SECTION 23 36 00 AIR TERMINAL UNITS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Constant volume terminal units.

2. Variable volume terminal units.

3. Fan powered terminal units.

4. Variable volume regulators.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for fan powered terminal units for placement by this section.

2. Section 23 09 00 - Instrumentation and Control for HVAC: Product requirements for control components to interface with air terminal units.

3. Section 23 09 23 - Direct-Digital Control System for HVAC: Controls remote from unit.

4. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation applying to units in this section.

5. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to air terminal units specified by this section.

1.02 REFERENCES

A. American Refrigeration Institute:

1. ARI 880 - Air Terminals.

2. ARI 885 -Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

D. Underwriters Laboratories Inc.:

1. UL 181 - Factory-Made Air Ducts and Connectors.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings indicating airflow, static pressure, heating coil capacity and NC designation. Include electrical characteristics and connection requirements. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 1 inch to 4 inches wg (250 to 1000 Pa).

C. Manufacturer's Installation Instructions: Submit support and hanging details, and service clearances required.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of units and controls components.

C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.05 QUALITY ASSURANCE

A. Test and rate air terminal unit’s performance for air pressure drop, flow performance, and acoustical performance in accordance with ARI 880 and ARI 885. Attach ARI seal to each terminal unit.

B. Perform Work in accordance with IBC-NJ and Building Standard.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.08 COORDINATION

A. Division 0101 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with Sections 23 09 00, 23 09 23 and 23 09 93 - Instrumentation and Controls.

1.09 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

1.10 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Requirements for extra materials.

B. Furnish two (2) additional electric motors of each size of fan powered terminal units.

PART 2 - PRODUCTS

2.01 SINGLE DUCT SUPPLY VARIABLE AIR VOLUME TERMINAL UNITS (NON-LAB)

A. Manufacturer: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:

1. Anemostat Air Products.

2. Nailor.

3. Titus.

4. **Johnson Controls.**

5. Substitutions: Division 01 - Product Requirements.

B. Product Description: Variable air volume terminal units for connection to central air systems, with electronic/DDC controls, pressure independent and with or without heating coils.

C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.

D. Basic Assembly:

1. Casings: Minimum 22 gage (0.8 mm) galvanized steel.

2. Lining: Minimum 1 inch (25 mm) thick aluminum foil faced dual density fiber-lock insulation, 1.5 lb./cu ft (24 g/L) density, meeting NFPA 90A requirements and UL 181 erosion requirements , sealed edges with zinc coated steel. Minimize mold growth to meet ASTM G21/22.

E. Basic Unit:

1. Configuration: Air volume damper assembly inside unit casing. Locate control components inside protective metal shroud.

2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings; maximum damper leakage: 2 percent of design air flow at 3 inches (0.75 kPa) rated inlet static pressure.

3. Mount damper operator to position damper normally open.

F. Attenuation Section: Line attenuation sections with 2 inch (50 mm) thick insulation where indicated on drawings.

G. Heating Coil:

1. Hot Water Coil:

a. Construction: 1/2 inch (13 mm) copper tube mechanically expanded into aluminum plate fins, leak tested under water to 1.3 operating pressure, 200 psig minimum.

b. Capacity: As indicated on drawings and based on tests run in accordance with ARI Standard 410.

H. Automatic Damper Operator:

1. VAV boxes shall be complete with 24 volt electric motor drive and DDC modules installed at the factory by the VAV box manufacturer. They shall be mounted in an easily accessible enclosure, and completely wired requiring only power, signal and room temperature sensor connection. An automatic air measuring device shall indicate cfm of each box instantaneously on the portable field console. The VAV box manufacturer shall pipe the controller's transducers to the box flow sensor. The VAV box manufacturer will coordinate with the manufacturer of the DDC modules to insure that the actuators positively lock on the VAV box shaft/linkage. See Section 3.04 for items to be supplied by controls system contractor for installation by VAV terminal manufacturer installation and related work. The VAV manufacturer must mount the DDC controllers to the VAV boxes. In addition, the VAV terminal box manufacturer shall coordinate with ATC Contractor for initial damper set-up and adjustments.

a. Provide access door at bottom of each VAV box.

