DIVISION 23: HEATING, VENTILATING, AND AIR-CONDITIONING

23 0500 COMMON WORK RESULTS FOR HVAC

23 0501 COMMON HVAC REQUIREMENTS
23 0529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

23 3000 HVAC AIR DISTRIBUTION

23 3001 COMMON DUCT REQUIREMENTS
23 3114 LOW-PRESSURE METAL DUCTS
23 3400 HVAC FANS

END OF TABLE OF CONTENTS
SECTION 23 0501
COMMON HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common requirements and procedures for HVAC systems.
   2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
   3. Interface with Testing And Balancing Agency.
   4. Furnish and install sealants relating to installation of systems installed under this Division.
   5. Furnish and install Firestop Penetration Systems for HVAC system penetrations as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:
   1. Sleeves, inserts, and equipment for mechanical systems installed under other Sections.

C. Related Requirements:
   1. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   2. Section 07 9213: 'Elastometric Joint Sealant' for quality of sealants used at building exterior.
   4. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.
   5. Section 26 2913: 'Enclosed Controllers' for magnetic starters and thermal protective devices (heaters) not factory mounted integral part of mechanical equipment.
   6. Division 26: Raceway and conduit, unless specified otherwise, line voltage wiring, outlets, and disconnect switches.
   7. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.
         1) Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
         2) Include name, address, and phone number of each supplier.
   2. Shop Drawings:
      a. Schematic control diagrams for each separate fan system, heating system, control panel, etc. Each diagram shall show locations of all control and operational components and devices. Mark correct operating settings for each control device on these diagrams.
      b. Diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches, and relays. Include drawings showing electrical power requirements and connection locations.
      c. Drawing of each temperature control panel identifying components in panels and their function.
      d. Other shop drawings required by Division 23 trade Sections.
B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):
         1) At beginning of HVAC section of Operations And Maintenance Manual, provide master
            index showing items included.
            a) Provide name, address, and phone number of Architect, Architect's Mechanical
               Engineer, General Contractor, and HVAC, Sheet Metal, Refrigeration, and
               Temperature Control subcontractors.
            b) Identify maintenance instructions by using same equipment identification used in
               Contract Drawings. Maintenance instructions shall include:
               (1) List of HVAC equipment used indicating name, model, serial number, and
                   nameplate data of each item together with number and name associated with
                   each system item.
               (2) Manufacturer's maintenance instructions for each piece of HVAC equipment
                   installed in Project. Instructions shall include name of vendor, installation
                   instructions, parts numbers and lists, operation instructions of equipment, and
                   maintenance and lubrication instructions.
               (3) Summary list of mechanical equipment requiring lubrication showing name of
                   equipment, location, and type and frequency of lubrication.
               (4) Manual for Honeywell T7350 thermostat published by Honeywell.
            c) Provide operating instructions to include:
               (1) General description of each HVAC system.
               (2) Step by step procedure to follow in putting each piece of HVAC equipment
                   into operation.
               (3) Provide diagrams for electrical control system showing wiring of items such as
                   smoke detectors, fuses, interlocks, electrical switches, and relays.
      b. Warranty Documentation:
         1) Include copies of warranties required in individual Sections of Division 23.
      c. Record Documentation:
         1) Manufacturers documentation:
            a) Copies of approved shop drawings.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Perform work in accordance with applicable provisions of Gas Ordinances applicable to Project.
      Provide materials and labor necessary to comply with rules, regulations, and ordinances.
   2. In case of differences between building codes, laws, local ordinances, utility company regulations,
      and Contract Documents, the most stringent shall govern. Notify Architect in writing of such
      differences before performing work affected by such differences.
   3. Sustainable Design Compliance:
      a. Submit all Sustainable Design Requirements to comply with Section 01 8113 for information
         needed by the Design Professional to demonstrate that particular credits have been
         achieved. In particular, credits that depend on knowing the cost and quantity of certain types
         of products cannot be achieved without obtaining that information from the Contractor.
         These include renewable content, locally sourced new products, and reused products. In
         addition, a form is provided for each installer to certify that they have not used adhesives,
         sealants, and for suppliers and installers to certify they have not used composite wood with
         prohibited VOC content.
   4. Identification:
      a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels
         shall be in place when Project is turned over to Owner.

