



**Request for Bid
Materials Lab VAV Box Replacement**

Issued by:
IOWA DEPARTMENT OF TRANSPORTATION
Purchasing Section
Proposal No. **17501**

Letting Date: October 12, 2016

Must be submitted no later than 1:00 PM Central Time
Bid Responses received after this date will be rejected

***For information about this notice, and during this procurement,
interested persons shall contact only:***

Laura Linduski
800 Lincoln Way
Ames, Iowa 50010
Phone: 515-239- 1429
Fax: 515-239-1538
E-Mail: laura.linduski@dot.iowa.gov

**Issued addenda and all other correspondence
will be posted to Iowa DOT's website:**

<http://www.iowadot.gov/purchasing>

Procurement Timetable

The following dates are set forth for informational and planning purposes. The Iowa DOT reserves the right to revise the dates as needed. All times listed are Central Time.

Event/Dates	Section Reference	Date/Time
Issue RFB	cover	9/21/2016
Number of Copies of Bid Responses Required	1	1
<p>Bidders Conference (Pre-Bid)</p> <p><input type="checkbox"/> <i>Box will be checked when attendance is mandatory</i></p> <p>It is recommended that contractors attend a scheduled pre-bid meeting. Interested contractors must notify Laura Linduski by September 28, 2016. Location: Admin Building, Ames Complex, front lobby, 800 Lincoln Way, Ames, IA 50010</p>	2.28	9/29/2016 1:00 P.M.
DOT Response from Bidder's Conference Questions	2.28	10/3/2016
Bidder Questions, Requests for Clarification, & Changes <i>(no later than)</i>	2.2/2.5	10/5/2016
DOT Response to Questions Issued <i>(no later than)</i>	2.2/2.5	10/7/2016
Bid Opening/Proposal Due	2.8/2.9	10/12/2016
Presentations & Demonstrations "Short list" <i>(by invitation only)</i>	2.22/ 5.3	N/A
Announce Successful Bidder Intent to Award* <i>see note below</i>	4.1	10/14/2016
Completion of Contract Negotiations & Execution of the Contract	4.3	10/24/2016
Contract Begin Date	See schedule of prices	10/31/2016
Contract End Date	See schedule of prices	12/30/2016

*Intent to Award - See Section 2.22

It is intended that Bid Responses will be evaluated and a notice of "intent to award" will be issued within thirty (30) days of the bid opening date. Bid Responses prices, terms and conditions must be held firm for a 180-day period from the date of the notice of "intent to award" the contract.



Solicitation Response

		Response Due Date October 12, 2016	Time 1:00 P.M.	Location 800 Lincoln Way, Ames, IA	
Proposal Number 17501	Description Materials Lab VAV Box and Ductwork Replacement				
Contract Begin Date	Contract Completion Date	Bid Bond (N/A) % of submitted bid	Performance Bond (Y/N) Yes	Liquidated Damages If specified	
Purchasing Agent assigned Laura Linduski	E-mail Address Laura.linduski@dot.iowa.gov	Phone 515-239-1429	Fax 515-239-1538		
RESPONDER INFORMATION					
Company Name			Federal Tax ID		
Street Address		City	State	Zip Code	
Contact Name	E-mail Address	Phone	Fax		
Responder agrees to sell goods/services or both at the same prices, terms and conditions to any other Iowa state agency, Regent or Political Subdivision upon request. Please check Yes or No. <input type="checkbox"/> Yes <input type="checkbox"/> No			Responder is an Iowa Targeted Small Business <input type="checkbox"/> Yes <input type="checkbox"/> No		

GENERAL INFORMATION

This solicitation includes the Solicitation Response cover page, Schedule of Prices, Standard Terms and Conditions, Supplemental terms (if any), Specifications, Plans and Drawings, mailing label and all other information needed to prepare and submit a response to the solicitation. Information in the "Solicitation Response" above must be typed or completed in ink, signed, and returned in a flat style envelope along with any other information required in the solicitation prior to the response due date and time. Please use the furnished mailing label, or label the response as "Iowa Department of Transportation, proposal number and response due date on the outside of the return envelope. Responders may personally deliver, mail, or select a carrier that ensures timely delivery. **Faxed or e-mail responses will not be accepted.**

If required, each response must be accompanied by a bid bond in an accepted form, in the percent amount indicated above. Refer to the Standard Terms and Conditions for the accepted forms in which the bid bond requirement may be fulfilled. **Responses without a required bid bond will not be considered for award.** If the intended awarded responder fails to enter into a formal contract within fifteen (15) days after award is made for any reason on their part, the bid bond may be retained by the State.

The entire contents of this solicitation, Addendums, Schedule of Prices, Specifications, Plans and Drawings, Supplemental Terms and Conditions, Standard Terms and Conditions, shall become part of the contract.

We certify that we have not, either directly or indirectly, entered into any agreement or participated in any collusion or otherwise taken any action in restraint of free competition; that no attempt has been made to induce any other person or firm to submit or not to submit a response; that this response has been independently arrived at without collusion with any other responder, competitor, or potential competitor; and that this response has not been knowingly disclosed prior to the opening of responses to any other responder or competitor.

We certify that all materials, equipment goods and/or services proposed meet or exceed the specifications and will be supplied in accordance with the entire contents of this solicitation including delivery schedules. We promise to complete the contract within the contract period, or pay any liquidated damages, if stipulated, for each calendar day as set forth in the solicitation documents.

Signed _____ Date _____

Schedule of Prices

Project Description:

Item No.	Description	Quantity	Unit/Price	Total Bid Amount
1	Vendor to provide and install VAV Boxes and Ductwork for the Materials Lab at Ames Complex per plans and specifications	1 Job	Lump/Sum or applicable	\$ _____

I hereby certify that this Bid Response meets or exceeds the minimum requirements including specifications and addendums.

Authorized
Signature:

Contact Person:

Company:

(Print Name)

Address:

(City) (State) (Zip Code)

Contractor's
Registration No (If applicable): _____

Phone No: _____

Email: _____

Fax No.: _____

I acknowledge receipt of addendums: _____



Iowa Department of Transportation
Standard Terms and Conditions

For

Submission of Quotations, Bids or Proposals

-FORMAL-

Formal is the procurement process required by Iowa law when the estimated, aggregate amount of the purchase equals or exceeds \$50,000.

The entire contents of this solicitation shall become a part of a contract or purchase order. In case of a discrepancy between the contents of the solicitation documents, the following items listed by descending order shall prevail:

- Addendums to the solicitation
- Solicitation
 - Schedule of Prices
 - Specifications
 - Plans and Drawings
- Supplemental Terms and Conditions
- Standard Terms and Conditions

(Example - if a statement in the specifications contradicts a statement in the Standard Terms and Conditions, the statement in the specifications shall apply)

Preparation of Solicitation or Bid Response: All responses must clearly address all aspects of the solicitation. Responses must be typed or completed in ink and submitted on the forms supplied by the Iowa DOT.

Responses must be signed and received prior to the opening date and time indicated on the Solicitation Response page or other specified areas throughout the solicitation document. The Responder's signed Response shall become the official Response to be considered for award.

No email, fax or web link bid Responses will be accepted. Responses must be signed, sealed and delivered in person or by a mail courier that ensures timely delivery.

A. Solicitation

1. **Opening:** The openings of responses are made public and conducted at the Iowa DOT, Ames complex unless otherwise specified. Responses received after the time of the opening will be returned unopened and considered non-compliant.
2. **Communications:** Questions concerning this solicitation should be directed to the purchasing agent listed on the Solicitation Response page. Inquiries can be written, phoned, or faxed. In all cases, written communication will take precedence over verbal communication.
3. **Bid Bond:** If required, the Solicitation Response page will indicate the fixed percent of the bid security based on the amount of the Bidder's bid. A Bid Bond can be supplied in one of the following ways: **(1)** Certified check or credit union certified share draft, cashier's check, or bank draft, drawn on a solvent bank or credit union. Certified checks and certified share drafts shall be drawn and endorsed in the amount indicated. Checks or drafts shall be made payable either to the Iowa Department of Transportation (Iowa DOT) or to the bidder. If payable to the bidder, the check or draft shall be endorsed without qualifications to the Iowa DOT by the bidder or an authorized agent. **(2)** An insurance or surety company may be retained to provide a bond in fulfillment of the Bid Bond requirement. A properly completed and signed copy of the Bid Bond (*Form 131084*) must accompany the bid. **The Iowa DOT's Bid Bond form must be used; no other forms or formats will be accepted.**

4. **Pricing and Discount:** Unit prices shown in the response shall be quoted as the price per unit (e.g., gal., case, each, etc.) as requested in the solicitation. If there is a discrepancy between the unit bid prices, extended price, or total amount of response, the unit prices shall prevail. Unless otherwise indicated, prices shall be firm for the duration of the contract or purchase order. Discounts for early payment are allowed, but not considered in award of the contract.
5. **Acceptance/Rejection:** The Iowa DOT reserves the right to accept or reject any or all responses and to waive irregularities or technicalities, provided such waiver does not substantially change the offer or provide a competitive advantage to any supplier(s) or provider. The Iowa DOT also reserves the right to accept that response which is deemed to be in the best interests of the state. Any unauthorized changes, additions, or conditional response including any ties to another response or any reservations about accepting an award or entering into a contract, may result in rejection of the response. Responses must remain available for award for thirty (30) days from opening date and time.
6. **Results & Disclosure:** Tabulation results will be posted on the Iowa DOT website at www.iowadot.gov/purchasing under the *Bid Award* link referencing the proposal number with an award recommendation indicated. At the conclusion of the selection process, the contents of all received responses will be placed in the public domain and be open to inspection by interested parties, according to state law. Trade secrets or proprietary information that are recognized as such and are protected by law may be withheld if clearly identified as such in the response.
7. **Quality of Goods:** All material shall be new and of first quality. Items which are used, demonstrators, refurbished, obsolete, seconds, or which have been discontinued are unacceptable without prior written approval by the Iowa DOT.
8. **Recycled Content:** The Iowa Code encourages purchase of products and materials with recycled content, including but not limited to paper products, oils, plastic products, compost materials, aggregate, solvents, and rubber products. Recycled items or alternatives must be noted in the Solicitation Response, if known.
9. **Shipping Terms:** Deliveries shall be F.O.B. Destination unless otherwise specified. All deliveries shall be accompanied by a packing slip indicating the Supplier, quantities shipped, and the purchase order number(s). All delivery charges shall be included in the response price and paid by the Supplier. No collect C.O.D. deliveries shall be accepted. When entering into a contract, the Supplier shall notify the freight company that all freight and delivery charges are to be prepaid by the Supplier. Goods delivered to the Iowa DOT Distribution Center at 800 Lincoln Way, Ames, IA shall be received between the hours of 7:00 a.m. and 3:00 p.m. on any day except Saturday, Sunday, or a holiday. For deliveries to other Iowa DOT locations, the Supplier may contact the destination location for available times to deliver as not all Iowa DOT locations have the same business hours. The Iowa DOT will not be liable for any freight claims or unpaid freight bills arising from contract or purchase order issues.

B. Award

The binding agreement (award) may be issued in the form a purchase order or contract or both depending on the requirements and complexity of the agreement.

1. **Method of Award:** Award shall be made to the responsible, responsive Responder whose Quotation, Bid or Proposal meets the requirements of the solicitation and is the most advantageous to the Iowa DOT. An Iowa company or individual will be given preference over an out-of-state company or individual when responses are equal in all aspects and are tied in price. By virtue of statutory authority preference will be given to products and provisions grown and coal produced within the State of Iowa.
2. **Award Protests:** Protests of award recommendations are to be addressed to the Director of Purchasing, and shall be made in accordance with paragraph 761--20.4(6)"e" of the Iowa Administrative Code.
3. **Contracts:** Successful Contractor(s) may be sent either a formal Contract, Notification of Award or Purchase Order as confirmation of acceptance and award. Any of these binding agreements shall be for the term stated in the solicitation or on a purchase order and may be renewed for additional period(s) under the same terms and conditions upon mutual agreement as defined. The successful Contractor may not assign a contract to another party without written authorization from the Iowa DOT Purchasing Section. The Iowa DOT may offer a contract extension to the Contractor when a scheduled target date cannot be met.

4. **Consumer Price Index (CPI-U):** A CPI may be allowed as specified in the terms of the solicitation and at the discretion of the Iowa DOT based on currently posted CPI-U, US City Average, All Items – non seasonally adjusted unless otherwise specified. This applies each of any subsequent renewals, extensions, amendments issued under the contract for the duration of the contract.
5. **Payment Terms:** The Iowa DOT typically pays properly submitted invoices within thirty (30) days of receipt, providing goods and/or services have been successfully delivered, installed or inspected (if required), and accepted. Invoices presented for payment must be only for quantities received by the Iowa DOT and must reference the purchase order number or contract number to be submitted for processing.
6. **Default (Supplier):** Failure of the Supplier to adhere to specified delivery schedules or to promptly replace rejected materials shall render the Supplier liable for all costs in excess of the bid price when alternate procurement is necessary. This shall not be the exclusive remedy and the Iowa DOT reserves the right to pursue other remedies available to it by law or under the terms of the binding agreement.
7. **Default (Contractor):** Failure of a Contractor other than a Supplier to meet any specified project completion deadline shall render the Contractor liable for all costs incurred by the Iowa DOT that were: a) necessary to meet said deadline; or b) necessary to complete said project after said deadline. This shall not be the exclusive remedy and the Iowa DOT reserves the right to pursue other remedies available to it by law or under the terms of the agreement.

C. General

1. **Administrative Rules:** For additional details on the rules governing the actions of the Iowa DOT Purchasing Section, refer to 761 IAC, Chapter 20, Iowa Administrative Code, entitled “Procurement of Equipment, Materials, Supplies and Services”.
2. **Affirmative Action:** The Contractor (and also subcontractor, vendor, service provider or supplier) is prohibited from engaging in discriminatory employment practices forbidden by federal and state law, executive orders and rules of the Iowa Department of Management, pertaining to equal employment opportunity and affirmative action. Contractor may be required to have on file a copy of their affirmative action program, containing goal and time specifications. Contractors doing business with Iowa in excess of \$5,000 annually and employing 50 or more full time employees may be required to file with the Iowa Department of Management a copy of their affirmative action plan. Failure to fulfill these non-discrimination requirements may cause the contract to be canceled and the contractor declared ineligible for future state contracts or subject to other sanctions as provided by law or rule.
3. **Applicable Law:** The contract shall be governed under the laws of the State of Iowa. The contractor shall at all times comply with and observe all federal and state laws, local laws, ordinances, and regulations which are in effect during the period of a contract and which in any manner affect the work or its conduct. Any legal action relating to a contract shall only be commenced in the Story County, Iowa, District Court or the United States District Court for the Southern District of Iowa.
4. **Conflict of Interest:** No state or county official or employee, elective or appointive shall be directly or indirectly interested in any contract issued by the Iowa DOT, see Code of Iowa 314.2.
5. **Debarment and Vendor Suspension:** By submitting a response, the contractor is certifying that it and its principals and/or subcontractors are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by the State of Iowa or any Federal department or agency.
6. **Equal Opportunity:** Responders to the solicitation must be an “Equal Opportunity Employer” as defined in the Civil Rights Act of 1964 and in Iowa Executive Order Number Thirty-four.
7. **Indemnification-Goods:** To the extent the goods are not manufactured in accordance with Iowa DOT’s designs, Supplier shall defend, indemnify and hold harmless Iowa DOT, its assignees, and other users of the goods from and against any claim of infringement of any letters patent, trade names, trademarks, copyright or trade secrets by reason of sale or use of any articles purchased. Iowa DOT shall promptly notify Supplier of any such claim.
8. **Infringement:** Goods shall be delivered free of the rightful claim of any third party by way of infringement. Contractor shall indemnify and save harmless the State of Iowa and the Iowa DOT against all claims for infringement of, and/or royalties claimed under, patents or copyrights on materials and equipment furnished under this bid.

9. **Iowa Open Records Law:** All Solicitation Responses are subject to terms and provisions of Iowa Code Chapter 22 Examination of Public Records (Open Records), specifically 22.7- Confidential Records.
10. **Records Audit:** The contractor agrees that the Auditor of the State of Iowa or any authorized representative of the state, and where federal funds are involved, the Comptroller General of the U.S. Government, shall have access to and the right to examine, audit, excerpt, and transcribe any directly pertinent books, documents, papers, and records of the contractor relating to orders, invoices, or payments of a contract or purchase order.
11. **Targeted Small Businesses:** The Iowa DOT seeks to provide opportunities for women and/or minority small business enterprises. To apply for certification as an Iowa Targeted Small Business, contact the Iowa Department of Inspection and Appeals (515-281-5796). Contractors shall take documented steps to encourage participation from Targeted Small Businesses for the purpose of subcontracting and supplying of goods or services or both.
12. **Taxes:** Prices quoted shall not include state or federal taxes from which the state is exempt. Exemption certificates will be furnished upon request.
13. **Termination:**
 - **Termination Due to Lack of Funds or Change in Law**

The Iowa DOT shall have the right to terminate this Contract without penalty by giving thirty (30) days written notice to the vendor as a result of any of the following:

 - Adequate funds are not appropriated or granted to allow the Iowa DOT to operate as required and to fulfill its obligations under contract.
 - Funds are de-appropriated or not allocated or if funds needed by the Iowa DOT, at the Iowa DOT's sole discretion, are insufficient for any reason.
 - The Iowa DOT's authorization to operate is withdrawn or there is a material alteration in the programs administered by the Iowa DOT.
 - The Iowa DOT's duties are substantially modified.

Following a 30 day written notice, the Iowa DOT may terminate a binding agreement in whole or in part without the payment of any penalty or incurring any further obligation to the Responder. Following termination upon notice, the Responder shall be entitled to compensation upon submission of invoices and proper proof of claim for goods and services under contract up to and including the date of termination.

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Mailing Label

Section 1 Introduction

1.1 Purpose & Overview of the RFB Process

The purpose of this Request for Bid (RFB) is to solicit Bid Responses from responsible, responsive Bidders to provide the goods and/or services identified on the RFB cover page and described further in Section 3 of this RFB. The Iowa DOT intends to award a contract(s) beginning and ending on the dates listed on the Procurement Timetable. The Iowa DOT may renew the contract(s) for up to the number of annual extensions identified on the Procurement Timetable at the sole discretion of the Iowa DOT. Any contract(s) resulting from the RFB shall not be an exclusive contract.

Bidders will be required to submit Bid Responses according to the Procurement Timetable. The Iowa DOT will evaluate all responsible Bidders that submit timely responsive Bid Responses to be considered for award.

OverView

Successful Bidder shall be required to provide all materials, labor, and equipment necessary to replace and install VAV boxes and ductwork for the Materials Lab at the Ames Complex as per the plans and specifications.

1.2 Definitions

The terms used in individual sections of this document are intended to be consistent with those commonly used in the application field in question. When responding, use the terms and acronyms used in this document, and define any terms or conditions that require further clarification.

1.2.1 “Bid Response” means the bid document submitted by the bidder in response to the RFB.

1.2.2 “Contract” or “Resulting Contract” means the contract(s) entered into with the successful Bidder(s) as described in section 4.

1.2.3 “Bidder” means individual, company or entity submitting a response in response to the RFB.

1.2.4 “Iowa DOT” means the Iowa Department of Transportation.

1.2.5 “Participating Agency” or “Participating Agencies” means the all state boards, and commissions, and any political subdivisions as identified on the RFB cover sheet as Participating Agencies and any other agency that decides to utilize the executed contract.

1.2.6 “Procurement Timetable” (*on the page immediately following the RFB cover*) provide timeline, event and date information.

1.2.7 “Purchase Order” means the documentation issued by the State to the Contractor for a purchase of goods and/or services in accordance with the terms and conditions of the Contract. It may include an identification of the items to be purchased, the delivery date and location, the address where the supplier should submit the invoices, and any other requirements deemed necessary by the State. Any preprinted contract terms and conditions included on Bidder’s forms or invoices shall be null and void.

1.2.8 “Responsible Bidder” means a bidder that has the capability in all respects to perform the requirements of the Bid Proposal specifications. In determining

whether a Bidder is a responsible, responsive Bidder, the Iowa DOT may consider various factors including, but not limited to, the Bidder's competence and qualifications to provide the goods or services requested, the Bidder's integrity and reliability, the past performance of the Bidder relative to the quality of the goods or services offered by the Bidder, the proposed terms of delivery, and the best interest of the Iowa DOT and Participating Agencies.

1.2.9 "RFB" means Request for Bid and any attachments, exhibits, schedules or addenda hereto. A written response by a Bidder shall be considered a bid and referred to as a Bid Response.

1.2.10 "State" means the Iowa DOT, State of Iowa, and Participating Agencies identified on the title page and all state agencies, boards, and commissions, and any political subdivisions making purchases off of the resulting Contract as permitted by this RFB.

1.2.11 "Subcontractor" Includes every person furnishing material, equipment or performing labor as a sublet of any part of contract.

1.3 General

1.3.1 Owner:

The Owner of these projects is the Iowa Department of Transportation, 800 Lincoln Way, Ames, Iowa 50010.

**Ames Materials Lab/Ames Complex
800 Lincoln Way
Ames, IA 50010**

1.4 Bidding Documents

1.4.1 Addenda

- Addenda, if issued, will be posted to the Iowa DOT's website. All addendums must be acknowledged by bidders and included in the Bid Response.
- All addenda so issued shall become part of the contract documents.

1.4.2 Withdrawal Period

Prime Contractors, subcontractors and material suppliers on these projects agree to guarantee their proposal costs and work to be performed for a period of thirty (30) days after the date of receipt of bids.

