including the following:
  - a. Clearance for servicing equipment, including space for equipment disassembly required for periodic maintenance.
  - b. Exterior wall and foundation penetrations.

- c. Fire rated wall and floor penetrations.
- d. Equipment connections and support details.
- e. Sizes and location of required concrete pad and bases.

## 1.7 WORKMANSHIP

- A. All materials and equipment shall be installed in accordance with the recommendations of the manufacturer to conform with the contract documents. The installation shall be accomplished by workmen skilled in the type of work involved.
- B. The Electrical Contractor shall have a licensed or certified Master Electrician assigned to direct the electrical work. Furthermore, a licensed or certified journeyman electrician shall be assigned to supervise the actual performance of all electrical work under Division 16. All installers must be certified journey man.
  - 1. All workmen doing electrical work of any nature must at all times carry their electrician's license with them and show it upon request.
  - 2. The licensed or certified journeyman assigned to supervise the performance of Division 16 electrical work, shall be required to be on the job site at all times, while Division 16 work is being performed.
- C. The installation shall conform to the applicable rules of the National Electrical Code and National Electrical Safety Code except where more stringent requirements are noted in these specifications. Conflicts shall be brought to the attention of the Architect/Engineer.
- D. The Contractor and Sub-contractors shall comply with OSHA and EPA Standards while in the performance of this contract.

## 1.8 SUBSTITUTIONS

- A. The equipment specified carries brand names and catalog numbers and shall be interpreted as establishing a standard of quality. Use only specified items or those listed by addenda.
- B. Any conflict arising from the use of substituted equipment shall be the responsibility of the `supplier, who shall bear all costs required to make the equipment comply with the intent of the plans and specifications.
- C. At the option of the Architect, samples may be required for non-standard items before installation during construction.
- D. No materials or apparatus shall be substituted after the bid opening except where the equipment manufacturer has been discontinued or delivery becomes a problem, then written approval of the Architect is required.

## 1.9 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, indicate installed conditions for:
  - 1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
  - 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

## PART 2 - PRODUCTS

- A. NOT USED.

## PART 3 - EXECUTION

### 3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

### 3.2 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

### 3.3 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 4000-psi, 28-day compressive-strength concrete and reinforcement.

### 3.4 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove demolished material from Project site.
- E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

### 3.5 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.
- C. Repair conduit and system that have been disturbed or broken, see 3.4A.

### 3.6 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
  - 1. Raceways.
  - 2. Building wire and connectors.
  - 3. Supporting devices for electrical components.
  - 4. Electrical identification.
  - 5. Electricity-metering components.
  - 6. Concrete bases.
  - 7. Electrical demolition.
  - 8. Cutting and patching for electrical construction.
  - 9. Touchup painting.

### 3.7 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint to match existing. Coordinate with BYU paint shop for paint materials and application requirements.
  - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
  - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
  - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.8 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

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12/09/2008

- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 16050

## SECTION 16060 - GROUNDING AND BONDING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Data: For the following:
  - 1. Ground rods.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports to include the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

#### 1.4 QUALITY ASSURANCE

- A. 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.
  - 1. Comply with UL 467.
- B. Comply with NFPA 70; for medium-voltage underground construction, comply with IEEE C2.
- C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

### PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Grounding Conductors, Cables, Connectors, and Rods:
    - a. Chance/Hubbell.
    - b. Copperweld Corp.
    - c. Erico Inc.; Electrical Products Group.
    - d. Framatome Connectors/Burndy Electrical.
    - e. Harger Lightning Protection, Inc.
    - f. Heary Brothers Lightning Protection Co.
    - g. Kearney/Cooper Power Systems.
    - h. Korns: C. C. Korns Co.; Division of Robroy Industries.
    - i. Lyncole XIT Grounding.
    - j. O-Z/Gedney Co.; a business of the EGS Electrical Group.
    - k. Raco, Inc.; Division of Hubbell.
    - l. Thomas & Betts, Electrical.

