

**February 15, 2016**

**Hoffman Estates Park District**  
**Hoffman Estates, Illinois**



**Prairie Stone**  
**Sports & Wellness Center**  
**Natatorium HVAC Units Replacement**

The Mechanical Contractor shall provide the entire scope of work within all divisions of the specifications and as shown on the drawings. This is to include but not necessarily limited to Mechanical, demolition, structural supports, Electrical, etc. Where it becomes necessary for the Mechanical contractor, in order to fulfill this contract, to furnish labor or materials other than that which is generally accepted by the trade agreement of general practice to belong to the particular trade or branches of work that contractor shall sublet same to subcontractor engaged in the type of work involved to the end that there will be not stoppage of work due to violation of trade agreements as to jurisdiction. All subcontractors shall be required to show proof of insurance.

**Project Manual**  
**Bid Proposal and Specifications**

There will be a Prebid Meeting held on February 17, 2016 at 9:00 am at the  
Prairie Stone Sports and Wellness Center - 5050 Sedge Blvd., Hoffman Estates, IL 60192.  
Bids are due on February 25, 2016 at 10:00 am and will be opened and read aloud  
on February 25, 2016 at 10:30 am at the Hoffman Estates Park District Administration Office –  
1685 W. Higgins Rd., Hoffman Estates, IL 60194

**W-T Mechanical/Electrical Engineering**

2675 Pratum Avenue  
Hoffman Estates, IL 60192  
(224) 293-6333

E-Mail: [Mark.Ventrelli@WTEngineering.com](mailto:Mark.Ventrelli@WTEngineering.com)  
Web Site: [www.wtengineering.com](http://www.wtengineering.com)

Bidder Name: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone #: \_\_\_\_\_

Facsimile: \_\_\_\_\_

**NAME OF PROJECT**

**Prairie Stone Sports & Wellness Center**

**Natatorium HVAC Units Replacement**

**BID DATE: February 25, 2016**

**BID TIME: 10:00 am**

PREPARED BY:

HOFFMAN ESTATES PARK DISTRICT

1685 W. Higgins Road

Hoffman Estates, IL 60169-2998

Telephone: (847) 885-7500

Facsimile: (847) 885-7523

## HOFFMAN ESTATES PARK DISTRICT

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Date: 2-15-2016

Dear Bidder:

Enclosed you will find the plans, specifications and bidding materials for Prairie Stone Sports & Wellness Center Natatorium HVAC Units Replacement. All pertinent information is included in the attached package. Please submit the Proposal Forms, Certification, References, and Bid Bonds. Please copy your proposal and retain one copy for your records.

I look forward to reviewing your bid proposal and working with you on this project. If you have further questions or need to meet at the site, please contact me 1-847-561-1327. I can be reached Monday through Friday from 8:30 a.m. until 4:30 p.m.

Sincerely,

Bill Falsetti  
Division Director



## INVITATION TO BIDS

Sealed bids for the Prairie Stone Sports & Wellness Center Natatorium HVAC Units Replacement project will be received by the Hoffman Estates Park District at our office; 1685 West Higgins Road, Hoffman Estates, Illinois 60169 until **exactly 10:00 A.M., February 25, 2016** then publicly opened and read. Bids submitted after the closing time will be returned unopened. No oral or telephone proposals or modifications will be considered.

The Hoffman Estates Park District Board of Commissioners will make the final award.

Proposals shall be submitted on the attached Form of Proposal and returned in the envelope, if provided. No bidder may withdraw his proposal after the hour set for the opening thereof, or before award of the contract, unless said award is delayed for a period exceeding sixty (60) calendar days.

The Hoffman Estates Park District requires all bidders to comply with all provisions of the Park District Prevailing Wage Ordinance #O-14-03. This ordinance specifies that no less than the general prevailing rate of wages as found by the Park District or Department of Labor or determined by a court on review shall be paid each draft type of worker or mechanic needed to execute the contract or perform the work.

The Hoffman Estates Park District may reject any or all of the bids on any basis and without disclosure of a reason. The failure to make such a disclosure shall not result in accrual of any right, claim, or cause of action by any unsuccessful Bidder against the Hoffman Estates Park District.

Bid results and the award of the bid will be published on the Hoffman Estates Park District website [www.heparks.org](http://www.heparks.org).

Sincerely,

Bill Falsetti  
Division Director

HOFFMAN ESTATES PARK DISTRICT

INSTRUCTIONS TO BIDDERS

1. Identification of Project

The official name and location of the project shall henceforth be known as:

Prairie Stone Sports & Wellness Center  
Natatorium HVAC Units Replacement  
5050 Sedge Blvd.  
Hoffman Estates, Illinois 60192

The official name and address of the project owner shall henceforth be known as:

HOFFMAN ESTATES PARK DISTRICT  
1685 West Higgins Road  
Hoffman Estates, IL 60169-2998

Bid Opening: February 25, 2016 10:00 am

Committee Approval: March 1, 2016

Board Approval: March 1, 2016

Contract Awarded: March 2, 2016

Commencement of Work: Commencement of paperwork shall begin immediately upon notification of award. Actual work shall commence **June 13, 2016 or sooner** and shall continue with due diligence until full completion and acceptance.

Substantial Completion Date: June 24, 2016 or sooner

2. Contract Documents

The Notice to Bidders, the Instructions to Bidders, the Supplementary Conditions, Drawings, Specifications, the supplied Form of Proposal, the accepted Bid Sheet and certification comprise the Contract Documents. Copies of these documents can be obtained in person from the office of the Hoffman Estates Park District, 1685 W. Higgins Road, Hoffman Estates IL 60169-2998.

### 3. Explanation to Bidders

Any explanation desired by a bidder regarding the meaning or interpretation of the invitation for bids, drawings, specifications, etc., must be requested in writing and with sufficient time allowed for a reply to reach bidders before the submission of their bids.

Any interpretation made will be in the form of an amendment of the invitation for bids, drawings, specifications, etc., and will be furnished to all prospective bidders. Its receipt by the bidder must be acknowledged in the space provided on the Bid Form or by letter or telegram received before the time set for opening of bids. Oral explanations or instructions given before the award of the contract will not be binding.

### 4. Conditions Affecting the Work

Bidders should visit the site and take such other steps as may be reasonably necessary to ascertain the nature and location of the Work, the general and local conditions, which can affect the Work or the cost thereof. Failure to do so will not relieve bidders from responsibility for estimating properly the difficulty or cost of successfully performing the Work.

### 5. Bid Guarantee, Bonds and Required Paperwork

- A. A Bid Guarantee, five (5%) percent, is required by the invitation for bids. Failure to furnish a Bid Guarantee in the proper form and amount by the time set for opening of bids may be cause for rejection of the bid in the absolute discretion of the Owner.
- B. A Bid Guarantee shall be the form of a bid bond, postal money order, certified check, or cashier's check made payable to the Owner. Bid guarantees, other than those stated, will be returned to the bidder upon opening of bids. Such bids will not be considered for award (a) to unsuccessful bidders as soon as practical after the award of the job, and (b) to the successful bidder upon execution of such further contractual documents and bonds as may be required by the bid as accepted.
- C. The successful bidder, upon being given a "Written Notice to Proceed", will have five (5) calendar days to provide the required Labor and Material Payment Bond, Performance Bond, and Insurance Policies or certificates for same, and commence with the Work. Failure to comply with the conditions set forth in the Contract Documents shall result in the termination of the contract for default. In such event, the Contractor may be liable for any costs of performing the work which exceed the amount of his bid, and the Bid Guarantee shall be available toward offsetting such difference, if not previously returned to the Contractor.