Section 2 Administrative Information

2.1 Issuing Agent

The Issuing Agent, identified on the cover page is the sole point of contact regarding the RFB from the date of issuance until the notice of intent to award is issued (selection of the successful contractor).

2.2 Restriction on Communication

From the issue date of this RFB until the notice of intent to award is issued (announcement of the successful bidder), bidders may contact only the Issuing Agent.

The Issuing Agent will respond only to questions regarding the procurement process. Questions related to the interpretation of this RFB must be submitted in writing to the Issuing Officer by the deadline found in the Procurement Timetable listed immediately after the cover sheet. Verbal questions related to the interpretation of this RFB will not be accepted. Questions related to the interpretation of this RFB must be submitted as provided in section 2.5. Contractors may be disqualified if they contact any state employee other than the Issuing Agent. *Exception: Contractors may contact the State Targeted Small Business Office on issues related to the preference for Targeted Small Businesses.*

In NO CASE shall verbal communication override written communications. Only written communications are binding on the State.

The Iowa DOT assumes no responsibility for representations concerning conditions made by its officers or employees prior to the execution of a contract, unless such representations are specifically incorporated into this RFB. Verbal discussions pertaining to modifications or clarifications of this RFB shall not be considered part of the RFB unless confirmed in writing. All such requests for clarification shall be submitted in writing. Any information provided by the Contractor verbally shall not be considered part of that Contractor's proposal. Only written communications from the Contractor and received by the Department shall be accepted.

With the exception of the written Bid Response which must be submitted by Contractors in accordance with Section 2 herein, communications between the Issuing Agent and Contractors may be conducted by regular prepaid US mail, courier service, e-mail or facsimile transmission.

2.3 Downloading the RFB from the Internet

All correspondence for this Bid Proposal will be posted on the Iowa DOT's website at www.iowadot.gov/purchasing/lettingschedule. **Bidders are required** to visit the Iowa DOT's home page periodically for any and all addendums or other pertinent information regarding this bid opportunity.

2.4 Procurement Timetable

The dates listed in the Procurement Timetable (on the page immediately following the RFB cover) are set forth for informational and planning purposes; however, the Iowa DOT reserves the right to change the dates. If a change is made to any of the deadlines for Contractor submission, the Iowa DOT will issue an addendum to the RFB. All times listed are Central Times.

2.5 Questions, Requests for Clarification, and Suggested Changes

Contractors are invited to submit written questions and requests for clarifications regarding the RFB during the time indicated in the Procurement Timetable. Contractors may also submit suggestions for changes to the requirements of this RFB. The questions, requests for clarifications or suggestions must be in writing and received by the Issuing Agent on or before the deadline stated in the Procurement Timetable. Oral questions will not be permitted. If the questions, requests for clarifications, or suggestions pertain to a specific section of the RFB must be referenced.

Written responses to questions, requests for clarifications or suggestions will be posted on or before the deadline stated in the Procurement Timetable and posted on the Iowa DOT's website (see Section 2.3) If the Iowa DOT decides to adopt a suggestion, the Iowa DOT will issue an addendum to the RFB.

The Iowa DOT assumes no responsibility for verbal representations made by its officers or employees unless such representations are confirmed in writing and incorporated into the RFB.

Each bidder must inform themselves fully of the conditions relating to the proposal. Failure to do so will not relieve a successful bidder of their obligation to furnish all services required to carry out the provisions of his contract. Insofar, as possible, the Contractor, in carrying out the work, must employ such methods or means as will not cause any interruption of, or interference with the work of any other contractor.

If a bidder discovers any significant ambiguity, error, conflict, discrepancy, omission, or other deficiency in this RFB, the bidder should immediately notify the Issuing Agent in writing of such error and request modification or clarification of the RFB document.

2.6 Revisions to Contractor Bid Response

Contractors who submit Bid Proposals in advance of the bid opening date may withdraw, modify, and resubmit Bid Proposals at any time until the bid opening date and time. Contractors must notify the Issuing Agent in writing if they wish to withdraw their Bid Response. A Contractor shall not withdraw its Bid Response or its prices prior to the end of the one hundred and eighty (180) day period immediately following the notice of intent to award a contract.

2.7 Submission of Bid Responses

The Iowa DOT must receive Bid Responses addressed to the Department of Transportation, Purchasing Section, 800 Lincoln Way, Ames, Iowa 50010 before the deadline stated in the Procurement Timetable. **This is a mandatory requirement and will not be waived by the Iowa DOT.** Any Bid Response received after this deadline will be rejected and returned unopened to the contractor.

Contractors mailing Bid Responses must allow ample mail delivery time to ensure receipt by the Iowa DOT on or before the due date. Postmarking by the due date will not substitute for actual receipt of the Bid Response.

Electronic mail and faxed Bid Responses will not be accepted.

Contractors must furnish all information necessary to evaluate the Bid Response. Bid Responses that fail to meet the mandatory requirements of the RFB will be disqualified. Verbal information provided by the Contractor shall not be considered part of the Contractor's Bid Response.

2.8 Bid Response Opening

The Iowa DOT will open Bid Responses on the date and time stated in the Procurement Timetable. Bid Responses will remain confidential until a bid tabulation has been posted on the Iowa DOT's website for all bidders to view the results in the form of "Intent to Award". (See Iowa Code Section 72.3.)

The names of the Contractors who submit compliant Bid Responses within the time frame permitted will be available for public review after the contract has been awarded.

2.9 Costs of Preparing the Bid Response

The costs of preparation and delivery of a Bid Response are solely the responsibility of the Contractor.

No payments shall be made by the State to cover costs incurred by any Contractor in the preparation of or the submission of this RFB or any other associated costs.

2.10 Reasonable Accommodations

Upon request, the Iowa DOT will provide reasonable accommodations, including the provision of informational material in an alternative format, for individuals with disabilities. If accommodations are required at time of a bid opening, contact the Issuing Agent designated on the cover page.

2.11 Rejection of Bid Responses

The Iowa DOT reserves the right to reject any or all Bid Responses, in whole or in part, received in response to this RFB at any time prior to the execution of a written contract. Issuance of this RFB in no way constitutes a commitment by the Iowa DOT to award a contract. This RFB is designed to provide Contractors with the information necessary to prepare a competitive Bid Response. This RFB process is for the Iowa DOT benefit and is intended to provide the Iowa DOT with competitive information to assist in the selection of a Contractor to provide services.

It is not intended to be comprehensive and each Contractor is responsible for determining all factors necessary for submission of a comprehensive Bid Response.

The Iowa DOT reserves the right to negotiate the terms of the contract, including the award amount, with the awarded Contractor prior to entering into a contract. If contract negotiations cannot be concluded successfully, the Iowa DOT reserves the right to negotiate a contract with the next lowest Bidder.

2.12 Disqualification

The Iowa DOT may reject outright and shall not evaluate proposals for any one of the following reasons:

2.12.1 The Contractor states that a requirement of the RFB cannot be met.

2.12.2 The Contractor's Bid Response materially changes a requirement of the RFB or the Bid Response is not compliant with the requirements of the RFB.

2.12.3 The Contractor's response limits the rights of the Iowa DOT.

2.12.4 The Contractor fails to include a *Bid Bond*, also or bid security, *if required*. See Bid Response cover page and **Section 2.31**.

2.12.5 The Contractor fails to include any signature, certification, authorization, stipulation, disclosure or guarantee (if required).

2.12.6 The Contractor presents the information requested by this RFB in a format inconsistent with the instructions of the RFB or otherwise fails to comply with the requirements of this RFB.

2.12.7 The Contractor initiates unauthorized contact regarding the RFB with state employees.

2.12.8 The Contractor provides misleading or inaccurate responses.

2.12.9 The Contractor fails to attend the mandatory Contractors Conference or Pre-Bid meeting.

2.12.10 The Contractor's Bid Response is materially unbalanced.

2.12.11 There is insufficient evidence (including evidence submitted by the Contractor and evidence obtained by the Iowa DOT from other sources) to satisfy the Iowa DOT that the Contractor is a "Responsible Contractor".

2.12.12 The Contractor alters the Bid Proposal language in any way.

2.13 Nonmaterial and Material Variances

The Iowa DOT reserves the right to waive or permit cure of nonmaterial variances in the Bidder's Bid Response if, in the judgment of the Iowa DOT, it is in the Iowa DOT best interest to do so. Nonmaterial variances include minor informalities that do not affect responsiveness; that are merely a matter of form or format; that do not change the relative standing or otherwise prejudice other Contractors; that do not change the meaning or scope of the RFB; or that do not reflect a material change in the services. In the event the Iowa DOT waives or permits cure of nonmaterial variances, such waiver or cure will not modify the RFB requirements or excuse the Contractor from full compliance with RFB specifications or other contract requirements if the Contractor is awarded the contract. The determination of materiality is in the sole discretion of the Iowa DOT.

2.14 Reference Checks

The Iowa DOT reserves the right to contact any reference to assist in the evaluation of the Bid Response, to verify information contained in the Bid Response and to discuss the Contractor's qualifications and the qualifications of any subcontractor identified in the bidders Bid Response.

2.15 Information From Other Sources

The Iowa DOT reserves the right to obtain and consider information from other sources concerning a Contractor, such as the Contractor's capability and performance under other contracts, the qualifications of any subcontractor identified in the Contractor's Bid Response, specifically, the Contractor's financial stability, past or pending litigation, and publicly available information.

2.16 Verification of Bid Response Contents

The content of a Bid Response submitted by a Contractor is subject to verification. Misleading or inaccurate responses shall result in disqualification and rejection of the Bid Response.

2.17 Criminal History and Background Investigation

The Contractor hereby explicitly authorizes the Iowa DOT to conduct criminal history and/or other background investigation(s) of the Contractor, its officers, directors, shareholders, partners and managerial and supervisory personnel retained by the Contractor for the performance of the contract.

- 2.18 Bid Response Clarification Process** The Iowa DOT reserves the right to contact a Contractor after the submission of Bid Response for the purpose of clarification to ensure mutual understanding.

This contact may include written questions, interviews, site visits, a review of past performance if the Contractor has provided goods or services to the Iowa DOT or any other political subdivision wherever located, or requests for corrective pages in the Contractor's Bid Response. The Iowa DOT will not consider information received if the information materially alters the content of this Bid Proposal or alters the type of goods and services the Contractor is offering to the Iowa DOT. An individual authorized to legally bind the Contractor shall sign responses to any request for clarification. Responses shall be submitted to the Iowa DOT within the time specified in the Iowa DOT request. Failure to comply with requests for additional information may result in rejection of the Bid Response as non-compliant.

2.19 Disposition of Bid Responses

At the conclusion of the selection process, the contents of all Bid Responses will be in the public domain and be open to inspection by interested parties except for information for which Contractor properly requests confidential treatment or is subject to exceptions provided in Iowa Code Chapter 22 or other applicable law.

2.20 Public Records and Requests for Confidential Treatment

The Iowa DOT may treat all information submitted by a Contractor as public information following the conclusion of the Intent to Award. Iowa DOT release of information is governed by Iowa Code chapter 22. Contractors are encouraged to familiarize themselves with chapter 22 before submitting a Bid Response. The Iowa DOT will copy and produce public records as required to comply with the public records laws.

2.21 Release of Claims

By submitting a Bid Response, the Contractor agrees that it will not bring any claim or cause of action against the Iowa DOT based on any misunderstanding concerning the information provided herein or concerning the Iowa DOT failure, negligent or otherwise, to provide the Contractor with pertinent information as intended by this RFB.

2.22 Award Notice and Acceptance Period

Notice of intent to award will be posted on the Iowa DOT's website at www.iowadot.gov/purchasing/bidaward. Final negotiation and execution of the contract(s) shall be completed no later than thirty (30) days from the date of the Notice of Intent to Award or such other time as designated by the Iowa DOT.

If the successful Contractor fails to negotiate and deliver an executed contract by that date, the Iowa DOT in its sole discretion may cancel the award and redirect the contract to the next lowest bidder meeting the specifications.

2.23 No Contract Rights until Execution

The full execution of a written contract shall constitute the making of a contract for services and no Contractor shall acquire any legal or equitable rights relative to the contract services until the contract has been fully executed by the successful Contractor and the Iowa DOT.

2.24 Restrictions on Gifts and Activities

Iowa Code Chapter 68B restricts gifts which may be given or received by state employees and requires certain individuals to disclose information concerning their activities with state government. Contractors are responsible to determine the applicability of this Chapter to their activities and to comply with the requirements. In addition, pursuant to Iowa Code section 722.1, it is a felony offense to bribe or attempt to bribe a public official.

The laws of Iowa provide that it is a felony to offer, promise, or give anything of value or benefit to a state employee with the intent to influence that employee's acts, opinion, judgment or exercise of discretion with respect to that employee's duties. Evidence of violations of this statute will be submitted to the proper prosecuting attorney.

2.25 No Minimum Guaranteed

The Iowa DOT anticipates that the selected Contractor will provide services as requested by the Iowa DOT. The Iowa DOT will not guarantee any minimum compensation will be paid to the Contractor or any minimum usage of the Contractor's services.

2.26 Conflicts Between Terms

The Iowa DOT reserves the right to accept or reject any exception taken by the Contractor to the terms and conditions contained in this RFB. Should the Contractor take exception to the terms and conditions required by the Iowa DOT, the Contractor's exceptions may be rejected and the entire proposal declared nonresponsive. The Iowa DOT may elect to negotiate with the Contractor regarding contract terms that do not materially alter the substantive requirements of the request for proposals or the contents of the Contractor's Bid Response.

2.27 News Releases

No news releases or other materials pertaining to this procurement, or any part of this proposal, will be made available to the media or the public, the Contractor's clients or potential clients without the prior written approval of the Iowa DOT.

2.28 Pre-Bid Conference

If the Procurement Timetable indicates a Contractor's Pre-Bid Conference will be held in conjunction with this RFB, it will be held at the date, time, and location listed on the Procurement Timetable immediately following the cover page. If Attendance at the Contractor's Pre-Bid Conference is a mandatory requirement to submit a Bid Response, it will be indicated on the Procurement Timetable. The purpose of the Pre-Bid conference is to discuss with prospective Contractors the work to be performed and allow prospective Contractors an opportunity to ask questions regarding the RFB. Verbal discussions at the Pre-Bid conference shall not be considered part of the RFB unless confirmed in writing by the Iowa DOT and incorporated into this RFB. The conference may be recorded. Questions asked at the conference that cannot be adequately answered during the conference may be deferred.

A copy of the questions and answers will be posted on the DOT website for viewing.

In an effort to seek competitive bids the DOT reserves the right to schedule a second pre-bid meeting in the event only one or no vendors are in attendance at the scheduled mandatory pre-bid. The Potential bidder in attendance at the scheduled pre-bid will not be required, but is welcome to attend the second pre-bid if they choose.

2.29 Contractors Responsibilities

2.29.1 Codes, Laws and Regulations

The laws of the State of Iowa in relation to and pertaining to public improvements shall apply to these projects. All construction, materials and methods shall comply with the State and Local Building Codes and with Local Ordinances, except where plans and specifications establish a higher standard.

2.29.2 Licenses, Permits and Inspections

The Bidders shall comply with all codes, laws, ordinances, rules and regulations of any public authority having jurisdiction that bears on the performance of its work. Bidders shall pay for all licenses, permits and inspection fees required for its work. Bidders must furnish copies of all approved inspection certificates and approvals from authorities having jurisdiction in a timely fashion upon completion of the work.

2.30 Consideration of Bids

2.30.1 Rejection of Bids

The Iowa DOT reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Iowa DOT that such bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein.

Conditional bids will not be accepted.

2.30.2 Qualification of Bidder

The Iowa DOT may make such investigations as they deem necessary to determine the ability of the Bidder to perform the required work, and the bidder shall furnish to the Iowa DOT all such information and data for this purpose as the Iowa DOT may request.

2.31 Bonds

2.31.1 Bid Bond

Bid Bond's must be submitted on Iowa DOT Form No. 131084 (Appendix B) or the bid will be rejected.

The Bid Bond from the qualified responsive Bidder will be retained until an executed contract is in place and the required bonds and Insurance Certificates are in the possession of the Iowa DOT after which the bid security will promptly be returned.

2.31.2 Performance and Payment Bond(if required)

The Solicitation Response page will indicate the fixed percent of the bid security required based on the amount of the Bidder's bid. See also Standard Terms and Conditions Section A-3.

It is the responsibility of the Contractor to notify the surety company of the required amount of the performance bond. The performance bond is based on the percentage of the contractors total bid response.

If the contracted amount is \$25,000 or more, the successful Bidder shall furnish a performance bond covering the faithful performance of 100% of the Contract and the payment of all obligations arising thereunder.

One copy of the bond shall be submitted on Iowa Department of Transportation **Form 131070**. All items must be properly filled in, including Bidder's signature.

A Resident Commission Agent or attorney-in-fact must file a copy of the power of attorney.

2.31.3 Power of Attorney

Attorney-in-fact who signs the Bid Bond and/or Performance Bond must file with each bond a certified and effectively dated copy of the Power of Attorney.

2.32 Labor Regulations

All Bidders, before entering into a contract with the Department, must be registered with the Division of Labor in the Iowa Department of Workforce Development (515-281-3606) according to chapter 91C, Code of Iowa 2015. This pertains to contractor's who engage in the business of construction.

Section 3 General Requirements

3.1 Scope of Work

Successful Bidder shall be required to provide all materials, labor, and equipment necessary for the replacement of VAV Boxes and Pipes in the Materials Lab as per the plans and specifications.

Work to include:

- VERIFY SIZE AND LOCATION OF EXISTING PIPING, DUCTWORK AND EQUIPMENT AS IT RELATES TO NEW WORK.
- MECHANICAL CONTRACTOR SHALL COORDINATE ALL PIPING AND DUCTWORK WITH ALL DUCTWORK AND OTHER TRADES PRIOR TO COMMENCEMENT OF WORK. COORDINATE CONTROLS INSTALLATION WITH SCOTT UNDERWOOD OF JOHNSON CONTROLS, INC. AT (515) 203-3658.
- FURNISH AND INSTALL MECHANICAL PRODUCTS IN COMPLIANCE WITH LOCAL BUILDING CODES AND THE AUTHORITY HAVING JURISDICTION, AND IN ACCORDANCE WITH GENERALLY ACCEPTED INDUSTRY STANDARDS AND PRACTICES AND MANUFACTURER'S RECOMMENDATIONS.
- REMODEL WORK TO BE PERFORMED DURING NORMAL BUSINESS HOURS.
- Any and all shut downs should be coordinated with the owner
- Contractor shall field verify prior to submitting bid
- Warranty period of one (1) year for parts and labor
- Start date: October 31, 2016 Completion date: December 30, 2016
- See Attached specifications and plans.
- All work to be coordinated with Brett Hambly, 515-239-1275 or Ashley Smelser 515-239-1270.

3.2 Adoption of General Conditions

3.2.1 The General Requirements of this Contract shall include the "General Conditions", "Plans and Specifications" and any and all requirements of this RFB, as herein stated.

3.2.2 "THE GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION", A.I.A. FORM #A-201, LATEST EDITION AND A.I.A. DOCUMENT, "INSTRUCTIONS TO BIDDERS", FORM #A-701, LATEST EDITION, SHALL BE INCLUDED, AS MODIFIED IN THE "SUPPLEMENTARY INSTRUCTIONS TO BIDDERS" AND "SUPPLEMENTARY GENERAL CONDITIONS", AND BOUND WITH THE STANDARD FORM OF AGREEMENT BETWEEN THE CONTRACTOR AND OWNER", A.I.A. FORM #101, LATEST EDITION, AS A PART OF THIS CONTRACT SPECIFICATION.

3.2.3 All bidder information and conditions, bid check lists and similar documents included in the specifications issued by the Iowa DOT, Ames, Iowa are hereby made a part of the General Conditions.

3.3 Contractor Response

3.3.1 Guidelines

- Contractors shall comply with Iowa Occupational Safety and Health Standards as found in 29 CFR Parts 1910 and 1926. Of particular importance are those standards referring to the use of personal protective equipment (PPE), fall protection and ventilation.
- Contractor may be required to make available to the Iowa DOT all Safety Data Sheets (SDS) for all products provided at time the apparent low bidder has been determined. SDS shall be sent to the Issuing Agent (when applicable) prior to issuance of the contract.

3.3.2 Guarantee

The Contractor shall guarantee all work executed under this contract, both as the workmanship and materials, for a period of twelve (12) months after the substantial completion date. Neither the final payment nor any provision of the contract documents shall relieve the Contractor of responsibility for faulty materials or workmanship. The Contractor shall remedy any defect thereto and pay for any damage to other work resulting therefrom, which shall appear within a period of one (1) year from the date of the final acceptance. With one month remaining in the guarantee period, the Contractor shall notify the Iowa DOT and set up a complete walk-through inspection.

- All materials, items of equipment, and workmanship furnished under this division of the specifications shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, or workmanship which may develop, shall be made good, forthwith.
- The Guarantee shall include, but not be limited to the following elements and services:
 - a. Repair or replace defective materials, equipment, workmanship and installation that develops within the guarantee period, promptly and to Iowa DOT's satisfaction and correct damage caused in making necessary repairs and replacements, including all other damage done to areas, materials, and other systems resulting from the failure or defect, under guarantee by and at the expense of the Contractor.
 - b. Replace material or equipment that requires excessive service during guarantee period, as defined and as directed by the Iowa DOT.
 - c. Make all service calls, replacements, repairs and adjustments during the guarantee period without cost to the Iowa DOT.

3.3.3 Workmanship

Work shall be performed in best, most workmanlike manner by mechanics, Contractor personnel. Installation shall be made by the manufacturer or their authorized installer where specified. Unsatisfactory work shall be replaced at Contractor's expense.