## 2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."
- B. Material, copper-clad and copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- E. Grounding Electrode Conductors: Stranded copper cable.
- F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- G. Bare Copper Conductors: Comply with the following:
1. Solid Conductors: ASTM B 3.
  2. Assembly of Stranded Conductors: ASTM B 8.
  3. Tinned Conductors: ASTM B 33.
- H. Copper Bonding Conductors: As follows:
1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
  2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
  3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

## 2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit forms, and selected per manufacturers written instructions.

## 2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad.
  - 1. Size: 3/4 inches in diameter, 120 inches long.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
- F. Grounding Bus: Install in all electrical and all telephone equipment rooms, in rooms housing service equipment, under all raised floors and elsewhere as indicated.
  - 1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
  - 2. At doors, route the bus up to the top of the doorframe, across the top of the doorway, and down to the specified height above the floor.
- G. Underground Grounding Conductors: Use tinned- copper conductor, No. 4/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

### 3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment-grounding conductors in all feeders and circuits.
- C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:

1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
- D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment-grounding conductor. Isolate equipment-grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- E. Nonmetallic Raceways: Install an equipment-grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

### 3.3 INSTALLATION

- A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
1. Drive ground rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.
  2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- F. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.
- G. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c), using a minimum of 20 feet of bare copper conductor not smaller

than No. 4 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

### 3.4 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

- A. Duct Banks: Install a grounding conductor with at least 50 percent ampacity of the largest phase conductor in the duct bank.
- B. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

### 3.6 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
  - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
  - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
  - 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
    - a. Equipment Rated 500 kVA and Less: 10 ohms.
    - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
    - c. Equipment Rated More Than 1000 kVA: 3 ohms.
    - d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
    - e. Manhole Grounds: 10 ohms.
  - 4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

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ADMINISTRATION, AND STADIUM BLDGS.

DFCM PROJECT NO. 08059810  
12/09/2008

3.7 GRADING AND PLANTING

A. Refer to section 02200.

END OF SECTION 16060

## SECTION 16071 - ELECTRICAL SUPPORTS AND SEISMIC RESTRAINTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Seismic restraints for electrical equipment and systems.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IBC: International Building Code.
- C. IMC: Intermediate metal conduit.
- D. RMC: Rigid metal conduit.
- E. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.

#### 1.4 SUBMITTALS

- A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support and 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 evaluation service member of the ICC Evaluation Program.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- C. Field quality-control test reports.

#### 1.5 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

- B. Testing of Seismic Anchorage Devices: Comply with testing requirements in Part 3 and in Division 16 Section "Electrical Supports and Seismic Restraints."

## 1.6 PROJECT CONDITIONS

- A. Site Class as Defined in the IBC: Refer to structural specifications for IBC seismic values.
- B.  $S_s$ , Mapped Maximum Considered Earthquake Spectral Response at Short Periods: Refer to structural specifications for IBC seismic values.
- C.  $S_1$ , Mapped Maximum Considered Earthquake Spectral Response at 1-Second Period: Refer to structural specifications for IBC seismic values.
- D. Assigned Seismic Use Group or Building Category as Defined in the IBC: Refer to structural specifications for IBC seismic values.

## 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 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of two (2) times the applied force.
- B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.
  - 1. Manufacturers:
    - a. Cooper B-Line; a division of Cooper Industries.
    - b. ERICO International Corporation.
    - c. Allied Support Systems; Power-Strut Unit.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
  - 2. Finishes:
    - a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.
    - b. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-3.
  - 3. Channel Dimensions: Selected for structural loading and applicable seismic forces.

- C. Raceway and Cable Supports: As described in NECA 1.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored 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.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. 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.
    - a. Manufacturers:
      - 1) Cooper B-Line; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc
      - 3) Hilti, Inc.
      - 4) ITW Construction Products.
      - 5) MKT Fastening, LLC.
      - 6) Powers Fasteners.
  - 2. Concrete Inserts: Steel or malleable-iron slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.
  - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - 4. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
  - 5. Toggle Bolts: All-steel springhead type.
  - 6. Hanger Rods: Threaded steel.

