

# COLOR ME MINE TENANT FIT-UP

## SECTION 23 30 00 - HVAC FOR DISTRIBUTION

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

- A. The drawings and the specifications including SECTION 23 05 00 "Common Work Results for HVAC" are hereby made a part of the work of this section.

#### 1.2 DESCRIPTION OF WORK

- A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to install the ductwork systems indicated.

#### 1.3 SUBMITTALS

- A. Substitutions: Your attention is directed to Section 23 05 00-"Substitutions", relative to competition and the (ONLY) notation. Familiarity with this section should be achieved before reading the PRODUCTS section of this specification.
- B. The items for which the submittals paragraph in Section 23 05 00 "Common Work Results for HVAC", apply are as follows:
  - 1. Ductwork.
  - 2. Ductwork accessories.
  - 3. Air devices.
  - 4. Acoustical duct liner.
  - 5. Firestopping materials and methods.
  - 6. Dampers.
  - 7. Ductwork sealing products.
  - 8. Fans.
  - 9. Duct insulation.

### PART 2 PRODUCTS

#### 2.1 DUCTWORK

- A. Classification of Ductwork: Low pressure ductwork: up to 2" W.G. static pressure. Medium pressure ductwork: 2" to 6" W.G. static pressure. Ductwork downstream of Energy Recovery Ventilators shall be considered medium pressure systems. All flat oval and round ductwork shall be of medium pressure construction. The duct pressure class shall be determined by multiplying the total static pressure scheduled in the fan schedules by 1.2.
- B. Materials: Unless otherwise indicated low pressure ductwork shall be galvanized steel. Galvanized sheet metal shall be new galvanized steel sheets of lock forming quality with zinc coating that will not flake or peel under forming operation.
- C. Construction for Low Pressure Round and Rectangular Ductwork:
  - 1. Material: Galvanized steel conforming to ASTM A527, weight of galvanized coating shall be not less than 1-1/4 ounces total for both sides of one sq.ft. of a sheet.

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Construction, metal gage, and reinforcements shall conform with SMACNA "Duct Construction Standards" and NFPA 90A for 2" W.G. pressure class.

2. Fittings: Shall be constructed in accordance with SMACNA Standards and shall be of the types indicated (ONLY).
3. Longitudinal seams shall be Pittsburgh lockseam (ONLY). Button punch snap locks are not acceptable.
4. Joints and seams shall be sealed to SMACNA seal class B (Leakage Class 12 for rectangular ducts and Leakage Class 6 for round and flat oval ducts).

### D. Construction for Spiral Seam Round and Flat Oval Ductwork:

1. Ductwork and fittings shall be United McGill Uni-seal or Uni-rib, Eastern Sheetmetal, Lindab, Semco or Monroe Sheetmetal, galvanized steel, factory fabricated, spiral lockseam or welded longitudinal seam, round or flat oval type, as indicated. Seams shall be solid welded or spot-welded and factory sealed airtight. Ducts and fittings shall be specifically designed for medium pressure application. Round or flat oval ductwork indicated as acoustically lined or double-wall (DW) shall be United-McGill Acousti-K27, double wall medium pressure construction with solid 26 gauge sheetmetal inner liner and 1" thick fiberglass insulation. Fittings shall be furnished with solid liners. Insulation shall be provided with thermal conductivity of 0.27 BTU/HR-°F-FT<sup>2</sup>-IN. Exposed ductwork in finished spaces specified to be painted shall be "Paint-Grip" galvanized material. Interior ductwork shall be constructed of galvanized sheetmetal. Exposed supply ductwork shall be double-wall construction with "Paint-Grip" galvanized outer shell.
  - a. Sheetmetal Gauges: Per SMACNA for listed pressure class.
  - b. Fittings: Fittings shall be machine formed type or welded multi-segment type. All seams shall be factory sealed or welded airtight. Tap offs shall be 90° conical type or 45° standard type, with smooth, machine formed entrance, designed for low pressure drop and low noise generation. 90° elbows shall be 5 piece construction (where space permits) or vaned type mitered elbow where space is restricted. Unless specifically indicated (and field-verified) as 5 piece construction, use vaned 90° elbows. Vanes shall be single thickness, solid-welded in place.
  - c. Joints on round spiral ductwork shall be slip type, coupling type, Van Stone flanges, or factory fabricated flange system type connectors, as standard with the manufacturer. Flat oval joints shall be Van Stone flanges (gasketed) or factory fabricated flange system type connectors. Joints shall be made up with joint sealer applied in strict accordance with the manufacturer's recommendations. Joint sealer shall be as recommended by the manufacturer.
  - d. Duct and fittings shall have been tested for air friction loss and leakage in an independent testing laboratory. Test results shall be submitted with the Shop Drawings for review.
  - e. External reinforcing angles shall be provided in accordance with the manufacturer's recommendations. External reinforcing angles shall be galvanized or painted with a rust inhibiting aluminum paint. Include

