Direct Digital Controls (DDC)

Microprocessor based technology is now commonplace in HVAC building management systems, particularly in larger building applications. Most controls companies have therefore developed DDC controllers and software programs for terminal units, to enhance energy efficient VAV systems and the well proven associated control strategies. VAV digital controllers are only one part of a much larger fully integrated building management system and the common availability and specification of terminal unit DDC controllers from control companies ensures compatibility and common protocol for trouble-free systems communication, maintenance support and trouble shooting. Digital VAV controls offer all the advantages of accurate, pressure independent operation plus the additional benefits of a networking capability and two-way communication. Parameters can be loaded and downloaded via communication with a remote PC.

Nailor has extensive experience factory mounting digital controls supplied by the temperature control contractor. Nailor has developed individual factory mounting programs for most manufacturers currently offering digital controls, providing the assurance of a high quality, professional installation and minimizing start-up problems.

Nailor has designed its terminal units to be generic in nature and compatible with all DDC controllers.

• Nailor supplies as standard a NEMA 1 full controls enclosure for protection of the controls during shipment, installation and for the life of the building HVAC system. Dust tight construction is an option.

• The vast majority of digital controls require a flow sensor. Nailor's Diamond Flow multi-point averaging sensor is compatible with all such controls. Nailor will mount its own sensor as standard, whether the digital controls are to be factory or field mounted, ensuring accurate measurement regardless of inlet conditions. Factors have been developed for loading into the flow control algorithm.

• UL Class 2 control transformers and disconnect switches are available from Nailor factory installed. All components carrying 120 VAC or higher should be supplied and installed by Nailor in order to maintain ETL listings.

• Separate isolation control transformers are available on fan terminal units to protect digital components from potentially harmful voltage spikes.

• An economical factory approved tri-state 24 VAC, 40 in. - lb. (4.5 Nm) torque direct drive actuator is available from Nailor when the DDC controller being mounted is available for use with a separate actuator.

Models: MEP-4003 60°/minute
MEP-5061 18°/minute

Optional Nailor supplied and mounted 'Tri-state' Series Actuator.

Nailor EZvav Digital Controls

The EZvav Digital Controls by Nailor bring simplicity to the Variable Air Volume (VAV) terminal unit market. Designed for both stand-alone applications and for integration with BACnet building automation systems, EZvav are precise P+I pressure independent VAV controllers that are pre-configured for standard control sequences that cover the vast majority of terminal unit applications.

All terminal units with electric or hot water heating coils are supplied as standard with a DAT Discharge Air Temperature control sensor that can limit the discharge air temperature to a maximum of 15°F above room set point, helping compliance with ASHRAE Standard 62.1 and 55.

Field commissioning and balancing can all be performed using the standard digital display room temperature sensor, which has an intuitive menu driven setup. No laptop, expansion modules, communication interface or software is required.

EZvav Digital Controls

Nailor EZvav Digital Controls (continued)

Features & Benefits:

- Integrated controller/actuator/transducer.
- Factory mounted and wired for new building applications.
- Ideal for retrofitting and upgrading pneumatic and analog controls to a digital solution.
- Room temperature sensor (thermostat) options include Digital Display, Occupancy Sensor and compact Rotary Dial models.
- Remote fan volume adjustment from 0 – 100% for EPIC ECM fan powered terminals.
- Simple menu driven setup.
- BACnet BMS network integration ready.

Application Control Sequences Include:

- Single Duct VAV or CAV Cooling only and Heat/Cool Changeover.
- Single Duct VAV Cooling with reheat.
- Dual Duct Variable Volume or Constant Volume control.
- Series Fan Powered Constant Volume with/without supplementary heat.
- Parallel Fan Powered Variable Volume with/without supplementary heat.

Heating Control Options:

Binary (up to 3 stages of electric heat), Modulating (0 – 10 Vdc analog) or Floating heat control.

Native BACnet

All models are BACnet Applications Specific Controllers that are ready to connect to a BACnet MS/TP network. Device instance, MAC address and baud rate are set from an STE-8001W36 without special software.

EZ to order

Nailor Representatives' Automated Pricing Program (RAPP) features EZ quick select options for control sequences and room temperature sensor options based on terminal unit type and application requirement.

EZ to install

For field retrofit applications, the EZvav controller is mounted within a terminal unit controls enclosure and directly coupled to the damper shaft. The flow sensor, power supply, heat and temperature sensors are then connected. The EZvav controller automatically detects them without programming or software tools.