2. VAV boxes shall be pressure independent and shall reset primary air volume as determined by the space thermostat regardless of changes in system air pressure. The primary air shall be normally open on loss of power unless otherwise specified. VAV boxes shall have test ports for manual verification and calibration of the air flow measuring device. VAV box controllers shall include provision for automatic calibration of air flow measuring device.

3. Velocity Reset Controller and Sensor:

a. Electric: 24 volt.

b. Calibration pressure taps for pressure independent control to compensate for varying inlet static pressure.

c. Minimum and maximum limits set at reset device.

d. Maintain airflow to within 5 percent of set point with inlet static pressure variations up to 4 inches (1.0 kPa).

4. Sound Ratings: Not to exceed criteria listed in Specifications Section 23 05 48 - Noise and Vibration Controls for HVAC Piping and Equipment:

I. Temperature Sensor: Refer to Section 23 09 23 and 23 09 93.

J. Sequence of Operation: Refer to Section 23 09 93.

2.02 FAN POWERED VARIABLE AIR VOLUME UNITS (FPVAV)

A. Manufacturer: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:

1. Anemostat Air Products.

2. Nailor.

3. Titus

4. Substitutions: Refer to Division 1- Product Requirements.

B. Product Description: Fan-powered ariable air volume terminals for connection to central air systems with electronic/DDC controls and heating coils. FPVAV terminals shall be Series (Constant Volume) type as scheduled on the contract drawings.

C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.

D. Basic Assembly:

1. Casings: Minimum 20 gage (0.8 mm) galvanized steel.

2. Lining: Minimum 1 inch (25 mm) fiber-free insulation, 1.5 lb./cu ft (24 g/L) density, meeting NFPA 90A requirements, ASTM G21/G22 and UL 181 erosion requirements.

3. The terminal casing shall have two top and two bottom access panels, which allows removal of fan assembly and servicing of terminal without disturbing duct connections. The terminal shall have internal and external attenuators factory installed. The external attenuator shall be shipped internal to the unit to protect it from shipping damage. The external attenuator shall be

slid into the operation position and secured without the need for additional screws. Factory provided attenuators that require field installation are not acceptable.

E. Basic Unit:

1. Configuration: Air volume damper assembly and fan in series or parallel arrangement inside unit casing. Locate control components inside protective metal shroud.

2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings; maximum damper leakage: 2 percent of design air flow at 3 inches 0.75 kPa) rated inlet static pressure.

3. Mount damper operator to position damper normally open.

F. Automatic Damper Operator:

1. VAV boxes shall be complete with electric motor drive and DDC modules furnished (maybe by ATC Contractor) and installed at the factory by the VAV box manufacturer. They shall be mounted in an easily accessible enclosure, and completely wired requiring only power, signal and room temperature sensor connection. An automatic air measuring device shall indicate cfm of each box instantaneously on the portable field console. The VAV box manufacturer shall pipe the controller's transducers to the box flow sensor. The VAV box manufacturer will coordinate with the manufacturer of the DDC modules to insure that the actuators positively lock on the VAV box shaft/linkage. The VAV manufacturer must mount the DDC controllers to the VAV boxes. In addition, the VAV terminal box manufacturer shall coordinate with ATC Contractor for initial damper set-up and adjustments.

2. VAV boxes shall be pressure independent and shall reset primary air volume as determined by the space thermostat regardless of changes in system air pressure. The primary air shall be normally open on loss of power unless otherwise specified. VAV boxes shall have test ports for manual verification and calibration of the air flow measuring device. VAV box controllers shall include provision for automatic calibration of air flow measuring device.

3. Velocity Reset Controller and Probe:

a. Electric: 24 volt.

b. Calibration pressure taps for pressure independent control to compensate for varying inlet static pressure.

c. Minimum and maximum limits set at reset device.

d. Maintain airflow to within 5 percent of set point with inlet static pressure variations up to 4 inches.

e. Provide four point, center-averaging differential pressure airflow sensor. A sensor that delivers the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.

G. Fan Assembly:

1. Fan: Forward curved centrifugal type with direct drive ECM variable speed drive brushless motor, thermally protected motor. Refer to Section 23 05 13.