B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
   1. Company:
      a. Company specializing in performing work of this section.
         1) Minimum five (5) years experience in HVAC installations.
2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
   b. Upon request, submit documentation.
2. Installer:
   a. Licensed for area of Project.
   b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
   c. Upon request, submit documentation.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
   1. Accept valves on site in shipping containers with labeling in place.

B. Storage And Handling Requirements:
   1. In addition to requirements specified in Division 01: 
      a. Stored material shall be readily accessible for inspection by Architect until installed.
      b. Store items subject to moisture damage, such as controls, in dry, heated spaces.
      c. Provide temporary protective coating on cast iron and steel valves.
      d. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
   2. Protect bearings during installation. Thoroughly grease steel shafts to prevent corrosion.

1.5 WARRANTY

A. Manufacturer Warranty:
   1. Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record 'start-up' date of each piece of equipment on certificate.

B. Special Warranty:
   1. Guarantee HVAC systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
   2. If HVAC sub-contractor with offices located more than 150 miles (240 km) from Project site is used, provide service / warranty work agreement for warranty period with local HVAC sub-contractor approved by Architect. Include copy of service / warranty agreement in warranty section of Operation And Maintenance Manual.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.

B. Pipe And Pipe Fittings:
   1. Use domestic made pipe and pipe fittings on Project.
   2. Weld-O-Let and Screw-O-Let fittings are acceptable.

C. Sleeves:
   1. In Framing: Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga (2 mm) galvanized sheet metal two sizes larger than bare pipe or insulation on insulated pipe.
   2. In Concrete And Masonry: Sleeves through outside walls, interior shear walls, and footings shall be schedule 80 black steel pipe with welded plate.
D. Valves:
   1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers:
   1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Drawings:
   1. HVAC Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
   2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over HVAC Drawings.
   3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

B. Verification Of Conditions:
   1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which mechanical work is dependent for efficiency and report work that requires correction.
   2. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
   3. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.
   4. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.

3.3 PREPARATION

A. Changes Due To Equipment Selection:
   1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings, if requested by Architect, showing proposed installations.
   2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
   3. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for proper operation of system resulting from selection of equipment.
   4. Be responsible for the proper location of roughing-in and connections provided under other Divisions.
3.4 INSTALLATION

A. Interface With Other Work:
   1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient
time to be incorporated into construction as work proceeds. Locate these items and see they are
properly installed.
   2. Electrical: Furnish exact location of electrical connections and complete information on motor
controls to installer of electrical system.
   3. Testing And Balancing:
      a. Put HVAC systems into full operation and continue their operation during each working day
of testing and balancing.
      b. Make changes in pulleys, belts, fan speeds, and dampers or add dampers as required for
correct balance as recommended by Testing And Balancing Agency and at no additional
cost to Owner.

B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut
beams, columns, or trusses.

C. Locating Equipment:
   1. Arrange pipes, ducts, and equipment to permit ready access to valves, cocks, unions, traps,
filters, starters, motors, control components, and to clear openings of doors and access panels.
   2. Adjust locations of pipes, ducts, switches, panels, and equipment to accommodate work to
interferences anticipated and encountered.
   3. Install HVAC work to permit removal of equipment and parts of equipment requiring periodic
replacement or maintenance without damage to or interference with other parts of equipment or
structure.
   4. Determine exact route and location of each pipe and duct before fabrication.
      a. Right-Of-Way:
         1) Lines that pitch shall have right-of-way over those that do not pitch. For example,
steam, steam condensate, and drains shall normally have right-of-way.
         2) Lines whose elevations cannot be changed shall have right-of-way over lines whose
elevations can be changed.
      b. Offsets, Transitions, and Changes in Direction:
         1) Make offsets, transitions, and changes in direction in pipes and ducts as required to
maintain proper head room and pitch of sloping lines whether or not indicated on
Drawings.
         2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect
these offsets, transitions, and changes in direction.

