



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

STANDARD LOW BID PROJECT

February 17, 2010

HVAC UPGRADE RIO GRANDE DEPOT

**DEPARTMENT OF COMMUNITY AND
CULTURE
SALT LAKE CITY, UTAH**

DFCM Project Number 09180080

Heath Engineering
377 West 800 North
Salt Lake City, Utah
801-322-0487

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Technical Specifications:
Drawings:

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/StdDocs/index.html> "Standard Documents" – "Reference Documents I" – "Item 6. Supplemental General Conditions" or are available upon request from DFCM:

DFCM Supplemental General Conditions dated July 1, 2009 *
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.

*** NOTE: THE NEW SUPPLEMENTAL GENERAL CONDITIONS EFFECTIVE JULY 1, 2009 ADDRESSING HEALTH INSURANCE AND IMMIGRATION ARE REFERENCED AT THE LINK ABOVE.**

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:

HVAC UPGRADE - RIO GRANDE DEPOT
DEPARTMENT OF COMMUNITY AND CULTURE – SALT LAKE CITY
DFCM PROJECT NO: 09180080

Bids will be in accordance with the Contract Documents that will be available at 10:00 AM on Wednesday, February 17, 2010, 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 Lucas Davis, DFCM, at 801-842-8210. No others are to be contacted regarding this bidding process. The construction estimate for this project is \$57,000.

A **mandatory** pre-bid meeting will be held at 10:00 AM on Tuesday, February 23, 2010 in the Rio Grande Depot, 270 South Rio Grande Street, Salt Lake City, Utah. Meet in main entrance lobby. All bidders wishing to bid on this project are required to attend this meeting.

Bids will be received until the hour of 3:00 PM on Tuesday, March 9, 2010 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
Marla Workman, Contract Coordinator
4110 State Office Building, Salt Lake City, Utah 84114

PROJECT DESCRIPTION

This project includes, but is not limited to the demolition and new construction of an HVAC distribution system for the north wing of the second floor in the Rio Grande Depot building. The existing system does not temper the space properly due to inadequate ducting, high ceilings, and minimal control. The project consists mainly of mechanical work, but will also include some general construction due to the return chases that will need to be constructed to match the existing interior of this historic building. Project is to be constructed according to the drawings and specifications.

**PROJECT SCHEDULE**

PROJECT NAME: HVAC UPGRADE - RIO GRANDE DEPOT				
DEPARTMENT OF COMMUNITY AND CULTURE – SALT LAKE CITY, UTAH				
DFCM PROJECT NO. 09180080				
Event	Day	Date	Time	Place
Bidding Documents Available	Wednesday	February 17, 2010	10:00 AM	DFCM 4110 State Office Bldg SLC, UT and the DFCM web site *
Mandatory Pre-bid Site Meeting	Tuesday	February 23, 2010	10:00 AM	Main Entrance Lobby Rio Grande Depot 270 South Rio Grande Street Salt Lake City, UT
Last Day to Submit Questions	Monday	March 1, 2010	2:00 PM	Lucas Davis – DFCM E-mail lucasdavis@utah.gov Fax 801-538-3267
Addendum Deadline (exception for bid delays)	Thursday	March 4, 2010	2:00 PM	DFCM web site *
Prime Contractors Turn In Bid and Bid Bond	Tuesday	March 9, 2010	3:00 PM	DFCM 4110 State Office Bldg SLC, UT
Sub-contractor List Due	Wednesday	March 10, 2010	3:00 PM	DFCM 4110 State Office Bldg SLC, UT Fax 801-538-3677
Substantial Completion Date	Thursday	May 13, 2010		

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



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 **HVAC UPGRADE - RIO GRANDE DEPOT - DEPARTMENT OF COMMUNITY AND CULTURE – SALT LAKE CITY, UTAH - DFCM PROJECT NO. 09180800** 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 **May 13, 2010**, should I/we be the successful bidder, and agree to pay liquidated damages in the amount of **\$100.00** 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.

A bid bond properly signed by a qualified surety, as indicated on the DFCM Bid Bond form provided along with this Instruction to Bidders, in the amount of 5% of the bid, shall accompany the bid submission to DFCM. **THIS BID BOND MUST BE ON THE DFCM BID BOND FORM PROVIDED WITH THIS INSTRUCTION TO BIDDERS IN ORDER TO BE CONSIDERED AN ACCEPTABLE BID** unless only one bid is received by DFCM, or the failure to comply with the bid bond requirements is determined by the Director of DFCM to be nonsubstantial based on the following:

- (a) the bid bond is submitted on a form other than DFCM's required Bid Bond form and the bid bond meets all other requirements including being issued by a surety firm authorized to do business in the State of Utah and be listed in the U.S. Department of the Treasury Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies for an amount not less than the amount of the bond to be issued. A co-surety may be utilized to satisfy this requirement; and
- (b) the contractor provides a bid bond properly signed by a qualified surety and on the required DFCM Bid Bond form by the close of business of the next succeeding business day after the DFCM notifies the bidder of the defective 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.

**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
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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 #

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 and July 1, 2009 ("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
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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

Agency: _____
Agent: _____
Address: _____
Phone: _____

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: _____ (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

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.

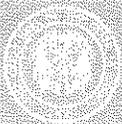
The Contractor shall complete or correct the Work on the list of (Punch List) items appended hereto within _____ calendar days from the above date of issuance of this Certificate. The amount withheld pending completion of the list of items noted and agreed to shall be: \$_____. If the list of items is 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
5-Exceptional	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"			
4-Very Good	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
3-Satisfactory	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
2-Marginal	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
1-Unsatisfactory	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

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

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

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

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.	Score
<u>Agency Comments:</u>	
<u>A & 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 & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

Signed by:	Date:	Mean Score
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Additional Comments:

RIO GRANDE DEPOT HVAC UPGRADE

270 South Rio Grande St.
Salt Lake City, UT 84101



State of Utah—Department of Administrative Services

DIVISION OF FACILITIES CONSTRUCTION
AND MANAGEMENT

4110 State Office Building/Salt Lake City, Utah 84114/538-3018

DFCM PROJECT NO. 09180080

December 2009

MECHANICAL INDEX

- 15000 - General Mechanical Requirements
- 15005 - Demolition
- 15060 - General Pipes and Fittings
- 15100 - Valves
- 15190 - Mechanical Identification Accessories
- 15195 - Operation and Maintenance Manuals
- 15250 - Mechanical Insulation
- 15515 - Hydronic Piping and Specialties
- 15890 - Ductwork
- 15910 - Ductwork Accessories
- 15940 - Air Outlets and Inlets
- 15950 - Mechanical Control Systems
- 15970 - Direct Digital Control System (DDC)
- 15995 - System Commissioning, Testing and Balancing

SECTION 15000 - GENERAL MECHANICAL REQUIREMENTS

PART I - GENERAL

1.01 RELATED DOCUMENTS:

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

Sections of other Divisions which relate to mechanical work apply to the work of this section.

- B. Related Sections: Refer to Electrical Requirements for Mechanical Equipment Section in Division 15 for basic electrical requirements for all mechanical equipment. Special and specific electrical requirements are specified within each respective equipment specification section.

1.02 SUMMARY: This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of Division 15000. It expands and supplements the requirements of Division 01000.

This Division does not define, nor is it limited by, trade jurisdictions. All work described herein is a part of the General Contract and is required of the Contractor regardless.

1.03 DESCRIPTION OF PROJECT: The mechanical work described in these mechanical specifications is for a project located in Salt Lake City, Utah. Design weather conditions are: 95° db, 62° wb, and winter 3°F. Altitude readings, unless otherwise noted, are for an elevation of 4,500 feet above sea level. Make adjustment to manufacturer's performance data as needed.

1.04 CODES AND PERMITS, AUTHORITIES HAVING JURISDICTION:

- A. Perform the mechanical work in strict accordance with the applicable provisions of the various codes ordinances and adoptions pertaining to the project location in effect on the date of invitation for bids. Provide all materials and labor necessary to comply with rules, regulations and ordinances. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications govern.
- B. Hold and save the Owner and Architect/Engineer free and harmless from liability of any nature or kind arising from failure to comply with codes and ordinances.
- C. Secure all permits necessary for the prosecution of the work under this contract. Owner to pay all fees including connection fees related to utility hookups.
- D. Reference Standards:

- American Welding Society
- International Mechanical Code/State Code
- International Building Code/State Code
- SMACNA Duct Design Standards
- Local/State Plumbing Code
- Locally enforced NFPA Codes
- Local Fuel Utility Regulations
- Local Power Utility Regulations
- American Gas Association
- ASME Codes for Pressure Vessels and Piping
- ANSI B31.1 Piping

- E. Final inspection by the Architect/Engineer will not be made nor Certificate of Substantial Completion issued until certificates of acceptability from the Authorities having jurisdiction are delivered.

1.05 DEFINITION OF PLANS AND SPECIFICATIONS: The mechanical drawings at reduced scale show the general arrangement of piping, ductwork, equipment, etc., and shall be followed as closely as the actual building construction and the work of other trades will permit. Request clarification and participate in resolution in the event of conflict.

Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Investigate the structural and finish conditions affecting the work and arrange the work accordingly, providing such extensions, fittings, valves and accessories to meet the conditions as may be required. Some small scale work is not shown such as control conduit and piping, incidental piping, specialties. Provide as directed by note or specification.

Examine the actual construction site prior to bidding and obtain an understanding of the conditions under which the work will be performed. No allowances will be made for failure to make such examination.

During construction, verify the dimensions governing the mechanical work at the building. No extra compensation shall be claimed or allowed because of differences between actual dimensions and those indicated on the drawings. Examine adjoining work on which mechanical work is dependent for perfect efficiency, and report any work of other trades which must be corrected. No waiver of responsibility for defective work shall be claimed nor allowed due to failure to report unfavorable conditions affecting the mechanical work.

1.06 ROUGH-IN:

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

1.07 MECHANICAL INSTALLATIONS:

- A. Coordinate mechanical equipment and materials installation with other building components.
- B. Verify all dimensions by field measurements.
- C. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.
- D. Coordinate the cutting and patching of building components to accommodate installation of mechanical equipment and materials.
- E. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
- F. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- G. Coordinate the installation of mechanical materials and equipment above ceilings with suspension systems, light fixtures, existing structures and other installations.

- H. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- I. Where mechanical work penetrates other trade work such as gypsum walls, etc., penetration shall be neatly cut and walls shall be filled and patched.

1.08 ACCESSIBILITY:

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- B. Establish required clearance to all installation features involving operation and maintenance. Respect manufacturers recommendations for access and clearance.

1.09 CHANGE ORDERS: See General Conditions.

1.10 ALTERNATIVE CONSTRUCTION/SUBSTITUTION: These documents outline a way in which the Owner may be delivered a functional and reliable facility. Drawings and specifications describe reasonable engineering practice for the Contractor to follow.

Coordination between trades may result in periodic needs to adjust the installation from that indicated, but in no case shall the intended function be compromised.

The Contractor may perceive some work methods which differ from those specified which could save time and effort. These may be presented to the Architect/Engineer with a breakdown of possible cost savings for review. Implement only with authorization.

Materials substitutions will generally be covered in a review process prior to bidding. After bidding, substitutions shall be proposed only on the basis of definitive cost accounting and implemented only with authorization.

1.11 CUTTING AND PATCHING:

- A. Lay out the project where new work is involved ahead of time, providing sleeves and blockouts, and have work specifically formed, poured and framed to accommodate mechanical installations. Cut and patch only as needed.
- B. Refer to the Division 1 Section: CUTTING AND PATCHING for general requirements for cutting and patching.
- C. Refer to Division 16 Section: BASIC ELECTRICAL REQUIREMENTS for requirements for cutting and patching electrical equipment, components, and materials.
- D. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- E. Arrange for repairs required to restore other and any work damaged as a result of mechanical installations.
- F. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.

- G. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - 1. Install equipment and materials in existing structures.
- H. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
- I. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping and other mechanical items made obsolete by the new Work.
- J. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- K. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

1.12 SUBMITTALS: Submittal of shop drawings, product data, and samples will be accepted only from the Contractor to the Architect/Engineer. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed. Document each transmittal and sign and stamp the submittal indicating that it has been reviewed and is in compliance with the criteria of the project, any exceptions being clearly noted.

- A. Shop Drawings: As soon as possible after the contract is awarded, submit to the Architect/Engineer, seven (7) copies of the descriptive literature covering all equipment and materials to be used in the installation of mechanical systems for this project. Written confirmation of acceptable review by the Owner's Representative shall be obtained before ordering, purchasing, acquiring or installing any such equipment or materials for the project.

Prepare the submittals in an orderly manner after the order of this specification, contained in a three-ring looseleaf binder(s) with identification tabs for each item or group of related items. Submitted literature shall clearly indicate performance, quality, utility requirements, dimensions of size, connection points and other information pertinent to effective review.

Equipment must fit into the available space with allowance for operation, maintenance, etc. The Contractor shall take full responsibility for space and utility requirements for equipment installed.