3.3.4 Shop Drawings and Samples

Shop drawings, specification data, and samples shall be submitted to the Iowa DOT for approval and/or selection prior to the placing of orders for any equipment and materials.

- Shop Drawings: Submit details of materials, systems and equipment to the Iowa DOT for review. The Contractor shall provide three **(3)** copies of each shop drawing for all systems and equipment as indicated in each Division of the specifications: (Note: Submission of Shop Drawings not in binders, but in loose sheet form, may be considered cause for rejection with resubmission in proper form required).
- Product Data: Submit manufacturer's product data to the Iowa DOT for approval, consisting of complete specifications, test report data, installation instructions, and other pertinent technical data required to complete product.
 - a. Intent of Shop Drawings and Product Data review is to check for capacity, rating and certain construction features. Ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction, and for coordination of work of this and other Sections.
 - b. Perform work in accordance with submittals marked "No Exception Taken" to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports, access, service and errors, nor for deviations from requirements of Contract Documents. Requirements of Contract Documents are not limited, waived, nor superseded by Shop Drawing Review.
 - c. Submittals of various systems shall indicate equipment supplier used and that all equipment of particular system is being furnished by same supplier. Supplier shall be qualified to supervise installation, connection and testing of system and have competent maintenance service for respective systems.
 - d. Shop Drawings and samples will be reviewed with reasonable promptness and will be stamped indicating appropriate action as follows:
 - 1) **"No Exception Taken"** means that fabrication, manufacture, or construction may proceed providing submittal complies with Contract Documents.
 - 2) **"Make Corrections Noted"** means that fabrication, manufacture, or construction may proceed providing submittal complies with Engineer's notation and Contract Documents. If, for any reason, notations cannot be complied with, resubmit as described for submittals stamped **"Reject"**.

- 3) **"Revise and Resubmit"** means submittal information is incomplete or ambiguous and therefore clarification or additional information is required to ascertain compliance with the contract documents, and that fabrication, manufacture or construction shall not proceed. Provide additional data required by the contract documents and resubmit.
- 4) **"Reject"** means that submittal does not comply with Contract Documents and that fabrication, manufacture, or construction shall not proceed. Resubmit in accordance with requirements of Contract Documents.

3.3.5 Use of Premises

- All Contractors shall confine all apparatus, storage of materials and construction to areas as directed by the Iowa DOT and shall not encumber the premises with materials.
- Notwithstanding any approvals or instructions which must be obtained by the Contractors from the Iowa DOT in connection with use of premises, the responsibility for the safe working conditions at the site shall remain that of the Contractors.

3.3.6 Cutting and Patching

Similarly, each Contractor shall perform all necessary patching that result from cutting of holes. The Prime Contractor shall resolve any conflict between trades, and it will be the Contractor's responsibility to see all patches are made. Any and all through-wall penetration requiring structural modifications and or structural members shall be provided by the Prime Contractor.

3.3.7 Clean-Up

Throughout the period of construction, the Contractor shall clean up all work and yard areas and keep the area reasonably free of debris, etc., as required for proper protection of the work. Prior to final acceptance, the Contractor shall remove all debris, tools and equipment from the project site.

3.3.8 Inspection and Supervision

- All work shall be according to the approved design and shall be under the direct supervision of the Iowa DOT.
- Periodic site inspections will be carried on by the Iowa DOT with the Contractor to ensure coordination of the project.
- The Iowa DOT will provide a list of items requiring inspection prior to or during installation. The Contractor is to give the Iowa DOT notice no less than 24 hours in advance of installation.
- The Iowa DOT contact after the contract award shall be determined.

3.3.9 Contractors Construction Schedule

The Successful Bidder will, at the pre-construction meeting, submit a detailed construction schedule including dates of commencement and completion on each phase of the proposed construction. Upon acceptance of the schedule, the Contractor will be expected to adhere to these dates as proposed.

3.3.10 Verifying Work of Other Contractors

- When a Contractor's work depends on proper execution of work by other contractors, such Contractor shall promptly report to the Iowa DOT project lead any defects in such work and/or discrepancies between executed work plans, drawings or specifications.
- Contractors shall employ such methods and means in carrying out work as will not cause interruption or interference with any other Contractor. General Contractors shall give other Contractors sufficient notice to permit installation of sleeves, piping, conduit, and other items, prior to placing concrete or laying masonry. Any Contractor failing to comply with above shall be responsible for expense caused by such failure.

3.4 Sub-Contractors

- Specific attention shall be given by the Contractor to Article 5 of the A.I.A. Document A-201, "The General Conditions of the Contract for Construction".
- The Successful Bidder for the project shall furnish the Iowa DOT with a complete list of subcontractors, schedule of values, and major material suppliers at the pre-construction meeting.
- The Iowa DOT shall approve and maintain the list of subcontractors and major suppliers and issue a general approval of same after official award of the contract, subject to the specific requirements of the Plans, Specifications and the "General Conditions of the Contract, and of these supplementary Conditions," "Special Provisions," and elsewhere with contract documents, as applicable. Deviations from the list of subcontractors and material suppliers shall be made only with the specific approval of, or at the request of the Iowa DOT.

3.5 Protection of Persons and Property

3.5.1 Safety and Health Regulations

The Contractor, serving in the role of the employer for the project, shall exercise at all times the protection of all persons and property. Contractor shall comply with all requirements of the Occupational Safety and Health Act of 1970, Iowa Bureau of Labor and all applicable state and municipal laws, as well as building and construction codes. It is the Contractor's responsibility to enforce all regulations that apply to these projects.

3.5.2 Protection of Site

The Contractor shall furnish all permanent and temporary guards, signs, fencing, shoring, and underpinning and other protection necessary in the performance of the contract and for the necessary protection of all public and private property and shall be responsible for any damage caused by failure to comply with this requirement.

- After building operations are completed, the Contractor shall replace or satisfactorily repair all damaged walks or pavements which shall have become damaged due to operations of these projects.
- The Contractor shall take care of all underground pipes, conduits, etc., encountered in the excavations, and protect same from damage until such time as they can be permanently disposed of.

- The Contractor shall continuously maintain adequate protection of all work from damage and shall protect the Owner's property and adjacent property from damage arising in connection with this contract.

3.6 Miscellaneous Provisions

3.6.1 Iowa State Building Code

- All construction under this section shall conform to the requirements of the Iowa State Building Code. The provisions of the Iowa State Building Code will be strictly adhered to, and will take precedence over any local Governmental Body Regulations. Work not regulated by the Iowa State Building Code shall be performed in accordance with local Governmental Body Regulations.
- All construction shall conform to the Standard Specifications for Highway and Bridge Construction, Series 2012 where applicable.

3.6.2 Discriminatory Practices

- All Contractors or subcontractors working under the terms of these projects are prohibited from engaging in discriminatory employment practices as forbidden by the Iowa Civil Rights Act of 1965. These provisions shall be fully enforced, as directed through Executive Order Number 34 dated July 22, 1988. Any breach of the provisions contained in the Iowa Civil Rights Acts of 1965 shall be regarded as a material breach of contract.
- Bidder agrees that if awarded a contract to construct and/or remodel any portion of the project described in these Specifications, neither the Contractor nor any subcontractors will engage in any discriminatory employment practices based on race, color, creed, religion of natural origin and that they will in all contracts comply with all statutes of the State of Iowa against discrimination. Failure to do so could be deemed a material breach of contract.

3.7.1 Pre- bid / Site Visit

X

Non- Required Pre- bid meeting with site visit. This is not a mandatory meeting but is highly recommended that prospective bidders attend the following scheduled meeting where DOT staff will be available. To address any questions or concerns regarding the project.

Pre-bid Date: 9/29/2016 Time: 1:00 P.M.

Location: Ames Complex, Administration Building, front lobby, 800 Lincoln Way, Ames, IA 50010

Contractors are to pre-register by 9/28/2016 with Laura Linduski if interested in attending the pre-bid/site visit.

(In cases where DOT staff have to travel it is acceptable to ask that interested bidders contact the purchasing agent by a certain date and time to avoid traveling and having nobody attend.)

- No considerations or revision in the contract price or scope of the project will be considered by the Iowa DOT for any item which could have been revealed by a thorough on-site inspection and examination or pre- bid meeting.

3.7.2 Conditions of Work

Bidders must inform themselves fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve successful bidders of their obligation to furnish all material and labor necessary to carry out the provisions of this contract. Insofar as possible, the Contractor, in carrying out the work, must employ such methods or means as will not cause any interruption of, or interference with the work of any other Contractor.

3.7.3 Obligation

At the time of the bid opening, each bidder will be presumed to have read and become thoroughly familiar with the drawings, specifications, and other contract documents, including all addenda.

Bidders are responsible for the proper submission of bids. Omissions by a bidder to examine a form, instrument, or document shall in no way relieve that bidder from any obligations in respect to their bid.

3.8 Bid Proposal Documents

3.8.1 Plans and Specifications

Electronic Plans and specifications are available on the Iowa DOT's website, www.iowadot.gov/purchasing. The Bidder is responsible for all copies of plans and specifications necessary for the execution of the work.

In the event of a conflict between the specifications and the drawings, the specifications shall take precedence.

3.8.2 Materials and Equipment

Manufacturers and products, in addition to those specifically listed, may be acceptable when it is proven to the satisfaction of the Iowa DOT that:

- A. The level of quality proposed is equal to or better than that of the referenced manufacturer/Bidder's quality.
- B. The technical characteristics of the proposed product meet or exceed the requirements of the drawings and specifications.
- C. The use of the materials or equipment does not require major revisions of the drawings and specifications to permit their use.
 - Any additional cost in other work incurred as a result of these approvals shall be borne by the Contractor, including all costs for modifying other related materials/systems and the cost of any additional engineering or design fees required to accommodate the substitution/approval.
 - Contractors must be confident that a proposed product or material meets or exceeds the requirements shown on the drawings and specifications. It will be the responsibility of the Contractor to verify and demonstrate that a proposed product meets or exceed the drawings and specifications at time of shop drawing reviews. If a proposed product or material is determined to be technically unacceptable as judged by the Iowa DOT, the Contractor shall be required to supply products or materials that meet the requirements required to supply products or materials that meet the requirements

stated in the drawings and specifications at no cost increase to the Iowa DOT. Under no circumstances will the Iowa DOT be required to prove that proposed substitutions is not equal to the project requirements. The decision of the Iowa DOT on all requested proposals/substitutions is final.

Section 4 Contract Terms & Conditions

4.1 Contract Award

Award will be based on the total lump sum amount of bid price shown on the Schedule of Prices. The DOT will award to the lowest, most responsive, responsible bidder. The Iowa DOT reserves the right to accept the bid(s) which best serves the interest of the State.

Bid price will include all requirements listed in Section 3 to complete this proposed project. The Prime Contractor shall be responsible for taking all sub-bids and for all coordination between trades.

A "Prime" contract shall be awarded for each project for all work shown on the Drawings and described in the Specifications including Site work, General construction, Demolition, Plumbing, Mechanical, Energy management and control and Electrical work. The Prime Contractor shall be responsible for taking all sub-bids and for all coordination between trades.

Protests of award recommendations shall be made in accordance with Paragraph 761--20.4(6)"e", Iowa Administrative Code.

4.2 Contract Period

See Bid Proposal timeline for dates. The date of completion shall be stated in calendar days on the Bidder's Bid Response, and if necessary, adjusted by mutual agreement between the Iowa DOT and successful bidder prior to executing the contract documents.

The Iowa DOT realizes that deliveries and site conditions have a definite bearing on the completion date. The Iowa DOT will demand diligence in the prosecution of the work, but with good cause and satisfactory past performance by the Contractor, the Iowa DOT may revise the completion date to another mutually-acceptable date, when requested in writing and in good faith by the Contractor.

4.3 Liquidated Damages

Time is an essential component of the contract, and it is important that the work be to completed on the or before the dates listed on the Procurement Timetable. For each calendar day that any work shall remain uncompleted beyond the substantial completion date and beyond the final completion date or any extension granted under Extension of Contract Period, the amount per calendar day specified in the Bid Response cover page will be assessed, not as a penalty but as predetermined and agreed upon liquidated damages.

If work remains uncompleted on more than one portion for which calendar days and liquidated damages have been specified, the liquidated damages assessed will be the total of the damages per day listed for each uncompleted portion. The Iowa DOT shall prepare and forward to the Contractor an invoice or credit change order for such liquidated damages. The final payment shall be withheld until payment of the invoice has been made or the credit change order has been agreed upon.

Assessment of liquidated damages will be based only on the number of calendar days required to complete the contract beyond the contract completion date, plus authorized extensions.

The provision for the assessment of liquidated damages for failure to complete work within the contract period does not constitute a waiver of the Iowa DOT's right to collect any additional damages other than time delays, which the Iowa DOT may sustain by the failure of the Contractor to carry out the terms of the contract.

4.4 Immunity of Iowa Department of Transportation

The Contractor shall defend, indemnify and hold harmless the Iowa DOT and its officials and employees from liability arising out of or resulting from the Contractor's activities at the designated work site, its performance or attempted performance of the contract, as well as the Contractor's activities with Sub-Contractors and all other third parties.

4.5 Payments and Completion of Contract

4.5.1 Final payment shall be authorized not later than thirty (30) days following the completion and final acceptance of the contract, provided that the provisions herein and all other contract requirements have been fulfilled, accepted and approved, where no claims have been filed or following adjudication or release of claims as provided in Chapter 573 of the Code of Iowa.

4.5.2 No notification of payment being processed, no payment made to the Contractor, no partial payment, nor shall the entire use or occupancy of the work by the Iowa DOT be held to constitute an acceptance, in whole or in part, by the Iowa DOT prior to making the final payment and acceptance in full completion of the contract.

4.6 Contractor(s) Insurance Requirements

The resulting Contract will require the successful Contractor to maintain insurance coverage(s) of the type and in the amounts set forth below.

- It shall be the Contractor's responsibility to have liability insurance covering all of the project operations incident to contract completion and the Contractor(s) must have on file with the Contracting Authority a current "Certificate of Insurance" prior to award of contract. The certificate shall identify the insurance company firm name and address, contractor firm name, policy period, type of policy, limits of coverage, and scope of work covered (single contract or statewide). This requirement shall apply with equal force, whether the work is performed by persons employed directly by the Contractor(s) including a subcontractor, persons employed by a subcontractor(s), or by an independent contractor(s).
- In addition to the above, the Contracting Authority shall be included as an insured party, or a separate owner's protective policy shall be filed showing the Contracting Authority as an insured party.
- The liability insurance shall be written by an insurance company (or companies) qualified to do business in Iowa. For independent contractors engaged solely in the transportation of materials, the minimum coverage provided by such insurance shall be not less than that required by Chapter 325A, Code of Iowa, for such truck operators or contract carriers as defined therein. For all other contractors, subcontractors, independent contractors, and the Contracting Authority, the minimum coverage by such insurance shall be as follows:

- Commercial General Liability including Contractual Liability;
- Contingent Liability; Explosion, Collapse and Underground Drainage
- Damage; Occurrence Basis Bodily Injury: Broad Form Personal Injury; Broad Form Property Damage.

Bodily Injury

The contractor will purchase and maintain throughout the term of this contract the following minimum limits and coverage:

• Each person	\$750,000
• Each accident/occurrence	\$750,000
• Workers Compensation	\$750,000
• Statutory Limits	\$750,000
• Employer's liability	\$750,000
• Pollution liability	
• Occupation Disease	\$750,000

Operations

- Property Damage \$250,000 each occurrence

The Contractor(s) shall require all subcontractor(s) meet the above insurance requirements.

The Certificate of Insurance must include the following;

- Iowa Department of Transportation must be listed as an additional insured
- Proposal Number
- Proposal Description
- Letting Date and Contract Period

- For independent contractors engaged solely in the transportation of materials, the minimum insurance coverage provided shall be not less than that required by Chapter 325A, Code of Iowa, for such truck operators or contract carriers as defined therein.

Builders Risk Insurance (if applicable)

- Each Contractor holding a valid contract with the Iowa DOT shall furnish and pay for builder's risk insurance, providing coverage for at least the following losses: fire, extended coverage, vandalism and malicious damage to materials incorporated in the project, and materials purchased to be incorporated in the project, either stored on or off the permanent job site. If this insurance coverage is not provided, the Contractor shall assume all responsibility for the perils outlined above which may occur prior to project completion and acceptance.
- Failure on the part of the Contractor(s) to comply with the requirements of this Article will be considered sufficient cause to suspend the work, withhold estimates, and to deny the Contractor(s) any further contract awards, as provided in Article 1103.01.
- The Contractor(s) shall require all subcontractor(s) meet the above insurance requirements.

4.7 Public Contract Termination

The provisions of Iowa law as contained in Chapter 573A of the Code of Iowa, an Act to provide for termination of contracts for the construction of public improvements when construction or work thereon is stopped because of national emergency, shall apply to and be a part of this Contract, and shall be binding upon all parties hereto, including sub-contractors and sureties upon any bond given or filed in connection herewith.

**SECTION 00 0101
PROJECT TITLE PAGE**



PROJECT MANUAL

FOR

MATERIALS LAB VAV REPLACEMENT

OWNER'S PROJECT NUMBER: BG-3A22(040)--80-85

IOWA DOT

800 LINCOLN WAY

PROJECT LOCATION ADDRESS 2

AMES , IA 50010

DATE: SEPTEMBER 2016

END OF SECTION

SECTION 00 0110

~~~ MASTER NOTE ~~~~~

Listing of all sections, in Masterformat 2004 order, linked to each appropriate section.

Supporting Documentation for this Section is available at the BSDSoftlink.com website:

Go To: > For Customers > Supporting Documents > Division 00, Division 01, Division DC (The Front End)
> How to Specify - Division 00 > 00 0110 (00010) - Table of Contents

Use this section to generate a customized Table of Contents when sections or other external documents not in SpecLink must be included in the Project Manual. Add any additional sections or documents required.

A copy of the Masterformat 2004 recommended section numbers and titles can be obtained at www.csinet.org/masterformat. Go to [More Subscriber Resources on the Web](#) for BSD's cross-reference between the "old" and "new" section numbers and titles (our "map") -- it's a spreadsheet that you can add your own section numbers and titles to.

Select the Subgroups and Divisions included in the project. If a Division is not used, select "Not Used" following the title. All SpecLink sections already included in the project will automatically show in the list.

When printed, this Table of Contents will not include the number of pages in each section. If the number of pages is required, use the automatically generated Table of Contents from the Print dialog box on the File Menu.

NOTE: The sections in this list are in a different order than in Section 00010 - Table of Contents (for Masterformat 1995).

SECTION 00 0100 -- TABLE OF CONTENTS, Copyright 2004-2016, Building Systems Design, Inc.

~~~ END of MASTER NOTE ~~~~~

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END OF SECTION

**SECTION 23 0500
COMMON WORK RESULTS FOR HVAC**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The work shall include the furnishings of systems, equipment and materials specified in this Division and as called for on the Mechanical Drawings to include supervision, quality control, operation, methods and labor for the fabrication, installation, start-up and tests for the complete mechanical installation. The work shall also include the furnishing of necessary hoisting facilities to set materials and equipment in place and the furnishing of any scaffolding and transportation associated with this work.
- B. Examine the project site and become familiar with existing conditions which will affect the work. Review the drawings and specifications of other trades and take note of conditions to be created which will affect the work. All conditions shall be considered in the preparation of bids; no additional compensation will be made on the behalf of this Contractor.
- C. Provide labor necessary to demolish the existing mechanical system as shown on the drawings, as described in Part 3, Existing Conditions, or as required.
- D. Where noted on the drawings or where called for in other sections of the specification, the Contractor for this division shall install equipment furnished by others, and shall make required service connections. Verify with the supplier of the equipment the requirements for the installation. This contractor shall be responsible for the removal and installation of railings, piping, ductwork, louvers, etc. as required to install new equipment. Coordinate shipping splits for all equipment provided by this contractor.

1.2 DAMAGE

- A. The Contractor shall be responsible for damage to the work of other trades or to the building and its contents, caused by equipment installation.

1.3 PERMITS AND INSPECTIONS

- A. Obtain and furnish necessary permits and inspection certificates for material and labor furnished. Permits and certificates shall be obtained from the proper inspection authorities. The cost of permits, certificates and fees required in connection with the installation shall be borne by the Contractor, unless otherwise noted in the detailed contractual description preceding these specifications. Where applications are required for the procuring of utility services to the building, see that such application is properly filed with the utility, and that information required for such an application is presented to the extent and in the form required by the utility company.

1.4 CODES AND STANDARDS

- A. Applicable provisions of the following codes and standards are hereby imposed on a general basis for the mechanical work (in addition to specific applications specified by individual work sections of these specifications):
 - 1. ASHRAE/IES 90.1 - 2010 Code for Energy Efficiency
 - 2. ANSI Pressure Piping Standards (B31)
 - 3. ASHRAE Safety Code for Mechanical Refrigeration (ANSI B9.1)
 - 4. AWWA Standards

5. ASME Boiler and Pressure Vessel Code and State Boiler Code
 6. American Gas Association
 7. AWS Standards for Welding
 8. National Electrical Code
 9. Local and/or State Plumbing, Mechanical and Building Codes
 10. Occupational Safety and Health Act (OSHA)
 11. International Energy Conservation Code 2012
 12. Uniform Plumbing Code
 13. International Mechanical Code
 14. NFPA Standards and Pamphlets
- B. If any work indicated on the drawings or specified herein conflicts in any way with any of the rules and regulations of the above authorities, the Contractor shall notify the Architect/Engineer in writing 72 hours before bids are opened. In the event the Contractor fails to notify the Architect/Engineer and changes are required by said conflicts, the Contractor shall make such changes as are required without additional cost to this Owner.
- C. Installations must be safe in every respect, and must not create a condition which will be harmful to building occupants; to operating, installing or testing personnel; to workmen; or to the public. The contractor for each installation shall be solely responsible for providing installations which will meet these conditions. If the Contractor believes that the installation will not be safe for all parties, report these beliefs in writing to the Architect/Engineer before any equipment is purchased or work is installed, giving recommendations. The Architect/Engineer will work out required changes and adjustments in contract price where adjustments are warranted.