EZ to setup, commission and balance

All options can be set by using an STE-8001W36 sensor as a technician's service tool or installed as a permanent room sensor. The EZvav Controller can be stocked by representatives to provide a simple digital solution to their customers that wish to upgrade their pneumatic or analog inventory to a new digital solution, perfect for retrofit applications!

EZvav Digital Controllers:

Model Number	Application
BAC-8001-36	Single Duct Cooling and Heat/Cool changeover
BAC-8005-36	Single Duct with Reheat and Fan Powered Applications
BAC-8007-36	Dual Duct Master
TSP-8001-36	Dual Duct Secondary Actuator

Room Temperature Sensor (Thermostat) Options:

STE-8001W36 Digital Display

- Temperature readout in deg F or C. (and time of day when networked). User Set point adjustment.
- Field Commissioning Tool.
- Password Capable.

STE-8201W36 Digital Display with Occupancy Sensor

- Same Features as STE-8001W36 with Occupancy Motion Sensor that provides unoccupied, setback and standby control.

STE-6014W36 Rotary Dial

- Small, compact and discreet.
- Economical.
- Set point Adjustable Only.

Nailor EZvav Digital Controls (continued)

Technical Specifications:

Inputs and Outputs

All inputs and outputs for EZvav controllers are set up at the factory and do not require field programming.

Inputs

- Sensors are automatically detected.
- Inputs accept industry-standard 10K ohm thermistor sensors.
- Input over voltage protection up to 24 volts AC, continuous.
- 12-bit analog-to-digital conversion.

Triac outputs

- Optically isolated triac output.
- Maximum switching 24 volts AC at 1.0 ampere for each output.
- Maximum for controller is 3.0 amperes.

Analog outputs

- Short-circuit protected.
- Output voltage 0–10 volts DC.
- 30 mA per output, 30 mA total for all analog outputs.
- 12–bit digital-to-analog conversion.

Airflow sensor

CMOS differential pressure 0–2 inches of water (0–500 Pa) measurement range. Internally linearized and temperature compensated.

- Configured as BACnet analog input object.
- Span accuracy 4.5% of reading.
- Zero point accuracy 0.0008 in. H_2O/0.2 Pa at 77° F (25° C).
- Barbed connections for 1/4 inch FR tubing.

Actuator

Torque	40 in-lb. (4.5 N.m)
Angular Rotation	0 to 95°
	Adjustable end stops at 45 and 60° rotation

Motor Timing

90 sec./90°at 60 Hz. 108 sec./90° at 50 Hz.

Shaft size

Directly mounts on 3/8 to 5/8 inch (9.5 to 16 mm) round or 3/8 to 7/16 inch (9.5 to 11 mm) square damper shafts.

BACnet communication

- Integrated peer-to-peer BACnet MS/TP network communications.
- Network speed from 9600 to 76,800 baud.
- Meets or exceeds ANSI/ASHRAE BACnet Standard 135-2008 for Application Specific Controllers.

Installation:

Supply voltage	24 volts AC (–15%, +20%),
	50–60 Hz, 5 VA, Class 2 only
Weight	13.2 ounces (376 grams)
Case material	Gray and black flame retardant plastic

Environmental limits

Operating	32 to 120° F (0 to 49° C)
Shipping	–40 to 140° F (–40 to 60° C)
Humidity	0–95% relative humidity (non-condensing)

Regulatory

- UL 916 Energy Management Equipment.
- BACnet Testing Laboratory listed as Application Specific Controller (ASC).
- CE compliant.
- SASO PCP Registration KSA R-103263.
- FCC Class B, Part 15, Subpart B and complies with Canadian ICES-003 Class B.

Digital Controls Factory Mounting Authorization Program

Nailor Industries Terminal Units are generic in nature and compatible with all DDC controls currently available.

Nailor usually supplies and mounts its own Diamond Flow multi-point averaging flow sensor.

Controls may be factory mounted and wired by **Nailor** or field installed by the controls contractor. Nailor has a wealth of experience supplying terminal units with digital controls supplied by the Air Temperature Control (ATC) contractor, a very common requirement in today's VAV marketplace.

We have worked with all major controls companies in recent years and have developed standard factory mounting programs to ensure the highest professional, quality installation. Nailor provides custom wiring diagrams in color for each individual project.

A 24 volt Class 2 control transformer and fan relay are provided by Nailor as standard on all fan powered terminals intended for use with digital controls in order to comply with UL and ETL requirements.

