

Special School Board Meeting

Tuesday, May 23, 2023 7:00 AM

Google Hangouts, 130 145th Street East, Rosemount, MN 55068

I. Call to Order - Chair Cindy Nordstrom

II. Conduct Pledge of Allegiance - Chair Cindy Nordstrom

III. Visitors Opportunity to be Heard - Chair Cindy Nordstrom

IV. New Business

IV.A. Review and Approve Bids for HVAC System
Replacement at Alliance Education Center -
Nicolle Roush

V. Adjournment - Chair Cindy Nordstrom



To: School Board Members
Superintendent Michael Favor

From: Nicolle Roush Executive Director of Business Services

Date: May 23, 2023

Subject: HVAC unit replacement project

Pertinent Facts:

1. Intermediate School District #917 published legal notice in the St. Paul Pioneer press for HVAC unit replacement project at Alliance Education Center run dates on April 20th and 27th, 2023 for formal bid opening on May 9, 2023, at 2:00 pm. Per Minnesota statute 123B.52 Board must approve formal bids for projects over \$175,000.
2. Intermediate School District #917 received two official bids from Twisted Mechanical in the amount of \$287,600 and Cool Air Mechanical in the amount of \$294,800. In addition, as per specifications in the bid each vendor provided a 5% performance bond for the total amount of the bid.
3. Intermediate School District #917 will fund this project using LTFM member district levy in the amount of \$177,000 and the remaining using general education revenues.
4. EDI-Dolejs Inc. has reviewed and determined vendors have submitted qualified bids in compliance with specifications in the project to move forward with the lowest bidder Twisted Mechanical (reference project specification details attached).

Recommendation: Seeking Board approval to award Twisted Mechanical the HVAC unit replacement project for FY24 in the amount of \$287,600.

DIVISION 01 - SPECIFICATION INDEX

<u>Section</u>	<u>Title</u>
01 04 00	Advertisement for Bids
01 05 00	Instructions to Bidders
01 06 00	Bid Form Proposal
01 08 00	General Conditions
01 09 00	Supplementary Conditions
01 10 00	Summary of Work
01 12 07	Application for Payment
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01 20 00	Project Meetings
01 30 00	Submittals
01 50 00	Temporary Facilities
Division 23	Mechanical Specification

END OF SECTION

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SECTION 01 04 00

ADVERTISEMENT FOR CONSTRUCTION BIDS

JOB TITLE: Intermediate School District #917 2023 HVAC Unit Replacement
Rosemount, MN

OWNER: Intermediate School District #917

ENGINEER'S PROJECT NO.: 23-002

PART I - ADVERTISEMENT

- 1.01 Intermediate School District #917 will receive bids for the HVAC Unit Replacement Project up to 2:00 p.m. on Tuesday, May 9, 2023 in its offices at the District Office, at which time the bids will be opened publicly and read aloud.
- 1.02 Bids shall be upon the form included in the specification documents. Envelopes containing bids must be sealed and marked "Intermediate School District #917 HVAC Unit Replacement", with the name and address of the bidder and the date of the opening. Bids shall be delivered to:

Ms. Nicolle Rousch
Intermediate School District #917
1300 145th Street East
Rosemount, MN 55068

- 1.03 Proposals received after the designated time and date mentioned above will be returned unopened.

PART 2 - INFORMATION FOR BIDDERS

2.01 ISSUING OFFICE:

- A. Full sets of Project Documents are available from the Engineer in PDF format and will be distributed electronically to the bidding contractors.

2.02 DOCUMENTS FOR EXAMINATION: Sets of Project Documents may be seen at the following location:

- A. Bidding Documents can be examined at the office of EDI-Dolejs, Inc.
1624 North Riverfront Drive, Mankato, MN 56001. Plan holders will be notified via email as addenda are issued.

2.03 PRE-BID WALK - THRU:

- A. There is no formal pre-bid meeting. Interested bidders may contact Scott Zehnder at 651-423-8127 to arrange a tour of the project site.

- 2.04 WITHDRAWAL OF BIDS: No bidder may withdraw his Bid within thirty (30) days after Receipt of Bids.
- 2.05 OWNER'S RIGHT: The right is reserved to accept or reject any or all proposals and to waive any informalities and irregularities in the Bidding.
- 2.06 OWNER'S DIRECT REPRESENTATIVE: As set forth hereinafter, in this specification, when reference is made to the Owner's Direct Representative for this Project it shall be Nicolle Rousch, Phone: 651-4238227.
- 2.07 THE PROJECT OWNER: The Owner for this project is:

Intermediate School District #917
1300 145th Street East
Rosemount, MN 55068

END OF SECTION

SECTION 01 05 00 - INSTRUCTIONS TO BIDDERS

.01 BIDDING DOCUMENTS

Bidding Documents will be provided to all bidding Contractors in electronic format. Any additional bidding documents that may be necessary will also be issued in Electronic-Only format.

.02 DEFINITIONS

All definitions set forth in the Conditions of the Contract (General, Supplementary and other Conditions) shall apply to the Bidding Documents.

The Bidding Documents consist of the Advertisement for Bids, Instructions to Bidders, Bid Form, Agreement Form, Performance and Payment Bond Form and the proposed Contract Documents including any Addenda issued prior to receipt of bids.

Addenda are written or graphic instructions issued by the Engineer prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

.03 EXAMINATION OF DOCUMENTS AND SITE

Bidders shall thoroughly examine the Bidding Documents and satisfy themselves as to the requirements contained therein. Bidders shall examine the Bidding Documents for other work being bid concurrently and work presently under contract. Bidders shall visit the site, examine existing site conditions and compare them with the proposed Contract Documents and inform themselves of all local conditions and limitations which may affect the work to be performed. No extra compensation shall be given for conditions which the Contractor could have discovered or reasonably anticipated by examining the site and Bidding Documents prior to Bidding.

.04 INTERPRETATION OF BIDDING DOCUMENTS

Bidders shall promptly notify the Engineer of inconsistencies, errors and omissions found in the Bidding Documents, prior to bid date.

Questions regarding the bidding and requests for interpretation of the Bidding Documents shall be submitted to the Engineer in writing in duplicate in sufficient time to be received at least 10 days prior to the date for receipt of bids.

Interpretation and correction of the Bidding Documents will be made by Addendum. Interpretations and corrections made by any other method shall not be binding on the Owner or the Engineer.

.05 SUBSTITUTION OF MATERIALS

Bidders, sub-bidders, suppliers and manufacturers shall require the approval of the Engineer to substitute materials, products or equipment for proprietary products specified. The Engineer's approval will be required even though "or equal" or synonymous terms are used.

The specified products have been used in the design of the Project and the preparation of the Drawings

and Specifications and as such establish minimum standards of function, dimension appearance and quality necessary and requisite for this Project which substitutes must meet to be considered acceptable. The burden of proof of equality rests with the party making the request.

REQUESTS FOR SUBSTITUTIONS MUST BE MADE IN WRITING AND BE RECEIVED BY THE ENGINEER, AT LEAST FIVE (5) DAYS PRIOR TO THE DATE FOR RECEIPT OF BIDS.

Requests shall be submitted in duplicate and shall clearly describe the material, product or equipment for which approval is requested and shall be accompanied by manufacturer's literature, specifications, drawings, performance data or other information necessary to completely describe the item and establish its acceptability.

Each bidder, sub-bidder, supplier or manufacturer in submitting his request for substitution agrees that if his proposed material, product or equipment is approved and subsequently used in the work, he shall assume all costs incurred on account of additional work and changes required to incorporate his product into the Project including all such work and changes performed under other contracts. Each Bidder shall include sufficient sums in his bid to cover such costs.

The approval or rejection of a proposed substitution is vested in the Engineer whose decision shall be final and binding. The determination may or may not express the reason for the decision. Substitutions will be approved by Addendum. No information or approval will be made in any other manner.

Bids shall be based upon the specified materials, products and equipment or substitutions approved by Addendum.

.06 ADDENDA

Prior to receipt of bids, Addenda will be E-mailed to each person or organization known by the Engineer to have a complete set of Bidding Documents and to each location indicated in the Advertisement for Bids where Bidding Documents are available for public inspection. Addenda will be issued (mailed or delivered) at least five (5) days prior to receipt of bids.

Each Bidder shall ascertain prior to submitting his bid that he has received all Addenda issued for his work and shall acknowledge their receipt in his Bid.

.07 BID FORM

Bids shall be submitted on the Bid Form issued by the Engineer, a copy of which is included in this Project Manual. All blank spaces on the Bid Form shall be appropriately filled. Amounts shall be given in both figures and in writing; and, in case of discrepancy between the two, the written amount shall govern. Any interlineation, alteration or erasure shall be initialed by the Bidder.

The Bidder shall make no additional stipulations on the Bid Form or qualify his bid in any other manner.

.08 SIGNING OF BIDS

Bids by an individual as a sole owner shall be signed by the individual. Bids submitted by partnerships shall be signed by one or more partners.

Bids by corporations shall contain the correct name of the corporation and the state of incorporation. The signature of the president or other authorized officer of the corporation shall be manually written below the name of the corporation, together with the title of the officer.

If a bid is submitted by any other legal entity, the type of legal entity shall be stated, and the authority of the person signing shall be attached to the bid.

.09 SUBMISSION OF BIDS

The Bid shall be enclosed in a sealed opaque envelope. The envelope shall be identified with (1) the project name, (2) the Bidder's name and address and (3) time and date set for receipt of bids, and shall be addressed to the office of the owner's direct representative. Neither the Owner nor the Engineer will be responsible for the premature opening, or failure to open, a bid not properly addressed or identified.

Oral or telephonic bids will not be considered.

If the bid is sent by mail, the sealed envelope shall be enclosed in an additional envelope.

Bids shall be delivered to the designated locations prior to the time and date indicated in the Advertisement for Bids. Bids received after the time and date for receipt of bids will be returned unopened.

.10 BID SECURITY

Each bid shall be accompanied by a certified check, cashier's check or corporate surety bond in an amount equal to five percent (5%) of the Base Bid, payable without conditions to the Owner as a guarantee that the Bidder, if awarded the Contract, will promptly execute such Contract in accordance with his bid and the Bidding Documents and will furnish a Performance and Payment Bond acceptable to the Owner. It is agreed that the bid security will constitute liquidated damages and not a penalty for the failure of the Bidder to enter into a Contract and furnish a satisfactory bond.

The bid security of the three (3) lowest Bidders will be retained until the Contract has been executed. The bid security of all other Bidders will be returned as soon as possible after award of the Contract.

.11 MODIFICATION AND WITHDRAWAL OF BIDS

Proposals may not be modified after submission.

A bidder may withdraw his bid prior to the time for receipt of bids by written or telegraphic request. Requests received after the time set for receipt of bids will not be considered. Written requests shall be over the signature of the Bidder. Telegraphic requests shall have written confirmation over the signature of the bidder placed in the mail and postmarked on or before the date for receipt of bids. Oral or telephonic requests will not be considered.

No bids may be withdrawn by a bidder for a period of 30 days after the date for receipt of bids.

.12 CONTRACTOR'S QUALIFICATION STATEMENT

Prior to the award of the contract, the selected Bidder shall upon the request of the Engineer, submit in duplicate a properly executed Contractor's Qualification Statement, AIA Document A305.

.13 SUBMISSION OF POST-BID INFORMATION

Upon request of the Engineer, the selected Bidder shall within seven (7) days thereafter submit the following:

- 01) A statement of costs for each major item of work included in the bid.
- 02) A designation of the work to be performed by the Bidder with his own forces.
- 03) A list of all subcontractors, major material supplies and such other persons or organizations (including those who are to furnish materials or equipment fabrication to a special design) that the Bidder proposes to use on the work.

.14 AWARD AND REJECTION OF BID

The Owner reserves the right to reject any or all bids and to waive any informality or irregularity in any bid received. In addition, the Owner reserves the right to reject a bid if the Bidder failed to furnish the required bid security, or if the bid is in any way incomplete or irregular in a material matter.

.15 EXECUTION OF CONTRACTS

If awarded the Contract, the Bidder shall execute and deliver to the Owner and Agreement in the form specified within ten (10) days after written notification of award and receipt of the Agreement form. The Agreement form will be prepared by the Owner. A copy of the Agreement form may be examined in the Office of the Owner's direct representative.

.16 AVAILABILITY OF THE SITE

The site will be available for construction upon the award of the Contract; however, the Contractor shall not commence work nor allow any subcontractor to commence work until the requirements of the Conditions of the Contract have been satisfied and the Owner has issued a Notice to Proceed.

.17 NON-SMOKING BUILDING AND GROUNDS

Contractors shall note that the building site and grounds are a non-smoking environment and that no contractor, sub-contractor, representative or employee thereof shall smoke at this site or on the grounds during the fulfillment of this contract.

END OF SECTION

SECTION 01 06 00 - BID FORM PROPOSAL

(All work is under one Prime Contractor)

Mechanical, Electrical & General Construction for Intermediate School District #917 2023 HVAC Unit Replacement

For
Intermediate School District #917
1300 145th Street East
Rosemount, MN 55068

The undersigned having carefully examined the Contract Documents (the Drawings, Specifications and Addenda) hereinafter enumerated, all as prepared by Dolejs Associates, Consulting Engineers, Mankato, Minnesota, and having visited the site and examined all conditions affecting the equipment necessary for MECHANICAL, ELECTRICAL and GENERAL CONSTRUCTION in accordance with such Contract Documents for the sums listed below.

BASE BID: (RTU-1, RTU-2, RTU-10, RTU-11) _____ Dollars (\$ _____)

If the Undersigned be notified of acceptance of this proposal within twenty-nine (29) days after above date, he agrees to execute a contract of type specified, within ten (10) days after its receipt for the above mentioned compensation, and at such time to deliver to the Engineer the Surety Bond specified, as well as the specified insurance and insurance certificates.

The Undersigned agrees to bring the work to substantial completion and have the building operational by November 13, 2023.

Addenda No. _____, _____, _____ have been received and are incorporated in this proposal.

Respectfully submitted,

Firm Name

Official Address:

By _____

Title _____

- _____
 Sole Owner
 Partnership
 Corporation

END OF SECTION

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SECTION 01 08 00 - GENERAL CONDITIONS

The General Conditions of the Contract for Construction, AIA Document A201-2017, Articles 1 through 15, are hereby incorporated by reference as the General Conditions of this Contract and are as fully a part of this Contract as if repeated herein.

.02 MODIFICATIONS

The articles contained in the Supplementary Conditions, Section and Sections of Division 01, General Requirements, may modify, delete or add to the provisions of the 01 09 00 General Conditions and shall take precedence over the General Conditions. Where any part of the General Conditions is modified or voided by these articles, the unaltered provisions of the part shall remain in effect.

Whenever the term "Architect" is used in the General Conditions, the term "Engineer" shall be substituted.

END OF SECTION

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SECTION 01 09 00 - SUPPLEMENTARY CONDITIONS

The General Conditions, Section 01 08 00 are hereby made a part of this Section.

Where articles, paragraphs, subparagraphs are supplemented by the following paragraphs, supplemental provisions are added to the original provisions which remain in effect.

Articles, paragraphs, subparagraphs not amended, voided, or superseded by the following paragraphs remain in effect.

ARTICLE 1 - GENERAL PROVISIONS

1.1.3 THE WORK

Add the following sub-paragraph:

1.1.3.1 The term "Provided" shall mean furnished and installed in place.

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following subparagraph:

1.2.4 If there is an inconsistency in quality or quantity of Work required by the Contract Documents, provide quality or quantity consistent with Architect's interpretation. No change shall result in Contract sum based upon that interpretation providing that Work so required was within range of quality or quantity described in the Documents.

1.4 INTERPRETATION

Add the following four subparagraphs:

1.4.2 The general character and scope of the Work is shown by the Drawings. Where a portion of the Work is fully drawn and the remainder is merely indicated, the portion fully drawn shall apply to all similar parts of the Work.

1.4.3 Figured dimensions on the Drawings shall be followed in preference to scaled measurements on the Drawings.

1.4.4 Where Specifications are abbreviated type, they indicate complete sentences in the same manner as when a note occurs in the Drawings. Omissions of a word such as "the Contractor shall" and "as shown on the Drawings" is intentional. The words "shall" or "shall be" are to be supplied by inference.

1.4.5 Where a number is listed in the Specifications (as for gauges, weights, temperatures, amounts of time, etc.), the number shall be interpreted as that or better.

