# Suggested Specifications

**Dual Duct Terminal Units**

# 3200 Series

## Model 3210 • Without attenuator

**1.01** Furnish and install **Nailor Model 3210 Dual Duct Variable Volume Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (DDC, analog electronic, pneumatic) controls. Units shall reset to any flow between 0 and the maximum cataloged airflow as allowed by the specific controller.

**1.02** The terminal units shall be provided with two primary variable air volume dampers that control the air quantity in response to a (DDC, analog electronic, pneumatic) thermostat. The space limitations shall be reviewed carefully to insure that all units will fit into the space allowed.

**1.03** Unit casing shall be 22 gauge galvanized steel with round or flat oval inlets with 5 1⁄2" (140 mm) deep inlet duct dollar for field connection. Outlets shall be rectangular and configured for slip and drive connections. Casing leakage downstream of the damper shall not exceed 1% at 1" w.g. (250 Pa). High side casing leakage shall not exceed 2% at 3" w.g. (750 Pa).

**1.04** Damper assemblies of 16 gauge galvanized steel shall be multiple opposed blade construction arranged to close at 45 degrees from full open to minimize air turbulence and provide near linear operation. Damper blades shall be fitted with flexible seals for tight closure and minimized sound generation. Damper blades shall be screwed through the shaft to insure that no slippage occurs. Blade shafts shall pivot on corrosion free Celcon® bearings. In the fully closed position, air leakage past the closed damper shall not exceed 2% of the nominal catalog rating at 3" w.g. (750 Pa) inlet static pressure as rated by ASHRAE Standard 130.

**1.05** The terminal units shall be capable of operation as described herein with an inlet static pressure of 0.10" w.g. (24 Pa) from 0 to 2000 fpm. (The sequence of operations should be described here, if not part of the temperature controls specifications.) Each unit shall be complete with factory mounted (DDC, analog electronic, pneumatic) controls. Gauge tap ports shall be supplied in the piping between the flow pick up and the controller.

**1.06** Each unit shall be constructed with single point electrical (or pneumatic) connections. All electrical components shall be ETL or UL listed or recognized and installed in accordance with the National Electrical Code. All electrical components shall be installed in a control box. The entire assembly shall be ETL listed and so labeled.

**1.07** Each unit shall be internally lined with 3⁄4" (19) dual density fiberglass insulation. Edges shall be sealed against airflow erosion. Units shall meet NFPA 90A and UL 181 standards.

**1.08** All sound data shall be compiled in an independent laboratory and in accordance with the latest version of AHRI Standard 880 and ANSI/ASHRAE Standard 130. All units shall be AHRI certified and bear the AHRI certification label. 11. An electronic motor speed controller sized and designed for the specific blower motor combination shall be provided to allow infinitely adjustable fan speed from the minimum voltage stop to the line voltage signal to the motor. A minimum voltage stop shall be employed to ensure that fan cannot run in stall mode.

## Model 3230 • With compact mixing attenuator

**1** Furnish and install **Nailor Model 3230 Dual Duct Variable Volume Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (DDC, analog electronic, pneumatic) controls. Units shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

**2** The terminal units shall be provided with two primary variable air volume dampers that control the air quantity in response to a (DDC, analog electronic, pneumatic) thermostat. The space limitations shall be reviewed carefully to insure that all units will fit into the space allowed.

**3** Unit casing shall be 22 ga. (.86) galvanized steel with round or at oval inlets with 5 1⁄2" (140) deep inlet duct collar for field connection. Outlets shall be rectangular and configured for slip and drive connections. Casing leakage downstream of the damper shall not exceed 1% at 1" w.g. (250 Pa) of terminal rated airflow.

**4** Damper assemblies of 16 ga. (1.63) galvanized steel shall be multiple opposed blade construction arranged to close at 45 degrees from full open to minimize air turbulence and provide near linear operation. Damper blades shall be fitted with flexible seals for tight closure and minimized sound generation. Damper blades shall be screwed through the shaft to insure that no slippage occurs. Blade shafts shall pivot on corrosion free Celcon® self lubricating bearings. Damper leakage shall not exceed 2% of nominal terminal flow at 3" w.g. (750 Pa).

**5** The terminal units shall be capable of operation as described herein with a minimum inlet static pressure that shall not exceed 0.66" w.g. (164 Pa) at 2000 fpm. (The sequence of operations should be described here, if not part of the temperature controls specifications.) Each unit shall be complete with factory mounted (DDC, analog electronic, pneumatic) controls.

**6** Each unit shall be constructed with single point electrical (or pneumatic) connections. All electrical components shall be ETL or UL listed or recognized and installed in accordance with the National Electrical Code. All electrical components shall be installed in a control box. The entire assembly shall be ETL listed and so labeled.