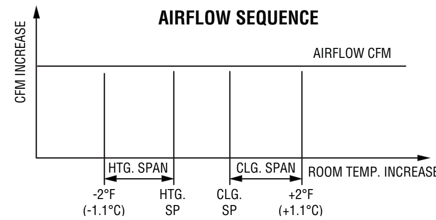
Standard Control Sequences • Single Duct Terminal Units

Nailor EZvav • Pressure Independent

Control Sequence N110

Models: 3001, 3001Q and 30HQ
Cooling Only, Constant Volume

1. Airflow setpoint is maintained.



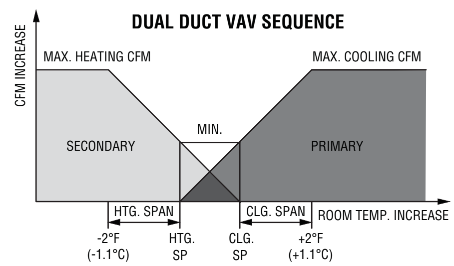
Standard Control Sequences • Dual Duct Terminal Units

Nailor EZvav • Pressure Independent

Control Sequence N200

Models: 3230 and 3240
Variable Volume

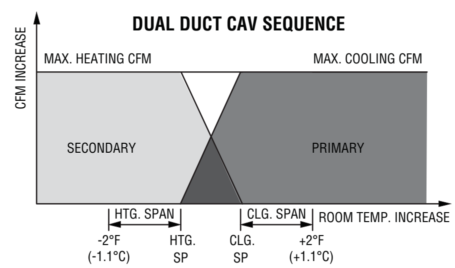
1. As the space temperature rises above the cooling setpoint, the primary airflow is modulated from the cooling minimum flow to the cooling maximum flow.
2. As the space temperature falls below the heating setpoint, the secondary airflow is modulated from the heating minimum flow to the heating maximum flow.
3. Between the heating and cooling setpoints, both the primary airflow and secondary airflow are modulated to maintain the dual mixing minimum.



Control Sequence N201

Models: 3230 and 3240
Constant Volume

1. As the space temperature rises above the cooling setpoint, the primary airflow is modulated from the cooling minimum flow to the cooling maximum flow.
2. As the space temperature falls below the heating setpoint, the secondary airflow is modulated from the heating minimum flow to the heating maximum flow.
3. Between the heating and cooling setpoints, both the primary airflow and secondary airflow are modulated to maintain the dual mixing minimum.



Standard Control Sequences • Dual Duct Terminal Units

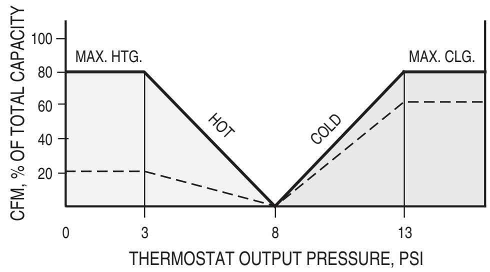
Pneumatic • Pressure Independent • 3000 Controller

The typical control diagrams shown on this page represent the most commonly used dual duct control strategies. The schematics illustrate operation with a direct acting thermostat. Similar control sequences are available for use with reverse acting thermostats. Further variations for each sequence include right or left hand cold deck and damper failure state, normally open or normally closed upon loss of main air. Application specific control strategies are available from your Nailor representative.

Control Sequence DP1 • Model 3210

- **Variable Volume – Hot and Cold Airflow without Mixing and Zero Minimum**
- **Hot and Cold Deck Inlet Sensing.**

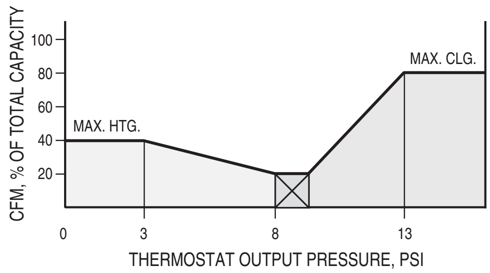
The hot and cold decks are set for equal or unequal maximum air volumes, with minimum setting of zero flow at 8 psi. With rise in room temperature the cold air damper will open to the preset maximum airflow in response to signals from room stat. The hot air damper will be closed. As the space temperature drops the cold air damper modulates to shut off at 8 psi and then the hot air damper begins to open. If the space temperature continues to drop, the hot air damper opens to the maximum setting. No mixing of hot or cold airflow occurs.



