

**SECTION 23 3600**  
**AIR TERMINAL UNITS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Single-duct terminal units.
  - 1. Single-duct, constant-volume units.
  - 2. Single-duct, variable-volume units.
- B. Fan-powered units.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 23 0913 - Instrumentation and Control Devices for HVAC: Thermostats and actuators.
- D. Section 23 0923 - Direct-Digital Control System for HVAC.
- E. Section 23 0993 - Sequence of Operations for HVAC Controls.
- F. Section 23 2113 - Hydronic Piping: Connections to heating coils.
- G. Section 23 2114 - Hydronic Specialties: Connections to heating coils.
- H. Section 23 3100 - HVAC Ducts and Casings.
- I. Section 23 3300 - Air Duct Accessories.
- J. Section 23 3700 - Air Outlets and Inlets.
- K. Section 23 8200 - Convection Heating and Cooling Units: Air coils.
- L. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils; 2001 (R2011).
- B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2011 with Addendum 1.
- C. AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets; 2008 with Addendum 1.
- D. ASHRAE Std 62.1 - Laboratory Method of Testing to Determine the Sound Power in a Duct; 2013.
- E. ASHRAE Std 130 - Methods of Testing Air Terminal Units; 2008 (R2014).
- F. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2013).
- G. ASTM A603 - Standard Specification for Zinc-Coated Steel Structural Wire Rope; 1998 (Reapproved 2014).
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- I. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2015.
- J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- M. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors' National Association; 2008.
- N. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

- O. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
- D. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
- E. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### **1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for air terminal units.

### **PART 2 PRODUCTS**

#### **2.01 SINGLE-DUCT, VARIABLE-VOLUME AND CONSTANT-VOLUME UNITS**

- A. Manufacturers:
  - 1. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp.; \_\_\_\_\_: [www.commercial.carrier.com](http://www.commercial.carrier.com).
  - 2. Trane, a brand of Ingersoll Rand; \_\_\_\_\_: [www.trane.com](http://www.trane.com).
  - 3. Tuttle and Bailey; \_\_\_\_\_: [www.tuttleandbailey.com/sle](http://www.tuttleandbailey.com/sle).
  - 4. Titus; [www.titus.com](http://www.titus.com)\_\_\_\_\_.
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Basis of Design: Trane.
  - 1. Single-Duct Terminal Unit: VCWF \_\_\_\_\_.
- C. General:
  - 1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
  - 2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

- D. Unit Casing:
1. Minimum 22 gage, 0.0299 inch galvanized steel.
  2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
  3. Unit Discharge: Rectangular, with slip-and-drive connections.
  4. Acceptable Liners:
    - a. 3/4 inch thick polyurethane foam adhesive complying with UL 181 erosion requirements in accordance with ASHRAE Std 62.1, and having a maximum smoke developed index of 50 for both insulation and adhesive, when tested in accordance with ASTM E84.
    - b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.
- E. Damper Assembly:
1. Heavy-gage, galvanized steel or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
  2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
  3. Incorporate low leak damper blades for tight airflow shutoff.
    - a. Air Leakage Past Closed Damper: Maximum two percent of unit maximum airflow at 3 inch wg inlet static pressure, tested in accordance with ASHRAE Std 130.
- F. Hot Water Heating Coil:
1. Coil Casing: Minimum 22 gage, 0.0299 inch galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
  2. Coil Fins: Aluminum or aluminum plated fins, mechanically-bonded to seamless copper tubes.
  3. Coil leak tested to minimum 350 psig.
  4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.
- G. Controls:
1. DDC (Direct-Digital Controls):
    - a. Basis of Design: Trane Tracer Ensemble.
      - 1) The unit level controller to include the following:
        - (a) 24 VAC power terminal or RJ-12 Power connection.
        - (b) T-Stat Port for thermostat connection.
        - (c) Service Port for Price Linker diagnostic equipment.
        - (d) Damper actuator.
        - (e) Fan output connection.
        - (f) LED indication for troubleshooting.
        - (g) Three binary staged heating outputs.
        - (h) Binary cooling output.
        - (i) S.A.T. sensor input.
        - (j) Contact closure input.
        - (k) Four analog outputs.
        - (l) BACNET expansion module.
        - (m) VAV expansion module.
    - b. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
    - c. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
      - 1) Occupied and unoccupied operating mode.
      - 2) Remote reset of temperature or CFM set points.
      - 3) Proportional, plus integral control of room temperature.
      - 4) Monitoring and adjusting with portable terminal.
      - 5) Time-proportional reheat coil control.
    - d. Room Sensor:

- 1) Compatible with temperature controls specified.
- 2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
- 3) Wireless connection to controller
- e. See Section 23 0923.
2. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
  - a. Basis of Design: Trane.
    - 1) Plastic parts are fire-resistant, complying with UL 94.
    - 2) Provides accuracy within 5 percent with a 90 degree sheet metal elbow directly at the inlet of the assembly.
    - 3) Control tubing is protected by grommets at the wall of the air flow sensor's housing.
    - 4) Furnished with twelve total pressure sensing ports and a center averaging chamber that amplifies the sensed air flow signal.
    - 5) Provide velocity pressure sensor with a removable access section for maintenance.
  - b. Signal accuracy: Plus/minus five percent throughout terminal operating range.
3. Control Sequence:
  - a. Suitable for operation with duct pressures between 0.25 and 3.0 inch wg inlet static pressure.
  - b. Include factory-mounted and piped, 5-micron filter; and adjustable, velocity-resetting, high-limit control with amplifying relay.
  - c. See Section 23 0993.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.
- E. Do not support from ductwork.
- F. Connect to ductwork in accordance with Section 23 3100.
- G. Verify that electric power is available and of the correct characteristics.

### **3.02 ADJUSTING**

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow. Set units with heating coils for minimum 50 percent full flow.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.

### **3.04 CLEANING**

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

### **3.05 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.

**END OF SECTION 23 3600**



