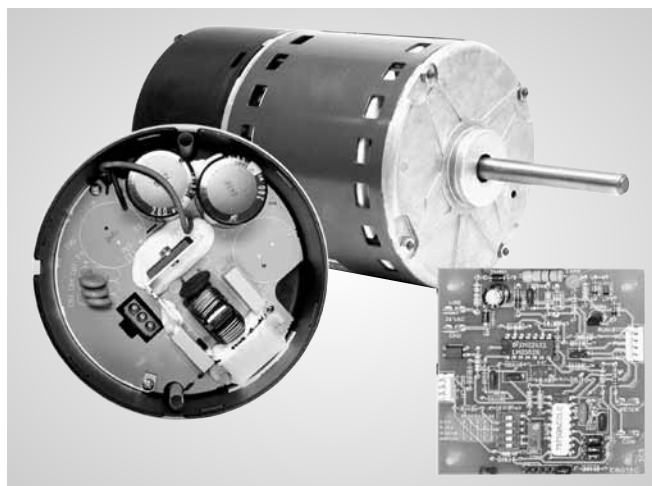




## ECM/EPIC™ FAN TECHNOLOGY®

- Significant energy savings (67% average compared to PSC motors)
- Unique factory pre-set air volume capability (+/- 5%)
- Pressure independent fan operation
- LED for visual indication of air volume
- Field adjustable fan air volume controller
- Remote fan air volume adjustment capability from BAS
- Larger turndown ratios mean more flexibility for tenant changes



Since 1985, equipment manufacturers have used ECM motors in residential air conditioners and furnaces. These motors have made it possible to achieve SEER ratings of 12 and higher. Until more recently though, they were only manufactured in 120 and 240 VAC, which precluded their use in commercial applications. Following two years of research and development and the availability of a new 277 VAC version, Nailor Industries was first to introduce the ECM motor to the commercial HVAC market (ASHRAE Journal, April 1997) as an option for use in commercial fan powered terminal unit applications.

### WHAT IS AN ECM MOTOR?

The ECM (Electronically Commutated Motor) is an ultra high efficiency programmable brushless DC motor utilizing a permanent magnet motor and a built-in inverter. DC motors are significantly more energy efficient than AC motors and much easier to control. The major weakness of commercial fan coil units until now, has been their low fan motor efficiency. The widely used three speed fractional horsepower shaded pole and permanent split capacitor (PSC) induction motor in combination with a 3 speed switch or an electronic SCR speed controller is extremely inefficient at typical operating conditions. Due to acoustical considerations, the fan motor is usually adjusted to operate at considerably less than full load (where PSC motor efficiencies may be as high as 62%). PSC motor efficiency drops off dramatically when turned down; typically by at least half. Installed PSC motor efficiencies are therefore typically in the range of only 12 – 45%. ECM motors in contrast, maintain a high efficiency of 65 – 72% at all speeds.

In addition to lower operating costs, EPIC Fan Technology® allows Engineered Comfort to pre-set the fan airflow volume at the factory.

The graphs below show the lower watts per cfm (translating into lower operating costs as shown on the next page) and wider operating ranges of commercial fan coils employing EPIC Fan Technology® versus PSC induction motors.

### FEATURES AND BENEFITS

Soft starts and slewed speed ramps are programmed into the ECM motor eliminating stress transmitted to the mounting bracket or hardware. They incorporate ball bearings providing permanent lubrication unlike sleeve bearings requiring a

minimum rpm operation for oiling. The wider operating range of the ECM motor allows each model to actually replace two models using induction motors. This feature alone provides several benefits: a simpler product line to choose from, little or no equipment changes necessary, more similar sized units on the job, decreased spare parts inventory and increased contractor flexibility. The low operating temperature of the ECM motor (essentially ambient) requires very little energy to offset the heat gain from the motor versus PSC motors which run hot, typically around 90 – 150°F (32 – 66°C).

These features also extend the life of the ECM motor, which are expected to provide an average 90,000 hours of operation (versus 50,000 hours for a typical PSC motor). This translates into about 10 years for a typical fan coil as opposed to 7 for one using a PSC motor.

### EPIC FAN TECHNOLOGY®

In addition to the above standard features, Nailor Industries pioneered and developed EPIC Fan Technology® in order to provide the following primary benefits – Maximized Energy Savings, Variable Air Volume (VAV) control and factory pre-set fan airflow.

### Why and how do you pre-set fan airflow?

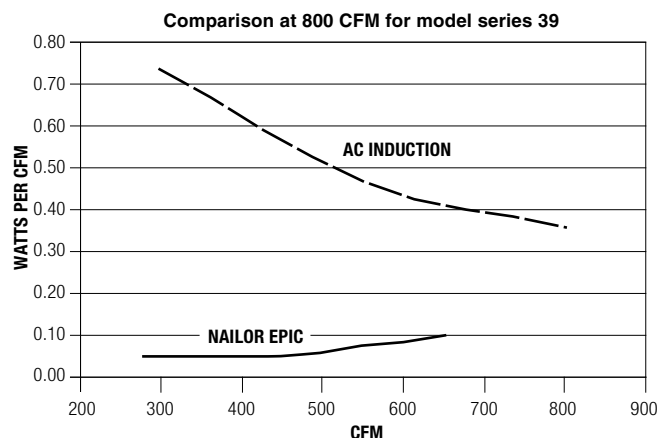
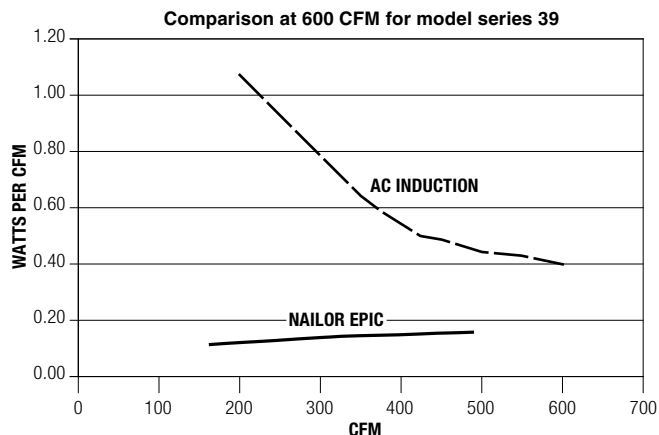
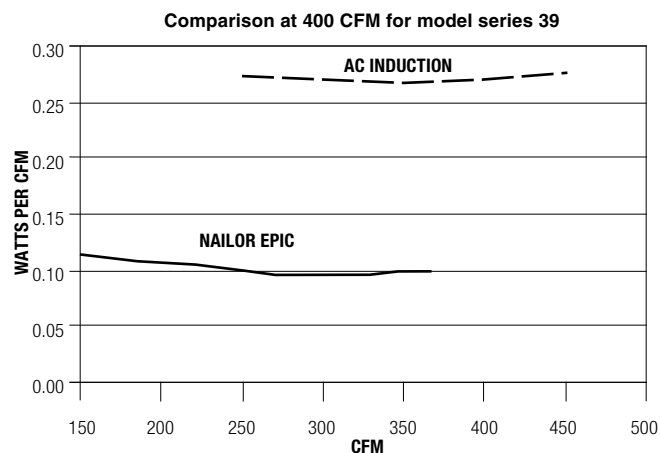
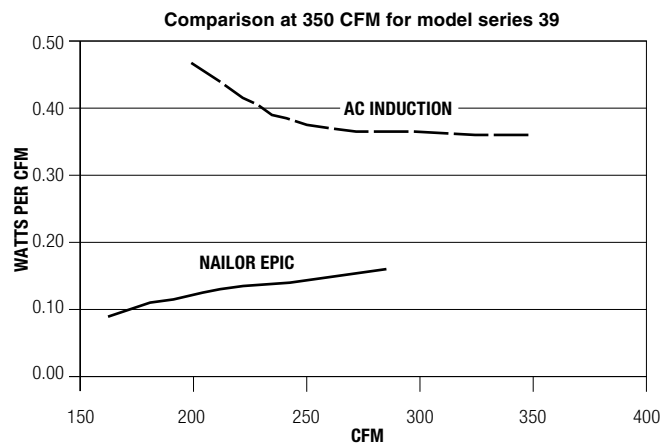
Pre-setting the fan airflow (cfm) has not been an issue with fan coil manufacturers because these units were either on at full load or off in normal operating conditions. With EPIC Fan Technology®, the fan coils can now be run as a VAV device with all of the requisite savings that VAV brings to other commercial applications. (See control sequence for further explanation.)