Factory-wired equipment shall include shop drawings of all internal wiring to be furnished with unit.

Review of the Architect/Engineer is for general conformance of the submitted equipment of the project specification; in no way does such approval relieve Contractor of his obligation to furnish equipment and materials that comply in detail to the specification, nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions which may affect his work.

- B. Record Drawings: During the course of construction, maintain a set of drawings, specifications, change orders, shop drawings, addenda, etc., for reference and upon which all deviations from the original layout are recorded. Turn these marked-up documents over to the Architect/Engineer at the conclusion of the work so that the original tracings can be revised. If the Contractor fails to mark up the prints, reimburse the Architect/Engineer for time required to do so.

1.13 OPERATION AND MAINTENANCE TRAINING:

- A. Instruction Of Owner's Personnel: At a time prior to Owner making use of a device or system, and in general after testing and balance work for a building or major system is complete, prepare, schedule and conduct a series of training sessions for Owner's operating and supervisory personnel. Instructions shall cover each device and system with emphasis on understanding of the purpose and function, the maintenance requirements and the proper adjustment and operating technique.
- B. Instruct building operating staff in operation and maintenance of mechanical systems utilizing Operation and Maintenance Manual when so doing.
- C. Minimum instruction periods shall be as follows:
 - 1. Mechanical - two hours, total.
 - 2. Temperature Control - four hours, total. Programming help as needed.
- D. Initial instruction periods shall occur after pre-final inspection when systems are properly working and before final payment is made. Schedule subsequent visits with the Owner's Building Operation Personnel throughout the first year.
- E. None of these instructional periods shall overlap another.
- F. Vendors for each piece of equipment controls, etc., shall participate along with the Contractor(s).

1.14 GUARANTEE/WARRANTY: The following guarantee is a part of this specification and is binding on the part of the Contractor and his assigns:

"Contractor guarantees that this installation is in accordance with the terms of the Contract and is free from mechanical defects. He agrees to replace or repair, to the satisfaction of the Owner's Representative, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance. See also the General Conditions of these specifications. Failed equipment in the repair or replacement shall be guaranteed for one full year from the date of recommission."

Compile and assemble the warranties required by Division 15 into a separated set of vinyl covered, insert sheets, tabulated and indexed for each reference, included in the O & M Manual.

Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

Mechanical systems and equipment shall not be considered for substantial completion and initiation of warranty until they have performed in service continuously without malfunction for at least thirty (30) working days.

1.15 TESTS AND CERTIFICATIONS: Make all tests required by code or specification in the presence of a representative of the Owner, with tests recorded and certified by the Contractor and Representative. Involve local authorities where required.

1.16 PERMITS, FEES, LICENSES: Refer to General Conditions. See Paragraph 1.04.

1.17 **CEILING SPACE COORDINATION:** Carefully coordinate ceiling cavity space with all trades; however, installation of mechanical equipment within the ceiling cavity space allocation, in the event of conflict, shall be in the following order: plumbing waste lines; supply, return and exhaust ductwork; domestic hot and cold water; fire protection; control conduit. Respect clearances required for lights, electrical conduits, protected structure, etc. All spaces above any and all ceilings shall be defined and considered as return air plenum space.

1.18 **MECHANICAL COORDINATION DRAWINGS:** For congested areas, or areas of great detail, prepare and submit a set of coordination drawings showing major elements, components and systems of mechanical equipment and materials in relationship with other building components (structure, fire sprinkler, electrical, etc.). Prepare drawings to an accurate scale of 1/4" - 1-0" or larger. Indicate the locations of all equipment and materials, including clearances for installing and maintaining equipment, servicing and maintaining equipment, valve stem movement, and similar requirements. Indicate movement and positioning of large equipment into the building during construction.

Prepare floor plans, reflected ceiling plans, elevations, sections and details to conclusively coordinate and integrate all installations. Indicate locations where space is limited, and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:

- A. Work in pipe spaces and chases.
- B. Ceiling and floor plenums which contain piping, ductwork, or equipment in congested arrangement. To include structure, ductwork, piping, fire protection, large electrical conduit, recessed lights, etc.
- C. Installations in mechanical riser shafts, at typical sections and crucial offsets and junctures.
- D. Pipe expansion loops.
- E. Numbered valve location diagrams.
- F. General floor plan layouts with ductwork, piping, lighting, structure, etc.
- G. Use drawings to coordinate all affected trades. Do not work without coordinated drawings.

1.19 **SCHEDULING/METHODS OF PROCEDURE:** Where interruptions of service are needed to effect work of this contract, outline the work, coordinate with other trades, determine the Owners acceptable downtime and prepare a time based schedule to accomplish the work. Give notice of a necessary systems or utility interruption (or shutdown) to any existing system to the owner's construction coordinator not less than 72 hours prior to the proposed shutdown. This will then be coordinated with the occupants involved for approval to go ahead with the shutdown or re-schedule. Set up for evening, nighttime or weekend hours as necessary to accomplish the work with minimum disruption.

PART II - GENERAL MECHANICAL MATERIALS AND METHODS

2.01 QUALITY OF MATERIALS AND EQUIPMENT:

- A. All equipment and materials shall be new, and shall be the standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment, and shall be the manufacturer's latest design. Specific equipment shown in schedules on drawings and specified herein is to be the basis for the Contractor's bid. Provisions for substitute equipment are outlined in the General Conditions. All materials shall be produced by manufacturing plants located in the United States of America.
- B. Furnish and install all major items of equipment specified in the equipment schedules on the drawings complete with all accessories normally supplied with catalog items listed, and all other accessories necessary for a complete and satisfactory installation.

2.02 PROTECTION OF MATERIALS AND EQUIPMENT:

- A. Close pipe and duct openings with caps or plugs to prevent lodgement of dirt or trash during the course of installation. Cover equipment tightly and protect against dirt, water and chemical or mechanical injury. At the completion of the work, equipment and materials and deliver in a factory dock condition for the Owner's acceptance. Make damage and defects developing before acceptance of the work good at Contractor's expense.

2.03 QUALIFICATIONS OF WORKMEN:

- A. All mechanics shall be capable journeymen, skilled in the work assigned to them. Apprentices may be used with appropriate direction.
- B. Employ no unskilled persons in the work which he is given to do; execute all work in a skillful and workmanlike manner. All persons employed upon this work shall be competent, faithful, orderly and satisfactory to the Owner. Should the Owner's Representative deem anyone employed on the work incompetent or unfit for his duties, and so certify, Contractor shall dismiss him and he shall not be again employed upon the work without permission of the Owner's Representative.

2.04 FOREMAN: Dedicate and designate a full-time general mechanical foreman to the Owner's Representative to be consistently available on site during the life of the project for consultation. Do not replace this individual without prior approval from the Owner's Representative.

2.05 USE OF COMMON VENDORS: Regardless of subcontract delegations, coordinate purchasing between trades so that equipment and materials of similar nature come from a single vendor, i.e., all package HVAC terminal units shall be common source. Valves, terminal boxes, speed drives, etc., the same. Do not burden the Owner with multiple brands of similar equipment unless so directed.

2.06 HANGERS AND SUPPORTS (GENERAL):

- A. Provide hangers and/or supports for all equipment, piping and ductwork. Primary information is contained in these specifications and on the drawings.
- B. Provide hangers and supports to correlate with seismic restraint and vibration isolation.

- 2.07 MANUFACTURER'S DIRECTIONS: Install all equipment in strict accordance with directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the plans and specifications, report such conflicts to the Architect/Engineer who shall direct adjustments as deemed necessary and desirable.
- 2.08 LUBRICATION: Lubricate equipment at startup. Then, provide all lubricants for the operation of all equipment until acceptance by the Owner. The Contractor is held responsible for all damage to equipment and bearings while the equipment is being operated by him consequent to preacceptance operation.

2.9 ELECTRICAL WIRING AND CONTROL:

- A. In general, motor starters, related motor starter equipment and power wiring indicated on the electrical drawings and control diagrams are to be furnished and installed under Division 16000 of this Specification. Items of electrical control equipment specifically mentioned to be furnished by the Division 15000 either in these specifications or on the electrical or mechanical drawings, shall be furnished and mounted by this Contractor and shall be connected under and as required by this Division 15000 and Division 16000 of these specifications.
- B. Refer to the control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the contractor.
- C. Division must be fully coordinated with Division 16000 to insure that all required components of the work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of coordination.
- D. Where the detailed electrical work is not shown on the electrical drawings, the Mechanical Contractor shall furnish, install and wire or have prewired all specified and necessary controls for air handling equipment specified for this project. The objective of this paragraph is to make sure a complete operating system is obtained at no additional cost to the Owner for field wiring required related to the equipment.

- 2.10 FLUSHING AND DRAINING OF SYSTEMS/CLEANING OF PIPING AND DUCTS: Fill, clean and flush and sterilize where appropriate, all water piping systems with water and drain these systems before they are placed in operation. Flushings shall consist of not less than six (6) short, intermittent flushes of five (5) to ten (10) minutes duration. Sample and test each flush for cleanliness. Blow out all other piping systems with compressed air or nitrogen to remove foreign materials that may have been left or deposited in the piping system during its erection. Duct systems shall have all debris removed and fans shall be run to blow out all dust and foreign matter before grilles, outlets or mixing boxes are installed and connected.

Damp wipe all ductwork on installation, cap open ducts, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

2.11 JOBSITE CLEANUP:

- A. Keep site clean during progress of work.
- B. At the conclusion of work, clean all installation thoroughly.
1. Leave equipment in a factory dock condition. Correct any damage and touch up or repaint if necessary.
 2. Remove all debris from site.

END OF SECTION 15000

SECTION 15005 - DEMOLITION

PART I - GENERAL

1.1 SECTION INCLUDES:

- A. Remove existing mechanical systems in the remodel area Rio Grande Building which are made obsolete by this remodel.
- B. Maintain existing installation which continues in service or is adapted
- C. Adapt existing installation to new conditions, i.e., remove and reinstall ductwork and piping which must be offset or revised to accommodate new installation, layouts, etc.

1.2 REFERENCES:

- A. Respond to General Conditions, Supplemental General Conditions, Division 1000, etc.
- B. Respond to General Requirements of Technical Divisions.

1.3 PROJECT/SITE CONDITIONS:

Work under this project is confined to specific areas in an existing building. These areas are noted on the drawings. Much of the existing ductwork, and piping system will be modified, replaced, altered and removed. The contractor is to be familiar with existing conditions in and around the building. The building is to be restored to full service.

Except for the areas being remodeled, this building will be occupied with all systems serving these occupied spaces kept in service. Where temporary disruption to any system is required it shall be scheduled as noted below and in other sections of this specification. Where disruption occurs with approval ductwork, piping, etc. shall be immediately capped and sealed with all systems restored to the occupied spaces.. All building spaces outside of the remodel areas are considered occupied.

- #### 1.4 SCHEDULING/METHODS OF PROCEDURE:
- Where interruptions of service are needed to effect work of this contract, outline the work, coordinate with other trades, determine the Owners acceptable downtime and prepare a time based schedule to accomplish the work. Give notice of a necessary systems or utility interruption (or shutdown) to any existing system to the owner's construction coordinator not less than 72 hours prior to the proposed shutdown. This will then be coordinated with occupants involved for approval to go ahead with the shutdown or re-schedule. Set up for evening, nighttime or weekend hours as necessary to accomplish the work with minimum disruption.

PART II - PRODUCTS

PART III - EXECUTION

3.1 PIPING AND EQUIPMENT:

Remove all piping and equipment rendered obsolete by this work and as designated on the drawings. Dispose of removed material off-site. Identify capped ends to be able to properly restore directional flow. Value and cap active piping to insure building system function is maintained to remainder of the building.

3.2 DUCTWORK AND EQUIPMENT:

Remove all ductwork and equipment rendered obsolete by this work, and as designated on the drawings. Dispose of removed material off-site. Keep inactive openings covered and protected from damage, contamination, etc. Cap and seal active openings to insure building system functions are maintained to the remainder of the building

3.3 CONTROLS:

Remove control wiring only as required for reconnection or relocation as indicated on the drawings.

END OF SECTION 15005

SECTION 15060 – GENERAL REQUIREMENTS FOR PIPES AND FITTINGS

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is Division-15 General Pipes and Fittings section, and is part of each Division-15 section making reference to pipes and pipe fittings specified herein.
- C. Division-15 General Mechanical Requirements apply to work of this section.

1.02 SUMMARY:

- A. This section is generic in that it describes material and installation required by several other sections of this specification.
- B. Types of pipes and pipe fittings specified in this section include the following:
 - 1. Steel Piping
 - 2. Copper Piping
 - 3. Miscellaneous Piping Materials/Products.
- C. Pipes and pipe fittings furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-15 sections.

1.03 QUALITY ASSURANCE:

- A. **Manufacturer's Qualifications:** Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. **Installer's Qualifications:**
 - 1. Firm with at least three years history of successful experience on projects of similar nature.
 - 2. Licensed as a firm in the contractor state of origin and in the State of Utah.
 - 3. Have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the contractor.
 - 4. All workmen employed on the project to carry state licenses as journeyman or apprentice pipe fitters with additional certification for welders.