D. Piping:
   1. Furnish and install complete system of piping, valved as indicated or as necessary to completely
control entire apparatus.
      a. Pipe drawings are diagrammatic and indicate general location and connections. Piping may
have to be offset, lowered, or raised as required or directed at site. This does not relieve this
Division from responsibility for proper erection of systems of piping in every respect.
      b. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block
access to doors, windows, or access openings.
         1) Arrange so as to facilitate removal of tube bundles.
         2) Provide accessible flanges or ground joint unions, as applicable for type of piping
specified, at connections to equipment and on bypasses.
            a) Make connections of dissimilar metals with di-electric unions.
            b) Install valves and unions ahead of traps and strainers. Provide unions on both
sides of traps.
         3) Do not use reducing bushings, street elbows, bull head tees, close nipples, or running
couplings.
         4) Install piping systems so they may be easily drained. Provide drain valves at low points
and manual air vents at high points in hot water heating and cooling water piping.
         5) Install piping to insure noiseless circulation.
6) Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.

c. Do not install piping in shear walls.

2. Properly make adequate provisions for expansion, contraction, slope, and anchorage.
   a. Cut piping accurately for fabrication to measurements established at site. Remove burr and cutting slag from pipes.
   b. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
   c. Make changes in direction with proper fittings.

2. Expansion of Thermoplastic Pipe:
   1) Provide for expansion in every 30 feet (9 meters) of straight run.
   2) Provide 12 inch (300 mm) offset below roof line in each vent line penetrating roof.

3. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete floors on grade. Seal sleeves with specified sealants.
   a. Sleeves through floors shall extend 1/4 inch (6 mm) above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
   b. Sleeves through floors and foundation walls shall be watertight.

4. Provide spring clamp plates (escutcheons) where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.

5. Remove dirt, grease, and other foreign matter from each length of piping before installation.
   a. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
   b. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
   c. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.

E. Penetration Firestops: Install Penetration Firestop System appropriate for penetration at HVAC system penetrations through walls, ceilings, roofs, and top plates of walls.

F. Sealants:
   1. Seal openings through building exterior caused by penetrations of elements of HVAC systems.
   2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.

3.5 REPAIR / RESTORATION

A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
   1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
   2. Surface finishes shall exactly match existing finishes of same materials.

3.6 FIELD QUALITY CONTROL

A. Field Tests:
   1. Perform tests on HVAC piping systems. Furnish devices required for testing purposes.

B. Non-Conforming Work:
   1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
   2. Repeat tests on new material, if requested.
3.7 SYSTEM START-UP

A. Off-Season Start-up:
   1. If Substantial Completion inspection occurs during heating season, schedule spring start-up of cooling systems. If inspection occurs during cooling season, schedule autumn start-up for heating systems.
   2. Notify Owner seven days minimum before scheduled start-up.
   3. Time will be allowed to completely service, test, check, and off-season start systems. During allowed time, train Owner's representatives in operation and maintenance of system.
   4. At end of off-season start-up, furnish Owner with letter confirming that above work has been satisfactorily completed.

B. Preparations that are to be completed before start up and operation include, but are not limited to, following:
   1. Dry out electric motors and other equipment to develop and properly maintain constant insulation resistance.
   2. Make adjustments to insure that:
      a. Equipment alignments and clearances are adjusted to allowable tolerances.
      b. Nuts and bolts and other types of anchors and fasteners are properly and securely fastened.
      c. Packed, gasketed, and other types of joints are properly made up and are tight and free from leakage.
      d. Miscellaneous alignings, tightenings, and adjustings are completed so systems are tight and free from leakage and equipment performs as intended.
   3. Motors and accessories are completely operable.
   4. Inspect and test electrical circuitry, connections, and voltages to be properly connected and free from shorts.
   5. Adjust drives for proper alignment and tension.
   6. Make certain filters in equipment for moving air are new and of specified type.
   7. Properly lubricate and run-in bearings in accordance with Manufacturer's directions and recommendations.

3.8 CLEANING

A. Clean exposed piping, ductwork, and equipment.

B. No more than one week before Final Inspection, flush out bearings and clean other lubricated surfaces with flushing oil. Provide best quality and grade of lubricant specified by Equipment Manufacturer.

C. Replace filters in equipment for moving air with new filters of specified type no more than one week before Final Inspection.

3.9 PROTECTION

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.

B. Do not operate pieces of equipment used for moving supply air without proper air filters installed properly in system.

C. After start-up, continue necessary lubrication and be responsible for damage to bearings while equipment is being operated up to Substantial Completion.