Control Sequence DP2 • Model 3230 and 3240

- **Variable Volume – Hot and Cold Airflow with Mixing at Minimum Flow**
- **Total Air Sensing – In Common Discharge • (Hot Deck Make-up Illustrated)**

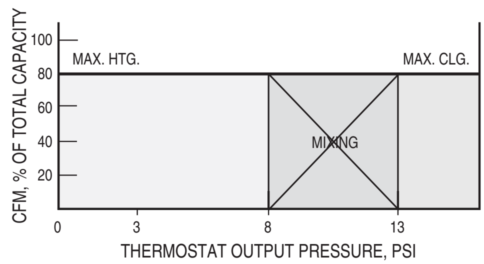
The hot and cold decks may be for equal or unequal maximum air volumes. The cold duct minimum flow rate is set for zero at 8 psi, while the hot duct minimum setting at 8 psi may be set at any desired volume up to but not exceeding its maximum setting. As the hot duct sensor located downstream is measuring total airflow, when thermostat output pressure begins to exceed 8 psi and the cold deck begins to open, the hot duct damper starts closing again and holds total airflow at the hot duct minimum setting. As the cooling load increases and the cold deck continues to open, the cold airflow, which is not controlled by the downstream sensor, exceeds the hot duct minimum setting at which point the hot duct damper is fully closed.



Control Sequence DP3 • Model 3230 and 3240

- **Constant Volume – Mixing Hot and Cold Airflow**
- **Total Air Sensing – In Common Discharge • (Hot Deck Make-up Illustrated)**

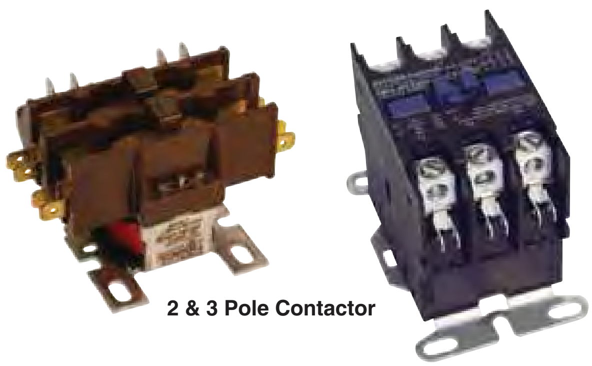
A downstream velocity sensor controls the hot deck and also holds total airflow of any hot-cold air mixture to a constant volume. Because the hot air velocity sensor is downstream of the unit, it directly measures the condition that is being controlled, i.e., total flow. The cold duct controls operate independently in response to signals from a room stat. The hot and cold deck maximum airflows are set for the same maximum flow rate. The hot deck minimum is set for zero flow at 13 psi. The cold deck minimum is set for zero flow at 8 psi. This arrangement will provide an extremely accurate constant volume flow cooling range over the entire heating and cooling range.



Electric Heater Controls

Nailor offers three control options for controlling electric heat on terminal units, conventional staged heat, SCR (Silicon Controlled Rectifier) and SCR with Discharge Temperature Control (DTC). All options provide a method for controlling, dependent on demand, the amount of heat needed within an occupied space. By adjusting the heat output into the occupied zone, energy is conserved by more precisely regulating output to closely match demand. Each control type subsequently requires a control signal, a control interface and device to energize heating coil elements.

Nailor's conventional staged heat works with digital (DDC), electronic and pneumatic control systems. A maximum of 3 stages are available. When heating is needed an on/off control signal typically 24 VAC, powers a mechanical contactor to energize a set of heating elements connected to line voltage. If the unit is equipped with more than one stage of heat, additional mechanical contactors can be triggered as demand requires. This setup allows for a wide range of line voltages as well as phase requirements needed to meet job specifications.



2 & 3 Pole Contactor

Nailor offers 2 versions of SCR proportional heat control, basic SCR and SCR with DTC. SCR heater controls provide proportional modulation over the full heater operating range. Since the SCR unit is controlled by solid state electronics, the control signal is very precise, reliable and silent. SCR control works with digital (DDC) (additional component required), analog and pneumatic controls packages. When heating is required, a control input signal is sent to the SCR controller board as 4-20mA, 2-10VDC or 0-10 VDC. In turn, a 1-24 VDC pulsed output will be sent to a single or multiple SSR's (Solid State Relay) to energize the heating elements. Simultaneously, all the heater elements will be pulsed on and off based on the time proportional signal from the SCR controller. The result is proportioned heat to meet demand, thus conserving energy.

SCR Controller with SSR

To further increase efficiency, Nailor offers an SCR controller with a DTC option. By measuring differential temperature across the heating coils, the SCR controller will update the proportional signal sent to the SSR's to ensure the heat output of the elements is optimized. As an added benefit and safety measure, during low flow situations the heater will de-energize if it detects too great a temperature differential across the heater. This saves both energy and costs as a mechanical airflow switch is no longer needed. The DTC option also has an adjustable potentiometer, which allows the controller to limit the maximum discharge air temperature of the heater, allowing you to meet the requirements of the ASHRAE standards. SCR heat is very precise, energy efficient, silent and compatible with modern controls packages.