1.5 DRAWINGS

- A. A complete set of drawings and specifications shall be on the site at all times. Prior to installing any of the work, check the drawings for dimensions and see that the work does not interfere with clearance required for ceilings, beams, foundations, finished columns, pilasters, partitions and electrical equipment as shown on the drawings and details. After work is installed and it develops that interferences occur which have not been called to the Architect/Engineer's attention before the installation, the Contractor shall, at his own expense, make such changes in his work as directed by the Architect/Engineer.
- B. The contract drawings for mechanical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate sizes and locations of equipment and materials. Where job conditions require reasonable changes in indicated locations and arrangement, the Contractor shall make such changes as directed by the Architect/Engineer, without additional cost to the Owner.
- C. Because of the scale of the drawings, certain basic items such as pipe fittings, access panels, and sleeves may not be shown; but where such items are required by other sections of these specifications or where they are required by the nature of the work, they shall be furnished and installed. Rough-in dimensions and locations shall be verified with the supplier of equipment furnished by other trades, or by the Owner, prior to the time of roughing-in.

- D. Equipment specification may not deal individually with minute items required such as components, parts, controls and devices which may be required to produce the equipment performance specified, or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for.
- E. The drawings and the specifications are cooperative and supplementary. It is the intent of both said drawings and specifications to cover all mechanical requirements in their entirety as nearly as possible. The Contractor shall closely check the drawings and specifications for any obvious errors or omissions and bring any such condition to the attention of the Architect/Engineer prior to the receipt of bids, in order to permit clarification by means of a mailed Addendum. If there is no question prior to the bid proposal date, the Architect/Engineer shall assume that the drawings and specifications are complete and correct and will expect the intent of said documents to be complied with, and the installation to be complete in all respects, according to said intent.
- F. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Minor deviations from the contract drawings may be made to allow for better accessibility, but changes of magnitude, or which involve extra cost, shall not be made without prior approval. Ample space shall be allowed for removal of parts that may require replacement or service in the future.

1.6 RESPONSIBILITY

- A. The Contractor's responsibility shall not end with the installation and connecting of the various apparatus. It shall include the services of an experienced superintendent, who shall be constantly in charge of the work, together with the qualified journeymen, helpers and laborers required to properly unload, install, connect, adjust, start, operate and test the work involved, including equipment and materials furnished by other trades or by the Owner, until such time as the entire mechanical installation functions properly in every detail.

1.7 COORDINATION

- A. Coordinate the work with other trades prior to installation.
- B. No piping, ducts or equipment foreign to the electrical equipment or architectural appurtenances shall be run over the top of any electrical panels or electrical equipment, in accordance with NEC 110-16 and 384-4. This does not prohibit sprinkler protection for the installation.
- C. The determination of quantities of material and equipment required shall be made from the drawings. Schedules on the drawings and in the specifications are completed as an aid, but where discrepancies arise, it shall be the Contractor's responsibility to provide the required quantity.
- D. Where the specifications state that equipment shall be furnished, installed or provided, it shall be understood to mean this Contractor shall furnish and install completely, unless it is specifically stated that the equipment is to be furnished and installed by others.
- E. The Architect/Engineer reserves the right to determine space priority of the contractors in the event of interference between the piping and equipment of the various contractors. Conflicts between the drawings and specifications, or between requirements set forth for the various trades, shall be called to the attention of the Architect/Engineer. If clarification is not asked for prior to the taking of bids, it will be assumed that none is required, and that the Contractor has submitted his bid in conformance with plans and specifications as issued and that no interference exists.

- F. No piping, ducts or equipment foreign to an elevator hoistway and machine room shall be run inside the hoistway and machine room in accordance with NEC 620-37 and ASME A17.1, 102.2.

1.8 GUARANTEE AND MAINTENANCE

- A. Materials and equipment shall be guaranteed to be free from defects and to be new equipment; no secondhand, used or salvaged equipment will be allowed.
- B. Keep the entire portion of the work in repair, without additional cost to the Owner, so far as defects in workmanship, apparatus, material or construction are concerned for one (1) year from the date of final acceptance, except as otherwise specified herein.
- C. Equipment, which fails to meet performance ratings as specified and shown on the drawings, shall be removed and replaced by new equipment that meets the specified requirements, without additional cost to the Owner.
- D. Materials and workmanship shall be subject to the review of the Architect/Engineer, in whose presence various tests shall be made as required by these specifications.

PART 2 PRODUCTS

2.1 SUBMITTAL PROCESS

- A. Submit shop drawings and catalog data for mechanical equipment specified in Division 23 in accordance with front end documents.
- B. Submittal data for mechanical equipment shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment to include dimensions, wiring diagrams, performance curves, rating, control sequence, and other descriptive data necessary to describe fully the item proposed and its operating characteristics. Shop drawings shall be submitted on equipment and materials as required by the specifications.
- C. Approval of materials, including alternate or substitute items, shall be obtained in writing from the Architect/Engineer, verbal approval will not be considered binding.
- D. Shop drawings shall be submitted and shall have been signed, checked, approved, and initialed by the Contractor prior to submittal to the Architect/Engineer. The Architect/Engineer will review shop drawings to aid in interpreting the plans and specifications, and will in so doing assume that the shop drawings conform to specified requirements set forth in this specification. The approval of the shop drawing by the Architect/Engineer does not relieve the Contractor of the responsibility of complying with elements of the specification. The name of the job, Architect/Engineer, location, and specification section shall appear on all pages of shop drawings. Equipment marks (such as EF-1, RTU-1) shall be indicated for each item.
- E. At the completion of the job, furnish three (3) copies of parts lists, operating and maintenance instructions, and manuals organized and bound, in three books.
- F. At the completion of the project, prepare and submit to the Owner record drawings showing the location of piping and ductwork. Drawing shall give accurate dimensions of such equipment for future use by the Owner. This drawing shall be submitted as soon as work is completed and before authorization of final payment.

2.2 SUBCONTRACTORS AND MATERIALS

- A. Submit to the Architect/Engineer for review, when requested, a list of subcontractors, materials and equipment proposed to be used. The list must be reviewed by the Architect/Engineer before this Contractor may enter into any subcontractual agreement. Equipment, materials, and devices, etc. shall be subject to the review of the Architect/Engineer, whether or not said items are herein specified.

2.3 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Materials shall be new, complete with manufacturer's guarantee or warranty, and shall be as listed by Underwriters Laboratories (UL), Inc., Air Movement and Control Association (AMCA), American Gas Association (AGA), Air Conditioning and Refrigeration Institute (ARI), etc., if a standard has been established by that agency for the type of material.
- B. Materials shall also comply with applicable standards of the National Electrical Manufacturer's Association, National Board of Fire Underwriters, National Fire Protection Association, National Safety Council, National Bureau of Standards, the National Electrical Code and the Williams-Steiger Occupational Safety and Health Act of 1970. Such standards are hereby made a part of these specifications.
- C. Work shall be performed by workmen skilled in the particular craft, shall be executed in a workmanlike manner, and shall present a neat mechanical appearance when completed. Align, level and adjust equipment for satisfactory operation, and install so that connecting and disconnecting of piping and accessories can be made readily and so that parts are easily accessible for inspection, operation and maintenance. Methods and techniques of installation shall be subject to the review of the Architect/Engineer.
- D. Materials shall be the standard product of a reputable manufacturer regularly engaged in the manufacture of the specific product. Materials of the same type of class shall be the products of one manufacturer. For example, fans shall be from the same manufacturer and pumps from the same manufacturer.
- E. Materials shall be protected from damage, and stored indoors or protected from the weather at all times, unless other storage arrangements are approved by the Architect/Engineer.
- F. Bearing lubrication fittings shall be as recommended by the manufacturer and shall be extended, where necessary, to an accessible location.
- G. Material and equipment shall be installed in strict accordance with the manufacturer's recommendations.

2.4 MATERIAL SUBSTITUTIONS

- A. Proposals as submitted shall be based on the products specifically named in the specification or on the drawings. Material or equipment by manufacturers other than those specified may be used only by permission of the Architect/Engineer. Such permission for substitution must be requested, in writing in accordance with front end documents.
- B. The Architect/Engineer reserves the sole right for the approval of proposed material or equipment, and the phrase, "or approved equivalent", used in these specifications, or on the drawings, shall be interpreted to mean an equivalent approved by the Architect/Engineer.
- C. Changes required by alternate equipment shall be made at no additional cost to the Owner; and costs incurred by other trades, public utilities or the Owner, as a result of the use of such equipment, shall be the responsibility of the Contractor.
- D. Furnish to the Architect/Engineer, when requested, samples of proposed material or equipment substitutions. These samples shall remain with the Architect/Engineer as long as needed.
- E. Identify the differences in alternate material or equipment as compared to that specified, and indicate the benefits to the project as a result of selecting the alternative.
- F. The Architect/Engineer reserves the right to refuse approval of equipment which does not meet the specification, in their opinion, or of equipment for which no local experience of satisfactory service is available. The Architect/Engineer further reserves the right to reject equipment for which maintenance service and the availability of replacement parts is questionable.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

- A. Examine the existing buildings and grounds and become familiar with the conditions as they exist, or that will in any manner affect the work under this contract. No allowance will be made subsequently, in this connection, on behalf of the Contractor for any error or negligence by the Contractor.
- B. Existing equipment, such as duct or pipe, in or on the existing building and grounds which is to be replaced, or which interferes in any way with the remodeling of the existing facilities and/or installation of new equipment, shall be removed from the premises or relocated by this Contractor, as directed by the Architect/Engineer. Do not remove from the premises, any equipment that may have maintenance value to the Owner without permission of the Owner. Equipment, duct or pipe not to be reused shall be removed from the premises, unless otherwise noted herein or shown on the drawings.
- C. Where existing equipment is removed or changed, all duct and pipe no longer in service shall be removed and stubs plugged as directed by the Architect/Engineer. Building surfaces damaged and openings left by removal of equipment shall be repaired by the proper trades and paid for by this Contractor, unless otherwise noted on the drawings. The cutting and fitting shall be done by this Contractor. The cutting of floor, ceiling or wall surfaces shall be done by this Contractor with extreme care, in order to avoid any disrupting or damage of existing utility services which may be encountered. Coordinate with other trades and with the General Contractor to minimize the damage to the building in order to reduce the amount of patching required.
- D. Where new openings are cut and concealed piping is encountered, such items shall be removed or relocated as required. Where systems to be removed stub through floors, walls or ceilings, openings shall be patched so that no evidence of the former installation remains.
- E. Existing active services (water, gas, sewer, electric), when encountered, shall be protected against damage. Do not prevent or disturb operation of active services that are to remain. If active services are encountered which require relocation, make request to authorities with jurisdiction for determination of procedures. Where existing services are to be abandoned, they shall be terminated in conformance with requirements of the utility or municipality having jurisdiction.
- F. The location, size and elevation of underground utilities shown on the drawings are in accordance with data supplied by the Owner and/or the various utility companies. The Contractor shall verify this data and shall report any discrepancies to the Architect/Engineer before submitting his bid.

3.2 INTERRUPTION OF SERVICE

- A. Changes in service shall be made so as to provide a minimum of interference with the operation of services in the building. When changes require shutdown of building services, notify the proper building authorities no less than 24 hours in advance and obtain approval from these authorities before making changes. Such notices shall give duration and nature of shutdown. Temporary arrangements shall be approved by the Architect/Engineer and/or Owner.
- B. Any and all interruptions to building services shall be in accordance with front end documents.

3.3 OPENINGS, CUTTING, AND PATCHING

- A. The General Contractor shall coordinate the placing of openings in the new structure, as required for the installation of the mechanical work.

- B. Furnish to the General Contractor the accurate locations and sizes for required openings. This shall not relieve this Contractor of the responsibility of checking to assure that proper size openings are provided. When additional patching is required due to this Contractor's failure to inspect this work, this Contractor shall make arrangements for the patching required to properly close the opening, to include patch painting. This Contractor shall pay any additional cost incurred in this respect.
- C. When cutting and patching of the structure is made necessary due to this Contractor's failure to install piping, ducts, sleeves or equipment on schedule, or due to this Contractor's failure to furnish, on schedule, the information required for the leaving of openings, it shall be this Contractor's responsibility to make arrangements for this cutting and patching. This Contractor shall pay any additional cost incurred in this respect.
- D. Provide cutting and patching and patch painting in the existing structure, as required for the installation of the work. Furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Architect/Engineer. Extent of cutting shall be minimized. Use core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

3.4 PAINTING

- A. The finish of any item that has been marred, scratched or damaged in any way by this Contractor shall be repainted at the expense of this Contractor, and to the satisfaction of the Architect/Engineer and the Owner.

3.5 CLEANING

- A. Keep the premises clean of all debris, caused by the work as described in front end documents.
- B. At the conclusion of the construction, the site shall be thoroughly cleaned of all rubble, debris and unused material and shall be left in good order. Closed off spaces shall be cleaned of waste such as material, cartons, and wood frame members used in the construction.

3.6 SUSPENSION FROM WOOD STRUCTURAL MEMBERS

- A. In general, concentrated or other loads shall not be suspended directly from the bottom of wood structural members, unless approved by the Architect/Engineer. Loads suspended from open web joists or trusses may be transferred to the bottom chord of the structural member at the panel points. Loads suspended from solid web joists shall be transferred to the joists only through the top flange or web. Suspension systems shall be reviewed by the Architect/Engineer.

3.7 WIRING FOR MECHANICAL EQUIPMENT

- A. The electrical contractor will provide power to and connection of motors and equipment furnished by this Contractor. Where disconnect switches are not specified to be furnished with the equipment, the electrical Contractor will furnish disconnect switches for equipment furnished by this Contractor.
- B. Provide integral wiring, alarm wiring, control wiring, temperature control wiring and interlock wiring for equipment furnished, whether or not such wiring is furnished by the equipment vendor.
- C. Except where other Sections call for starters to be furnished by manufacturers as part of their equipment, the electrical contractor will furnish motor starters for motors furnished by this Contractor.

- D. Furnish to the electrical contractor, shop drawings and a schedule for motors and other mechanical equipment furnished, which require electrical services. The schedule shall include the locations for rough-ins, electrical loads, size, and electrical characteristics for services required.
- E. Additional costs incurred, where motors or equipment furnished by this Contractor require larger services or services of different electrical characteristics than those called for on the Electrical Drawings, due to the Contractor furnishing substitute equipment, shall be paid for by this Contractor.
- F. Review the Electrical Drawings and call to the attention of the Architect/Engineer, prior to bidding, omissions of electrical services required for equipment.
- G. Mechanical equipment which requires fuse protection, to maintain UL listing, shall be coordinated with the electrical contractor to provide such protection.

3.8 MOTORS

- A. TEFC and ODP motors for equipment supplied by this contractor shall meet or exceed the listed values when tested in accordance with IEEE Standard 112 Method B as defined by NEMA Standard MG 1-12.6C. Efficiency values listed are based on NEMA Premium Efficiency Motors of NEMA MG 1-2003, Table 12-12 at 1800 RPM:

HP	ODP	TEFC
1	85.5	85.5
1.5	86.5	86.5
2	86.5	86.5
3	89.5	89.5
5	89.5	89.5
7.5	91.0	91.7
10	91.7	91.7
15	93.0	92.4
20	93.0	93.0
25	93.6	93.6
30	94.1	93.6
40	94.1	94.1
50	94.5	94.5
60	95.0	95.0
75	95.0	95.4
100	95.4	95.4
125	95.4	95.4
150	95.8	95.0
200	95.8	95.0

- B. All motors that are indicated to be used with Variable Frequency Drives (VFDs) shall be inverter duty rated. Coordinate all motor requirements with the electrical contractor.

3.9 PROTECTION

- A. Special care shall be taken for the protection of equipment furnished by this Contractor. Equipment and material shall be protected from elements such as weather, painting and plastering until the project is completed. Damage from rust, paint or scratches shall be repaired as required to restore equipment to original condition.

- B. Protection of equipment during the plastering and painting of the building shall be the responsibility of the contractor performing that work, but this shall not relieve this Contractor of the responsibility of checking to assure that adequate protection is being provided.
- C. Where the installation or connection of equipment requires this Contractor to work in areas previously finished by other contractors, this Contractor shall be responsible that such areas are protected and are not marred, soiled or otherwise damaged during the course of such work. This Contractor shall arrange with the other contractors for repairing and refinishing of such areas which may be damaged.
- D. When heavy materials must be placed upon or transported over the roof deck, sheeting shall be placed to distribute the weight and support such materials. Any damage shall be immediately corrected at no cost to the Owner.

3.10 ASBESTOS IDENTIFICATION AND CONTROL

- A. In the event that suspected asbestos containing material (ACM) is encountered during the course of the work, cease operations in the immediate area and promptly notify the Architect/Engineer. Suspected materials will then be sampled and analyzed by the Owner. Should ACM be identified, the Owner's Representative will direct the procedures for abatement, either by subcontract to the Contractor or separate contractor. During abatement operations, cease operations in the immediate area of the abatement. Operations in other areas of the project may be performed, but care must be taken to control dust to avoid contamination of the abatement containment or air monitoring samples. The Contractor shall coordinate activities with the asbestos abatement contractor.
- B. Should no ACM be identified, operations may be resumed. Delays caused by identification, analysis or abatement may be added to the time of the contract, at the discretion of the Architect/Engineer by Change Order.

3.11 NOISE AND VIBRATION

- A. Be responsible for the installation of all equipment in such a manner as to control the transmission of noise and vibration from any installed equipment or system, so that the sound level does not exceed NC35 in any occupied space. Be responsible for the correction of any objectionable noise in any occupied area due to improperly installed equipment.

3.12 TESTS AND DEMONSTRATIONS

- A. Systems shall be tested and placed in proper working order prior to demonstrating systems to the Owner.
- B. Prior to acceptance of the mechanical installation, demonstrate to the Owner or his designated representatives essential features and functions of all systems installed, and instruct the Owner in the proper operation and maintenance of such systems.
- C. Furnish the necessary trained personnel to perform the demonstrations and instructions, and arrange to have the manufacturer's representatives for the system present to assist with the demonstrations. The Owner and Contractor shall each sign a certification stating that the training has been performed and the Owner accepts same.

3.13 UTILITY REBATE APPLICATIONS

- A. This contractor shall be responsible for gathering information necessary for completing local utility rebate applications, and submitting to the proper utility companies for gas and electric rebates. Potential rebates include high efficiency gas boilers, thermostats, timeclocks, motors, and other items furnished by this mechanical contractor.

END OF SECTION

B. Body materials, unless otherwise stated:

1. Bronze: 125-150 lbs., ASTM B62
2. Iron: 200-300 lbs., ASTM B61
3. Cast Iron: ASTM A126, Class B
4. Cast Iron: ASTM 448
5. Ductile Iron: ASTM A395
6. Cast Steel: ASTM A216

2.3 BALL VALVES

- A. 2 in. and smaller: ASTM B584 bronze body, 2-piece, full port stainless steel ball, screwed or soldered ends with teflon seats and seals, blow out proof stem, tee or lever handle rated to 150 SWP/600W06.
- B. Over 2 in.: Carbon semi-steel or ductile iron body, 2-piece, full port stainless steel ball, ANSI rated flanged ends with teflon seats and lever handle.

2.4 EXECUTION

2.5 VALVE LOCATIONS – GENERAL

- A. Install isolation valves at each branch off of horizontal mains and vertical risers.

2.6 INSTALLATION INSTRUCTIONS

- A. Follow the manufacturer's recommended installation instructions concerning soldering, silver brazing, welding, threading, and installation of flanged valves in order to prevent damage to the valve and assure its maximum efficiency. Additional specific installation requirements are as follows:
1. Thread pipe for threaded valves to standard length only, using new block dies.
 2. Put pipe compound on the pipe end, not into the valve threads. Securely screw pipe and valve together.
 3. Blow out or otherwise thoroughly clean pipe sections before they are installed.
 4. Close valve before installation.
 5. Secure and adjust valves for no leaks and for easy operation.
 6. Install valves with stems horizontal or vertical above the pipe and square with building construction.
 7. Install valves so piping does not place a stress or strain on the valve body.
 8. Install extended-stem valves where insulation is indicated. Stems shall be extended such that the handle moves freely without contact with the insulation.
 9. Install drain valves at low points of piping, at each mechanical equipment item, and elsewhere, where indicated.

2.7 VALVE SCHEDULE

- A. Gate - All Sizes: Water, steam and oil for HVAC and process piping systems. For applications where ball valves are not suitable.
- B. Ball - All Sizes: Water for HVAC piping systems; for operation up to 200 psi at 500° F.

END OF SECTION

SECTION 23 0529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install pipe hangers and supports.
- B. Pipe support systems shall secure pipes in place, prevent pipe vibration, provide vertical adjustment for maintaining required grades, and provide for expansion and contraction.
- C. Where supports are attached to concrete or other structural members, care shall be taken to prevent damage or weakening of the structural members.
- D. Where concrete inserts are to be used, it shall be this Contractor's responsibility to accurately locate and attach inserts to concrete forms.

