

**SECTION 23 36 16**  
**VARIABLE-AIR-VOLUME UNITS**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

- A. The other Contract Documents complement the requirements of this Section.
- B. The General requirements apply to the work of this Section.

1.2 SCOPE

- A. Provide material, equipment, labor, and supervision necessary to install Variable Air Volume Terminal Units as required by the Drawings and this Section.

1.3 STANDARDS

- A. All lining materials shall meet the requirements of NFPA 90A, UL 181 and ASTM C655.
- B. Provide proof of compliance with performance specifications, for air pressure drop and flow and radiated/discharge sound power levels, by manufacturers published certified data derived from tests conforming to ARI 880.
- C. Use electrical components listed by Underwriters Laboratories for their intended use.

1.4 QUALIFICATIONS

- A. Arrangement, capacity, performance, and type as scheduled and/or indicated on the Drawings and specified herein.
- B. Provide certification of equipment in accordance with ARI 880 for air and acoustical performance.
  - 1. All units shall meet or exceed specified acoustical parameters.

1.5 SUBMITTALS

- A. Submit product information on terminal units including physical dimensions, heaters, air performance, acoustical data, access/maintenance requirements, support locations, wiring diagrams, and similar data.
- B. Provide certified sound performance data for each terminal unit (and silencers, if necessary) at the scheduled operating conditions with 1.5" of inlet static pressure (corrected for silencer pressure drop).
  - 1. Provide pressure drop data for each terminal unit at the scheduled conditions.

1.6 COMMISSIONING

- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
  - 1. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- D. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements.

**PART 2 EQUIPMENT**

2.1 GENERAL

- A. Acceptable Manufacturers
  - 1. Variable Air Volume Terminal Units by Trane, Envirotech, Aneomostat, Titus, or Carrier are acceptable.

- B. Use variable air-volume terminal units of size, capacity, and style shown on the drawings.
  - 1. Use casing constructed of not less than welded 22-gauge galvanized steel.
    - a. Leakage rate shall not exceed 4% of the design airflow at 3" water gauge.
  - 2. The interior surface of the casing shall be acoustically and thermally lined with 1" thick, 1.0 lb/cu ft density glass-fiber insulation (minimum R-value 3.85) with a high density facing covered with a 26 gauge galvanized steel inner liner isolating the fiberglass from the airstream. Cut edges of insulation shall be covered by metal flanges.
    - a. Insulation shall be UL listed, and meet NFPA 90A, UL 181 requirements and bacteriological standard ASTM C655.
  - 3. Provide units with a cylindrical, cast-aluminum airflow control device, or damper assembly with internal or external actuator.
    - a. Verify control requirement with Control Subcontractor.
    - b. Leak rate shall be 4 percent or less at 3.0' WG.
    - c. Provide a pressure independent 16 point airflow sensor (8 points on the high side and 8 points on the low side) and calibration chart on unit. Damper assembly shall maintain airflow to within  $\pm 5\%$  of rated unit airflow with 1.5 diameters of straight duct upstream of the unit.
    - d. Flow sensor transducer shall not be integral to the unit.
    - e. Flow coefficient calibration data shall be provided for each terminal unit at or near the unit inlet.
    - f. Flow sensor pressure transducer shall be pressure tested, with air, prior to field installation.
  - 4. The Owner's Authorized Control Representative shall provide any VAV-box terminal unit controls consisting of the volume control external (only) actuator and the microprocessor based volume controller.
    - a. The control representative will ship control components and a typical wiring diagram to the terminal box manufacturer for factory installation (field installation is not acceptable).
    - b. The control representative for each box shall identify the components.
    - c. The terminal box manufacturer shall factory mount the components on the terminal box and complete all interconnecting wiring between the controller, actuator, and electrical heater to allow for a single point power connection to the terminal box disconnect.
    - d. Provide a fuse-type overprotection device for the control circuit.
    - e. The terminal box manufacturer is solely responsible for proper integration of owner furnished control components and the terminal box operation.
  - 5. Provide factory wired electric heaters as specified in schedule, UL listed resistance open-type element of nickel-chromium.
    - a. Provide with airflow switch, disc-type automatic thermal primary safety device, and manual reset thermal secondary device.
    - b. Provide with ceramic insulators, interlocking door handle disconnect, and magnetic contractors.
    - c. Provide electric heaters listed for use with a circuit breaker protection.
  - 6. Provide disconnect and transformer for control voltage circuit on VAV boxes without electric heat.