ARTICLE 3 - CONTRACTOR

3.4 LABOR AND MATERIALS

Add the following four subparagraphs:

3.4.4 Manufacturer's printed instructions covering details of installation shall be followed where not in conflict with these Specifications. If there is a conflict, notify the Architect and obtain approval before proceeding.

3.4.5 Completed Work shall be left plumb, level, true to line or plane, anchored securely in place, free from damage.

3.4.6 Unless otherwise called for, all pieces of material shall be as large a stock size as is in conformity with standard good practice of the trade.

3.4.7 Except where in conflict with the Specifications, current manufacturer's printed Specifications of herein-specified proprietary products are made part of the specifications.

3.7 PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS

Add the following sub-subparagraph:

3.7.1.1 The Contractor will purchase and pay for the building permit.

Add the following to subparagraph **3.7.2**:

When the Contract Documents require Work better than that required by Statute, the Contract Documents shall govern.

3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

Add the following to subparagraph **3.10.1**:

The General Contractor with the overall Project Construction Schedule shall coordinate the schedule.

3.13 USE OF SITE

Add the following subparagraph:

3.13.2 Owner may perform certain other work on site during the course of construction with own personnel or by separate Contract. Permit full access to entire site by Owner or other Contractors, coordinate Work with theirs, and cooperate in any way possible.

3.18 INDEMNIFICATION

Add the following sub-subparagraph:

3.18.2.1 *In addition to any indemnification required under paragraph 3.18, purchase insurance as provided in the State Statutes, as most recently amended, and as required in **Article 11**. Provide copies of insurance to Owner, Architect, and include these items as additional insured.*

Add to **ARTICLE 3**:

3.19 VERIFICATION OF FIELD CONDITIONS:

3.19.1 *Take field measurements and verify field conditions. Thoroughly compare such measurements and conditions with Contract Documents and Shop Drawings or product information before commencing Work. Report any error, inconsistency, or omission to Architect immediately.*

3.19.2 *No change in Contract Sum will be allowed because of minor differences between actual field conditions and conditions described in Contract Documents.*

ARTICLE 4 - ARCHITECT

4.2 ADMINISTRATION OF THE CONTRACT

Add the following to subparagraph **4.2.3**:

The Architect shall not be responsible for the acts or omissions of the Owner.

ARTICLE 5 - SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

Add the following to subparagraph **5.2.1**:

Contractor's responsibility to furnish materials, products, and equipment in conformance with requirements of the Contract Documents shall not be modified or limited by Owner's or Architect's lack of reasonable objection to any selected Subcontractor or Supplier.

ARTICLE 7 - CHANGES IN THE WORK

7.2 CHANGE ORDERS

Add the following subparagraphs:

7.2.2 Change Orders are understood to include cost plus amount for overhead and profit agreed upon under 7.3.3.3 supplemented herein and required adjustments to Contract Time. No further consideration for additional impact upon Contract Sum or Contract Time will be made as result of any or all change orders as may be agreed to by Owner and Contractor.

7.2.3 Neither the Owner nor the Architect is responsible to give Notice of Change Orders to the Contractor's Surety.

7.3 CONSTRUCTIVE CHANGE DIRECTIVES

Change sub-subparagraph 7.3.3.3 as follows:

Delete the final "or" and add: "a reasonable allowance for overhead and profit shall not be more than: ten (10 %) percent of the net cost of the changed Work accomplished by Contractor's own forces; ten (10 %) percent of the net cost of the materials used in the changed Work; and five (5 %) of the net cost if the changed Work accomplished by the subcontractors. Subcontractors may add an allowance of not more than (10 %) percent of the net cost of the changed Work including materials performed or used by their own forces to cover their overhead and profit;

ARTICLE 8 - TIME

8.3 DELAYS AND EXTENSION OF TIME

Add the following subparagraph:

8.3.4 Contractor shall be responsible for damages incurred by Owner, Architect, Engineer and any other separate Contractors for delay resulting from Contractor's failure to complete work within Contract Time.

ARTICLE 9 - PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following subparagraphs:

9.2.2 The schedule of values shall follow the respective Specification Section numbering system and each amount including subcontractors work shall be broken down as per labor and materials.

9.2.3 *Data to substantiate shall include on an attached document, the name, address, telephone number and contract amounts for each subcontractor and major material supplier to be utilized by the Contractor in completing the Work.*

9.3 APPLICATIONS FOR PAYMENT

Add the following to subparagraph **9.3.1**:

Substantiating documents shall include waivers of liens from subcontractors and suppliers.

Add the following subparagraph:

9.3.4 *Progress payments shall be made monthly upon application, in the amount of ninety-five (95 %) of the Work completed and materials stored on site. The retained five (5 %) percent shall be held until such time as all the Contractor's Work has been completed in full. Said retainage of five (5 %), does not preclude the Owner and Architect to withhold additional sums for Contractor's failure to perform, or make payments to its subcontractors and suppliers.*

9.8 SUBSTANTIAL COMPLETION

Add the following to subparagraph **9.8.1**:

Minor corrective Work and the replacement of defective work or materials, and the adjustment of control apparatus will not delay the determination of substantial completion. See paragraph 12.2.2.2.

9.9 PARTIAL OCCUPANCY OR USE

Add the following to subparagraph **9.9.1**:

The insurance company or companies providing property insurance required by Paragraph 11.3 shall consent to use or occupancy by endorsement prior to such use or occupancy.

Add the following to subparagraph **9.9.2**:

After occupancy, the Owner will allow the Contractor reasonable access to occupied areas to complete and correct the work.

Add the following to subparagraph **9.9.3**:

Use or occupancy by the Owner shall not be deemed to constitute waiver of existing claims on behalf of Owner or Contractor against each other.

Add the following subparagraph:

9.9.4 *Owner shall have the right to install furnishings and equipment within project prior to substantial completion of the Work. Such installation shall not constitute occupancy or use by Owner.*

ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following four subparagraphs:

10.1.2 *The Contractor shall have on site at all times a copy of its Safety Program, Hazardous Communications Program and Material Safety Data Sheets (MSDS) for products to be used in connection with the Work; a copy of each Program and MSDS shall be provided to the Architect prior to commencing Work on site.*

10.1.3 *The Contractor shall immediately notify the Architect of all accidents which happen in connection with the Work, and within 24 hours have a written report as to what happened and what if any remedies or cautions are being implemented to prevent further injuries or damages. The contractor shall also give the Architect a copy of OSHA Form 200, each time it is updated.*

10.1.4 *If reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material, substance or condition encountered on the site by the Contractor, the Contractor shall upon recognizing the condition, immediately stop the work in the affected area and report the condition to the Owner and Architect in writing. The Owner, Contractor, and Architect shall then proceed in the same manner as outlined in Subparagraph 10.3.1.*

10.1.5 *The Owner shall be responsible for obtaining services of a licensed laboratory to verify a presence or absence of the material or substance reported by the Contractor and, in the event such material, substance or condition is found to be present, to verify that it has been rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material, substance or condition and who are to perform the task or removal or safe containment of such material, substance, or condition. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either have reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection.*

ARTICLE 11 - INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

Delete paragraphs 11.1.1 through 11.1.4 and substitute the following:

11.1.1 Purchase from and maintain in a company or companies lawfully authorized to do business in jurisdictions in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations under the Contract, and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone whose acts any of them may be liable.

11.1.2 Worker's Compensation and Employer's Liability Insurance coverage as per State Statute.

11.1.3 Commercial General Liability

- .1 \$1,000,000 General Aggregate.*
- .2 \$1,000,000 Products-Completed Operations Aggregate.*
- .3 \$1,000,000 Each Occurrence.*
- .4 \$1,000,000 Personal Injury.*

The Commercial General Liability shall provide at a minimum the following coverages:

- .5 Operations of Contractor;*
- .6 Operations of Contractor (Contingent Liability);*
- .7 Products/Completed Operations (To be carried for one year after completion of contract);*
- .8 Personal injury including employee related claims;*
- .9 Employees as additional insured;*
- .10 Broad Form Property Damage including but not limited to hazards of Explosion, Collapse and Underground; and*
- .11 Contractual Liability.*

11.1.4 Comprehensive Automobile Liability

- .1 \$1,000,000 Combined single limit bodily injury and property damage;*
- .2 All owned vehicles;*
- .3 All non-owned vehicles;*
- .4 All hired vehicles.*

11.1.5 Umbrella Liability

- .1 \$1,000,000 Each Claim;*
- .2 \$1,000,000 Annual Aggregate; and,*

- .3 Umbrella Liability shall provide excess limits over and above Commercial General Liability, Employers Liability, and Comprehensive Automobile liability limits stated in this Article.*

11.1.6 Insurance required by 11.1.1 shall be written for limits specified or required by law, whichever is greater. Coverages, whether written on an occurrence or claims made basis, shall be maintained without interruption from date of final payment and termination of any coverage required to be maintained after final payment.

11.1.7 Certificates of Insurance. File Certificates of Insurance with Architect prior to commencement of work, indicating that all insurance required by this Article is in force; such certificates to be prepared on ACORD or CICC forms. Such coverage shall contain provision that coverages afforded shall not be canceled or non-renewed without 30 days prior written notice to Owner.

11.3 PROPERTY INSURANCE

Add the following:

- 11.3.1.6 Owner, Architect, and Engineer shall be listed as additional insured on the Contractor Insurance Certificate.*

ARTICLE 12 - UNCOVERING AND CORRECTION OF WORK

12.2 CORRECTION OF WORK

Add the following to sub-subparagraph 12.2.2.1:

12.2.2.1.1 Warrant Work for one year from date of Substantial Completion Certification. Any specific warranties required by Contract Documents to remain in effect beyond a one year period shall not be considered modified by this one year warranty. Warranty period on Work not completed on date of Substantial Completion will begin on the date of Final Completion Certification or actual completion of the Work, whichever is later.

12.2.2.1.2 Neither the final Certificate of Payment nor any provision in the Contract Documents shall relieve the Contractor of responsibility for negligence or for faulty materials or work within extent and period provided by law. Upon written notice, remedy, any defect due thereto, and pay all expenses to any other work resulting therefrom.

END OF SECTION

SECTION 01 10 00 - SUMMARY OF WORK

.01 CONDITIONS OF THE CONTRACT

The Conditions of the Contract (General, Supplementary and other conditions) and the General Requirements (Sections of Division 1) are hereby made apart of this section. The articles contained in this Section may delete, modify and shall take precedence over the Conditions of the Contract.

.02 PROJECT

The project shall consist of replacement of existing roof-mounted HVAC units with new HVAC units in the same locations, including modifications to ductwork, gas piping, electrical and controls as required to accommodate the unit replacements.

.03 OWNER

The Owner of the Project is: Intermediate School District #917
1300 145th Street East
Rosemount, MN 55068

.04 ENGINEERS

The Mechanical/Electrical Engineer, a consultant to the Owner for the project is EDI-Dolejs, Inc., 1624 North Riverfront Drive, Mankato, Minnesota.

.05 SYSTEM

The project shall consist of the work set forth in the Contract Documents for HVAC unit replacement project including the Conditions of the Contract (General, Supplementary and Other Conditions) and the Plans and Specifications dated April 19, 2023.

.06 COMMENCEMENT OF THE WORK

The Contractor shall not commence the Work nor allow any Subcontractor to commence any of the Work until:

- (1) The Contract has been fully executed and the Owner has issued a Notice to Proceed.
- (2) The Owner has approved evidence of the Contractor's Liability Insurance, Owner's Protective Liability Insurance and any other insurance required to be purchased by the Contractor.
- (3) Specified equipment is at the site.

.08 BUILDING PERMITS AND FEES

The Contractor shall secure and pay for the required permit; pay the related inspection fees; and secure and pay for all other permits, governmental fees and licenses necessary for the proper execution and completion of the Work which are applicable at the time bids are received.

.09 RESPONSIBILITY FOR THE SITE

The Contractor shall take all reasonable precautions for the safety of all employees on the Work and all other persons who may be affected thereby.

The Contractor shall provide all reasonable protection to prevent damage, injury or loss to the work of the Project, materials and equipment to be incorporated into the Work which are stored on or adjacent to the site and other property including property of others at or adjacent to the site which is not designated for removal, relocation or replacement in the course of construction, and he shall repair all damage and injury and replace loss of such property.

.10 PROJECT MEETINGS

Coordination Meetings. The Engineer will schedule coordination meetings to discuss scheduling, coordination between the Contractors and problems that may have arisen. Each Contractor doing work at the site shall attend each meeting. Subcontractors shall attend at their discretion or at the request of the Engineer.

.11 TIME OF COMPLETION

Commence work in the shortest time possible after receipt of Notice to Proceed.

Construction work shall begin as soon as possible and shall be completed as soon as possible.

.12 TESTING AGENCIES

Where the Contract Documents of the Work to be made by an independent testing agency or laboratory or independent professional consultant, the independent testing agency or laboratory or independent professional consultant shall be satisfactory to the Engineer.

END OF SECTION

SECTION 01 12 07 - APPLICATIONS FOR PAYMENT

1.01 GENERAL

- A. Schedule of Values: Submit the Schedule of Values to the Engineer at the earliest date, but no later than 7 days before the date scheduled for submittal of the initial Application for Payment.
1. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format.
 - a. Identification: Include the following identification:
 - 1) Project name and location
 - 2) Name of the Architect
 - 3) Project number
 - 4) Contractor's name and address
 - 5) Date of submittal
 - b. Break Contract Sum down in enough detail to facilitate evaluation of Applications for Payment. Round amounts off to the nearest dollar; the total shall equal the contract sum.
 - c. For each item where an Application for Payment includes products purchased or fabricated and stored, but not installed, provide separate line items for cost.
 - d. Show line items for indirect costs, and margins on costs, to extent that such items will be listed individually in applications for payment. Each item in the Schedule of Values and Applications for Payment shall be complete including total cost and share of overhead and profit.
- B. Applications for Payment: Each application for payment shall be consistent with previous applications and payments as certified by the Engineer and paid for by the owner.
1. Payment Application Forms: Use AIA Document G702 and Continuation Sheets G703 as the form for the application.
 2. Application Preparation: Complete every entry, including notarization and execution by person authorized to sign on behalf of the owner. Incomplete applications will be returned without action.
 - a. Entries shall match data on the Schedules of Values.
 - b. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the period covered by the application.
 3. Transmittal: Submit three (3) executed copies of each application to the Engineer within 24 hours; one copy shall be complete, including waivers of lien and similar attachments.
 - a. Transmit each copy with a transmittal listing attachments, and recording information related to the application.
 4. Waivers of Lien: Upon request of the owner, with each application, submit waivers of lien form every entity who may file a lien arising out of the Contract, and related to the Work covered by the payment.
 - a. Waiver Delays: Submit each application with Contractor's waiver of lien for the period covered by the application.
 - b. Submit final Application for Payment with final waivers from every entity involved with performance of Work covered by the application

who could be entitled to a lien.

- c. Waiver Forms: Submit waivers of lien on forms, and executed in a manner, acceptable to Owner.
- C. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include:
- 1. List of subcontractors (if any)
 - 2. List of suppliers and fabricators
 - 3. Schedule of Values
 - 4. Contractor's Construction Schedule
 - 5. List of Contractor's staff assignments
 - 6. Certificates of insurance
 - 7. Performance and payment bonds (if required)
- D. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions. Administrative actions and submittals that precede or coincide with this application include:
- 1. Warranties (if any)
 - 2. Maintenance instructions
 - 3. Final cleaning
 - 4. Application for reduction of retainage, and consent of surety.
- E. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment application include:
- 1. Completion of Project closeout requirements.
 - 2. Completion of item specified for completion after Substantial Completion.
 - 3. Transmittal of required Project construction records to Owner.
 - 4. Proof that taxes, fees and similar obligations have been paid.

END OF SECTION

SECTION 01 17 00 - CUTTING AND PATCHING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Related requirements specified elsewhere:
 - 1. General Provisions: DIVISION 23

- B. Execute cutting (including excavating) and fitting of Work, required to:
 - 1. Make several parts fit properly.
 - 2. Uncover work to provide for installations of ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract Documents.

- C. Cutting and Patching Proposal: Submit a proposal describing procedures in advance of the time cutting and patching will be performed. Request approval to proceed. Include the following:
 - 1. Describe extent of cutting and patching. Show how it will be performed and indicate why it cannot be avoided.
 - 2. Describe changes to existing construction. Include changes to structural elements and operating components and changes in the building's appearance and other significant visual elements.
 - 3. List products to be used and firms that will perform Work.
 - 4. Indicate dates when cutting and patching will be performed.
 - 5. Utilities: List utilities that will be disturbed or relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
 - 6. Where cutting and patching involves adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with the original structure.
 - 7. Approval to proceed does not waive the Engineer's right to later require complete removal and replacement of unsatisfactory work.