END OF SECTION
SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common hanger and support requirements and procedures for HVAC systems.

B. Related Requirements:
   1. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   2. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.
   3. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Class Two Quality Standard Approved Manufacturers. See Section 01 6200:

B. Performance:
   1. Design Criteria:
      a. Support rods for single pipe shall be in accordance with following table:

<table>
<thead>
<tr>
<th>Rod Diameter</th>
<th>Pipe Size</th>
<th>Rod Diameter</th>
<th>Pipe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 inch</td>
<td>2 inches and smaller</td>
<td>10 mm</td>
<td>50 mm and smaller</td>
</tr>
<tr>
<td>1/2 inch</td>
<td>2-1/2 to 3-1/2 inches</td>
<td>13 mm</td>
<td>63 mm to 88 mm</td>
</tr>
<tr>
<td>5/8 inch</td>
<td>4 to 5 inches</td>
<td>16 mm</td>
<td>100 mm to 125 mm</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>6 inches</td>
<td>19 mm</td>
<td>150 mm</td>
</tr>
<tr>
<td>7/8 inch</td>
<td>8 to 12 inches</td>
<td>22 mm</td>
<td>200 mm to 300 mm</td>
</tr>
</tbody>
</table>

b. Support rods for multiple pipes supported on steel angle trapeze hangers shall be in accordance with following table:

<table>
<thead>
<tr>
<th>Rods</th>
<th>Number of Pipes per Hanger for Each Pipe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Diameter</td>
</tr>
<tr>
<td>2</td>
<td>3/8 Inch</td>
</tr>
</tbody>
</table>
## C. Materials:

1. **Hangers, Rods, Channels, Attachments, And Inserts:**
   a. Galvanized and UL approved for service intended.
   b. Support horizontal piping from clevis hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
   c. **Class Two Quality Standards:**
      1) Support insulated pipes with clevis hanger equal to Anvil Fig 260 or roller assembly equal to Anvil Fig 171 with an insulation protection shield equal to Anvil Fig 167. Gauge and length of shield shall be in accordance with Anvil design data.
      2) Except uninsulated copper pipes, support uninsulated pipes from clevis hanger equal to Anvil Fig CT-65 copper plated hangers and otherwise fully suitable for use with copper tubing.

d. **Riser Clamps For Vertical Piping:**
   1) **Class Two Quality Standard:** Anvil Figure 261.

e. **Furnace / Fan Coil Support Channel:**
   1) **Class One Quality Standard:** Unistrut P1000.
   2) Acceptable Manufacturers: Hilti, Thomas & Betts.
   3) Equal as approved by Architect before installation. See Section 01 6200.

f. **Swivel Attachment:**
   1) **Class One Quality Standard:** Unistrut EM3127.
   2) Acceptable Manufacturers: Hilti, Thomas & Betts.
   3) Equal as approved by Architect before installation. See Section 01 6200.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

A. **Piping:**

1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
   a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using support channels and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
   b. **Supports For Horizontal Piping:**
      1) Support metal piping at 96 inches (2400 mm) on center maximum for pipe 1-1/4 inches (32 mm) or larger and 72 inches (1800 mm) on center maximum for pipe 1-1/8 inch (28 mm) or less.
      2) Support thermoplastic pipe at 48 inches (1200 mm) on center maximum.
      3) Provide support at each elbow. Install additional support as required.
   c. **Supports for Vertical Piping:**
      1) Place riser clamps at each floor or ceiling level.
2) Securely support clamps by structural members, which in turn are supported directly from building structure.

3) Provide clamps as necessary to brace pipe to wall.

d. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.

e. Expansion of Thermoplastic Pipe:
   1) Provide for expansion in every 30 feet (9 meters) of straight run.
   2) Provide 12 inch (300 mm) offset below roof line in each vent line penetrating roof.

END OF SECTION
SECTION 23 3001

COMMON DUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
1. General procedures and requirements for ductwork.
2. Repair leaks in ductwork, as identified by duct testing, at no additional cost to Owner.

B. Related Requirements:
2. Section 23 0501: 'Common HVAC Requirements'.

1.2 REFERENCES

A. Reference Standards:
1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
   a. ANSI/ASHRAE 62.1-2010, 'Ventilation for Acceptable Indoor Air Quality'.
3. Sheet Metal And Air Conditioning Contractors' National Association / American National Standards Institute:

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Schedule conference immediately before installation of ductwork.

