

**SECTION 23 30 00**  
**AIR DISTRIBUTION**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. Provide Air Distribution Materials as specified herein and as shown on the Drawings.
- B. Material characteristics and size shall be as indicated on the Drawings.
- C. Related Work: The requirements of Section 23 05 00, Common HVAC Materials and Methods, also apply to this section.

**1.02 QUALITY ASSURANCE**

- A. Air Distribution Equipment Rating: In accordance with AMCA certified rating procedures and bearing the AMCA label.
- B. See Commissioning specification for additional requirements.

**1.03 SUBMITTALS**

- A. Submit catalog data, construction details and performance characteristics for all manufactured materials.
- B. Submit operating and maintenance data.
- C. For adhesives and sealants used on the interior of the building (inside the waterproofing system), include printed statement of volatile organic compound (VOC) content. Use LEED Low-Emitting Materials form.

**PART 2 - PRODUCTS**

**2.01 SHEET METAL**

- A. Quality Assurance: Galvanized steel sheet metal except where otherwise indicated. Metal gauges, joints and reinforcement in accordance with Mechanical Code, ASHRAE and SMACNA standards. Ductwork shall be fabricated to the following pressure classifications:
  - 1. Return and exhaust ducts: 2" negative.
  - 2. Supply ducts from fan discharge to VAV box inlet: 4" positive. VAV box discharge to diffuser: 1" positive.
- B. ~~Acoustical Duct Lining: Line ducts with 1" thick lining (unless noted otherwise) for installation inside the building insulation envelope, and 1-1/2" for installation outside the building insulation envelope. Schuller "Linacoustic," Owens Corning "Aeroflex" Type 150, and Certainteed "ToughGard" Type 150 approved, meeting NFPA 90A and B requirements for maximum flame spread and smoke developed. Duct liner adhesive shall conform to ASTM C916. Mechanically attach lining to sheet metal duct with fasteners conforming to SMACNA Standard MF-1-1971, Schuller Grip Nails or Gramweld welding pins. Apply fire retardant type adhesive similar to Schuller No. 44 adhesive, Benjamin Foster 81-99, Insul-Cooustic 22 or 3M equivalent on all leading edges, joints and seams.~~

**Acoustical Duct Lining:**

- 1. For applications with duct velocity 1000 FPM or below:**

- a. **Line ducts with 1" thick lining for installation inside the building insulation envelope, and 1-1/2" for installation outside the building insulation envelope. Schuller "Linacoustic," Gustin Bacon "Ultra-Liner," or Owens Corning "Aeroflex" approved, meeting NFPA 90A requirements for maximum flame spread and smoke developed. Mechanically attach lining to sheet metal duct with Schuller Grip Nails or Gramweld welding pins. Apply fire-retardant type adhesive similar to Schuller No. 44 adhesive, Benjamin Foster 81-99, Insul-Coustic 22 or 3M equivalent on all leading edges, joints and seams.**
  - 2. **For applications with duct velocities of over 1000 FPM:**
    - a. **Close cell foam insulation compliant with ASTM D1056,2B1. ASTM E84 25/50 compliant. ASTM C534, Type II compliant to Grade 1. Compliant with ASTM G21/C1338 for mold resistance and ASTM G22 for resistance to bacteria. Armaflex F.S. or equal.**
- C. **Duct Sound Control Wrap:**
  - 1. **Mass- loaded Vinyl Sheet: Each loaded vinyl sheet shall weigh 0.4 – 0.5 lb/square foot, be 0.025 – 0.040 inches thick, and have smooth finish surface.**
  - 2. **Manufacturers: Kinetics Noise Control model KNM-50B, Soundcoat Sound fab, EAR Composite Specialties model EAR WB-5, Claremont Sales Coustifab.**
- D. **Duct Sealing Tapes: Provide one of the following UL listed ductwork sealing tape systems.**
  - 1. **Two-part sealing system with woven fiber, mineral gypsum impregnated tape and non-flammable adhesive. Hardcast "DT" tape and "FTA-20" adhesive, United "Uni-Cast" system, or accepted substitute.**
  - 2. **For joints and seams exposed to the weather in lieu of soldering, United "Uni-Cast" system or approved.**
  - 3. **Sealing systems with VOC content are not allowed.**
  - 4. **Sealants and Primers – General: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No. 1168.**
- E. **Optional Duct Joints for Sheet Metal Ducts: "Ductmate System" by Ductmate Industries, Inc., Ward Duct Connectors, Inc., Mez Industries, or acceptable substitute. Spiramir self-sealing round duct connector system meeting Class 3 leakage standards with EPDM o-ring seal.**
- F. **Exposed to View Spiral Seam Duct and Fittings: Round and flat oval spiral seam duct shall be manufactured of galvanized steel sheet metal with spiral lock seam. Matching fittings shall be manufactured of galvanized steel with continuous welded seams. Gauge shall be per SMACNA Duct Construction Standard third addition table for appropriate pressure, and reinforcement or at least 26 gauge.**
- G. **Concealed Round Duct: Round and flat oval spiral seam duct shall be manufactured of galvanized sheet metal with spiral lock seam. Construction, gauges, and reinforcement in accordance with SMACNA standards. Fittings shall be manufactured of galvanized steel with spot welded or riveted and sealed seams or continuously welded seams. Snap lock longitudinal seam duct shall fully comply with SMACNA standards for duct gauge and seam type for appropriate pressure class. Adjustable elbows are prohibited.**