2. Speed Control: Infinitely adjustable with electronic controls.

3. Isolation: Fan/motor assembly on rubber isolators.

4. Electrical Characteristics:

a. The terminal unit manufacturer shall provide a factory installed PWM (SCR) controller for DDC controlled fan cfm adjustment. The manual PWM controller shall be field adjustable with a standard screwdriver. The remote PWM controller shall be capable of receiving a 0-10 Vdc signal from the DDC controller (provided by the controls contractor) to control the fan cfm. When the manual PWM controller is used, the factory shall preset the fan cfms as shown on the schedule.

H. Attenuation Section: Line attenuation sections with 2 inch (50 mm) thick insulation where indicated.

I. Heating Coil:

1. Hot Water Coil:

a. Construction: 1/2 inch (13 mm) copper tube mechanically expanded into aluminum plate fins, leak tested under water to 1.3 operating pressure, 200 psig minimum.

b. Capacity: As indicated on drawings and based on tests run in accordance with ARI Standard 410.

J. Wiring:

1. Factory mount and wire controls. Mount electrical components in control box with removable cover. Incorporate single point electrical connection to power source.

2. Factory mount transformer for control voltage on electric and electronic control units. Furnish terminal strip in control box for field wiring of thermostat and power source.

3. Wiring Terminations: Wire fan and controls to terminal strip. Furnish terminal lugs to match branch-circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box.

4. Disconnect Switch: Factory mount non-fused disconnect switch in control panel.

K. Sound Ratings:

1. Unit maximum radiated sound power levels at 1.0 inch w.g. inlet pressure and 0.25 inch w.g. discharge static pressure shall not exceed noise of

scheduled terminal box. No credit or reduction shall in any way be considered for room, plenum, ceiling and/or similar item effects.

L. Sound performance shall be ARI certified. If NC is provided instead of octave band sound power data, the radiated and discharge path attenuation function for the specified NC shall be based upon factors found in ARI Standard 885-98, Appendix E. No additional attenuation factors shall be deducted from the sound power.

M. Controls: Electronic/DDC Controls: Contain in NEMA 250 Type 1 enclosure with access panel sealed from airflow and mounted on side of unit. Factory mount controls and thermostat.

N. Temperature Sensor: Refer to Sections 23 09 23 and 23 09 93.

O. Sequence of Operation: Refer to Section 23 09 93.

P. Parallel terminals shall have gasketed backdraft damper at the fan discharge section.

Q. Accessories:

1. Induced air filter 1" Class 1 UL-181 NFPA 90A.
2. Metal controller cover.
3. Fan switch for setback.
4. Hanger brackets.
5. Camlocks on access door.
6. Disconnect switches.

2.03 FUME HOOD EXHAUST TERMINAL BOXES - Refer to Section 23 09 23.

2.04 LABORATORY GENERAL EXHAUST TERMINAL BOXES - Refer to Section 23 09 23

2.05 LABORATORY SUPPLY AIR TERMINAL BOXES - Refer to Section 23 09 23

PART 3 - EXECUTION

3.01 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify ductwork is ready for air terminal installation.

3.02 INSTALLATION

A. Connect to ductwork in accordance with Section 23 31 00.

B. Install ceiling access doors or locate units above easily removable ceiling components.

C. Support units individually from structure. Do not support from adjacent ductwork. All unit supports shall clear the access panels on the boxes.

D. Connect fan-powered air terminal units by flexible duct independently of ducts.

E. Provide transformers, wiring and accessories,

F. Refer to Section 23 05 48 - Noise and Vibration Controls for HVAC Piping and Equipment.

G. Install Work in accordance with IBC-NJ.

H. Install lined duct elbow on return air opening. Provide access for filter replacement.

3.03 ADJUSTING

A. Division 01 - Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to 0 percent full flow.

3.04 INTERFACING WITH AUTOMATIC TEMPERATURE CONTROLS (ATC) VENDOR - DIVISION 23 09 93

A. The following equipment will be supplied by the ATC Contractor and installed by the terminal manufacturer:

1. Damper motor.

2. DDC microprocessor.

3. Pressure transducers if it is not self-contained in the DDC microprocessor.

B. Contractor shall exchange information and coordinate the following set points with the ATC Contractor for each box.

1. Maximum primary air velocity or CFM set point.

2. Minimum primary air velocity or CFM set point.

3. Cooling set point.

4. Heating set point.

5. Terminal unit discharge air volume (CFM).

C. All VAV boxes shall be identified on the bottom of the unit and on the shipping carton with the floor and box number that identifies it along with the CFM settings.

END OF SECTION