AC motors are not synchronous machines and the rpm, and consequently the unit cfm, changes when static pressure changes. The difficulty in pre-setting the fan lies in estimating the motor workload required at the job site in actual working conditions. The fan operated by an AC motor will not produce the same volume of air as it did at the factory without the duct work or loaded filter. Because there is no way to accurately predict the downstream static pressure as it would exist at the job site, it was impossible to pre-set the fan cfm. The ECM motors are DC and inherently synchronous machines. The motors are programmed to calculate the work they are doing and then compare the work accomplished to the cfm requirement. The integral microprocessor based controller

automatically adjusts the speed and torque in response to system pressure changes and pressure independent constant airflow operation is achieved without the need for an external flow sensor feedback loop. Engineered Comfort fan coil units incorporate our own custom EPIC fan controller, an electronic PWM volume control device that allows adjustment of airflow volume. Minimum and Maximum airflow can be pre-set at the factory. It is field adjustable either manually using a screwdriver and voltmeter locally at the fan coil or with the Engineered Comfort thermostat and controller or remotely using a 0 – 10 VDC analog output from a digital controller via the BAS. A fan volume versus DC volts calibration chart is provided. The importance of this feature is the energy that is saved due to controlling the fan airflow as well as the large reduction in noise generation. This also removes the uncertainty of diffuser flow measurement with hoods. Laboratory tests show the fan cfm to be accurate within +/- 5% of the factory set point. This is a huge benefit to the owner, the occupant, the controls contractor, and the mechanical contractor.

## ENERGY SAVINGS

The following graphs show the energy savings of units with EPIC Fan Technology® compared to units with PSC motors. The Engineered Comfort airflows are shown at relatively lower set points (81%) due to a lower discharge air temperature (See control sequence for further explanation).



## WHAT IS THE PAYBACK PERIOD WITH EPIC FAN TECHNOLOGY® ?

The payback period varies. It depends on which unit you use, where you set the airflow, how much you run the equipment and what you are paying for electricity. The charts below are calculated assuming 24/7 operation of the Nailor unit vs. 80% run time on a competitive unit and \$ 0.10 per kWh. If you run the equipment longer in your building or if you pay more for electricity, the payback will change proportionally. The charts consider only operating costs of the fan, other savings at the chiller and at the higher room set points can double the savings cutting the payback in half. On tall buildings, reduced riser sizes may offset the fan costs at the time of construction. Typically, you can run anywhere from 3 to 11 Engineered Comfort units for the same price as one of the competitions making the payback period as short as 6 months to as long as 36 months.

HIGH SPEED AIR FLOW (CFM)	COST TO RUN AC INDUCTION FAN 1 YEAR	COST TO RUN ENGINEERED COMFORT FAN 1 YEAR	NO. OF ENGINEERED COMFORT UNITS THAT CAN BE RUN FOR THE COST OF ONE COMPETITOR'S UNIT
350	\$79.19	\$15.77	5.02
400	\$84.32	\$17.04	4.95
600	\$161.32	\$21.81	7.40
800	\$188.52	\$16.51	11.42

## Variable Air Volume EPIC Fan Technology® Fan Coil Operation with Constant Discharge Air Temperature

### THE PROBLEM

High humidity at part load conditions has always been a problem with traditional fan coil unit operation and will become a greater factor in the selection of equipment by design engineers in the future. Too much humidity and comfort zone temperatures decrease to the point that occupants feel chilled or clammy. This may also create favorable conditions for mold and mildew growth.

As air moves across a cooling coil, the temperature of the coil is normally below the dew point of the return air. This causes the water in the air to condense on the coil surface where it is gathered in a drain pan and disposed of through drain lines. The air leaving a coil is typically about 55 to 60°F. Since the temperature of the coil is usually below the dew point of the entering air, water has been condensed from the air and the air is very nearly saturated. This nearly saturated air warms slightly as it moves through the duct to the diffusers. By the time it exits into the room, it has risen a degree or two in a typical system. It then mixes with the room air and is again warmed, typically to about 74 – 78°F (23 – 26°C). Both air temperature and water content are increased in the room; however, relative humidity levels decrease because the warmer air is capable of holding more water. The percentage compared to saturated air at the higher temperature has decreased. See line A-B on the attached psychrometric chart.

### THE SOLUTION

The attached sequence of operation (See Figure 2) and psychrometric chart (Figure 3), illustrate how the EPIC control sequence utilizes variable air volume control, chilled water valve modulation and constant discharge air temperature to control a typical space using our unique controls. Engineered Comfort has chosen 52°F (11°C) as the optimum discharge air temperature for fan coil operation.