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- reinforcing data with Shop Drawing submittal. Duct and reinforcing shall be designed for a positive static pressure of 6 inches of water gage.
- f. No internal tie rod reinforcing will be allowed.
  - g. Hangers shall be of the clamp-on or trapeze type. Exposed ductwork shall use clamp-on hangers only. Holes shall not be drilled through the ducts.
- F. Acoustical duct liner for rectangular ductwork shall be Type AP Armaflex SA duct liner. The liner shall be elastomeric unicellular (closed cell) and have a thermal conductivity of 0.27 Btuh/<sup>0</sup>F.-sf-in. and be cleanable and suitable for duct velocities of 4000 FPM. Duct liner thickness shall be 1" unless indicated otherwise. The installation shall include 100% coverage of the manufacturer's recommended adhesive and protective Z-strips at all exposed upstream edges. Mechanical fasteners shall be used in addition to adhesive. Insulation shall comply with NFPA 90A and NFPA 90B and be approved by Factory Mutual. Duct dimension are net inside of liner.
- G. Exposed Ductwork: Interior exposed ductwork shall be "Paint-Grip" galvanized, suitable for field-painting without dents or other visible cosmetic damage. Ductwork associated with the Vehicle and Welding Exhaust systems shall be continuously welded.

## 2.2 DUCTWORK ACCESSORIES

- A. Access Doors:
- 1. Medium Pressure Duct Systems: Ruskin Model ADHP-3, 12"x12" size, 16 gauge galvanized steel, foam gasket, insulated door, spring latches.
  - 2. Low Pressure Duct Systems: Ruskin Model ADC2, 12"x12" size, 24 gauge galvanized steel, steel on both sides of door, foam gasket seals, 1" insulation, 2 cam locks, no hinge.
- B. Fire Dampers: Greenheck DFD-series, Ruskin Model IBD2, or Cesco, curtain type, 100% free area (ONLY), Style C for round duct installations, and Style B or ODFD type for rectangular duct applications. Fire dampers located immediately behind transfer grilles may be Style A dampers. The dampers shall be UL rated for 1-1/2 hours and have a 165°F fusible link. Fire dampers shall be "dynamic" rated and shall comply with UL "Standard for Safety" 555.
- C. Flexible Duct Connections: Ventfabrics, Inc. neoprene coated glass fabric.
- D. Drawbands for Flexible Ducts: Clinch type stainless steel with screwdriver adjustment, or nylon with lever action tightening tool provided by the drawband manufacturer.
- E. Turning Vanes: (Low Pressure):
- 1. Solid blade, mounted with the long edge down stream in accordance with duct construction details indicated. Submit a 12"x12" sample elbow for review prior to fabrication.
- F. Volume Dampers:

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1. Factory fabricated as specified, or shop fabricated in accordance with SMACNA "HVAC Duct Construction Standards".
2. Rectangular: Ruskin Model MD-35, or American Warming and Ventilating, 12 gauge galvanized steel, locking quadrant, opposed blade over 11", single blade 11" and under.
3. Round: Ruskin Model MDRS25, or American Warming and Ventilating, 20 gauge galvanized steel with locking quadrant(ONLY). Dampers may be provided integral with spin-in fittings.

### G. Flexible Ductwork:

1. Low Pressure Duct Systems: Wiremold type WGCF, polyester core with wire helix, 1-1/2" thick, 3/4 lb fiberglass insulation, polyolefin jacket/vapor barrier, 2" W.G. rated pressure. Maximum lengths shall be 4'-0" except as indicated on the Drawings.

### H. Joint Sealer:

1. Hardcast DT tape and FTA-50 activator or Airseal #33 fiber-reinforced water-based brush-on sealer by Polymer Adhesive Sealant Systems, Inc. (UL-listed and LEED-compliant).
2. Provide waterproof sealer where watertight seal is specified.

