

## SECTION 15891 DUCTWORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This section includes: general requirements for fabrication and installation of rectangular, round, flat-oval metal ducts and plenums for general Heating, Ventilating and Air Conditioning systems operating in pressure classes from minus 2" to plus 10 inches WG (minus 500 Pa to plus 2,490 Pa) and velocities less than 2,500 fpm. Ductwork described within are as follows:
  - 1. Low pressure Galvanized-Steel ducts.
  - 2. Medium pressure Galvanized-Steel ducts.
  - 3. Stainless-Steel Kitchen Exhaust ducts.
  - 4. Exhaust ducts concealed in ductshaft.
- B. Related Sections include the following:
  - 1. Division 15, Section 15250, "Mechanical Insulation".
  - 2. Division 15, Section 15820, "Duct Accessories".
  - 3. Division 15, Section 15845, "Air Terminals".
  - 4. Division 15, Section 15855, "Diffusers, Registers and Grilles".
  - 5. Division 15, Section 15990, "Testing, Adjusting and Balancing".
  - 6. Division 1, Section 1110, "Clean Room Construction Protocol".
  - 7. Division 1, Section 1111, "Clean Room Special Construction and Cleaning Procedure".

#### 1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM).
  - 1. ASTM A36-94, Standard Specification for Structural Steel.
  - 2. ASTM A123-89, E1, Rev. A, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 3. ASTM A527-90, Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
  - 4. ASTM D1056-91, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- B. National Fire Protection Association (NFPA).
  - 1. NFPA 90A-93, Standard for the Installation of Air Conditioning and Ventilating Systems.
  - 2. NFPA 90b, Standard for Installation of Warm Air Heating and Air Conditioning Systems.
- C. Sheet Metal and Air Conditioning Contractors National Association (SMANCA).
  - 1. SMACNA, HVAC Duct Construction Standards - Metal and Flexible, 1985.
  - 2. SMACNA, HVAC Air Duct Leakage Test Manual, 1985.

#### 1.4 SUBMITTALS

- A. Submit the following for information:
  - 1. Leakage test procedures prior to leak testing.
- B. Product Data: For duct liner and sealing materials.

- C. Shop Drawings: Show details of the following:
  - 1. Show fabrication, assembly, and installation details, including plans, elevations, sections, components, and attachments to other work.
  - 2. Duct layout indicating pressure classifications and sizes on plans.
  - 3. Fittings.
  - 4. Reinforcement and spacing.
  - 5. Seam and joint construction.
  - 6. Penetrations through fire-rated walls and other partitions.
  - 7. Terminal unit, coil, and humidifier installations.
  - 8. Hangers and supports, including methods for building end attachment, vibration isolation, seismic restraints, and duct attachments.
- D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations with ceiling-mounted items. Show the following:
  - 1. Ceiling suspension assembly members.
  - 2. Other systems installed in same space as ducts.
  - 3. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
  - 4. Coordinate with all ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
- E. Welding Certificates: Copies of certificates indicating welding procedures and personnel that comply with requirements in "Quality Assurance" Article.
- F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- G. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

## 1.5 QUALITY ASSURANCE

- A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports; AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members; and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.
- C. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.

## 1.6 SCHEDULING

- A. Notify Construction Manager prior to the actual fabrication start date. The CM shall have the option to inspect prior to, during, and upon completion of fabrication and installation and witness tests and inspections.