1.4 SUBMITTALS

A. Action Submittals:
1. Product Data: Specification data on sealer and gauze proposed for sealing ductwork.
2. Samples: Sealer and gauze proposed for sealing ductwork.

B. Informational Submittals:
1. Manufacturer Instructions:
   a. Installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.
2. Sustainable Design Submittals:
   a. Product Data for Prerequisite EQ 1:
      1) Documentation indicating that duct systems comply with ANSI/ASHRAE 62.1, Section 5 - 'Systems and Equipment'.
   b. Product Data for Prerequisite EA 2:
      1) Documentation indicating that duct systems comply with ANSI/ASHRAE/IESNA 90.1, Section 6 - 'Heating, Ventilating, and Air-Conditioning' (Section 6.4.4 - 'HVAC System Construction and Insulation').
   c. Leakage Test Report for Prerequisite EA 2:
      1) Documentation of work performed for compliance with ANSI/ASHRAE/IESNA 90.1, Section 6 - 'Heating, Ventilating, and Air-Conditioning' (Section 6.4.4.2.2 - 'Duct Leakage Tests').
      d. Duct-Cleaning Test Report for Prerequisite EQ 1:
1) Documentation of work performed for compliance with ANSI/ASHRAE 62.1, Section 7 - 'Construction and System Start-Up'.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. ASHRAE Compliance:
      a. Applicable requirements in ANSI/ASHRAE 62.1, Section 5 - 'Systems and Equipment' and Section 7 - 'Construction and System Start-Up'.
   2. ASHRAE/IESNA Compliance:
      a. Applicable requirements in ANSI/ASHRAE/IESNA 90.1, Section 6 - 'Heating, Ventilating, and Air-Conditioning'.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Performance:
   1. Design Criteria:
      a. Standard Ducts: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA, 'HVAC Duct Construction Standards - Metal and Flexible'.

B. Materials:
   1. Duct Hangers:
      a. One inch (25 mm) by 18 ga (1.27 mm) galvanized steel straps or steel rods as shown on Drawings, and spaced not more than 96 inches (2,400 mm) apart. Do not use wire hangers.
      b. Attaching screws at trusses shall be 2 inch (50 mm) No. 10 round head wood screws. Nails not allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.

B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.

C. Hangers And Supports:
   1. Install pair of hangers as required by spacing indicated in table on Drawings.
   2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
   3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
   4. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.

3.2 CLEANING

A. Clean interior of duct systems before final completion.

END OF SECTION
SECTION 23 3114
LOW-PRESSURE METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install above-grade low-pressure steel ducts and related items as described in Contract Documents.

B. Products Installed But Not Furnished Under This Section:
   1. Duct smoke detectors.

C. Related Requirements:
   1. Section 01 4546: 'Duct Testing, Adjusting, And Balancing' for ductwork.
   2. Section 23 0713: 'Duct Insulation' for thermal Insulation for ducts, plenum chambers, and casings.
   3. Section 23 3001: 'Common Duct Requirements'.
   4. Section 23 0933: 'Electric And Electronic Control System For HVAC':
      a. Temperature control damper actuators and actuator linkages.
      b. Furnishing of duct smoke detectors.
   5. Section 23 8216.02: 'Air Coils: Water'.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A653/A653M-11, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'.
   2. Sheet Metal And Air Conditioning Contractors' National Association / American National Standards Institute:

1.3 SUBMITTALS

A. Informational Submittals:
   1. Sustainable Design Submittals:
      a. Product Data for Credit EQ 4.1:
         1) For adhesives, including printed statement of VOC content.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:
   1. Sheet Metal:
      a. Fabricate ducts, plenum chambers and casings of zinc-coated, lock-forming quality steel sheets meeting requirements A653/A653M, with G 60 coating.
   2. Duct Sealer For Interior Ducts:
a.  For indoor applications:
   1)  Provide 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.  Category Four Approved Products.  See Section 01 6200 for definitions of Categories:
   5)  MTS100 or MTS 200 by Hercules Mighty Tough, Denver CO, www.herculesindustries.com.