**7** Each unit shall be provided with two flow sensor. Flow sensors may be located in the cold or hot deck inlet or as a combination of inlet and total flow location. The airflow sensor shall be a multi-point averaging type Diamond Flow Sensor constructed of aluminum. Gauge tap ports shall be supplied in the piping between the Diamond Flow Sensor and the controller.

**8** The casing shall include integral mixing baffles constructed inside a mixing attenuator to efficiently mix the cold and hot supply airstreams. When operating in mixing mode, the mixing attenuator shall provide an efficiently mixed cold and hot airstream so that the average discharge temperature variation is no more than 1°F (0.6°C) for every 12°F (6.7°C) difference between the cold and hot supply air temperatures.

**9** Each unit shall be internally lined with 3/4" (19) dual density fiberglass insulation. Edges shall be sealed against airflow erosion. Units shall meet NFPA 90A and UL 181 standards.

**10** All sound data shall be compiled in an independent laboratory and in accordance with the latest version of AHRI Standard 880 and ANSI/ASHRAE Standard 130. All units shall be AHRI certified and bear the AHRI certification label.

## Model 3240 • "BLENDMASTER™" with high efficiency mixing attenuator

**1** Furnish and install **Nailor Model 3240 "BLENDMASTER™" Dual Duct Variable Volume Terminal Units** of the sizes and capabilities as indicated on the drawings. Units shall be pressure independent with (DDC, analog electronic, pneumatic) controls. Units shall reset to any flow between minimum and the maximum cataloged airflow as allowed by the specific controller.

**2**  The terminal units shall be provided with two primary variable air volume dampers that control the air quantity in response to a (DDC, electric, analog electronic, pneumatic) thermostat. The space limitations shall be reviewed carefully to insure that all units will fit into the space allowed.

**3**  Unit casing shall be 22 ga. (.86) galvanized steel with round or flat oval inlets with 5 1⁄2" (140) deep inlet duct collar for field connection. Outlets shall be rectangular and configured for slip and drive connections. Casing leakage downstream of the damper shall not exceed 1% at 1" w.g. (250 Pa) of terminal rated airflow. High side casing leakage shall not exceed 2% at 3" w.g. (750 Pa).

**4** Damper assemblies of 16 ga. (1.63) galvanized steel shall be multiple opposed blade construction arranged to close at 45 degrees from full open to minimize air turbulence and provide near linear operation. Damper blades shall be fitted with flexible seals for tight closure and minimized sound generation. Damper blades shall be screwed through the shaft to insure that no slippage occurs. Blade shafts shall pivot on corrosion free Celcon® self lubricating bearings. Damper leakage shall not exceed 2% of nominal terminal airflow at 3" w.g. (750 Pa).

**5** The terminal units shall be capable of operation as described herein with a minimum inlet static pressure that shall not exceed 0.51" w.g. (127 Pa) at 2000 fpm (10.2 m/s). (The sequence of operations should be described here, if not part of the temperature controls specifications.) Each unit shall be complete with factory mounted (DDC, analog electronic or pneumatic) controls.

**6** Each unit shall be constructed with single point electrical (or pneumatic) connections. All electrical components shall be ETL or UL listed or recognized and installed in accordance with the National Electrical Code. All electrical components shall be installed in a control box. The entire assembly shall be ETL listed and so labeled.

**7**  Each unit shall be provided with two flow sensors. Flow sensors may be located in the cold or hot deck inlet or as a combination of inlet and total flow location. The airflow sensor shall be a multi-point averaging type Diamond Flow constructed of aluminum Sensor constructed of aluminum. Gauge tap ports shall be supplied in the piping between the Diamond Flow Sensor and the controller.

**8** The easing shall include integral mixing baffles constructed inside a mixing attenuator to efficiently mix the cold and hot supply airstreams. When operating in mixing mode, the mixing attenuator shall provide an efficiently mixed cold and hot airstream so that the average discharge temperature variation is no more than 1°F (0.6°C) for every 30°F (16.7°C) difference between the cold and hot supply air temperatures.

**9** Each unit shall be internally lined with 3⁄4" (19) dual density fiberglass insulation. Edges shall be sealed against airflow erosion. Units shall meet NFPA 90A and UL 181 standards.

**10**  All sound data shall be compiled in an independent laboratory and in accordance with the latest version of AHRI Standard 880 and ANSI/ASHRAE Standard 130. All units shall be AHRI certified and bear the AHRI certification label.

# Control Specifications (select one)

## EZvav Digital Controls

**1.1 ASC VAV BACnet CONTROLLERS**

A. Digital VAV Controllers shall be responsible for monitoring and controlling directly connected VAV Terminals as required. Controllers shall include fully adjustable analog outputs and digital outputs as required utilizing a proportional plus integral control loop to control damper, electric heat and hot water coils for the purpose of maintaining user setpoints. Each controller shall be classified as a native BACnet device, conforming to the BACnet Advanced Specific Controllers (B-ASC) profile, ANSI/ASHRAE BACnet Standard 135.