### 6. Preparation and Submission of Bids

Before submitting proposal, each bidder shall carefully examine all documents pertaining to the Work and visit the site to verify conditions under which Work will be performed.

Submission of bid will be considered presumptive evidence that the Bidder has visited the site and is conversant with local facilities and difficulties, the requirements of the documents and of pertinent State or Local Codes, State of Labor and Material Markets, and has made due allowance in his bid for all contingencies. Include in bid all costs of labor, material, equipment, contractor's license, permits, guarantees, applicable taxes (sales tax does not apply), insurance and contingencies, with overhead and profit necessary to produce a completed project, or to complete those portions of the Work necessary to produce a completed project, or to complete those portions of the Work covered by the specifications on which proposal is made, including all trades, without further cost to the Owner. The Owner shall be responsible for the building permit fee.

No compensation will be allowed by reason of any difficulties which the Bidder could have discovered reasonably, prior to bidding.

All proposals must be made upon the Proposal Form furnished by the Owner attached hereto and should give the amounts bid for work, in numbers, and must be signed and acknowledged by the contractor. The Proposal should be enclosed in the envelope marked **"Bid Proposal for Hoffman Estates Park District Prairie Stone Sports & Wellness Center Natatorium HVAC Units Replacement"** to be received until **10:00 A.M., February 25, 2016** showing the return address of the sender and addressed to: Hoffman Estates Park District, 1685 W. Higgins Road, Hoffman Estates, Illinois 60169. Bids should be sealed, marked and addressed as directed above. Failure to do so may result in a premature opening of or a failure to open such bid.

The proposal submitted must not contain erasures, inter-lineations, or other corrections unless each correction is suitably authenticated by affixing in the margin immediately opposite the correction the surname or surnames of the person or persons signing the bid.

Modifications of bids already submitted will be considered if received at the office designated in the invitation for bids by the time set for opening of bids. Telegraphic modifications will be considered, but should not reveal the amount of the original or reversed bid.

#### 7. Prices

The prices are to include the furnishing of all materials, equipment, tools, insurance, bonds, warranties, and all other facilities, and the performance of all labor and services necessary for the proper completion of the Work except as may be otherwise expressly provided in the Contract Documents.

#### 8. Time Schedule

The timely execution of any project is extremely important. The successful bidder shall take every means to meet the completion date stated above except for extensions granted by the Owner in writing for circumstances beyond the control of the Bidder.

#### 9. Late Bids and Modifications or Withdrawals

Bids and modifications or withdrawals thereof received at the office designated in the invitation for bids after the exact time set for opening of bids will not be considered.

10. Withdrawal of Bids

Bids may be withdrawn by written or telegraphic request received from bidders prior to the time set for opening of bids.

11. Public Opening of Bids

Bids will be publicly opened at the time set for opening in the invitation for bids. Their content will be made public for the information of bidders and others interested, who may be present either in person or by representative.

12. Award of Contract

- A. Award of Contract will be made to the lowest responsible bidder, as determined by the Board of Commissioners of the Hoffman Estates Park District, whose bid conforms to the invitation for bid.
- B. The Board of Park Commissioners may reject any or all of the bids on any basis and without disclosure of a reason. The failure to make such a disclosure shall not result in accrual of any right, claim, or cause of action by any unsuccessful bidder against the Hoffman Estates Park District.

13. Contract and Insurance

The written contract between the accepted bidder and the Owner shall be considered finalized and entered into between the parties upon the Park District Board's approval and award of the contract to the accepted bidder and the Park District's execution of the accepted bidder's Form of Proposal, and said written contract shall be comprised by the Contract Documents. The accepted bidder shall provide the Owner with a Labor and Material Payment Bond, Performance Bond, and copies of applicable Insurance Policies and endorsements and certificates for same within five (5) calendar days of the "Written Notice to Proceed" and prior to the commencement of work.

14. Postponement of Date for Opening Proposals

The Owner reserves the right to postpone the date of presentation and opening of proposals and will give telegraphic notice of any such postponement to each interested party.

## SUPPLEMENTARY CONDITIONS

### SECTION I – GENERAL

#### 1. Application

These Supplementary Conditions shall be used in conjunction with and are a part of any and all Sections of the Specifications and all Contracts and Subcontracts that may be made for the completion of the work in all its parts as identified and described in the Contract Documents.

#### 2. Definitions

Owner: The Hoffman Estates Park District, Board of Commissioners, Staff and its appointed Owner's representative.

Contractor: A firm, corporation or individual with whom the Owner makes a direct Contract for the construction of all or any portion of the work.

Architect/Engineer: The authorized representative of the Owner.

Subcontractor: A firm, corporation or individual other than employees of a Contractor with whom a Contractor or Subcontractor makes a contract to furnish labor, and/or materials, and/or services in connection with the project.

Owner Representative: An employee of the Hoffman Estates Park District responsible for the coordination of the work involved on the project.

The words "approve", "equal to", "as directed", etc., are interpreted and will be taken to mean "to the satisfaction of the Owner." Samples shall be submitted and approvals shall be requested in ample time to avoid any delays should resubmission of an item be necessary.

#### 3. Contract Documents

The Contract Documents shall consist of the Notice to Bidders, the Instructions to Bidders, the Supplementary Conditions, the Drawings, the Specifications, the supplied Form of Proposal, and the accepted Bid Sheet and certification.

#### 4. Bonds

- A. With proposal, and attached hereto, each Bidder shall furnish Bid Security payable to the Owner in the amount of 5% of bid.
- B. Include allowance in Lump Sum Proposal for Performance Bond and Labor and Materials Payment Bond in the amount of 100% of Contract Price.
  - 1. The Contractor, before commencing the Work, shall furnish a Performance Bond and a Labor and Material Bond. The Performance Bond shall be in an amount equal to 100% of the full amount of the Contract Sum as security for the faithful performance of the obligation of the Contract Documents, and the Labor and Material Payment Bond shall be in an amount equal to 100% of the full amount of the Contract Sum as security for the payment of all persons performing labor and



furnishing materials in connection with the Contract Documents. Such bonds shall be on standard AIA Documents, issued by the American Institute of Architect/Engineers, shall be issued by a surety satisfactory to the Owner, and shall name the Owner as a primary co-obligee. The cost of the bonds is to be included in the Bid Proposal. The Performance Bond and Labor and Material Payment Bond will become a part of the Contract. Each Bidder shall list the name of the surety company that will be furnishing the Bonds on its Bid Proposal. The failure of a Bidder to list the name of its surety company on its Bid Proposal shall be a non-responsive bid. The failure of the successful Bidder to supply the required Bonds within five (5) days after the Notice of Award or within such extended period as the Owner may grant if the forms do not meet its approval shall constitute a default, and the Owner may either award the Contract to the next responsible, responsive Bidder or re-advertise for bids. A charge against the defaulting Bidder may be made for the difference between the amount of the bid and the amount for which a contract for the work is subsequently executed, irrespective of whether the amount thus due exceeds the amount of the bid guarantee.