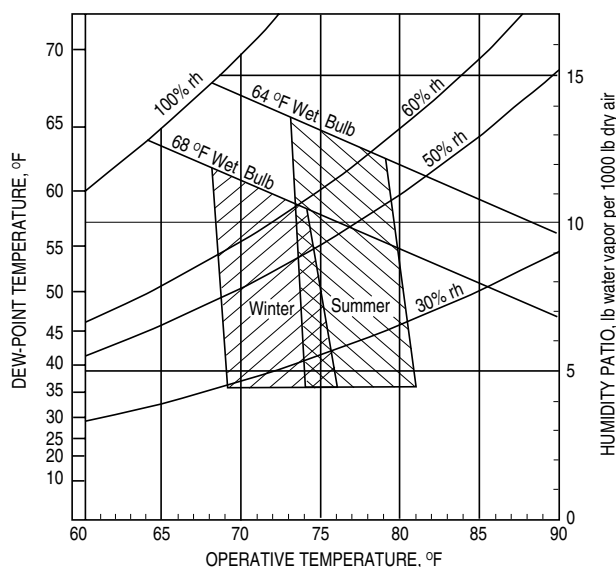
By lowering the discharge air temperature slightly, the humidity levels in the room can be lowered. See line C-D on the attached psychrometric chart. This causes the occupants to feel more comfortable at a slightly higher temperature. The room temperature required to maintain acceptable comfort can be raised by as much as 4°F (2.5°C). Most occupants will be more comfortable at the increased temperature. This accomplishes five very important results in addition to the energy and reheat savings already provided by the ECM motor.

#### 1. Lower relative humidity:

If the air volume and water to the coil are modulated to maintain the discharge air temperature at all room conditions as described in the EPIC control sequence, room relative humidity levels decrease by 10 to 20%, and there is less chance for wall sweating, which in turn lowers the chances of mold growth. See line A-B vs. C-D on the attached psychrometric chart.

#### 2. Higher comfort level temperature Setpoint:

The lowered relative humidity allows the occupant to reset the room temperature higher by 1 – 4°F (0.5 – 2.5°C), while maintaining acceptable comfort levels. This in turn saves energy due to higher room set points. (See Figure 1 printed from ASHRAE Handbook, Fundamentals 2005, Chapter 8, page 8.12)



**Figure 1: ASHRAE Summer and Winter Comfort Zones**

(Acceptable ranges of operative temperature and humidity for people in typical summer and winter clothing during primarily sedentary activity.)

#### 3. Increased chiller efficiency:

If the air volume and water to the coil are modulated to lower flow during part load conditions, fan energy and pumping energy is saved by taking advantage of room to room building diversity on both the water and air sides of the unit. Additionally, this holds the water and air in contact longer at the coil allowing greater heat transfer from the air to the water. This increases the return water temperature to the chiller and decreases the required pumping energy while increasing the efficiency of the chiller operation. Consequently, the pipe sizes needed for the risers and any duct run outs may be reduced. These reductions may offset any additional first cost of the equipment.

#### 4. Lower airflow and reduced fan energy cost:

If the supply air temperature is lowered using the EPIC control sequence, less air from the fan coil is needed to satisfy the room demand. The reduction in airflow can be calculated as follows:

$$CFM_1 \times \Delta T_1 = CFM_2 \times \Delta T_2$$

Where:  $CFM_1$  = Airflow and  $\Delta T_1$  = EAT – LAT for Std. FCU

$CFM_2$  = Airflow and  $\Delta T_2$  = EAT – LAT for EPIC FCU

$$\text{Therefore: } CFM_2 = CFM_1 \times \left( \frac{\Delta T_1}{\Delta T_2} \right)$$

**Example 1:**

$$\Delta T_1 = 74 - 55 = 19 \quad \Delta T_2 = 76 - 52 = 24$$

$$CFM_2 = CFM_1 \times 0.79 \left( \frac{19}{24} \right)$$

**Example 2:**

$$\Delta T_1 = 78 - 55 = 23 \quad \Delta T_2 = 79 - 52 = 27$$

$$CFM_2 = CFM_1 \times 0.85 \left( \frac{23}{27} \right)$$

$$\text{Average} = \frac{0.79 + 0.85}{2} = 0.82$$

$$\text{Average } CFM_2 = CFM_1 \times 0.82 \left( \frac{0.72 + 0.85}{2} \right)$$

Std. FCU (CFM <sub>1</sub> ) =	300	400	600	800	1000	1200
EPIC FCU (CFM <sub>2</sub> ) =	246	328	492	656	820	984

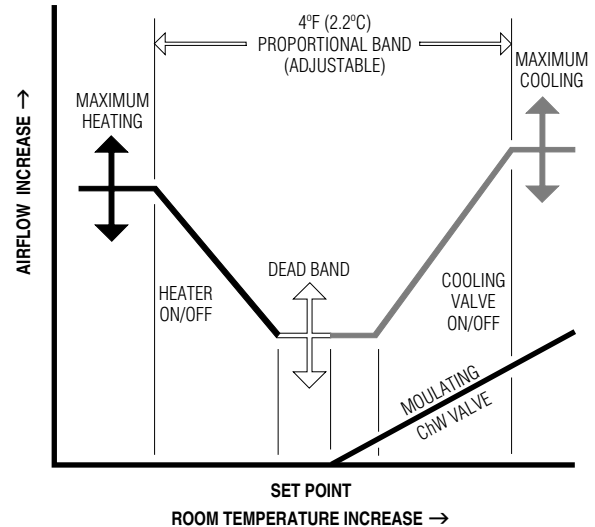
**Table 1. Airflow Reduction Comparisons**

Airflow can be lowered by approximately 18%, reducing the fan energy consumption by 20 to 50%, depending on setpoint, in addition to the input savings. (See Table 1.)