1.2 REFERENCES

- A. American National Standards Institute, ANSI:
- B. ANSI B31.1: Power Piping
- C. Manufacturers Standardization Society of the Valve and Fittings Industry, MSS, 1815 North Fort Myer Drive, Arlington, VA 22209.
 - 1. MSS SP-58: Materials Standardization Society: Pipe Hangers and Supports-Materials, Design, and Manufacturer.
 - 2. MSS SP-69: Materials and Standardization Society: Pipe Hangers and Supports - Selection and Application.
 - 3. NFPA 13-Standard for the Installation of Sprinkler Systems.
 - 4. ASTM A123-Specification for Zinc Hot-Galvanized Coatings by the Hot Dip Process.
 - 5. ASTM A653 G90-Specification for Steel Sheet, Zinc on Iron and Steel.

1.3 SUBMITTALS

- A. Submit manufacturer's product data on all hangers and support devices. Product data to include, but not be limited to materials, finishes, approvals, load ratings, and dimensional information.

PART 2 PRODUCTS

2.1 HANGERS AND SUPPORTS

- A. Hangers and support devices shall be Anvil International Inc., Tolco, Fee and Mason, Michigan, B-Line or approved equivalent. Figure numbers based on Anvil.

PART 3 EXECUTION

3.1 INSTALLATION - HORIZONTAL PIPE SUPPORTS

- A. Hanger rods for steel, wrought iron and brass pipe shall be installed in accordance with MSS SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1-1/4"	3/8"	7'-0"
1-1/2" and 2"	3/8"	9'-0"
2"	3/8"	10'-0"
2-1/2", 3" and 3-1/2"	1/2"	10'-0"
4" and 5"	5/8"	12'-0"
6"	3/4"	12'-0"
8"	7/8"	14'-0"
10" and 12"	7/8"	16'-0"
14" and 16"	1"	16'-0"
18"	1-1/8"	18'-0"
20" and 24"	1-1/4"	20'-0"

- B. Hanger rods for copper pipe and tube shall be installed in accordance with MSS-SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
1/2" and 3/4"	3/8"	5'-0"
1"	3/8"	6'-0"
1-1/4"	3/8"	7'-0"
1-1/2"	3/8"	8'-0"
2"	3/8"	8'-0"
2-1/2"	1/2"	9'-0"
3", 3-1/2" and 4"	1/2"	10'-0"
5"	1/2"	13'-0"
6"	5/8"	14'-0"
8"	3/4"	16'-0"

- C. Support horizontal cast iron soil pipe with two hangers for each pipe length. Locate hangers close to couplings.
- D. In addition to the above specified spacings, install additional hangers at change in pipe direction and at concentrated loads, large valves and strainers.
- E. Where more than one pipe is to be run parallel together, they may be supported on trapeze type hangers. Trapeze bar angles and hanger rods shall be of sufficient size to support the particular group of pipes. Trapeze hanger spacing shall be based on the smallest pipe on the rack. When hanging from light gauge metal trusses, coordinate pipe hanger spacing and hanger rod connection points with the truss manufacturer.
- F. For suspending hanger rods from brackets attached to walls, use welded steel brackets; Fig. 194 for loads up to 750 lbs; Fig. 195 for loads up to 1500 lbs; Fig. 199 for loads up to 3000 lbs.
- G. Where pipes are to be racked along walls, use "Unistrut" pipe racks or 12 gauge steel strut channel, 1-5/8" x 1-5/8" minimum.
1. Mount pipes to strut channel with two-piece pipe straps to match outside diameter of pipe including insulation.
- H. Attach all pipe hangers from support rods using double locknuts tightened to prevent loosening.

3.2 INSTALLATION - VERTICAL PIPE SUPPORTS

- A. Support vertical steel, wrought iron, copper and brass pipe at every other floor line.
- B. Support vertical cast iron soil pipe at every floor line.
- C. In addition to the above, support vertical pipes at base of riser with base fitting set on concrete or brick pier, or by hanger located on horizontal connection close to riser.
- D. Where pipe sleeves extend above floor, place pipe clamps at ceiling below and support clamp extensions from inserts or other approved attachment.

3.3 PIPE ATTACHMENTS

- A. For horizontal steel and wrought iron pipe, use carbon steel adjustable clevis hanger, Fig. 260. For floor support or support directly above steel beams, use pipe roll stand, Fig. 177.
- B. For horizontal copper pipe and tube, use copper-plated adjustable swivel ring, Fig. CT-69.
- C. When thermal expansion for horizontal pipe is in excess of 1/2" axially, use adjustable swivel pipe roll, Fig. 181, or pipe roll stand, Fig. 177.
- D. For horizontal cast iron soil pipe, use clevis hanger, Fig. 260.
- E. For vertical, steel, wrought iron and cast iron pipe, use extension pipe clamps, Fig. 261.
- F. For vertical copper pipe and tube, use copper-plated extension pipe clamp, Fig. CT-121.

3.4 INTERMEDIATE ATTACHMENTS

- A. Hanger rods: use carbon steel single or double end threaded, Figs. 140, 253 as required. Continuous threaded rod: Fig. 146 may be used wherever possible.
- B. Chain wire or perforated strap hangers will not be permitted. One pipe shall not be suspended from another pipe.

3.5 STRUCTURAL ATTACHMENTS

- A. For attaching steel or copper plated hanger rods to reinforced concrete, use galvanized malleable iron concrete inserts; Fig. 282 for loads up to 1140 lbs.
- B. For attaching steel hanger rods to structural steel beams, use malleable iron C-clamps; Fig. 92, Fig. 93 or Fig. 94 with retaining clip Fig. 89 or Fig. 89X for loads up to 500 lbs; Fig. 218 with extension piece for loads up to 1,365 lbs. For copper plated hanger rods, use copper plated malleable iron C-clamps; Fig. CT-138R for loads up to 180 lbs.
- C. For attaching steel hanger rods to wood structural members, use malleable iron ceiling flange; Fig. 153 for loads up to 1,270 lbs. For copper plated hanger rods, use copper plated malleable iron ceiling flange: Fig. CT-128R for loads up to 180 lbs.
- D. Vertical expansion shields or toggles shall not be used for suspending hanger rods, except with permission in cases where inserts have been omitted or cannot be used. If permitted, use expansion shields; for rod sizes up to 1/2", 320 lbs. max. load. For hanger rods larger than 1/2" use attachment plate, Fig. 52, with wedge anchors.
- E. Powder actuated anchoring methods shall not be used.

3.6 PIPE COVERING PROTECTION

- A. Hangers and supports for insulated piping shall not injure or pierce insulation. Provide insulation protection shields in conjunction with hanger or roll device. Use Fig. 160 and 165, Protection Saddles.

3.7 SUPPLEMENTAL STEEL

- A. Provide supplemental steel required to hang or support mechanical equipment or piping.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide materials, equipment labor and supervision necessary to install piping identification products.
- B. Comply with ANSI A13.1 for lettering size, length or color field, colors, and installed viewing angles of identification devices.

1.2 QUALIFICATIONS

- A. Brady Corp., Industrial Safety Supply, Emedco, Seton or Brimar.

1.3 SUBMITTALS

- A. Submit manufacturer's product data.

PART 2 PRODUCTS

2.1 PIPE MARKERS

- A. Provide manufacturer's standard preprinted, semi-rigid snap-on or self-sticking, color-coded pipe markers, complying with ANSI A13.1.
- B. Provide full-band pipe markers, extending 360° around pipe at each location or self-sticking pipe markers, fastened in the following method:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Secure to piping and install banding tape on both ends of each pipe label.
- C. Lettering shall be manufacturer's pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance.
- D. Print each pipe marker with arrows indicating direction of flow, integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic or on banding tape.

2.2 EQUIPMENT MARKERS

- A. Provide engraved signage nameplates and tags constructed of multi-layered acrylic that has been treated for outdoor use and can withstand temperatures up to 160° F. Nameplates shall have beveled edges with contrasting color core, letters, and border. Minimum size of nameplate shall be 3" high by 6" long. The minimum letter height shall be 3/4". Attachment shall be by double faced 2 mil permanent acrylic adhesive. For equipment that doesn't allow for direct attachment, furnish sheet metal backing to integrate with equipment such that signage can be read from 5 feet above the finished floor. Unless noted otherwise, signage shall be provided with black lettering, black border, and yellow core. All signage shall include up to 14 characters per line, minimum of 3 lines per tag. Furnish signage for equipment shown in Section 3:
 - 1. All pumps shall include the full name description for system served such as *"Primary Chilled Water Pump – 1."*
 - 2. All air handling unit filter sections shall be labeled with the exact quantity of filters, size, and type of filter such as *"14 – 24"x24"x2", 30% Pleated Filters."*
- B. All equipment shall be named consistent with the plans and specifications as indicated on the schedules or as directed by the Owner.

2.3 BRASS VALVE TAGS

- A. Provide manufacturer's standard brass valve tags with stamped black filled lettering, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 3/16" hole for fastener.
- B. Provide 1-1/2" round brass tags with black lettering. Seton 250 BL or equal.

2.4 VALVE TAG FASTENERS

- A. Manufacturer's standard solid brass chain or solid brass S-hooks of sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

PART 3 EXECUTION

3.1 INSTALLATION OF MECHANICAL IDENTIFICATION

- A. Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Install pipe markers on each system, and include arrows to show normal direction of flow.
- C. Locate pipe markers as follows: wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) above lay-in type ceilings and exterior non-concealed locations.
 - 1. Near each valve and control device.
 - 2. Near each branch, excluding short take-offs for fixtures, mark each pipe at branch where there could be question of flow pattern.
 - 3. Near locations where pipes pass through walls or floors/ceilings, (both sides) or center non-accessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. At each pipe passage to underground.
 - 7. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
 - 8. On piping above removable acoustical ceilings, maximum spacing of 20' along each piping run.
 - 9. Where self-sticking labels are used, the pipe or its covering surface shall be properly prepared. This consists of removal of loose dirt, oil and grease, loose paint or peeling insulation covering. This can be done with a brush and cloth; washing is not required. Use solvent for removal of oil or grease.
 - 10. Banding tape must be used on both ends of all self-sticking labels. The tape shall encircle the pipe completely and overlap itself so the banding tape can adhere to itself.

- D. Provide valve tags for all major valves 3/4" size or larger. Included are all main, zone and branch valves, valves in all equipment rooms, etc. All types of valves, ball, globe, butterfly, cocks, control, regulating, relief, reducing, solenoid, etc. are to be identified except check valves. Do not identify end use point valves for plumbing fixtures, and similar rough-in connections.
- E. Provide damper tags on all automatic control dampers, motorized dampers, and smoke dampers.
- F. List each tagged valve in schedule for each system showing function and location. Provide separate charts for mechanical divisions of work. Charts shall be installed on a conspicuous wall in the main mechanical equipment room. Provide unframed copies of valve lists as part of closeout documents.

3.2 ADJUSTING AND CLEANING

- A. Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

3.3 PIPING DUCTWORK, AND EQUIPMENT IDENTIFICATION

- A. Piping systems that shall be identified by their controls (including directional arrows) on this project shall include, but are not necessarily limited to, the following:
 - 1. Heating water (supply and return).
- B. Equipment/Ductwork
 - 1. Variable Air Volume Boxes
 - 2. Provide name plates for all equipment scheduled on the drawings. Coordinate nameplate tag with Owner's sequencing system. If the Owner has no preference, the nameplates shall correspond with the equipment schedule.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 QUALIFICATIONS

- A. Testing and balancing shall be performed by an independent certified testing and balancing contractor. The Contractor shall be certified by the AABC (American Association of Balancing Contractors), NEBB (National Environmental Balancing Bureau), or SMARTA (Sheet Metal and Air Conditioning and Roofing Trade Association). The Balancing Contractor shall provide labor, services, and test equipment required to test, adjust, and balance the specified systems. Personnel involved in the execution of the work under the Balancing Contract shall be experienced and trained in the total balancing of mechanical systems, as well as being regular employees of the Balancing Contractor.

1.3 SUBMITTALS

- A. Submit under provisions of front end documents
- B. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- C. Field Reports: Submit under provisions of front end documents.
- D. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Prior to commencing work, submit report forms or outline indicating adjusting, balancing, and equipment data required.
- F. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.
- G. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- H. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
- I. Test Reports: Indicate data on forms containing information indicated in Schedules.

1.4 SEQUENCING

- A. Sequence work to commence after completion of systems installation and schedule completion of balancing work before Substantial Completion of Project.
- B. Do not proceed with balancing work until systems scheduled for testing, adjusting, and balancing are clean and free from debris, dirt, and discarded building materials.

PART 2

2.1 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 OTHER CONTRACTOR RESPONSIBILITIES

- A. The Mechanical and Plumbing Contractors shall cooperate with the balancing agency by:
 - 1. Including balancing dampers as required by the Drawings and Specifications.
 - 2. Putting complete system into operation during duration of balancing period.
 - 3. Providing up-to-date set of Drawings and advising immediately of changes made to the system during construction.
 - 4. Providing labor and equipment and cost of performing corrections such as dampers, belts, and pulley changes, etc. as required without undue delay.
 - 5. Providing complete submittal information for mechanical equipment complete with pertinent engineering information.

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions.
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.4 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 of design for return and exhaust systems.
- B. Diffusers, Registers and Grilles: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust diffusers, registers and grilles in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.5 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostat to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.6 AIR SYSTEM PROCEDURE

- A. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- B. Measure air quantities at air inlets and outlets.
- C. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- D. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- E. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- F. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

3.7 WATER SYSTEM PROCEDURES

- A. Adjust water systems to provide required or design quantities.

- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.
- G. Three way valves shall be tested and balanced for flow capacities at full coil flow and full bypass flow, as indicated on the drawings or at a maximum coil flow, whichever is less.

3.8 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

- 1. Variable Air Volume Units
- 2. Diffusers, Registers and Grilles

B. REPORT FORMS

- 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone number of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - j. Report date
- 2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
 - e. Nomenclature used throughout report

- f. Test conditions
- 3. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date
- 4. Heating Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Water flow, design and actual
 - g. Water pressure drop, design and actual
 - h. Entering water temperature, design and actual
 - i. Leaving water temperature, design and actual
 - j. Entering air temperature, design and actual
 - k. Leaving air temperature, design and actual
 - l. Air pressure drop, design and actual
 - m. Coils with 3 way control valves shall have flow measured at full coil flow and full bypass flow. The bypass balancing valve shall be adjusted for flow as indicated on the drawings or at a maximum coil flow, whichever is less.
- 5. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure

- i. Air temperature
- j. Air correction factor
- 6. Variable Air Volume Units (VAV Box) Data:
 - a. Manufacturer
 - b. Type, constant, variable, single, dual duct
 - c. Identification/number
 - d. Location
 - e. Model number
 - f. Size
 - g. Minimum static pressure
 - h. Minimum design air flow
 - i. Maximum design air flow
 - j. Maximum actual air flow
 - k. Inlet static pressure
- 7. Air Distribution Test Sheet (Diffusers, Registers and Grilles):
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow

END OF SECTION

**SECTION 23 0700
HVAC INSULATION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install insulation to hot and cold surfaces of piping, tanks, ductwork, fittings and other surfaces.
- B. Insulation shall include insulating materials, jackets, adhesive, mastic coatings, tie wire and other materials as required to complete the insulating work.

1.2 CODES AND STANDARDS

- A. Insulating materials, jackets and mastics shall meet flame spread, fuel contribution and smoke developed ratings in accordance with NFPA-90A. Flame spread rating in accordance with NFPA 255, ASTM E-84 or UL 723 of not more than 25; smoke developed rating of not more than 50, unless otherwise noted in this section.
- B. Insulation that has been treated with a flame-retardant additive to meet the flame spread and smoke developed ratings shown above is not permitted.
- C. Insulation materials shall be noncorrosive to the materials they are applied to, including stress corrosion cracking of stainless steel, and shall not breed or promote fungus and bacteria.
- D. Insulation shall meet or exceed all requirements of the 2012 International Energy Conservation Code.

1.3 QUALIFICATION

- A. Insulating materials by Owens-Corning, Aracell, Pittsburgh-Corning, Knauf, Johns Manville, or approved equivalent.
- B. Mastics and adhesives as recommended by insulation manufacturer.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, flame spread and smoke development rating, k-value, density, temperature limitations, sound absorption coefficients, thickness, and furnished accessories for each mechanical system requiring insulation.

PART 2 PRODUCTS

2.1 PRODUCTS

A. Description:

- 1. Type A: Preformed, sectional, heavy density fiberglass insulation, suitable for operating temperatures form -20° F to $+850^{\circ}$ F. Equipped with factory-applied, all-service vapor barrier jacket constructed of white Kraft paper bonded to aluminum foil reinforced with fiberglass yarn, with pressure-sensitive, self-sealing longitudinal laps and butt strips. Thermal conductivity of 0.23 BTU-in/hr-ft²-°F @ 75° F mean temperature. Water vapor permeance of 0.02 perms. Johns Manville "Micro-Lok HP or approved equivalent.

Mean Temperature Rating (F)	Conductivity BTU in/(hr sqft F)
250	0.32 - 0.34
200	0.29 - 0.32
150	0.27 - 0.30
125	0.25 - 0.29
100	0.21 - 0.28
75	0.21 - 0.28

2. Type I: Fiberglass duct wrap, 1.5 PCF density, fabricated of inorganic glass fibers bonded with thermosetting resin with factory applied white metalized polypropylene scrim-fraft (PSK) facing, suitable for operating temperature up to +250° F. Thermal conductivity of 0.26 BTU-in/hr-ft²-°F @ 75° F mean temperature. Water vapor permeance of 0.02 perms. Knauf "Duct Wrap" or engineer approved equivalent.
3. Type J: Flexible fiberglass duct liner, 1.5 PCF density, fabricated of inorganic glass fibers bonded with thermosetting resin, with mat face suitable for air velocities up to 4000 FPM and operating temperatures up to +250° F. Thermal conductivity of 0.25 BTU-in/hr-ft²-°F @ 75° F mean temperature. Knauf "Duct Liner E-M" or engineer approved equivalent.

2.2 INSULATION JACKETS

- A. 20-mil high impact PVC secured with spray contact adhesive. All PVC jacketing shall meet the 25/50 SDR. Manville "Zeston 2000" or equivalent.
- B. 6-oz/sq yd UL listed cotton canvas fabric secured with Childers CP50 lagging adhesive.
- C. Fitting and valve jackets shall be premolded PVC with joints and seams sealed with a spray contact adhesive or vapor barrier mastic. Premolded jackets shall be Manville "Zeston 2000" or approved equivalent.
- D. At wall penetrations and on exterior pipe, provide an additional jacket of 0.020 inch thick smooth finish aluminum. Metal jacket shall have factory applied moisture barrier. Fitting and valve covers to be preformed of same material as adjacent metal jacket
- E. Where PVC or metal jackets are used, delete the factory applied ASJ on pipe and equipment operating above 75° F.
- F. PVC jackets shall be used in the following areas and systems:
 1. Whenever piping is routed exposed through occupied spaces.
 2. Premolded PVC at all fittings and valve jackets.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use only experienced applicators regularly engaged in the trade. Rough work will be rejected. Application details shall be in accordance with the insulation materials supplier's recommendations, except where a higher standard is specified.
- B. Install materials after systems have been tested and approved. Material such as rust, scale, dirt and moisture shall be removed from surfaces to be insulated.
- C. Insulation shall be kept clean and dry at all times.
- D. Where pipes and ducts pass through fire rated walls, floors and partitions, a fire seal shall be provided.

3.2 PIPE INSULATION INSTALLATION

- A. Insulate fittings, valves, unions, flanges, strainers, flexible connections and expansion joints with premolded or mitered segments of same insulating material as for adjacent pipe covering.
- B. Pipe insulation shall continue through sleeves and hangers with vapor barrier and/or jacket.

- C. Insert to be between support shield and piping but under the finish jacket. Provide an insert at hangars not less than 6 inches long, of same thickness and contour as adjoining insulation, to prevent insulation from sagging at support points. Inserts shall be heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.
- D. Neatly finish insulation at supports, protrusions and interruptions.
 - 1. On hot systems where fittings are to be left exposed, insulation ends shall be beveled away from bolts for easy access.
 - 2. On cold systems, valve stems shall be sealed with caulking which allows free movement of the stem, but provides a seal against moisture incursion.
- E. For outdoor pipe insulation, increase pipe insulation thickness by ½" from thickness listed in schedule.
- F. Wherever piping penetrates a floor or is exposed in a finished area such as kitchens, furnish a floor pipe escutcheon and/or PVC (white) jacket to protect insulation and allow for a smooth finish for cleaning.

3.3 DUCT COVERING APPLICATION

- A. Covering shall be cut slightly longer than circumference of duct to ensure full thickness at corners. Insulation shall be applied with edges tightly banded, and shall be adhered to duct with fire-resistant adhesive. Adhesive shall be applied so that insulation conforms to duct surfaces uniformly and firmly.
- B. In addition to the adhesive, the insulation shall be additionally secured to the bottom of ducts 18" or wider by means of adhesive pins and speed clips. The protruding ends of the pins shall be cut off flush after the speed clips have been applied. The vapor barrier facing shall be thoroughly sealed with a vapor barrier mastic and tape where the pins have pierced through. The vapor barrier shall be continuous to prevent condensation. Insulation shall not be compressed at any location so as to reduce insulating characteristics.
- C. Joints shall be sealed with 2" wide pressure-sensitive tape or vapor barrier tape or strips, using a fire-resistive adhesive. Cuts or tears shall be sealed with strips of vapor barrier jacket applied with adhesive or pressure-sensitive tape.

