

CONTROLS

• Pneumatic Controls

A comprehensive range of factory supplied, installed and calibrated controls are available for pressure independent control applications with all terminal types. Pressure dependent controls are also available for certain terminals and applications.

• Analog Electronic Controls

Pressure Independent: New, improved controller/actuator and thermostat design. A comprehensive range of control options are available for all terminal types and pressure independent application sequences. Featuring 'Diamond Flow' multi-point sensor for accurate feedback control.

Pressure Dependent: Factory supplied and installed. A new generation of pressure dependent controls featuring advance micro-computer electronics and proportional integral control algorithms provide precise temperature control. Available for single duct and by-pass applications.

• Direct Digital Controls (DDC)

Nailor has a wealth of experience supplying terminal units for use with state-of-the-art digital controls. We have worked with all major controls companies in recent years and have developed standard factory mounting programs to ensure operational efficiency is maximized for all terminal types and applications.

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

Pneumatic Control Components

Pressure Independent Operation

The heart or 'brain' of the control package is the reset controller, which processes signals from the room thermostat (temperature) and 'Diamond Flow' sensor and resets the primary air damper accordingly.

Airflow is controlled in response to the thermostat demand for heating and cooling to accurately meet the load conditions. At the same time, it holds the airflow rate dictated by the thermostat, regardless of fluctuations in upstream duct pressure. In other words, it is pressure independent. The flow control or reset function is between the minimum and maximum air volume limits. These limits are factory set to the job specification, but can be easily readjusted in the field as required.

In operation, the amplifying sensor located in the terminal inlet signals to the pneumatic reset controller which in turn energizes the pneumatic damper actuator to obtain the required airflow. There is actually a pressure signal feedback to the controller as a result of the damper movement which will correct itself for any velocity pressure fluctuations. Hunting and over controlling are minimized, resulting in stable operating conditions.

Nailor 3000 Controller

Currently the industry's most popular model. Universal pneumatic reset controller (**Model CSC-3011**) compensates for changes in duct pressure-flow. Control is pressure independent with adjustable minimum and maximum air volume settings. Can be used for any combination of direct or reverse acting thermostat action with a normally open or normally closed damper fail position.

Features:

- The controller is factory calibrated to the specified airflow, and is field adjusted easily. Field adjustment is needed only when operating conditions change.
- Pressure independent.

- Reset span remains constant with both maximum and minimum cfm adjustments.
- Reset span is adjustable from 0 to 10 psi (69 kPa) to match any thermostat. Standard setting is 5 psi (35 kPa).
- Reset start point is adjustable from 0 to 10 psi (69 kPa) to work with auxiliaries such as reheat coils. Standard setting is 8 psi (55 kPa).
- Settings for either direct acting or reverse acting thermostat action. Settings for either normally-open or normally-closed damper position, without further controls.
- Accurate control over a duct velocity range of 0 – 3000 fpm (15 m/s).
- Adjustments are made on the face of the controller.
- Adjustments are directly accessible through a ceiling opening with controls mounted and facing downward.
- Operates at low system pressure. Effective from as low as 0.02" w.g. (5 Pa) Ps and as high as 6.0" w.g. (1.5 kPa) Ps.
- Control air consumption is no more than 1.0 SCFH @ 20 psi (0.472 l/min @ 138 kPa).
- Operates on a control air pressure of 15 to 30 psi (103 to 207 kPa).



Nailor 3000 Controller

All pneumatic velocity controllers are not equal

Often an otherwise well designed HVAC system doesn't perform as well as expected, mainly because the reset span (throttling range) of the velocity controllers is too narrow.

Some conventional controllers will modulate over a full 5 psi reset span only when the maximum cfm limit is set at 100% of the terminal unit's capability. Other controllers have a full 5 psi reset span only when the minimum cfm limit is zero. The reset span may also be affected by both the maximum and minimum setting.

Under normal operating conditions the maximum cfm limit is more often set at less than 100% (typically 60 – 80%) of the unit's capability, and the minimum may be above zero. As a result, there are many controllers with working reset spans of only a fraction of 5 psi (see example 1).

