

**SECTION 23 36 00**  
**AIR TERMINAL UNITS**

SPEC WRITER NOTES:

1. Delete between // --- // if not applicable to project. Also delete any other item or paragraph not applicable in the Section and renumber the paragraph.
2. References to pressure in this section are gauge pressure unless otherwise noted.
3. Provide the year of latest edition to each publication given in paragraph APPLICABLE PUBLICATIONS.

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Air terminal units and air flow control valves.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- E. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- G. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
- H. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.
- I. //Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//
- J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- K. Section 23 31 00, HVAC DUCTS and CASINGS.
- L. Section 23 34 00, HVAC FANS
- M. //Section 23 82 16, AIR COILS.//

**1.3 APPLICABLE PUBLICATIONS**

SPEC WRITER NOTES:

1. Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project unless the reference applies to all HVAC systems. Publications that apply

to all HVAC systems may not be specifically referenced in the body of the specification but shall form a part of this specification.

- 2. Insert the year of approved latest edition of the publications between the brackets // // and delete the brackets if applicable to this project.

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

- B. Air Conditioning, Heating, and Refrigeration Institute (AHRI):  
880-//2017//.....Performance Rating of Air Terminals

- C. American Society for Testing and Materials (ASTM):  
C665-//2017//.....Standard Specification for Mineral-Fiber  
Blanket Thermal Insulation for Light Frame  
Construction and Manufactured Housing

- D. National Fire Protection Association (NFPA):  
90A-//2021//.....Standard for the Installation of  
Air-Conditioning and Ventilating Systems

- E. Underwriters Laboratories, Inc. (UL):  
181-//2013(R2017)//.....Standard for Factory-Made Air Ducts and Air  
Connectors

- F. Department of Veterans Affairs (VA):  
PG-18-10-//2017(R2020)// HVAC Design Manual

**1.4 SUBMITTALS**

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE", with applicable paragraph identification.

- C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

- 1. Air flow control valves.

SPEC WRITER NOTE: Samples are generally not required as submittals. However, for

large installations, samples can be requested in consultation with the COR and VAMC. See paragraph below for compliance.

- D. Samples: Provide one typical air terminal unit for approval by the COR. This unit will be returned to the Contractor after all similar units have been shipped and deemed acceptable at the job site.

SPEC WRITER NOTE: Coordinate O&M Manual and commissioning requirements with Section 01 00 00, GENERAL REQUIREMENTS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS. O&M Manuals shall be submitted for content review as part of closeout documents.

- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:
1. Include complete list indicating all components of the systems.
  2. Include complete diagrams of the internal wiring for each item of equipment.
  3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.
- F. //Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician, and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//
- G. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

### **1.5 QUALITY ASSURANCE**

- A. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.
- B. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

**1.6 AS-BUILT DOCUMENTATION**

- A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

**PART 2 - PRODUCTS**

SPEC WRITER NOTE: See VA HVAC Design Manual for high humidity areas.

**2.1 GENERAL**

- A. Coils:
1. //Surgical Suite Air Terminal Units: Provide copper fins and copper coils for all hot water reheat coils serving Surgical Suite//.
  2. //All Air Terminal Units: Provide aluminum fins and copper coils for all hot water reheat coils//.
  3. Water Heating Coils:
    - a. AHRI certified, continuous plate or spiral fin type, leak tested at 2070 kPa (300 psig).
    - b. Capacity: As indicated, based on scheduled entering water temperature.
    - c. Headers: Copper or Brass.
    - d. Fins: Aluminum, maximum 315 fins per meter (8 fins per inch).
    - e. Tubes: Copper, arrange for counter-flow of heating water.
    - f. Water Flow Rate: Minimum 0.032 Liters/second (0.5 gpm).
    - g. Provide vent and drain connection at high and low point, respectively of each coil.
    - h. Coils shall be guaranteed to drain.
  4. Electric Heating Coils:
    - a. AHRI certified, spiral fin type.
    - b. Capacity: As indicated, based on scheduled data.
    - c. Coil: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material. Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings will not be allowed.
- B. Labeling: Control box shall be clearly marked with an identification label that lists such information as nominal CFM, maximum and minimum factory-set airflow limits, coil type and coil connection orientation, where applicable.

- C. Factory-calibrate air terminal units to air flow rate indicated. All settings including maximum and minimum air flow shall be field adjustable.
- D. Dampers with internal air volume control, see Section 23 31 00, HVAC DUCTS and CASINGS.
- E. Terminal sound attenuators, see Section 23 31 00, HVAC DUCTS and CASINGS.
- F. Air terminal performance shall be in compliance with AHRI 880.