- D. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.
 - 1. Obtain approval before cutting and patching the following structural elements:
 - a. Bearing and retaining walls.

- E. Operational Limitations: Do not cut and patch operating elements in a manner that would reduce their capacity to perform as intended. Do not cut and patch operating elements in a manner that would increase maintenance or decrease operational life or safety.
 - 1. Obtain approval before cutting and patching the following operating elements or safety related systems:
 - a. Primary operational systems and equipment.
 - b. Fire protection systems.
 - c. Electrical wiring systems.

- F. Visual Requirements: Do not cut and patch exposed construction in a manner that would, in the Engineer's opinion, reduce the building's aesthetic qualities. Do not cut and patch in a manner that would result in visual evidence of cutting and patching. Remove and replace construction cut and

- patched in a visually unsatisfactory manner.
- G. Existing Warranties: Replace, patch and repair material and surfaces cut or damaged in such a manner as not to void warranties.

PART 2 MATERIALS

- 2.01 Use materials identical to existing materials. Use materials that visually match adjacent surfaces to the fullest extent possible if identical materials are unavailable. Use materials whose performance will equal that of existing materials.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine surfaces to be cut and patched and conditions under which work is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action.
1. Before proceeding, meet with parties involved. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- B. Temporary Support: Provide temporary support of work to be cut.
- C. Protection: Protect existing construction to prevent damage. Provide protection from adverse weather conditions for portions that might be exposed during cutting and patching operations.
- D. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- E. Avoid cutting pipe, conduit or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

3.02 INSTALLATION

- A. Performance: Employ skilled workmen. Proceed at the earliest feasible time and complete without delay.
1. Cut construction to install other components or perform other construction and subsequent fitting and patching required to restore surfaces to their original condition.
- B. Cutting: Cut using methods that will not damage elements retained or adjoining construction. Comply with the original installer's recommendations.
1. Use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. To avoid marring finished surfaces cut or drill from the exposed or finished side into concealed surfaces.
 3. Cut through concrete and masonry using a cutting machine, such as a carborundum saw or a diamond-core drill.
 4. Comply with requirements of applicable Division 1 Sections where cutting and patching requires excavating and backfilling.
 5. Where services are required to be removed, relocated, or abandoned, by-pass utility services before cutting. Cut off pipe or conduit in walls or partitions to be removed.

Cap, valve, or plug and seal the remaining pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

- C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
1. Inspect and test patched areas to demonstrate integrity of the installation.
 2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. Remove floor and wall coverings and replace with new materials to achieve uniform color and appearance.
 - a. Where patching occurs in a smooth painted surface, extend final paint coat over entire surface containing the patch after the area has received primer and second coat.
 4. Patch, repair, or re-hang ceilings as necessary to provide an even-plane surface of uniform appearance.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty and similar items. Clean piping, conduit and similar features before applying paint or finishing materials. Restore damaged pipe covering to its original conditions.

END OF SECTION

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SECTION 01 20 00 - PROJECT MEETINGS

1.01 GENERAL

- A. This section specifies administrative and procedural requirements for project meetings, including, but not limited to, the following:
 - 1. Preconstruction conferences
 - 2. Progress meetings

- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction. Review responsibilities and personnel assignments.

- C. Attendees: Authorized representatives of the owner, engineer and their consultants; the contractor and its superintendent; major sub-contractors; and other concerned parties shall attend.
 - 1. Participants shall be familiar with the project and authorized to conclude matters relating to the work.

- D. Agenda: Discuss items that could affect progress, including the following:
 - 1. Tentative construction schedule.
 - 2. Daily Construction Hours
 - 3. Critical work sequencing
 - 4. Submittal of Shop Drawings, Product Data and Samples
 - 5. Use of the premises

- E. Progress Meetings: The owner and engineer shall conduct progress meetings at the project site at regular intervals.

- F. Attendees: The owner, engineer and other entities concerned with current progress or involved in planning, coordination or future activities shall be represented. Participants shall be authorized to conclude matters relating to the work.

- G. Agenda: Review and correct or approve minutes of the previous meeting. Review items of significance that could affect progress. Include topics for discussion appropriate to project status.
 - 1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule. Determine how to expedite construction behind schedule; secure commitments from parties involved to do so. Discuss revisions required to ensure subsequent activities will be completed within the Contract Time.
 - 2. Review the present and future needs of each entity present, including the following:
 - a. Time
 - b. Sequences
 - c. Status of submittals
 - d. Deliveries and off-site fabrication problems
 - e. Temporary facilities and services
 - f. Quality and work standards

g. Change Orders

3. Reporting: Distribute meeting minutes to each party present and to parties who should have been present. Include a summary of progress since the previous meeting and report.
4. Schedule Updating: Revise the Contractor's Construction Schedule after each meeting where revisions have been made. Issue the revised schedule concurrently with the report of each meeting.

1.02 PRODUCTS

\\NOT USED

1.03 EXECUTION

\\NOT USED

END OF SECTION

SECTION 01 30 00 - SUBMITTALS

1.01 GENERAL

- A. Summary: This Section specifies requirements for handling submittals.
- B. General Procedures: Coordinate submittal preparation with performance of construction activities and with purchasing of fabrication, delivery, other submittals and related activities. Transmit in advance of performance of related activities to avoid delay.
1. Coordinate transmittal of different submittals for related elements so processing will not be delayed by the need to review concurrently for coordination. The engineer reserves the right to withhold action on a submittal requiring coordination until related submittals are received.
 2. Submittal Preparation: Place a label or title block on each submittal for identification. Provide a 4"x5" space on the label or beside the title block on shop drawings to record Contractor's review and approval markings and action taken. Include the following information on the label for processing and recording action taken.
 - a. Project name
 - b. Date
 - c. Name and address of Engineer
 - d. Name and address of Contractor
 - e. Name and address of sub-contractor
 - f. Name and address of supplier
 - g. Name of manufacturer
 3. Submittal Transmittal: Package submittals appropriately for transmittal and handling. Transmit with a transmittal form. Submittals received from other than the Contractor will be returned without action.
- C. Contractor's Construction Schedule: Submit a fully developed, bar-chart type construction schedule, within 10 ten days of the date established for Commencement of the Work. Provide a separate bar for each construction activity and a vertical line to identify the first working day of each week. Use the breakdown of units of work as indicated in the "Schedule of Values".
1. Secure commitments for performing critical construction operations from parties involved. Coordinate each activity with other activities and show in proper sequence; include minor elements involved in the construction sequence. Indicate sequences necessary for completion of related portions.
 2. Coordinate the Construction Schedule with the Schedule of Values, list of sub-contracts, payment request and other schedules.
 3. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the Schedule to allow time for the Architect's procedures necessary for certification of substantial completion.

- D. Distribution of Schedules: Distribute copies of the Construction Schedule to the Architect, Owner, sub-contractors and other parties required to comply with scheduled dates. Post a copy in the temporary field office. When revisions are made, distribute to the same parties and post in the same locations.
1. Updating: Revise each schedule after each meeting or activity, where revisions have been made. Issue the updated schedules concurrently with report of each meeting.
- E. Shop Drawings: Submit newly prepared information drawn to scale. Indicate deviations from the contract documents. Do not reproduce contract documents or copy standard information. Include the following information:
1. Dimensions
 2. Identification of products and materials included by sheet and detail number.
 3. Compliance with standards.
 4. Notation of coordination requirements.
 5. Notation of dimensions established by field measurement.
 6. Sheet Size: Except for templates and full-size Drawings, submit one correctable, reproducible print and one blue- or black-line print on sheets at least 8-1/2 x 11" but no larger than 24x36". The Engineer will return the reproducible print.
 - a. Do not use shop drawings without an appropriate final stamp indicating action taken.
- F. Product Data: Collect Product Data into a single submittal for each element of construction. Mark each copy to show applicable choices and options. Where product data includes information on several products, mark copies to indicate applicable information.
1. Include the following information:
 - a. Manufacturer's printed recommendations
 - b. Compliance with trade association standards
 - c. Compliance with recognized testing agency standards
 - d. Application of testing agency labels and seals
 - e. Notation of dimensions verified by field measurement
 - f. Notation of coordination requirements
 2. Preliminary Submittal: Submit a preliminary single copy of product data where selection of options is required.
 3. Submittals: Submit 2 copies; submit 4 copies where required for maintenance manuals. The Engineer will retain one and return the other marked with action taken.
 - a. Unless noncompliance with contract documents is observed, the submittal serves as the final submittal.
 4. Distribution: Furnish copies to installers, subcontractors, suppliers and others required for performance of construction activities. Show distribution on transmittal forms. Do not proceed with installation until a copy of product data is in the installer's possession.
 - a. Do not use unmarked product data for construction
- G. Samples: Submit samples as requested by Engineer:
1. Samples will be reviewed for kind, pattern, texture and color selections.

- H. Engineer's Action: Except for submittals for record, information or similar purposes, where action and return is required, the engineer will review each submittal, mark to indicate action taken and return. Compliance with specified characteristics is the Contractor's responsibility.
1. Action Stamp: The Engineer will stamp each submittal with a self-explanatory action stamp. The stamp will be appropriately marked to indicate action taken.

END OF SECTION

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SECTION 01 32 00 - PROJECT SCHEDULE

1.01 SCHEDULES

A. Project schedules included as a part of the Section shall apply to other sections of this specification and the scope of work as applicable. The following estimated project schedules shall apply:

1. Demolition and Construction Schedule as follows:
 - a. Receipt of Bids: May 9, 2023, 2023
 - b. Notice to Proceed: May 16, 2023
 - c. Project Completion: Approximately November 13, 2023

NOTE: The Owner's preference is that the project be completed prior to September 2, 2022. If this date cannot be met due to equipment lead times, any work that remains shall be completed after 3:00 PM or on weekends.

- B. Refer to other Sections of the Specifications for schedules or reports that may be contained therein.
- C. Execution: Furnish and install work as described by these schedules in accordance with all provisions of these Specifications.

END OF SECTION

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SECTION 01 50 00 - TEMPORARY FACILITIES

1.01 GENERAL

- A. Summary: This section specified temporary services and facilities, including utilities, construction and support facilities, security and protection. Provide facilities ready for use. Maintain, expand and modify as needed. Remove when no longer needed, or replaced by permanent facilities.
- B. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Engineer and will not be accepted as a basis of claims for a Change Order.
- C. Conditions of Use: Keep facilities clean and neat. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload, or permit facilities to interfere with progress. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.
- D. Materials and Equipment: Provide new materials and equipment; if acceptable to the Engineer, undamaged previously, used materials and equipment in serviceable condition may be used. Provide materials and equipment suitable for the use intended.
- E. Temporary Utility Installation:
 - 1. Water Service: Water will be provided from the existing building service without cost to the contractor.
 - 2. Electric Power Service: The Owner will provide 110 volt electric power for lighting and small power tools without cost to the contractor. Contractor shall install and pay for wiring extensions from the point of service if necessary.
- F. Temporary Construction and Support Facilities Installation: Locate for easy access. Maintain facilities until Substantial Completion. Personnel remaining after substantial completion will be permitted to use permanent facilities, under conditions acceptable to the owner.
 - 1. Toilets: Use of the owner's public toilet facilities will be permitted.
 - 2. Collection and Disposal of Waste: Collect waste daily. Comply with NFPA 241 for removal of combustible waste. Enforce requirements strictly. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of in a lawful manner.
- G. Termination and Removal: Remove each facility when the need has ended or no later than substantial completion. Repair damaged work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.

END OF SECTION

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SECTION 23 00 00

HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) SPECIFICATION INDEX

23 05 00	Basic Fire Protection, Plumbing and HVAC Requirements
23 05 53	Identification for HVAC Equipment
23 05 93	Testing, Adjusting, and Balancing for HVAC
23 07 00	HVAC Insulation
23 09 23	Direct Digital Control System for HVAC - Extension of Existing Building Automation System (BAS)
23 31 00	HVAC Ducts and Casings
23 33 00	Air Duct Accessories
23 33 15	Duct Cleaning
23 40 00	HVAC Air Cleaning Devices
23 81 03	Packaged Rooftop Air Conditioning Units

END OF SECTION

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SECTION 23 05 00

BASIC HVAC REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Basic Mechanical Requirements specifically applicable to Division 23 Sections, in addition to Division 01 - General Requirements.

1.2 SCOPE OF WORK

- A. The Mechanical Contract shall also include furnishing and installing replacement rooftop heating, ventilating and air conditioning units for the building:
 - 1. Packaged Gas/DX Rooftop units.
 - 2. Ductwork modifications as required.
 - 3. Building Automation System (BAS) extension.
 - 4. All other related work as called for under Specifications and shown on Drawings.
 - 5. Electrical modifications as required.

1.3 WORK INCLUDED

- A. The Mechanical Contract shall include all Work under the listed Sections of the Specifications Index and all related Mechanical Work as shown on the Drawings for the Project.
- B. The Mechanical Contractor shall be responsible for any costs related to the change in RTU equipment including existing piping, existing ductwork and existing electrical components.

1.4 CODES, FEES AND LATERAL COSTS

- A. The Mechanical Installation shall meet all applicable local, state and federal codes and standards.
- B. All required permits necessary for a complete mechanical installation shall be paid for by this Contractor.
- C. Except in those municipalities which provide state-approved electrical inspection, all installation of electrical equipment wiring shall be inspected by the State Board of Electricity. Allowance shall be made in the bid and Contract for the cost of such inspection.
 - 1. Fees for such inspection shall be charged in accordance with the rules and regulations of the State Board of Electricity. Evidence of payment of fees shall be provided by the Contractor with their Application for Payment.
- D. Mechanical Contractor(s) shall be responsible to provide for all State or local inspector

tests required by the current codes. Verify with the project inspector the tests, reports and witnessing that is required before construction begins.

1.5 CONTRACT TYPE

- A. The Mechanical addition and remodeling installation to be made under Division 23 is set up for Contract bidding as follows:
 - 1. Combined Gas Piping, Heating, Ventilating and Air Conditioning and Electrical Contract as a prime bid to the General Contractor/Owner.

1.6 REFERENCES

- A. All equipment, piping, etc., shall be new and shall be installed to meet the approval of the following additional ordinances: ASME Rules for Pressure Tanks, National Board of Fire Underwriter's Rules, American WaterWorks and the American Gas Association.

1.7 SUBMITTALS

- A. Submit shop drawings under provisions of Division 01 and/or where noted in specific sections of the Specification.
- B. Proposed Products List: Include information on products specified in the following Sections for Engineer's review, approval and for inclusion in the Owner's Manuals:
 - 1. 23 05 53 Identification for HVAC Equipment
 - 2. 23 05 93 Testing, Adjusting, and Balancing for HVAC
 - 3. 23 07 00 HVAC Insulation
 - 4. 23 09 23 Direct Digital Control System for HVAC - Extension of Existing Building Automation System (BAS)
 - 5. 23 33 15 Duct Cleaning and Equipment Cleaning
 - 6. 23 81 03 Packaged Rooftop Air Conditioning Units
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal for each specification section.
- D. Mark dimensions and values in units to match those specified.
- E. Electronic Submittals:
 - 1. Shop drawings shall be submitted electronically in a digital format (i.e., PDF document file), and arranged as described above and shall bear the contractors dated review stamp.
 - 2. All shop drawings shall include a transmittal cover sheet from the contractor that shall be attached to the same shop drawing file so the Engineer or Construction Manager do not have to electronically merge files. If there are multiple transmittals involved due to construction management or sub-contracting, all of the transmittals for each specification section shall be attached within the same shop drawing file.
 - 3. Multiple shop drawings in a book format with one transmittal shall not be acceptable as each specification section requires its own transmittal and review stamp.

- F. **NOTICE:** Before release of the shop drawing is acceptable, the Contractor's stamp, initialed or signed, must be provided certifying their review of the submittal, verification of products, verification of field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and the Contract Documents. **If shop drawings are not stamped by the Contractor and marked as "Reviewed", "Approved" or "Approved as Noted", they may not be processed by the Engineer. If the Engineer does review them in this instance, the contractor is still responsible for a detailed review of them and stamping them before release to their supplier.**
- G. It is the contractor's responsibility to provide submittals that are fully-compliant with the requirements of the construction documents. The engineer will review the equipment submittals for compliance with the requirements of the plans and specifications. After the submittals have been reviewed, they will be marked "Approved", "Approved as Noted" or "Rejected – Re-Submit". The engineer will make every effort to identify non-compliant equipment in the submittal process, but the engineer will not be responsible for any costs that may be required to correct non-compliant conditions (up to and including replacement of installed non-compliant equipment with the correct equipment), regardless of the fact that the submittal may be marked "Approved" or "Approved as Noted".