This situation is analogous to oversizing a valve so that all of its regulating must be done in a nearly closed position. Accurate control is difficult at best, because of practical limits to the sensitivity of a thermostat.

The Nailor 3000 Solution

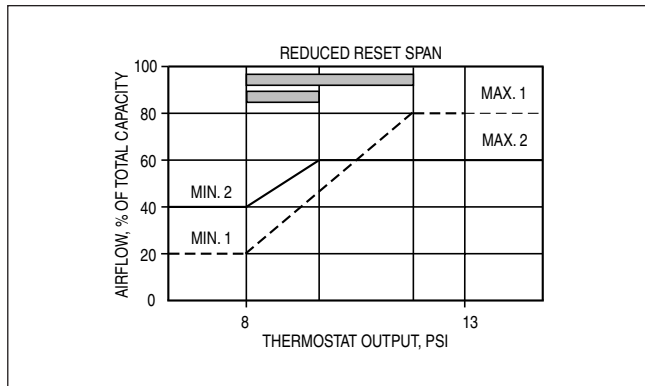
The **Nailor 3000** universal controller always modulates through the full reset span, regardless of the maximum or minimum cfm setting. Hunting is avoided. (See example 2).

The reset span can be adjusted from 3 to 10 psi (5 psi is standard). It is then held constant, even if the cfm settings are changed.

Also, the reset start point is adjustable to match various thermostat throttling ranges such as 3 – 8, 5 – 10, or 8 – 13 psi and to co-ordinate with auxiliaries such as heating coils.

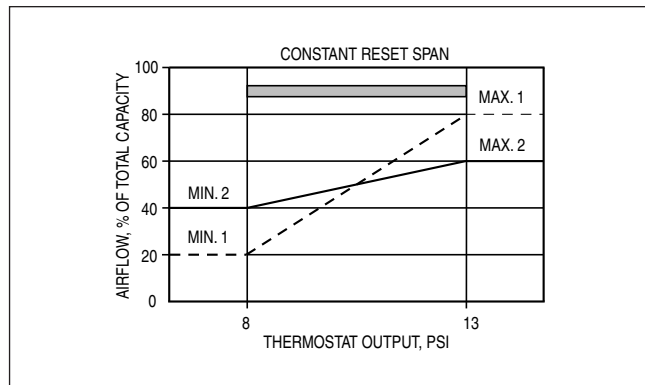
Nailor 2000 Controller (No Longer Available)

While the pneumatic controls market for VAV Terminal Units continues to decline at the expense of DDC and Analog controls, there is still a significant amount of retrofit business. Due to the superior performance of the Nailor 3000 controller described above and the small cost differential, Nailor no longer offers the 2000 controller (CSC-2003 and CSC-2004).



Example 1. Standard Controller (old Nailor 2000)

Reset span is reduced as utilized capacity of terminal and flow settings are reduced.



Example 2. Nailor 3000 Controller

Reset span remains constant regardless of minimum and maximum flow settings.

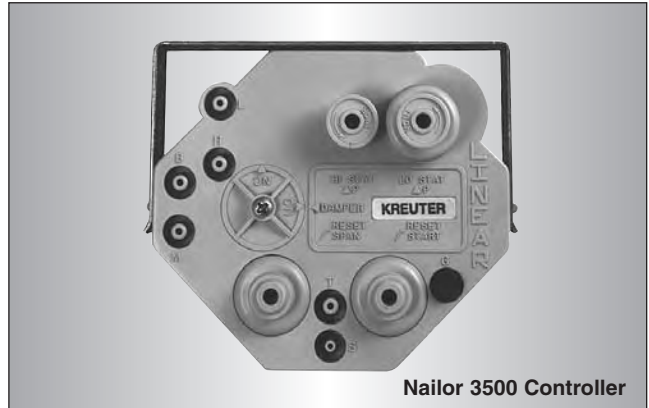


Nailor 2000 Controller (discontinued 2001)