## 2.3 AIR DEVICES (Krueger, Price, Anemostat, Metal Aire, Titus) ONLY

- A. Material and Finishes: Construct diffusers, registers, and grilles of aluminum. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Steel parts shall be factory zinc-phosphate treated prior to priming and painting or have a baked-on enamel finish. Aluminum parts shall be finish painted. Provide frame style compatible with ceiling or wall type. Colors shall be selected by Architect. Devices to be installed on exposed duct installations shall be furnished in primer suitable for field application of color coat.
- B. **Sound Level:** Manufacturer certified sound level rating of inlets and outlets in accordance with ADC 1062 R4. Conform with the maximum permissible room / diffuser noise criteria (NC) level for each device as scheduled. Provide submittal data accordingly.
- C. Throw: Defined as distance from the diffuser, register, or grille to the point which the resultant room air velocity is 50 to 35 feet per minute.
- D. Ceiling Diffusers: Equip with core styles required to provide air distribution pattern indicated. Internal parts shall be removable through the diffuser-neck for access to the duct and without the use of special tools. Construct each diffuser of four or more concentric elements designed to deliver air in a generally horizontal direction. The interior elements of square and rectangular ceiling diffusers may be square or rectangular as manufacturer's standard. Screws or bolts in exposed face of frames or core elements are not acceptable. Diffusers shall have an opposed blade volume damper in the diffuser neck if no damper is indicated in the branch duct (see Drawings). Diffusers shall have a 24"x24" lay-in panel for areas with acoustical ceilings and surface-mount frame for GWB ceilings. Ceiling diffusers shall be Price AMX series, high induction type with induction vanes.

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- E. Grilles and Registers: Construction and finish as indicated, 1/2" louver spacing, 45° curved blade. Registers shall have opposed-blade volume dampers with screwdriver adjuster. Unless otherwise indicated, registers shall be provided.
- F. Linear Diffusers and Bar Grilles: Linear bar grilles/registers and linear slot diffusers shall be as scheduled and indicated. Bar grilles shall have a 1" border with face screws. Provide opposed blade volume dampers for each bar grille / diffuser and adjustable pattern controllers (for linear slot supply diffusers). Return air slots shall be without pattern controllers. "Revers-A-Core" diffusers shall have deflection vanes. Construction shall be extruded aluminum with an anodized finish. Slot diffusers shall have a factory fabricated "sloped shoulder" boot plenum with 1/2" thick Armaflex duct liner.
- G. General: The interior of all sheetmetal connections to grilles, registers and diffusers shall be painted with a non-specular flat black paint so that no sheetmetal surfaces are visible from the finished space.

### 2.4 FANS

- A. Shall be model indicated. Fan manufacturers shall be Greenheck, Cook or equal. The fans shall include housing, fan wheel, shaft, bearings, inlet shroud, motor, mounting support and mounting frame as a factory-assembled unit. An OSHA-approved belt guard for each fan shall be included. The fan drive shall have a 1.5 service factor for the maximum rated horsepower. Provide a disconnect switch for each fan. Roof and sidewall fans shall have a factory-applied epoxy coating with color selection by the Architect. Provide gravity-operated, gasketed backdraft dampers for all exhaust fans.
- B. Bearings shall be precision, flange-mounted self-aligning ball bearings at inlet and discharge. Minimum average L50 design life shall be 200,000 hours at maximum catalogued operating conditions. Grease lines shall extend to the exterior of the fan housing.
- C. Submit sound power data for inlet and discharge sound.
- D. Submit fan curves for each fan with the design operating point clearly marked.
- E. Spring Type Vibration Isolators: Mason Industries Model HS, select for 1.5" static deflection. Provide for all fans that are not curb-mounted. Wall-mounted fans shall have a welded angle-iron wall bracket.
- F. Roof fans and duct penetrations thru the roof shall have 18" high insulated pre-fabricated and self-flashing insulated curbs by Conn-Fab, or approved equal. Provide a suitable foam gasket or seal between the curb and fan base to seal airtight. Single phase fan motors shall be ECM-type, where available or scheduled, Greenheck "Vari-Green" or equal. Three-phase motors shall be premium, high efficiency type.
- H. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
- I. Fan shall be controlled by a space mounted thermostat. The fan shall be energized at space temperatures above 85°F (adjustable) and de-energized at space temperatures below 80°F.