1.8 SYMBOLS AND ABBREVIATIONS

- A. Refer to symbol sheets on drawings. Other symbols are in common usage, but if uncertainty exists regarding any plan symbols or abbreviations, they shall be brought to the attention of the Engineer and he shall clarify same by issuing an addendum or clarification.
- B. Where the phrase starts "Provide.....," "provide" shall be construed to mean the same as "Furnish and install.....".

1.9 APPROVED MANUFACTURERS

- A. Throughout these specifications or addendums, manufactures and materials are listed as approved equal. The approval applies only in so far as they comply with the requirements of the drawings and specification and is subject to final approval with submission of shop drawings.
- B. Any extra costs of any changes in any trade's work, as a result of any substitutions, shall be borne by the CONTRACTOR making the substitutions.
- C. The project date of Substantial Completion must also be considered for equal equipment substitutions.

1.10 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

1.11 SEQUENCING AND SCHEDULING

- A. Construct Work in sequence under provisions of Division 01.

1.12 PRE-CONSTRUCTION COORDINATION AND VERIFICATION

- A. This Contractor shall coordinate his Work with other Contractors on this job. Any conflict which cannot be resolved shall be settled by the Architect/Engineer.
- B. Field verification of scale dimensions on Drawings is directed since actual locations, distances and levels shall be governed by actual field conditions.
- C. The Contractors shall check architectural, structural, plumbing, heating, ventilating and electrical drawings and conditions to avert possible installation conflicts. Shall drastic changes from original Drawings be necessary to resolve such conflicts this Contractor shall notify the Architect/Engineer and secure written approval and agreement on necessary adjustments before the installation is started.
- D. Discrepancies shown on different Drawings or between Drawings and actual field conditions or between Drawings and Specifications shall promptly be brought to the attention of the Architect/Engineer for a decision. Contractor shall not scale drawings for exact locations of equipment. (Verify final location.) All dimensions shall be taken from Architectural Drawings.
- E. The Contractor shall consider and review existing site conditions and the complete set of documents including Architectural, Structural, Mechanical, Electrical, etc., (Drawings and Specifications) as his complete set of documents. He shall be responsible for all mechanical work shown or stated (to be by him), to include this Work in his bid and install such items even though they are not specifically shown or stated on the Mechanical Section of the Drawings and Specifications.

1.13 INTERPRETATIONS OF DOCUMENTS

- A. Contractors shall promptly notify the Engineer of inconsistencies, errors and omissions found in the Drawings and Specifications prior to bid date.
- B. Questions regarding the bidding and requests for interpretation of the Drawings and Specifications shall be submitted to the Engineer in writing in sufficient time to be received prior to the date for receipt of bids.
- C. Interpretation and correction of the Drawings and Specifications shall be made by addendum. Interpretations and corrections made by any other method shall not be binding on the Owner or the Engineer.
- D. The drawings and Specifications are complementary to one another. This defines a relationship such that any item which is provided for in one document is to be considered as provided for in both sets of documents. Where conflicts exist between the Specifications and/or drawings, the more stringent requirement shall apply.

1.14 CUTTING, PATCHING

- A. Where cutting is required, it shall be done by this Contractor. All patching left after demolition and left by cutting shall be done by the Mechanical Contractor.

1.15 PROTECTION OF FINISHES

- A. All contractors shall take the necessary means to protect the existing building finishes and roofing during construction. Any damage that occurs shall be repaired as required to match the pre-damage conditions at no additional cost to the owner. The contractors shall provide protective coverings as required when executing work that is likely to cause damage.

1.16 ELECTRICAL

- A. As a sub-bid to the Prime Electrical Contractor, Electrical Sub-Contractor shall furnish all electrical work as indicated on the plans.

1.17 GUARANTEE / WARRANTY

- A. The Contractor shall be responsible for the proper installation and working of everything in their portion of the project and shall guarantee to remedy free of charge any defects in workmanship and materials that may appear to give or gives rise to trouble of any kind for a period of one year from the date of Substantial Completion of the work (unless noted otherwise as a longer warranty period in an individual specification section).

1.18 OWNER'S MANUALS AND OPERATING INSTRUCTIONS

- A. Under this Contract the Mechanical Contractor shall furnish the Owner with two 3-ring binders of all pertinent systems information and related documents. Submit these manuals to the Engineer for their review. The books shall contain the following items:
 1. All Shop drawings of major equipment, complete with Engineer's and Mechanical Contractor's approval stamp.
 2. Installation and Operating Instructions for all major equipment.
 3. Packaged RTU start-up reports.
 4. Document RTU training method, date of training and list of personnel that was present.
 5. VFD start-up report for each VFD unit. Document when training was provided, what information was shared, who provided the training and who was present.
 6. Submit certification reports to Engineer showing that all required testing for the project, including natural gas piping and storm piping.
 7. Maintenance instructions for all major equipment.
 8. Wiring diagrams for all equipment.
 9. Building Automation System points and sequence of operation verification report and compliance statement.
 10. Final Test and Balance Report.

- B. Using the Owner's manuals, the Mechanical Contractor shall instruct the Owner/Owner's Representative on the proper operation of all equipment installed as part of this Contract. These instructions shall include, but not be limited to preventative maintenance, safety instructions and normal operating procedures.
- C. After the Owner has been instructed, the Contractor shall submit a letter to the Mechanical Engineer documenting that the information was given to the Owner and that he has signed off on this part of the Contract.

1.19 EQUIPMENT START-UP AND TRAINING

- A. The Mechanical Contractor shall be responsible for providing both a heating season start-up and cooling season start-up of heating, cooling, humidification, BAS and dehumidification equipment including:
 - 1. Training the owner in all methods needed for winterization of equipment, coils, drain down, etc.
 - 2. Training the owner regarding lubrication of all components and establishing a preventative maintenance schedule.
 - 3. Training the Owner in regards to BAS programming modifications and seasonal changes.
 - 4. Training the Owner in proper operation and maintenance of all seasonal equipment, again using the O & M manuals.
 - 5. Observing and establishing a recommended filter changing schedule or establishing a static pressure point for change based on pressure differential measuring.

1.20 DEMOLITION

- A. If, in the process of removing piping, equipment, wiring or duct work the support of other apparatus is affected, such supports shall be rearranged or additional supports added as required to meet code. All such work shall be included in the bid.
- B. Any duct that is inadvertently removed or damaged during demolition shall be replaced in the same or better condition than the existing installation.
- C. If ceiling removal is necessary to facilitate the removal of existing equipment and/or the installation of new equipment, the ceiling removal shall be the responsibility of the mechanical contractor. The repair or replacement of the ceiling when the work is complete shall also be the responsibility of the mechanical.

1.21 EQUIPMENT ACCESS

- A. The installing Contractor shall be responsible for determining means and methods for gaining access to building roof for the purpose of removing equipment and installing new equipment. In the process of removing old equipment and/or installing new equipment, it may be necessary to remove existing mechanical (ductwork, piping, supports, etc.), electrical (conduits, wiring, etc.), in order to gain adequate access to the spaces. All costs associated with this work shall be the Mechanical Contractor's responsibility and shall be included in the Mechanical Bid. The Owner shall not be responsible for any additional

costs associated with equipment access.

- B. The installing Contractor shall coordinate adequate space for maintenance personnel to work on the installed equipment regardless of location. This is a critical issue that needs to be discussed and coordinated early in the Contractor coordination meetings.

1.22 EQUIPMENT REMOVAL

- A. The Mechanical Contractor shall remove all unused piping, mechanical RTU equipment and ductwork as noted and/or where existing is not to be re-used for the Project.
- B. The Mechanical Contractor shall be responsible for disposal.

1.23 PRODUCT SUBSTITUTIONS

- A. The details and arrangements shown on the plans may be specific to the products included on the product schedule. Utilizing products by other approved manufacturers (approved equals) may result in the requirement for modifications to the equipment arrangement or installation materials including different piping configurations, valving, venting, clearances, access, etc. It shall be the Contractor's responsibility to identify any necessary changes. Any modifications that are required to provide a fully functioning system that meets the project requirements and complies with the equipment manufacturer's installation recommendations shall be provided as part of the project at no additional cost to the Owner.
- B. If changes are required, the Contractor shall be responsible for providing a description and drawing that shows the necessary modifications for Engineer review prior to equipment installation. This drawing shall be submitted with the shop drawings for the Equipment that is impacted and shall be drawn to the same scale as the original plans where this equipment is shown.

PART 2 PRODUCTS

\\Not Used

PART 3 EXECUTION

\\Not Used

END OF SECTION

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SECTION 23 05 53

IDENTIFICATION FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Pipe markers.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Craftmark Identification Systems.
 - 2. Safety Sign Co.
 - 3. Seton Identification Products.
 - 4. Brady Markers.
 - 5. Marking Services, Inc. (MSI)
 - 6. EMED, Inc.
 - 7. Brimar Industries

2.2 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
 - 1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

2.3 EQUIPMENT NAMEPLATES AND LABELS

- A. Outdoor type description: 0.020" thick aluminum, size 4.0 inch wide x 2 inch tall with two mounting holes or optional adhesive. Red label with 5/8" tall engraved aluminum lettering and symbols.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Equipment Nameplates: Install with screws.
 - 1. Install outdoor equipment tags on north or shadiest side of equipment to minimize damage from sun exposure.
- B. Pipe Markers: Install in accordance with manufacturer's instructions.
- C. Equipment: Identify air handling RTUs, with aluminum nameplates for exterior equipment.

3.2 PIPE MARKING

- A. Identify gas piping with color coded banding. Identify service and pressure. Install in clear view and align with axis of piping. Locate identification near RTUs.
- B. All piping shall be designated by color code in accordance with the following:
 - 1. Coding is to be accomplished by bands of colored banding completely encircling the pipe or pipe covering. Banding shall be as manufactured by Seaton, Inc. "Setmark Pipe Markers", or approved equal and shall be the correct type for the service involved. 8" long with 3/4" high letters up to 2-3/8" OD and 12" long with 1-1/4" high letters up to 7-7/8" OD. (8" long color field)
- C. The standard piping color code is as follows:

<u>Color</u>	<u>Opti-Code No.</u>	<u>Legend Function</u>
Yellow/Black	M4159	Natural Gas Piping

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting and balancing of air systems.
 - 2. Measurement of final operating condition of HVAC systems.
- B. Related Sections:
 - 1. Section 23 09 23 - Direct-Digital Control System for HVAC: Requirements for coordination between DDC system and testing, adjusting, and balancing work.

1.2 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- C. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms or NEBB Report forms. Submit data in S.I. units.
- D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty or Copy of NEBB Certificate of Conformance Certification.

- F. Submit draft copies of report for review prior to final acceptance of Project.
- G. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents 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.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of flow measuring stations and balancing valves.
- C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- B. Maintain one copy of each document on site.
- C. Prior to commencing Work, calibrate each instrument to be used.

1.6 QUALIFICATIONS

- A. Approved Agencies
 1. Mechanical Test and Balance (AABC)
 2. Test and Balance Associates, Inc. (Minneapolis)
 3. Systems Mgmt. and Balancing - Center City, MN or Des Moines, IA. (AABC)
 4. Air Systems Engineering - St. Louis Park
 5. Bal-Tech - St. Louis Park (NEBB)
 6. Flow Dynamic Balancing – Minneapolis (NEBB)
- B. Perform Work under supervision of AABC Certified Test and Balance or NEBB Certified Testing, Balancing and Adjusting registered professional engineer experienced in performance of this Work.
- C. The Balancing Agency shall be an independent firm hired by the Mechanical Contractor and shall not be part of the Mechanical Contractor's corporation.

1.7 PRE-BALANCING MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.

- B. Convene minimum of one 85-95% progress inspection and one week prior to commencing work of this section.

1.8 SEQUENCING

- A. Division 01 – Summary: Work sequence.
- B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.9 RE-BALANCING

- A. Contractor shall further balance the air and/or water distribution systems to meet the air volumes and/or flows as shown on the plan and any re-balancing required during the first year of operation.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify systems are complete and operable before commencing work. Verify the following:
 1. Systems are started and operating in 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.

3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.

- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.
- B. Air Outlets and Inlets: Adjust total to within plus or minus 10 percent of design to space.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Verify recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- E. Report defects and deficiencies noted during performance of services, preventing system balance.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities at site altitude.
 - 1. It shall be the Balancing Company's responsibility to change sheaves and/or drives as necessary on up to 25 percent of the equipment installed.
- B. Make air quantity measurements in main ducts by pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air and exhaust dampers to check leakage.

3.6 SCHEDULES

- A. Equipment Requiring Testing, Adjusting and Balancing:
 - 1. Replacement Packaged Roof Top Heating/Cooling Units.
 - 2. Air Terminal Units.
 - 3. Air Inlets and Outlets.
- B. Report Forms
 - 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers 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 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. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP and kW
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
5. V-Belt Drive:
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
6. Air Moving Equipment: (Replacement RTU)
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Arrangement/Class/Discharge
 - f. Air flow, specified and actual
 - g. Return air flow, specified and actual
 - h. Outside air flow, specified and actual
 - i. Total static pressure (total external), specified and actual
 - j. Inlet pressure
 - k. Discharge pressure
 - l. Sheave Make/Size/Bore
 - m. Number of Belts/Make/Size
 - n. Fan RPM
7. Return Air/Outside Air Data: (RTU)
 - a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
 - h. Return air temperature
 - i. Outside air temperature
 - j. Required mixed air temperature
8. 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

3.7 IMPORTANCE AND PAYMENTS

- A. The entire HVAC portion of this project shall not be considered substantially complete until the balancing is acceptable to the Engineer. Total mechanical payment for HVAC portion of the project beyond 90 percent will not be approved until such balancing and commissioning is acceptable to the Engineer.

END OF SECTION

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SECTION 23 07 00

HVAC INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ductwork insulation.
 - 2. Ductwork insulation jackets.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - 2. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet Form.
 - 3. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
 - 4. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 5. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - 6. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 7. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 - 8. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- B. Sheet Metal and Air Conditioning Contractors':
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

1.4 QUALITY ASSURANCE

- A. Test pipe, duct and equipment insulation for maximum flame spread index of 25 and maximum smoke developed index not exceeding 50 within plenum in accordance with ASTM E84.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storage and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature during and after installation for minimum period of 24 hours.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.8 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for man made fiber.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS (PIPE INSULATION)

- A. Owens Corning Fiberglass
- B. Certainteed
- C. Johns-Manville
- D. Knauf, Inc.
- E. Rubatex
- F. Armoflex
- G. Imcoshield/Imcolock
- H. Therma-Cel

2.2 ACCEPTABLE MANUFACTURERS - (DUCT INSULATION)

- A. Owens Corning
- B. Certainteed
- C. Johns Manville
- D. Knauf
- E. CSG

2.3 MATERIALS (DUCT INSULATION)

- A. Type B: Rigid glass fiber; ANSI/ASTM C612, Class 1; 'k' value of 0.24 per inch at 75°F; 3.0 lb/cu ft minimum density, 0.002 inch foil scrim or FSK facing for air conditioning, heating and venting ducts.
- B. Type C: Flexible glass fiber; ANSI/ASTM C612; commercial grade; 'k' value of 0.29 per inch at 75°F, 0.75 lb/cu ft minimum density, 0.002 inch foil scrim or FSK facing for air conditioning, heating and venting ducts.
- C. Type E: AP Armaflex sheet or AP Coilflex Duct Liner: Flexible elastomeric thermal insulation board, 'k' value of 0.25 per inch at 75°F, 3.0 lb/cu.ft. density, with anti-microbial coating, manufactured without use of CFCs, HFCs or HCFCs and suitable for mechanical fasteners or for gluing only with Armaflex 520 adhesive. Support LEED, IECC and ASHRAE 90.1 with R-4.2 at 1" thick, R-6 at 1.5" thick and R-8 at 2" thick.
- D. Adhesives: Waterproof fire-retardant type.
- E. Lagging Adhesive: Fire resistive to ASTM E84, NFPA 255, UL 723.
- F. Joint Tape: Glass fiber cloth, open mesh.
- G. Mechanical Fasteners: Pin-type with welded connection to duct side wall. Do not use nail-type fasteners or glue type connections.
- H. Vapor Barrier Jacket
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, 0.0032 inch ASJ jacket.
 - 2. Moisture vapor transmission: ASTM #96; 0.04 perm.
 - 3. Secure with pressure sensitive tape.