2. The Contractor shall deliver the required bonds to the Owner not later than five (5) days following the date the Agreement is entered into, or if the Work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to the commencement of the Work, submit evidence satisfactory to the owner that such bonds will be furnished.
3. The contractor shall require the attorney-in-fact who executed the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.
4. Whenever the Contractor shall be and is declared by Owner to be in default under the Contract, the Surety and the Contractor are each responsible to make full payment to the Owner or any and all extra Work incurred by the Architect/Engineer as a result of the Contractor's default, and to pay to Owner all attorney's fees and court costs incurred by Owner as a result of the Contractor's default, and in protecting Owner's rights under the Agreement to remedy Contractor's default.
5. The Contractor shall (i) furnish all Surety Company's bonds through Surety Company's local agents approved by and/or as directed by Owner; (ii) fully covered and guarantee with said bond the faithful performance and completion of the entire Contract, including without limitation, the faithful performance of prevailing wage requirements; and (iii) guarantee with said bond payment in all cases by the Contractor or by the Surety Company for all labor performed, material and supplies furnished with the entire Work in the Contract. Said Bond shall remain in full force and effect during the entire period of all general guarantees given by the Contractor with the Contract as called for in the Specifications and Contract, except in cases where other bonds are specifically called for in the specifications and Contract in connection with special guarantees.

## 5. Payment

The Contractor may present estimate of work for which he desires payment no later than the first Monday of each month, based on cost of labor and material incorporated into the work. Estimate shall be a Sworn Statement and shall show relative amount of each item completed. Submit Partial Waivers of Lien, including for first payout, from Contractors,

Subcontractors and Material Suppliers with Sworn Statement for monthly payout. Payments will be made within approximately thirty (30) days after review by the Owner. Notwithstanding, anything to the contrary contained in the Contract Documents, payouts are to be made by checks payable to the Contractor. The Contractor will be required to submit a sworn payroll statement according to the Illinois Department of Labor documenting his compliance with the Illinois Prevailing Wage Act.

Final Payment will be made within approximately thirty (30) days of final inspection and approval and receipt of all waivers, sworn statements, guarantee statements, and other documents set forth in the Contract Documents.

## 6. Preparation of Bids

Before submitting proposal, each bidder shall examine carefully all documents pertaining to the work and visit the sites to verify conditions under which work will be performed. Submittal of the Bid Proposal by the Contractor is a representation by the Contractor, that the Contract Documents are full and complete, are sufficient to enable the Contractor to determine the cost of the Work and that the Contract Documents are sufficient to enable it to construct the Work outlined therein, in accordance with applicable laws and regulations, and otherwise to fulfill all its obligations hereunder, including, but not limited to, Contractor's obligations to construct the Work for an amount not in excess of the contract Sum on or before the date(s) of Completion established in the Agreement. The Contractor further acknowledges and declares that it has visited and examined the Project site, examined all physical and other conditions affecting the Work and is fully familiar with all of the conditions thereon and thereunder affecting the same. In connection therewith, Contractor specifically represents and warrants to Owner that prior to the submission of its bid it has: (a) thoroughly examined the location of the work to be performed, is familiar with local conditions, and has read and thoroughly understands the Contract Documents as they relate to the physical conditions prevalent or likely to be encountered in the performance of the work at such location; (2) examined the nature, location and character of the general area in which the Project is located, including without limitation, its climatic conditions, available labor supply and labor costs, and available equipment supply and equipment costs; and (3) examined the quality and quantity of all materials, supplies, tools, equipment, labor, and professional services necessary to complete the Work in the manner and within the cost and time frame required by the Contract Documents.

Submission of bid will be considered presumptive evidence that the Bidder has visited the site and is conversant with local facilities and difficulties, the requirements of the documents and of pertinent State, County or Local Codes, State of Labor and Material Markets, and has made due allowance in his bid for all contingencies.

Include in bid all costs of labor, material, equipment, allowance, fees, permits, guarantees, applicable taxes (**sales tax does not apply**), insurance and contingencies, with overhead and profit necessary to complete those portions of the work covered by the specifications on which proposal is made, including all trades, without further cost to the Owner. Obtain all permits and arrange for all inspections. Pay all fees, permits and costs incurred.



No compensation will be allowed by reason of any difficulties, which the Bidder could have discovered prior to bidding.

7. Fees and Inspection

The Contractor is responsible for all license fees and arrangements for all inspections required by State, County, Local and other authorities having lawful jurisdiction. The Owner is responsible for all building permit fees associate with the Work.

8. Subcontracts

Contractors operating under direct Contracts with the Owner may let Subcontracts for the performance of such portions of the work as are usually executed by special trades. All such Subcontracts shall be based on conformance with all pertinent conditions set forth in the Contract Documents, including the Supplementary Conditions as well as the detailed requirements of the portions of the drawings and specifications which depict or describe the work (labor and materials) covered by the Subcontract.

No Work may be sublet without approval of the Owner, who reserves the right to disapprove any proposed Subcontractor whose record does not establish his experience, competence, and financial ability to perform the work.

9. Materials

Materials shall conform to the drawings, specifications, manufacturer's specifications for all products incorporated into the work, and all applicable standards and guidelines.

Some specific equipment and materials have been specified for use on this project to establish minimum performance requirements or desired features. To receive consideration of alternate equipment or materials, the Bidder must submit all appropriate product data and receive pre-bid approval from the Owner. All materials are subject to the approval by the Owner both before and after incorporation in the project.

All condemned material or work shall be removed from the premises and properly disposed of.

10. Law Compliance

All project construction work shall comply with all State and Municipal Laws and Regulation, and with all Local Ordinances and Rules pertaining to this work. Such Laws, Regulations, Ordinances and Rules shall be considered a part of these specifications.

- A. The Contractor warrants that it is familiar with and shall comply with Federal, State and local laws, statutes, ordinances, rules and regulations and the orders and decrees of any courts or administrative bodies or tribunals in any manner affecting the performance of the Contract including without limitation Workers= Compensation Laws, minimum salary and wage statutes and regulations, laws with respect to permits and licenses and fees in connection therewith, laws regarding maximum working hours. No plea of misunderstanding or ignorance thereof will be considered.