SCR Controller with DTC

Electric Heating Coils

Application Guidelines

Discharge Air Temperature

When considering the capacity and airflow for the heater, discharge air temperature can be an important factor. Rooms use different types of diffusers and they are intended to perform different functions. Slots that blend the air at the glass and set up air curtains within the room, must be able to blow the air very low in the room. Hot air will be too buoyant to be effective in this case. Discharge air temperatures for this application should be in the 85 – 90°F (29 – 32°C) range.

Diffusers in the center of the room blend their discharge air as it crosses the ceiling. Discharge air temperatures in this application can be as high as 105°F (41°C) and still be effective. However, if the return air grilles are in the discharge air pattern, the warm air will be returned to the plenum before it heats the room. Again, the air temperature needs to be blended down to an acceptable temperature that can be forced down into the occupied space by the time the air gets to the walls. Discharging warm air into the room at temperatures above 105°F (41°C) usually will set up stratification layers and will not keep the occupants warm if there is a ceiling return because only the top 12" – 24" (300 – 600 mm) of the room will be heated.

The maximum approved discharge air temperature for any Nailor Fan Powered Terminal Unit with supplemental heat is 120°F (49°C). No heater should be applied to exceed this temperature.

Electric Heater Selection

To properly select an electric heater, three things must be determined: the heat requirement for the room, the entering air temperature and the desired discharge air temperature. The heat requirement for the room is the sum of the heat loss calculation and the amount of heat required to raise the entering air temperature to the desired room temperature. Usually, the second item is small compared to the first for fan powered terminal units in a return air plenum. MBH can be converted to kW by using the chart or by calculation. There are 3.413 MBH in 1000 kW. If using the chart, find the MBH on the left scale, then move horizontally to the right and read kW.

Next, the desired discharge air temperature should be ascertained. This will depend on the type of diffusers that are in the room.

The desired heating airflow for the room can then be calculated using the following equation:

$$\text{cfm} = \frac{\text{kW x 3160}}{\Delta t \text{ (discharge air temp – inlet air temp.) °F}}$$

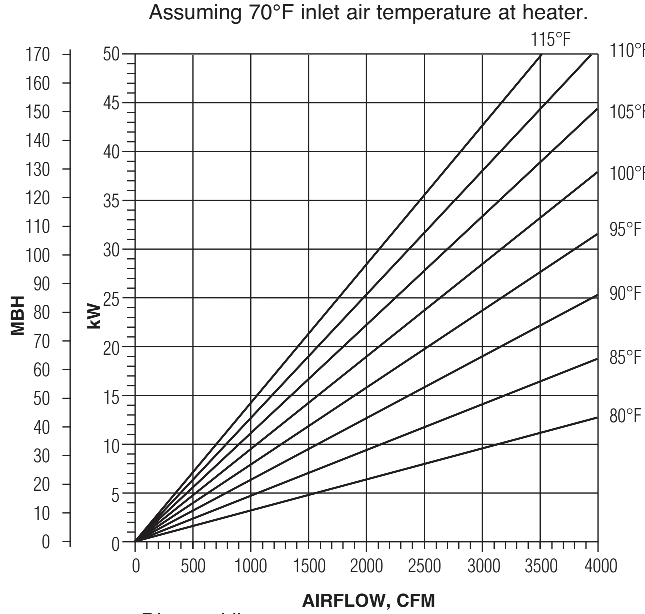
Assuming 70°F (21°C) supply air temperature to the heater, the room airflow can be selected directly from the chart. Start at the left at the design kW. Move horizontally to the desired discharge air temperature. Then, move vertically down to the cfm at the bottom of the chart.

The kW can be selected directly from the chart. Start at the bottom with the design cfm into the room. Move vertically up to the line that represents the desired discharge air temperature. Then, move left to the kW.

The discharge air temperature can also be selected directly from the chart. Start at the bottom with the design cfm into the room. Move to the left side of the chart and find the design kW. Move horizontally and vertically into the chart until the lines intersect. The intersection will be the desired discharge air temperature. Interpolation between the curves is linear.

Heater Selection Chart

Assuming 70°F inlet air temperature at heater.



Diagonal lines are constant output temperature.

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 ½" (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 ¾" (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.

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 ½" (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 exible 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 easing shall include integral mixing baffles constructed inside a mixing attenuater 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.

Dual Duct Terminal Units • 3200 Series

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 ½" (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 provide 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 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 ¾" (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.

Dual Duct Terminal Units • 3200 Series

Control Specifications (select one) (continued)

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.