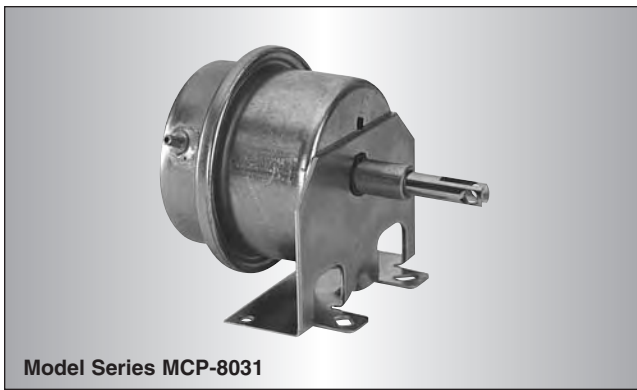
Nailor 3500 Controller

The **CSC-3501** linear pneumatic reset controller provides state of the art technology. Actual velocity is reset linearly with thermostat pressure rather than velocity pressure resulting in a constant reset slope throughout the reset curve. Room stability is improved at low flow conditions.

The 3500 controller has real advantages in dual duct terminal applications where hot and cold decks track each other more accurately as 'reset curve' hysteresis is eliminated and therefore maintain an accurate and near constant total volume flow level during mixing.



Nailor 3500 Controller



Model Series MCP-8031

MCP-8031 Series Actuator

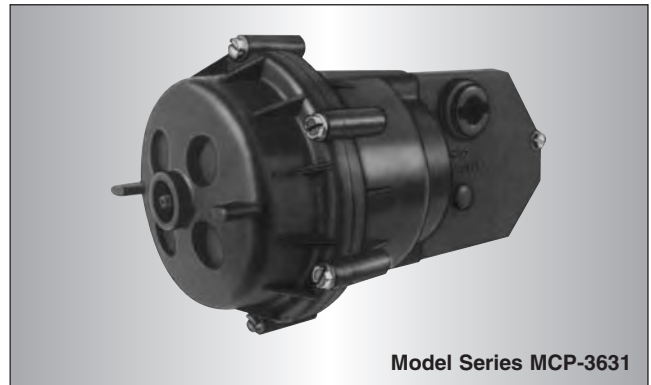
'Piston type' spring return pneumatic damper actuator; totally enclosed all metal casing with neoprene diaphragm. (8 sq. inch effective area). Standard 5 – 10 psi spring range on pressure independent reset controller applications, maximizes performance. Standard on all single duct, dual duct and fan powered pneumatic control terminal units.

- MCP-8031-3101 5 – 10 psi spring range
- MCP-8031-5101 8 – 13 psi spring range
- MCP-8031-8101 3 – 8 psi spring range

MCP-3631 Series Rotary Actuator

Unique rotary-drive design with spring return action upon main air failure. Glass-filled nylon body with neoprene diaphragm (8 sq. inch effective area). Direct drive operation eliminates any possible linkage play. Compact design is suited to tight or restricted installations, such as internal retrofit applications. Standard on 3200 Series Dual Duct and 3400 Mk II Series Bypass terminal units. Optional on other models.

- MCP-3631-3000 5 – 10 psi spring range
- MCP-3631-5000 8 – 13 psi spring range
- MCP-3631-8000 3 – 8 psi spring range



Model Series MCP-3631

Pressure Dependent Operation

In pressure dependent control operation, the pneumatic controller and flow sensor are omitted and the pneumatic actuator is controlled directly by the thermostat. Airflow is entirely pressure dependent. This version of the pneumatic terminal unit is used where neither pressure independent nor regulated maximum airflow settings are required.

One example is a single duct variable air volume supply in which the supply duct pressure is held constant by other controls. A mechanical airflow setting can be made as a function of the damper driveshaft rotation. Bypass terminal units, due to their design, are inherently pressure dependent.

Electric and Analog Electronic Components

Pressure Dependent Control

Micro-processor based technology has resulted in the widespread development and use of pressure independent controls for VAV terminal units and the demise of pressure dependent controls. Although more expensive, they generally provide superior room temperature control of the occupied space and improved occupant comfort. Pressure dependent controls are still used however on some light commercial projects with constant volume packaged air handlers. A popular use still is on Bypass terminal units which are an inherently pressure dependent design. The following components are used in pressure dependent control applications.