2.4 ADHESIVE FOR DUCT INSULATION

- A. Water Base Type
 - 1. Cain – Hydrotak
 - 2. Duro Dyne – WSA
 - 3. Hardcast - IA-901
 - 4. Kingco - 10-568

5. Miracle - PF-101
 6. Mon-Eco - 22-67
 7. Techno Adhesive – 133
 8. United McGill - Unitack
- B. Solvent Base (Non-Flammable)
1. Cain - Safetak
 2. Duro Dyne - FPG
 3. Hardcast - Glas-Grip 648-NFSE
 4. Kingco - 15-137
 5. Miracle - PF-91
 6. Mon-Eco - 22-24
 7. Techno Adhesive - ‘Non-Flam’ 106

2.5 FASTENERS FOR DUCT INSULATION

- A. Adhesively secured fasteners not allowed.
- B. Approved Manufacturers
1. AGM Industries, Inc - “DynaPoint” Series DD-9 pin
 2. Cain
 3. Duro Dyne
 4. Omark dished head “Insul-Pins”
- C. Grip nails may be used if each nail is installed by “Grip Nail Air Hammer” or by Automatic Fastener Equipment” in accordance with Manufacturer’s recommendations.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administration Requirements: Coordination and project conditions.
- B. Verify that surfaces are clean, foreign material removed and dry.

3.2 PREPARATION (DUCT INSULATION)

- A. Install external materials after ductwork has been tested or and approved.
- B. Insulated ductwork conveying air conditioning, room air or air below ambient temperature:
1. Provide insulation with vapor barrier jackets.
 2. Finish with tape and vapor barrier jacket.
 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. External Insulation (Type B or Type C) Application:
1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.

2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
4. Seal all insulation butt joints and insulation terminations at diffusers, registers, branch ducts and main duct connections with tape such that no insulation is left exposed to ambient air.

D. External Insulation (Type D) Application:

1. Secure insulation with vapor barrier sleeve using vapor barrier adhesive tape.
2. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping or vapor barrier.
3. Slide sleeve over round branch ducts in five foot lengths.
4. Seal all insulation butt joints and insulation terminations at diffusers, registers, branch ducts and main duct connections with tape such that no insulation is left exposed to ambient air.

3.3 FAN POWER SYSTEMS (DUCT INSULATION)

- A. All fan powered supply air system such as externally wrapped duct insulation and vapor barrier jacket.

3.4 DUCT INSULATION SCHEDULE

<u>DUCTWORK</u>	<u>TYPE</u>	<u>INSULATION THICKNESS</u>	<u>FINISH</u>
Rectangular Supply Ducts	B / C	1-1/2"	Vapor Barrier
Flexible Connectors at Supply Air Ductwork	B / C	1-1/2"	Vapor Barrier

3.5 LOCAL CODES - INSULATION THICKNESS

- A. Where local codes are more stringent than the material thickness specified above, Contractor shall increase insulation thickness to comply with applicable Codes. **Do not** increase duct liner thickness without consulting the Engineer.

END OF SECTION

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SECTION 23 09 23

DIRECT DIGITAL CONTROL SYSTEM (Extension of Existing Automation System)

PART 1 GENERAL

1.1 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 23 33 00 - Ductwork Accessories: Installation of automatic dampers, smoke detectors. Connection of damper end switches.

1.2 RELATED SECTIONS

- A. Section 23 05 00 - Basic Fire Protection, Plumbing and HVAC Requirements.
- B. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- C. Section 23 81 03 – Package Roof Top Air Conditioning Units
- D. Section 26 05 00 - Basic Electrical Requirements

1.4 CODES, STANDARDS AND REFERENCES

- A. Air Movement and Control Association (AMCA)
- B. American National Standards Institute (ANSI)
- C. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - 1. ASHRAE 135-2004 BACnet Standard
- D. Federal Communications Commission (FCC)
- E. Institute of Electrical and Electronics Engineers (IEEE)
- F. International Organization for Standardization (ISO)
- G. National Electrical Manufacturers Association (NEMA)
- H. National Fire Protection Association (NFPA)
- I. Underwriters Laboratories (UL)
- J. U.S. National Archives and Records Administration (NARA)

1.5 DEFINITIONS

- A. Insure terminology used in submittals conforms to ASHRAE\85 or ASME MC85.1.

1.6 SYSTEM DESCRIPTION

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units. All new equipment shall be compatible with the existing system.
- B. All necessary central and remote hardware, software, and interconnecting wire and conduit shall be provided.
- C. All control work shall be performed by Trane Twin Cities personnel. No exceptions.

1.7 SUBMITTALS

- A. Division 01 - Submittal Procedures.
- B. Shop Drawings shall include:
 - 1. Trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - 2. List of connected data points, including connected control unit and input device.
 - 3. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 - 4. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 5. Descriptive data and sequence of operation of operating, user, and application software.
- C. Product Data: Provide data for each system component and software module.
- D. Manufacturer's Installation Instructions: Include for all manufactured components.

1.8 PROJECT RECORD DOCUMENTS

- A. Accurately record actual location of control components, including panels, thermostats and sensors.
- B. Revise shop drawings to reflect actual installation and operating sequences. Also show any existing system modification to the existing system. Submit two sets of revised drawings to the owner at completion of the contract.
- C. During the construction, Contractor shall maintain a clean set of drawings for the sole purpose of recording changes and actual "as installed" information. Marking of the record set shall be done methodically as work progresses, clearly and neatly, in color.
- D. As a general guide, the type of information to be recorded on the record set includes:
 - 1. Revisions made, except minor or non-critical dimensions.
 - 2. Omissions, including work omitted by accepted alternates.
 - 3. Locations of control valves.
 - 4. Additions to the work.
 - 5. Changed footage or other elevations

6. Changes in locations of control panelboards, control equipment, outlets, pneumatic piping drains, pneumatic piping openings, control dampers and other similar data.

E. Include above data specified in "Submittals" in final "Record Documents" form.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01.

B. Include interconnection wiring diagrams complete field installed system with identified and numbered, system components and devices.

C. Include keyboard illustrations and step-by-step procedures indexed for each operator function.

D. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.10 QUALIFICATIONS

A. Manufacturer: Trane

B. Installer: Trane

C. Contact information: Trane Twin Cities, Tony Lanphier, 303-889-9237

1.11 PRE-INSTALLATION CONFERENCE

A. Convene a conference one week prior to commencing work of this Section, under provisions of Division 01.

B. Require attendance of all parties directly affecting the work of this Section.

1.12 COORDINATION

A. Insure installation of components is complementary to installation of similar components in other systems.

B. Coordinate installation of system components with installation of mechanical systems equipment such as roof top air handling units.

C. The Contractor shall be fully responsible for the complete installation and commissioning of the DDC System extension including, but not limited to, interfacing of new and existing DDC equipment, sensors and controls, existing central computer, programming peripherals, communication links and new remote panel programming.

D. After the installation the Contractor shall be responsible for debugging and calibration, including software and application strategies.

- E. Contractor shall be responsible for “all on-site programming and editing required to provide a fully operational DDC System extension. (System extension shall be 100 percent programmed for all points listed in I/O Summary Table.)
- F. Ensure system is completed and commissioned.

1.13 WARRANTY

- A. Provide one year warranty under provisions of the contract following final acceptance of the project by the Architect/Owner.
- B. Warranty: Include coverage for field programmable micro-processor based units and all installed equipment and accessories.

1.14 MAINTENANCE SERVICE

- A. Furnish service and maintenance of energy management and control system for one year.
- B. Provide service of systems, including call backs. Make minimum of two complete normal inspections of approximately four hours duration in addition to normal service calls to inspect, calibrate, and adjust controls and submit written reports.

1.15 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software extension, the Owner and the party providing the software will enter into a revised software license agreement with provisions for the following:
 - 1. Limiting use of software to equipment provided under these specifications.
 - 2. Limiting copying.
 - 3. Preserving confidentiality.
 - 4. Prohibiting transfer to a third party.

PART 2 PRODUCTS

2.1 MANUFACTURERS (BMS) BUILDING MANAGEMENT SYSTEMS

- A. Trane.
- B. No approved equals. (Refer to specification section 23 09 24 for alternate bid information)

2.2 GENERAL PRODUCT DESCRIPTION

- A. The extension of the existing Facility Management System (FMS) shall be capable of integrating multiple building functions, including equipment supervision and control, alarm management, energy management and trend data collection.
- B. The FMS shall consist of the following:
 - 1. Connection to the existing Digital Panel

2. Standalone Application Specific Controllers (ASCs)
- C. The system is modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASCs and operator devices. Each remote panel shall have a minimum of 10 percent spare capacity for future point connection. The type of spares shall be in the same proportion as the implemented I/O functions of the panel, but in no case shall there be less than two (2) spares of each implemented I/O type. Provide all processors, power supplies and communication controllers complete so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring. Provide sufficient internal memory for the specified control sequences and have at least 15 percent of the additional memory available for future use.
- D. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

2.3 NETWORKING/COMMUNICATIONS

- A. The extension of the existing FMS shall be integrated into existing network. Inherent in the system's design shall be the ability to expand or modify the network either via a local or web-based network.
- B. Local Network
 1. Computer/Panel Support: The existing Computer or Digital Panel shall directly oversee a local network such that communications may be executed directly to and between ASCs. The Personal Computer version and Digital Panel version shall be referred to as the "Digital Panel(s)" throughout this document.
 2. Data Access: All operator devices shall have the ability to access all point status and application report data on the network. Access to system data shall not be restricted by the hardware configuration of the facility management system.
 3. Global Data Sharing: Global Data Sharing or Global Point Broadcasting shall allow point data to be shared between ASCs, when it would be inefficient or impractical to locate multiple sensors.
 4. General Network Design: Network design shall include the following provisions:
 - a. Data transfer rates for alarm reporting and quick point status from multiple ASCs. The minimum baud rate shall be 9600 baud.
 - b. Support of any combination of ASCs. A minimum of 100 ASCs shall be supported on a single local network. The bus shall be addressable for up to 155 ASCs.
 - c. Detection of a single or multiple failures of ASCs or the network media.
 - d. Error detection, correction and retransmission to guarantee data integrity.
 - e. Commonly available, multiple-sourced, networking components shall be used.
 - f. Use of an industry standard protocol, such as Optomux and IEEE RS-485 communications interface.

2.4 DIGITAL PANELS

- A. General: Digital panels shall be microprocessor-based, multi-tasking, multi-user, digital

control processors.

- B. Memory: Each digital panel shall have sufficient memory to support its own operating system and data bases including:
 - 1. Control processed
 - 2. Energy Management Applications
 - 3. Alarm Management
 - 4. Trend Data
 - 5. Maintenance Support Applications
 - 6. Operator I/O
 - 7. Dial-Up Communications
 - 8. Manual Override Monitoring
- C. Expandability: The system shall be modular in nature and shall permit easy expansion through the addition of field controllers, sensors and actuators.
- D. Serial Communication Ports: Digital panels shall provide at least two RS-232C serial data communication ports for simultaneous operation of multiple operator I/O devices such as lap-top computers, personal computers and video display terminals.
- E. Hardware Override Monitoring: Digital panels shall monitor the status of all overrides and include this information in logs and summaries to inform the operator that automatic control has been inhibited.
- F. Integrated On-Line Diagnostics: Each digital panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment. Digital panels shall provide both local and remote annunciation of any detected component failures or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each digital panel.
- G. Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.
- H. Power Fail Restart: In the event of the loss of normal power, there shall be an orderly shutdown of the Digital Panel 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 real time clock and all volatile memory for a minimum of 72 hours. Upon restoration of normal power, the Digital Panel shall automatically resume full operation without manual intervention. Should Digital Panel memory be lost for any reason, the user shall have the capability of reloading the Digital Panel via the local RS-232C port or telephone line dial-in.

2.5 SYSTEM SOFTWARE FEATURES

- A. General
 - 1. All necessary software extensions to form a completely integrated operating

- system for the entire complex, as described in this specification, shall be provided.
2. The software programs specified in this section shall be provided as an integral part of the Digital Panel and shall not be dependent upon any higher level computer for execution.
- B. Control Software Description
1. Equipment Cycling Protection: Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
 2. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
- C. Energy Management Applications: Digital Panels shall have the ability to perform any or all of the following energy management routines:
1. Time of scheduling
 2. Calendar based scheduling
 3. Holiday scheduling
 4. Optimal start
 5. Optimal stop
 6. Load rolling
 7. Heating/Cooling interlock
- D. All programs shall be executed automatically without the need for operator intervention and shall be flexible enough to allow user customization. Programs shall be applied to building equipment described in the "Execution" portion of this specification.
- E. Programming Capability: Digital Panels shall be able to execute configured processes defined by the user to automatically perform calculations and control routines.
1. Process Inputs and Variables: It shall be possible to use any of the following in a configured process:
 - a. Any system-measured point data or status
 - b. Any calculated data
 - c. Any results from other processes
 - d. Boolean logic operators (and,or)
 2. Process Triggers: Configured processes may be triggered based on any combination of the following:
 - a. Time of day
 - b. Calendar date
 - c. Other processes
 - d. Events (e.g., point alarms)
 3. Data Access: A single process shall be able to incorporate measured or calculated data from any and all other ASCs.
 4. In addition, a single process shall be able to issue commands to points in any and all other ASCs on the local network.

2.6 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS

- A. Each digital panel shall be able to extend its monitoring and control through the use of standalone Application Specific Controllers (ASCs).
- B. Each ASC shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a micro-processor-bases, multi-tasking, real-time digital control processor.
- C. Each ASC shall have sufficient memory to support its own operating system and data bases including:
 - 1. Control Processes
 - 2. Energy Management Applications
 - 3. Operator I/O (Portable Service Terminal)
- D. Application Descriptions:
 - 1. Roof Top Air Handling Unit (RTU) Controllers:
 - a. RTU controllers shall support, but not be limited to the following configurations of systems to address current requirements as described in the "Execution" portion of this specification and for future expansion:
Mixed Air-Single Path
Generic Point Multi-plexing
 - b. RTU controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally standalone fashion.
 - c. RTU controllers shall have a library of control routines and program logic to perform the Sequence of Operation specified in the "Execution" portion of this specification.
 - d. Continuous Zone Temperature Histories: Each RTU Controller shall automatically and continuously maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored.
 - e. Alarm Management: Each RTU controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

2.7 OPERATOR INTERFACE

- A. Dynamic Graphic Displays: Graphic system schematics for each new piece of Mechanical equipment, including air handling units, rooftop units, terminal units, VAV, boilers, pumps, etc. shall be provided as specified in the Execution portion of this specification to optimize system performance analysis and speed alarm recognition.
 - 1. System Selection/Penetration. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands.
 - 2. Dynamic Data Displays: Dynamic temperature values, humidity values, flow values and

status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.

- B. System Configuration and Definition: All new temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.
1. The system shall be provided complete with all equipment and documentation necessary to allow an operator to independently perform control/programming functions:
 2. Programming Description: Definition of operator device characteristics, ASCs, individual points, applications and control sequences shall be performed through fill-in-the-blank templates.
 - a. Network-Wide Strategy Development: Inputs and outputs for any process shall not be restricted to a single ASC, but shall be able to include data from any and all other ASCs to allow the development of network-wide control strategies.
 3. System Definition/Control Sequence Documentation: All portions of system definition shall be self-documenting to provide hardcopy printouts of all configuration and application data.
 4. Data Base Save/Restore/Back-Up: Back-up copies of all ASC and Digital Panel data bases shall be stored in at least one personal computer or lap-top. Users shall also have the ability to manually execute downloads of an ASC or Digital Panel data base.

2.8 SENSORS AND INSTRUMENTATION DEVICES

- A. Transmitters
1. The electrical output of a transmitter shall be 0 to 10 VDC, 4 to 20 milliamps or 0 to 20 milliamps for analog variables and binary contacts for status variables.
 2. The resolution of a transmitter may not exceed the following:
 - a. 0.01 Volts per increment for 0-10 VDC transmitters
 - b. 0.02 Milliamps per increment for 4-12 or 0-20 milliamp transmitters.
 - c. The process variable change that corresponds to the transmitter resolution is the smallest reportable change that can be processed.
 3. Transmitters that connect directly to the FT-10A field bus are considered to be application specific devices.
- B. Temperature Sensors
1. Temperature sensors shall be resistance element detector (RTD) type or sealed element thermistor type.
 2. Space temperature sensors shall be provided with blank covers with no exposed setpoints or setpoint adjustment.
 3. Duct temperature sensors shall be rigid stem or averaging type as required for the application. All mixed air and discharge air temperature sensors shall be of the remote bulb type.
 4. Water temperature sensors shall be provided with a separable copper, monel or stainless steel well.