## 2.3 SEISMIC-RESTRAINT COMPONENTS

- A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an agency acceptable to authorities having jurisdiction.
  - 1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least two (2) times the maximum seismic forces to which they will be subjected.
- B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.
- C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.
  - 1. Manufacturers:

- a. Amber/Booth Company, Inc.
  - b. Loos & Co., Inc.
  - c. Mason Industries, Inc.
2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.
  3. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod, of design recognized by an agency acceptable to authorities having jurisdiction.
  4. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

### PART 3 - EXECUTION

#### 3.1 APPLICATION

- A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.
- 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 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system.
  1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

#### 3.2 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION

- A. Comply with NECA 1 for installation requirements, except as specified in this Article.
- B. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.
- C. 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 New Concrete: Bolt to concrete inserts.
  2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  3. To Existing Concrete: Expansion anchor fasteners.
  4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  5. To Light Steel: Sheet metal screws.
  6. 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 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS

- A. Restraint Cables: Provide slack within maximums recommended by manufacturer.
- B. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

### 3.4 FIELD QUALITY CONTROL

- A. Testing: Test pullout resistance of seismic anchorage devices.
  1. Provide necessary test equipment required for reliable testing.
  2. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  3. Test at least four (4) of each type and size of installed anchors and fasteners selected by Architect.
  4. Test to 90 percent of rated proof load of device.
  5. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- B. Record test results.

END OF SECTION 16071

## SECTION 16075 – ELECTRICAL IDENTIFICATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

#### 1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate color, lettering style, and graphic features of identification products.

#### 1.4 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

### PART 2 - PRODUCTS

#### 2.1 RACEWAY AND CABLE LABELS

- A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
  - 1. Color: Black letters on orange field.
  - 2. Legend: Indicates voltage and service.
- B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.

- C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.
- D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- E. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch- thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- F. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.
- G. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch thick, laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.
- H. Brass or Aluminum Tags: 2 by 2 by 0.05-inch metal tags with stamped legend, punched for fastener.

## 2.2 NAMEPLATES AND SIGNS

- A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- D. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

## 2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength: 50 lb minimum.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: According to color-coding.
- B. Paint: Formulated for the type of surface and intended use.
  - 1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.

2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
- E. Install painted identification according to manufacturer's written instructions and as follows:
  1. Clean surfaces of dust, loose material, and oily films before painting.
  2. Prime surfaces using type of primer specified for surface.
  3. Apply one intermediate and one finish coat of enamel.
- F. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.
- G. Circuit Identification Labels on Boxes: Install labels externally.
  1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
  2. Concealed Boxes: Plasticized card-stock tags.
  3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- H. Color-Coding of Secondary Phase Conductors: Use the following colors for service feeder and branch-circuit phase conductors:
  1. 208/120-V Conductors:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Neutral : White
    - e. Ground : Green

2. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
  - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
  - b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.
- I. Apply identification to conductors as follows:
  1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
  2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
  3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
- J. Apply warning, caution, and instruction signs as follows:
  1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
  2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- K. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- high lettering on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
  1. Panelboards, electrical cabinets, and enclosures.
  2. Access doors and panels for concealed electrical items.
  3. Emergency system boxes and enclosures.
  4. Disconnect switches.
  5. Enclosed circuit breakers.
  6. Push-button stations.
  7. Contactors.
  8. Remote-controlled switches.
  9. Control devices.

END OF SECTION 16075

## SECTION 16120 – CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.
- B. Related Sections include the following:
  - 1. Division 16 Section "Control/Signal Transmission Media" for transmission media used for control and signal circuits.
  - 2. Division 16 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field Quality-Control Test Reports: From Contractor.

#### 1.4 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

## 2.2 CONDUCTORS AND CABLES

### A. Manufacturers:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.
5. Okonite.
6. kerite.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper complying with NEMA WC 5 stranded conductor.

D. Conductor Insulation Types: Type THHN-THWN complying with NEMA WC 5.

E. Minimum Conductor Size: #12 AWG

F. MC-Cable or Romax cables can not be used in this project.

## 2.3 CONNECTORS AND SPLICES

### A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THHN-THWN, single conductors in raceway .

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway .

C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway .

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN-THWN, single conductors in raceway.

- E. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway .
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway .
- G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- H. Underground Feeders and Branch Circuits: Type THHN-THWN, single conductors in raceway.
- I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.
- J. Fire Alarm Circuits: Type THHN-THWN, in raceway if not specified in the fire alarm system specification.
- K. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- L. Class 2 Control Circuits: Type THHN-THWN, in raceway .