## 2.2 AIR TERMINAL UNITS (BOXES)

- A. General: Factory-built, pressure independent units, factory set-field adjustable air flow rate, suitable for single duct applications. Use of dual-duct air terminal units is prohibited. Clearly show on each unit the unit number and factory set air volumes corresponding to the contract drawings. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC work assumes factory set air volumes. Coordinate flow controller sequence and damper operation details with the contract drawings and Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. All air terminal units shall be brand new products of the same manufacturer.

SPEC WRITER NOTE: All boxes for the new construction and major renovation shall be DDC controlled. Use non-DDC boxes for minor replacement projects, where the existing air-handling units are not DDC controlled.

- B. Capacity and Performance: The maximum capacity of a single terminal unit shall not exceed 566 Liters/second (1,200 cfm) with the exception of operating rooms and Cystoscopy rooms, which shall be served by a single air terminal unit at a maximum of 1,250 Liters/second (2,649 CFM).

SPEC WRITER NOTE: Coordinate selection of the air terminal units with the acoustic analysis to be performed by the designer. For each terminal unit size, use maximum allowable radiated and transmitted sound power levels, in all octave bands, based on the maximum inlet static pressure and air volume for each size.

- C. Sound Power Levels: Acoustic performance of the air terminal units shall be based on the design noise levels for the spaces stipulated in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND

EQUIPMENT. Equipment schedule shall show the sound power levels in all octave bands. Terminal sound attenuators shall be provided, as required, to meet the intent of the design.

- D. Casing: Unit casing shall be constructed of galvanized steel no lighter than 0.85 mm (22 Gauge). Air terminal units serving the operating rooms and Cystoscopy rooms shall be fabricated without lining. Provide hanger brackets for attachment of supports.
1. Lining Material: Suitable to provide required acoustic performance, thermal insulation and prevent sweating. Meet the requirements of NFPA 90A and comply with UL 181 for erosion as well as ASTM C665 antimicrobial requirements. Insulation shall consist of 13 mm (1/2 inch) thick non-porous foil faced rigid fiberglass insulation of 4-lb/cu.ft, secured by full length galvanized steel z-strips which enclose and seal all edges. Tape and adhesives shall not be used. Materials shall be non-friable and with surfaces, including all edges, fully encapsulated and faced with perforated metal or coated so that the air stream will not detach material. No lining material is permitted in the boxes serving operating rooms and Cystoscopy rooms.
  2. Access Panels (or doors): Provide panels large enough for inspection, adjustment and maintenance without disconnecting ducts, and for cleaning heating coils attached to unit, even if there are no moving parts. Panels shall be insulated to same standards as the rest of the casing and shall be secured and gasketed airtight. It shall require no tool other than a screwdriver to remove.
  3. Total leakage from casing, not to exceed 2 percent of the nominal capacity of the unit when subjected to a static pressure of 750 Pa (3 inches WG), with all outlets sealed shut and inlets fully open.
  4. Octopus Connector: Factory installed, lined air distribution terminal. Provide where flexible duct connections are shown on the contract drawings connected directly to terminals. Provide butterfly-balancing damper, with locking means in connectors with more than one outlet. Octopus connectors and flexible connectors are prohibited in the Surgical Suite.
- E. Construct dampers and other internal devices of corrosion resisting materials which do not require lubrication or other periodic maintenance.

1. Damper Leakage: Not greater than 2 percent of maximum rated capacity, when closed against inlet static pressure of 1 kPa (4 inches WG).
- F. Provide multi-point velocity pressure sensors with external pressure taps. Provide direct reading air flow rate table pasted to box.
- G. Provide static pressure tubes.
- H. Externally powered DDC variable air volume controller and damper actuator to be furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for factory mounting on air terminal units. The DDC controller shall be electrically actuated.

SPEC WRITER NOTE: Use of fan-powered terminal units is prohibited for the Nursing Wing and Special Treatment Spaces involving patient care and monitoring.

I. Fan Powered Terminal Units:

1. General: The fan will be in a series configuration inside the unit casing.
2. Fan Assembly: Forward curved centrifugal direct drive blower with adjustable speed controller.
  - a. Motor: Integral thermal overload protection.

SPEC WRITER NOTE: Schedule motor voltage.

- 1) 115 V single phase.
  - 2) 208/240 V single phase.
  - 3) 277 V single phase.
- b. Motor Assembly: Completely isolated from cabinet with rubber vibration mounts.
3. Wiring: Factory mounted and wire controls. Mount electrical components NEMA 1 control box with removable cover. Incorporate single point electrical connection to power source. Provide terminal strip in control box for field wiring of power source. Provide factory wired non-fused disconnect switch on each terminal unit.
4. Provide 25 mm (1 inch) thick throwaway filter in the return air inlet.