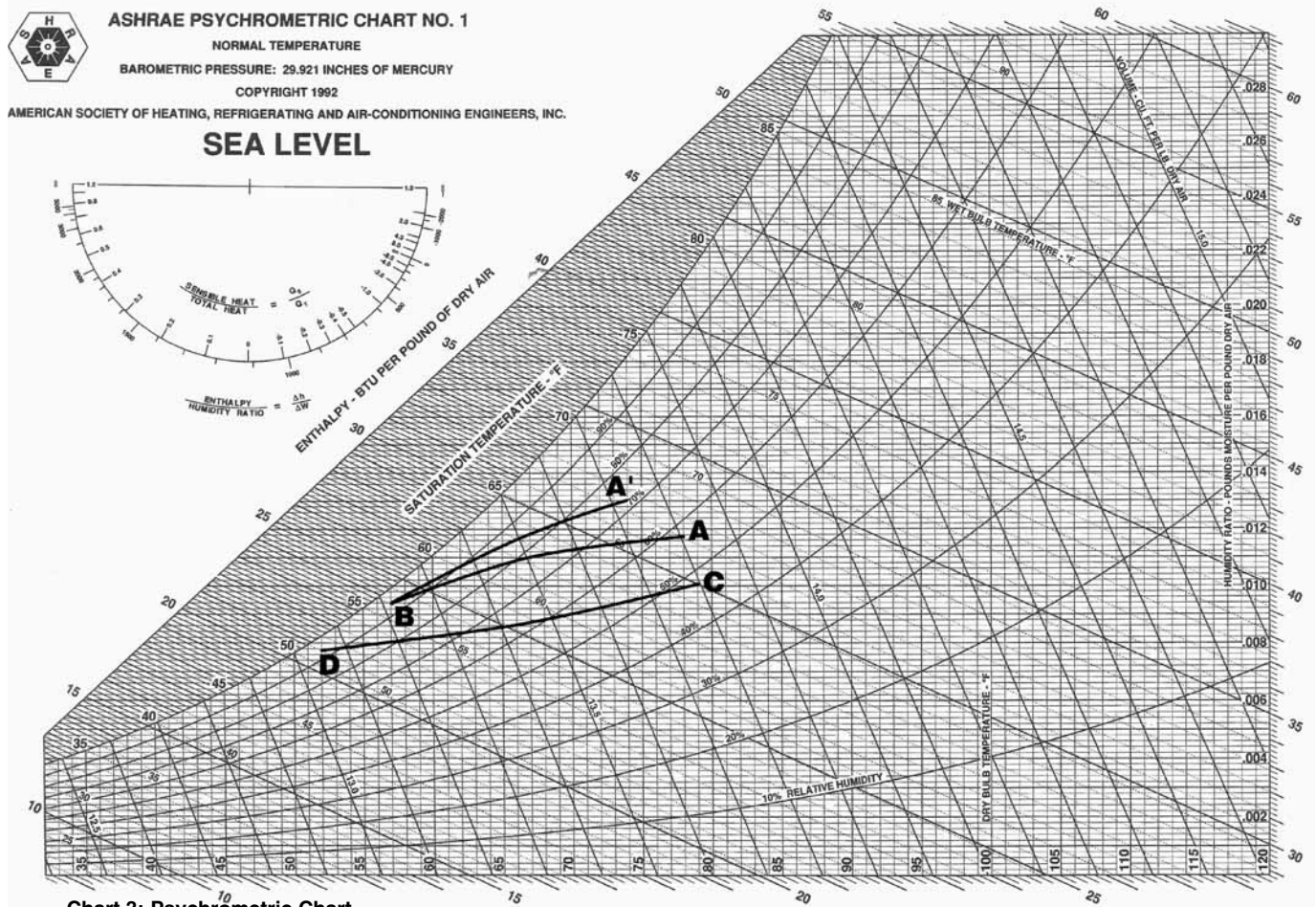
## 5. Lower humidity levels at part load conditions:

If the air volume is modulated to maintain the discharge air temperature at all room conditions, the perceived comfort level in the space stays constant and the noise levels decrease. Also, the relative humidity is greatly decreased when compared to what happens without modulated air at part load conditions. See line AB' on the psychrometric chart. Under part load conditions, without controlled discharge air temperature, the relative humidity levels in

the space can rise to as much as 70% because of reduced run time or lowered discharge air temperatures on the dehumidifying equipment. This would cause the room set points to be greatly reduced to satisfy occupant comfort, which increases operating costs at part load conditions. At these reduced set points, the room will feel clammy and mold growth potential increases.



**Figure 2. EPIC Fan Coil Unit Sequence of Operation**



**Chart 3: Psychrometric Chart**

## Analog Electronic Controls

Variable Air Volume • EPIC Fan Technology® • ECM Motor

### FEATURES:

- Proportional + Integral control action provides precise flow and temperature control.
- Standalone operation.
- Pressure Independent fan operation ensures airflow settings remain constant.
- Factory calibrated controls simplify field installation and eliminate field balancing.
- Less costly than digital controls with no software programming requirement.
- Suitable for all types and sizes of residential and commercial building applications.
- Modern ergonomic, easy to use thermostat with large LCD display for live temperature read-out and nine function keys.
- Nine programmable functions for Set-point. Maximum Airflow, Minimum (deadband) Airflow, °F/°C mode, Two Unoccupied Modes (off and deadband mode), Proportional Band, Integration Time and Temperature Offset adjustment.



CTE-5201W36 Analog LCD thermostat



CEE-5201 Analog controller

## Standard Control Sequence ACN • Cooling and 1 or 2 Stage Heating

### Cooling Operation:

On a call for cooling, the chilled water valve will begin to modulate open. As the cooling demand increases, the valve will continue to open until the discharge air temperature reaches 52°F (11°C). On a continued call for cooling, the fan will begin to modulate toward the maximum cooling fan airflow as the chilled water valve continues to modulate open maintaining a 52°F (11°C) discharge air temperature. This process will continue until the fan reaches the cooling maximum airflow.

### Deadband Operation:

With no demand in the space, there will be no call for heating or cooling. The fan will be at minimum airflow. The chilled water valve will be off. The hot water valve on the electric heat will also be off.

### Heating Operation:

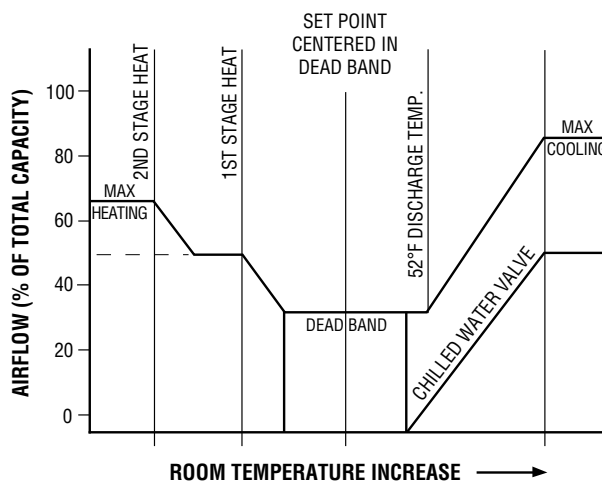
On a call for heating, the fan will ramp up to the fan heating setting and the first stage of heat will be energized. This may be either an on/off hot water valve or a stage of electric heat. Units with electric heat have an optional second stage available. The fan may also be set to operate at a second higher heating airflow setting. In the case of single stage heating, it can be energized at either output. On a decrease in heating demand, the sequence will reverse.