3.4 PIPE INSULATION SCHEDULE (BASED ON 2012 IECC)

SERVICE	TEMP (°F)	TYPE	NOMINAL PIPE SIZE (INCHES)				
			<1	1 TO <1-1/2	1-1/2 TO <4	4 TO <8	8+
Heating Water, Condensate	141 - 201	A	1-1/2"	1-1/2"	2"	2"	2"

3.5 MINIMUM DUCT INSULATION SCHEDULE (BASED ON 2012 IECC)

SERVICE	TYPE	THICKNESS
Supply Air Ducts	I	2"
Diffusers (top/backside)	I	2"
Transfer Duct/Return Duct	J	1"

END OF SECTION

**SECTION 23 0900
INSTRUMENTATION AND CONTROL FOR HVAC**

PART 1 GENERAL

1.1 SUMMARY

- A. Temperature control system shall be provided and installed by Johnson Controls under a separate contract with the IDOT and are not part of this bid. This contractor shall be responsible for items called out to be provided/installed by mechanical contractor throughout this specification section. This contractor shall be responsible for coordinating with Johnson Controls prior to bid.
- B. Provide materials, labor, and supervision necessary to furnish and install a Direct Digital Control (DDC) system. The DDC system herein specified shall be fully integrated and installed as a complete package by the Direct Digital Control Manufacturer. The system shall include all computer software and hardware, operator input/output devices, automation sensors and controls, wiring, piping, installation, supervision and labor, calibration, adjustments and check out necessary for a complete and fully operational system.

1.2 QUALIFICATIONS

- A. The control system shall meet specifications and qualifications as described. The controls contractor shall have a minimum of five years experience associated with variable air volume systems and hot water systems and other systems as required by the sequence of operations.
- B. The DDC controls system shall be an extension of the existing Johnson Controls system.
- C. All work is to be installed by a qualified person skilled in the installation of electronic automatic control systems. The control contractor is responsible for the proper installation of the control system.
 - 1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
 - 2. The installer shall have a service office within 50 miles of the project site and provide 24-hour response in the event of a customer call.
- D. The contractor may elect to subcontract the installation of the electronic control system but will be responsible in total as outlined above.
- E. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing prior to bid date. Spare parts shall be available for at least 10 years after completion of this contract. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.

1.3 WORK BY OTHERS

- A. The following incidental work shall be furnished by the Mechanical Contractor under the supervision of this Contractor.
 - 1. Install automatic valves and separable wells.
 - 2. Furnish and install all necessary valves, pressure taps, flow meters, water, drain and overflow connections and piping.

3. Furnish and install all necessary piping connections required for flow devices, valve position indicators, etc.
4. Install all automatic dampers and minimum outdoor air stations, airflow stations.
5. Provide necessary blank off plates (safing) required to install dampers that are smaller than duct size.
6. Assemble multiple section dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors.
7. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and affix and seal permanently in place only after stratification problem has been eliminated.
8. Provide access door or other approved means of access through ducts for service to control equipment.

1.4 DESCRIPTION

- A. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems on this project.
- B. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.
- C. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.
- D. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.
- E. The documentation is schematic in nature. The Contractor shall provide hardware and software necessary to implement the functions and sequences shown.

1.5 SUBMITTALS

- A. Qualification of Guaranteed Unit Pricing
 1. A list of pricing criteria for components that include remote control units, foundation modules, input/output modules, expansion modules, stand alone controller, modems, damper actuators, valves, valve actuators, sensors, transmitters, controllers, relays, EP switches, PE switches, accessories, thermostats, standard software, special software, and any other items necessary for future expansion of the system.
 2. Include an hourly rate labor cost for 24-hour on call service technicians.
 3. It is desired to obtain a guarantee on the pricing criteria (including any multiplier) for a period of five (5) years not to exceed cost of living index. The submittal must indicate the guaranteed prices and be signed by an officer of the control company.
 4. The pricing criteria list shall be submitted to the Owner for review and approval upon request.

5. A submittal of the owner training program will be required for review and approval by the Owner.
 6. An Owner approved guaranteed unit pricing submittal is required upon request.
 7. Preliminary wiring/communications hierarchy indicating communication levels between devices containing microprocessors.
- B. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until submittals have been reviewed by the Engineer and Owner for conformity with the plan and specifications. All shop drawings shall be done on AutoCAD, and provided to the Engineer for review and to the Owner on electronic media.
- C. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.
- D. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
- E. Submit the following within 30 days of contract award:
1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
 2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
 3. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
 - a. Building Controllers, Custom Application Controllers, and Application Specific Controllers
 - b. Operator Interface Computer
 - c. Auxiliary Control Devices
 - d. Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling.
 - e. Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled.
 - f. Points list showing all system objects, and the proposed English language object names.
 - g. Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project.
 - h. Color prints of proposed graphics with a list of points for display.

- F. Project Record Documents: Upon completion of installation submit five (5) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
1. Project Record Drawings - These shall be as-built versions of the submittal shop drawings. One set of magnetic media including CAD .DWG or .DXF drawing files shall also be provided.
 2. Operating and Maintenance (O & M) Manual - These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
 - a. Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
 - b. Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
 - c. Programming Manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.
 - d. Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
 - e. A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided
 - f. One set of magnetic media containing files of all color-graphic screens created for the project.
 - g. A list of recommended spare parts with part numbers and supplier.
 - h. Complete original issue documentation, installation and maintenance information for all third party hardware provided including computer equipment and sensors.
 - i. Complete original issue diskettes for all software provided including operating systems, programming language, operator workstation software, and graphics software.
 - j. Licenses, Guarantee, and Warrantee documents for all equipment and systems.
 - k. Recommended preventive maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.
- G. Training Manuals: The Contractor shall provide a course outline and training manuals for all training classes at least six weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer and shall be completed at least 3 weeks prior to first class.

1.6 CODES & STANDARDS

- A. Input/output devices, specified or future, associated with the DDC control system shall be ASCII (American Standard Code for Information Interchange) coded with standard EIA (Electronic Industries Association) interface hardware.
- B. Wiring performed by the DDC Contractor shall be installed in accordance with all applicable local, state, and national codes.
- C. Instrumentation hardware shall be supplied to directly interface with Instrument Society of America (ISA) Standards.
- D. Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.
 - 1. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
 - 2. National Electrical Code - NFPA 70.
 - 3. Federal Communications Commission - Part J.

1.7 WARRANTY

- A. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.
- B. Operator workstation software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.

1.8 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project developed hardware and software shall become the property of the Owner. These include but are not limited to: Project graphic images, Record drawings, Project database, Job-specific application programming code, All documentation.

1.9 SYSTEM PERFORMANCE

- A. Performance Standards. The system shall conform to the following:
 - 1. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points.
 - 2. Graphic Refresh. The system shall update all dynamic points with current data within 30 seconds.
 - 3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 30 seconds. Analog objects shall start to adjust within 30 seconds.
 - 4. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current, within the prior 60 seconds.
 - 5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.

6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Multiple Alarm Annunciation. All workstations on the network shall receive alarms within 5 seconds of each other.
9. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

a. TABLE I -- REPORTING ACCURACY

<u>Measured Variable</u>	<u>Reported Accuracy U.N.O</u>
Space temperature	±1°F
Ducted air	±2°F
Outside air	±2°F
Water temperature	±1°F
Delta-T	±0.25°F
Relative humidity	±5% RH
Water flow	±5% of full scale
Air flow (terminal)	±10% of reading *Note 1
Air flow (measuring stations)	±5% of reading
Air pressure (ducts)	±0.1" W.G.
Water pressure	±2% of full scale *Note 2
Electrical power	5% of reading
Carbon dioxide (co2)	±20 PPM

Note 1: 10%-100% of scale

Note 2: for both absolute and differential pressure

PART 2 PRODUCTS

2.1 OPERATOR INTERFACE (EXISTING PC)

- A. Furnish a full graphics system to interface with the owners existing PC "operator workstation". The system shall include all software and hardware necessary to provide full graphics at the location of the existing operator workstation. Verify the available PC system data and furnish additional hardware to meet the requirements of this section.
- B. All alarms shall print out on the owners existing printer.

2.2 SUPERVISED TRAINING

- A. Provide 2 working days (16) of supervised training for up to 5 of the Owners representatives simultaneously to include system operation, programming, report generation, and construction of graphics. Training shall take place at the project site during the normal work hours of 8am to 5pm weekdays. Training shall include:
 - 1. Explanation of drawings, operations and maintenance manuals.
 - 2. Walk-through of the job to locate control components.
 - 3. Operator workstation and peripherals.
 - 4. DDC custom application controllers, ASC, TEC, SAC operation and function.
 - 5. Operator control functions including graphic generation and field panel programming.
 - 6. Explanation of adjustment, calibration and replacement procedures.
- B. Provide operator orientation to the overall operational program, equipment functions (both individually and as part of the total integrated system), commands, advisories, and appropriate operator intervention required in responding to the systems operation. An Owner's manual prepared for this project by the DDC manufacturer shall be used in addition to the instruction. Five copies of the Owner's manual shall be provided.
- C. The technical training will also include adequate instruction and documentation to enable maintenance staff to trouble shoot, repair, and maintain entire system and recreate all programming without factory assistance.
- D. The technical training will also include adequate instruction and documentation to allow expansion by the maintenance staff of the system in the future to interface with existing pneumatic, electric, and electronic control systems. This would include activities associated with hardware and software.

2.3 COMMISSIONING OF SYSTEM

- A. The Temperature Control Contractor shall verify that each analog and binary device and operator responds correctly to the signal given at the control panel by physically changing each parameter and witnessing the correct corresponding reaction. The results of this testing shall be logged in a written report and submitted to the Owner and Engineer prior to final payment.
- B. The Owner's representative shall witness the commissioning of the system.

2.4 SYSTEM SOFTWARE

- A. Operating System. Furnish a commercially available, concurrent multi-tasking operating system. The operating system shall also support the use of other common software applications that operate under Microsoft Windows. Examples include Lotus 123, Microsoft Excel, Word Perfect, and Paradox. Acceptable operating systems are Windows NT, Windows 95 (or later version), Unix, and OS/2.
- B. System Graphics. The Operator Workstation software shall be graphically oriented. The system shall allow display of up to 10 graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on line. An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the point.

1. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in industry standard formats such as PCX, TIFF, and GEM. The graphics generation package shall also provide the capability of capturing or converting graphics from other programs such as Designer, or AutoCAD.
2. Graphics Library. Furnish a complete library of standard HVAC equipment such as chillers, boilers, air handlers, terminals, unit heaters, fan coils, and unit ventilators. This library shall also include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program. All individual pieces of equipment shall be graphically represented with input and output values (both binary and analog).
3. Engineering Units. Allow for selection of the desired engineering units in the system. Unit selection shall be able to be customized by locality to select the desired units for each measurement. Engineering units on this project shall be Standard Inch Pound.

2.5 SYSTEM APPLICATIONS

- A. Each workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation.
 1. Automatic System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each building controller. This database shall be updated whenever a change is made in any panel in the system. The storage of this data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first workstation to detect the loss shall automatically restore the database for that panel.
 2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
 3. System Configuration. The workstation software shall provide a graphical method of configuring the system. The user with proper security shall be able to add new devices, assign modems to devices, and obtain a visual riser diagram of the system. This shall allow for future system changes or additions.
 4. On-Line Help. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
 5. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time shall be set per operator password. All system security data shall be stored in an encrypted format.
 6. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.

- a. Alarm Reactions. The operator shall be able to determine what actions, if any, are to be taken, by object (or point), during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day. An object in alarm that has not been acknowledged within an operator specified time period shall be re-routed to an alternate operator specified alarm receipt device.
 - b. Binary Alarms. Each binary object shall be set to alarm based on the operator specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.
 - c. Analog Alarms. Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.
7. Trend Logs. The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, and once a month shall be selectable. All trends shall start based on the hour. Each trend shall accommodate up to 64 system objects. The system operator with proper password shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk. Trend data shall be able to be viewed and printed from the operator interface software. They shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages.
 8. Alarm and Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the workstation.
 9. Object and Property Status and Control. Provide a method for the operator with proper password protection to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on graphics, or through custom programs.
 10. Clock Synchronization. The real time clocks in all building control panels and workstations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks, daily from any operator designated device in the system. The system shall automatically adjust for daylight savings and standard time if applicable.
 11. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer.
 - a. Custom Reports: Provide the capability for the operator to easily define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title and the name of the facility.
 - b. Standard Reports. The following standard system reports shall be provided for this project. These reports shall be readily customized to the project by the owner.

- 1) Electrical Meter Report: Provide a monthly report showing the daily electrical consumption and peak electrical demand for each building meter. Provide an annual (12 month) summary report showing the monthly electrical consumption and peak demand for each meter.
 - 2) Gas Meter Report: Provide a monthly report showing the daily natural gas consumption for each meter. Provide an annual (12 month) report that shows the monthly consumption for each meter.
 - 3) Weather Data Report: Provide a monthly report showing the daily minimum, maximum and average outdoor air temperature and the number of heating and cooling degree days for each day. Provide an annual (12 month) report showing the minimum, maximum and average outdoor air temperature for the month and the number of heating and cooling degree days for the month.
 - 4) Tenant Override Reports: Provide a monthly report showing the daily total time in hours that each tenant has requested after hours HVAC and lighting services. Provide an annual summary report that shows the override usage on a monthly basis.
- B. Workstation Applications Editors. Each PC workstation shall support full screen editing of all system applications. Provide editors for each application at the PC workstation. The applications shall be downloaded and executed at the appropriate controller panels.
1. Controller. Provide a full screen editor for each type controller and application that shall allow the operator with proper password to view and change the configuration, name, control parameters, and system set-points.
 2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. The advance and delay time for each object shall be adjustable from this master schedule.
 - a. An operator with proper password level shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and/or dates.
 - b. Occupied/Unoccupied schedules shall be individually adjustable for each terminal unit. The user shall be able to easily change the schedule of rooms, etc. An occupied space shall automatically start the unit in normal start up mode.
 3. Equipment Coordination. Provide a full screen editor that allows equipment to be grouped for proper operation as specified in the sequence of operations. This shall include the coordination of VAV boxes with their associated Air Handling Equipment.
 4. Custom Application Programming. Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded. The programming language shall have the following features:
 - a. The language shall be English language oriented and be based on the syntax of programming languages such as BASIC. It shall allow for free form or fill in the blank programming. Alternatively, the programming language can be graphically-based using function blocks as long as blocks are available that directly provide the functions listed below, and that custom or compound function blocks can be created.

- b. A full screen character editor/programming environment shall be provided. The editor shall be cursor/mouse-driven and allow the user to insert, add, modify, and delete code from the custom programming. It shall also incorporate word processing features such as cut/paste and find/replace.
- c. The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.
- d. The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and to observe any intermediate values and or results. The debugger shall also provide error messages for syntax and execution errors.
- e. The programming language shall support conditional statements (IF/THEN/ELSE/ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
- f. The programming language shall support floating point arithmetic using the following operators: +, -, /, x, square root, and xy. The following mathematical functions shall also be provided: natural log, log, absolute value, and minimum/maximum value from a list of values.
- g. The programming language shall have pre-defined variables that represent clock time, day of the week, and date. Variables that provide interval timing shall also be available. The language shall allow for computations using these values.
- h. The programming language shall have ability to pre-defined variables representing the status and results of the System Software, and shall be able to enable, disable, and change the values of objects in the system.

2.6 POWER FAIL RESTART

- A. In the event of the loss of normal power, there shall be an orderly shutdown of the digital panels and workstation to prevent the loss of data base or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the clock and all volatile memory for a minimum of 72 hours.
- B. Upon restoration of normal power, the panels shall automatically resume full operation without manual intervention.
- C. Should Digital panel memory be lost for any reason, the user shall have the capability of reloading the panel via the local RS-232 port, or telephone line dial-in.

2.7 SYSTEM SOFTWARE

- A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.
- B. System Security
 - 1. User access shall be secured using individual security passwords and user names.
 - 2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.
 - 3. User logon/logoff attempts shall be recorded.

4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
- C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, nightsetback, and economizer actions. Each schedule may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:
1. Weekly Schedule. Provide separate schedules for each day of the week. Provide separate scheduling that is easily edited by the operator to define the occupied hours for each office, lab, and room.
 2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
 3. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
 4. Optimal Start/Stop. The scheduling application outlined above shall support an optimal start/stop algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less than and greater than 24 hours. Provide the ability to modify the start/stop algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.
- D. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages and display graphics.
- E. Remote Communications. The system shall have the ability to dial out in the event of an alarm. Receivers shall include PC Workstations and text messages to cell phones. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications.
- F. Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts, and/or calendar date limits.
- G. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, set-point, and PID gains shall be user-selectable. The set-point shall optionally be chosen to be a reset schedule.
- H. Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts shall be user-selectable.
- I. Anti-Short Cycling. All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected as noted above for the chillers.

2.8 BUILDING CONTROLLERS

- A. General. Provide Building Controllers to provide the performance specified in this section. Each of these panels shall meet the following requirements.
1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the global strategies described in System software section.
 2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 3. The controller shall provide a communications port for connection of a Portable Operators Terminal.
 4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 5. Data shall be shared between networked Building Controllers.
 6. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. Assume a predetermined failure mode.
 - b. Generate an alarm notification.
- B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 32 F to 120 F.
- C. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- D. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- E. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.

2.9 CUSTOM APPLICATION CONTROLLERS

- A. General. Provide Custom Application Controllers to provide the performance specified in this specification. Each of these panels shall meet the following requirements.
1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the local strategies described in System software section.
 2. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 3. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 4. Data shall be shared between networked Controllers.

5. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. Assume a predetermined failure mode.
 - b. Generate an alarm notification.
- B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
 1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA Type 4 waterproof enclosures, and shall be rated for operation at -40° F to 150° F.
 2. Controllers used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32° F to 120° F.
- C. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- D. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- E. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.

2.10 APPLICATION SPECIFIC CONTROLLERS

- A. General. Application specific controllers (ASC) are microprocessor-based DDC controllers which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
 1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 2. Each ASC will contain sufficient I/O capacity to control the target system.
- B. Environment. The hardware shall be suitable for the anticipated ambient conditions.
 1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA Type 4 waterproof enclosures, and shall be rated for operation at -40° F to 150° F.
 2. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32° F to 120° F.
- C. Serviceability. Provide diagnostic LEDs for power, and communications. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- D. Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.
- E. Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80%.
- F. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.

2.11 COMMUNICATIONS

- A. The controls Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the inter-network.
- B. All Building Controllers shall have a communications port for connections with the operator interfaces.
- C. Communications services over the inter-network shall result in operator interface and value passing that is transparent to the inter-network architecture as follows:
 - 1. Connection of an operator interface device to any one controller on the inter-network will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the inter-network.
 - 2. All database values (i.e. points, software variable, custom program variables) of any one controller shall be readable by any other controller on the inter-network. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform inter-network value passing.
- D. The time clocks in all controllers shall be automatically synchronized daily.

2.12 INPUT/OUTPUT INTERFACE

- A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on/off signals or from remote devices. The binary inputs shall provide a wetting current of at least 12 ma to be compatible with commonly available control devices.
- D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 2 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.
- E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
- F. Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device.

2.13 AUXILIARY CONTROL DEVICES

A. Electronic damper/valve actuators.

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. Furnish a separate damper actuator for each damper greater than 48" in any dimension.
2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
3. All rotary spring return actuators shall be capable of both clockwise and counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
5. All 24 VAC/DC actuators shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not require more than 11 VA.
6. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
7. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
8. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
9. Actuators shall be Underwriters Laboratories Standard 873 listed.
10. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque. Actuators shall include a stroke limiting device.

B. Control Valves

1. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled, shown, or as indicated in the sequence of operation.
2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - a. Water Valves:
 - 1) Two-way: 150% of total system (pump) head.
 - 2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
3. Water Valves:
 - a. Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.

- b. Sizing Criteria:
 - 1) Two-position service: Line size.
 - 2) Two-way modulating service: Pressure drop shall be equal to the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or a maximum of 4 psi.
 - 3) Three-way Modulating Service: Pressure drop equal to the pressure drop through the coil exchanger (load), 4 psi maximum.
 - 4) Valves 1/2" through 2" shall be bronze body or cast brass ANSI Class 250, spring loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball.
 - 5) 2-1/2" valves and larger shall be cast iron ANSI Class 125 with guided plug and Teflon packing.
- 4. General
 - a. Water valves shall fail normally open or closed as scheduled on plans or as follows:
 - 1) Duct mounted heating coil valves - normally closed.
 - 2) Heating coils in air handlers - normally open.
 - 3) Other applications - as scheduled or as required by sequence of operation.
- C. Sensors:
 - 1. Room and duct humidity sensors shall be of the thin film capacitance type containing a humidity sensitive material that modifies its dielectric constant to maintain accuracy of + 5% RH @ 77° F, range of 20% to 95% RH, including hysteresis, linearity, and repeatability. The sensor shall be rated for operation between 15 to 170 degrees F.
 - 2. All temperature and humidity sensors shall be of the electronic type. The temperature sensors shall be resistance temperature device (RTD) or thermistor type.
 - a. Room sensors shall include covers for horizontal or vertical mounting and concealed adjustments. Sensors shall include adjustable slide temperature sensors, and two-hour push button override. All wall sensors located on exterior walls or surfaces that will cause abnormal sensor readings shall be furnished with an insulated base.
 - b. Room sensors shall have a range of 32-120 degrees F with a factory calibration of 74° F. Accuracy shall be plus or minus 1 degree F at calibration point.
 - c. Duct Temperature Sensors - accuracy of + 1° F @ 77 deg F. Duct air sensors shall be duct single point, averaging probe or averaging bulb as required under sequence of operation.
 - d. Use insertion elements with a brass well with a minimum length of 2.5"
 - e. Outside air sensor shall have watertight inlet fitting and contain a shield from direct sunlight.
 - 3. Duct pressure sensors shall be compatible for use in HVAC air distribution or air handling systems and shall have an accuracy of plus or minus .1" w.g. Sensors shall have an operating temperature range from 0-175° F and 10-90% relative humidity. Sensors shall be Mamac Systems or approved equal.

