SECTION 23 3114 - DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round and flat-oval ducts and fittings.
4. Double-wall round and flat-oval ducts and fittings.
5. Laboratory exhaust ductwork.
6. Sheet metal materials.
7. Duct cleaning and contamination protection.
8. Sealants and gaskets.
9. Hangers and supports.

B. Related Sections:

1. Section 23 0529 "Mechanical Supporting Devices."
2. Section 23 0550 "Vibration Isolation."
3. Section 23 0553 "Mechanical Systems Identification."
4. Section 23 0594 "Testing, Adjusting, and Balancing (TAB)."
5. Section 23 0700 "Mechanical System Insulation."
6. Section 23 3314 "Ductwork Specialties" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, flange connectors, flexible connectors, duct accessory hardware, louvers, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in the "Duct Schedule" Article and on the drawings.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.7 SPECIAL WARRANTIES

A. Five (5) years, see Division 01.

PART 2 - PRODUCTS

2.1 FIBROUS GLASS (DUCTBOARD) DUCTS

A. Not allowed.

2.2 LINED DUCTWORK

A. Not allowed.

2.3 ELBOWS, TRANSITIONS, OFFSETS, BRANCH CONNECTIONS, LATERALS, AND OTHER DUCT CONSTRUCTION REQUIREMENTS

A. Fabricate and install all duct fittings, branches, inlets, outlets, transitions, take-offs, laterals, offsets, and elbows to minimize air turbulence and resistance and to ensure proper airflows. S,t,Tw 402(c 0.0 Tc

Flexible," Chapters 3 and

1. McGill AirFlow LLC.
2. SEMCO.

B. General Fabrication Requirements: Comply with SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated. Duct wall thickness to be minimum 22 gage except where any welding other than longitudinal seams is performed, then the minimum thickness shall be 18 gage.

C. Contractor Fabricated Ductwork: Ductwork of this section (2.5) may be fabricated by the contractor if it can be demonstrated that it meets or exceeds the performance of the manufacturer's products listed directly above.

D. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct. But, duct wall thicknesses to be minimum 22 gage except where any welding other than longitudinal seams is performed, then the minimum thickness shall be 18 gage.

E. Outer Duct: Comply with SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

F. Transverse Joints: Select joint types and fabricate according to SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." But, transverse (girth) joints T-4, 9, 17 through 20, and 23 not permitted.

G. Longitudinal Seams: Select seam types and fabricate according to SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." But, button punch snaplock seams are not permitted.

H. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.
5. Insulation Thickness: See PART 3.

I. Inner Duct: Minimum 0.028-inch thick solid sheet galvanized steel.

J. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible." But, transverse (girth) joints T-4, 9, 17 through 20, and 23 not permitted.

2.6 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated but, only spiral seam or fully welded longitudinal seam duct is to be used. And, longitudinal seam ductwork not to be used if exposed.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McGill AirFlow LLC.
b. SEMCO Incorporated.
c. Spiral Manufacturing Co., Inc.

B. Contractor Fabricated Ductwork: Ductwork of this section (2.6) may be fabricated by the contractor if it can be demonstrated that it meets or exceeds the performance of the manufacturer's products listed directly above.

C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension). SMACNA Type 1 reinforcement (Figure 3-6 of SMACNA's Duct Construction Standards) is not allowed.

a. McGill AirFlow LLC.
b. SEMCO Incorporated.
c. Spiral Manufacturing Co., Inc.

B. Contractor Fabricated Ductwork: Ductwork of this section (2.7) may be fabricated by the contractor if it can be demonstrated that it meets or exceeds the performance of the manufacturer's products listed directly above.

C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct. SMACNA Type 1 reinforcement (Figure 3-6 of SMACNA's Duct Construction Standards) is not allowed.

D. Outer Duct: Comply with SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

E. Transverse Joints: Select joint types and ateupesC03(d 2T-24.4(40.6(a)-12.2(na.9(i)-8.m2Tj 0 T3(9)-13.2(i)3

2.9 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Duct wall thickness to be minimum 22 gage except where any welding other than longitudinal seams is performed, then the minimum thickness shall be 18 gage.

B. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316 (Type 316 only for Lab exhaust), as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E.

C. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint (SMACNA Joints T-24, T-25, and proprietary slip-on flanges) Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Pressure Sensitive Tapes for Primary Sealing of Ducts: Not allowed.

G. Duct Sealer

C. Seal all ducts to Seal Class A according to SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible."

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's 2005 "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and SupportsH17

B. Leakage Tests:

1. Leakage tests shall be conducted in accordance with 1985, 1st Edition, of SMACNA's "HVAC Air Duct Leakage Test Manual," Sections 3 and 5. Positive pressure ductwork to be tested under positive pressure. Negative pressure ductwork to be tested under positive and negative pressure. Submit a test report for each test.
2. Test the following systems:

    a. Supply Ducts with a Pressure Class of 3-Inch wg (750 Pa) or Higher: Test representative duct sections, selected by Engineer from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    b. All Lab exhaust ductwork.

3. Leakage tests to be witnessed by the University.
4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
5. Test for leaks before applying external insulation and before ducts are concealed.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give seven days' advance notice for testing.
8. Leakage shall not exceed the values in the following Table 23-3114-3:

Table 23-3114Tw 2.06 0 Td [(C)-2.9(ond)-12.3(uc)-8(t)-1.1(t)-1.1(es)-8(t)-1.1(5e36.4(n)-12

E. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Clean existing ducts 10' each direction which become open due to equipment or duct removal, and clean before testing, adjusting, and balancing.

C. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 3314 "Duct Specialties" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

D. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent (e)-E1nEco2.1(O)-7.1(dor)-6.3(C)-0.1(J 1(o)-12.2(Meuf)-13.2 f)-13.1(i)3.1csiy46(f)-13.1(or)-646(09.)-1.13n-

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with project TAB requirements.

3.11 DUCT SCHEDULE AND OTHER REQUIREMENTS

A. Fabricate ducts with galvanized sheet steel unless called for as another material on drawings, or if Lab exhaust, dishwasher exhaust, and any other high humidity applications or areas, ducting to be stainless s.1( )]TJ 0.002[(l2.1(t)J 0.ed [18 0 Td [6x(F)-5.5(abrA-0.002 T1( )-12.1(di)3.1(i)]TJTJ

a. Pressure Class: Positive ***2-inch wg (500 Pa)*** <Insert value>.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

F. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units <Insert equipment>:

a. Pressure Class: Positive or negative ***2-inch wg (500 Pa).***
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units <Insert equipment>:

a. Pressure Class: Positive or negative ***3-inch wg (750 Pa)***.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative ***3-inch wg (750 Pa)***.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

G. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative ***3-inch wg (750 Pa)***.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Air-Handling Units <Insert equipment>:

a. Pressure Class: Positive or negative ***3-inch wg (750 Pa)***.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts .00M5ane-6.3(:)-(e C)-2.5.325 -2.349 Td (3.)Tj 0 Tc 0 Tw 0.831 0 Td ( )Tj -0.002 Tc 0.001 Tw 2.

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