### Off Unoccupied Mode:

The fan coil unit will be off. The heating set point will default to 50°F (10°C).

### Deadband Unoccupied Mode:

In the unoccupied mode the fan will run at the preset minimum fan set point. The room temperature set point will default to 70°F (21°C), the heating set point will default to 60°F and the cooling set point will default to 80°F (27°C).



## Analog Control Thermostat and Controller

### LCD Analog Thermostat

#### MODEL: CTE-5201W36

The CTE-5201W36 single output with limits and PI function thermostat is designed to be used with the CEE-5201 Fan Coil Unit controller. The thermostat comes with the following factory default settings:

**Set Point (Default):** 70°F (21.1°C)    **F/C Mode:** Degrees F  
**MAX:** 100%    **MIN:** 20%  
**PROP:** 4°F (2.2°C)    **UNOCC Mode:** OFF  
**INT:** 30 Minutes

#### Operation and Adjustment

To change any one of these values, except the F/C Mode, first push the button to display the value to be changed. Use the Up / Down buttons to change the value. Then hold down the corresponding button for approximately 10 seconds until the display begins to flash. The new value has now been written into memory. To change to degrees C mode simply press and hold the F/C button down for 10 seconds until the display begins to flash. To change back to degrees F repeat the procedure.

#### Set Point (Normal)

The set point range is 60 – 85°F (15.6 – 29.4°C). To change the set point, push the SET POINT button to display the current value. Use the Up / Down buttons to change the value. The display will time out and revert back to displaying the room temperature and the thermostat will control to the new set point.

#### Set Point (Default)

If power is lost, when the unit is powered back up, the set point will revert to the default value of 70°F (21.1°C). This default value can be changed to any value in the set point range. This default set point is also used in the dead band unoccupied mode.

#### MAX

This is the maximum value that the output can attain. It is adjustable up to 100% (10 volts) and down to the MIN setting.

#### MIN

This is the min. value that the output can attain. It is adjustable down to 0% (0 volts) and up to whatever the MAX is set for.

#### F/C Mode

The F/C button toggles the display between °F and °C. Room temperature, set point, proportional band, dead band, and offset will be displayed in the desired units.

#### UNOCC

Momentarily pressing this button will put the unit into the unoccupied mode. It will stay in this mode until either the Set Point or Up / Down buttons are pushed. There are two unoccupied modes, OFF or DEADBAND.

#### OFF UNOCC Mode

The output voltage is forced to 0 volts (0%). A safety override will bring the output up to 2 volts placing the unit in heating if the room temperature falls below 50°F (10°C). The output will return to 0 volts when the room temperature reaches 55°F (12.8°C).

#### DEADBAND UNOCC Mode

In this mode the set point is set to 70°F (21.1°C), the integral action is disabled, and a dead band of +/- 10°F (5.5°C) is set around the set point. As long as the room temperature is within the dead band the fan will run at MIN conditions.

#### PROP

The proportional band is the temperature band around the set point over which the output will vary from MIN to MAX due to the proportional action alone. The proportional band is adjustable from 2 – 6°F (1.1 – 3.3°C).

#### INT

As long as there is a difference between room temperature and set point, the integral action will cause the output to integrate up or down. The integral time is the time it takes the integral action to repeat the effect of the proportional action. The integral time is adjustable from 15 to 30 minutes. Setting the integral time to 0 will disable the integral action.

#### Temperature Offset

By pressing both MIN and INT together it is possible to offset the internal temperature sensor by +/- 2°F (-16.7 – -18.9°C). After using the Up / Down buttons to change the offset both the MIN and INT buttons must be held down together for 10 seconds until the display begins to flash in order to write the new offset into memory

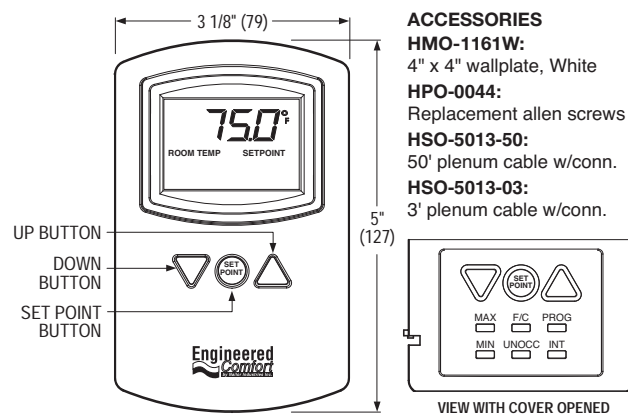


Figure 1: Model CTE-5201W36 Analog Thermostat

#### Thermostat Specifications:

<b>Supply Voltage:</b>	14 -19 VDC
<b>Set Point Range:</b>	60 – 85°F (15.6 – 29.4°C) (Power On Default: 70°F (21.1°C))
<b>Temperature Sensor Type:</b>	Thermistor
<b>Accuracy:</b>	+/- 0.36°F (0.2°C)
<b>Display Degrees F or C:</b>	Selectable (Factory Setting: Degrees F)
<b>Direct Acting Output:</b>	0 – 10 VDC
<b>MIN / MAX Limits:</b>	Adjustable 0 – 100% (Factory Settings: MIN=20, MAX=100)
<b>Proportional Band:</b>	2 – 6°F (1.1 – 3.3°C) (Factory Setting: 4°F)
<b>Integration Time:</b>	15 – 60 Minutes (0=OFF) (Factory Setting: 30)
<b>Unoccupied Setpoint Modes:</b>	OFF or Deadband (Factory Setting: OFF)
<b>OFF Mode:</b>	Output Voltage = 0.0 Volts (Safety Override: Output Cycles 0.0 Volts to 2.0 Volts. To Maintain 50°F to 55°F (10 to 12.8°C)
<b>Deadband Mode:</b>	Integral Action Disabled & Set Point. Set to Default +/- 10°F (5.5°C) Deadband. Deadband Output Midway between Max & Min.
<b>Temperature Offset:</b>	Adjustable +/-2°F (1.1°C) (Press MIN & INT together)
<b>Operating Ambient:</b>	34 – 125°F (1.1 – 51.6°C)
<b>Shipping Ambient:</b>	-40 – 140°F (-40 – 60°C)
<b>Humidity:</b>	0 – 95% Non Condensing
<b>Case Material:</b>	White ABS. UL Frame Class 94HB. RJ-11 Female Connector. PIN1 NC PIN2 COM PIN3 SUPPLY PIN4 OUT PIN5 COM PIN6 NC



## Analog Fan Coil Unit Controller

### MODEL: CEE-5201

The Engineered Comfort CEE-5201 controller is mounted inside the controls enclosure on the fan coil unit and is factory wired. Engineered Comfort fan coil units with analog controls provide extremely accurate variable air volume control. They are factory calibrated for each unit permitting quick and easy start-up with no field settings required, but may be simply and easily field adjusted if necessary to suit changing requirements.

