# Price Fan Powered Terminal Units

# Division 23 – Heating, Ventilating, and Air Conditioning

# Section 23 3600 – Air Terminal Units

The following specification is for a defined application. Price would be pleased to assist in developing a specification for your specific need.

# PART 1 - GENERAL

## 1.01 Section Includes

1. Fan-powered units.

## 1.02 Related Requirements

1. Section 22 0513 - Common Motor Requirements for Plumbing Equipment.
2. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
3. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
4. Section 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
5. Section 23 0913 - Instrumentation and Control Devices for HVAC: Thermostats and actuators.
6. Section 23 0923 - Direct-Digital Control System for HVAC.
7. Section 23 0943 - Pneumatic Control System for HVAC.
8. Section 23 0993 - Sequence of Operations for HVAC Controls.
9. Section 23 2113 - Hydronic Piping: Connections to heating coils.
10. Section 23 2114 - Hydronic Specialties: Connections to heating coils.
11. Section 23 3100 - HVAC Ducts and Casings.
12. Section 23 3300 - Air Duct Accessories.
13. Section 23 3700 - Air Outlets and Inlets.
14. Section 23 8200 - Convection Heating and Cooling Units: Air coils.
15. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

## 1.03 Reference Standards

1. All referenced standards and recommended practices in this section pertain to the most recent publication thereof, including all addenda and errata.
2. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.
3. AHRI 880 - Performance Rating of Air Terminals.
4. AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
5. ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
6. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.
7. ASHRAE 130 - Methods of Testing for Rating Ducted Air Terminal Unit.
8. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
9. ASTM C1338 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
11. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements.
12. CSA C22.2 No. 236 – Heating and Cooling Equipment.
13. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
14. NFPA 70 - National Electrical Code.
15. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.
16. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
17. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.
18. UL 1995 – Standards for Heating and Cooling Equipment.

## 1.04 Administrative Requirements

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

## 1.05 Submittals

1. See Section 01 30 00 - Administrative Requirements for submittal procedures.
2. Product Data shall be provided with data indicating configuration, general assembly, and materials used in fabrication, including catalog performance ratings that indicate air flow, static pressure, NC designation, electrical characteristics, and connection requirements.
3. Shop Drawings shall indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
4. Manufacturer shall include schedules listing discharge and radiated sound power level for each of the second through seventh octave bands (125 – 4000 Hertz) at specified differential static pressures.
5. Certificates shall be issued to certify that the air coil capacities, pressure drops, and selection procedures meet or exceed specified requirements or coils are tested and rated in accordance with AHRI 410.
6. Manufacturer's Installation Instructions shall indicate support and hanging details, installation instructions, and recommendations.
7. Project Record Documents shall record actual locations of units and controls components and locations of access doors.
8. Operation and Maintenance Data shall include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
9. Maintenance Materials shall be furnished for the Owner's use in maintenance of the project.
10. See Section 01 60 00 - Product Requirements, for additional provisions.
11. Extra Filters: Furnish one spare filter as required per unit.

## 1.06 Quality Assurance

1. Manufacturer Qualifications shall be specified in this section, with minimum ten years of documented experience.
2. Product Listing Organization Qualifications: The manufacturer shall be listed with an organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.07 Warranty

1. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
2. Provide 18 month manufacturer warranty from date of shipment for air terminal units, integral sound attenuators, integral heating coils, and integral controls.

# PART 2 - PRODUCTS

## 2.01 Fan-Powered Units

1. Basis of Design: Price Industries, Inc.
2. Constant-Volume Series Fan-Powered Unit: FDC (direct digital controls).
3. Performance Requirements:
4. The assemblies shall be pressure independent and shall reset to any air flow between zero and the maximum cataloged air volume. Sound ratings of air distribution assemblies shall not exceed \_\_\_\_ NC at \_\_\_\_ inlet static pressure, with a downstream static pressure of \_\_\_\_\_.
5. Use attenuation values found in AHRI 885 Appendix E.
6. General:
7. The manufacturer shall supply factory-assembled and wired, AHRI 880 rated, horizontal fan-powered terminal units with blower, motor, mixing plenum, and primary air damper contained in a single unit housing.