**2.3 AIR FLOW CONTROL VALVE (AFCV)**

SPEC WRITER NOTE: Air valves are typically used on fume hood type systems. When higher velocities are encountered these devices can be noisy. It is recommended that the engineer or designer consult the manufacturer when using air

valves to ensure that all aspects of the application are covered including controls, acoustics and corrosion. Consult various manufacturers to ensure the intent and quality of operation is met by all.

- A. Airflow control device shall be a venturi valve type air flow control valve.

SPEC WRITER NOTE: For critical applications (e.g. fume hoods, biological hoods, and isolation rooms) requiring pressure control shall use a venturi valve. Rooms that require differential airflow control can use a VAV box if approved by the facility.

- B. Pressure independent over a 150 Pa - 750 Pa (0.6 inch WG - 3 inch WG) drop across valve.
- C. Volume control accurate to plus or minus 5 percent of airflow over an airflow turndown range of 16 to 1. No minimum entrance or exit duct diameters shall be required to ensure accuracy or pressure independence.
- D. Response time to change in command signal and duct static pressure within three seconds.

SPEC WRITER NOTE: Provide aluminum construction for non-fume hood and non-corrosive applications such as isolation room exhaust tracking.

- E. 16 gauge spun aluminum valve body and control device with continuous welded seam and 316 stainless-steel shaft and shaft support brackets. Pressure independent springs shall be stainless-steel. Shaft bearing surfaces shall be Teflon or polyester.

SPEC WRITER NOTE: Provide stainless-steel valve body and valve with phenolic coating for standard fume hood applications.

- F. 316 stainless-steel continuous welded seam valve body, control device, shaft, shaft support bracket, pivot arm and internal mounting link. The control device shall have a baked on corrosion resistant phenolic coating. The shaft shall have a Teflon coating and all shaft bearing surfaces shall be made of Teflon. The pressure independent springs shall be made of stainless-steel.

SPEC WRITER NOTE: In addition to the above paragraph; provide the following

paragraph if working in highly corrosive environments.

- G. The airflow device shall have no exposed aluminum or stainless-steel components. The shaft support brackets, pivot arm, internal mounting link, and pressure independent springs shall have a baked-on corrosion resistant phenolic coating. Internal nuts, bolts, and rivets shall be titanium or phenolic coated stainless-steel.
- H. Constant Volume Units:
1. Actuator to be factory mounted to the valve.
  2. Closed loop control of airflow by way of flow feedback signal with less than 1 second response time.
  3. Shaft positioned using direct potentiometer measurement to produce a linear factory calibrated feedback.
  4. The maximum and minimum airflows shall be as scheduled.
- I. Variable Volume Units:
1. Actuator to be factory mounted to the valve.
  2. Closed loop control of airflow by way of flow feedback signal with less than 1 second response time.
  3. Shaft positioned using direct potentiometer measurement to produce a linear factory calibrated feedback.
- J. Certification:
1. Control Device: Factory calibrated to airflows detailed on plans using NIST traceable air stations and instrumentation having a combined accuracy of plus or minus 1 percent of signal over the entire range of measurement.
  2. Electronic Airflow Control Devices: Further calibrated and their accuracy verified to plus or minus 5 percent of signal at a minimum of eight different airflows across the full operating range of the device.
  3. All Airflow Control Devices: Individually marked with device specific, factory calibration data to include tag number, serial number, model number, eight point characterization information (for electronic devices), and quality control inspection numbers.
- SPEC WRITER NOTE: Venturi valves are preferred.
- K. Airflow measuring devices and airflow control devices that are not venturi valves (e.g., Pitot tube, flow cross, air bar, orifice ring,

vortex shedder, etc.) are acceptable, provided the following conditions are met:

1. They meet the performance and construction characteristics stated throughout this section of the specification.
2. Suppliers of airflow control devices or airflow measuring devices requiring minimum duct diameters shall provide revised duct layouts showing the required straight duct runs upstream and downstream of these devices.
3. Supplier of the airflow control system shall submit coordination drawings reflecting these changes and include static pressure loss calculations as part of submittal.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. If an installation is unsatisfactory to the COR, the contractor shall correct the installation at no additional cost or time to the Government.
- B. Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.
- C. Handle and install units in accordance with manufacturer's written instructions.
- D. Support units rigidly so they always remain stationary. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.
- E. Locate air terminal units to provide a straight section of inlet duct for proper functioning of volume controls.

#### **3.2 STARTUP AND TESTING**

- A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. //The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.//

**3.3 //COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

**3.4 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for //4//  
// // hour//s// to instruct each VA personnel responsible in operation and maintenance of the system.
- B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

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