Tri-State Floating Actuators

These 3-wire 24 VAC reversible actuators are available in varies cycle time models to suit the application. All models feature direct drive mounting and built in adjustable mechanical end stops which limit damper rotation and provide a minimum position air volume capability. A manual clutch release speeds installation. A magnetic coupling provides stall torque protection. Optional auxiliary end switches for heat activation are available.

KMC Controls, 50 in. – lb., 95° rotation.

MEP-5061: 18°/min. (5 minutes 90°)

MEP-5071: 60°/min. (1 1/2 minutes 90°)

Honeywell, 35 in. – lb., 90° rotation.

ML6161B-2032: 12.9°/min. (7 minutes 90°)

ML6161B-2073: 30°/min. (3 minutes 90°)

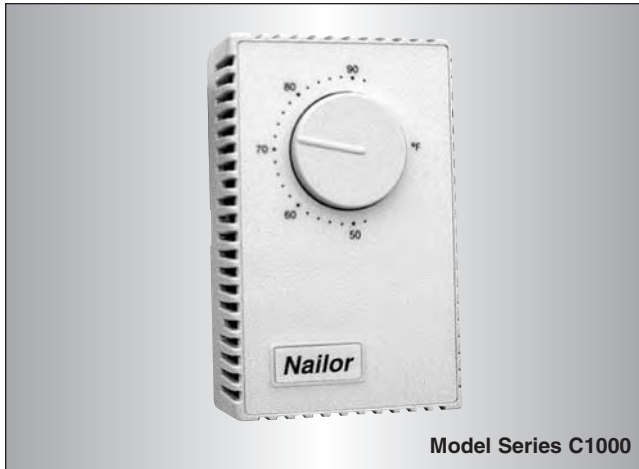
ML6161B-2024: 60°/min. (1 1/2 minutes 90°)



Model Series ML616B and MEP-5000

C1000 Series Room Thermostat

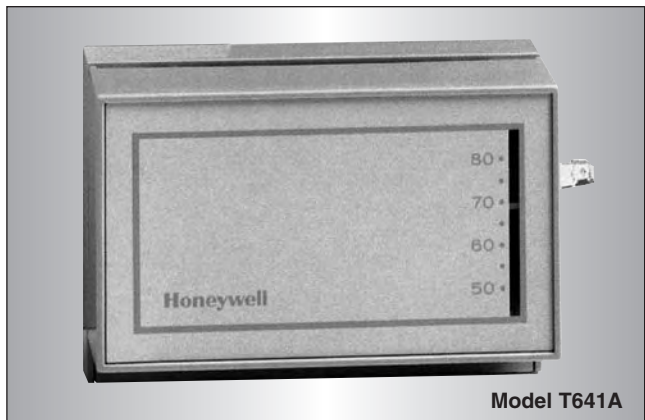
Advanced micro-computer electronics and PI control algorithms provide precise temperature control. The thermostat provides a true multi-position modulating output to a tri-state floating actuator. This eliminates wasted energy caused by typical on-off cycling with conventional thermostats resulting in significant energy savings and superior comfort. Control accuracy is $\pm 0.4^{\circ}\text{F}$ ($\pm 0.2^{\circ}\text{C}$) around set point. The room occupant is able to reduce the set point to the lowest comfortable setting. A mechanical air volume minimum stop is provided (field set) on the damper actuator.



Model Series C1000

T641A SPDT Room Thermostat

A 24 VAC single pole double throw, center-off, floating control thermostat for use with slow cycling 3-wire (floating type) electric actuators in pressure dependent VAV systems. Features include silent mercury switches, thermometer indication and external warmer/cooler set point adjustment, 3°F dead band.



Model T641A

GENERAL PRODUCT OVERVIEW

A

Analog Electronic Components

Pressure Independent Control

Control Features:

- Proportional plus integral control function provides precise flow and temperature control.
- Stand alone operation.
- Simple installation and balancing.
- Reliable operation and excellent repeatability (settings do not drift with time)
- Less costly than digital controls with no programming requirement.
- Suitable for all types and sizes of building applications.
- Flexibility built-in to handle all control applications.