- B. Whenever required, the Contractor or Subcontractor shall furnish the Architect/Engineer and Owner with satisfactory proof of compliance with said Federal, State and local laws, statutes, ordinances, rules, regulations, orders, and decrees.
- C. Contractor shall carefully examine the Occupational Safety and health Act as issued by the Federal Register (OSHA), and the specific regulations governing procedures, techniques, safety precautions, equipment design, and the configuration of the same as required under this Act and shall comply with all terms of the Act and to perform and complete in a workmanlike manner all work required in full compliance with said Act.
- D. Contractor shall comply with all terms of the Illinois Preference Act and all terms of the Equal Employment Opportunity Clause of the Illinois Fair Employment Practices Commission.
- E. At all times Contractor shall remain in compliance with the Illinois Public Works Employment Discrimination Act (775 ILCS 10/1, et seq.) and the Illinois Human Rights Act (775 ILCS 5/2-101, et seq.), and in addition shall at all times comply with Section 2-105 of the Illinois Human Rights Act requiring a written sexual harassment policy as defined therein.
- F. Contractor and all subcontractors shall be solely responsible for complying with the Substance Abuse Prevention on Public Works Projects Act, Public Act 095-06345.
- G. Contractor agrees to maintain all records and documents for projects of the District in compliance with the Freedom of Information Act, 5 ILCS 140/1 et seq. In addition, Contractor shall produce records which are responsive to a request received by the District under the Freedom of Information Act so that the District may provide records to those requesting them within the time frames required. If additional time is necessary to compile records in response to a request, then Contractor shall so notify the District and if possible, the District shall request an extension so as to comply with the Act. In the event that the District is found to have not complied with the Freedom of Information Act due to Contractor's failure to produce documents or otherwise appropriately respond to a request under the Act, then Contractor shall indemnify and hold the District harmless, and pay all amounts determined to be due including but not limited to fines, costs, attorney's fees and penalties.
- H. Contractor understands, represents and warrants to the Owner that the Contractor and its Subcontractors (for which the Contractor takes responsibility to insure that they comply with the above-mentioned Acts) are in compliance with all requirements provided by the Acts set forth in Article 15 and that they will remain in compliance for the entirety of the Work. A violation of any of the Acts set forth in this Article is cause for the immediate cancellation of the Contract. However, any forbearance or delay by the Owner in canceling this Contract shall not be considered as, and does not constitute, Owner's consent to such violation and a waiver of any rights the Owner may have, including without limitation, cancellation of this Contract.
- I. Contractor and each of its Subcontractors shall pay prevailing wages as established by the Illinois Department of Labor for each craft or type of work needed to execute the contract in accordance with 820 ILCS 130/01 et seq. The Contractor shall prominently post the current schedule of prevailing wages at the Contract site and shall notify immediately in writing all of its Subcontractors, of all changes in the schedule of prevailing wages. Any increases in costs to the Contractor due to changes in the prevailing rate of wage during the terms of any contract shall be at the expense of the Contractor and not at the expense of the Owner. The change order shall be computed using the prevailing wage rates applicable at the time the change

order work is scheduled to be performed. The Contractor shall be solely responsible to maintain accurate records as required by the prevailing wage statute and shall be solely liable for paying the difference between prevailing wages and any wages actually received by laborers, workmen and/or mechanics engaged in the Work

11. Supervision

The Contractor shall maintain a highly qualified technician on the job site at all times. The Contractor shall enforce strict discipline and good order among his employees and the Subcontractors at all times work is in progress. The Contractor shall not employ any unfit person or anyone not skilled in the work assigned to him.

12. Equipment and Tools

Furnish and maintain all equipment tools and apparatus, scaffolding, and all temporary work and materials necessary to perform the work.

13. Expediting

Place orders for materials and equipment immediately upon receipt of Contract or Notice to Proceed and follow up vigorously to insure adequate and timely supply to the work. Perform all tracings and expediting actions and arrange to get workmen in the job at the proper time to avoid delays.

14. Sanitary

The Contractor shall provide suitable, temporary toilet facilities at a specified location, for workmen on the project, complying in every respect with Local and County requirements. Unit shall be chemically treated, serviced at regular intervals, and maintained in a sanitary condition at all times.

15. Existing Utilities

The Contractor shall be responsible for locating and protecting all existing utilities, public and private, for the duration of the job. Prior to the commencement of any work, the Contractor shall notify all public and private utilities for the purpose of verifying, marking, and recording the locations of all under ground or overhead utilities, temporary or permanent. Any repair/replacement costs or associated damage will be the responsibility of the Contractor.

16. Testing and Observations

The Contractor shall give the Owner, Village Inspector, and Manufacturer's Representative proper notice of readiness of Work for all required observations, tests, or reviews.

If Laws or Regulations of any public body having jurisdiction requires any Work (or part thereof) to specifically observed or tested, Contractor shall assume full responsibility therefor, pay all costs in connection therewith and furnish Engineer with the required

certificates of inspection, testing, or approval. Contractor shall be responsible for and pay all costs in connection with any inspection or testing required in connection with Owner's or Manufacturer's agreed to Supplier of materials or equipment proposed to be incorporated into the Work, or of materials or equipment submitted for approval prior to the Contractor's purchase thereof for incorporation in the Work.

The cost of all observations, tests, and approvals in addition to the above which are required by the Contract Documents shall be paid by the Owner (unless otherwise specified).

All observations, tests, or reviews other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by organizations agreed to by Owner and Contractor (or Manufacturer if so specified).

**Should testing reveal deficiencies due to Contractor error, subsequent testing costs shall be paid by Contractor.**

If any work (including the work of others) that is to be observed or tested is covered without the written concurrence of the Owner, it must, if requested by Engineer, be uncovered of observation. Such uncovering shall be at the expense of the Contractor unless Contractor has given Owner or Village Inspector timely notice of Contractor's intention to cover such work and Engineer has not acted with reasonable promptness in response to such notice. Neither observations by Owner nor observations, tests, nor reviews by others shall relieve the Contractor from his obligations to perform the work in accordance with the Contract Documents.

#### 17. Acceptance Preceding Work (if applicable)

Before starting any operation, the Contractor and Subcontractors shall examine work performed by others to which his work adjoins or is applied and report any condition that will prevent satisfactory accomplishment of his Contract. Failure to notify the Owner in writing of deficiencies or faults in preceding work will constitute acceptance thereof and waiver of any claims and its unsuitability.

#### 18. Cutting and Patching

When necessary to cut or alter completed work to accommodate another trade, the Contractor or Subcontractor for work in places, shall do all cutting for and repair of portions of the work so disturbed. Where cutting is necessitated by fault or negligence of another Contractor, all costs of cutting and repairing shall be borne by the party at fault.

#### 19. Damage to Current

Each Contractor shall adequately protect all preceding work from damage caused by him or his works. All breakage or damage will be repaired by trade concerned at the cost of the party causing damage. Each Contractor, however, shall be responsible for adequate protection of his own work against normal construction risks.

#### 20. Housekeeping



Keep site of operations free from accumulations of rubbish and waste materials at all times. See that Subcontractors remove and dispose of their rubbish. Arrangements for removal and disposition of rubbish will be made by Contractors concerned at no cost to the Owner.