1.04 SUBMITTALS:

- A. **Product Data:** Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.
- B. **Brazing Certifications:** Submit reports as required for piping work.

- C. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in maintenance manual; in accordance with requirements of General Conditions.

1.05 REFERENCES:

- A. Codes And Standards:
 - 1. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.
 - 2. NSF Labels: Where plastic piping is indicated to transport potable water, provide pipes and pipe fittings bearing approval label by National Sanitation Foundation (NSF).

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Except for concrete, corrugated metal, hub-and-spigot, clay, and similar units of pipe, provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping. Raise slightly one end of sealed piping to prevent accumulations of condensate and pitting where condensate accumulates.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART II - PRODUCTS

2.01 GENERAL:

- A. Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards. Use United States (domestic) manufactured pipe only. Do not use foreign made pipe.
- B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable. Use domestic manufactured fittings only. Do not use foreign manufactured fittings.

2.02 STEEL PIPES AND PIPE FITTINGS:

- A. Black Steel Pipe: Seamless or ERW, ASTM A 53.
- B. Galvanized Steel Pipe: ASTM A 53.
- C. Galvanized Seamless Steel Pipe: ASTM A 53.

- D. Electric-Resistance-Welded Steel Pipe: ASTM A 135.
- E. Electric-Fusion-Welded Steel Pipe: ASTM A 671, A 672, or A 691.
- F. Cast-Iron Flanged Fittings: ANSI B16.1, including bolting.
- G. Cast-Iron Threaded Fittings: ANSI B16.4.
- H. Malleable-Iron Threaded Fittings: ANSI B16.3; plain or galvanized as indicated.
- I. Unions: ANSI B16.39; 300 lb. ground joint malleable iron, hexagonal, selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated.
- J. Dielectric Unions: 175 psig WSP at 250°F. Equal to Walter Vallet Company V-line insulating coupling.
- K. Threaded Pipe Plugs: ANSI B16.14.
- L. Steel Flanges/Fittings: ANSI B16.5, including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.
 - 1. Material Group: Group 1.1.
 - 2. End Connections: Buttwelding.
 - 3. Facings: Raised-face.
 - 4. Steel Pipe Flanges For Waterworks Service: AWWA C207.
- M. Forged-Steel and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe.
- N. Forged Branch-Connection Fittings: Except as otherwise indicated, provide type as determined by Installer to comply with installation requirements.
- O. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2", and where pipe size is less than 1-1/2", and do not thread nipples full length (no close-nipples).

2.03 COPPER TUBE AND FITTINGS:

- A. Copper Tube: ASTM B 88; Type K, L (wall thickness) as indicated for each service; hard-drawn temper, except as otherwise indicated. Do not use Type M piping.
- B. DWV Copper Tube: ASTM B 306.
- C. ACR Copper Tube: ASTM B 280.
- D. Cast-Copper Solder-Joint Fittings: ANSI B16.18.
- E. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.
- F. Cast-Copper Solder-Joint Drainage Fittings: ANSI B16.23.

- G. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.
- H. Cast-Copper Flared Tube Fittings: ANSI B16.26.
- I. Bronze Pipe Flanges/Fittings: ANSI B16.24.
- J. Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

2.04 MISCELLANEOUS PIPING MATERIALS/PRODUCTS:

- A. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by Installer to comply with installation requirements. Use **no lead** bearing solders in domestic water applications.
 - 1. Tin-Antimony Solder: ASTM B 32, Grade 95TA.
 - 2. Silver-Lead Solder: ASTM B 32, Grade 96TS.
- B. Brazing Materials: Except as otherwise indicated, provide brazing materials as determined by Installer to comply with installation requirements.
 - 1. Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.
- C. Strainers:
 - 1. Y pattern, self cleaning, line size. Armstrong, Bailey, Crane, Fisher, Metraflex, Mueller, Sarco, Strong, or Yarway.
 - a. Iron Body, Screwed Ends 2" and Smaller: 250 psig at 425°F, screen mesh to suit service.
 - b. Flanged Iron Body 2 1/2" and Larger: 125 psig steam pressure rating, screen mesh to suit service.

PART III - EXECUTION

3.01 INSTALLATION:

- A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently- leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible union, flanges, etc., for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance. Do not cold spring. Store filler weld materials in accordance with codes.

Comply with ANSI B31 Code for Pressure Piping.

- B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold

pipng close to walls, overhead construction, columns and other clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated. Provide high point vents, low point drains with valves and extension to drain for all piping.

- C. All piping in mechanical rooms, fan rooms, etc., shall be exposed. Do not conceal or imbed piping in walls, floors or other structures.
- D. Make changes in direction or size with manufactured fittings. Anchor and support piping for free expansion and movement without damage to piping, equipment or to building.
- E. Arrange piping to maintain head room and keep passageways clear.
- F. Provide unions at connections to equipment and elsewhere as required to facilitate maintenance.
- G. Run full pipe size through shutoff valves, balancing valves, etc. Change pipe size within three pipe size diameters of final connection to equipment, coils, etc.
- H. Erect all piping to insure proper draining. Heating water shall slope down a minimum of 1" per 40 feet towards the drains. Pitch standpipes down to fire department connections a minimum of 1" per 40 feet. Slope soil, waste, vent, and roof drain lines in accordance with requirements of Uniform Plumbing Code.
- I. On horizontal straight runs of pipe, use eccentric reducers with straight side on top for water piping.
- J. Electrical Equipment Spaces: Do not run piping in or through transformer vaults and other electrical or electronic equipment spaces and enclosures or above electrical gear unless authorized and directed. Install drip pan under piping that must be run through electrical spaces.

3.02 PIPING SYSTEM JOINTS:

- A. General: Provide joints of type indicated in each piping system.
- B. Threaded: Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- C. Brazed: Braze copper tube-and-fitting joints where indicated, in accordance with ASME B31.
- D. Soldered: Solder copper tube-and-fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

- E. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

3.03 CLEANING, FLUSHING, INSPECTING:

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Flushing shall consist of not less than six (6) short intermittent flushes of five (5) to ten (10) minutes duration. Sample and test each flush for cleanliness. Inspect each run of each system for completion of joints, supports and accessory items.
 - 1. Inspect pressure piping in accordance with procedures of ASME B31.
- B. Disinfect water mains and water service piping in accordance with AWWA C601.
- C. Clean, flush as above and treat heating and cooling systems in accordance with Sections chemical treatment. Certify by signature of Contractor and Owner's Representative.

3.04 PIPING TESTS:

- A. General: Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
 - 1. Required test period is 2 hours.
 - 2. Test long runs of Schedule 40 pipe at 150 psi, except where fittings are lower Class or pressure rating.
 - 3. Test each piping system at 150% of operating pressure indicated, but not less than 25 psi test pressure.
 - 4. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.
- B. Notifications: At least 10 days prior to commencement of required testing, notice shall be submitted for review. Tests shall be made prior to painting insulating or covering of any joints and shall be in accordance with ANSI Code for Pressure Piping.
- C. Inspections: Contractor to visually inspect piping while under hydrostatic pressure. Copies of inspection shall be submitted for review. At option of contract, welds not hydrostatically tested may be x-ray tested.
- D. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
- E. Drain test water from piping systems after testing and repair work has been completed.
- F. Test pressure piping in accordance with ANSI B31.

- G. Test waste, drain and vent systems in accordance with local plumbing code and these specifications. Repair failed sections by disassembly and reinstallation.
- H. If test procedures in other sections differ from the above, comply with more stringent requirements.

END OF SECTION 15060

SECTION 15100 - VALVES

PART I - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is Division-15 Valves section, and is part of each Division-15 section making reference to valves specified herein.
- C. Division-15 General Mechanical Requirements apply to work of this section.

1.2 SUMMARY:

- A. Extent of valves required by this section is indicated on drawings and/or specified in other Division-15 sections.
- B. Types of valves specified in section include the following:
 - 1. Drain Valves.
 - 2. Ball Valves.
 - 3. Miscellaneous Valves.
- C. Valves furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-15 sections.

1.3 QUALITY ASSURANCE:

- A. **Manufacturer's Qualifications:** Firms regularly engaged in manufacture of valves, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. **Valve Types:** Provide valves of same type by same manufacturer.
- C. **Valve Identification:** Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

1.4 SUBMITTALS:

- A. **Product Data:** Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valve schedule showing Manufacturer's figure number, size, location, and valve features for each required valve.
- B. **Shop Drawings:** Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components.
- C. **Maintenance Data:** Submit maintenance data and spare parts lists for each type of valve. Include this data, product data, and shop drawings in Maintenance Manual; in accordance with requirements of General Conditions.

1.5 REFERENCES:

A. Codes and Standards:

1. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions".
2. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged- or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves".
3. UL and FM Compliance: Provide valves used in fire protection piping, which are UL-listed and FM approved.

PART II - PRODUCTS

2.1 VALVES:

- A. General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.
- B. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
- C. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves, 4" and smaller, other than plug valves. Provide one wrench for every 10 plug valves. Provide gear operators for quarter-turn valves 6" and larger. Provide chain-operated sheaves and chains for overhead valves 8'-0" and higher above finished floor.
- D. Connections: Unless otherwise noted for a particular reason, any valve 2" and larger shall have flanges. For grooved joint steel pipe in 6" and larger sizes, convert to flanged pipe, use indicated ball or butterfly valves.

2.2 HEATING WATER:

A. Ball Valves:

1. Steel piping, 2" and smaller: 400 psig WOG @ 250°F, bronze construction, threaded ends, bubble tight mineral filled PTFE seat at 250 psig under water, hard, stainless steel ball and stem. Operate with flow in either direction. Lever or tee handle as required. Suitable for throttling and tight shut-off. Watts B-6000-SS or B-6001-SS, Apollo 70-100 or 70-200, Milwaukee BA-100S or BA 150S, Hammond, Belimo. No other manufacturers approved. All drain valves shall be furnished with capped 3/4" threaded hose outlet connection.
2. Copper piping, 2" and smaller: 400 psig WOG @ 250°F bronze construction, threaded or solder ends, bubble tight mineral filled. PTFE seat at 250 psig under water, hard stainless steel ball and stem. Operate with flow in either direction. Lever or tee handle as required. Suitable for tight shut-off. Watts B-6000-SS or B-6001-SS, Apollo 70-100 or 70-200, Milwaukee BA-100S or BA-150S, Hammond, Belimo. No other manufacturer approved. All drain valves shall be furnished with capped 3/4" threaded hose outlet connection.

- B. Balancing Valves: Circuit balancing valve with venturi and pressure taps. Do not use gate valves or butterfly valves as balancing valves. Provide schedule showing pressure drop and flow rate of each valve. Flow Set Accusetter, Gerund, Armstrong. If improperly sized balance valves are found during the test and balance work, the improperly sized balanced valves shall be replaced by the contractor at no additional cost to the Owner or project.

2.3 MISCELLANEOUS VALVES AND SPECIALTIES:

- A. Air Vent Valves: Stockham B-64, 300 psi working pressure, 3/8" bronze or Crane No. 88.
- B. Gauge Valves: Ball valve with Tee handle.
- C. Valve should be installed with bonnets at least 45 degrees above the horizontal to ensure debris does not collect in bonnet.

PART III - INSTALLATION

3.1 VALVE INSTALLATION:

- A. Locate all valves in locations which will allow easy operation and facilitate maintenance.
- B. Install valves with stems horizontal or above.

END OF SECTION 15100

SECTION 15190 - MECHANICAL IDENTIFICATION

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 SUMMARY:

- A. All plumbing, heating, air conditioning, automatic temperature control equipment (excluding thermostats and relays), and distribution systems shall be labeled. Electrical switches and starters for mechanical equipment shall also be labeled.

PART II - GENERAL MECHANICAL MATERIALS AND METHODS

2.01 EQUIPMENT, PIPE AND DUCT IDENTIFICATION:

A. Equipment:

- 1. Identification number and name shall generally be the same as that shown on the drawings or in these specifications. Equipment nameplates shall be black face formica with white engraved lettering 3/16" high or larger, and shall be attached securely.
- 2. Information on equipment nameplates shall include the following where applicable:
 - Identification name.
 - Identification number.
 - Capacity specified.
 - Actual capacity.
 - Area on zone served.

Operating conditions, including head or static pressure, area or zone served, name of lubricant, frequency of lubrication.

B. Valve Identification:

- 1. All valves, regardless of size, shall have brass tags at least 1-1/4" by 3" in size and 0.051 inches thick. Legend on tag shall use engraved lettering at least 1/8" high. Each valve on the drawing shall be identified separately, and valve tags shall match the drawing identification.
- 2. Valve tags shall include the following minimum information:
 - a. Normal Position
 - b. Duty
- 3. Tag numbers shall be identified as follows:

<u>Valve Tags</u>	<u>Duty</u>
1-99	HW
- 4. Make a schedule of all tagged valves, include in O&M Manuals.
- 5. Connect valve tags to valve stems with brass chain.