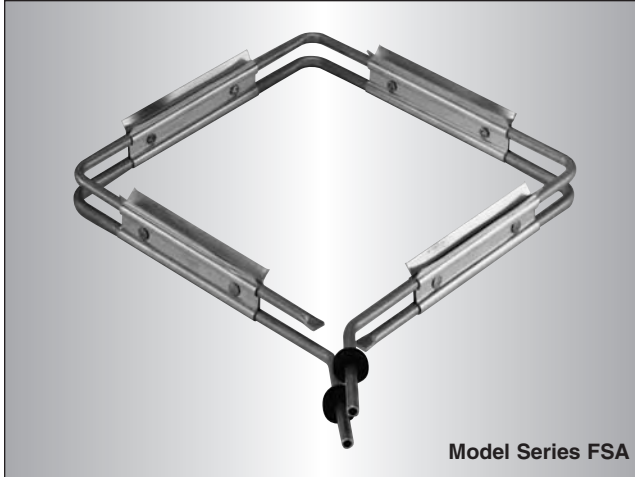
Nailor is pleased to make available a new and improved range of pressure independent analog electronic controls for terminal units. These controls now incorporate the 'Diamond Flow' multi-point averaging sensor for accurate flow measurement as standard, a re-designed higher torque controller/actuator and new room thermostat design.



Model Series CSP-5000

Controller/Actuator Features

- Compact combination design eliminates separate circuit boards.
- Onboard flow-through transducer utilizing twin platinum resistance temperature detectors.
- Direct drive 24 VAC tri-state damper actuator @ 50 in. - lb. (5.7 Nm) torque.
- Magnetic clutch and gear disengagement button.
- Tri-color LED indicates green for opening, red for closing and white for satisfied damper positions.
- Available control options include proportional (0 – 10 VDC) or two position hot water or electric reheat, dual minimum, fan induction, dual duct and automation interface. (Additional relays supplied as necessary).
- Heat/cool auto changeover ability with addition of duct temperature sensor.



Model Series FSA

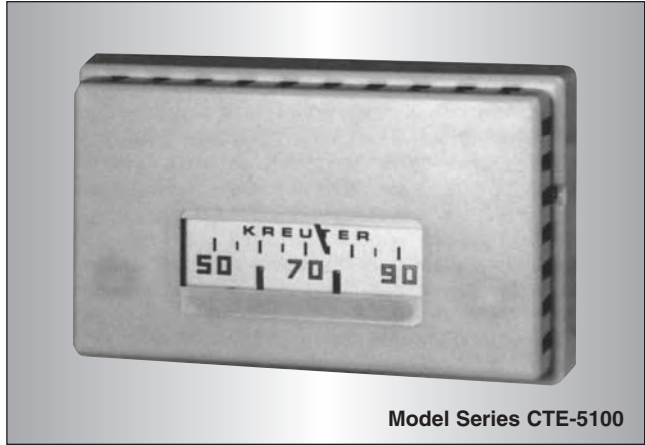
'Diamond Flow' Sensor

All components are matched and calibrated to provide regulated airflow in response to the electronic room thermostat, which is furnished as an integral part of the control package. Minimum and maximum airflow settings are adjusted at the thermostat, using a small screwdriver and digital voltmeter. Voltage settings correspond to airflow volumes on the Nailor calibration chart supplied with each project. It is not necessary to enter the ceiling space and locate the terminal itself for field calibration thereby reducing time and disruption.

Analog Electronic (continued)

Thermostat Features:

- Single function models with single set point slider for cooling only or heating only applications.
- Dual function models with two set point sliders for cooling/heating applications.
- Bi-metallic thermometer and set point indicator.
- Live velocity readout.
- Minimum, maximum and auxiliary flow limit adjustments.
- Attractive modern design.
- Fahrenheit or Celsius scale plate option.
- Set point sliders hidden on underside of tamper-proof cover.
- Mounting choice – decorative backing plate for electrical box attachment or drywall mounting kit.



Model Series CTE-5100

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 VAV 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, 50 in.-lb. (5.7 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-5061 18°/minute
MEP-5071 60°/minute



Optional Nailor supplied and mounted 'Tri-state' MEP-5000 Series Actuator.

A GENERAL PRODUCT OVERVIEW