- H. Flexible Ductwork-Low Pressure: Insulated low pressure flexible duct, factory fabricated assembly consisting of a zinc-coated spring steel helix seamless inner liner, wrapped with a nominal 1" thick insulation for installation inside the building insulation envelope, and 1-1/2" for installation outside the building insulation envelope, 1 pound/cubic foot density fiberglass insulation. The assembly shall be sheathed in a vapor barrier jacket, factory vapor resistance sealed at both ends of each section. The composite assembly, including insulation and vapor barrier, shall meet the Class 1 requirements of NFPA Bulletin No. 90-A and be labeled by Underwriters Laboratories, Inc., with a flame spread rating of 25 or less and a smoke developed rating of 50 or under. The duct shall have factory sealed double air seal (interior and exterior) to assure an airtight installation. Genflex, ATCO, Wiremold, Thermaflex, Glassflex, Clevepak, Schuller, or accepted substitute.

## **2.02 ACCESSORIES**

- A. Manual Volume Dampers: Construct of material two gauges heavier than duct in which installed; single plate up to 12" wide; multiple over 12" wide. Hem both edges 1/2" and flange sides 1/2". Use Young, Duro-Dyne, MAT, or accepted substitute damper accessories. Young numbers are shown.
1. No. 605 bearing set with No. 403 regulator for dampers up to 24" long.
  2. For dampers over 24" long use No. 660 3/8" rod, No. 656 end bearing and No. 403 regulator.
  3. Where damper regulators are not readily accessible, use No. 660 or No. 661 rod extensions and No. 301 and No. 315 concealed damper regulators or MAT cable operated dampers as required.

Location of all volume dampers is not necessarily shown on Drawings; minimum required is one in each supply, return or exhaust main, and one in each branch.

- B. Exterior Wall Louvers: Prefabricated extruded aluminum stormproof blades with frame to suit building construction. 1/2", 16 gauge aluminum wire mesh on back side of all intake louvers and insect screen on exhaust/relief louvers. 4" deep, 37½ degree fixed drainable type blade, AMCA 500 tested for 800 fpm without water penetration, and maximum of 0.07" wg intake pressure loss and 0.09" wg exhaust pressure loss. Louver color selected by Architect, color is custom color. Ruskin ELF375D as basic pattern on blade and frame, Greenheck, Cesco, Pottorff, or approved.
- C. Gravity Exhaust Head:
1. Aluminum cap with backdraft dampers on relief only, curb connection, flashing, 1/2" mesh galvanized bird screen and hinged access. Greenheck, Carnes, Cook or accepted substitute.
  2. Install with automatic relief / outside air intake damper in curb as indicated on the Drawings.
- D. Locking Connection Straps: 1/2" wide positive locking steel straps or nylon self-locking straps. Panduit or accepted substitute.
- E. Connection Fittings: Connections to non-metallic ducts manufactured sheet metal "spin-in" fittings. Genflex, Wiremold, Thermaflex, Glassflex, Clevepak, Schuller, or accepted substitute.
- F. Access Doors In Sheet Metal Work:
1. Hollow core double construction of same or heavier gauge material as duct in which installed. Use no door smaller than 12" by 12" for simple manual access or smaller than 18" by 24" where personnel must pass through infrequently. Use 24" by 60" minimum for filters and more frequent maintenance. Use Ventlok or accepted substitute hinges and latches on all doors.