- C. All accessible duct and piping shall be color coded and identified with wording and arrows every 50 feet, at each riser, at each junction, at each access door, and where required to easily identify the medium transported.
- D. Duct and piping systems shall be identified by:
 - 1. Lettering color, and
 - 2. Flow Direction Arrow.
 - 3. Identifying lettering shall be painted or stenciled on duct or pipe. Self-adhesive or glue-on type labels are acceptable. Letters shall be 2" high for duct and larger piping 3" or more, 1" high for 1-1/4" to 2-1/2" pipe, and 1/2" high for 1" pipe and smaller.
 - 4. Arrows to indicate direction of flow shall be painted or stenciled on the duct or pipe in the same color as the lettering. The arrow shall point away from the lettering. On duct and large piping 3" or more in diameter, the "shaft" of the arrow shall be 2" long and 1" wide. Smaller piping, 2-1/2" or less, shall have arrows with a shaft 1/2" wide and 2" long. Use a double-headed arrow if the flow can be in either direction.
 - 5. Piping and duct shall be identified with the following colors:

Medium in Pipe or Duct	Banding Color	Identifying Lettering	Abbreviation & Lettering Color
Water:			
Heating Water Supply (Bldg. Heat)	One Yellow Two Orange	Heating Water Supply	BHWS Black
Heating Water Return (Bldg. Heat)	One Yellow One Orange	Heating Water Return	BHWR Black
Supply Duct			Supply Duct (Unit Served)

2.02 PANEL IDENTIFICATION:

- A. All panel devices on panel faces shall have engraved black face formica with white engraved lettering labels.
- B. All internal panel components shall have engraved black face formica with white engraved lettering labels. Fasten label beneath each device.
- C. All panel wiring and tubing shall be numerically or alphabetically coded.

END OF SECTION 15190

SECTION 15195 - OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.
- B. Division-15 General Mechanical Requirements sections apply to work of this section.

1.02 SUMMARY:

- A. Furnish two sets of bound operation and maintenance manuals. Manuals shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.

1.03 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS:

- A. General:
 - 1. The "Operating and Maintenance Manual" is a bound compilation of drawings and data that the owner requires for each building or project. These manuals, complete with drawings and data, shall be furnished to the Owner.
 - 2. The mechanical contractor has overall responsibility to obtain the necessary data and compile the data as set forth in this specification, including items or equipment purchased by the Owner and delivered to the contractor for installation.
 - 3. The number of binders (or "volumes") required will depend on the amount of information to be catalogued. Total "sets" see paragraph 1.02A.
 - 4. Make all information legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.
- B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

PART II - MATERIALS AND METHODS

2.01 PAGE SIZE: All pages shall be standard 8-1/2 x 11 inches size or approximate multiples (preferably 16 x 11 inches) folded to 8-1/2 x 11 inch.

2.02 DRAWINGS: All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

2.03 BINDERS: Binders shall be Buckram (stiffened fabric), bar-lock type binders with block lettering for sheet size 8-1/2 x 11 inches with 2" to 3-1/2" expandable metal capacity as required for the project. The number of binders, however, shall be based on not filling them beyond 4".

A. Place the following information 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 (Per DFCM project number).
4. Building name and number.
5. Engineer's name.
6. General Contractor's name.
7. Mechanical Contractor's name.
8. Items 5 through 7 need not be printed on the backbone.

2.04 CONTENTS AND INDEXING:

A. Manuals shall contain descriptions of the building systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.

B. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.

C. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:

1. Copy of purchase order change (if any).
2. Outline drawings, special construction details, as built electrical wiring and control diagrams for all major and supplementary systems.
3. Manufacturer's test or calculated performance data and certified test curves.
4. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.
5. Manufacturer's brochure marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included.
6. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:

Part I Building and System Descriptions
Part II Purchased Equipment Data
Part III Test Reports and Valve Charts
Part IV Start-Up and Operation

Part V Preventative Maintenance Recommendations

7. A copy of the approved submittals for each piece of equipment.
8. A copy of all testing, adjusting and balancing reports.
9. Wiring diagrams, marked with model and size and plan symbol.
10. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.

END OF SECTION 15195

SECTION 15250 - MECHANICAL INSULATION

PART I - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections apply to work of this section.
- B. Division-15, Section 15000 - General Mechanical Requirements applies to work of this section.

1.2 SUMMARY:

- A. Extent of mechanical insulation required by this section is indicated on drawings and schedules as required by the current International Energy Code, and by requirements of this section. Use no asbestos in this work. Include restorations of insulations of damaged work including repair of damaged existing insulation due to new work.
- B. Types of mechanical insulation specified in this section include the following:
 - 1. Piping Systems Insulation:
 - a. Fiberglass.
 - 2. Ductwork System Insulation:
 - a. Fiberglass.
 - b. Rigid Flexible Wrap.
- C. Refer to Division-15 section "Supports and Anchors" for protection saddles, protection shields, and thermal hanger shields.
- D. Refer to Division-15 section "Ductwork" for duct linings.
- E. Refer to Division-15 section "System Identification" for installation of identification devices for piping, ductwork, and equipment.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's specifications and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.
- B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.5 DELIVERY, STORAGE AND HANDLING:

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

PART II - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide mechanical insulation materials of one of the following (except as noted):
 - 1. Armstrong World Industries, Inc.
 - 2. Babcock and Wilcox Co., Insulating Products Div.
 - 3. CertainTeed Corp.
 - 4. Knauf Fiber Glass GmbH.
 - 5. Manville Products Corp.
 - 6. Owens-Corning Fiberglass Corp.
 - 7. Pittsburgh Corning Corp.
 - 8. Rubatex Corp.

2.2 PIPING INSULATION MATERIALS:

- A. Preformed Fiberglass Piping Insulation: ASTM C 547. (Class 1 for use to 450°F (230°C); Class 2 for use to 650°F (345°C); Class 3 for use to 1200°F (650°C).
- B. Jackets for Piping Insulation: All purpose (ASJ) fire retardant jacket, ASTM C 921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.
- C. Encase pipe fittings insulation with one-piece premolded PVC fitting covers, fastened as per manufacturer's recommendations.
- D. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
- E. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
- F. Insulation Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

- G. Thermal Hanger Shields: constructed of 360 degrees insert of high density, 100 psi, water-proofed calcium silicate, encased in 360 degrees sheet metal shield. Provide assembly of same thickness as adjoining insulation

2.3 DUCTWORK INSULATION MATERIALS:

- A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class 1. Class 1 - 400°F (204°C); Class 2 - 400°F (204°C); Class 3 - 850°F (454°C); Class 4 - 1000°F (538°C); Class 5 - 1800°F (982°C); Class 1 - 10 lbs/ft³; Class 2, 3 and 4 - 12 lbs/ft³; class 5 - 20 lbs/ft³.
- B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, Class B-4. Type 1 - resilient, flexible; Class B-1 - 0.65 lbs/ft³; Class B-2 - 0.75 lbs/ft³; Class B-3 - 1.0 lbs/ft³; Class B-4 - 1.5 lbs/ft³; Class B-5 - 2.0 lbs/ft³; Class B-6 - 3.0 lbs/ft³; Type II - flexible; Class F-1 - 4.5 lbs/ft³; Type III - semirigid; Class F-2 - 4.5 lbs/ft³.
- C. Jackets for Ductwork Insulation: ASTM C 921, Type I for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient.
- D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

2.4 PIPING SEALANT THROUGH WALLS: See also Section Mechanical Firestopping.

- A. Sealant shall be a two-part foamed silicone elastomer equal to Dow Corning 3-6548 Silicone RTV foam or equivalent by 3M or "Spec Seal" by STI. Sealant shall be applied at any piping of pipe or duct penetration through fire or smoke walls to prevent air from passing through the opening.
- B. Sealant cell structure, foamed in place, shall be U.L. classified and shall meet the smoke development and fuel contribution ratings specified. Sealant shall be stable at extreme temperatures, and shall effectively confine such hazards as fire, smoke and gases.
- C. Sealant required at any fire/smoke wall penetration to be according to approved detail for each specific wall assembly. Contractor shall submit detail for engineer approval.

PART III - EXECUTION

3.1 GENERAL:

- A. Piping insulation shall be fiberglass one-piece preformed pipe insulation, class related to temperature, with all purpose (ASJ) fire retardant jacket, additional jacketing as noted.
- B. Fittings and valves shall be insulated and covered with Zeston covers.
- C. All cold water, chilled water, roof drains or any other lines upon which condensate moisture could form, shall have a vapor-proof jacket.

D. Fire and smoke hazard for a complete insulation system shall not exceed:

1. Flame spread - 25
2. Fuel contribution - 50
3. Smoke development – 50

E. Hangers shall not contact pipe where pipe is specified to be insulated.

3.2 INSPECTION:

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.3 HVAC PIPING SYSTEM INSULATION:

A. Insulation Omitted: Omit insulation on hot piping within radiation enclosures or unit cabinets; on cold piping within unit cabinets provided piping is located over drain pan; on heating piping beyond control valve, located within heated space; on condensate piping between steam trap and union; and on unions, flanges strainers, flexible connections, and expansion joints.

B. Hot Pressure Piping (to 250°F):

1. Application Requirements: Insulate the following hot low pressure HVAC piping systems (water piping up to 200 degrees F).
 - a. HVAC hot water supply and return piping, valves and fittings.
2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: 1" thick for pipe sizes up to and including 1-1/2", 2" thick for pipe sizes over 1-1/2".

3.4 DUCTWORK SYSTEM INSULATION:

A. Insulation Not Required: Do not insulate lined ductwork.

B. Hot, Cold and Dual Temperature Ductwork:

1. Application Requirements: Insulate the following ductwork:
 - a. Outdoor air intake ductwork between air entrance and fan inlet or HVAC unit inlet.
 - b. HVAC supply ductwork between fan discharge, or HVAC unit discharge, and room terminal outlet. Insulate neck and bells of supply diffusers.
 - c. HVAC return ductwork between room terminal inlet and return fan inlet, or HVAC unit inlet: except omit insulation on return ductwork located in return air ceiling plenums.
2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

- a. Rigid fiberglass: Class 1, 1-1/2" thick, increase thickness to 2" in machine, fan and equipment rooms.
 - b. Flexible Fiberglass: Type 1, Class B-4, 1-1/2" lb/ft³ density, 1-1/2" thick, application limited to concealed locations.
- C. Duct Insulations:
- 1. Wrap insulation snugly on the ductwork such that maximum thickness is maintained. Butt all circumferential joints and overlap longitudinal joints a minimum of 2". Adhere insulation with 4" strips of Insulation Bonding Adhesive, at 8" on center.
 - 2. On circumferential joints, staple the 2" flange of the facing with 9/16" flare-door staples on 6" centers and taped with minimum 3" wide foil reinforcing Kraft tape. Tape all pin penetrations or punctures in the facing.

3.5 INSTALLATION OF PIPING INSULATION:

- A. General: Install insulation products in accordance with the manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete the run. Do not use cut pieces or scraps abutting each other.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.
- F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- H. Provide neatly beveled edge at all terminations and interruptions of insulation.
- I. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints.
- J. Saddles and Shields:
 - 1. General: Except as otherwise indicated, provide protection saddles or thermal hanger shields with protection shields under all piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and thermal shields for exact fit to mate with pipe insulation.

2. Protection Saddles: See section Supports and Anchors for saddle. Fill interior voids with segments of insulation matching adjoining insulation.
3. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation. Use on pipes 1-1/4" and smaller. Use with thermal hanger shields for pipes 1-1/2" and larger.
4. Thermal Hanger Shields: High density calcium silicate encased in 360 degrees sheet metal shield. Provide assembly of same thickness as adjoining insulation. Use on pipes 1-1/2" to 8".

3.6 INSTALLATION OF DUCTWORK INSULATION:

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.
- E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
- F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.
- G. Ductwork Exposed to Weather: Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by manufacturer.
- H. Corner Angles: Install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.7 EXISTING INSULATION REPAIR:

- A. Repair damaged sections of mechanical insulation damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

3.8 PROTECTION AND REPLACEMENT:

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during construction period to avoid damage and deterioration.

END OF SECTION 15250

SECTION 15515 - HYDRONIC PIPING AND SPECIALTIES

PART I - GENERAL

1.1 RELATED DOCUMENTS:

- A. All pertinent sections of Division - 15 "General Mechanical Requirements" are a part of the work described in this section.
- B. All pertinent sections of Division - 15 "General Pipes and Fittings" are a part of the work described in this section.
- C. Other Specification sections related to Insulation, System Commissioning, Testing and Balancing.

1.2 SUMMARY: Work shown on the drawings and required by these specifications including incidental work classified as "best practices of the trade".

- A. Heating water systems.
- B. Other work as indicated.