Should any Contractor or Subcontractor allow rubbish or waste material to accumulate on any portion of the site or in any portion of the building to such extent that the accumulation constitutes a hazard or obstructs the prosecution of the work in any way. The Owner may, if Contractor or Subcontractor at fault fails to remove such rubbish or waste materials within three (3) days after written notice to clear up the accumulation, engage prior labor or services of another Contractor to make necessary removal and disposition and to charge cost against monies due to Contractor or Subcontractor at fault.

## 21. Protection

- A. Property: Each Contractor and Subcontractor shall take such precaution as are necessary adequately to protect from damage or deterioration and to safeguard from theft or pilferage, all materials, tools and equipment pertaining to his work which are on the site, whether stored or incorporated in the structure.
- B. Safety: Provide all barricades or other temporary protection as may be required by local authorities having lawful jurisdiction, or be considered of general safety, around all openings in floors and walls of the structure, and around all open pits or trenches in its vicinity.
- C. Weather: Each Contractor and Subcontractor shall at all times provide protection against rain, snow, wind storms, frost or heat so as to maintain all work, materials, apparatus, and fixtures, free from injury or damage.

At the end of each day's work, all new work subject to damage by the elements and all points where water or frost may enter any part of the structure or work shall be covered.

- D. Water: General Contractor shall at all times protect excavations, trenches, and building from damage from rain water, snow, spring water, ground water backing up of drains or sewers and all other water. He shall provide all pumps and equipment enclosures required for such protection.

He shall also construct and maintain any temporary drainage necessary to direct or lead water away from the work and shall do all pumping necessary to keep excavation and lowest floor free of water at all times.

- E. Damage: All work damaged by failure to provide protection shall be removed and replaced with new work at the expense of the Contractor at fault.

## 22. Guarantee

The Contractor and/or manufacturer shall provide a minimum of one (1) year warranty for all materials and workmanship associated with the project or work performed under the Contract.

## 23. Insurance

- **Worker's Compensation**
  - State: Statutory
  - Applicable Federal (e.g., Longshoremen's): Statutory
  - Employer's Liability
    - \$500,000.00 Per Accident
    - \$500,000.00 Disease, Policy Limit
    - \$500,000.00 Disease, Each Employee
- If written under **Commercial General Liability Policy Form**
  - \$2,000,000.00 General Aggregate
  - \$1,000,000.00 Products Completed Operations Aggregate
  - \$1,000,000.00 Personal and Advertising Injury
  - \$1,000,000.00 Each Occurrence
  - \$ 50,000.00 Fire Damage (any one fire)
  - \$ 50,000.00 Medical Expense (any one person)
- **Business Automobile Liability** (including owned, non-owned and hired vehicles):
  - Bodily Injury
    - \$1,000,000.00 Per Person
    - \$1,000,000.00 Per Accident
  - Property Damage
    - \$1,000,000.00 Per Occurrence
- **Umbrella Excess Liability**
  - \$2,000,000.00 over Primary Insurance
  - \$2,000,000.00 Retention for Self-Insured Hazards Each Occurrence

- A. General: The Contractor shall not commence work under the Contract until he has obtained all insurance required, and it has been approved by the Owner, nor shall Contractor allow any Subcontractor to commence work on any portion of the work until all insurance required of the Subcontractor and Sub-subcontractor has been similarly approved by the Owner.

All such insurance shall be purchased only from companies licensed and duly authorized by the Department of Insurance of the State of Illinois to do business in Illinois and to write the types of insurance policies as herein specified. Insurance companies must have a minimum policy holder's rating of A+ and a financial rating of AAAAA as stated in the latest edition of Best's Insurance Guide.

The insurance coverages must be maintained by the Contractor and the Subcontractor until all work is completed by the Contractor and accepted by the Owner. If the policy is written on claims made basis, then the Contractor shall

purchase such additional insurance as may be necessary to provide specified coverage to the District for a period of not less than five (5) years from the completion of the work.

- B. Automobile Liability: Contractor shall obtain at his expense and keep in force at all times during the performance of the work, Comprehensive Automobile Liability Insurance providing for bodily injury, personal injury and property damage, limits of an amount not less than \$500,000 per occurrence and \$1,000,000 per annual aggregate.
- C. General Liability Insurance: Contractor shall obtain at his expense and keep in force at all times during the performance of the work, Comprehensive General Liability Insurance providing for bodily injury, personal injury and property damage, limits of not less than \$1,000,000 per occurrence and \$1,000,000 annual aggregate.
- D. Worker's Compensation and Employer's Liability Insurance: Contractor shall obtain at his expense and keep in force at all times during the performance of work, worker's compensation and related insurance coverage at amounts required by statute and employer's liability with limits of not less than \$1,000,000 per occurrence.
- E. Certificates of Insurance: Within five (5) calendar days after receipt of the "Written Notice to Proceed", the Contractor shall file with the Owner, a Certificate of Insurance and Policy Endorsement showing complete coverage of all insurance required by this Section signed by the insurance companies or their authorized agents, certifying to the name and address of the party insured, the description of the work covered by such insurance, the insurance policy numbers, the limits of liability of the policies and the dates of their expirations, with a further certification from said insurance companies that their policies will not be modified, amended, changed, cancelled or terminated without thirty (30) business days prior written notice to the Owner. If any form of umbrella or excess coverage policy is utilized by the Contractor, the Owner reserves the right to require a copy of the entire policy.
- F. All policies of insurance purchased or maintained in fulfillment of this paragraph 24 shall name the Owner and Architect/Engineer as additional insureds thereunder.
- G. Failure of Owner to demand any certificate, endorsement or other evidence of full compliance with these insurance requirements or failure of Owner to identify a deficiency from evidence that is provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance. The Contractor agrees that the obligation to provide the insurance required by these documents is solely its responsibility and that this is a requirement which cannot be waived by any conduct, action, inaction or omission by the Owner.
- H. Nothing contained in the insurance requirements of the Contract Documents is to be construed as limiting the liability of the Contractor, the liability of any Subcontractor or any tier or either of their respective insurance carriers. The Owner, does not in any way, represent that the coverages or limits of insurance specified is sufficient or adequate to protect the Owner, Contractor, Architect/Engineer, or any Subcontractor's interests or liabilities but are merely at minimums. The obligation of the Contractor, the Architect/Engineer, and any Subcontractor of any tier to purchase insurance, shall

not, in any way, limit their obligations to the Owner in the event the Owner should suffer an injury or loss in excess of the amount recoverable through insurance, or any loss or portion of the loss which is not covered by either the Contractors or any Subcontractor insurance.