5. Outside air temperature sensor shall be remote bulb or bimetallic rod and tube type.
 6. Temperature sensors may be transmitters or thermistors as long as all performance requirements are met.
 7. RTDs shall only be used with transmitter based sensors. They shall not be wired directly to a controller.
 8. Conditioned Space Temperature Sensors
 - a. Operating Range: 50 to 86 degrees F
 - b. Conformity: +/- 1 degree F over the specified operating range
 9. Unconditioned Space Temperature Sensors
 - a. Operating Range: 20 to 150 degrees F
 - b. Conformity: +/- 1 degree F between 50 and 86 degrees F and +/- 2 degrees F over the remaining range.
 10. Duct Temperature Sensors
 - a. Operating Range: 40 to 140 degrees F
 - b. Conformity: +/- 2 degrees F
 11. Outside Air Temperature Sensors
 - a. Operating Range: -50 to +150 degrees F
 - b. Conformity: +/- 2 degrees F
 12. Heating Hot Water
 - a. Operating Range: 70 to 250 degrees F
 - b. Conformity: +/- 2 degrees F
- C. Point Temperature Sensors
1. Shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper.
- D. Thermowells
1. Thermowells shall be series 300 threaded stainless steel.
 2. Inside diameter and insertion length shall be as required for the application.
- E. Relative Humidity Sensors
1. Shall use bulk polymer, resistive or thin film capacitive type, non-saturating sensing elements capable of withstanding a saturated condition without permanently affecting calibration or sustaining damage.
 2. Shall include removable protective membrane filters.
 3. For exterior installations, the sensors shall survive below freezing temperatures and direct contact with moisture without affecting sensor calibration.
 4. For indoor installations, the sensor calibration shall not be altered by exposure to a condensing air stream.
 5. The sensors shall be of the wall mounted or duct mounted type as required by the application and shall be furnished with all accessories for a complete and functional installation.
 6. Sensors used in duct high limit applications shall use a bulk polymer resistive sensing element.
 7. Duct mounted sensors shall be equipped with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage.
 8. Operating Range: 0 to 100% relative humidity
 9. Conformity: +/- 2 % relative humidity

10. Environmental Range: 25 to 140 degrees F

F. Thermostats

1. Electric Room Thermostats:
 - a. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
 - b. Service: Cooling only.
2. Line Voltage Thermostats:
 - a. Integral manual On/Off/Auto selector switch, single or two-pole.
 - b. Dead band: Maximum 2 degrees F.
 - c. Load Motor capacity rating.
3. Room Thermostat Accessories:
 - a. Thermostat Covers: PVC.
 - b. Insulating Bases: For thermostats located on exterior walls.
 - c. Adjusting Key: Matching device.
4. Outdoor Reset Thermostat:
 - a. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
 - b. Scale range: -10 to 70 degrees F.
5. Immersion Thermostat: Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.
6. Air-stream Thermostats:
 - a. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
 - b. Averaging service remote bulb element: 20 feet.
7. Electric High Limit Duct Thermostat:
 - a. Snap acting, single pole, single throw, automatic reset switch tripping when temperature sensed across any 12 inches of bulb length is equal to or above setpoint.
 - b. Bulb length: Minimum 20 feet.
 - c. Furnish one thermostat for every 20 sq. ft of coil surface.
8. Fire Thermostats:
 - a. UL labeled, factory set in accordance with NFPA 90A.
 - b. Normally closed contacts, manual reset.

G. Current Transducers

1. Current transducers shall accept an AC current input and shall have an accuracy of +/- 2% of full scale.
2. An integral power supply shall be provided for the analog output signal if required. The device shall have a means for calibration.

H. Current Sensing Relays

1. Current sensing relays (CSRs) shall provide a normally-open contact with a voltage and amperage rating greater than its connected load. Current sensing relays shall be of split-core design.
2. The CSR shall be rated for operation at 200% of the connected load. Voltage isolation shall be a minimum of 600 volts. The CSR shall auto-calibrate to the connected load.

- I. Voltage Transducers
 - 1. Voltage transducers shall accept an AC voltage input and have an accuracy of +/- 0.25% of full scale.
 - 2. An integral power supply shall be provided if required for the analog output signal. The device shall have a means for calibration. Line side fuses for transducer protection shall be provided.

- J. Occupancy Sensors
 - 1. Occupancy sensors shall have occupancy-sensing sensitivity adjustment and an adjustable off-delay timer with a range encompassing 30 seconds to 15 minutes. Occupancy sensors shall be rated for operation in ambient air temperatures ranging from 50 degrees F to 104 degrees F or temperatures normally encountered in the installed location. Sensors integral to wall mount on-off light switches shall have an auto-off switch. Wall switch sensors shall be decorator style and shall fit behind a standard decorator type wall plate. All occupancy sensors, power packs, and slave packs shall be UL listed. In addition to any outputs required for lighting control, the occupancy sensor shall provide a contact output rated at 1A at 24 VAC or a SNVT output.
 - 2. Passive Infrared Occupancy Sensors: PIR occupancy sensors shall have a multi-level, multi-segmented viewing lens and a conical field of view with a viewing angle of 180 degrees and a detection of at least 6 meters (20 feet) unless otherwise shown or specified. PIR Sensors shall provide field-adjustable background light-level adjustment with an adjustment range suitable to the light level in the sensed area, room, or space. PIR sensors shall be immune to false triggering from RFI and EMI.
 - 3. Ultrasonic Occupancy Sensors: Ultrasonic sensors shall operate at a minimum frequency 32 kHz and shall be designed to not interfere with hearing aids. Dual-Technology Occupancy Sensor (PIR and Ultrasonic) Dual-Technology Occupancy Sensors shall meet the requirements of both PIR and Ultrasonic Occupancy Sensor.
 - 4. Dew Point Sensor
 - a. Sensor shall be suitable for measurement of dew point from -40 to +80 degrees F over a pressure range of 0 to 150 psig. The transmitter shall provide both dry bulb and dew point temperatures on separate outputs.
 - b. The end to end accuracy of the dew point shall be +/-5 degrees F and the dry bulb shall be +/-1 degree F. Sensor shall be automatic zeroing and shall require no normal maintenance or periodic recalibration.

- K. Temperature Switches
 - 1. Duct Mounted Low Limit Safety Switch. Duct mount temperature low limit switches (freezestats) shall be manual reset, low temperature safety switches with a minimum element length of 1 foot per square-foot of coverage which shall respond to the coldest 18 inch segment with an accuracy of 3.6 degrees F. The switch shall have a field-adjustable set point with a range of at least +30 to +50 degrees F. The switch shall have two sets of contacts, and each contact shall have a rating greater than its connected load. Contacts shall open or close upon drop of temperature below set point as shown and shall remain in this state until reset.

- L. Damper End Switches
 - 1. Each end switch shall be a hermetically sealed switch with a trip lever and over-travel mechanism.
 - 2. The switch enclosure shall be suitable for mounting on the duct exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the damper blade.

- M. Thermostat and Sensor Guards
 - 1. BAPI-GUARD, or approved equal manufacturer prior to bidding, for protection from tampering, adjustment and physical damage.
 - 2. Constructed of thick, durable polycarbonate with:
 - a. Key lock.
 - b. Low profile, compact design.
 - c. Suitable for horizontal or vertical mounting.

- N. Carbon Dioxide Sensor
 - 1. Veris #OWL and CDL CO₂, RH and Temperature sensing all in one unit including the following features:
 - a. 5-year calibration interval
 - b. Low ambient sensitivity
 - c. Field-selectable outputs.
 - d. Integrated transducer and probe
 - e. 4-20mA analog output
 - f. 32° to 122°F CO₂, operating range
 - g. 0-2000 ppm CO₂ range
 - h. 2% plus or minus CO₂ accuracy
 - i. 0-100% RH range with ± 0.1% accuracy
 - j. 50°-95° RH and temperature operating range
 - k. 1°F ± accuracy

2.9 OUTPUT DEVICES AND DAMPERS

- A. Output Devices
 - 1. Output Devices as Application Specific Devices
 - a. Output Devices that receive commands as network variables are considered to be application specific devices.
 - b. These devices shall meet the requirements specified previously for application specific devices.
 - 2. Actuators
 - a. Actuators shall be electric (electronic).
 - b. Electric actuators shall have an electronic cut off or other means to provide burnout protection if stalled. Actuators shall have a visible position indicator.
 - c. Electric actuators shall provide position feedback to the controller as shown. Actuators shall smoothly open or close the devices to which they are applied.
 - d. Electric actuators shall have a full stroke response time in both directions of 90 seconds or less at rated load.

- e. Where multiple electric actuators operate from a common signal, the actuators shall provide an output signal identical to its input signal to the additional devices.
 - f. Positive Positioning Devices: Positive positioning devices shall be a pneumatic relay with a mechanical position feedback mechanism and an adjustable operating range and starting point.
3. Electronic Damper Actuators
- a. Electronic damper actuators shall be direct shaft mount.
 - b. Modulating and two-position actuators shall be provided as required by the Sequence of Operations. Damper sections shall be sized based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the Sequences of Operations. All actuators shall have external adjustable stops to limit the travel in either direction and a gear release to allow manual positioning.
 - c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
 - d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in Sequence of Operations as "quick acting", shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
4. Control Dampers
- a. The BMS Contractor shall furnish all automatic dampers other than those included within packaged equipment such as rooftop units. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawing.
 - b. Damper Assembly
 - 1) A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall be made from a combination of sections.
 - 2) Dampers shall be steel or other materials where shown. Flat blades shall be made rigid by folding the edges.
 - 3) Blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section shall not be located directly in the air stream.
 - 4) Damper axles shall be 0.5 inches minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings.

- 5) Pressure drop through dampers shall not exceed 0.04 inches water gauge at 1,000 ft/min in the wide-open position.
 - 6) Frames shall not be less than 2 inches wide.
 - 7) Dampers shall be tested in accordance with AMCA 500-D.
- c. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
- d. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
- e. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16 gauge minimum hot-dipped channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed again, 4" w.g. static pressure when tested in accordance with AMCA Std. 500.
- f. Pressure drop through dampers shall not exceed 0.04 inches water gauge at 1000 ft/min. in wide open position.
- g. Operating Linkages
1. Operating links external to dampers, such as crank arms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, shall withstand a load equal to at least 300% of the maximum required damper operating force.
 2. Rod lengths shall be adjustable.
 3. Links shall be brass, bronze, zinc-coated steel, or stainless steel.
 4. Working parts of joints and clevises shall be brass, bronze, or stainless steel.
 5. Adjustments of crank arms shall control the open and closed positions of dampers.
- h. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g. Acceptable manufacturers are Johnson Controls D-7250, D-1250 or D-1300, Ruskin CD50 and Vent Products 5650.

2.10 AIR FLOW/TEMPERATURE MEASUREMENT

- A. Manufacturers:
1. Ebtron - Gold Series Models
 2. Air Monitor Corp.
 3. Or approved equal prior to bidding
- B. Air Flow/Temperature Measurement - General
1. The BAS Contractor shall verify the compatibility of the selected device with the intended airflow measuring application.
 2. The air flow/temperature measurement station (AFTMS) indicated on the plans

shall be capable of monitoring air flow and temperature rates at each measurement location. Sensors shall use thermal dispersion technology with two “bead in glass”, hermetically sealed thermistor probes at each measurement point. The system shall be factory tested prior to shipment and not require calibration or adjustment over the life of the equipment when installed in accordance to manufacturer’s guidelines. Each sensor probe shall be provided with a UL plenum-rated connecting cable with circular terminal connectors and gold plated contacts. Connecting cable shall be a minimum of 10 feet in length (up to 50 feet) for each probe as required for mounting in location with proper ambient conditions. Sensor probes shall be “plug and play” design and do not have to be matched to a specific transmitter. All sensor calibration data shall be stored in the sensor probe. No additional devices or transducers shall be required to interface with the host controls.

3. Sensors shall be factory-calibrated at 16 air flow rates and 3 temperatures to NIST-traceable standards for both airflow and temperature. Each sensing point shall independently measure airflow and temperature prior to averaging. Installed accuracy shall be percent of reading and demonstrated at both maximum and minimum air flow rates for each measurement location.

C. Duct and Plenum Mounted Sensor Probes

1. Sensor probes shall be constructed of gold anodized aluminum alloy tube with 303 stainless steel mounting brackets. Probes shall be constructed as insertion, internal, or standoff mounting, depending on the installation requirements.
2. Probe Performance Requirements: the sensor accuracy for airflow shall be at least $\pm 2\%$ of Reading over the sensor probe operating ranges. The installed total accuracy for airflow shall be better than $\pm 3\%$ of Reading over the sensor probe operating ranges when installed in accordance with manufactures’ guidelines. The sensor accuracy for temperature shall be better than $\pm 0.15^\circ\text{F}$ over the entire operating range.
3. Probe Sensor Density: The number of independent sensing points shall be as indicated below:

Area (ft ²)	Sensors
<= 1	2
>1 to <4	4
4 to <8	6
8 to <12	8
12 to <16	12
>= 16	16

4. Probe Operating Ranges”
 Airflow: 0 to 5,000 FPM
 Temperature: -20°F to +160°F
 Relative Humidity: 0 to 99% (non-condensing)

D. Fan Inlet Velocity Sensors

1. Sensors shall be constructed with stainless steel sensor bodies, stainless steel mounting brackets and with adjustable cadmium-plated mounting rods.
1. Fan Inlet Performance Requirements: The individual sensor accuracy for airflow shall be better than $\pm 3\%$ of Reading over the sensor probe operating ranges when

installed in accordance with manufacturers' guidelines. The installed accuracy for temperature shall be better than $\pm 0.15^{\circ}\text{F}$ over the entire operating range.

3. Fan Inlet Sensor Density: Probes shall be provided with an adjustable mounting, and two sensors per inlet, for single or dual inlet fans.
 4. Fan Inlet Sensor Operating Ranges:
Airflow: 0 to 10,000 FPM
Temperature: -20°F to $+160^{\circ}\text{F}$
Relative Humidity: 0 to 99% (non-condensing)
- E. Dynamic Pressure "Bleed Airflow" Sensors
1. Each sensing point shall independently measure bleed airflow rates and direction, or dynamic differential pressure plus temperature. Sensor housing shall be constructed of an engineered thermoplastic with 1/2 NPT female threads on the inlet and outlet of the housing.
 2. DP Sensor Performance Requirements: The installed total accuracy for airflow shall be better than 2% of reading, and 4% of reading for pressure, over the sensor operating range when installed in accordance with manufacturers' guidelines. The sensor accuracy for temperature shall be better than 0.15°F over the entire operating ranges.
 3. DP Sensor Operating Ranges:
Bleed Airflow: -2,000 FPM to 2,000 FPM
Or
Differential Pressure: $-0.25''\text{WG}$ to $+0.25''\text{WG}$
And
Temperature: -20°F to $+160^{\circ}\text{F}$
Relative Humidity: 0 to 99% (non-condensing)
- F. Air Flow Measurement Device Locations
1. Refer to control schematics.
- G. Fan Inlet Sensors
1. Refer to control schematics.

PART 3 EXECUTION

3.1 INSTALLATION

- A. BMS Wiring
1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
 2. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
 3. The sizing, type and provision of cable, conduit, cable trays and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor,

the Contractor shall be responsible for all costs incurred in replacing the selected components.

4. Class 2 Wiring
 - a. All Class 2 (24VAc or less) wiring shall be installed in conduit unless otherwise specified.
 - b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Grounding cabling and conduit at the panel terminations. Avoid grounding loops.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Division 01.
- B. Start-up and commission system extension. Allow for start-up time and commissioning prior to placing control systems in permanent operation. When installation is complete, calibrate equipment and verify transmission media operation before the system is placed on-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 command and the field controller device. Verify calibration of each field temperature sensor with a hand-held calibrated digital thermometer. 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 Owner/Engineer for the final acceptance. Provide test ports of sufficient size adjacent to all sensors and seal with removable plugs.
- C. Compliance Inspection Checklist: Submit in the form requested, the following items of information to the Owner's Representative and Engineer for verification of compliance to the project specifications. The Owner's Representative and Engineer will initial and date the checklist to signify Contractor's compliance before acceptance of system.
 1. Manually generate an alarm at each remote panel to demonstrate the capability of the on-site central computer to receive alarms within five (5) seconds.
 2. Disconnect one (1) remote panel from the network to demonstrate that a single device failure shall not disrupt or halt communication. Panel to be disconnected will be selected by the Engineer.
 3. At remote panel of the owner/Engineer's choice, demonstrate the ability to display on the existing Portable Operator's Terminal (POT);
 - a. At least one (1) temperature setpoint and at least one (1) status condition; i.e. on or off for a system or piece of equipment attached to that panel as well as for points on another remote panel on the network.
 - b. The diagnostic results as specified for a system or piece of equipment attached to that panel, as well as a system or piece of equipment attached to another remote panel.