7. For units with internal actuators, provide a removable access panel in the bottom of each VAV unit for access to the actuator.
  - a. Provide fully gasketed access doors not exceeding the specified casing leakage rates.
8. All VAV terminal box units shall meet the following levels of radiated and discharge noise without any credit for environmental adjustment, space effect, sound division, end reflection, or similar elements external to the terminal box.
  - a. Noise levels shall be measure at inlet static pressures of 1.5" W.G.
  - b. Radiated Noise
    - i) 

Octave Band	2	3	4	5	6	7
Frequency	63	125	250	500	1000	2000
dB	76	69	62	57	56	55
    - ii) 

Octave Band	2	3	4	5	6	7
Frequency	63	125	250	500	1000	2000
dB	70	65	61	75	71	66
  - c. Discharge Noise
    - i) 

Octave Band	2	3	4	5	6	7
Frequency	63	125	250	500	1000	2000
dB	70	65	61	75	71	66
    - ii) 

Octave Band	2	3	4	5	6	7
Frequency	63	125	250	500	1000	2000
dB	70	65	61	75	71	66
    - iii) 

Octave Band	2	3	4	5	6	7
Frequency	63	125	250	500	1000	2000
dB	70	65	61	75	71	66
  - d. A maximum variance of +1db is allowed in each octave band and 2db in any octave band.
  - e. The Manufacturer may opt to install a pre-manufactured duct type silencer mounted on the box discharge to obtain the listed discharge noise levels.
    - i) Provide copy of calculations, including the effect of silencer generated noise levels, indicating the net discharge noise levels and compliance with the above requirements.
    - ii) Base the performance for silencers upon independent testing performed in accordance with ASTM E477.
    - iii) Add additional pressure drop associated with the silencer to the inlet static pressure requirements in determining discharge and radiated noise levels.
  - f. Noise levels listed are for internally lined boxes without foil facing.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide ceiling access doors or locate units above easily removable ceiling components.
  1. Locate bottom of unit not more than 18" above finished ceilings.
  2. Design and installation work shall be coordinated to avoid location of VAV units above the ceiling mounted light fixtures.
  3. Support units individually from structure.
  4. Do not support from adjacent ductwork.
- C. Connect to ductwork using rigid duct at inlet and outlet.
  1. Provide a minimum of 5 straight duct diameters upstream of the terminal box inlet and a minimum of 10' of duct downstream of the terminal box prior to the first air device connection.
- D. Locate and install units ensuring the minimum service area clearance meets NEC requirements.
  1. Provide 42" of unobstructed clearance in front of control and electric heater panels, spanning the width of the panels (minimum of 30") and vertically from ceiling grid to 6" above the top of VAV terminals.

The School District of Palm Beach County

Project Name:

SDPBC Project No.

2. Keep building structural components, any piping (including sprinklers), any ductwork, and equipment out of the service clearance area.
3. Advise other trades of encroachment violations and have offending items relocated or with the Engineers approval relocate terminal box to correct nonconforming conditions at no additional cost to the Owner.

### 3.2 FUNCTIONAL PERFORMANCE TESTING

- A. System Functional Performance Testing is part of the Commissioning Process.
  1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
  2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
- B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
- C. Perform the functional performance testing of HVAC pumps as part of the Chilled Water System Functional Performance testing.

### 3.3 DEMONSTRATION AND TRAINING

- A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative.
  1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
  2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
  3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements
- B. Perform demonstration and training for all equipment covered by this section and installed in this project.

END OF SECTION