B. The VAV controller shall be available with integrated applications (based on model) for Single Duct, Dual Duct, and Fan Powered terminal units, including any of the following as required by the control sequence. For Single/Dual Duct terminals: Cooling Only, Cooling/Heating with Changeover and Morning Warm up. For Fan Powered terminals: Cooling with Reheat/Supplementary Heat, Heating coil operation may be with analog, floating or binary control as required.

C. The controller shall be fully configurable via the Digital Display Sensor, including communication parameters (instance, MAC, baud) and application settings (K-factor, flow limits, box configuration, reheat or fan type, default user setpoints, etc.), without any specific PC-based software. VAV controllers shall not require the use of a personal computer and PC based software and/or any interface modules.

D. The VAV controller shall be capable of being balanced from the Digital Room Sensor without any specific pc-based software.

E. The controller shall have integrated MS/TP communications. The communication port shall have network protection bulbs and integrated end-of-line (EOL) terminations.

F. The controller shall have an integrated actuator rated at 40 in-lbs. Connection to the damper shall be with a v-bolt clamp, accepting 3/8" to 5/8" damper shaft sizes. The actuator shall travel 0 to 95 degrees with adjustable end stops at 45 and 60 degrees of rotation. The actuator shall have an integrated gear disengagement mechanism.

G. The controller shall have an integrated transducer pressure sensor for airflow measurement. The sensor shall have a range or 0-2"wc, consuming and accurate to 4.5% of reading or 0.0008"wc, whichever is greater.

H. The controller shall have a Dedicated Room Sensor port for direct interface to a Digital Display Room Sensor or Discrete Room Sensor. The controller shall have the ability of detecting if a sensor has been connected to the port and identify its type, either digital display or discrete. Sensors shall be hot-swappable without powering down the controller. Sensor information via the ports shall not consume any of the devices terminated input capacity.

I. The controller shall have screw terminal blocks that can accommodate wire sizes 14-22 AWG. Terminals shall be color coded: black terminals for power, green terminals for input and outputs, and grey terminals for twisted-shielded-pair communication.

J. The power supply for the controller shall be 24 volts AC (-15%, +20%) power. Voltage below the operating range of the system shall be considered an outage.

**1.2 DIGITAL ROOM SENSOR**

A. The Digital Display Room Sensor (thermostat) shall provide space condition measurements and indications, including temperature and local motion/occupancy (optional), and user setpoint adjustments.

B. The Digital Room Sensor shall connect directly to the controller and shall not utilize any of the hardware I/O points of the controller. The Digital Display Room Sensor shall be able to be located up to 75’ from the controller.

C. The Digital Display Room Sensor shall provide a Temporary Network Interface jack, field accessible without uninstalling the sensor, for connection to the BACnet MS/TP communication trunk to which the devices connected. The Digital Display Room Sensor, the connected controller, and all other devices on the BACnet network shall be accessible through the temporary communication jack. Microprocessor based sensors whose port only allows communication with the controller to which it is connected shall not be acceptable.

D. The Digital Display Room Sensor shall have an integrated sensor for temperature measurement as standard and a second integrated sensor for motion/occupancy (optional).

E. User/Occupant setpoints may be adjusted via the Digital Display Room Sensor.

F. The Digital Display Room Sensor shall have pre-configured menus for all control sequences allowing access to communication and application parameters.

G. The Digital Display Room Sensor shall have two levels of password protection: One level to protect user setpoint adjustment, and one level to protect configuration menu parameters. Passwords shall be at least 4 digits in length.

Digital (DDC) Controls **(Pressure Independent)
Factory Mounting Procedure**

**1.** The terminals shall be equipped with pressure independent direct digital controls supplied by the control contractor under the automatic temperature controls Division 17 and mounted by the terminal unit manufacturer. The control contractor shall, in addition to sending the controls to the terminal unit manufacturer, provide technical data sheets for all components to be mounted, including dimensional data, mounting hardware and method, as well as application specific wiring and piping diagrams for each terminal type as depicted on the schedules and mechanical drawings.

**2.** Controls shall be compatible with the pneumatic ‘Diamond Flow' multi-point averaging flow sensor supplied by the terminal manufacturer. Sensors shall have four pick-up points on each side to ensure that controller fidelity shall be ± 5% of set volume with any typical air turbulence in the duct and any typical flex inlet condition and with an inlet static variation of 0.05" w.g. to 6.0" w.g. (12 – 1500 Pa). The sensor shall amplify the sensed velocity pressure and provide a minimum differential pressure of 0.03" w.g. (7.46 Pa) at 500 fpm (2.54 m/s) inlet velocity. Flow measuring taps and flow curves shall be furnished with each terminal.