3.  Duct Sealer For Exterior Ducts:
   a.  Category Four Approved Products.  See Section 01 6200 for definitions of Categories:

B.  Fabrication:
   1.  General:
      a.  Straight and smooth on inside with joints neatly finished.
      b.  Duct drops to diffusers shall be round, square, or rectangular to accommodate diffuser neck.  Drops shall be same gauge as branch duct.  Seal joints air tight.

2.  Standard Ducts:
   a.  General:
      1)  Ducts shall be large enough to accommodate inside acoustic duct liner.  Dimensions shown on Drawings are net clear inside dimensions after duct liner has been installed.
   b.  Rectangular Duct:
      1)  Duct panels through 48 inch (1 200 mm) dimension having acoustic duct liner need not be cross-broken or beaded.  Cross-break unlined ducts, duct panels larger than 48 inch (1 200 mm) vertical and horizontal sheet metal barriers, duct offsets, and elbows, or bead 12 inches (300 mm) on center.
         a)  Apply cross-breaking to sheet metal between standing seams or reinforcing angles.
         b)  Center of cross-break shall be of required height to assure surfaces being rigid.
         c)  Internally line square and rectangular drops.  Externally insulate round drops.
      2)  Duct with height or width over 36 inches (900 mm) shall be fabricated using SMACNA T-24 flange joints or of pre-fabricated systems as follows:
         a)  Ducts with sides over 36 inches (900 mm) up to 48 inches (1 200 mm):  Transverse duct joint system by Ductmate / 25, Elgen, Ward, or WDCI (SMACNA Class ‘F’ joint).
         b)  Ducts 48 inch (1 200 mm) And Larger:  Ductmate / 35, Elgen, or WDCI (SMACNA Class ‘J’ transverse joint).
         c)  Category Four Approved Products.  See Section 01 6200 for definitions of Categories:
            (1)  Ductmate Industries Inc, Charleroi, PA  www.ductmate.com or Ductmate Canada Ltd, Burlington, ON (905) 332-7678.
   c.  Round Duct:
      1)  Spiral Seam:  28 ga (0.4 mm) minimum for ducts up to and including 14 inches (355 mm) in diameter.
      2)  Longitudinal Seam:
a) 28 ga (0.4 mm) minimum for ducts up to and including 8 inches (200 mm) in diameter.
b) 26 ga 0.48 mm minimum for ducts over 8 inches (200 mm) and up to 14 inches (355 mm) in diameter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work: Reseal transverse joint duct leaks and seal longitudinal duct joint leaks discovered during air test and balance procedures specified in Section 01 4546, at no additional cost to Owner.

B. Install internal ends of slip joints in direction of flow. Seal transverse and longitudinal joints air tight using specified duct sealer. Cover horizontal and longitudinal joints on exterior ducts with two layers of specified tape installed with specified adhesive.

C. Securely anchor ducts and plenums to building structure with specified duct hangers attached with screws. Do not hang more than one duct from a duct hanger. Brace and install ducts so they shall be free of vibration under all conditions of operation.

D. Ducts shall not bear on top of structural members.

E. Paint ductwork visible through registers, grilles, and diffusers flat black.

F. Properly flash where ducts protrude above roof.

G. Under no conditions will pipes, rods, or wires be allowed to penetrate ducts.

END OF SECTION
SECTION 23 3400

HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install exhaust fans as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: ‘Common Duct Requirements’.
   2. Division 26: Control device and electrical connection.

1.2 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Bear AMCA seal and UL label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Contact List:

2.2 MANUFACTURED UNITS

A. Ceiling and Wall Mounted Exhaust Fans:
   1. Acoustically insulated housings. Sound level rating of 5.0 sones maximum for CFM and static pressure listed on Contract Drawings.
   2. Include chatterproof integral back-draft damper with no metal-to-metal contact.
   3. True centrifugal wheels.
   4. Entire fan, motor, and wheel assembly shall be easily removable without disturbing housing.
   5. Suitably ground motors and mount on rubber-in shear vibration isolators.
   6. Provide wall or roof cap, as required.
   7. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a. Acme: VQ.
      b. Broan: LoSone.
      c. Carnes: VCD.
      d. Cook: Gemini.
      e. Soler & Palau: FF.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor fan units securely to structure or to curb.

END OF SECTION
END OF DIVISION 23