## 2.02 Constant Volume Series Fan Powered Units (Price Model FDC)

1. Description:
	1. Furnish and install Price model FDC series fan powered terminal unit in the sizes and configurations as indicated on the plans.
2. Unit Casing:
3. The unit casing shall be constructed of galvanized steel with a minimum material thickness of 20 gauge. The discharge panel shall be constructed of 18 gauge galvanized steel for increased rigidity and sound attenuation.
4. Primary air inlet collar: Manufacturer shall provide round inlet collars, suitable for standard flexible duct sizes.
5. Unit Discharge: Manufacturer shall provide rectangular unit discharges, suitable for flanged duct connection.
6. Liners:
7. Standard:
8. Fiberglass Liner - FG.
9. Insulation shall comply with the requirements of UL 181 (erosion), ASTM C1338 (fungi resistance), ASHRAE 62.1, and ASTM C1071, having a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
10. The insulation shall be secured with adhesive.
11. Insulation edges exposed to the airstream shall be coated with NFPA 90A approved sealant.
12. Insulation thickness shall be 1 inch thick, R-value of 4.1.
13. Optional:
14. Fiber-Free Foam Insulation - FF.
15. Insulation shall comply with UL 181 erosion, mold growth, and humidity requirements in accordance with ASHRAE 62.1, and shall have a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
16. The insulation shall be secured with adhesive.
17. Insulation thickness shall be 1 inch thick, R-value of 4.0.
18. Foil Board Liner - FB.
19. Insulation shall comply with UL 181 erosion, mold growth and humidity requirements in accordance with ASHRAE 62.1, and shall have a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
20. The insulation shall be secured with adhesive.
21. Insulation edges exposed to airstream shall be coated with NFPA 90A approved sealant.
22. Insulation thickness shall be 1 inch thick, R-value of 4.2.
23. Primary Air Damper Assembly:
24. The damper assembly shall be heavy-gauge, galvanized steel with a solid shaft rotating in bushings.
25. The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.
26. The damper shaft shall be mounted on the [left], or [right] of the damper when looking in the direction of airflow.
27. The low leakage 18 gauge damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.
28. Air leakage past the closed damper shall not exceed two percent of the unit maximum airflow at 3 inch water gauge inlet static pressure, tested in accordance with ASHRAE 130.
29. The damper, seal and bushing system shall be tested to 1.25 million cycles, or the equivalent of 100 full open/closures per day for 35 years, with no visible signs of wear, tear, or failure of the damper assembly after such testing.
30. Airflow Sensor:
31. The airflow sensor shall be a differential pressure airflow device measuring total and static pressure, and shall be mounted to the inlet valve.
32. Plastic parts shall be fire-resistant, complying with UL 94.
33. The airflow sensor shall be RoHS (Restriction of Hazardous Substances) compliant. Materials containing polybrominated compounds shall not be acceptable.
34. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.
35. The airflow sensor shall be furnished with a minimum of twelve total pressure sensing ports and four static sensing ports, and shall include a center averaging chamber that amplifies the sensed airflow signal.
36. The airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.
37. Inlet Valve:
38. The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct.
39. The inlet valve shall include a 1/8 inch raised single bead weld for added strength.
40. The gasket seal shall be a low leakage continuous piece with a peripheral gasket for tight airflow shutoff.
41. The inlet valve shall include two heavy duty stop pins to accurately position the damper in the open and closed position.
42. Fan(s): The terminal unit shall be supplied with a forward curved, centrifugal type fan.
43. Fan Motor:
44. The fan motor shaft shall be directly connected to the fan.
45. The fan shall be isolated from the casing to prevent transmission of vibration, with the following motor type (select one):
	1. Permanent Split Capacitor (PSC):
46. Thermally protected, single speed, multi-voltage (120, 208/240, 277), 60 cycle, single phase, energy efficient design, permanently lubricated, using permanent split capacitor type for starting and specifically designed for use with a SCR (Silicon Controlled Rectifier) fan speed controller.