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### 2.5 DUCT INSULATION

- A. Fiberglass (Ductwrap): Fiberglass duct wrap with foil-scrim-kraft facing/vapor barrier, 1.5 lb/cu.ft. density (1.0 lb/cu.ft. for 3" thickness only), 0.29 Btu-in/hr-ft<sup>2</sup>-oF conductivity at 75°F mean temperature, 0.05 permeance rating. Insulation shall meet the requirements of NFPA 90A & B and shall be UL rated. Provide foil-scrim-kraft (FSK) tape.
- B. Fiberglass (Ductboard): Fiberglass insulation board with foil-scrim-kraft facing/vapor barrier, 3.0 lb./CF density, 0.25 Btu-in/hr-ft<sup>2</sup>-°F conductivity at 75°F mean temperature, 0.05 permeance rating. Insulation shall meet the requirements of NFPA 90A and B and shall be UL rated. Provide foil-scrim-kraft (FSK) tape.

## PART 3 - EXECUTION

### 3.1 SURFACE CONDITIONS

- A. Inspection:
  - 1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
  - 2. Verify that the duct systems may be installed in accordance with pertinent codes and regulations and the reviewed Submittals.

### 3.2 INSTALLATION OF DUCTWORK AND AIR DEVICES

- A. Provide and erect in accordance with the best practice of the trade ductwork shown on the drawings and as required to complete the intended installation. Make offsets as shown or required to place ductwork in proper position to avoid conflicts with other work and to allow the application of insulation and finish painting to the satisfaction of the Architect. Sizes given are "inside - clear" dimensions and not necessarily that of sheet metal. Ducts shall be arranged to adjust to "field conditions". The Sheet Metal trades shall coordinate his work with other trades. Work shall conform to ASHRAE duct construction recommendations, SMACNA "Duct Construction Standards", NFPA, and the requirements of the IBC.
- B. Joint Sealing: See PRODUCTS section.
- C. Longitudinal joints: See PRODUCTS section.
- D. Turns shall be made with long radius elbows or, if physically impossible to use long radius elbows, shall be square turns with specified turning vanes. CAUTION: Turns not conforming to this requirement shall be ordered removed and replaced with properly built turns.
- E. Access Doors: Provide access doors for concealed apparatus requiring service and inspection in the duct system including but not limited to dampers, sensors and motors, and upstream and downstream from duct coils.
- F. Duct Sleeves and Prepared Openings: Install duct sleeves and prepared openings for duct mains, duct branches, and ducts passing through walls, roofs, and ceilings. Insure the proper size and location of sleeves and prepared openings. Allow one-inch clearance between duct

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and sleeve or one-inch clearance between insulation and sleeve for insulated ducts, except at grilles, registers, and diffusers.

- G. Duct Supports: Unless otherwise indicated, provide one-inch wide by 16 gage galvanized steel sheet metal strips on each side of ducts. Anchor risers in the center of the vertical run to allow ends or riser free vertical movements. Attach supports only to structural framing members. Do not anchor supports to metal decking unless a means is provided (architectural review required) for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C clamps are used, use retainer clips.
- H. Flexible Collars and Connections: Provide flexible collars between fans and ducts or casings and where ducts are of dissimilar metals, except where fans are internally connected to the casing with flexible connectors. For round ducts, securely fasten flexible connections using stainless steel clinch-type draw-band. Nylon drawbands may be used if installed using the drawband manufacturer's lever-action tightening tool. For rectangular ducts, lock flexible connections to metal collars. All air handling equipment fan connections to the duct systems shall have flexible connections, factory or field-installed.
- I. Flexible Ducts: Provide where indicated. No fiberglass shall be exposed or in contact with air flow. Flexible duct length shall not be more than 4'-0". Install with metal band hangers and without excess length, provide maximum extension of flex duct. Securely fasten flexible ducts to metal collars using a stainless steel or tool-tightened nylon drawband on the duct core and a second drawband on the insulation vapor barrier. If the duct exceeds 12 inches diameter, position the drawband behind a bead on the metal collar. Taping in lieu of drawbands is not allowed.
- J. Any deviation in the duct system must be submitted as a shop drawing and stamped. CAUTION: Any deviation not submitted and favorably reviewed will be ordered removed from the system and replaced with that which is shown on the Drawings.
- K. Discrepancies between actual field conditions and the Contract Documents shall be brought to the attention of the Architect prior to fabrication.
- L. Field Changes to Ductwork: Field changes of ducts such as those required to suit the sizes of factory-fabricated equipment actually furnished shall be designed to minimize expansion and contraction. Use 4:1 transitions in field changes as well as modifications to connecting ducts.
- M. Transitions with a slope greater than 4 to 1 shall be ordered removed from the system and replaced with a transition which meets this criteria.
- N. Joints and seams at intake and exhaust plenums and joints on intake and exhaust ductwork for a distance of 3 feet from the plenum shall be sealed watertight on the bottom and side joints and seams.
- O. Isolation dampers at intake and exhaust louvers and vent hoods shall be sealed to the ductwork to provide an airtight assembly with similar performance characteristics to the isolation damper.
- P. The inside of sheetmetal connections to grilles, registers and diffusers shall be painted flat black so that no sheetmetal is visible from the finished space.