- I. On the Certificate of Insurance, delete in the cancellation provision the following words, "Endeavor to" and "but failure to mail such notice shall impose no obligation or liability of any kind upon the company, its agents or representatives."
- J. All the insurance required of the Contractor shall state that the coverage afforded to the additional insureds shall be primary insurance of the additional insureds with respect to claims arising out of operations performed by or on their behalf. If the additional insureds@ have other insurance or self-insured coverage which is applicable to the loss, it shall be on an excess or contingent basis.
- K. All insurance required of the Contractor shall provide that any failure to comply with reporting provisions of the policies shall not affect coverage provided to the Owner or Architect/Engineer or any of their officers, directors, commissioners, officials, employees, consultants, volunteers, or agents. I. All insurance required of the Contractor shall provide that the insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.
- L. In the event the Contractor fails to furnish and maintain the insurance required by this contract, the Owner may purchase such insurance on behalf of the Contractor, and the Contractor shall pay the cost thereof to the Owner upon demand or shall have such cost deducted from any payments due the Contractor. The Contractor agrees to furnish to the Owner the information needed to obtain such insurance.
- M. In order to protect the Owner and Architect/Engineer the Contractor shall require that all its Subcontractors purchase insurance protecting the Owner and Architect/Engineer to the same extent they are protected by the insurance required herein from the Contractor.
- N. Owner's Liability Insurance
  - 1. The Contractor shall purchase and maintain insurance covering the Owner's liability for claims which may arise from operations under the Contract and that will protect the Owner and the Architect/Engineer and their agents and employees from and against all claims, damages, losses and expenses including attorney's fees arising out of or resulting from the performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury or to destruction of tangible property (other than the work itself) including the loss of use resulting therefrom and (2) is cause in whole or in part by any negligent act of omission of the Contractor, and Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party to whom insurance is afforded pursuant to this paragraph. The minimum limits of liability purchased for such coverage shall be equal to the aggregate of the limits required for the Contractor's Liability Insurance under 24 above.



2. In any and all claims against the Owner or the Architect/Engineer or any of their agents or employees by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the insurance obligation under this paragraph shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under Workmen's Compensation Acts, disability benefit acts or other employee benefit acts.
3. The insurance obligations of the Contractor under this paragraph shall not extend to the liability of the Architect/Engineer, his agents or employees arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, change orders, designs or specifications or (2) the giving of or failure to give directions or instruction by the Architect/Engineer, his agents or employees provided that such giving or failure to give is the primary cause of the injury damage.
4. The Contractor shall provide the Owner with the Original policy and shall furnish the Architect/Engineer a memorandum copy of said policy. The named insured in the Protective Liability Policy shall be: Hoffman Estates Park District

#### 24. Indemnification

To the fullest extent permitted by law, the Contractor shall waive any right of contribution against the Owner and shall indemnify and hold harmless the Owner and the Architect/Engineer and their officers, officials, employees, volunteers and agents from and against all claims, damages losses and expenses, including, but not limited to, legal fees (attorney's and paralegal's fees, expert fees and court costs), arising out of or resulting from the performance of the Contractor's work provided that any such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or injury to or destruction of property, other than the work itself, including the loss of use resulting therefrom, or is attributable to misuse or improper use of trademark or copyright protected material or otherwise protected intellectual property, to the extent it is caused in whole or in part by any wrongful or negligent act or omission of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable. Such obligation shall not be construed to negate, abridge or otherwise reduce any other right to indemnity which the Owner would otherwise have. The Contractor shall similarly, protect, indemnify and hold and save harmless, the Owner, its officers, officials, employee, volunteers and agents against and from any and all claims, costs, causes, actions and expenses, including, but not limited to, legal fees, incurred by reason of Contractor's breach of any of its obligations under, or Contractor's default of any provisions of the Contract. The indemnification obligations under this paragraph shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the Contractor or any subcontractor under Workers' Compensation or Disability Benefit Acts or Employee Benefit Acts

#### 25. Labor Law

The Contractor and each and every Subcontractor performing work at the site of the project to which this Contract relates shall comply with applicable and provisions of all pertinent Federal, State, and Local Labor Laws.

## 26. Final Cleaning

Just prior to delivery of the job to the Owner, the Contractor shall perform a final cleaning of the equipment and haul away from the job site all debris created by his work on the site and surrounding area.

## 27. Time Schedule/Major Repairs

Work under the Contract shall commence within five (5) calendar days after given "Written Notice to Proceed" by Owners (or date specified) and shall continue with due diligence until due completion.

Each Contractor or Subcontractor shall and does hereby agree that he will start and prosecute his work so as to cause no delay to the Contractor and that he will complete all work under his Contract coincidentally with completion of Contractor's work.

The Contractor shall submit an estimated time schedule setting up order of procedure and time allowed for each branch of work. Contractor shall make every effort to adhere to these schedules, but reasonable modifications will be permitted from time to time to compensate for delays due to strikes or conditions beyond Contractor's control, exclusive of weather.

## 28. Avoidance of Delays (Major Repairs)

Each Contractor and Subcontractor shall be furnished a copy of the "Time Schedule" referred to above, and each shall so prosecute his work that he not only maintains his progress in accordance with the said Time Schedule but also shall cause no delays to other Contractors, either in person or through a Subcontractor, fail to maintain progress according to the approved Time Schedule or cause delay to another Contractor or Subcontractor, he shall furnish such additional labor and/or services or work such overtime as may be necessary to bring his operation up to schedule with no additional cost to Owner. Failure to maintain schedule or to the above steps to regain the agreed time schedule shall constitute default within the terms of the Contract and grounds on which the Owner may have recourse to the Contractor's Surety for remedial action.

## 29. Unit Prices and Measurement (if applicable)

Upon completion of the work, a final measurement will be conducted by the Contractor and Owner. Unit prices included in the bid proposal will be applied to the units measured to determine the final/total price of the work.

## 30. Assignment

The Contractor or any Subcontractor shall not assign the Contract nor any monies due to become due to him hereunder, to any Person, Firm, or Corporation without previous written consent of the Owner.

### 31. Extras

No extra work shall be allowed or paid for unless a Change Order is made and accepted by the Owner in writing.

### 32. Examination of Site

Before submitting proposal, contractors shall examine site. Such an examination will be presumed and no allowance will be made for extra labor or materials due to Contractor's failure to do so. Any information furnished by the Owner shall not constitute a representation concerning site conditions and the Contractor shall bear, solely and exclusively, all costs due to concealed, unknown, unusual or otherwise unforeseen conditions at the site. Contractor is aware that all such risk concerning site conditions is borne by it, has considered such in making its bid, and therefore freely waives all of its rights under the Illinois Public Construction Contract Act of 1999 .

### 33. Safety

The Contractor is responsible for the safe passage of pedestrian traffic for the duration of the job. Any precautionary measures, necessary warning signs, barricades, etc., required to inform the general public of potential hazards or dangers and as necessary to assist the Contractor in the performance of the work, shall be at his expense and provided for in his quoted price. **Public safety is a foremost concern of the Owner, therefore failure by the Contractor to take a pro-active approach to safety is unacceptable. If necessary, the Owner will take whatever steps deemed appropriate, at the cost of the Contractor, to ensure the safety of the general public and our employees.**

### 34. Personnel

If any person employed on the work site be, in the opinion of the Owner, intemperate, disorderly, incompetent, willfully negligent or dishonest in the performance of his duties, he shall be directed to cease work and vacate the job site immediately.

### 35. Liens

No payment shall become due until the Contractor, if required, shall deliver to Owner a complete release of all liens arising out of this Contract, or receipts in full in lieu thereof and, if required in either case, an affidavit that so far as he has knowledge or information, the releases and receipts include all the labor and material for which a lien could be filed. If any lien remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all monies that the latter may be compelled to pay in discharging such a lien, including all costs and a reasonable attorney's fee.