4. The Carbon Dioxide sensors shall have a measurement range from zero to 2000 parts per million (ppm) and an initial accuracy of plus or minus 20 ppm with a deviation of no more than 100 ppm after two years of continuous service. The response time shall not exceed 120 seconds. The operating temperature shall be between 55° F and 90° F and the operating relative humidity range shall be from 5 to 100%. The carbon dioxide sensor shall be by Vaisala or Engineer approved equal.
- D. Differential Pressure Switch (static) - shall sense static differential pressure for negative application (exhaust air duct), positive pressure (supply duct), or a differential pressure switch (filters) and shall be automatic reset type with an adjustable range from .05-12" WC.
 - E. Current Sensing Relays - shall be split core type with adjustable high and low trip settings. Range shall not exceed 175% of expected input. Coordinate special requirements for systems with variable speed drives.
 - F. Relays
 1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
 2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA Type 1 enclosure when not installed in local control panel.
 - G. Transformers and Power Supplies
 1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
 2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
 3. Unit shall operate between 0° C and 50° C.
 4. Unit shall be UL recognized.
 - H. Local Control Panels
 1. All indoor control cabinets shall be fully enclosed NEMA Type 1 construction with hinged door, key-lock latch, removable sub-panels. A single key shall be common to all field panels and sub-panels.
 2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control termination's for field connection shall be individually identified per control drawings.
 3. Provide on/off power switch with over-current protection and main air gauge for control power sources to each local panel.
 - I. Auxiliary Devices
 1. Furnish and install all necessary auxiliary electronic devices as appropriate to accomplish the sequence as specified. These totally electronic devices shall include (but not be limited to) such items as load limiting controllers, low signal selectors, high signal selectors, remote reset control devices, floating alarm units, staging networks, damper position indicators, unison amplifiers, reversing networks, sequencing networks and electronic power supplies.

2.14 WIRING

- A. All electric wiring required for the control system and any interlock wiring required for the controls sequence shall be provided by the Temperature Control Contractor.
- B. All line voltage control wiring shall be run in conduit. Reference Division 26 for requirements.
- C. Wire shall be a minimum of #18 gauge, color coded, stranded wire for all low voltage, electronic circuit with "spares" installed (one for every group of 10 wires) in conduit.
- D. Coordinate the requirements for 120V circuits for the ASC's. All control transformers shall be the responsibility of this contractor. Reference the electrical drawings for circuit locations.

2.15 SEQUENCE OF OPERATION

- A. See Drawing for Sequences

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install wiring in a neat and workmanlike manner. Wiring to finished spaces shall be run concealed.
- B. All work is to be installed by a qualified person skilled in the installation of electronic control systems. The control company representative is responsible for the proper installation of the control system and will provide supervision of the installation.
- C. Install terminal equipment controllers on terminal boxes and provide all necessary control wiring.
- D. Install system and materials in accordance with manufacturer's instructions and roughing -in drawings, and details and drawings. Install electrical work and use electrical products complying with requirements of applicable Division 26 sections of these specifications. Mount controllers at convenient locations and heights.
- E. Check and verify location of thermostats with plans and room details before installation. Install thermostats 48 inches above floor to meet the Americans with Disabilities Act (ADA). Align with lighting switches and humidistats.
- F. Wiring. The term "wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.
- G. Wiring System. Install complete wiring system for electric-electronic temperature controls. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
- H. Number-code or color-code conductors, appropriately for future identification and servicing of control system.

3.2 ON-SITE TESTING

- A. Provide Engineer and/or Owner approved operation and acceptance testing of the complete system. The Engineer and/or Owner will witness all tests.
- B. Field Test. When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed in line. All testing, calibrating, adjusting and final field tests shall be completed by the installer. Provide a cross-check of each control point within the system by making a comparison between the control command and the field-controlled device. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power. Submit the results of functional and diagnostic tests and calibrations to the Engineer for final system acceptance.

C. Compliance Inspection Checklist. Submit in the form requested, the following items of information to the Owner's representative and Architect/Engineer for verification of compliance to the project specifications. Failure to comply with the specified information shall constitute non-performance of the contract. The contractor shall submit written justification for each item in the checklist that he is unable to comply with. The Owner's Representative and the Architect/Engineer will initial and date the checklist to signify Contractor's compliance before acceptance of system.

1. Verify to the Owner's Representative and Architect/Engineer in letter form that supplier has in-place support facility. Letter shall show location of support facility, name and titles of technical staff, engineers, supervisors, fitters, electricians, managers and all other personnel responsible for the completion of the work on this project

User _____ Date _____ A/E _____ Date _____

2. Manually generate an alarm at the remote DDC Controller as selected by the Architect/Engineer to demonstrate the capability of the workstation and alarm printer to receive alarms within 5 seconds.

User _____ Date _____ A/E _____ Date _____

3. Disconnect one DDC Controller from the network to demonstrate that a single device failure shall not disrupt or halt peer-to-peer communication. Panel to be disconnected shall be selected by the Architect/Engineer.

User _____ Date _____ A/E _____ Date _____

4. At a DDC Controller of the Architect/Engineer's choice, display on the portable operator's terminal:

a. At least one temperature setpoint and at least one status condition; i.e.: on or off for a system or piece of equipment attached to the panel as well as for points at another DDC Controller on the network.

b. The diagnostic results as specified for a system or piece of equipment attached to that panel as well as for a system or piece of equipment attached to another DDC Controller.

c. The ability to add a new point to the DDC Controller with the POT and have it automatically uploaded to the workstation to modify that panel's stored database.

User _____ Date _____ A/E _____ Date _____

5. At the Architect/Engineer's choice, disconnect the trunk connection to demonstrate its lack of reliance on a DDC Controller to maintain full control functionality.

User _____ Date _____ A/E _____ Date _____

3.3 SERVICE AND GUARANTEE

A. General Requirements. Provide all services, materials and equipment necessary for the successful operation of the entire BAS System for a period of one year after completion of successful performance test. Provide necessary material required for the work. Minimize impacts on facility operations when performing scheduled adjustments and non-scheduled work.

B. Description of Work. The adjustment and repair of the system includes all computer equipment, software updates, transmission equipment and all sensors and control devices. Provide the manufacturer's required adjustment and all other work necessary.

- C. Personnel. Provide qualified personnel to accomplish all work promptly and satisfactorily. Owner shall be advised in writing of the name of the designated service representative, and of any changes in personnel.
- D. Schedule of Work. Provide two minor inspections at 6 month intervals and two major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude, and all work required as specified. Schedule major inspections in July and January. Minor inspections shall include visual checks and operational test of all equipment delivered. Major inspections shall include all work described for minor inspections and the following work:
 - 1. Clean all equipment, including interior and exterior surfaces.
 - 2. Perform signal, voltage and system isolation checks of system workstations and peripherals.
 - 3. Check and calibrate each field device. Check all analog points and digital points.
 - 4. Run all diagnostics and correct all previously diagnosed problems.
 - 5. Resolve and correct any previous outstanding problems.
- E. Emergency Service. Owner shall initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the complete system. Furnish Owner with a telephone number where service representative can be reached at all times. Service personnel shall be at the site within 4 hours after receiving a request for service. Restore the control system to proper operating condition within 24 hours.
- F. Operation. Performance of scheduled adjustment and repair shall verify operation of the system as demonstrated by the initial performance test.
- G. Systems Modifications. Provide any recommendations for system modification in writing to Owner. Do not make any system modifications, including operating parameters and control settings, without prior approval of Owner. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.
- H. Software. Provide all software updates and verify operation in the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and shall be incorporated into the operations and maintenance manuals, and software documentation.

3.4 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.5 GENERAL WORKMANSHIP

- A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
- F. Coordinate with the testing and balancing contractor to adjust low leakage dampers if damper leak rate exceeds specifications.

3.6 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequate for the environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Install duct static pressure tap with tube end facing directly down-stream of airflow.
- F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.
- I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.7 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
- B. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- C. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.8 WARNING LABELS

- A. Affix plastic labels on each starter and equipment automatically controlled through the Control System including all air handling unit fans at doors. Label shall indicate the following:

C A U T I O N

3.9 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum 1 cm letters on laminated plastic nameplates.

- D. Identify all other control components with permanent labels. Identifiers shall match record documents All plug-in components shall be labeled such that removal of the component does not remove the label.

3.10 CONTROLLERS

- A. Provide a separate Controller for each major piece of HVAC equipment. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.
- C. Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.11 PROGRAMMING

- A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.
- B. Point Naming. System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- C. Software Programming
 - 1. Provide programming for the system as per specifications and adhere to the strategy algorithms provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.
- D. Operators' Interface
 - 1. Standard Graphics. Provide graphics for each major piece of equipment and floor plan in the building. This includes each Chiller system, Air Handlers, all VAV terminals. These standard graphics shall show all points dynamically as specified in the points list.
 - 2. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.
 - 3. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of 16 hours on-site. Tests shall be made in the presence of the Owner or Owner's representative.
- E. Demonstration. A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 4 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

3.12 CLEANING

- A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.
- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.13 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.14 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.15 ACCEPTANCE

- A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

END OF SECTION

**SECTION 23 2113
HYDRONIC PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install complete piping system.

1.2 STANDARDS AND CODES

- A. Pipe materials specified in this Section shall apply to technical sections of Division 23 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.

1.3 PRODUCT HANDLING

- A. 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 well above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. Submit piping schedule listing each pipe material used and systems served.
- B. Submit Product Data which shall include product description, manufacturer, dimensions, size, rough-in requirements, finishes, connections to other equipment and piping, and performance data.

PRODUCTS

2.1 MATERIAL

- A. Pipe Material and Service
 - 1. Copper water tube, hard temper, ASTM B88:
 - a. Type L: Aboveground heating water piping.
 - 2. Black steel pipe ERW, Schedule 40, ASTM A53: heating water.
- B. Fittings
 - 1. Threaded pipe - malleable iron fittings, 125-pound standard flat band water pattern.
 - 2. Grooved fittings –may be used for chilled water and heating water, as approved by Code. Grooved fittings shall be Victaulic, Grinnell, or engineer-approved equivalent.
 - 3. Carbon steel pipe - material and strength shall correspond to pipe specifications. ANSI B31.5.

C. Joints

1. Threaded pipe - make joints using approved pipe joint compound, applied to male threads only. Cut pipe square, cut threads clean, remove burrs, and ream ends to full size of bore. Threads shall not be exposed on chromium-plated pipe.
2. Threadless brass pipe - use brazing alloy which will flow freely at 1300° F, use flux and brazing method as recommended by manufacturer of brazing alloy.
3. Copper water and drainage tube - use 95-5 tin antimony or silver solder, cut pipe square, clean and polish tube ends and inner surface of fittings, apply flux and solder joint as recommended by manufacturer of solder type fittings.

D. Nipples and Unions

1. Nipples shall conform to size, weight, and strength of adjoining pipe. When length of unthreaded portion of nipple is less than 1-1/2", use extra strong nipple; do not use close nipples.
2. For pipe 3" and smaller, use screwed unions; over 3", use flanged unions. For steel and wrought iron pipe, use malleable iron ground joint unions, black or galvanized, to conform to pipe. Cast iron flanged unions are to be gasket type. For threaded brass pipe, use bronze ground joint unions with octagon ends. Install unions on equipment intended to be disassembled.
3. Dielectric unions shall be installed between connections of copper pipe and ferrous piping.

2.2 AIR VENTS

- A. Manual air vents, equivalent to B & G No. 17 SR.
- 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, minimum 3/4" NPS inlet and outlet connections. Equivalent to Bell & Gossett #7 or #87 (#107A for high capacity where noted on Drawings), with copper overflow connection.
- C. Manufacturer: Subject to compliance with requirements, provide vent valves by Bell & Gossett-ITT Fluid Handling Division, Hoffman Specialty-ITT Fluid Handling Divisions, Spirax/Sarco, Watson-McDaniel Co., or an engineer-approved equivalent.

2.3 FLOW BALANCING

A. Automatic Flow Control Valves

1. Where indicated on drawings, provide automatic flow control valves with internal adjustment capability.
2. All internally adjustable cartridges shall include only non-abrasive and non-corrosive thermoplastic materials, whose shape and properties will not change over the life of the valve.
3. The cartridge shall be removable, without removing the valve or disturbing the line plumbing in any way, by unscrewing a plug in the valve body. The cartridge shall remain attached to the inside of the removed plug, to ensure it does not get misplaced and the plug is not re-installed without the cartridge.
4. Each cartridge shall be field adjustable to any of 8 flow rates with an Allen wrench.

5. Valves shall be warranted, by the manufacturer, to be free of defects in material and workmanship for a period of 5 years.
6. Valves shall control flow to within $\pm 5\%$ of design.
7. The valve flow curve shall be smooth over its entire nominal control range. Gaps, bumps and dips in flow curves shall not be acceptable.
8. Manufacturer: Subject to compliance with requirements, provide valves by Bell and Gossett, Taco, Griswold, Nibco, Armstrong, and Grinnell.

2.4 TEMPERATURE AND PRESSURE GAUGE CONNECTOR TAPS

- A. Provide temperature gauge connector taps pressure rated for 500 psi and 200° F (90° C). Construct of brass and finish in nickel-plate, equip with 1/2" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly for dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.
- B. Provide one test kit.
- C. Manufacturer: Subject to compliance with requirements, provide gauge connector taps manufactured by Peterson Engineering Co., Sisco, Trefice, or an engineer-approved equivalent.

2.5 FLEXIBLE CONNECTORS

- A. Flexible connectors through 4 in. size shall be fabricated of a corrugated bronze inner tube with a braided wire stainless steel outer jacket. Tubes to be welded to pipe ends, threaded through 2 in. size, flanged for sizes 2-1/2 in. through 4 inches.
- B. Flexible connectors for pipe sizes larger than 4" shall be fabricated of nylon reinforced rubber with ductile iron flanges and control rods to limit travel.

2.6 LOW PRESSURE Y-TYPE PIPELINE STRAINERS

- A. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 psi working pressure, with Type 304 stainless steel screens.
- B. Threaded Ends 2" and Smaller: Cast-iron body, screwed screen retainer with centered blow-down fitted valve for blow-down.
- C. Copper Piping 2" and Smaller: Use cast bronze strainer equal to Mueller #351 with blow-down valve and cap.
- D. Threaded End 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blow-down fitted with valve for blow-down. Fitted with 3/64 perforated screen.
- E. Flanged Ends 1-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blow-down fitted with valve for blow-down. Fitted with 3/64 perforated screen.
- F. Provide blow-down valve and cap or plug for each strainer.
- G. Manufacturer: Subject to compliance with requirements, provide Y-type strainers manufactured by, Armstrong, Hoffman Specialty, Metraflex, Mueller, Spirax/Sarco, Trane, Watts Regulator, or an engineer-approved equivalent.

2.7 SLEEVES

- A. Sleeves passing through non-load bearing walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: For pipes 2-1/2" in size and smaller - 24-gauge; 3 in. to 6 in. - 22-gauge; over 6 in. - 20-gauge.
- B. Sleeves passing through load bearing walls, concrete beams, fireproof walls, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.
- C. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.
- D. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2 in. above finished floors. Extend sleeves 1 in. above finished floors in areas likely to entrap water and fill space between sleeves and pipe with graphite packing and caulking compound.
- E. Sleeves passing through membrane waterproofing or roofing shall be flashed and sealed.

2.8 PIPE ESCUTCHEONS

- A. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extensions, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.
- D. Manufacturer: Chicago Specialty; Producers Specialty; or Sanitary-Dash.

2.9 FIRE SAFING

- A. Metal piping and sleeves passing through floors, roof, partitions and fire walls, shall be provided with firestop by packing space between pipe and sleeve with UL listed non-sag and self-leveling fire safing insulation per manufacturer's instructions.
- B. Plastic piping passing through fire rated floors and fire rated walls shall be provided with firestop by providing intumescent wrap strip around the pipe, enclosed in steel collar attached to structure.
- C. Cracks, Voids, or Holes Up to 4" Diameter: Use non-sag or self-leveling putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL listed.
- D. Openings 4" or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350oF (121 to 177oC), UL listed.
- E. Seal all holes or voids made by penetrations to ensure an effective barrier against smoke, fire, toxic and combustible gases.
- F. Unless protected, from possible loading or traffic, install firestopping materials in floors having void openings or four (4) inches or more to support the same floor load requirements.

- G. Manufacturer: Subject to compliance with requirements, provide non-sag and self-leveling fire barrier caulk, wrap/strip, moldable putty and sheet forms of one of the following:
1. 3M Brand.
 2. Flame Stop.
 3. Dow Corning.
 4. Metacaulk.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pipe for mechanical systems as shown on the Drawings, as called for in other Sections, and as specified herein.
- B. Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible, form right angles on parallel lines with building walls. Keep pipes close to walls, partitions, and ceilings, offsetting only where necessary to follow walls and avoid interference with other mechanical items. Locate groups of pipes parallel to each other; space at a distance to permit applying full insulation and to permit access for servicing valves. Piping to be run in concealed locations unless indicated exposed, or in equipment rooms.
- C. Install horizontal piping as high as possible without sags or humps so that proper grades can be maintained for drainage. Branch piping shall come off the tops of mains unless shown otherwise.
- D. Locate valves within reachable distance from equipment being served for easy access and operation. Do not locate valves with stems below horizontal.
- E. Check piping for interference with other trades; avoid placing water pipes over electrical equipment.
- F. Where rough-ins are required for equipment furnished by others, verify exact rough-in dimensions with Owner or equipment supplier before roughing-in.
- G. Install automatic temperature control valves, separable wells, humidifiers, pressure taps, and other items as called for and furnished by the temperature controls section.
- H. Install manual air vents for each element of radiation coils at all high points in mains, branches, run outs and at other points likely to entrap air.
- I. Install automatic air vents in boiler and equipment rooms, at points where supply and return lines rise or drop. Extend 1/4" copper overflow line to floor drain and elbow into drain.
- J. Install balance valves with flow meter fittings at each terminal unit and elsewhere as indicated.
- K. Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff valve in strainer blow-down connection. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blow-down connection.
- L. Locate Y-type strainers in supply line ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment:
1. Temperature control valves.
 2. Temperature or pressure regulating valves.
- M. Install control valves, flow switches, temperature sensor walls, gauge taps, flow meters, etc., provided by Temperature Controls Installer.

3.2 PIPING TESTS ALL HEATING, AND COOLING SYSTEMS PIPING

- A. Test pressure piping in accordance with ANSI B31.
- B. General: Provide temporary equipment for testing, including pump and gauges. Test piping system before insulation is installed whenever 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 or air and pressurize for the indicated pressure and time.
 - 1. Required test period is 2 hours.
 - 2. Test each piping system at 150% of operating pressure indicated, but not less than 25-psi test pressure.
 - 3. 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.
- C. Repair piping systems sections that fail the required piping test, by disassembly and reinstallation, using new materials to the extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
- D. Drain test water from piping systems after testing and repair work has been completed.
- E. Heating, cooling, and condenser water system pipes are to be thoroughly flushed and cleaned prior to being put into service. The flushing water must not go through any air handler, chiller, boiler, cooling or heating coils, terminal heating coils, or unit heaters. Strainer screens are to be removed prior to the flushing operation and are to be replaced when the flushing operation has been completed.
 - 1. As soon as possible after the flushing has been completed, the lines are to be filled with treated water to avoid the creation of a corrosive environment inside the pipes.
 - 2. Flushing operations are to be reviewed with and approved by the Owner's representative prior to any flushing operation. Pipe scale, welding slag, and any other debris shall be removed from pipes. The Owner's representative shall determine when the flushing operation is complete.

3.3 SLEEVES

- A. Install sleeves for piping passing through floors, roof, walls, concrete beams, and foundations.
- B. Install fire-proofing per manufacturer's written instructions.

3.4 ESCUTCHEONS

- A. Install escutcheons for pipes entering finished spaces.

3.5 PIPE PENETRATIONS

- A. Penetrations shall be free of debris and dirt. Dam the penetration (when required) with an acceptable material. Apply firestop material to the penetration per manufacturer's installation instructions. Use a caulking gun, putty knife or other normal trade tools. Remove damming materials where necessary after cure. Clean up with Xylene.

3.6 FIRE SAFING

- A. Install fire safing at all penetrations through walls, floors, etc. per manufacturer's installation instructions as required to meet UL listing.

END OF SECTION

**SECTION 23 3113
METAL DUCTS**

PART 1 GENERAL

1.1 SUMMARY

- A. Provide material, devices, labor, and supervision necessary to fabricate and erect ductwork as required by the Drawings and this Section.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.
- B. Shop Drawings: Submit ductwork shop drawings for entire facility, to scale, double line, indicating duct sizes, locations, fittings, equipment, accessories, structural clearances, etc. Do not install ductwork prior to approval of shop drawings by Engineer.
- C. Duct Leakage Test Reports: Submit test report to Engineer and include in O&Ms. Indicate sections tested, test pressure, leakage rate and highlight duct sections that were tested.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Ducts, plenums, apparatus casings, metal gauges, reinforcing, methods of supporting and hanging, and other sheet metal work as called for shall meet all functional criteria defined in Section VII, of the SMACNA "HVAC Duct Construction Standards Metal and Flexible" 1985 Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.
 - 2. Comply with applicable requirements of NFPA 91.

1.4 DESCRIPTION

- A. Air ducts shall be constructed as follows:
 - 1. Supply and return duct in Mechanical Rooms +6" w-g
 - 2. Supply duct upstream of VAV boxes +3" w-g.
 - 3. Supply duct downstream of VAV boxes +2" w-g.
 - 4. Miscellaneous duct (exhaust, transfer grille, return, etc.) ±2" w-g.