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- Q. All sharp edges and corners on ductwork, hangers or equipment located within 7'-0" of the finished floor shall be protected with a suitable padding material and identified with fluorescent orange paint.

### 3.3 DUCT INSULATION

- A. Rigid Insulation: Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from joint edges of boards, spaced not more than 12 inches on centers and secure with washers and clips. Spot weld anchor pins or attach with a waterproof adhesive especially designed for use on metal surfaces. Each pin or anchor shall be capable of supporting a 20-pound load. Cut off protruding ends of pins. After installing washers, provide foil-scrim-kraft (FSK) tape to seal break in vapor barrier, tape shall extend 1" minimum around pin. Apply insulation with joints tightly butted. Bevel insulation around name plates and access plates and doors. Seal joints with FSK tape. Provide additional adhesive or staples to assist tape adhesion in difficult applications.
- B. Flexible Blanket Insulation: Apply insulation with joints tightly butted. Staple laps of jacket with outward clinching staples and seal with foil scrim kraft (FSK) tape. Sagging of flexible duct insulation shall not be permitted. For ductwork over 24-inches wide on horizontal duct runs, provide pins, washers and clips. Install speed washers with pins and pin trimmed to washer. Cut off protruding ends of pins after clips are secured. Seal with FSK tape, extend tape 1" minimum around pin. Use pins on sides of vertical ductwork being insulated. Space pins and clips on 18 inch centers and not more than 18 inches from duct corners. Carry insulation over standing seams and trapeze-type hangers.

### 3.4 INSULATION APPLICATION SCHEDULE

<u>SERVICE</u>	<u>THICKNESS</u>	<u>MATERIAL/JACKET</u>
<b>DUCTWORK:</b>		
Outside Air and Exhaust Ductwork from the louver to the Air Handlers	3"	Ductboard, FSK or Ductwrap, FSK
Supply and Return Ductwork from the Air Handlers to spaces served	1-1/2"	Ductwrap, FSK
Exhaust Ductwork from a point three (3) feet interior of the motorized control damper or backdraft damper to the exterior wall, roof, or louver.	3" 3"	Ductwrap, FSK (Round) Ductboard, FSK (Rectangular)
Plenums at Intake and Exhaust louvers	3"	Ductwrap, FSK or Ductboard, FSK

### 3.5 CLOSING IN WORK

- A. Cover up or enclose work after it has been properly and completely tested and reviewed.
- B. No additional cost to the Owner will be allowed for uncovering or recovering any work that is covered or enclosed prior to required test and review.

### 3.6 TEST AND ADJUST



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- A. Before operating any system, the system shall be cleaned out to remove dust and foreign materials.
- B. After the installation is complete and ready for operation, test the system under normal operating conditions in the presence of the Architect and demonstrate that the system functions as designed.
- C. Correct defects which develop during the test period, conduct additional testing until defect free operation is achieved.

### 3.7 CLEANUP AND CORROSION PREVENTION

- A. Ductwork and equipment shall be thoroughly cleaned. Dirt, dust, and debris shall be removed and the premises left in a clean and neat condition.
- B. Before covering is applied to duct systems, clips, rods, clevises and other hanger attachments, and before uncovered piping is permitted to be concealed, corrosion and rust shall be wire brushed and cleaned and in the case of iron products, a coat of approved protective paint applied to these surfaces.

### 3.8 INSTRUCTIONS

- A. On completion of the project, instruct the Owner's representative in the care and operation of the system. The total period of instruction shall not exceed four (4) hours. The time of instruction shall be arranged with the Owner. In addition to the prime Mechanical Contractor, the control system Contractor, Balancing Contractor, and Owner's representative shall be present and participate in the Owner's instruction.

### 3.9 FIRESTOPPING

- A. Firestopping shall be performed in accordance with Specification Section 078400 "Firestopping". All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified.

\* END OF SECTION \*