## PART 2 - PRODUCTS

## 2.1 LOW PRESSURE GALVANIZED STEEL DUCTS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon steel structural shapes: In accordance with ASTM A36.
- C. Fasteners, such as bolts, nuts, sheet metal screws, etc.: Either zinc-coated or cadmium-plated steel.
- D. Galvanized steel structural shapes: In accordance with ASTM A36 and ASTM A123.
- E. Gaskets for flanged duct joints: 1/4-in.-thick, full face, closed cell, expanded Neoprene sponge in accordance with ASTM D1056, Grade SCE-43.
- F. Sealant: Duct Sealer by United Sheet Metal; Duct Sealant 601 by Hardcast, Inc.; PA-2084 Duct Sealant by Precision Adhesives.
- G. Access doors: Insulated double-wall galvanized steel construction. Door to have mounting knock-over edges, gasket, 1/2-in. thick minimum 1-lb/ft<sup>3</sup> density insulation, hinges, and latches, in accordance with SMACNA, HVAC Duct Construction Standards - Metal and Flexible, Fig. 2-12.
- H. Flexible connection material: Hypalon-coated glass fabric weighing no less than 24 oz./yd<sup>2</sup>; UL listed and NFPA 90A approved as noncombustible fabric and fire-retardant coating; and resistant to air and water penetration, ozone, alkalis, acids, gasoline, grease, and abrasion. For noncorrosive environments, material to weigh no less than 24 oz./yd<sup>2</sup> and be Ventlon (chlorosulfurated polyethylene) by Ventfabrics, Inc., or Durolon by Duro Dyne Corp. For corrosive environments, material to weigh no less than 14 oz./yd<sup>2</sup> and be Ventel (fluorocarbon) by Ventfabrics or Durolon by Duro Dyne Corp.

## 2.2 MEDIUM PRESSURE GALVANIZED STEEL DUCTS

- A. Carbon Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.
- B. Carbon steel structural shapes: In accordance with ASTM A36.
- C. Fasteners, such as bolts, nuts, sheet metal screws, etc.: Either zinc-coated or cadmium-plated steel.
- D. Galvanized steel sheet: In accordance with ASTM A527.
- E. Galvanized steel structural shapes: In accordance with ASTM A36 and ASTM A123.
- F. Gaskets for flanged duct joints: 1/4-in.-thick, full face, closed cell, expanded Neoprene sponge in accordance with ASTM D1056, Grade SCE-43.
- G. Sealant: Duct Sealer by United Sheet Metal; Duct Sealant 601 by Hardcast, Inc.; PA-2084 Duct Sealant by Precision Adhesives.
- H. Access doors: Insulated double-wall galvanized steel construction. Door to have mounting knock-over edges, gasket, 1/2-in. thick minimum 1-lb/ft<sup>3</sup> density insulation, hinges, and latches, in accordance with SMACNA, HVAC Duct Construction Standards - Metal and Flexible, Fig. 2-12.
- I. Flexible connection material: Same as paragraph 2.1.H above.

## 2.3 STAINLESS STEEL KITCHEN EXHAUST DUCTS (GREASE LADDEN AIR FLOW)

- A. Stainless Steel: ASTM A 480/A 480M, Type 316, sheet form with No.4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No.1 finish for concealed ducts.
- B. All welded construction.
- C. Horizontal runs shall be sloped down 1/8" per foot toward kitchen hood.
- D. Provide 24" x 24" fire rated door at all turns and vertical risers.
- E. Enclose in 2-hour rated shaft.

## 2.4 EXHAUST DUCTS CONCEALED IN DUCTSHAFT

- A. Industrial grade standardized factory machine formed duct (with longitudinal seams) and fittings, 16, 18, or 20 gauge as recommended by manufacturer for duct size involved, galvanized steel, United Sheet Metal, Metco, Semco, or equal.
  - 1. Use flanged joints with angle rings fastened with Type 316 SS screws.
  - 2. Seal joints with Gibson-Homans Co. #1120 Hypalon Sealant, Scotch-Seal Metal Sealer #2084 or equal. Joints shall be completely air and watertight.