#### Control Parameters:

- Maximum fan cooling airflow.
- Minimum fan cooling airflow.
- Modulating Chilled Water Valve Actuator.
- Stage 1 Heating with aux. fan airflow setting (on / off hot water valve or one stage electric heat).
- Stage 2 Heating with aux. fan airflow setting (on / off hot water valve or two stage electric heat).

Five potentiometers on the controller permit simple adjustment of flow settings with a 0 – 10 Vdc voltmeter. Meter taps are provided. A calibration chart is provided inside the controls enclosure for each unit.

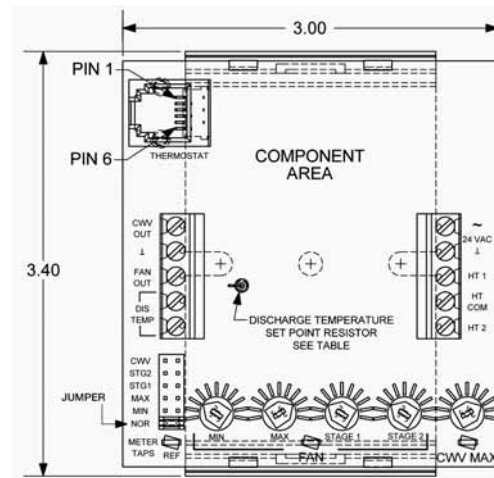


Figure 1. CEE-5201 Analog Fan Coil Unit Controller.

#### Specifications:

**Supply Voltage:** 24 VAC +20/-15% 50/50Hz

**Supply Power:** 1 VA plus output loads

**Discharge Temp Input:** 10K OHM@25°C, NTC 4.37% / °C

**Fan Output:** Min. Adjustable 0 – 10 VDC

Stage 1 Max adjustable from Min. to 10 VDC

Stage 2 Max adjustable from stage 1 Max to 10VDC

Cooling Max adjustable from Min. to 10 VDC

**CWV Output:** Max adjustable from 0 to 10 VDC

**Heat Stage 1 & 2 Outputs:** Triac outputs 10VA Max @ 24VAC

**Thermostat connector:** PIN 1 NC

PIN 2 DC COM

PIN 3 Supply Output 16 VDC +/-10% 10mA

PIN 4 T in 1-10 VDC 100 KOHM

PIN 5 DC COM

PIN 6 NC

**Connections:** Plated screw terminals 14 to 22 AWG Cu  
RJ-11 thermostat jack

**Ambient Limits:** Operating 0 to 120°F (-18 to 49°C)  
Shipping -40 to 140°F (-40 to 60°C)

**Mounting:** Open Board / Snaptrack supplied

CFM	0-10 VDC REF.	CFM	0-10 VDC REF.	CFM	0-10 VDC REF.	CFM	0-10 VDC REF.
0	0.00	364	2.74	708	5.19	982	7.65
217	0.36	373	2.81	718	5.27	989	7.72
219	0.43	382	2.89	727	5.34	997	7.79
221	0.51	392	2.96	736	5.41	1004	7.86
223	0.58	401	3.03	745	5.48	1012	7.94
225	0.65	411	3.10	755	5.56	1019	8.01
227	0.72	421	3.17	764	5.63	1027	8.08
229	0.79	431	3.25	772	5.70	1035	8.15
231	0.87	441	3.32	781	5.77	1043	8.23
233	0.94	452	3.39	790	5.84	1051	8.30
235	1.01	462	3.46	798	5.92	1059	8.37
237	1.08	472	3.54	807	5.99	1068	8.44
240	1.15	483	3.61	815	6.06	1076	8.51
241	1.23	493	3.68	823	6.13	1085	8.59
243	1.30	504	3.75	832	6.20	1094	8.66
245	1.37	514	3.82	840	6.28	1103	8.73
247	1.44	525	3.90	848	6.35	1112	8.80
250	1.52	535	3.97	856	6.42	1122	8.87
254	1.59	546	4.04	863	6.49	1132	8.95
258	1.66	556	4.11	871	6.57	1142	9.02
263	1.73	567	4.18	879	6.64	1153	9.09
268	1.80	577	4.26	886	6.71	1164	9.16
273	1.88	588	4.33	894	6.78	1175	9.24
279	1.95	598	4.40	901	6.85	1186	9.31
285	2.02	609	4.47	909	6.93	1198	9.38
292	2.09	619	4.55	916	7.00	1211	9.45
298	2.16	629	4.62	924	7.07	1223	9.52
306	2.24	639	4.69	931	7.14	1236	9.60
313	2.31	649	4.76	938	7.22	1250	9.67
321	2.38	659	4.83	945	7.29	1264	9.74
329	2.45	669	4.91	953	7.36	1279	9.81
337	2.53	679	4.98	960	7.43	1293	9.88
346	2.60	689	5.05	967	7.50	1308	9.96
355	2.67	699	5.12	975	7.58	1317	10.00

THIS UNIT HAS BEEN FACTORY SET AT CFM.  
RE-CALIBRATION IS NOT REQUIRED UNLESS THE ZONE DESIGN AIRFLOW REQUIREMENT HAS CHANGED.  
FOR CALIBRATION INSTRUCTIONS, REFER TO BULLETIN WNECM. CAUTION IF CALIBRATING IN SHADDED AREA.  
AT LOW VOLUMES, VARIATIONS IN FLOW FROM COOLING TO HEATING MAY BE GREATER THAN 5%. AT HIGH VOLUMES, NOISE MAY BE EXCESSIVE.  
SUBJECT TO CHANGE WITHOUT NOTICE

Figure 2. Typical Calibration Chart.



## Direct Digital Controls

### EZstat – The All-In-One Fan Coil Digital Controller

#### Control Options:

- **Variable Air Volume (VAV) EPIC Fan Technology® with ECM**
- **3-Speed ECM**
- **3-Speed PSC**

#### 1. OVERVIEW:

Engineered Comfort's new EZstat is the first commercial all-in-one digital controller/thermostat for fan coil applications and offers both simplicity and a competitive advantage for projects that require Direct Digital Controller (DDC) fan coil application. The EZstat is a fully digital and programmable standalone or networkable device that combines a controller, multiple sensor options, and BACnet networking into a single, integrated space-mounted device which allows for energy efficiency and superior user comfort through the use of proportional integral (PI) control algorithms.