1.3 QUALITY ASSURANCE:

- A. **Manufacturer's Qualifications:** Firms regularly engaged in the manufacture of hydronic piping products and equipment of types, materials and sizes required, whose products have been in service for not less than 5 years.
- B. **Installer's Qualifications:**
 - 1. Firm with at least 3 years history of successful experience on projects of similar nature.
 - 2. Licensed as a firm in the Contractor state of origin and in the State of Utah.
 - 3. Have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.
 - 4. All workmen employed on the project shall carry state licenses as journeyman or apprentice pipe fitters with additional certification for welders.

1.4 SUBMITTALS:

- A. **Product Data:** Submit manufacturer's technical literature indicating source, brand, type, model, performance characteristics, installation instructions, etc.
- B. **Record Drawings:** See Division - 15000.
- C. **Operation And Maintenance Information:** Provide information for all equipment including a comprehensive system operating description. See Section 15195.
- D. **Instruction Of Owner's Personnel:** Participate in specified instruction. See Division - 15000.

1. As part of the overall project warranty, furnish individual manufacturer warranties for each piece of equipment for a period of not less than one year from date of Owner's beneficial use (substantial completion).
2. Warrant the overall assembly of equipment, materials and labor comprising these systems.

1.5 REFERENCES:

- A. Standards: Comply with applicable sections, follow recommended practices.
 1. State Boiler and Pressure Vessel Regulations
 2. ASME Codes for Boilers and Pressure Vessels
 3. State and Local Plumbing and Mechanical Codes
 4. International Building Code/International Mechanical Code / International Plumbing Code
 5. ASHRAE Handbooks

PART II - MATERIALS AND METHODS - HEATING WATER

2.1 PIPING AND FITTINGS:

- A. Heating Water: Schedule 40 black steel, A-53 with malleable steel threaded fittings up to 2" size and forged steel welding fittings 2-1/2" and larger. Contractor option to use a grooved joint system accommodating for additional support and insulation work.
 1. Rigid type "K" or "L" copper, bronze or dielectric interface.
- B. Drains And Overflow: Install piping of any size from drains and overflows using type K or L copper piping with Solder joint type wrought copper or wrought bronze fittings. Drains and over flows shall be terminated over floor drains or drain funnels adjacent to equipment. Furnish drains from all pump bases to floor drains.
- C. Water Connections: Provide piping and fittings connecting to the domestic water system, such as fill lines, makeup water lines, etc., of Type K or L copper tubing with solder joint type wrought copper or wrought bronze fittings. Copper piping shall be connected to equipment and steel piping with insulated unions to prevent electrolysis.

2.2 GENERAL SERVICE VALVES: Comply with Section "Valves".

- A. General: Provide valves complying with Division-15 General Mechanical Materials and Methods section "Valves", in accordance with the following listing.
 1. Sectional Valves:
 - a. 2" and Smaller: Ball valves.
 - b. 2 1/2" and Larger: Butterfly valves.

- 2. Shutoff Valves:
 - a. 2" and Smaller: Ball valves.
 - b. 2 1/2" and Larger: Butterfly valves.
- 3. Drain Valves:
 - a. 2" and Smaller: Ball valves.
- 2.3 MISCELLANEOUS VALVES AND SPECIALTIES: See Section "Valves".
- 2.4 CIRCUIT BALANCE VALVES:
 - A. Circuit balance valve for flow balance complying with Section "Valves".
- 2.5 VENT VALVES:
 - A. Manual Vent Valves: Provide manual vent valves designed to be operated manually. Use ball valve.
 - B. Automatic Vent Valves: Provide automatic vent valves designed to vent automatically with float principle, stainless steel float and mechanisms, cast-iron body, pressure rated for 125 psi, 1/2" NPS inlet and outlet connections.
 - C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering vent valves which may be incorporated in the work include, but are not limited to, the following:
 - 1. Armstrong Machine Works.
 - 2. Bell & Gossett ITT; Fluid Handling Div.
 - 3. Hoffman Specialty ITT; Fluid Handling Div.
 - 4. Spirax Sarco.
 - 5. Amtrol.
- 2.6 STRAINERS:
 - A. General: Y pattern, self cleaning, line size.
 - B. Acceptable Manufacturers: Subject to compliance with requirements, provide strainers of one of the following:
 - 1. Armstrong
 - 2. Watts
 - 3. Victaulic
 - 4. Mueller
 - 5. Spirex Sarco
 - 6. Metraflex
 - C. 2" and Smaller: Watts No. 77S or equal in Armstrong, 250 lb. iron body, threaded, Y-pattern, 20-mesh stainless steel screen, full size drain connection with ball valve.
 - D. 2-1/2" and Larger: Watts No. 77F-125 or equal in Armstrong, 125 lb. iron body, flanged, Y-pattern, stainless steel screen, drain connection with ball valve.

PART III - EXECUTION

3.1 INSPECTION:

- A. General: Examine areas and conditions under which hydronic piping systems materials and products are to be installed.

3.2 GENERAL SYSTEM INSTALLATION:

- A. Arrange system in a neat, orderly and functional manner. Maintain access around all equipment. Provide sheeves for all structural penetrations.
- B. Plan ahead for seismic restraint and vibration isolation.
- C. Verify adequate ventilation for heat producing equipment, watch out for possible freezing conditions.
- D. Air Vents and Line Drains: Provide air vents at all high points of piping systems with vent line extended to valve installed in accessible location 5'-0" above the floor, vent line extended to drain. Provide drain valves at all equipment and at low points in the system, extend drain lines to drain funnel or floor sink.
- E. Provide pressure gauges and thermometers and pressure/temperature plugs as indicated on the flow diagrams, piping plans and equipment details.

3.3 INSTALLATION OF HYDRONIC PIPING:

- A. General: Install hydronic piping in accordance with Division-15 "General Pipes and Fittings."
- B. Install eccentric reducers where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush.
- C. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

3.4 INSTALLATION OF PIPING SPECIALTIES:

- A. Install piping specialties in accordance with Division-15 "Hydronic Piping and Specialties."

3.5 INSTALLATION OF SUPPORTS AND ANCHORS:

- A. Install supports and anchors in accordance with Division-15 "Mechanical Supporting Devices."

3.6 INSTALLATION OF VALVES:

- A. Install valves in accordance with Division-15 "Valves."
- B. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves 2 or more hydronic terminals or equipment connections, and elsewhere as indicated.

- C. Shutoff Valves: Install on inlet and outlet of each mechanical equipment item, and on inlet of each hydronic terminal, and elsewhere as indicated.
- D. Hydronic Terminal Outlet Valves: Install on inlet of each hydronic terminal, and elsewhere as indicated.
- E. Drain Valves: Install on each mechanical equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain hydronic piping system.
- F. Check Valves: Install in locations as indicated.

3.7 INSTALLATION OF EXPANSION COMPENSATION PRODUCTS:

- A. General: Provide for expansion and contraction of all piping systems with anchors, guides, loops, expansion joints, grooved joints, etc. Provide one expansion loop for every 100 feet of pipe or fraction thereof.

3.8 EQUIPMENT CONNECTIONS:

- A. General: Connect hydronic piping systems to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated. Install shutoff valve and union on supply and return, drain valve on drain connection.
- B. Hydronic Terminals: Install hydronic terminals with hydronic terminal shut-off valve and union on outlet; union, shutoff valve on inlet. Install manual air vent valve on element in accordance with manufacturer's instructions. Locate valves and balancing valves behind valve access doors for ease of maintenance. Where indicated, install automatic temperature control valve with unions on supply line.

3.9 INSTALLATION OF HYDRONIC SPECIALTIES:

- A. Balance Valves: At locations shown on drawings.
- B. Vent Valves:
 1. Manual Vent Valves: Install manual vent valves on each hydronic terminal at highest point, and on each hydronic piping drop in direction of flow for mains, branches, and runouts, and elsewhere as indicated.
 2. Automatic Vent Valves: Install automatic vent valves at top of each hydronic riser and elsewhere as indicated. Install shutoff valve between riser and vent valve, pipe outlet to suitable plumbing drain, or as indicated.

3.10 TESTS:

- A. Isolate sections of piping and equipment and pressure test to 175 psi or 1-1/2 times the maximum potential pressure of the system, but not to exceed the test pressure rating of a system component.
 1. Conduct an air pressure test, using a soap solution to check for leaks. Establish the pressure, close off the pressure source and let stand for 24 hours. Given constant temperature, there should be no drop in pressure.

2. After the air test, fill the system with water, raise to test pressure and inspect for leaks. Repair all leaks. Repeat tests. Report and certify all tests.
- B. Test other system components as needed to verify proper assembly and installation.
 - C. Participate in overall system test and balance work.

END OF SECTION 15515

SECTION 15890 - DUCTWORK

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.02 SUMMARY:

- A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.
- B. Types of ductwork required for the project include the following:
 - 1. Round
 - 2. Rectangular
 - 3. Factory duct
- C. Exterior Insulation of metal ductwork is specified in other Division-15 sections, and is included as work of this section.
- D. Refer to other Division-15 sections for ductwork accessories; not work of this section.
- E. Refer to other Division-15 sections for mechanical controls; not work of this section.
- F. Refer to other Division-15 sections for grilles and diffusers; not work of this section.
- G. Refer to other Division-15 sections for system commissioning, testing and balancing; not work of this section.

1.03 QUALITY ASSURANCE:

- A. **Manufacturer's Qualifications:** Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. **Installer's Qualifications:** A firm with at least 3 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

The installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

All workmen on the project shall carry state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.04 SUBMITTALS:

- A. **Product Data:** Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

- B. Shop Drawings: Submit scaled layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spacial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.
- C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of General Conditions.
- D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of General Conditions.

1.05 REFERENCES:

- A. Codes and Standards:
 1. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
 2. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.
 3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems".
 4. International Building Code/International Mechanical Code: Comply with all sections pertaining to mechanical work.
- B. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART II - PRODUCTS

2.01 DUCTWORK - GENERAL:

- A. Standards: All duct fabrications shall comply with standards and techniques detailed by SMACNA "Duct Construction Manuals" for the appropriate pressure class, and with the ASHRAE Handbook, 1988 edition, Chapter 1, Duct Construction
- B. Sheet Metal:

1. For supply air ductwork and portions of exhaust ductwork as noted on the drawings. Fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality, with G 90 zinc coating in accordance with ASTM A 525; mill phosphatized for exposed locations.
2. For chemical exhaust ductwork and other exhaust ductwork noted on the drawings to be stainless steel, fabricate ductwork from 304 or 316 stainless steel.

2.02 FITTINGS AND FABRICATION:

- A. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15° change of direction per section. Unless specifically detailed otherwise, use 45° lateral and 45° elbows for branch take-off connections. Where 90° branches are indicated, provide conical type tees.
- B. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.
- C. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-15 section "Duct Accessories" for accessory requirements.
- D. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.
- E. Offset, transition, adapt ductwork to structural obstacles and work of other trades in a coordinated effort. Layout work to avoid conflict with piping, etc. With review of conditions, teardrop around conflicting piping, lights, etc., all at no added cost to the owner.

2.01 LOW PRESSURE ROUND DUCTWORK: (1" SMACNA Pressure Class)

- A. Round type ductwork for use on low velocity supply systems (1200 fpm maximum), low pressure (0.75" maximum duct pressure), shall be fabricated on 26 gauge galvanized steel sheets with snap-lock longitudinal seams and crimped and beaded joints.
- B. All end joints shall have at least three screw fasteners and shall be wrapped airtight. Transverse and longitudinal seams shall be taped with "Hardcast TA". Elbows and fittings shall provide smooth air flow patterns and have a neat appearance.
- C. Use factory fabricated elbows of the multi-sectional adjustable type.

2.02 LOW PRESSURE RECTANGULAR DUCTWORK: (3" SMACNA Pressure Class)

- A. Rectangular ductwork for use on supply systems up to 2" maximum duct static pressure and 2000 fpm maximum duct velocity shall be constructed of galvanized steel using construction for nominal 3" SMACNA rated systems. Seal all transverse joints with duct cement or tape with "Hardcast TA".
- B. Use radius elbows or turning vanes with extended trailing edge. Use 45° tapping takeoffs with downstream balance damper.
- C. Duct dimensions are inside clear. Increase for acoustical lining.

- D. For rectangular exhaust ducts, increase metal gauge by 2 (i.e. 20 to 18) for all sizes. Seal all joints.

2.7 FACTORY DUCT:

- A. Extent of Work: Provide factory duct at connections to air terminal units, at runouts to grilles and diffusers, at points of round to round flexible connections (see also "Flexible Connections") and at other locations indicated or required.
- B. Prohibited Material: Do not use single wire helix ducting with vinyl or plastic liner of any type.
- C. Factory Duct Non-corrosive Environments: Woven fiberglass fabric impregnated with vinyl or neoprene clamped in a continual helix of aluminum or cold rolled steel. U.L. listed for Class 1 duct, compliant with NFPA 90A and 90B, pressure rated to 12" w.g., equivalent to:
 - 1. Non-insulated: Wiremold 57; Flexmaster Type N145
 - 2. Insulated: Flexmaster Type 4; Thermaflex M-KC
- D. Installation: Follow manufacturers instructions. Use stainless steel or nylon band clamping rings. In general, do not use lengths in excess of 1 foot. Make bends only in long radius format. Support duct to avoid droops and kinks.