### 3.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."
- F. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."
- G. Identify and color-code conductors and cables according to Division 16 Section " Electrical Identification."

### 3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

### 3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
  - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 16120

## SECTION 16130 – RACEWAYS AND BOXES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
  - 1. Division 2 Section "Underground Ducts and Utility Structures" for exterior ductbanks, manholes, and underground utility construction.
  - 2. Division 7 Section "Through-Penetration Firestop Systems" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
  - 3. Division 16 Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
  - 4. Division 16 Section "Seismic Controls for Electrical Work" for seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.
  - 5. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.

#### 1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

- C. Shop Drawings: Signed and sealed by a qualified professional engineer.
  - 1. Design Calculations: Calculate requirements for selecting seismic restraints.
  - 2. Detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  
- D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
  - 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  
- E. Manufacturer Seismic Qualification Certification: Submit certification that enclosures, cabinets, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." 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.

## 1.5 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

## 2.2 METAL CONDUIT AND TUBING

- A. Manufacturers:
1. AFC Cable Systems, Inc.
  2. Alflec Inc.
  3. Anamet Electrical, Inc.; Anaconda Metal Hose.
  4. Electri-Flex Co.
  5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
  6. LTV Steel Tubular Products Company.
  7. Manhattan/CDT/Cole-Flex.
  8. O-Z Gedney; Unit of General Signal.
  9. Wheatland Tube Co.
- B. Minimum Size  $\frac{3}{4}$ " for indoor, 1" for outdoor.
- C. Rigid Steel Conduit: ANSI C80.1.
- D. IMC: ANSI C80.6.
- E. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- F. Plastic-Coated IMC and Fittings: NEMA RN 1.
- G. EMT and Fittings: ANSI C80.3.
1. Fittings: Set-screw type.
- H. FMC: Zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket.
- J. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

## 2.3 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers:
1. American International.
  2. Anamet Electrical, Inc.; Anaconda Metal Hose.
  3. Arnco Corp.
  4. Cantex Inc.
  5. Certainteed Corp.; Pipe & Plastics Group.
  6. Condux International.
  7. ElecSYS, Inc.
  8. Electri-Flex Co.
  9. Lamson & Sessions; Carlon Electrical Products.

10. Manhattan/CDT/Cole-Flex.
11. RACO; Division of Hubbell, Inc.
12. Spiralduct, Inc./AFC Cable Systems, Inc.
13. Thomas & Betts Corporation.

- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Schedule 40 PVC.
- D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
- E. LFNC: UL 1660.
- F. Minimum Size  $\frac{3}{4}$ " for indoor, 1" for outdoor.

#### 2.4 METAL WIREWAYS

- A. Manufacturers:
  1. Hoffman.
  2. Square D.
  3. Walker.
- B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- E. Wireway Covers: Screw-cover type .
- F. Finish: Manufacturer's standard enamel finish.

#### 2.5 NONMETALLIC WIREWAYS

- A. Manufacturers:
  1. Hoffman.
  2. Lamson & Sessions; Carlon Electrical Products.
  3. Hubbell
  4. Wiremold
- B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.

- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

## 2.6 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating .
  - 1. Manufacturers:
    - a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).
    - b. Thomas & Betts Corporation.
    - c. Walker Systems, Inc.; Wiremold Company (The).
    - d. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
  - 1. Manufacturers:
    - a. Butler Manufacturing Co.; Walker Division.
    - b. Enduro Composite Systems.
    - c. Hubbell, Inc.; Wiring Device Division.
    - d. Lamson & Sessions; Carlon Electrical Products.
    - e. Panduit Corp.
    - f. Walker Systems, Inc.; Wiremold Company (The).
    - g. Wiremold Company (The); Electrical Sales Division.
- C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

## 2.7 DUCT BANKS

- A. Duct banks shall be provided to house high voltage or communication underground cables. Duct banks shall be concrete encased round bore plastic duct. The duct sizes are called on the drawing sheet. Duct banks shall have a minimum slope of 4 inches per 100 ft. Seal around all cables entering man hole with permagum. Provide plastic plugs in both ends of all unused ducts and seal with silicon sealant. Add die to the concrete for electrical systems.
- B. Concrete encasement will be a minimum of three inches between ducts and between ducts and earth. The top of the concrete encasement will be a minimum of 3 ft. below finished grade. Care shall be taken during installation to insure no debris gets in to the line. After completion a mandrel not less than 12 inches long and approximately 1-1/2 inches diameter less than the duct diameter will be pulled through each duct to insure that no debris has collected in the duct. Mandrel pulls shall be witnessed by the Engineer and the University Representative. Engineer should inspect duct bank construction before concrete is poured. Provide polypropylene pull rope in each unused duct.