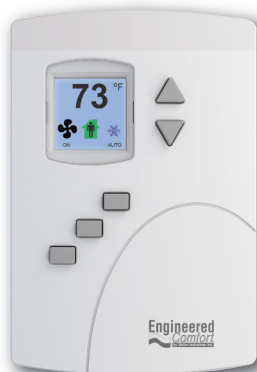


Fig. 1 EZstat

#### 2. FEATURES & BENEFITS

The EZstat comes with the following standard features:

- **Factory programmed** No special programming, software applications, or setup tools are required to configure and commission an EZstat. EZstat comes fully programmed for standard control sequences.
- **Standalone or Network operation** Installation can be scalable from a single room to a network of multiple rooms. The EZstat can be initially installed as standalone thermostat and a MS/TP network connection to a building automation system (BAS) can easily be added at a later date as needed.
- **Easy installation** EZstat includes intuitive installation and operation as well as a powerful set of additional features. The attractive two-piece design has screw terminal blocks mounted on the backplate for easy wiring and installation on the wall or unit.
- **Energy savings** Significant reduction in energy costs can be realized when the EZstat is packaged with the EPIC ECM.

- **Cost competitive** EZstat can functionally replace many competitors' antiquated and bulky controller board and separate two-piece temperature sensor products at a lower cost.
- **Network ready** All models are native BACnet, Application Specific Controllers ready to connect to a BACnet MS/TP network.
- **PI Control** PI control algorithms ensure precise temperature control.
- **New or retrofit applications** Ideal for new installations or upgrades of older, less efficient thermostats.
- **Bright, full-color display** The full color LCD display (with LED back lighting), animated icons, and five push buttons make the EZstat intuitive and simple to configure and operate. The display is easy to read across a room even in bright sunlight. Color icons indicate cooling or heating, occupied, unoccupied or local set back modes and fan operations. Through the contextual menu-driven display, an operator can change setpoints, configure available options (e.g. easily choose between Fahrenheit or Celsius values), and commission the installation.
- **Multiple applications** EZstat includes inputs, outputs, and sequences of operation for the following functions:
  - Modulating or 3-speed fan control
  - Automatic or manual fan control
  - Two-pipe heating and cooling with either modulating valves or On/Off
  - Four-pipe heating and cooling with either modulating valves or On/Off
  - Remote space temperature sensor (Optional accessory)
- **Schedule** The schedule in the EZstat controls the occupancy mode. If the schedule is set to ON, the EZstat uses the occupied set point as the active set point. If the schedule is OFF, the unoccupied set point is used. The schedule in the EZstat is a BACnet schedule object. If the EZstat is connected to a BACnet network the schedule can be set up with a BACnet operator workstation.

#### 3. NETWORKING

EZstat is an integrated native BACnet Application Specific Controller (ASC) that does not require the use of external communication or occupancy modules. The EZstat meets or exceeds BACnet® Application Specific Controller (ASC) specifications in the ANSI/ASHRAE BACnet Standard 135. This enables the controller to integrate seamlessly with either a future or existing BACnet BAS network allowing for the network to do the following:

- Monitor all of the EZstat's variables
- Assign setpoints values
- Initiate occupied and unoccupied modes.

Ultimately, leveraging the level of control and visibility inherent to most BAS systems.

## Direct Digital Controls (con't)

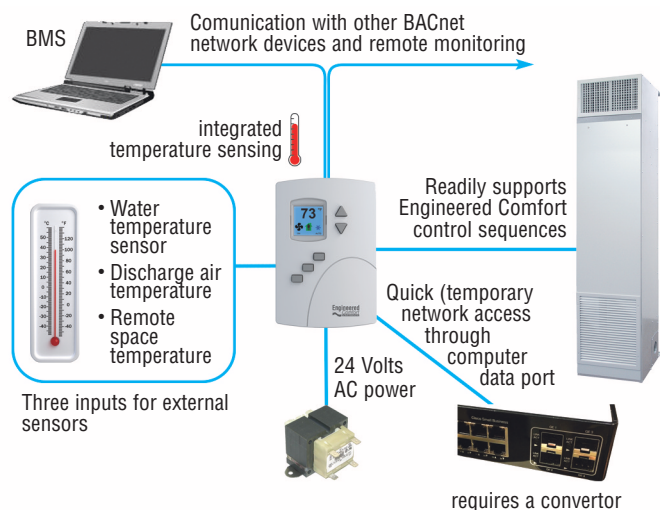


Fig. 2 Network setup

## 4. STANDARD CONTROL SEQUENCES – Engineered Comfort's most Popular Offerings

The EZstat can be factory or field configured for a number of Engineered Comfort's standard sequences. The sequence will dictate whether the operation is 2 or 4 pipe and influence the associated valve actuator's performance and type, i.e. 0-10 VDC modulating and/or On/Off.

The EZstat may be used in digital applications using the EPIC ECM along with monitoring the discharge air temperature (DAT). The EPIC ECM is a variable speed DC motor that can be adjusted to any speed required and capped at the maximum CFM allowed by the unit it is installed in. A 0-10 VDC signal is sent to the EPIC ECM which results in the control of VAV operation. Alternatively, if a 3-speed ECM or PSC motor is selected then the output would result in a constant air volume. End users will benefit considerable energy savings in fan coil units equipped with EPIC ECM, EZstat, and modulating water valves or electric heat, when compared to units fitted with the standard PSC motors. The reduction in energy consumption is achieved by the ultra-high efficiency ECM and having the EZstat modulate the motor speed to maintain the room comfort level. The EZstat can be programmed up to a maximum airflow for the cooling side and/or the maximum airflow required for the heating side, as well as the minimum CFM required for low energy consumption whilst the unit is in deadband (more information on deadband can be found below). More information on the EPIC ECM can be found herein under the Fan Coil Unit Controls section of this catalog.

Exclusive Engineered Comfort control sequences can accommodate all of the following Variable Air Volume (VAV) applications:

- N501: Modulating Cooling/Modulating Heating with auto Changeover
- N502: Modulating Cooling/Modulating Heating with Auxiliary Staged Electric Heat
- N503: Modulating Cooling with Staged Electric Heat
- N505: Modulating Cooling/Modulating Heating
- N506: Modulating Cooling with Proportional Electric Heat
- N507: Modulating Cooling with On/Off Heat

- N508: Proportional Electric Heat or Modulating Heating (sequence driven by fan coil selection)
- N509: Staged Electric Heat or On/Off Hot Water Heat (sequence driven by fan coil selection)
- N510: Modulating Cooling

### EPIC ECM VAV Control for 4-pipe & 2-pipe Operation: EPIC Discharge Air Temperature (DAT) Control

An EPIC ECM sequences include a Discharge Air Temperature (DAT) sensor. The sensor monitors the coil discharge temperature on both the cooling and heating cycle.