### 36. Default

In case of default by the Contractor, the Owner may procure the articles or services from other sources and hold the Contractor responsible for any excess cost occasioned thereby.

### 37. Cancellation of Contract

If the Contractor or any of his Sub-contractors shall, in the judgment of the Hoffman Estates Park District, be unable to carry on the work satisfactorily, or if the Contractor or any of his Sub-contractors shall violate any of the provisions of this contract, or in case of bankruptcy of the Contractor, or failure of the Contractor to pay for supplies or workmen, or a work-stoppage, or a failure by the Contractor to provide sufficient workmen or sufficient material for the job, the Owner may serve written notice upon the Contractor and his Surety of his intention to terminate the Contract, and, if within seven (7) days after the service of such notice, the Contractor or the Sub-contractor or the Surety have not proceeded to carry on the work in accordance with this Contract and to the satisfaction of the Owner, this Contract shall cease and terminate and the Owner shall have the right to take over the work and prosecute the same to completion by Contract for the account and at the expense of the Contractor and the Surety; and the Contractor and Surety shall be liable to the Owner for any excess costs occasioned by the Owner thereby, and in such event the Owner may take possession of and utilize in completing the work such materials, appliances, and plants as may be on the site of the work and necessary therefore; provided, however, that in the event the Owner determines that the failure of the Contractor, Sub-contractor or Surety to carry on the work in accordance with this Contract has resulted in an emergency which will require that the Owner take over the work immediately, to avoid loss or waste of a substantial part of the work already performed, the Owner may immediately take over the work and prosecute the same at the expense of the Contractor and Surety to the extent necessary to avoid damage, and may prosecute the same at the expense of the Contractor and Surety to the extent necessary to avoid damage, and may prosecute the same to completion at the expense of the Contractor and the Surety unless within seven (7) days after the services of the above described notice, the Contractor, Sub-contractor or Surety has proceeded to carry on the work in accordance with this Contract and to the satisfaction of the Hoffman Estates Park District.

### 38. Lien Waivers (if applicable)

Neither by partial nor final payment will the Owner be deemed to have waived any remedy for defective work or negligence on the part of the Contractor or any other portion of the Contract which, by its nature, survives after time of payment.

Supporting partial Waivers of Lien for each Subcontractor, supplier and prime contractor must accompany each request for progress payment.

Waivers must spell out exact description of work performed for which Waiver is issued and state whether dollar amount is full amount received or amount of work less retainage, held by prime contractor.

For final payment it is necessary to submit final waivers in the full amount of the Contracts for all Subcontractors, suppliers and prime contractors.

Waivers must be accompanied by a sworn statement listing Subcontractors and suppliers, the amount of their Contracts and the amount requested.



39. Line and Grade Stakes (if applicable)

Stakes for lines and grades shall be provided once by the Engineer. Costs for replacement of damaged stakes shall be paid by the Contractor. Prior to commencing work and before pouring or finally adjusting any structure or closing any excavation, the Contractor shall verify the correctness of any grades so as to conform to the Contract Documents.

40. Construction Observation

A Consultant may be called upon to observe the work on behalf of the Owner and will provide general assistance during construction insofar as proper interpretation of the Contract Documents is affected. The consultant shall not be responsible for the acts or omissions of the Contractor's superintendent or other employees.

All materials used and all completed work by the Contractor shall be subject to the observation of the Owner/Owner's representative. The Contractor shall furnish such samples of materials for examination and tests as may be requested by the Owner and shall furnish any information required concerning the nature or source of any materials or equipment, which he proposes to use. Any material, equipment, or work which does not satisfactorily meet the Contract Documents may be rejected by the Owner by giving written notice to the Contractor. All rejected materials, equipment, or work shall be promptly removed and replaced at the Contractor's expense.

41. Field Representatives

Field representatives may be appointed by the Owner, Architect or Engineer to see that the work is performed in accordance with the Contract Documents. Field representatives shall have the authority to condemn and/or reject defective work materials. Only the Owner shall have authority to suspend work. Field representatives shall have no authority to permit deviation from the Contract Documents and Owner, the Contractor shall be liable for any deviations made without a written order from the Engineer.

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## SECTION 230500 - COMMON WORK RESULTS FOR HVAC

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2. SUMMARY

- A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
  2. Transition fittings.
  3. Mechanical sleeve seals.
  4. Sleeves.
  5. Escutcheons.
  6. Grout.
  7. HVAC demolition.
  8. Equipment installation requirements common to equipment sections.
  9. Painting and finishing.
  10. Supports and anchorages.

#### 1.3. DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
1. CPVC: Chlorinated polyvinyl chloride plastic.
  2. PE: Polyethylene plastic.
  3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4. SUBMITTALS

- A. Product Data: For the following:
1. Transition fittings.
  2. Dielectric fittings.
  3. Mechanical sleeve seals.
  4. Escutcheons.

- B. Welding certificates.

#### 1.5. QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

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1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- D. All materials, workmanship and labor contained in Division 23 specifications shall conform to the requirements for LEED Silver certification. Refer to the latest edition of the U.S. Green Building Council Design and Construction manual.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
  - B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- 1.7 COORDINATION
- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
  - B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
  - C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- 1.8 WARRANTY
- A. The warranty period of all labor and equipment shall commence at the date of substantial completion established by the architect.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.



## 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## 2.3 JOINING MATERIALS

- A. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Solvent Cements for Joining Plastic Piping:
  - 1. CPVC Piping: ASTM F 493.
  - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- F. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## 2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Plastic]. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

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- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. One-Piece, Floor-Plate Type: Cast-iron floor plate.

## 2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
  - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.

6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- 3.2 PIPING CONNECTIONS
- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
- 3.3 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS
- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- 3.4 PAINTING
- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- 3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGES
- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

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3.6 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

## SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

### PART 2 - PRODUCTS

#### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 Premium Efficiency unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

#### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

#### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium Efficiency, as defined in NEMA.
- C. Service Factor: 1.15.