- C. Where duct banks enter manholes, buildings or vaults, a 10 ft. length of rigid galvanized steel conduit will be used for each duct. All conduit bends over 30 degrees shall be made of rigid galvanized steel. Wrap all metallic conduit with scotchwrap as specified in General Notes.

## 2.8 BOXES, ENCLOSURES, AND CABINETS

### A. Manufacturers:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.
3. Erickson Electrical Equipment Co.
4. Hoffman.
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet-PLM Division.
10. Spring City Electrical Manufacturing Co.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

### B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

### C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

### D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

### E. Floor Boxes: Cast metal, fully adjustable, rectangular.

### F. Floor Boxes: Nonmetallic, nonadjustable, round.

### G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

### H. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

### I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

### J. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

## 2.9 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

- B. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

### PART 3 - EXECUTION

#### 3.1 RACEWAY APPLICATION

- A. Outdoors:

1. Exposed: Rigid steel or IMC.
2. Concealed: Rigid steel or IMC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R.

- B. Indoors:

1. Exposed: EMT .
2. Concealed: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Damp or Wet Locations: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

- a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

- C. Minimum Raceway Size: 3/4-inch trade size for indoor, 1-inch trade size for outdoor.

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz.

- F. Do not install aluminum conduits for this project.

#### 3.2 INSTALLATION

- A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

- B. Complete raceway installation before starting conductor installation.

- C. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."

- D. Install temporary closures to prevent foreign matter from entering raceways.

- E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
  - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
  - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
  - 2. Space raceways laterally to prevent voids in concrete.
  - 3. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  - 4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above the floor.
- I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
  - 1. Run parallel or banked raceways together on common supports.
  - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- J. Join raceways with fittings designed and approved for that purpose and make joints tight.
  - 1. Use insulating bushings to protect conductors.
- K. Tighten set screws of threadless fittings with suitable tools.
- L. Terminations:
  - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
  - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- N. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

- O. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where otherwise required by NFPA 70.
- P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; LFMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- Q. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- R. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- S. Set floor boxes level and flush with finished floor surface.
- T. Set floor boxes level. Trim after installation to fit flush with finished floor surface.
- U. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

### 3.3 ACCESS DOORS

- A. Related documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Summary: Extent, location, and size of each type of access door required are indicated on drawings.
- C. Submittals:
  - 1. Product Data: Submit manufacturers technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions and directions for installation of anchorage devices.
  - 2. Include complete schedule, including types, general locations, sizes, wall and ceiling construction details, finishes, latching or locking provisions, and other data pertinent to installation.
- D. Quality assurance:
  - 1. Size variations: Obtain Architect's acceptance of manufacturer's standard size units which may vary slightly from sizes indicated.
- E. Coordination: Furnish inserts and anchoring devices which must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

- F. Manufacturers: Subject to compliance with requirements, provide access doors by one of the following:
  - 1. Bilco Company
  
- G. Materials and fabrication: Furnish each access door assembly manufactured as integral unit, complete with all parts and ready for installation.
  - 1. Locking Devices: Furnish flush, screwdriver-operated cam locks number required to hold door in flush smooth plane when closed.
  - 2. Provide one cylinder lock per access door. Furnish 2 keys per lock. Key all locks alike, unless otherwise scheduled.
  
- H. Installation: Comply with manufacturer's instructions for installation of access doors.
  - 1. Coordinate installation with work of other trades.
  
- I. Adjust and Clean:
  - 1. Adjust hardware and panels after installation for proper operation.
  - 2. Remove and replace panels or frames which are warped, bowed or otherwise damaged.

### 3.4 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.5 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 16130