- a. 100 series hinges and latches on low pressure system doors up to 18" maximum dimension.
  - b. 200 series on larger low pressure system doors and 333 series on high pressure systems.
2. Construct doors up to 18" maximum dimension with 1" overlap, furr and gasket with 3/4" by 1/8" sponge rubber. Fit larger doors against 1-1/2" by 1/8" or angle frame and gasket with 3/4" by 1/8" sponge rubber or felt.
- G. Anti-Backdraft Dampers: Connected, gasket-edged aluminum blades set in 14 gauge or heavier steel frame; brass, nylon or Teflon bearings; equip with spring helper with tension adjustment feature or with adjustable counterweight and adjust to open when not more than 0.10" wg pressure is applied. Ruskin CBS-4, Greenheck, Pacific Air Products, Air Balance, Controlair or accepted substitute.
- H. Opposed Blade Volume Damper: Install opposed blade volume damper in each zone supply duct on discharge of multi-zone units and where indicated on Drawings. Young No. 817 or accepted substitute.
- I. Flexible Connections: Neoprene impregnated fiberglass connection. Ventglass, Duro-Dyne, or accepted substitute.
- J. Control Dampers: Construct of aluminum frame and blades with continuous full length axle shafts and/or operating "jackshafts" as required to provide coordinate tracking of all blades. Interlocking multi-blade type, except where either dimension is less than 10", a single blade may be used. Opposed blade type on all modulating dampers and parallel blades on all two position dampers. Provide with metal jamb seal and neoprene blade seals. Damper assembly rated for maximum air leakage of 4 CFM per square foot at 1" WG pressure or less and with interconnecting blade linkages in the side channels of the frame.

### **2.03 GRILLES, REGISTERS AND DIFFUSERS**

- A. Description: Provide grilles, registers and diffusers as shown on the Drawings.
- B. Finishes:
- 1. Steel: Flat white enamel prime coat, factory applied on ceiling diffusers. Others are to have a baked enamel finish, color as selected by Architect.
  - 2. Aluminum: Anodized clear finish unless indicated otherwise.
- C. Manufacturers: Carnes, Krueger, Titus, Price, **Nailor, Metalaire**, and Tuttle & Bailey are accepted substitutes where only Titus model numbers are listed. Where other manufacturer's products are listed and/or "accepted substitute" is indicated, only the products or an accepted substitute for that item shall be provided.
- D. Ceiling Return and/or Exhaust Register: Perforated snap-in or concealed hinged face plate. Use in spaces containing ceiling diffusers and/or T-bar ceilings. Provide with damper except where dampered plenums are indicated. Match manufacturer of supply.
- E. Sidewall Supply Grille or Register: Double deflection grille with face bars parallel to long dimension on ceiling type and horizontal on wall type; bars to be individually adjustable, spaced on 0.66" to 0.75" centers; key operated opposed blade volume damper. Titus 300RL.
- F. Sidewall or Ceiling Return or Exhaust Register: Face bars parallel to long dimension on ceiling type and horizontal on wall type; bars set at 35 degrees to 45 degrees, spaced on 0.66" to 0.75" centers; key operated opposed blade volume damper. Titus 350RL series. At wood ceiling installation finish shall be matte black with boarder/frame for T-Bar installation.

- G. Modular Core Ceiling Diffusers: 1 to 4-way pattern control. Pattern of distribution as indicated. Provide with opposed blade volume dampers and frame for unit as required. Price SMCD series or equal Titus.
- H. Heavy Duty, Adjustable Bars Low Return Grille: All welded construction with heavy 14 gauge, adjustable round edge steel horizontal face bars at 1/2" on centers and reinforced every 6" to 8". Titus 33 series.
- I. Steel Door Transfer Grilles and Sidewall Transfer grilles: All welded construction with 20 gauge, fixed inverted V-blades with a deflection angle of 77 so as to provide a sight proof design.
- J. Gymnasium-Heavy Duty Return or Exhaust Register: All welded construction with 14 gauge frame 1/8" x 1/2" steel horizontal face bars set at 15 degrees. Face bars to be at 1/2" on centers and reinforced every 6" to 8". KEES GHD 40 series or equal.
- K. Plaster Frames: Provide plaster frames for all diffusers, grilles or registers installed in plaster walls or ceiling. Where register face is aluminum, the plaster frame shall be aluminum. Frame to match manufacturer of register or be of compatible size of listed manufacturer. Titus TRM/TRM-S.