**3.** Controls shall be configured and field calibrated in the field by the control contractor after terminal installation has been completed. Pneumatic tubing shall be UL Listed fire retardant (FR) type. Each terminal shall be supplied with a label showing unit type, model number, size and tag location.

**4.** The terminal manufacturer shall provide a Class 2, 24 VAC control transformer with internal current limiting protection and disconnect switch. All controls shall be installed in an approved NEMA 1 enclosure supplied and installed by the terminal manufacturer.

Analog Electronic Controls **(Pressure Independent)**

**1.** The terminal unit manufacturer shall provide factory mounted pressure independent analog electronic controls which can be reset to modulate airflow between zero and the maximum cataloged capacity. Each terminal shall be equipped with labels showing unit size, location and minimum and maximum airflow settings. Controls shall be factory calibrated and set for the scheduled minimum and maximum flow rates.

**2.** Units shall be supplied with two **Nailor** Diamond flow sensors with four pick-up points on each side to ensure that controller fidelity shall be within ± 5% of set volume under various same size duct inlet conditions and inlet static variation of 0.05" – 6.0" w.g. (12 – 1500 Pa). The sensor shall amplify the sensed velocity pressure and provide a minimum differential pressure of 0.03" w.g. (7.46 Pa) at 500 fpm (2.54 m/s) inlet velocity. Flow measuring taps shall be furnished with each terminal. All pneumatic tubing shall be UL listed for fire retardant (FR) type.

**3.** Velocity controllers shall have a constant 2°F (1.11°C) reset span regardless of minimum and maximum airflow limits. They shall include an onboard flow-through transducer utilizing twin platinum resistance temperature detectors and shall be capable of controlling a velocity set point from 0 – 3300 fpm with an accuracy of 3%. The controller shall allow all airflow adjustments to be made from the matching room thermostat. The thermostat shall be furnished by the terminal unit manufacturer and provide a live velocity readout and feature semi-concealed set point slider(s) and set point indicator(s) and thermometer with a Fahrenheit (centigrade optional) scale plate.

**4.** The terminal shall have two 24 VAC combination controller/actuator single assemblies. The actuator shall be of a direct drive design and provide a minimum torque of 50 in. lbs. (5.6 Nm). Actuators shall be of the floating reversible type and include a magnetic clutch, adjustable stops and a gear disengagement button. A tri-color LED shall indicate green for opening, red for closing and white for satisfied damper positions. Power consumption of the controller/actuator shall not exceed 4 VA.

**5.** The terminal manufacturer shall provide a Class 2, 24 VAC control transformer with internal current limiting protection. All controls shall be installed in an approved NEMA 1 enclosure.

Pneumatic Controls **(Pressure Independent)**

**1.** The terminal unit manufacturer shall provide factory mounted pressure independent controls which can be reset to modulate airflow between minimum and the maximum cataloged capacity. Maximum airflow limits or mechanical volume regulators are not acceptable.

**2.** Each unit shall be supplied with two **Nailor** Diamond flow sensors with four pick-up points on each side to ensure that controller fidelity shall be within ± 5% of set volume under various same size duct inlet conditions and inlet static variation of 0.05" – 6.0" w.g. (12 – 1500 Pa). The sensor shall amplify the sensed velocity pressure and provide a minimum differential pressure of 0.03" w.g. (7.46 Pa) at 500 fpm (2.54 m/s) inlet velocity. Flow measuring taps shall be furnished with each terminal.

**3.** Reset volume flow controllers shall have a constant reset span regardless of the minimum and maximum airflow settings selected. Reset span shall be adjustable from a minimum of 5 psi up to a maximum of 10 psi. Reset start point shall be adjustable from 3 – 10 psi. Controller air bleed off through the flow sensor is not acceptable. Controller shall be field convertible for direct or reverse acting. The compressed air consumption of each controller shall not exceed 1.0 SCFH at 20 psi. Acceptable controller is Kreuter CSC-3011 or equal.

**4.** Reset volume controllers shall be factory calibrated and set for the scheduled maximum and minimum airflow settings. Flow measuring taps and flow charts shall be supplied with each terminal unit for field balancing and adjustment of airflow. All pneumatic tubing shall be UL listed fire retardant (FR) type. Each terminal shall be supplied with a label showing unit type, size, tag location, minimum and maximum airflow settings and control sequence number. Pneumatic spring return actuators shall be provided and factory mounted by the terminal unit manufacturer.

**5.** Reset volume controllers shall be factory set and calibrated for operation with a direct/reverse (select one) acting room thermostat.

The cold duct actuator/damper connection shall be factory mounted to fail to a normally open/closed (select one) position upon loss of control main air pressure. The hot duct actuator/damper connection shall be factory mounted to fail to an open/closed (select one) position.