- D. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for one day period.
- E. Provide basic operator training for the system extension on data display, alarm and status descriptors, requesting data, execution of commands and request of logs.
- F. The contractor shall provide three (3) bound copies of an owner's manual describing all operating and preventative maintenance service procedures to be used with the system.

3.3 ACCEPTANCE TESTING

- A. After the installation is complete and proper operation has been demonstrated, a 60-day acceptance test shall begin. The entire system shall be required to operate for 60 days with no malfunctions - field repairable malfunctions excepted. Any malfunction during the 60-day test which cannot be corrected with 24 hours by the supplier shall be considered a non-field repairable malfunction and, after repairs are complete, the test shall be repeated.
- B. The acceptance test shall apply to all equipment furnished under this section.
- C. Substantial completion may be obtained prior to starting the acceptance test.
- D. Final completion shall not be considered prior to successful completion of the acceptance test.

3.4 INPUT/OUTPUT SCHEDULE - ON PLANS

END OF SECTION

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SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Duct materials.
 - 2. Transverse duct connection system.
 - 3. Ductwork fabrication.

- B. Related Sections:
 - 1. Section 23 07 00 - Duct Insulation: Product requirements for duct lining and wrapping.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - 3. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements.
 - 4. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 6. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

- B. National Fire Protection Association:
 - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction standard - Metal and Flexible.
 - 2. SMACNA - HVAC Air Duct Leakage Test Manual.

- D. Underwriters Laboratories Inc.:
 - 1. UL 181 - Factory-Made Air Ducts and Connectors.

- E. AARST-ANSI (Association of Radon Scientist and Technologists)

1.3 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.4 DEFINITIONS

- A. Rectangular Duct Sizes: Metal duct dimensions are indicated on plans and the sizes on the plans have been increased to take any duct liner into account, where the ducts are specified to be lined.

1.5 PAYMENTS

- A. During the construction period ductwork shall not be considered billable on a payment request until it has been fabricated and delivered to the job site.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G60 or G90 zinc coating of in conformance with ASTM A90.
 - 1. G90 galvanized used on duct exposed to weather or high moisture areas such as showers, exhaust, kitchen exhaust, etc.

2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

2.3 TRANSVERSE DUCT CONNECTION SYSTEM

- A. Manufacturers:
 - 1. Ductmate
 - 2. Nexus
 - 3. SMC (R-Angle)
 - 4. Ward Industries
 - 5. Transverse Duct Connections (TDC)
 - 6. Fab Duct
 - 7. Approved equal prior to bidding.
- B. SMACNA "E" rated class rigidly connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administration Requirements: Coordination and project conditions.
- B. Verify sizes of equipment connections before fabrication of transitions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Duct supports shall be at duct joints and shall be installed at maximum of 8 feet or 10 feet dependent on SMACNA duct construction choices,
- C. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- D. Joint Sealing - All low pressure ductwork to be sealed in accordance with SMACNA.
 - 1. Seal Class 'B': Seal all transverse joints and longitudinal seams 3" WG and less.
- E. Connect flexible ducts to metal ducts with liquid adhesive plus tape or draw bands and/or sheet metal screws.
- F. All in-line duct transitions shall be gradual (20°) taper to minimize pressure loss and noise increase due to turbulent flow.

3.3 SCHEDULES

A. DUCTWORK MATERIAL SCHEDULE

<u>AIR SYSTEM</u>	<u>MATERIAL</u>
Low Pressure Supply/Return	Steel
Med. and High Press. Supply	Steel

B. DUCTWORK PRESSURE CLASS SCHEDULE

<u>AIR SYSTEM</u>	<u>PRESSURE CLASS</u>
Variable Volume (Upstream of Boxes)	2 inch regardless of velocity
Constant Volume Supply (System w/Cooling Coils)	2 inch
Return and Relief	1 inch

3.4 MINIMUM DUCT SEAL LEVELS

		<u>Supply Duct Static</u>			
A.	<u>Duct Location</u>	$\leq 2''$ w.c.	$>2''$ w.c.	Exhaust	Return
	Conditioned Space	B	B	B	C

1. Type - B: All transverse joints, longitudinal seams. Pressure-sensitive tape shall not be used as the primary sealant, unless it has been certified to comply with UL 181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.
2. Type - C: Transverse joints only.

3.5 DUCT CONSTRUCTION TABLE

- A. The following table does not constitute all requirements for the construction's compliance. Complete details are provided in the manual entitled HVAC Duct Construction Standards, Metal and Flexible.
1. Use back-up member from Columns 11 or 12. Exception: The drive only requires back-up over 20" length.
 2. Spacing in Column 3 refers to joint-to-joint, joint-to-intermediate or intermediate-to-intermediate.
 3. The same sheet thickness must be used on all sides of duct. Each duct dimension, width or depth, controls the minimum reinforcement requirements for that particular side.
 4. Duct sides 19" wide and larger which have more than ten square feet of unbraced panel shall be beaded or cross broken unless the ducts will have external insulation or internal liner. This applies to ducts of 20 gauge or less.
 5. Duct with 4 feet joint spacing shall conform as if 4' and 2' were given in Column 3 where 5' and 2-1/2' are shown.
- B. Table 1-4 E5, & 1-5 E5

END OF SECTION (AFTER TABLES)

2" w.g. STATIC POS. OR NEG.		NARROWSCOPE DUCT CONSTRUCTION TABLE 1-5 E5										INTERMEDIATE REINFORCEMENT			
		TRANSVERSE JOINT REINFORCEMENT													
DUCT DIM.	DUCT GA. (MIN.)	REINF. SPACING (MAX.)	REINF. CODE GRADE	SLIP GAGE		BACKUP	STANDING S T-10	STANDING S T-18	STANDING S (BAR REINFORCED) T-13	STANDING S (WITH GASKET) T-24 H = 1.38" H = 1.38" (WITH GASKET) T-24a H = 1.38" (WITH GASKET) T-24b H = 1.38" (WITH GASKET) T-24b	STANDING S REINFORCED T-14	STANDING S REINFORCED T-14	H x T	ANGLE	ZEE
				DRIVE SLIP T-3 Hemmed "S" SLIP T-6	None										
10" dia	26	None		24	None	None	None	None	None	None	None	None	H x T	ANGLE	ZEE
11" 20"	26	5"	C	24	*	*	1 x 22 ga	1 x 22 ga	1 x 22 ga	1 x 22 ga	1 x 22 ga	1 x 22 ga	1 x 1/8	1 x 1/8	1 x 3/4 x 1/8 ga
21" 26"	26	5"	D	24	*	*	1 x 20 ga	1 x 20 ga	1 x 20 ga	1 x 20 ga	1 x 20 ga	1 x 20 ga	1 x 1/8	1 1/4 x 1/2 ga or 1 x 1/8	1 1/2 x 3/4 1/8 ga
27" 30"	24	5"	E	24	*	*	1 x 18 ga	1 x 18 ga	1 x 18 ga	1 x 18 ga	1 x 18 ga	1 x 18 ga	1 1/2 x 18 ga	2 x 1/8	1 1/2 x 3/4 1/8 ga
31" 38"	22	5"	F	24	*	*	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 20 ga	2 x 1/8	1 1/2 x 3/4 1/8 ga
37" 51"	24	2 1/2"	F	24	*	*	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 20 ga	2 x 3/16	1 1/2 x 3/4 1/8 ga
55" 60"	24	2 1/2"	G	24	*	*	NOT GIVEN	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	2 x 3/16	1 1/2 x 3/4 1/8 ga
61" 72"	22	2 1/2"	H	24	*	*	NOT GIVEN	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	1 1/2 x 18 ga	2 x 3/16	1 1/2 x 3/4 1/8 ga
77" 81"	22	2 1/2"	I	22	*	*	NOT GIVEN	NOT GIVEN	NOT GIVEN	NOT GIVEN	NOT GIVEN	NOT GIVEN	NOT GIVEN	2 x 3/16	2 x 1 1/8 x 1/2 ga
65" 96"	20	2 1/2"	I	22	*	*	NOT GIVEN	NOT GIVEN	NOT GIVEN	NOT GIVEN	NOT GIVEN	NOT GIVEN	NOT GIVEN	2 x 3/16	2 x 1 1/8 x 1/2 ga

NOTES:

- *Means use back-up member from columns 11 or 12. Exception: the drive only requires back up over 20" length.
- Spacing in column 3 refers to joint-to-joint, joint-to-intermediate, or intermediate-to-intermediate.
- The same sheet thickness must be used on all sides of duct. Each duct dimension, width, or depth, controls the minimum reinforcement requirements for that particular side.
- Duct sizes 19" wide and larger which have more than ten square feet of unbraced panel shall be braced or crossbraced unless the ducts will have external insulation or internal liner. This applies to ducts of 20 ga. or less.

5. Contents of the narrow scope tables and these notes do not constitute all requirements for the construction's compliance. Complete details are provided in the manual entitled HVAC Duct Construction Standards, Metal and Flexible. The manual is available from local SMACNA chapter offices or the National Association office; inquire for terms.

6. Construction conforming to the standard does not prevent some traditionally acceptable rattle (noise) under sudden pressure change conditions such as start up and shut down of systems.

COMMENT:
Construction tables are prepared in "narrow scope" for 2" water gage and 1" water gage pressure classifications. These tables have been produced for the convenience of those contractors or engineers who wish to have fewer options.

Sheet Metal and Air Conditioning Contractors Association, Chantilly, Va.

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flexible duct connections.

1.2 REFERENCES

- A. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - FLEXIBLE DUCT CONNECTIONS

- A. Ventfabrics
- B. Ventglas
- C. Duro-Dyne

2.2 INSULATED FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
- B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz per sq yd, approximately 6 inches wide, crimped into metal edging strip. Insulate with one inch thick flexible fiberglass insulation and a flame safe jacket. Similar to Duro-Dyne's insulflex connections.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment and supported by vibration isolators.

END OF SECTION

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SECTION 23 33 15

DUCT CLEANING

PART 1 GENERAL

1.1 SUMMARY

- A. Description of Work
 - 1. Work to be performed under this section consists of supplying all equipment, accessories, material and labor to complete the system cleaning by source removal methods of dirt, bacteria, fungi, dust and debris that have accumulated inside the ducts and HVAC equipment.
 - 2. This work applies to the supply and return ductwork for the existing rooftop units being replaced.

1.2 QUALITY ASSURANCE

- A. Qualifications: The cleaning of HVAC systems/ductwork shall be performed by a Ventilation Cleaning Contractor which has on staff management/operations personnel who are certified by National Air Duct Cleaners Association (NADCA).

1.3 CONTINUITY OF SERVICE

- A. Contractor shall not interrupt existing services except at such times and for such periods of time as is acceptable to the owner.

1.4 CODES AND PERMITS

- A. This Contractor shall obtain and pay for all permits or licenses required under this contract.

1.5 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.
- C. Product Data: Submit data for shop fabricated assemblies and hardware used.
- D. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
 - 1. List of equipment and methods to be used.
 - 2. List of similar projects where the same equipment and methods were used for reference.

1.6 SUMMARY OF WORK

- A. Air ducts shall be cleaned to meet NADCA (National Air Duct Cleaners Association) Standard ACR-2005.
- B. Remove and dispose of all visible dirt, debris and other contaminants.
- C. Clean and decontaminate all existing supply, return and outside air ductwork, diffusers, grilles and registers.
- D. Repair of damaged fiberglass duct liner and coating of all existing internal duct insulation (fiberglass duct liner) and repaired liner areas with insulation coating shall be included. A repair cost for each item listed shall be provided to the owner/architect/engineer for their review, acceptance or rejection.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Access Panels:
 - 1. Pre-manufactured sheet metal service panels that are cross broke, hemmed, pre-drilled and gasketed.
 - 2. Pre-manufactured service panels (same as above) with liner.
 - 3. Pre-manufactured access door with locking seal.
- B. Sealants: Use a silicone based product specifically rated for sealing ductwork.
 - 1. Air tight plugs.
- C. Cleaning Chemicals: Chemicals for cleaning coils, dampers and fans.
 - 1. Degreaser - Zep
 - 2. Coil Cleaner - ReNeuz
 - 3. Sanitizer - Oxine (for non-porous surfaces only)
- D. Insulation: “Tough Coat” mechanical insulation repair coating designed specifically for mechanical insulation. This repair coating shall not affect thermal or acoustical properties of the insulation, must meet NFPA Standard 90A and 90B, must meet State of Minnesota TVOC requirements, must have anti-microbial agent that meets the Microbiological Testing Standards of UL181, ASTM C1071, ASTM G21, ASTM G22.
 - 1. IMCOA: An expanded, closed cell, polyolefin type liner used to replace damaged mechanical insulation in air-handling units, rooftop units and other areas.

2.2 EQUIPMENT

- A. Cleaning Collection System: For HVAC cleaning and decontamination use a vacuum collection system or approved equal. The unit shall incorporate a HEPA filtered vacuum collector system which shall be capable of maintaining up to 1 inch of static pressure inside the isolated area of ductwork as stated in ACR2005. All operations shall be subject to the approval of Owner’s on-site representative.
 - 1. HEPA filtration on all indoor wet/dry vacuums.
 - 2. Electrical air compressor capable of providing a minimum of 160 psi at 26 CFM.
 - 3. Duct cleaning system consisting of the following equipment:

- a. Portable power brushing for duct agitation.
- b. Portable pressure washer with operating ranges from 500 PSI at .7 GPM to 1200 PSI at 1.7 GPM.

PART 3 EXECUTION

3.1 WORK AREA PREPARATION

- A. Preparation: Protect all furnishings, equipment, etc. in work area with polyethylene or equivalent.
 1. Provide video or still pictures in hard copy and on a "CD" format of before and after the cleaning process for quality assurance and documentation.
 2. Seal off ends and openings of any ductwork, not being immediately worked on.
 3. Suitably support and brace any ductwork which will be entered by personnel for decontamination, if deemed necessary by Cleaning Contractor.
 4. Notify the owner/engineer of any unusual situations or areas needing cleaning that appear to be out of the scope of work before proceeding.

3.2 CLEANING AND DECONTAMINATING DUCTS

- A. Small Ductwork: Small ducts are those which are not accessible to personnel to enter for cleaning purposes.
 1. The vacuum collection cleaning method shall be used in these areas as specified.
- B. Vacuum Collection Cleaning Method:
 1. Provide within the ductwork protective seals of any areas downstream from receiving particulate during the installation of access points.
 2. Existing exterior duct insulation and ductwork shall be neatly cut, as required, in order to provide access to facilitate cleaning of the ductwork and components. No access opening shall be larger than 22"x22". Reference NADCA 05 Standard.
 3. Install the vacuum collection unit at a predetermined location and clean the section of the ductwork with the multi-directional nozzle and the pneumatically powered rotary brush system as deemed necessary. Large ducts which are crawl able can be hand vacuumed or power brushed and air washed as deemed necessary. Pre-vacuum diffusers, grilles and registers in affected ductwork. If necessary, remove, chemically wash/clean and re-set. Isolate equipment which generates noise from occupied areas.
 4. At the completion of each installation of the vacuum collection unit, notify the Engineer's or owner's on-site representative for a visual inspection of the cleaned ductwork. Photographic inspection recording shall be provided by Cleaning Contractor. Re-clean if necessary.
 5. Where required, coat and repair mechanical insulation by applying Tough-Coat mechanical insulation repair coating following the procedures as outlined by the manufacturer or methods approved by the Engineer. AT the completion of the application, notify the Engineer's or owner's on-site representative for final visual inspection.
 6. Upon approval of Engineer's on-site representative, neatly patch ductwork in such a manner as to prevent any air leakage. When internal insulation has been cut for access, coat all exposed edges with Tough-Coat duct butter. Seal access

openings with galvanized sheet metal of the same gauge as existing ductwork, overlapping the opening, zip-screw into place and silicone seal or gasketed at the seams. Cap all 1 inch holes with air-tight plugs.