#### **2.04 AIR TERMINALS**

- A. Variable Air Volume Terminal Box: Construct unit casings of 22 gauge galvanized steel fully lined with 1/2", 2 lb. density, neoprene coated fiberglass complying with the UL Standard 181 for erosion, and NFPA 90A for fire resistivity.
  - 1. Unit Inlets: Round, obround, or rectangular with double thickness gasketed damper blade mounted in self-lubricating bearings.
  - 2. Attenuation Section: Integral to the basic unit.
  - 3. ARI Certified: Test in accordance with ARI Standard 885-98 appendix E.
  - 4. Unit Sound Power Levels (second through seventh octave band): At minimum pressure drop, ratings shall not exceed 32 NC ducted or radiated.
  - 5. Pressure Independent VAV Terminals: Equip with velocity controls to control cfm independent of duct static pressure.
  - 6. Factory Furnished Accessories: All actuators, controls, and circuitry contained in a sheet metal enclosure.
  - 7. Control Sequences: Operational sequences shall be specified in Section 23 09 93.
  - 8. Reheat Coil: Provide heating water reheat coils of capacities indicated. See Section 23 57 00 for requirements.
  - 9. Manufacturers: Titus, Price, Carnes, Nailor Krueger, Envirotech, or approved substitute.

#### **2.05 BOILER VENT MATERIAL**

- A. Vent Material:
  - 1. Condensing boiler flue material shall be listed to be compatible with boilers. The vent material shall be from a single supplier.
  - 2. Stainless steel AL-29-4C positive pressure UL listed vent system. The vent material shall include a factory installed internal seal at each joint. Seal material shall be silicone or material as allowed in vent UL listing procedure. Joint connection shall be banding or multiple straps as tested for listing of materials. Field modification or 3rd party fabricated devices are not allowed.
  - 3. Provide shop drawings of new devices. Shop drawings shall show each stack component device to be used in the installation.

## **2.06 EXHAUST FANS**

- A. Roof Mounted Exhaust Fan (Direct Drive):** Curb mounted on roof; vertical shaft, direct driven, open BI wheel as shown on Drawings with EC motor; bird screen; weatherproof aluminum housing for mounting on square base; capacity as indicated on Drawings. Motor located outside the air stream. Casing to be easily removed for service. Motor and fan assembly to be mounted on rubber vibration isolators unless noted otherwise. Provide with 2-position motorized damper with the same interior frame size as the duct connection to the fan. Provide damper with actuator. Actuator shall be Belimo only. Provide single point J-Box to operate fan and damper together. Provide disconnect switch at fan with NEMA rating per code. Greenheck, Soler & Palau, Jen Fan, Carnes, Acme, PennBarry, Cook, Twin City or approved.

## **PART 3 - EXECUTION**

### **3.01 EQUIPMENT INSTALLATION**

- A. Air Handling Equipment Installation and Arrangement: Install and arrange as shown on Drawings. Comply with the manufacturer's recommendations for installation, connection, and start-up.
- B. Equipment Access Panels: Locate free of all obstructions such as ceiling bars, electrical conduit, lights, ductwork, etc.
- C. Filters: Install specified filters or accepted substitute temporary construction filters in supply units and systems prior to start-up or use for drying and/or temporary heat. Replace prior to acceptance of project.

### **3.02 INSTALLATION OF GRILLES, REGISTERS AND DIFFUSERS**

- A. Size and air handling characteristics shall be as shown on the Drawings.
- B. Locate, arrange, and install grilles, registers and diffusers as shown on the Drawings. Locate registers in tee-bar ceilings with diffusers centered on the tile unless indicated otherwise.

### **3.03 DUCTWORK INSTALLATION**

- A. Duct systems shall be assembled, transported, stored and installed in accordance with current SMACNA Duct Cleanliness for New Construction Guidelines. Duct Cleanliness Level is Intermediate.
- B. Support: Install ductwork with 1" wide strap cradle hangers not more than 8' on centers or as required by code. Support terminal units independent of adjacent ductwork. Attach to available building construction according to good practices for materials involved. Manufactured hanger system acceptable in lieu of fabricated hangers at contractors option. Ductmate "Clutcher" system or approved. Support flexduct where shown to be used for lengths beyond 4' per above requirements. Comply with SMACNA Duct Construction Standard Figure 3-9 and 3-10.
- C. Fan and Air Handling Unit Flexible Connections: Install neoprene impregnated fiberglass connections in ductwork at all rotating equipment. Ventglass, Duro-Dyne or accepted substitute.
- D. Elbows and Fittings: Construct elbows with throat radius equal to duct width in plane of turn or make them square and provide double wall, air foil turning vanes.