	1. Electrically Commutated Motor (ECM):
47. Brushless DC controlled by an integrated controller/inverter that operates the wound stator and senses rotor position to electrically commutate the stator. The motor shall be supplied with a speed controller. The speed controller shall have dual outputs to control up to two motors, and allow for manual dial motor speed adjustment, or a [2-10 VDC] or [4-20 mA] signal for variable speed control.
48. Permanent magnet type motor with near-zero rotor losses designed for synchronous rotation.
49. Designed to maintain a minimum 70 percent efficiency over the entire operating range.
50. The ECM shall be furnished with factory programming (**select one**):
51. High Turndown Program
52. A high turndown program shall be provided to allow the ECM to operate with constant torque to vary the airflow with fluctuations in external static pressure.
53. The motor shall be capable of operating at low speeds to accommodate an increased turndown ratio, a wider airflow range, and decreased energy consumption as compared to typical pressure independent motor programs.
54. Pressure Independent Program
55. A pressure independent program shall be provided to allow the ECM to compensate for fluctuations in external static pressure, providing constant airflow.
56. The air volume flow rate shall be maintained to within five percent of desired flow in a system with up to 0.50 inches water gauge of external static pressure.
57. Electrical Requirements:
58. Fan powered terminal units shall be provided with single-point power connection.
59. The terminal unit equipment wiring shall comply with the requirements of NFPA 70.
60. Controls:
61. See Section 23 09 13 - Instrumentation and Control Devices for HVAC: Thermostats and actuators for controls requirements.
62. Controls Sequence:
63. See Section 23 09 93 - Sequence of Operations for HVAC Controls for controls sequence requirements.
64. Electric Heating Coil (**optional**):
65. The electric heating coil shall be ETL listed to UL1995 and CSA C22.2 No. 236, and provided by the terminal unit manufacturer.
66. The electric coil casing shall be constructed from a minimum 20 gauge galvanized steel.
67. The heating elements shall be open wire nickel chrome construction, supported by ceramic insulators.
68. The integral control panel shall be a NEMA 250, Type 1 enclosure with hinged access door for access to all controls and safety devices.
69. The electric coils shall be provided with a primary automatic reset thermal cutout, a secondary manual reset thermal cutout, and an electrical fan interlock to prevent heater operation when the fan is not running.
70. Magnetic contactors shall be supplied for each stage of heat.
71. The electric heater and terminal unit assembly shall be field rotatable for installation in left hand or right hand configuration.
72. [**Optional**] The electric coils shall be provided with a door complete with interlocking disconnect switch.
73. Hot Water Heating Coil (**optional**):
74. The hot water coil casing shall be constructed from a minimum 22 gauge, 0.032 inch galvanized steel, factory-installed on the terminal discharge with slip-and drive attachment for downstream ductwork.
75. An optional gasketed and insulated access door shall be provided, located on bottom of unit.
76. Coil handing shall be identical to unit handing.
77. The water coil fins shall be 0.0045 inch aluminum fins, mechanically-bonded to seamless 0.50 by 0.016 inch copper tubes.
78. Fins shall be formed in a high heat transfer sine wave configuration.
79. Standard coil shall be constructed with 10 fins-per-inch fin spacing.
80. High capacity coil shall be constructed with 12 fins-per-inch fin spacing and larger casing to increase capacity.
81. All water coils shall be hydrostatically tested to a minimum 390 pounds per square inch, with a minimum burst pressure of 1800 pounds per square inch at ambient temperature. All water coils are rated for a maximum of 300 pounds per square inch working pressure at 200 degrees Fahrenheit.
82. The water coil shall be certified in accordance with AHRI 410 and units shall bear an AHRI 410 label.
83. Sensible Cooling Water Coil (**optional – FDC DOAS only**):
	* + 1. The sensible cooling water coil casing shall be constructed from a minimum 22 gauge, 0.032 inch galvanized steel, factory-installed on the terminal return with a flanged connection.