## 2.5 FABRICATION

- A. Fabricate rectangular ductwork and accessories in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and the SMACNA Air Duct Leakage Test Manual, Seal Class B, Leakage Class 12, and as follows:
  - 1. Straight Ductwork: Use the appropriate tables of SMACNA Section I for the pressure classes shown on the drawings.
  - 2. Standard radius elbows to be in accordance with Figs. 2-2, 2-5, and 2-6 with a minimum inside turning radius equal to the duct dimension in the direction of turn unless otherwise noted. Use galvanized steel splitters, where required, firmly secured to the duct via pop rivets or sheet metal screws.
  - 3. Unequal, square elbows shall not be used, unless otherwise detailed on the drawings. Where indicated on the drawings, fabricate 90 degrees equal square elbows with turning vanes. Provide single thickness turning vanes without trailing edges in accordance with Type 2, Fig. 2-3. Fabricate vanes and runners of the same material and gage as the ductwork. Securely fasten vanes to runners and runners to duct to prevent vibration or fluttering. Install vanes within the elbow to project tangents to the airflow.
  - 4. Install transitions and streamliner sections in accordance with Figs. 2-9 and 2-10, respectively.
  - 5. Install branch-from-main connections in accordance with Figs. 2-7 and 2-8.
  - 6. Install intake/exhaust storm covers in accordance with Figs. 5-6 and 5-7.
  - 7. Install manual volume dampers in accordance with Fig. 2-14.
  - 8. Install weather caps in accordance with ES-5.1-15.
- B. Fabricate round ductwork and accessories in accordance with design drawing details, Engineering Standards and the SMACNA HVAC Duct Construction Standards - Metal and Flexible, Seal Class B, Leakage Class 12, and as follows:
  - 1. Install straight ductwork in accordance with Section III, Table 3-2, and Figs. 3-1 and 3-2.
  - 2. Install radius elbows to be standard radius type fabricated in accordance with Fig. 3-3.
  - 3. Install volume dampers in accordance with Fig. 2-14.

4. Install weather caps in accordance with ES-5.1-14.
5. Install branch-from-main connections in accordance with Figs. 3-4 and 3-5.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that openings for the installation of the duct system are of the size and in the location shown on the drawings, that openings are clear of obstructions which might interfere with the installation of the ductwork or accessories, and no other interferences exist in the routing of ductwork. Notify the CM of conflicts. The CM will review to determine a resolution.

#### 3.2 INSTALLATION/APPLICATION/ERECTION

- A. Install and support ductwork in accordance with the SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Install access doors at fire dampers (for servicing spring latches and fusible links), at both the air-entering and the air-leaving sides of cooling and heating coils, at air-entering side of multi-blade balancing dampers, and at locations indicated on the drawings. Install and seal access doors to the ductwork in accordance with the manufacturer's instructions. Brace the door openings to prevent vibration and distortion during system operation.
- C. Cut and assemble field joints in accordance with the SMACNA HVAC Duct Construction Standards details.
- D. Install flexible connections as close as possible to the equipment being isolated in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, Fig. 2-19
- E. Install rectangular and/or round ductwork instrument test ports in the general locations shown on the drawings either on the top, bottom, or sides of the duct to permit insertion of a Pitot tube across the entire duct section without interference. Install ports in accordance with ES-5.11-1 for rectangular ductwork and ES-5.11-5 for round ductwork. Clear opening through the duct wall to be equal to the port inside dimension.
- F. Apply sealant to joints and seams in accordance with manufacturer's recommendations. Clean and dry joints, seams, and openings of oil, grease, and dirt before application of sealant.

#### 3.3 FIELD QUALITY CONTROL

- A. Duct Leakage Tests:
  1. Prepare leakage test procedures following the outlines and classifications in the SMACNA HVAC Air Duct Leakage Test Manual.
  2. Leak test ductwork at the 2-in. w. g. pressure class or at design pressure, if less than 2 in. w. g. Duct system to be SMACNA Seal Class B and Leakage Class 12.
  3. The leakage amount is not to be exceeded by the calculated amount for the pressure class or the allocated amount for that portion of the system, whichever is applicable.
  4. If a portion of the system fails to pass the leakage test, modify to bring it into compliance and retest it until acceptable leakage is demonstrated.
  5. Complete tests and necessary repairs. Verify in writing when completed. Notify CM for his inspection prior to concealment of ductwork.
- B. After the ductwork is installed, verify by inspection, and document that:
  1. Dampers are installed in the proper configuration and location shown on drawings.

2. Instrument test ports are installed, in the correct positions, and the opening through duct wall is full inside port dimension that is required by the instrument.
3. Duct interiors are free of debris.
4. Ductwork joints and seams are sealed.

### 3.4 CLEANING AND PROTECTION

- A. Ductwork for critical installations, such as, "Cleanrooms", shall be cleaned with end of segments sealed following fabrication and during installation.
- B. Clean ductwork internally and externally of duct and debris, section by section as it is installed by wiping down using a solution of IPA and DI water.

**END OF SECTION 15891**