- E. Fittings: Make transitions and take-offs as shown on Drawings. Provide volume dampers and splitter dampers as indicated on Drawings and as specified. Saddle tees are not allowed.
- F. Acoustical Duct Lining:
1. Acoustically line all fan unit intake and discharge plenums, all ductwork indicated as lined on the Drawings, all sheet metal ductwork specified per Section 23 07 00 as insulated, where exposed to view or subject to damage in areas such as mechanical rooms, and, at the Contractor's option, all insulated ductwork specified in Section 23 07 00 except outside air intake ducts. The duct size noted on the Drawings is the clear opening of the duct with insulation. Insulation shall not reduce duct size listed.
  2. All duct designated to receive duct liner shall be completely covered with a fire-resistant, fiber-bonding coating, or covering (composite, polymer, vinyl or neoprene) that reduces airflow resistance and controls fiber release. The duct lining shall be adhered to the sheet metal with 100% coverage of a fire retardant adhesive. The coated surface of the duct liner shall face the airstream. When width of duct exceeds 12" and also when height exceeds 24", use corrosion resistant mechanical fasteners 12" on center maximum lateral spacing and 18" on center maximum longitudinal spacing. Start fastening within 3" of upstream transverse edge of the liner and within 3" of the longitudinal joint. Mechanical fasteners shall be either impact-driven or weld-secured and shall not pierce the duct walls. Fasteners and washers of the specified type and length shall be used assuring no greater than 10% compression of the liner thickness. Installation shall be made so that no fastener pins protrude into the airstream. No gaps or loose edges shall occur in the insulation. Top pieces shall be supported by the side pieces. Provide insulated build out frames for attaching dampers at running vanes where required.
  3. All transverse and longitudinal abutting edges of duct lining shall be sealed and lapped 3" with a heavy coat of approved adhesive, in accordance with the manufacturer's recommendations. All upstream transverse edges shall be installed with sheet metal nosings. All raw exposed edges of lining shall be 'battered' with approved adhesive.
  4. **Where duct velocities exceed 1000 FPM fiberglass liner is not allowed. Use double wall or neoprene liner per these specifications.**
- G. Manual Volume Dampers: Location of all volume dampers are not necessarily shown on the Drawings. Provide a minimum of one volume damper in each supply, return or exhaust branch. Install dampers in fiberglass ductwork (where fiberglass ductwork is allowed) with galvanized sheet metal sleeves of sheet metal gauges required for metal duct systems of the same dimensions.
- H. Duct Insulation: Specified in Section 23 07 00.
- I. Sleeves: Provide galvanized sheet metal plaster ring around ductwork penetrating exposed finished walls. Sleeve and flash all duct penetrations through exterior walls in an air tight and weatherproof manner.
- J. Plenums: Construct sheet metal plenums and partitions of not lighter than 18 gauge galvanized steel and reinforce with 1-1/2" by 1/2" by 1/8" angles as required to prevent drumming or breathing.
- K. Access: Install necessary access opening and covers for cleaning, wiring or servicing motors, filters, fans, both entering and leaving air sides of coils, fire and/or smoke dampers and to other equipment located within or blocked by sheet metal work.
- L. Sealing: Caulk, seal, grout and/or tape ductwork and plenums to make airtight at seams, joints, edges, corners and at penetrations. Solder all seams, joints, etc., on all ductwork exposed to the weather. Install specified tape in accordance with manufacturer's requirements using degreaser on surfaces to be taped and wiped to eliminate moisture.

### **3.04 FIELD QUALITY CONTROL**

- A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.
- B. Conduct test, in presence of Balancer, at static pressures equal to maximum design pressure of system or section being tested. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
- C. Determine leakage from entire system or section of system by relating leakage to surface area of test section.
- D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round and flat-oval ducts, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (both positive and negative pressures). For rectangular ducts operating at pressures in excess of 2" WG (both positive and negative) test per leakage classification 6.
- E. Remake leaking joints and retest until leakage is less than maximum allowable.
- F. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual.

### **3.05 NEW DUCTWORK CLEANING**

- A. Store all ductwork materials on pallets or above grade, protected from weather, dirt/mud and other construction dust.
- B. Remove all accumulated dust, dirt, etc. from each duct section as it is being installed.
- C. Prior to installation of diffusers, grilles and registers, install temporary system filters and cover all diffuser, grille and register openings with temporary 25% efficiency filter materials and start the fan systems. Operate fans a minimum of 8 hours. Remove all temporary filters at the end of that period.
- D. Clean all diffusers, grilles and registers just prior to project final completion.
- E. Cover all ductwork terminations during construction to prevent accumulation of dust and debris.

**END OF SECTION 23 30 00**