2. The water coil fins shall be 0.0045 inch aluminum fins, mechanically-bonded to seamless 0.50 by 0.016 inch copper tubes.

1. Fins shall be formed in a high heat transfer sine wave configuration.
2. Standard coil shall be constructed with 10 fins-per-inch fin spacing.
3. All water coils shall be hydrostatically tested to a minimum 390 pounds per square inch, with a minimum burst pressure of 1800 pounds per square inch at ambient temperature. All water coils are rated for a maximum of 300 pounds per square inch working pressure at 200 degrees Fahrenheit.
4. The water coil shall be certified in accordance with AHRI 410 and units shall bear an AHRI 410 label.
5. Plenum Return Filter (**optional**):
	1. The plenum return shall be supplied with fiberglass filters.
	2. When tested in accordance with ASHRAE 52.2, the filter shall have a Minimum Efficiency Reporting Value of (**select one**):
6. MERV 3 filter.
7. MERV 8 filter, supplied complete with a filter boot to decrease filter face velocity and pressure drop.
8. Sound Attenuator (**optional**):
9. The manufacturer shall provide a close-coupled sound attenuator, as required, to meet scheduled acoustical performance requirements.
10. Attenuators shall be the following configuration (**select all that apply**):
	1. Inlet Attenuator
11. Discharge Attenuator (DAS).
	* + 1. Three foot discharge attenuator (DAS3).
			2. Five foot discharge attenuator (DAS5).
12. Discharge Silencer (SLR):
	1. The manufacturer shall provide an AHRI certified assembly complete with an acoustically tuned silencer.
	2. The silencer shall be available with the following acoustical media options:
		* 1. Fiberglass - FG
			2. Polymer Liner - PL
				1. Fiberglass insulating material wrapped with polymer film and isolated with acoustical stand-off and a perforated metal liner.
			3. Fiberglass Cloth - FC
				1. Fiberglass insulating material wrapped with fiberglass cloth and a perforated metal liner.
13. Return Silencer (RSLR – FDC DOAS only)
	1. The manufacturer shall provide an AHRI certified assembly complete with an acoustically tuned silencer
	2. The silencer shall be available with the following acoustical media options:

Fiberglass – FG

Polymer Liner – PL

1. Fiberglass insulating material wrapped with polymer film and isolated with acoustical stand-off and a perforated metal liner.
	1. The silencer should be mounted on the terminal unit return and shall be available in a one foot length and a three foot length

# PART 3 - EXECUTION

## 3.01 Examination

1. Verify that conditions are suitable for installation.
2. Verify that field measurements are as shown on the drawings.

## 3.02 Installation

1. Install the terminal units in accordance with the manufacturer's instructions.
2. Install the inlets of the air terminal units with the air flow sensors a minimum of three duct diameters from elbows, transitions, and duct takeoffs.
3. See drawings for the size(s) and duct location(s) of the air terminal units.
4. Provide ceiling access doors or locate units above easily removable ceiling components.
5. Support the terminal units individually from the structure in accordance with manufacturer’s recommendations.
6. Embed anchors in concrete in accordance with ASTM E488/E488M.
7. Do not support the terminal units from the ductwork.
8. Connect the terminals to the ductwork in accordance with Section 23 31 00.
9. Install heating coils in accordance with Section 23 82 00.
10. Verify that electric power is available and of the correct characteristics.

## 3.03 Adjusting

1. Ensure the damper operator attached to the assembly allows full modulation of flow range from 100 percent of design flow to zero.

## 3.04 Field Quality Control

1. See Section 01 40 00 - Quality Requirements, for additional quality requirements.

## 3.05 Cleaning

1. See Section 01 74 19 - Construction Waste Management and Disposal for additional cleaning requirements.

## 3.06 Closeout Activities

1. See Section 01 78 00 - Closeout Submittals for closeout submittals.
2. See Section 01 79 00 - Demonstration and Training for additional closeout requirements.