3.3 LINER COATING

- A. After cleaning and liner insulation repair, coat all existing and new fiberglass liner insulation with Tough-Coat or Fosters 40-20 product. Follow NADCA 05 Standards.

3.4 SYSTEM FINAL PURGE

- A. Work Area Preparation
 - 1. Cover all registers, grilles, diffusers, with cheesecloth or disposable blanket filter material. Seal airtight to device frame by use of tape.
 - 2. Inform owner's representative that all air outlets have been covered and purging can proceed.
- B. Insure all duct seals have been removed, all access openings covered and new filters have been installed.
- C. Start air moving unit (HVAC) and purge continuously for a minimum of 30 minutes. If unit should be a variable speed unit, owner's representative shall designate a competent individual to run unit up and down (minimum to maximum speed) several times to insure minor debris is excavated from system.
- D. Clean Up:
 - 1. Remove cheesecloth or dirt entrapment material from outlets. Discard in an approved manner.
 - 2. Should air terminal outlets be contaminated by this process, remove, wash and clean and reinstall as deemed necessary by cleaning Contractor.
 - 3. Vacuum all work areas and restore to original condition.
- E. Project Completion:
 - 1. Complete a mandatory pre-cleaning and post-cleaning walk-through of all areas with owner's representative for final approval.
 - 2. Complete any additional services/repair work approved by owner after review of "needed repair list".
 - 3. Assemble all documentation needed for post project report, including still photographic and hard copies, along with a "CD" format of the pictures and submit to Engineer/Owner for final acceptance of completed work.

3.5 PLAN NOTES

- A. Refer to Plan Sheets for duct cleaning.

END OF SECTION

SECTION 23 40 00

HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Disposable, extended area panel filters.
 - 2. Extended surface high efficiency media filters.

1.2 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 850 - Commercial and Industrial Air Filter Equipment.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- C. Military Standardization Documents:
 - 1. MIL MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods.
- D. Underwriters Laboratories Inc.:
 - 1. UL 586 - High-Efficiency. Particulate, Air Filter Units.
 - 2. UL 867 - Electrostatic Air Cleaners.
 - 3. UL 900 - Air Filter Units.

1.3 PERFORMANCE REQUIREMENTS

- A. Conform to ARI 850 Section 7.4.
- B. Dust Spot Efficiency: Plus or minus 5 percent.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on filter media, filter performance data and dimensions.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions for operation, changing and periodic cleaning.

1.6 EXTRA MATERIALS

- A. At substantial completion all equipment shall have one set of clean, pre-filters and final filters installed and an additional set stored nearby for the owners first filter change.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Camfil Farr Filters
- B. Tri-Dem Filters
- C. Cambridge Filters
- D. American Air Filters
- E. Flanders Filters

2.2 DISPOSABLE, MEDIUM-EFFICIENCY EXTENDED AREA PANEL FILTERS

- A. Media: UL 900 Class 2 Pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to cardboard grid; enclosed in cardboard frame; 2 inches thick.
- B. Rating: ASHRAE 52; 25-30 percent dust spot efficiency, 90-92 percent weight arrestance; maximum 500 FPM face velocity, 0.30 inch WG initial resistance, 0.80 inch WG recommended final resistance. 30 percent efficiency and MERV-7 based on ASHRAE 52.2.
- C. Model: 30-30 manufactured by Camfil Farr with 90 percent efficiency on 4.0 micron and larger.
- D. These units to be used in the rooftop units as pre-filters.

2.3 DISPOSABLE, HIGH-EFFICIENCY EXTENDED AREA FINAL FILTERS

- A. Media: UL 900 Class 2, polypropylene media in mini-pleat configuration for higher strength, supported by and bonded to a cardboard frame. Refer to plan schedules for filter thickness.
- B. Rating: ASHRAE 52.2; 80-85 percent dust spot efficiency, 92-96 percent weight arrestance, maximum 350 FPM velocity, 0.20 inch WG initial resistance, 0.75 inch WG recommended final resistance for 4" thick filter. 85 percent efficiency and MERV-13 based on ASHRAE 52.2.
- C. Model: Ultrasolve 80-85 manufactured by Camfil Farr.
- D. These units to be used in rooftop units as final filters.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install filters with felt, rubber, or neoprene gaskets to prevent passage of unfiltered air around filters.
- B. Do not operate fan system until temporary filters are in place. Replace temporary filters used during construction and testing, with clean set and store the extra sets in location designated by owner.

END OF SECTION

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SECTION 23 81 03

PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Packaged rooftop air conditioning unit.
 - 2. Roof curb.

- B. Related Sections:
 - 1. Section 22 11 23 - Facility Natural-Gas Piping: Natural gas piping connections.
 - 2. Section 23 09 23 - Direct-Digital Control System for HVAC: Controls remote from unit.
 - 3. Section 23 33 00 - Air Duct Accessories: Flexible connections.
 - 4. Section 26 05 03 - Equipment Wiring Connections: Electrical connection to units.

1.2 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
 - 2. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
 - 3. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

- C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 - 2. ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.
 - 3. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

- D. ASTM International:
 - 1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

- E. National Fire Protection Association:
 - 1. NFPA 54 - National Fuel Gas Code.
 - 2. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 DEFINITIONS

- A. Energy Efficiency Ratio (EER) - Ratio of net cooling capacity (in BTUH) to total rate of electric input (in W/HR) under designated operating conditions with equipment capacity of 65,000 BTUH or greater and three phase electrical power.
- B. Seasonal Energy Efficiency Ratio (SEER) - Total cooling output of an air conditioner during its normal annual usage period for cooling (in BTUH) divided by total electric energy input during the same period (in W/HR). Single phase equipment with less than 65,000 BTUH cooling capacity.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data indicating:
 - 1. Cooling and heating capacities.
 - 2. Dimensions.
 - 3. Weights.
 - 4. Rough-in connections and connection requirements.
 - 5. Duct connections.
 - 6. Electrical requirements with electrical characteristics and connection requirements.
 - 7. Controls.
 - 8. Accessories.
- C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Manufacturer's Field Reports: Submit start-up report for each unit.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of controls installed remotely from units.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6 QUALITY ASSURANCE

- A. Cooling Capacity: Rate in accordance with ARI 340/360.
- B. Sound Rating: Measure in accordance with ARI 270.
- C. Insulation and adhesives: Meet requirements of NFPA 90A.

- D. Performance Requirements: Conform to minimum efficiency rating prescribed by ASHRAE 90.1 when tested in accordance with ARI 210/240 for SEER ARI 340/360 for EER rated equipment.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Accept units on site. Inspect for damage.
- C. Protect units from damage by storing off roof until roof mounting curbs are in place.

1.8 COORDINATION

- A. Division 01 - Administrative Requirements: Requirements for coordination.
- B. Coordinate installation of roof curbs with roof structure, roof deck and roof membrane installation.

1.9 MAINTENANCE SERVICE

- A. Division 01 - Execution and Closeout Requirements: Maintenance service.

1.10 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one extra set of filters and fan belts (as required) for each unit.

1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for compressors.

PART 2 PRODUCTS

2.1 ROOFTOP AIR CONDITIONING UNITS

- A. Manufacturers
 1. AAON
 2. Addison
 3. Trane
 4. Approved equal manufacturer prior to bidding.

2.2 SUMMARY

- A. The contractor shall furnish and install package rooftop unit(s) capable of heating,

cooling, filtration economizer and providing room neutral dehumidified air as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

2.3 GENERAL UNIT DESCRIPTION

- A. Packaged rooftop(s) furnished and installed shall have:
 - 1. Dehumidification control with hot-gas re-heat.
 - 2. Combination modulating gas heat and electric DX cooling.
 - 3. Variable Volume supply airflow.
- B. Cooling capacity ratings shall be based on ARI Standards.
- C. Unit(s) shall consist of insulated weather-tight casing with compressor(s), air cooled condenser coil, condenser fans, evaporator coil and:
 - 1. Supply fan and motor.
 - 2. Gas-fired heating section.
- D. Factory-supplied outside air and supply air flow measuring station.
- E. Unit shall be 100 percent factory run tested and fully charged with R-410A refrigerant.
- F. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
- G. Units shall be dedicated downflow.
- H. Wiring internal to the unit shall be colored and numbered for identification.

2.4 UNIT CASING

- A. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with hinged access panels with quarter-turn quick opening handles. Structural members shall be 16 gauge with access doors and panels of minimum 20 gauge. Color as selected by Architect.
- B. Cabinet surface shall be tested 500 hours in salt spray test in compliance with ASTM B117.
- C. Cabinet construction shall allow for all service/maintenance from one side of the unit.
- D. Cabinet top cover shall be one piece construction or where seams exist, it shall be double hemmed and gasket sealed.
- E. Insulation: Provide 3/4" thick closed cell insulation on all exterior panels in contact with the return and conditioned air stream.
- F. The base of the unit shall have provisions for forklift and crane lifting.
- G. The bottom of the unit shall be double wall construction.

2.5 AIR FILTERS

- A. Air Filters: Factory installed filters shall mount integral within the unit and shall be accessible through access panels. Refer to Specification Section 23 4000 and plan schedule for 2” pre-filter and 4” final filter requirements.

2.6 FANS AND MOTORS

- A. Provide evaporator fan section with variable speed double width, double inlet, and centrifugal type fan.
- B. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
- C. Provide units 5 tons and below with direct drive, dynamically balanced supply fans and necessary accessories for balancing.
- D. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
- E. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

2.7 GAS-FIRED HEATING SECTION

- A. Completely assembled and factory installed heating system shall be integral to unit. UL or CSA approved specifically for outdoor applications. Threaded connection with plug or cap provided. Provide capability for gas piping connection through side of unit.
- B. Modulating gas valve and burner shall be forced combustion type power burner, negative pressure gas valve, manual shut off, hot surface ignition, and flame sensing safety control.
- C. Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, and continuous flame supervision. Upon a failure to ignite, two attempts of ignition will occur before lockout of the ignition system.
- D. Combustion blower shall be centrifugal type fan with built-in thermal overload protection on fan motor.
- E. Heat Exchanger: Provide drum and tube heat exchanger of free floating design manufactured from stainless steel.
- F. Limit Controls: High temperature limit controls will shut off gas flow in the event of excessive temperature resulting from restricted indoor airflow or loss of indoor airflow.

2.8 EVAPORATOR COIL

- A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.
- B. Provide an independent expansion device for each refrigeration circuit. Factory pressure test at 450 psig and leak tested at 200 psig.
- C. Provide drain pan for base of evaporator coil constructed of PVC or stainless steel with external connections.
- D. The quantity of rows shall be three (3) or greater and as required to meet discharge criteria. The use of less rows must be pre-approved by the Engineer before shop drawing submittal.
- E. Drain pan shall be constructed of either PVC or stainless steel and shall be pitched and shall have a break to direct condensate to drain outlet.

2.9 CONDENSER SECTION

- A. Provide internally finned 3/8" seamless copper tube mechanically bonded to aluminum fins. Factory pressure tested to 450 psig.
- B. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather-tight casing.
- C. Provide unit with hail guards to protect the coils.

2.10 REFRIGERATION SYSTEM

- A. Compressor(s): Provide two-stage scroll compressor with direct drive operating at 3600 rpm. Integral centrifugal oil pump, inlet dirt separator, rolling element bearings, crankcase heater, completely enclosed compression chamber with no leakage paths. Provide suction gas cooled motor with over temperature and over current protection.
- B. Units shall provide scheduled cooling capabilities down to 50°F ambient as standard.
- C. Provide with thermostatic temperature control in the compressor windings, to protect against excessive conditions.
- D. Unit shall have one refrigeration circuit including factory-supplied and completely piped with liquid line filter drier, suction, and liquid Schraeder valves.

2.11 DEHUMIDIFICATION SYSTEM

- A. Unit shall incorporate factory dehumidification controls that utilize fan speed, compressor staging and a hot gas re-heat coil to provide dehumidification.

- B. Unit shall incorporate factory mounted hot gas reheat coil capable of reheating cooled air to space neutral (73°-77°F) temperatures. Unit shall incorporate a refrigerant diverting valve capable of diverting refrigerant to reheat circuit or condensing circuit as necessary. Units that are not capable of providing room neutral air as described above are not acceptable.
- C. Unit shall divert refrigerant as necessary to hot gas reheat coil in the supply airstream when in dehumidification mode to reheat dehumidified supply air to space neutral temperature.
- D. Unit shall use refrigerant sub-cooling circuit in condensing section as necessary to maintain dehumidification capacity, supply air temperature, and unit efficiency.

2.12 OUTDOOR AIR SECTION

- A. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper shall fail to the closed position. Relief dampers shall be gravity balanced.
- B. Gaskets: Provide tight fitting dampers with edge gaskets, maximum leakage 5 percent at 2 inches pressure differential.
- C. Damper Operator: 24-volt with gear train sealed in oil with spring return.
- D. Mixed Air Controls: Maintain selected supply air temperature and return dampers to minimum position on call for heating when ambient air temperature exceeds return air temperature.

2.13 ROOF CURBS

- A. New rooftop units shall be mounted on the existing curb in the existing location. An insulated adapter curb shall be provided as required to accommodate the installation of the new unit in the existing location. Curbs shall be constructed of galvanized steel. Curbs are to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit.

2.14 CONTROLS

- A. The unit shall be provided with a factory-supplied packaged controller that is capable of operating all system functions. The BAS shall communicate with the controller to provide information (schedule, space temperature/RH, space temperature/RH set points) necessary for the system operation. The packaged controller shall operate the unit (variable speed supply fan, heating, cooling, economizer, and dehumidification) as required to maintain space conditions. The BAS shall directly monitor supply air flow and outside air flow via the factory-supplied airflow measuring stations. The rooftop unit controls shall monitor supply fan status and discharge air temperature. The rooftop unit controls shall communicate with the BAS via BACnet protocol.

2.15 ELECTRICAL

- A. Each unit shall have a 115-volt control circuit transformer 115 volt receptacle, supply air firestat, control circuit fuse and a single non-fused disconnect switch to cut power to the entire unit.
- B. The supply fan, compressor and condenser fan motor branch circuits shall be individually fused. Contactors and inherent thermal overload protection shall be furnished for each compressor and condenser fan motor. The supply shall have contactors and external overload protection. Main control panel shall be of weatherproof construction with a dead-front cover over the main power circuit controls.
- C. The electrical panel circuit breaker shall be acceptable as over-current protection. If the unit being provided is not rated for "Circuit Breaker" protection and requires a fused disconnect, then the manufacturer shall provide the fused disconnect and fuses at no additional cost.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 PREPARATION

- A. Verify requirements for adapter curbs to accommodate new unit on the existing roof curbs.

3.3 INSTALLATION

- A. Roof Curb:
 - 1. Assemble the adapter curb as required.
 - 2. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
 - 3. Install gasket material between unit base and roof curb.
- B. Connect units to supply and return ductwork with flexible connections. Refer to Section 23 33 00.
- C. Install condensate piping with trap and route from drain pan to nearest roof drain. Refer to Section 23 21 13.
- D. Install components furnished loose for field mounting.
- E. Install electrical devices furnished loose for field mounting.
- F. Install control wiring between unit and field installed accessories.

- G. Properly dispose of shipping panels removed from unit during installation of economizer and dampers.
- H. Properly protect the roof opening from moisture intrusion before installing the new rooftop unit.

3.4 INSTALLATION - NATURAL GAS HEATING SECTION

- A. Connect natural gas piping in accordance with NFPA 54.
- B. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.
- C. Install the following piping accessories on natural gas piping connections. Refer to Section 22 11 23.
 - 1. Strainer.
 - 2. Pressure gage.
 - 3. Shutoff valve.
 - 4. Pressure reducing valve.
- D. Install natural gas piping accessories above roof.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Division 01 - Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish initial start-up and shutdown during first year of operation.

3.6 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Vacuum clean coils and inside of unit cabinet.
- C. If use is allowed during construction period, install temporary filters during construction period. Replace with permanent filters at Substantial Completion.
- D. After substantial completion inspection and just before turning this equipment over to the Owner, a new set of filters shall be installed and an extra set, for the first filter change by the Owner, shall be stored in the Mechanical Room or closest Custodian space. The filters shall be labeled with the equipment served number for which they are intended.

3.7 DEMONSTRATION

- A. Division 01 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate unit operation and maintenance.

3.8 SCHEDULES

- A. Refer to Plan Sheet Schedule.

END OF SECTION