2.8 MISCELLANEOUS DUCTWORK MATERIALS:

- A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Runout Fittings: Runout fittings shall be used to make round to rectangular duct connections. Use 45° time and a half square to round fittings. Provide with locking quadrant dampers where balance is involved. Provide with insulation guard where insulated duct is involved.
- C. Duct Sealing Compound: Duct sealing compound shall be 3M brand number EC-750 or Duro-Dyne S-2. This material shall be used in making up duct joints or in water proofing, caulking plenums, etc.
- D. Acoustical Lining: Acoustical lining in ducts shall be 1" thick, 1-1/2 pound density, coated, flexible glass fiber type, set in adhesive and impaled on weld studs spaced not more than 12" on centers and secured with lock washers. Airstream surface faced with black coated matte. Acoustical lining shall completely line the ducts. Lining shall have a fire and smoke hazard rating not exceeding 20-50-50. Owens-Corning, Johns-Manville, Certainteed.
- E. All joints, edges and/or surface breaks in the coating of the acoustical lining shall be pointed up to a smooth surface with adhesive.
- F. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives and Duct Thermal Insulation".
- G. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.

- H. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement (type applicable for fabrication/ installation detail) as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.
- I. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
- J. Volume Control Devices: See Section 15965 for variable volume fume hood units and related controls.

Where adjustable volume control dampers are indicated for fixed air balance only, install factory built dampers of all stainless steel construction on the exhaust air side.

- K. Installation: Complete, airtight, sleeved and sealed at wall penetrations. Strip protective coating from finished stainless steel surfaces.

Participate in test and balance work.

PART III - EXECUTION

3.01 INSPECTION:

- A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF METAL DUCTWORK:

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary, the required area shall be maintained. All of these changes, however, must be approved and installed as directed at project. During the installation, the open ends of ducts shall be protected to prevent debris and dirt from entering.

- B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- C. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and

permanent-enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

- D. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures. Maintain clearances above of and in front of electrical panels.
- E. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.
 - 1. Where ducts pass through fire-rated floors, walls, or partitions, provide firestopping between duct and substrate, in accordance with requirements of Section "Firestopping".
- F. Ducts At Structural and Architectural Penetrations: Where ducts are shown connecting to or passing through concrete, gypsum board, masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2-1/8" galvanized angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron. Round high velocity ducts in vertical chases shall be supported with rolled angle rings. Close openings between duct and structure.
- G. Cross Breaking: Rectangular sheet metal ducts shall be cross broken on the four sides of each 4-foot panel. All vertical and horizontal sheet metal barriers, duct offsets, elbows, as well as 4-foot panels of straight sections of ducts shall be cross broken. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles; the center of cross break shall be of the required height to assure surfaces being rigid.
- H. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
- I. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

Related to final installation cleanliness, damp wipe all ductwork on installation. Cap open duct ends, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

3.03 INSTALLATION OF DUCT LINER:

- A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

3.04 As indicated on the drawings, supply, return and exhaust air ductwork shall be lined with acoustical insulation.

3.05 INSTALLATION OF FLEXIBLE DUCTS:

- A. Maximum Length: For any duct run using flexible ductwork, do not exceed 3'-0" extended length. No elbows allowed.
- B. Installation: Install in accordance with Section III of SMACNA's "HVAC Duct Construction Standards, Metal and Flexible".

3.06 HANGERS AND SUPPORTS:

- A. It is essential that all ducts shall be rigidly supported. Hangers for low velocity ducts up to 18" in width shall be placed on not more than 10' centers.

Low velocity ducts 19" through 35" in width and greater shall be supported on not more than 5' centers. Where vertical ducts pass through floors or roofs, heavy supporting angles shall be attached to ducts, and to structure. Angles shall be of sufficient size to support the ductwork rigidly and shall be placed on at least two sides of the duct.
- B. Construct hangers for rectangular ductwork from galvanized iron 1" x 1/16". Hangers shall extend down the sides of rectangular ducts the full depth of the duct and shall be bent underneath the duct 2". Hangers shall be secured to the duct using sheet metal screws or rivets of appropriate sizes on 6" centers, but not less than two screws in the side and one in the bottom of each hanger.
- C. For rectangular ducts 36" and greater in width construct hangers from galvanized iron 1-1/2" x 1/16". Hangers shall be installed and secured to duct as described in Paragraph B.

3.07 CONNECTIONS: Connections of high velocity supply and exhaust ducts, fittings, and high velocity mixing boxes shall be made airtight by coating joints with Minnesota Mining Co. Mastic, Type EC-800, Benjamin Foster, Sheet Metal Products Co., or approved equal, before joining, and then sealing the joint with one layer of "Glass-Fab" reinforcing tape set in a coating of the above compound. Tape and sealant shall not exceed a flame spread of 25 or a smoke development of 50.

3.08 AESTHETIC LAYOUTS: Contractor shall locate all diffusers, grilles and other exposed items in such a manner as to fit symmetrically in any grid system or other aesthetic architectural or lighting pattern. Refer to reflected ceiling plans and electrical lighting layouts for additional information. Provide duct offsets or extensions as required to make a proper installation.

Close or cap all duct ends. Use auxiliary blower with air flow meter to establish a duct pressure equivalent to the duct pressure class. Inspect all joints in duct system and seal all identifiable leaks.

3.09 FIELD QUALITY CONTROL:

- A. Leakage Tests: After each duct system which is constructed for duct classes over 3" is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Air leaks which are in excess of that required to bubble the soap suds (that is, actually blow the suds away) shall be sealed by additional taping and caulking to reduce the leakage to a rate not to exceed slow bubbles forming. Repair leaks and repeat tests until total leakage conforms with Chart of Figure 4-1, Seal Class A, Leakage Class 3 for round/oval, 6 for rectangular.

3.10 EQUIPMENT CONNECTION:

- A. General: Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.11 ADJUSTING AND CLEANING:

- A. Clean ductwork internally of dust and debris, as follows: Before the ceilings are installed, with filters in place, operate the fans at full capacity to blow out dirt and debris from ducts. If it is not practical to use the main supply blower for this test, the ducts may be blown out in sections by a portable fan.
- B. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- C. Balancing:
 - 1. Refer to Division-15 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. However, the Sheet Metal Contractor shall participate fully in this work. Seal any leaks in ductwork that become apparent in balancing process.
 - 2. If specified conditions cannot be obtained due to deficiencies in equipment performance or improper installation or workmanship, the Mechanical Contractor and his subcontractors shall make any changes necessary to obtain the specified conditions.

END OF SECTION 15890

SECTION 15910 - DUCTWORK ACCESSORIES

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 SUMMARY:

- A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.
- B. Types of ductwork accessories required for project include the following:
 - 1. Dampers.
 - a. Low pressure manual dampers.
 - b. Control dampers.
 - 2. Turning vanes.
 - 3. Duct hardware.
 - 4. Duct access doors.
 - 5. Flexible connections.
- C. Refer to other Division-15 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.03 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.
- C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of General Conditions.

1.05 REFERENCES:

- A. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".
2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Protection: Protect shop-fabricated and factory-fabricated accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Storage: Where possible, store accessories inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART II - PRODUCTS

2.01 DAMPERS:

- A. Control dampers for balance only where tight shutoff is not critical are to be furnished and installed by this Section. 6" galvanized blade, poly foam blade seals, flexible metal jamb. Parallel blade operation.

Ruskin CD-35
Greenheck

2.02 TURNING VANES: Turning vanes shall be installed in all square elbows. Turning vanes shall be single blade. Turning vane spacing shall be per SMACNA. Each blade shall be tack welded or crimped to the carrier frame to prevent rattling.

PART III - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES:

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

- B. Install hand operated volume dampers at locations and of sizes shown. Volume dampers shall be controlled by heavy duty locking quadrants mounted on the outside of the duct. Where ducts are insulated, the damper rod shall be extended and the operator shall be mounted on the outside of the insulation. Butterfly dampers may be constructed by the Sheet Metal Contractor. All multi-blade hand dampers shall be the product of one of the manufacturers listed in the Contract Documents. All operator fittings shall be heavy duty commercial grade.
- C. Install turning vanes in square or rectangular 90 degree elbows in supply and exhaust air systems, and elsewhere as indicated.
- D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 FIELD QUALITY CONTROL:

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.04 ADJUSTING AND CLEANING:

- A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
 - 1. Label access doors in accordance with Division-15 section "Mechanical Identification".
 - 2. Final positioning of manual dampers is specified in Division- 15 section "Testing, Adjusting, and Balancing".
 - 3. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 15910

SECTION 15940 - AIR OUTLETS AND INLETS

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY:

- A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of outlets and inlets required for project include the following:
 - 1. Ceiling air diffusers and grilles.
 - 2. Wall registers and grilles.
- C. Refer to other Division-15 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.
- D. Refer to other Division-15 sections for balancing of air outlets and inlets; not work of this section.
- E. Refer to other Division sections for louvers, not work of this section.

1.03 QUALITY ASSURANCE:

- A. **Manufacturer's Qualifications:** Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. **Installer's Qualifications:** A firm with at least 3 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

The Installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

All workmen on the project shall carry state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.04 SUBMITTALS:

- A. **Product Data:** Submit manufacturer's technical product data for air outlets and inlets including the following:
 - 1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
 - 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
 - 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

- B. Samples: 3 samples of each type of finish furnished.
- C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of General Conditions.

1.05 REFERENCES:

A. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
4. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
5. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART II - PRODUCTS

2.01 GRILLES AND DIFFUSERS:

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

- C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- D. Adjust all grilles and diffusers to fit neatly in the room ceiling pattern. Set final locations per architectural reflected ceiling plans.
- E. Volume Control Dampers: Provide duct mounted dampers of the externally adjustable opposed blade type where more than one grille or register is on a common duct. Provide access to each damper adjustment.
- F. Sound Level: The diffuser or grille generated noise shall not exceed the following sound power level curve at a point five feet away from the diffuser or grille.
 - Office Areas: NC 30-35
 - Work Rooms: NC30-40
 - Storage: NC 35-40
- G. Manufacturers: Subject to compliance with requirements, provide grilles and diffusers of one of the following:
 - 1. Krueger
 - 2. Titus
 - 3. EH Price
- H. Types: Provide grilles and diffusers of type, capacity, and with accessories and finishes as listed on grille and diffuser schedule and as specified herein.
- I. Grilles and Diffusers:
 - 1. Ceiling Supply Diffuser (S-1): Krueger Series RM2PLQ, round face, round neck. The architectural round ceiling diffuser shall be Krueger model RM2PLQ removable plaque core, white baked enamel finish, size as indicated on drawings.
 - 2. Sidewall Return Register (R-1): Krueger Series S80H. Steel construction, appropriate mounted frame, 3/4" blade spacing, blades on 35 deg. Angle unless otherwise shown on drawings, sponge rubber gasket, size as indicated on drawings. Color selected by Architects.

PART III - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

END OF SECTION 15940

SECTION 15950 - MECHANICAL CONTROL SYSTEMS

PART I - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-15 General Mechanical Requirements sections apply to work of this section.

1.2 SUMMARY:

- A. Extent of control systems work required by this section is indicated on drawings and schedules, and by requirements of these control related sections.
 - 1. See following sections for types of Control Systems included as a part of this section.
 - 2. Section 15955 - Electric Control Systems
 - 3. Section 15970 - Direct Digital Control Systems
 - 4. Control sequences are specified in this section under: "Sequence of Operation".
- B. Refer to other Division-15 sections for installation of instrument wells, valve bodies, and dampers in mechanical systems.
- C. Participate in "System Commissioning, Testing and Balancing".

1.3 QUALITY ASSURANCE:

- A. MANUFACTURER'S QUALIFICATIONS: Control Components will be purchased and furnished by the Contractor. Existing controls are Utah Controls. Approved contractors are as follows:
 - 1. Utah Yamas Controls
- B. INSTALLER'S QUALIFICATIONS: Firms and workmen specializing and experienced in electric control system installations for not less than 5 years. Approved installers are as follows:
 - 1. Utah Yamas Controls

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.
- B. Shop Drawings: Submit shop drawings for each control system, containing the following information:

1. Label each control device with setting or adjustable range of control.
 2. Indicate all required electrical wiring. Clearly differentiate between portions of work that are factory-installed and portions to be field-installed. Note contract responsibility to provide complete system regardless of delegation. Completely interface with and show existing installation in the existing building.
 3. Provide details of faces of any new control panels, including controls, instruments, and labeling.
 4. Include verbal written description of sequence of operation. Confirm correct function of proposed sequences.
- C. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Section 15195.
- 1.5 REFERENCES:
- A. Codes and Standards:
1. Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.
 2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.
 3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
 4. Comply with NEPA 70, "National Electric Code" for all electrical installation.
- 1.6 DELIVERY, STORAGE, AND HANDLING: Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.
- 1.7 INSTRUCTION OF OWNER'S PERSONNEL: (See Section 15000)
- A. Purpose is to provide a transition of the systems from the Contractor to the Owner, leaving the Owner's personnel familiar with and well qualified to operate and maintain the systems.
- B. Instruction to cover purpose and function of each system and its components, to show proper operating technique, to show proper maintenance technique.
- C. Prepare an outline of information to be conveyed, list materials available for reference. Submit to Architect along with a proposed schedule of instruction. Schedule to allow individual time for each trade and each system.