- D. Multispeed Motors: Variable torque.
    - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
    - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
  - E. Multispeed Motors: Separate winding for each speed.
  - F. Rotor: Random-wound, squirrel cage.
  - G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
  - H. Temperature Rise: Match insulation rating.
  - I. Insulation: Class F.
  - J. Code Letter Designation:
    - 1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS
- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
  - B. Motors Used with Variable Frequency Controllers:
    - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
    - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
  - C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.
- 2.5 SINGLE-PHASE MOTORS
- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
    - 1. Permanent-split capacitor.
    - 2. Split phase.
    - 3. Capacitor start, inductor run.
    - 4. Capacitor start, capacitor run.
  - B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
  - C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
  - D. Motors 1/20 HP and Smaller: Shaded-pole type.
  - E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

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PART 3 - EXECUTION (Not Applicable)

END OF SECTION



## SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.

#### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

#### 1.4 SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

#### 1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB or TABB.



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1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB or TABB.
  2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB or TABB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- 1.6 COORDINATION
- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use

tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine operating safety interlocks and controls on HVAC equipment.
- K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance, smoke, and fire dampers are open.
  - 5. Isolating and balancing valves are open and control valves are operational.
  - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 7. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance and in this Section."
  - 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
  - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- C. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check dampers for proper position to achieve desired airflow path.
- G. Check for airflow blockages.
- H. Check condensate drains for proper connections and functioning.
- I. Check for proper sealing of air-handling-unit components.
- J. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

### 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- 3.6 PROCEDURES FOR HEAT-TRANSFER COILS
- A. Measure, adjust, and record the following data for each refrigerant coil:
1. Dry-bulb temperature of entering and leaving air.
  2. Wet-bulb temperature of entering and leaving air.
  3. Airflow.
  4. Air pressure drop.
  5. Refrigerant suction pressure and temperature.
- 3.7 TOLERANCES
- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

### 3.8 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  1. Fan curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  1. Title page.
  2. Name and address of the TAB contractor.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Settings for supply-air, static-pressure controller.
    - g. Other system operating conditions that affect performance.



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- D. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
    - g. Sheave make, size in inches (mm), and bore.
    - h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches (mm), and bore.
    - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
    - g. Number, make, and size of belts.
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm (L/s).
    - b. Total system static pressure in inches wg (Pa).
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg (Pa).
    - e. Suction static pressure in inches wg (Pa).
- E. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
    - a. System and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F (deg C).
    - d. Duct static pressure in inches wg (Pa).
    - e. Duct size in inches (mm).
    - f. Duct area in sq. ft. (sq. m).
    - g. Indicated air flow rate in cfm (L/s).
    - h. Indicated velocity in fpm (m/s).
    - i. Actual air flow rate in cfm (L/s).
    - j. Actual average velocity in fpm (m/s).
    - k. Barometric pressure in psig (Pa).

### 3.9 INSPECTIONS

- A. Initial Inspection:

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1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
  2. Check the following for each system:
    - a. Measure airflow of at least 10 percent of air outlets.
    - b. Measure water flow of at least 5 percent of terminals.
    - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    - d. Verify that balancing devices are marked with final balance position.
    - e. Note deviations from the Contract Documents in the final report.
- B. Prepare test and inspection reports.
- 3.10 ADDITIONAL TESTS
- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
  - B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

## SECTION 230700 - HVAC INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
  - a. Cellular glass.
  - b. Flexible elastomeric.
  - c. Mineral fiber.
- 2. Adhesives.
- 3. Mastics.
- 4. Lagging adhesives.
- 5. Sealants.
- 6. Factory-applied jackets.
- 7. Field-applied fabric-reinforcing mesh.
- 8. Field-applied jackets.
- 9. Tapes.
- 10. Securements.
- 11. Corner angles.

- B. Related Sections:

- 1. Division 23 Section "Metal Ducts" for duct liners.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Qualification Data: For qualified Installer.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- D. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

### PART 2 - PRODUCTS

#### 2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.

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- d. Manson Insulation Inc.; Alley Wrap.
  - e. Owens Corning; All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ or FSK jacket. For equipment applications, provide insulation with factory-applied ASJ or with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
  - 1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Aeroflex USA Inc.; AeroSeal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).



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- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Chemical Company (The); 739, Dow Silicone.
    - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Speedline Vinyl Adhesive.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Products, Division of ITW; CP-35.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    - c. ITW TACC, Division of Illinois Tool Works; CB-50.
    - d. Marathon Industries, Inc.; 590.
    - e. Mon-Eco Industries, Inc.; 55-40.
    - f. Vimasco Corporation; 749.
  - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  - 5. Color: White.

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- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Products, Division of ITW; CP-30.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-35.
    - c. ITW TACC, Division of Illinois Tool Works; CB-25.
    - d. Marathon Industries, Inc.; 501.
    - e. Mon-Eco Industries, Inc.; 55-10.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
  3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
  4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Products, Division of ITW; Encacel.
    - b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
    - c. Marathon Industries, Inc.; 570.
    - d. Mon-Eco Industries, Inc.; 55-70.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
  3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Products, Division of ITW; CP-10.
    - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
    - d. Marathon Industries, Inc.; 550.
    - e. Mon-Eco Industries, Inc.; 55-50.
    - f. Vimasco Corporation; WC-1/WC-5.
  2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
  4. Solids Content: 63 percent by volume and 73 percent by weight.
  5. Color: White.

## 2.4 SEALANTS

### A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Products, Division of ITW; CP-76.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Pittsburgh Corning Corporation; Pittseal 444.
  - f. Vimasco Corporation; 750.
2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Products, Division of ITW; CP-70.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
6. Color: White or gray.
7. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Products, Division of ITW; CP-76-8.
  - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.5 FACTORY-APPLIED JACKETS

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

## 2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto PVC Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: Color as selected by Architect.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
  5. Factory-fabricated tank heads and tank side panels.
- D. Metal Jacket:

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1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Products, Division of ITW; Metal Jacketing Systems.
  - b. PABCO Metals Corporation; Surefit.
  - c. RPR Products, Inc.; Insul-Mate.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    - b. Compac Corp.; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 11.5 mils (0.29 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - b. Compac Corp.; 110 and 111.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 6.5 mils (0.16 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. Venture Tape; 1506 CW NS.



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2. Width: 2 inches (50 mm).
  3. Thickness: 6 mils (0.15 mm).
  4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches (50 mm).
  3. Thickness: 3.7 mils (0.093 mm).
  4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

#### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

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- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
    - a. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
  - 3. Cover joints and seams with tape as recommended by insulation material manufacturer.
  - 4. For below ambient services, apply vapor-barrier mastic over staples to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match

adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).

2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.5 MINERAL-FIBER INSULATION INSTALLATION

#### A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
  - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Impale insulation over pins and attach speed washers.
  - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).

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5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).



5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

### 3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
- C. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

### 3.7 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.

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- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.8 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed and exposed supply located in nonconditioned space.
  - 2. Indoor, outdoor air.
  - 3. Indoor, concealed and exposed return located in nonconditioned space.
  - 4. Outdoor, concealed and exposed supply and return.
- B. Items Not Insulated:
  - 1. Fibrous-glass ducts.
  - 2. Factory-insulated flexible ducts.
  - 3. Factory-insulated plenums and casings.
  - 4. Flexible connectors.
  - 5. Vibration-control devices.
  - 6. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, rectangular, round and flat-oval, supply-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. nominal density.
- B. Concealed, rectangular, round and flat-oval, return-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
- C. Concealed, round and flat-oval, outdoor-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. nominal density.
- D. Exposed, rectangular, outdoor-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. nominal density.
  - 2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. nominal density.

3.10 OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Rectangular, supply and return-air duct insulation shall be the following:
  - 1. Mineral-Fiber Board: 3 inches thick and 0.75-lb/cu. ft. nominal density.

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2. Provide aluminum jacket on all exposed insulation. Aluminum shall be smooth and 0.032 inch thick

END OF SECTION