PART 2 PRODUCTS

2.1 GENERAL

- A. Shop fabricated sheet metal work shall be constructed of prime quality resquared tight coat galvanized steel, except where other type material is specified. Manufacturer's name and U.S. gauge number shall appear on each sheet.
- B. Duct sealant shall be installed per SMACNA Class A-all transverse joints, longitudinal seams and duct wall penetrations.
- C. Duct Sealant for Low Pressure Duct: UL labeled non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. Sealant to be Mastic No. IG601 as manufactured by Hardcast or Engineer approved equivalent product manufactured by Ductmate or United McGill.

- D. Duct sealing tape and adhesive for high-pressure duct system by Hardcast Inc. or Engineer approved equivalent.
 - 1. Use Hardcast DT or JT pressureless tape in conjunction with Hardcast adhesive FTA20 on all fittings and joint connections.
 - 2. Use FTA20 full strength. Dip Hardcast tape in solution until saturated.
 - 3. Apply two wraps of wet tape on duct joint sections and fittings. Stretch tight to assure positive adhesion contact with the duct and to smooth out wrinkles.
 - 4. Follow manufacturer's written instructions.
- E. Round and/or oval ducts and fittings shall be as manufactured by Semco or United McGill.

2.2 DUCT

A. Rectangular Duct:

- 1. Sheet Metal: Except as otherwise indicated, fabricate ductwork from minimum 24 gage galvanized sheet steel complying with ASTM A527, lockforming quality; with G90 zinc coating in accordance with ASTM A525; and mill phosphatized for exposed locations.
- 2. Rectangular duct shall be fabricated to the SMACNA functional criteria for the pressure class indicated on the Drawings.
- 3. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

B. Rectangular Duct Fittings:

- 1. Elbows shall be constructed with centerline radius of not less than 1.5 times duct width; where space conditions will not permit this radius or where indicated on the Drawings, square elbows with single thickness streamline turning vanes shall be used. Provide trailing edge extension for elbows in series.
- 2. Slopes for transitions or other changes in dimension shall be minimum 1 to 3.
- 3. All duct seams and joints shall be sealed to SMACNA Class A requirements.
- 4. Rectangular branch taps from mains shall be 45° entry fittings.

C. Round Duct:

- 1. Round Duct shall be spiral lock seam type, fabricated of galvanized steel strip with airtight four-ply lock seams Minimum 24 gage.
- 2. Metal gauges shall be as listed in the SMACNA Standard for the pressure class indicated on the Drawings.
- 3. Round duct shall be externally insulated.

D. Round Fittings:

- 1. Elbows for round ducts shall have a center line radius of 1.5 times the duct diameter.
- 2. 45o and 90o elbows for ducts up to 8" diameter shall be die stamped two-piece with welded longitudinal seams.
- 3. Elbows for round ducts over 8" diameter shall be formed of segments with welded seams and following numbers of segments:
 - a. 90 degree elbow: 5 segments
 - b. 60 degree elbow: 3 segments
 - c. 45 degree elbow: 3 segments

- d. 30 degree elbow: 2 segments
- e. 22½ degree elbow: 2 segments
- 4. Tees, crosses and lateral cross fittings for round duct shall be of the conical type.
- 5. Reducers, increasers, offsets, wyes, crosses, divided flow fittings and similar fittings for round duct shall be one-piece construction with welded seams.
- 6. Metal gauges for fittings for round duct shall be as listed in SMACNA Standard for the pressure class indicated on the Drawings.
- 7. Duct and fitting welds shall be painted after fabrication to prevent corrosion where zinc has been burned by welding.
- 8. No bull headed tees shall be used.
- 9. Pipe-to-pipe joints for round ducts up to 50" diameter shall be made with male sleeve couplings reinforced by rolled bead.
- 10. Pipe-to-fitting joints for round ducts up to 50" shall be made by slip-fit of projecting collar of fitting into the duct.
- 11. Slip-fit joints shall be fastened with sheet metal screws, place ½" from fitting or coupling head.
- 12. Joints shall be sealed with duct sealant installed as recommended by the manufacturer.
- 13. Duct reinforcing, size of reinforcing angles and spacing shall be as recommended by SMACNA.

2.3 DUCTWORK SUPPORT MATERIALS

- A. Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

2.4 DUCT ACCESSORIES

- A. Transverse Duct Joints: May be made with the Ductmate Systems or an Engineer approved equivalent. The Ductmate Systems are to be used in accordance with the Ductmate factory installation and assembly instructions, (1-800-245-3188).
 - 1. Ductmate 440 or a Butyl Rubber Gasket which meets Mil-C 18969B, Type II Class B, T-C-1796 A, Type II Class B, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth associated with dark, damp areas of ductwork. The recommended test procedure for bacterial and fungal growth is found in 21CFR 177, 1210 closures with sealing gaskets for food containers.
 - 2. Ductmate or W.D.C.I. proprietary duct connection systems are acceptable. Duct constructed using these systems shall refer to the manufacturer's guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.
 - 3. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) are acceptable. Formed on flanges shall be constructed as SMACNA T-25 flanges, whose limits are defined on Page 1.36 1985 SMACNA Manual, First Edition. No other construction pertaining to formed on flanges will be accepted. Formed on flanges shall be accepted for use on ductwork 42" wide or less, 2" static positive pressure or less, and shall include the use of corners, bolts and cleat. (Over 42", the reinforcement/joint deflection criteria no longer conform to the UMC).

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve airtight (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.
- B. Inserts: Install concrete inserts for support of ductwork in coordination with form work, as required to avoid delays in work.
- C. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- D. 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. Install offsets, angles, and transitions as may be required to avoid interferences with other work, install streamlined easements around obstructions where necessary to pass obstructions through ducts. Maintain full capacity of ducts at offsets, angles, transitions and easements, except where Drawings indicated use of reducing or increasing transitions. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- E. 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.
- F. Where ducts pass through interior partitions and exterior walls, conceal the space between the construction opening and the duct or duct-plus-insulation with sheet metal flanges of the same gauge as the duct. Overlap the opening on all sides by at least 1 1/2".
- G. Coordinate duct installations with installation of accessories, equipment, controls and other associated work of the ductwork system.
- H. Each duct section shall be rigidly supported from structure. Attach hangers to structure with expansion plugs, concrete inserts, beam clamps or other approved means. Rubber-in-shear isolators shall be installed in hangers for ducts in equipment rooms, to prevent vibration transmission to the structure.
- I. Install as indicated on the Drawings duct mounted equipment as specified in other Sections.
- J. Duct sizes shown on Drawings are net inside dimensions. Increase duct sizes as required to allow for installation of duct liner, where specified.
- K. Application of Duct Sealant: All ducts to be properly sealed. Specified duct sealant to be pumped or painted into all joints and seams on all ductwork systems. Sealant shall be allowed to set 48 hours before any air pressure is applied to system.
- L. Electrical Equipment Spaces: Do not route ductwork through electrical equipment spaces and enclosures. Do not run ductwork above electrical panels.

3.2 EQUIPMENT CONNECTIONS

- 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.

3.3 ADJUSTING AND CLEANING

- A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. 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.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.
- C. Balancing: Refer to Section 23 0593, "Testing, Adjusting and Balancing for HVAC" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent during the balancing process.

3.4 DUCTWORK LEAKAGE TESTING

- A. Installed ductwork shall be tested prior to installation of access doors, take-offs, etc, and before duct is made inaccessible.
- B. Major supply, return and exhaust duct runs or ducts running through chases shall be pressure tested before branch ducts are added or chases are closed. It is recommended that the first 100'-300' of ductwork installed be tested to insure the quality of the workmanship at an early stage.
- C. Ducts having a pressure class of +/-3" wc, or higher shall have representative sections tested. A minimum of 25% of the total installed duct area for the designated pressure class shall be tested. This is not necessarily 25% of each floor. Include ducts in shafts or ducts that will be inaccessible above hard ceilings in the representative sample.
- D. Negative pressure systems may be tested with positive pressure tests.
- E. The maximum permissible duct leakage class of the tested duct shall be 6.0 as determined in accordance with ASHRAE 90.1.
- F. The testing shall be performed as follows:
 - 1. Perform testing in accordance with the SMACNA HVAC Air Duct Leakage Test Manual.
 - 2. Use a certified orifice tube for measuring the leakage.
 - 3. Define section of system to be tested and blank off.
 - 4. Determine the percentage of the system being tested.
 - 5. Using that percentage, determine the allowable leakage (cfm) for that section being tested.
 - 6. Pressurize to operating pressure and repair any significant or audible leaks.
 - 7. Repressurize and measure leakage.
 - 8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in Step 5.

END OF SECTION

**SECTION 23 3300
AIR DUCT ACCESSORIES**

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Volume dampers.
2. Turning vanes.
3. Flexible ducts.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Volume dampers.
2. Turning vanes.
3. Flexible ducts.

B. Shop Drawings:

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

1.3 QUALITY ASSURANCE

A. Codes and Standards

1. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
2. Ducts, plenums, apparatus casings, metal gauges, reinforcing, methods of supporting and hanging, and other sheet metal work as called for shall meet all functional criteria defined in the SMACNA "HVAC Duct Construction Standards Metal and Flexible" 2005, 3rd Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.
3. Comply with applicable requirements of NFPA 91.

PART 2 PRODUCTS

2.1 VOLUME DAMPERS

A. Manual Volume Dampers: Fabricated of same material as ducts, two metal gauges heavier than duct and hemmed 1" all around, mounted on 3/8" square rod with saw slot position indicated. Pivot bearings, elocking position regulator, Young Regulator Co., Series 443.

1. Where positioning regulator is not accessible, provide coupling and extension rod with regulator for ceiling wall or floor installation, as required. Young Series 301 and 315 for ceiling, Series 270-302 for walls.

2.2 TURNING VANES

- A. Manufacturers:
 - 1. Aero Dyne; Ductmate; Anemostat; Barber Coleman; Duro Dyne; or Hart & Cooley.
- B. Provide single thickness streamline type, except provide turning vanes with trailing edge at elbows which change dimensions or at consecutive elbows.
- C. Provide manufactured turning vanes and vane runners, fabricated from the same material as the duct, and constructed in accordance with SMACNA "HVAC Duct Construction Standards". Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert tabs which align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs. when fastened per the manufacturer's instructions.

2.3 FLEXIBLE DUCTS

- A. Flexible ducts shall only be used to supply diffusers above ceilings. All re-run, and open ceiling connections shall be hard ducted.
- B. Manufacturers:
 - 1. Flexible duct shall be by Thermaflex, Semco, Wiremold, or Engineer approved equal.
- C. General:
 - 1. Acceptable in supply ductwork only where shown (not allowed in exposed occupied areas). Flexible duct shall include wire, core, insulation, and vapor barrier and the composite assembly shall meet requirements of NFPA-90A and UL181 and shall be UL listed for flame spread rating of not more than 25 and smoke developed rated of not more than 50.
- D. Minimum length of flexible duct shall be 3 feet.
- E. Maximum length of flexible duct shall be 8 feet.
- F. Flexible duct shall have a minimum R-value of 4.2.
- G. Flexible duct shall have a maximum vapor transmission rating of .1 perms.
- H. Flexible duct shall be rated for operating temperatures between -20 and 250 degrees.
- I. All flexible duct shall be connected to metal fittings with stainless steel bands equal to snaplock. The use of duct tape to secure the core is not acceptable.
- J. Flexible duct shall have an operating positive pressure rating of 10" wg for nominal sizes 4 thru 12 inch and 6" wg for nominal sizes 14 thru 16 inch, and a negative pressure rating of 1" wg for sizes 4 thru 12 inches. Duct shall be rated for a velocity of 5,000 feet per minute. Duct shall be equal to Thermaflex M-KE.

2.4 QUADRANT LOCKS

- A. Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12".
- B. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

PART 2 EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install manual volume dampers in all supply, return and exhaust duct systems as required for controlling air volumes to trunk ducts, branch ducts, outlets and inlets. Contractor shall install a complete system of dampers as required for balancing air systems.
- B. Coordinate duct installations with installation of accessories, equipment, controls and other associated work of the ductwork system.
- C. Install turning vanes in all square or rectangular 90° elbows in supply, return, and exhaust air systems.
- D. Installation of Flexible Ducts: Flexible Ducts are to be installed only where indicated on Drawings.
 - 1. Maximum length of flexible duct is 8'-0" OAL.
 - 2. Minimum length of flexible duct is 3'-0" OAL.
 - 3. Square to round transition gages to comply with SMACNA rectangular duct (minimum 24 ga.).
 - 4. Flexible duct must meet UL 181 and be installed per SMACNA using a clamp for securing duct to collar and a supplemental clamp for securing the insulation and vapor barrier.
 - 5. Support flexible ductwork with minimum 2" wide sheet metal bands, secured to structure with ductwork support materials. Maximum spacing shall be 4 feet on center.
 - 6. The flexible duct shall be installed with a minimum centerline radius equal to 1.5 times the diameter of the duct.
 - 7. When connecting flexible duct to diffusers, the duct shall be installed with a minimum of 6" straight flex at the diffuser.

END OF SECTION

SECTION 23 3600
AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide material, equipment, labor and supervision necessary to install variable air volume units as required by the Drawings and this Section.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of terminal air box furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

1.3 QUALITY ASSURANCE

- A. Standards
 - 1. All unit lining materials shall meet the requirements of NFPA 90A and U.L. 181.
 - 2. Compliance with performance specified on drawings, including sound power, shall be verified by certified data derived from tests conforming to ADC Test Code 1062 and ANSI-S-1.21-72, except for specific requirements herein.
 - 3. ARI 880 - Air Conditioning and Refrigeration Institute Standard Rating Conditions for Air Terminals.
- B. The unit manufacturer shall refer to the temperature control specifications for interface devices and information required to ensure equipment compatibility.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide variable air volume units by Titus, Carnes, Nailor, Price, Krueger, Tuttle and Bailey or Engineer approved equivalent. Arrangement, capacity, performance and type as scheduled and/or indicated on the Drawings.

2.2 GENERAL

- A. Provide factory-fabricated and tested variable air volume units as indicated, selected with performance characteristics which match or exceed those indicated on schedule.
- B. Units shall consist generally of variable volume damper, adjustable maximum air volume regulator and other items as required for proper operation.

2.3 CASINGS

- A. Units shall be completely factory assembled, manufactured of corrosion protected welded steel, and fabricated with a minimum of 22-gauge metal.

- B. The terminal casing shall be minimum 22-gauge galvanized steel, internally lined with a non-porous, sealed liner which complies with UL 181 and NFPA 90A. Insulation shall be 4-pound density. All cut edges must be sealed from the airstream using mechanically bonded metal barrier strips. Liner shall be rigid permanently affixed scrim-reinforced foil covering. Liners made of Mylar, Tedlar, Silane or woven fiberglass cloth are not acceptable. Insulation shall be equivalent to Titus Steri-Loc or double wall lining is acceptable.
- C. Casing shall have removable panels large enough to provide access to all moving parts for inspection, adjustment, and maintenance without disconnecting ducts. Panels shall be flush, gasketed airtight, and held in place by screwdriver operated quarter-turn latches.
- D. Total leakage from casings shall not exceed 1% of the nominal capacity when subjected to a pressure of 1/2 inch W.G. in low pressure section with all outlets and inlets sealed off. Leakage rate of closed dampers shall not exceed 1% of specified capacity when close-off pressure differential is 4 inches W.G.
- E. Units shall be rigidly supported so they remain stationary at all times. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.

2.4 AIR DAMPERS

- A. Locate air volume damper and automatic flow control assembly inside unit casing. Construct from extruded aluminum or 20 gauge galvanized steel components. Key damper blades into shaft with nylon fitted pivot points. Flow sensor shall be provided regardless of control chosen. Flow sensor shall be a ring or cross. [Bar or single point sensing device is not acceptable.]
- B. Mount manually operated damper quadrant or automatic damper operator and automatic flow control assembly.
- C. Air volume control damper shall be factory calibrated assembly consisting of air modulation damper and extension for connection to control actuator. All actuator linkage shall be protected by a sheet metal enclosure.

2.5 CONTROLS

- A. Refer to Temperature Control specification sections.
- B. Controls for the unit are to be supplied, mounted, calibrated and tested in the field by the controls contractor. Thermostat, 24V power and all external control wiring by temperature control contractor.
- C. Disconnect and internal wiring shall be by unit manufacturer.
- D. Variable air volume units shall control and measure air flow within a +5% at any duct pressure.
- E. Variable air volume units shall be pressure independent and shall reset to any air flow between minimum and maximum scheduled cfm.

2.6 HEATING COIL

- A. 1/2 inch O.D. seamless copper tubes mechanically bonded to aluminum fins with continuous fin collar and sleeved end supports. Coil shall be suitable for working pressures up to 300 psig.
- B. Coil configuration and capacity shall be as scheduled on the drawings. Capacity is based on minimum cfm scheduled for each unit.
- C. The coil shall be factory furnished and installed on the air discharge of the unit. Coil discharge shall be provided with slip and drive duct connections.

2.7 IDENTIFICATION

- A. Identify each unit with clearly marked identification label and airflow indicator. Label shall include unit nominal air flow, maximum factory set air flow, minimum factory set air flow and box number which corresponds to schedule on drawings.

2.8 PROVIDE THE FOLLOWING FEATURES AND ACCESSORIES INDICATED ON DRAWINGS AND SCHEDULE:

- A. Bottom Access Panels

2.9 WIRING

- A. Mount electrical components in control box with removable cover. Incorporate single point electrical connections to power source.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install units as indicated on plans, and in accordance with manufacturer's installation instructions.
- B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer. Support units independently of adjacent ductwork.
- C. Duct Connections: Connect ductwork to units in accordance with Division 15 ductwork sections.
- D. Piping Connections: Connect piping and accessories to units in accordance with details on Drawings.

3.2 FIELD QUALITY CONTROL

- A. Upon completion of installation and prior to initial operation, test and demonstrate that units and duct connections to units are leak-tight.

3.3 ADJUSTING

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design air flow to 25 percent nominal air flow. Set units with heating coils for minimum cfm scheduled on Drawings.

END OF SECTION

SECTION 23 3713
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
 - 1. Provide materials, devices, labor and supervision necessary for the installation of diffusers, registers and grilles
 - 2. Provide diffusers, registers and grilles as per schedule on Drawings.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for diffusers, registers and grilles including the following:
 - 1. Schedule of diffusers, registers and grilles indicating drawing designation, room location, number furnished, model number, size and accessories furnished.
 - 2. Data sheet for each type of grille, register and diffuser and accessory furnished; indicating construction, finish and mounting details.
 - 3. Performance data for each type of grille, register and diffuser furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of grille, register and diffuser, indicating materials and methods of assembly of components.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. ARI Compliance: Test and rate diffusers, registers and grilles in accordance with ARI 650 "Standard for Air Outlets and Inlets".
 - 2. ASHRAE Compliance: Test and rate diffusers, registers and grilles in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
 - 3. NFPA Compliance: Install diffusers, registers and grilles in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Products by Titus, Krueger, Carnes, Metal-aire, Nailor, Price, or Engineer approved equivalent.

2.2 CEILING AIR 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. Types: Provide ceiling diffusers of type, capacity and with accessories and finishes as listed on diffuser schedule.
- E. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 degrees F for 30 minutes. The pencil hardness must be HB to H.
- F. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint shall pass a 250-hour ASTM D870 Water Immersion Test and pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- G. The manufacturer shall provide published performance data for the square panel diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

2.3 EGG CRATE GRILLE

- A. Furnish Eggcrate Grille with Aluminum Grid and Aluminum Border. Return grilles shall be the sizes and mounting types as shown on the plans and outlet schedule. Return grilles shall provide a free area of at least 90%. Outer borders shall be constructed of heavy extruded aluminum with a thickness of 0.040-0.050 inch and shall have countersunk screw holes for a neat appearance. Border width shall be 1¼ inches on all sides and shall be interlocked at the four corners and mechanically staked to form a rigid frame.
- B. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness shall be HB to H. The paint shall pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

2.4 ALUMINUM RETURN GRILLES

- A. Aluminum return grilles shall be of the sizes and mounting types shown on the plans and outlet schedule. The fixed deflection blades shall be available parallel to the long or short dimension of the grille. Construction shall be of extruded aluminum with a 1¼-inch wide border on all sides. Minimum border thickness shall be 0.040-0.050 inch. Sizes 24 x 24 inches and smaller shall be constructed using a roll-formed frame.
- B. Corners shall be welded with full penetration resistance welds. Sizes larger than 24 x 24 inches shall be constructed by using heavy aluminum extrusions and shall be interlocked at the four corners and mechanically staked to form a rigid frame. Screw holes shall be counter-sunk for a neat appearance.
- C. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed in place by crimping or welding. Blade deflection angle shall be available at 0°.
- D. The finish shall be an anodic acrylic paint, baked at 315° F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

- E. The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install diffusers, registers and grilles in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Install wall mounted grilles and registers plumb and level and flush to surface. Locations may be altered slightly, as acceptable to the Architect/Engineer so as to fit portions of the structure.
- D. In grid panel type ceilings, lay-in metal pan, acoustical, etc., diffusers, registers and grilles shall be located as shown on the reflected ceiling plan or as directed by the Architect/Engineer typically to minimize cutting of ceiling panels.
- E. Coordinate location of ceiling diffusers and registers with Architect's reflected ceiling plan.
- F. Provide transitions as required for connections to ductwork, including square to round.
- G. Install diffusers, registers, and grilles level and plumb.
- H. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

Bidder _____

SEALED BID

PROPOSAL NO: _____

PROPOSAL
DESCRIPTION: _____

LETTING DATE: _____

**Iowa Department of Transportation
PURCHASING – SEALED BID PROPOSAL
800 Lincoln Way
Ames, Iowa 50010**