- D. Convey information in formal classroom session. Teachers to include qualified contractor personnel and sales representatives for each major piece of equipment. Go from the classroom to the actual location to graphically illustrate concepts discussed.

1.8 WARRANTIES:

- A. As part of the overall project warranty, furnish individual manufacturer warranties for each piece of equipment for a period of not less than one year from date of Owner's beneficial use (substantial completion).
- B. Warrant the overall assembly of equipment, materials and labor comprising these systems.

1.9 CLEANING AND LUBRICATION: All instruments, shall be thoroughly cleaned before final acceptance. Provide lubrication for all furnished equipment.

1.10 TESTING AND ADJUSTING OF SYSTEM:

- A. During the system commissioning, testing and balancing of the building system, have a controls representative(s) present and available to interpret and adjust controls as needed. Demonstrate and report the integrity and accuracy of each function and control point.
- B. At the termination of the testing period, the Controls representative shall spend one working day instructing the Owner's operating personnel in the control system operation, and one working day checking each system for day-night and manual override with the Owner's operating personnel on each air system. A complete operating booklet shall be provided and used during the training period. Schedule this training with the Owner and Mechanical Contractor.
 - 1. Since system performance is partly a function of climatic conditions, the Controls contractor shall be available during the changing seasons of the warranty period to make further adjustments and modifications if required. A final complete check of all systems shall be made at the conclusion of the one year warranty period.

PART II - PRODUCTS

2.1 CONTROL CABINETS (if required for new VAV boxes): Furnish stamped steel with hinged door and locking latch control cabinets to protect and conceal all control devices. Arrange components neatly to provide adequate maintenance opportunity and proper device function. Label all components, numerically code all piping and wiring. Terminate all wiring at terminal blocks. Provide engraved plastic labels for all panel face devices.

- A. Provide with surge suppressor - one per panel.
- B. Provide with 120/60/1 outlet - one per panel.
- C. Provide with fuse - quantity as required.
- D. Provide with transformer, 120/24 VAC, quantity as required.

- E. Provide RS-232 service trunk from main panel into each ATC panel for "Laptop" computer access.

2.2 CONTROL VALVES:

- A. Furnish automatic control valves required by the project. Design valves to pass the quantities of fluid at the pressure drop scheduled on the drawings.
- B. Mount all control valves with stems in the up-vertical position. Valves shall have stainless steel trim, renewable seats.
- C. Furnish valve operators with adequate capacity to operate the valve smoothly through the operating range. Provide oversized motors or operator if needed. Voltage ranges or pressure ranges shall be adjustable, the equivalent of pilot positioning for electric functions.
- D. See Section 15970 for electric/electronic control valves.

PART III - CONTROL SEQUENCES

3.1 GENERAL:

- A. In general, the controls are existing. Controls contractor in conjunction with the balancing contractor shall verify all controls are functioning properly and perform the following control sequences.
- B. Utilize existing control systems to manage and manipulate mechanical equipment in a functional and energy conserving way.
- C. Provide control panels in the central fan rooms, with terminal block connections for interface, new VAV boxes, as required.

3.2 CENTRAL CONTROL AND MONITORING SYSTEM:

- A. Central Control Units shall provide for overall control and monitoring of the Building System.
- B. DDC panels shall also provide programmable time clock functions, optimum start, and signals to ATC panels and report space temperature and condition of air handling system.
- C. Locate any new DDC panels in mechanical room(s) and in rooms as shown on the drawings or as directed in the field.

3.3 VARIABLE VOLUME SUPPLY FAN STATIC PRESSURE CONTROL SEQUENCE: (Existing Controls)

- A. In automatic mode, the supply fan VFD starts via the DDC system, all safeties satisfied. In "Hand", the supply fan will run when all safeties are satisfied. Each supply fan damper opens when its respective fan runs.

- B. Control the speed of the supply fans through the existing duct static pressure sensor in order to maintain the duct static pressure set point at approximately 0.5" w.c. Verify that the location of the duct static pressure sensor is near the most remote terminal box to provide a signal to the DDC duct pressure controller. The DDC controller will provide an input signal to the variable speed drive serving the supply fan.
- C. Interlock the variable speed drive to the safeties relay to provide shutdown upon building fire alarm, smoke detection, freezing conditions or high duct pressure conditions. Interlock the variable speed drive with respective return/relief fan(s). Activate each fan through the central control panel.
- D. Interlock the unit's outside air and relief air dampers to close and the unit's return air damper(s) to open when the supply fan is off or during unoccupied mode.
- E. Close the chilled water control valve to the cooling coils when the unit's supply fan is off or during unoccupied mode.
- F. Open the heating water control valve to the unit's preheating coils when the unit's supply fan is off or during unoccupied mode.
- G. During occupied mode, unit's outside air dampers open at least to minimum position when the supply fan runs.
- H. Set up the system so that the supply fan speed can also be set and adjusted manually.

3.4 SUPPLY FAN TEMPERATURE CONTROL SEQUENCE: (Existing Controls)

- A. The DDC system shall control the system temperature.
- B. Minimum outside air shall be set so as to maintain a positive pressure in respect to the outside. The economizer control shall override the minimum outside air when outside conditions allow for free cooling. The return air dampers shall track the outside air damper.
- C. A control loop sensing the discharge air temperature will modulate the chilled water valve, economizer dampers or heating water valve to maintain a discharge temperature setpoint of 55°F (adjustable). Where the unit has two discharge ducts, the discharge temperature used to control the related valves and dampers shall be the average temperature in each SA duct extending from the unit.
- D. In heating mode, the control valve related to the units preheating coil or heating coil modulates open through the DDC system in order to maintain the discharge air temperature set point.
- E. On call for cooling, and when the outside air temperature is favorable, operate unit in an economizer cycle by modulating the return air and outside air dampers to maintain a mixed air temperature of 55°F (adj.), optimized for minimum mechanical cooling. Reset the low limit along with the cooling control valve to use outside air for cooling. Once the outside air temperature exceeds 75°F, the outside air damper shall close to minimum position.

- F. If the discharge air temperature setpoint cannot be met by the use of outside air, the chilled water valve shall modulate to provide chilled water to the cooling coil(s). The chilled water return temperature shall be sensed with input into the system controller to ensure that the chilled water is being fully utilized.
- G. In the economizer mode, if the mixed air temperature falls below 55°F (adj.) due to minimum outside air requirements, the heating function previously described is activated in order to maintain 55°F (adj.) setpoint.

3.5 BUILDING STATIC PRESSURE CONTROL SEQUENCE: (Existing Controls)

- A. The return/relief fan shall be controlled by its respective variable frequency drive through the central automation system.
- B. In auto, the return/relief fan cannot run if the related supply fans are all off. In hand or bypass, each return/relief fan will run.
- C. In auto, the speed of each return/relief fan VFD shall track the speed of the respective supply fan VFD through the DDC system.
- D. Existing differential pressure sensors send a signal to the central automation system. Each shall be set to maintain a 0.05" (adj.) positive space pressure related to outside.
- E. The central panel selects the lower of the air handling system's differential pressure sensor signals to control the respective systems relief dampers.
- F. Should the lowest differential pressure control signal from any system rise above set point, the relief dampers related to these systems shall modulate to full open position. On signal decrease the reverse shall occur.

3.6 NIGHT SET BACK CONTROL SEQUENCE: (Existing Controls)

- A. The building DDC system has the air handling units off during unoccupied hours. Should the unoccupied temperature drop to 65°F, the space sensor(s) activates the air handling system's heating functions until the temperature rises to 65°F.

3.7 MINIMUM OUTSIDE AIR CONTROL SEQUENCE: (Existing Controls)

- A. The outside air dampers modulates open to minimum position as specified and as needed to lower the CO₂ and volatile organic concentration levels below set point. The position of the outside air damper is also governed by the amount of makeup air required by the building exhaust fans, whichever requires the greater outside air flow as previously explained in this Control Sequence.

3.8 ROOM/SPACE TEMPERATURE CONTROL SEQUENCES: (Existing and new controls, see drawings for new controls)

- A. VARIABLE VOLUME COOLING WITH REHEAT: Each room VAV box with reheat coil shall be controlled by a DDC controller fed through the central control panel, including a VAV box inlet velocity/temperature sensor and outlet temperature sensor. This will allow for remote monitoring and remote changing of unit parameters.
1. When the room temperature is above the set point of the unit controller as sensed by the space sensor, the VAV box will be open, the heating coil valve will be closed.
 2. As the room temperature rises to set point, the VAV box modulates to its minimum. This minimum shall be fully automatically adjustable and set as called for on the Drawings.
 3. When any room drops below set point, the VAV shall modulate open to occupied minimum as cfm and the heating water valve shall modulate.

END OF SECTION 15950

SECTION 15970 - DIRECT DIGITAL CONTROL SYSTEMS (DDC)

PART I - GENERAL:

1.1 RELATED DOCUMENTS: See Section 15950.

1.2 DESCRIPTION OF WORK:

- A. This work incorporates a confirming checkout of construction work, individual component activation and overall system activation into one work program which shall serve as the transition period from the Contractor's job to Owner's facility.
- B. The Controls Contractor shall be skilled in the operation and manipulation of systems and in the direction of parties involved in the work.
- C. To include all components, materials and installation covered by this section.
- D. To include verifying the function of all existing control components and that the sequences of operation listed here in function properly.
- E. To include all control wiring initiating with power from the distribution panel(s) at line voltage (provide circuit breaker) and extending to transformers, devices, components, etc. which comprise a part of the system.

1.3 QUALITY ASSURANCE: See Section 15950.

- A. This specification wording is based on a Staefa Talon product line. Equivalent control package offerings by Honeywell or Johnson Controls are acceptable.

1.4 SUBMITTALS: See Section 15950.

1.5 DELIVERY, STORAGE AND HANDLING: See Section 15950.

1.6 INSTRUCTION OF OWNER'S PERSONNEL: See Section 15950.

1.7 WARRANTIES: See Section 15950.

1.8 CLEANING AND LUBRICATION: See Section 15950.

1.9 TESTING AND ADJUSTING OF SYSTEM: See Section 15950.

PART II - PRODUCTS

2.1 CONTROL CABINETS: See Section 15950.

- A. Panel mount all controllers and devices other than remote sensors and operators. Provide permanent labels, terminal blocks, etc.

B. POWER SUPPLY:

1. As required furnish complete power supply for all box controllers at appropriate voltage and in adequate capacity. Provide multiple power supply devices as needed, mount near existing. Load power supply units to no more than 70 percent of nameplate capacity.
2. Run all power wiring in conduit, neatly arranged and coordinated with other trades.
3. Group boxes served by each power supply unit in proximity, provide permanent mounted schedule of boxes served by each power supply.

C. COMMUNICATIONS CONDUCTORS:

1. Connect each and every VAV box controller back to the Central Direct Digital master controller with required conductors) shielded cable. (Beldon #18 gauge "Beldfoil 8760 or equivalent). Avoid common conduit with AC voltage or inductive loads. All in accordance with National Electric Code, conductors in conduit (3/4" minimum).

D. CONTROL WIRING:

1. In concealed locations above lay-in ceilings low voltage conductor may be installed without conduit. Low voltage conductor shall be UL listed Article 725 Plenum Cable. Install the cable parallel to building walls.
2. In all other building areas, ie., mechanical rooms, boiler rooms, above "hard" ceilings, within walls, etc., all control wiring shall be installed in conduit per National Electric Code. Installation shall be square with the walls of the buildings.
3. Number and code all wiring.

2.2 MR-VAV-AX BOX CONTROLLER WITH REHEAT COIL (As manufactured by Schneider Electric):

- A. Room space temperature sensing shall be from wall-mounted thermostats. In appropriate areas, thermostats shall have a temperature adjustment with a programmable setpoint and adjustment range. The programmed temperature adjustment range for these thermostats shall be $\pm 2^{\circ}\text{F}$ (initial setting), so adjustment can be made at the sensor. The sensor shall have a thermistor sensor and have occupancy override.
- B. A VAV box-mounted DDC controller shall be provided for control and operation of each VAV box and reheat coil. Sensor shall modulate the box primary air damper between minimum ventilation position and maximum designed airflow and position the reheat coil valve in sequence to maintain the desired space temperature. Heating and cooling setpoints and minimum and maximum CFM shall be individually adjustable from the man-machine interface device (Host computer) or the District offices.

- C. In the unoccupied mode, the night setback temperature shall be 62°F
- D. A velocity sensor installed at the VAV box shall monitor minimum and maximum airflow in real time. Information shall be available through the building control system.
- E. Reheat coil control valve and actuator shall be proportional. Valve and actuator shall be manufactured by Belimo.
- F. Each VAV box DDC controller shall have a 24-volt power connection with all 24 volt control wiring by the ATC contractor. Each VAV box shall have a discharge air temperature sensor on the downstream side of the VAV re-heat coil.
- G. All controllers and sensors must be fully compatible with the existing control system.

2.3 ELECTRONIC ROOM TEMPERATURE SENSOR:

- A. The electronic room temperature sensor shall be TSMN-57011 a resistance-temperature device (RTD) that provides electronic sensing of room temperature at wall locations.
 - 1. One with a thermistor sensor.
 - 2. Contemporary, low-profile packaging.
 - 3. Easy installed base plate and electronic assembly.
 - 4. High-impact cover.
 - 5. Suitable for direct-wall, 2x4 electrical box, 1/4 DIN electrical box, and surface box mounting.

PART III - EXECUTION

3.1 COMPLETE SYSTEM:

- A. Integrate into all controls into the existing control system. Provide all controls and related functions, with all power and communications wiring, with sensors, room thermostats, actuators, valves, etc.
- B. Note that the terminal box controller is to provide a "pressure independent" function for any terminal box provided for this project.
- C. Participate in the checkout and commissioning and shake out of all of the mechanical systems. Provide complete and detailed checkout and testing of all controls and control sequences. Provide thermal rise trend recording and logs during system testing and shake out.

3.2 CONTROL SEQUENCES:

- A. The sequences of control for the DDC system shall be equivalent to those specified for the base bid system with the added benefits of programmable algorithmic control.
- B. Fully describe the sequences in the submittals.

- C. Fully document all work by shop drawing and product bulletin submittal, work from reviewed drawings, maintain record documents during installation.

3.3 SYSTEM ACCEPTANCE:

- A. **GENERAL:** The system installation shall be complete and tested for proper operation prior to acceptance testing for the Owner's authorized representative. A letter shall be submitted to the Engineer requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative, the system will be accepted. The warranty period will start at this time.
- B. **FIELD EQUIPMENT TEST PROCEDURES:** DDC controls panels shall be demonstrated via a functional end to end test. Such that:
 - 1. All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operations verified.
 - 2. All analog input channels shall be verified for proper operation.
 - 3. All digital input channels shall be verified by changing the state of the field device and observing the appropriate change of displaying value.
 - 4. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.
 - 5. Automatic control operation shall be verified by introducing an error into the system and observing the proper corrective system response.
 - 6. Selected time and setpoint schedules shall be verified by changing the schedule and observing the correct response on the controlled outputs.
- C. **WORKSTATION TEST PROCEDURES:** The system workstation test procedures shall be as follows:
 - 1. Communication with each DDC control panel shall be demonstrated.
 - 2. Operator commands will be explained and demonstrated.
 - 3. Control sequences shall be demonstrated for proper operation.
 - 4. All available system reports and logs shall be demonstrated at the system workstation.
 - 5. Correct system start-up and shutdown procedures shall be demonstrated.
 - 6. All controllers shall be demonstrated to operate in a standalone mode.

- D. **AS-BUILT DOCUMENTATION:** After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply "6" complete 11x17 as-built drawing sets, together with AutoCad diskettes to the Owner.
- E. **OPERATION AND MAINTENANCE MANUALS:** Submit two copies of operation and maintenance manuals. Include the following:
1. Manufacturer's catalog data and specifications on sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals, and any miscellaneous components used in the system.
 2. An operator's manual which will include detailed instructions for all operations of the system.
 3. An operator's reference table listing the addresses of all connected input points and output points. Settings shall be shown where applicable.
 4. A programmer's manual which will include all information necessary to perform programming functions.
 5. A language manual which will include a detailed description of the language used and all routines used by the system.
 6. Flow charts of the control software programs utilized in the DDC system.
 7. Flow charts of the custom software programs utilized in the DDC system as approved.
 8. Complete program listing file and parameter listing file for all programs.
 9. A copy of the warranty.
 10. Operating and maintenance cautions and instructions.
 11. Recommended spare parts list.

END OF SECTION 15970

SECTION 15995 - SYSTEM COMMISSIONING, TESTING AND BALANCING

PART I - GENERAL

1.01 GENERAL CONDITIONS:

- A. Work of this section shall be subject to the requirements of the General Conditions of this contract, the General Mechanical Requirements, General Electrical Requirements and other sections where this work shares a responsibility.
- B. System commissioning of the existing mechanical systems shall be the responsibility of the Mechanical Contractor and his subcontractors.
- C. Testing and Balancing shall be the responsibility of the Mechanical Contractor with the full participation of all of the mechanical and electrical trades employed on the project and shall include the participation of an independent testing and balance contractor to coordinate all elements of the work and to perform special technical services outlined herein.

1.02 SYSTEM COMMISSIONING - EXTENT OF WORK:

- A. The work required by this section includes but is not necessarily limited to the following:
 - 1. Commission the existing north air handling system to ensure proper operation of all components and control system.
 - 2. System operations inspection.
- B. The intent of this work is to provide for proper operation of the existing mechanical systems in preparation for system balancing.
- C. Repair, replacement or adjustment of each item shall be performed by the installing contractor.
- D. Involves all new construction and those elements of existing construction which are affected by this project.

1.03 TESTING AND BALANCING - EXTENT OF WORK:

- A. This work incorporates a confirming checkout of construction work, as well as the existing system components, an individual component activation and an overall system verification and adjustment.
- B. The TAB Contractor shall be skilled in the operation and manipulation of systems and in the direction of parties involved in the work.
- C. Conduct and participate in the startup and shakedown of all mechanical systems installed and modified in this contract; test adjust and balance the entire systems to obtain optimum performance at a level which minimizes the required energy input, prepare and submit a complete report of work done and the final system condition obtained, participate in the instruction of Owner's personnel in the proper operation of systems and equipment.
- D. Involves all new construction and those elements of existing construction which are affected by this project, including the entire fan system.

1.04 QUALIFICATIONS OF SYSTEM COMMISSIONING AND TAB TEAM:

- A. Representatives of the General Contractor, Mechanical Contractor, etc., and Electrical Contractor shall be available on a daily basis through the commissioning and adjustment period. These men shall be experienced journeymen with prior experience in system operation and with specific experience on the construction of this project.
- B. Balancing shall be done by an independent firm specializing in this work. A definition of independent shall mean the firm is not associated with any engineering, contracting, or manufacturing firm and derives its income solely from testing, adjusting and balancing mechanical systems. Approved Contractors: Barnett Inc., Payson, Utah; BTC Services.
- C. The balancing work including air and hydronic portions shall be performed by the same firm having total responsibility for the final testing, adjusting and balancing of the entire system. A principal of the firm shall be directly involved in the project.
- D. The independent testing and balancing firm shall furnish all necessary tools, scaffolding and ladders that are required and shall provide all required instruments, take all readings and make all necessary adjustments.
- E. After all tests and adjustments are made a detailed written report shall be prepared and submitted for review, and shall bear the signature of the professional supervising the work. Final acceptance of this project will not be made until a complete and satisfactory report is received. Furnish two copies of the report.

PART II - EXECUTION, SYSTEM COMMISSIONING

2.01 PRE-STARTUP INSPECTION:

- A. The pre-startup inspection of all systems shall provide for verifying that each piece of equipment is properly installed and prepared for startup.
- B. All pertinent items shall be checked, including but not necessarily limited to the following:
 - 1. All systems properly filled.
 - 2. Filters in place and seal provided around edges.
 - 3. Initial lubrication of equipment is complete.
 - 4. Filters and strainers are clean.
 - 5. Control system is in operation.
 - 6. All controls have been connected and verified.
 - 7. All valves, dampers and operators are properly installed and operating.
 - 8. All ductwork is installed and connected.
 - 9. All other items necessary to provide for proper startup.

2.02 FIRST RUN INSPECTION:

- A. Recheck all items outlined in pre-startup inspection to insure proper operation.
- B. Check the following items:
 - 1. Excessive vibration or noise.
 - 2. Loose components.
 - 3. Initial control settings.
 - 4. Motor amperages.
 - 5. Control system is properly calibrated and functioning as required.
- C. Correct all items which are not operating properly.

2.03 SYSTEM OPERATION INSPECTION:

- A. Observe mechanical systems under operating conditions for sufficient time to insure proper operation under varying conditions, such as day-night and heating-cooling.
- B. Periodically check the following items:
 - 1. Strainers and filters.
 - 2. Visual checks of air flow for "best guess" settings for preparation for system air balancing under section applying.
 - 3. Control operation, on-off sequences, system cycling, etc.
 - 4. Visual checks of water flow, seals, packings, safety valves, operation pressures and temperature.
 - 5. Dampers close tightly.
 - 6. Valves close tightly.
 - 7. System leaks.
 - 8. All other items pertaining to the proper operation of the mechanical system whether specifically listed or not.

PART III - EXECUTION - TESTING AND BALANCING

3.01 TOTAL MECHANICAL SYSTEM BALANCE:

- A. The mechanical systems balance involves elements of the work of the General Contractor, the Electrical Contractor, the Mechanical Contractor, the Sheet Metal Contractor and the Controls Contractor. Total system balance requires that all elements be not only individually correct, but also correct as a composite system. Therefore, participation of all parties shall be required in the test and balance procedure.
- B. Prior to beginning work, a written description of the anticipated sequence of action shall be submitted to the Engineer/Owner for review and comment.

- C. The testing and balance specialist shall review the contract drawings during the bid period and shall advise the Engineer of any modifications to the layout which may be needed to facilitate the balance procedure. Modifications will be incorporated into the contract by Addendum during the bidding period.
- D. The test and balance specialist shall visit the project from time to time during the rough installation making a thorough inspection of those items which will affect his subsequent work. He shall advise the Contractor in writing with a copy to the Engineer of any work required by the contract which is not being performed adequately. This is in addition to the regular inspection efforts of the Engineer. Particularly note needed valves, dampers, access doors, thermometers, pressure gauges, belts and drives, diffuser styles, strainers and filters, etc.

3.02 AIR SYSTEMS BALANCE:

- A. Before any adjustments are made, check the systems for such items as dirty filters, duct leakage, filter leakage, damper leakage, equipment vibrations, correct damper operations, etc. Adjust all fan systems, major duct sections, registers, diffusers, etc., to deliver design air quantities within +5%. Individual air outlets, when one of three or more serve a space may have a tolerance of 10 percent from the average. Design static pressure is based on filters approximately 50% loaded with dirt. Pressure drop across filters during balancing shall be simulated to that condition. After balancing is completed check motor amperage with the filters clean.
- B. Adjust supply, exhaust and recirculation air systems towards air quantities shown on drawings. Establish a proper relationship between supply and exhaust. Follow proportional balance procedures outlined by AABC and/or SMACNA for such work.
- C. Distribution system shall be further adjusted to obtain uniform space temperatures free from objectionable drafts and noise within the capabilities of the system.

3.03 HYDRONIC SYSTEMS:

- A. Before any adjustments are made, clean strainers, check temperature control valve operation, check pump rotation, adjust pressure reducing valves, etc.

3.04 CONTROL SYSTEMS: The Testing and Balancing Contractor shall go through the entire control system with the Controls Contractor verifying proper operation of each and every device and the proper function of each system. Certify such effort in the report.

3.05 MISCELLANEOUS:

- A. Measure and set any special conditions such as minimum air quantities; coordinate outside air, return air and relief air damper operation; check and adjust outside and return air intakes so that the system will deliver substantially the same volume on either; make tests and record data as required in "REPORT" below.
- B. All balancing devices, i.e. dampers and valves, shall be clearly marked as to the final balanced position. Plug all test holes, replace access doors and belt guards.
- C. Upon request, based on perceived need, make 24-hour space temperature recordings. Any required rebalance of the system shall be performed without additional cost.

- D. Upon request, a representative of the balancing firm performing the work shall demonstrate fluid flow quantities shown in the report by reading back outlets or terminals selected specifically or at random by the Design Engineer. It is understood that the operating mode of the system shall be the same for read-back as it was during balancing.

3.06 REPORT:

- A. Provide a bound report in four copies containing a general information sheet listing instruments used, method of balancing, altitude correction, and manufacturer's grille, register and diffuser data.
- B. Balancing data sheets shall indicate the required and actual CFM of all supply, return and exhaust outlets or inlets, and be totaled and summarized by systems.
- C. Hydronic balancing data sheets shall list required temperature or pressure differentials used for balancing coils. Sheets shall show in comparison final as-balanced versus design values.
- D. Include a reduced set of contract drawings with outlets marked for easy identification of the signation used in the data sheets.
- E. Note any abnormal or notable conditions not covered in the above.
- F. Keep a daily log of all work performed, with a list of work scheduled for each day and the workers on the job.

END OF SECTION 15995