The adjustable cooling discharge temperature is factory set to 52°F (11°C) and provides the humidity control under part load conditions.

On heating, the adjustable discharge temperature is factory set to 90°F (32°C) to provide improved occupant comfort and meet ASHRAE standard 62.1 requirements.

The DAT is monitored by the control and will modulate the valve according to the demand versus DAT set point.

Nailor recommends modulating chilled water valves, utilizing our industry exclusive sequence design; with the superior benefits of maintaining a constant discharge temperature.

### Auto Changeover

A thermistor Type III water temperature sensor (WTS) provides auto changeover for 2-pipe cooling/heating operation. The sensor is attached to the incoming hydronic pipe and changes thermostat mode from cooling to heating based upon the water supply temperature.

### Cooling Operation

On a call for cooling, the chilled water valve will begin to modulate open. As the cooling demand increases, the valve will continue to open until the discharge air temperature reaches 52°F (11°C). Simultaneously, the fan will modulate from minimum airflow to maximum airflow to achieve room set point. Upon a decrease in cooling demand, the sequence will reverse.

### Deadband Operation

With no demand in the space, there will be no call for heating or cooling. The fan will be at a deadband set minimum airflow. The water valve will be off and the electric heat relay will also be off, if applicable.

### Heating Operation

On a call for heating, the hot water valve will begin to modulate open. The valve will continue to open until the discharge air temperature reaches 90°F (32°C). Simultaneously, the fan will modulate from minimum airflow to maximum airflow to achieve room set point. Upon a decrease in heating demand, the sequence will reverse.

### Auxiliary 2-pipe Electric Heat (Seasonal)

On a call for heat with chilled water in the pipe, the water valve closes and the electric heat turns on. The fan will step up to the stage 1 fan heating setting and the first stage of electric heat will be energized to achieve room set point. Units with electric heat may have an optional second stage available. On a continued call for heat, the fan will step up to the stage 2 fan heating setting and the second stage of heat will be energized to achieve room set point. On a decrease in heating demand, the sequence will reverse. On a call for heat with hot water in the pipe, the electric heat is locked out.

## Direct Digital Controls (con't)

The following are examples of two Engineered Comfort control sequences:

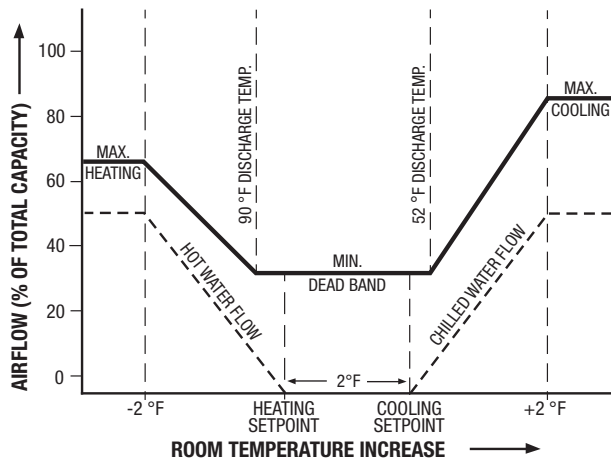


Fig. 3 EPIC Control Sequence Example: VAV Modulating Cooling and Modulating Heating (4-pipe and 2-pipe hydronic operation)

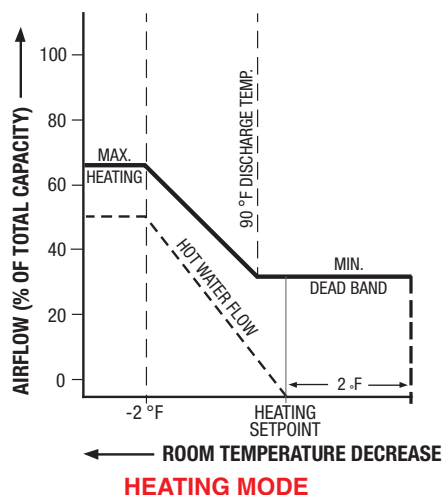
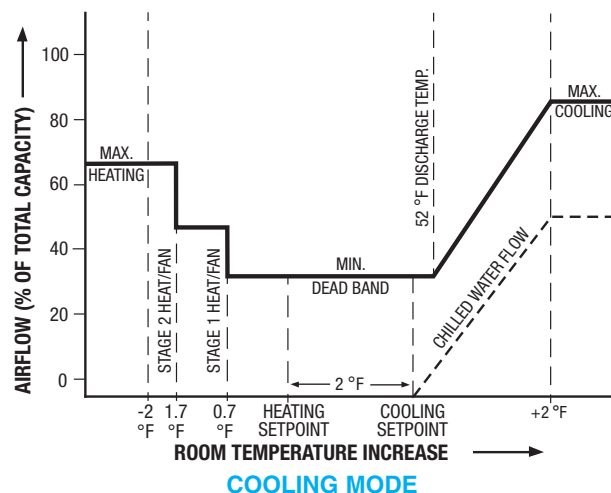


Fig. 4 EPIC Control Sequence Example: VAV Modulating Cooling/Modulating Heating w/Aux Staged Electric Heat

## 5. Product Specifications

Product specification includes a one piece wall mounted temperature sensor and controller design; two piece designs are not acceptable for controlling a room temperature.

Following specifications are subject to change without notice.

<b>Design</b>	Indoor use only
<b>Material</b>	White flame-retardant plastic
<b>Weight</b>	Approx. 6 oz. (170 grams)
<b>Supply Voltage</b>	24 VAC (-15%, +20%), 50 – 60 Hz, 12 VA, non supervised (all circuits, including supply voltage, are power limited circuits)
<b>Wiring</b>	Class 2 only
<b>Inputs</b>	0– 12 volts DC with internal 10 kΩ pull-up resistors
<b>Relay Outputs</b>	SPST, 24 volts, 1 amp AC or DC Maximum for all relay outputs is 3 amps
<b>Analog Outputs</b>	Short protected 10 mA 0– 12 VDC Operating 32 to 140 °F (0 to 49 °C)
<b>Environmental Limits</b>	Shipping - 40 to 160 °F (- 40 to 71 °C) Humidity 0 to 95% RH, non condensing
<b>Regulatory</b>	UL 916 Energy Management Equipment FCC Class A, Part 15, Subpart B and complies with Canadian ICES-003 Class A

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference
2. This device must accept any interference received, including interference that may cause undesired operation.

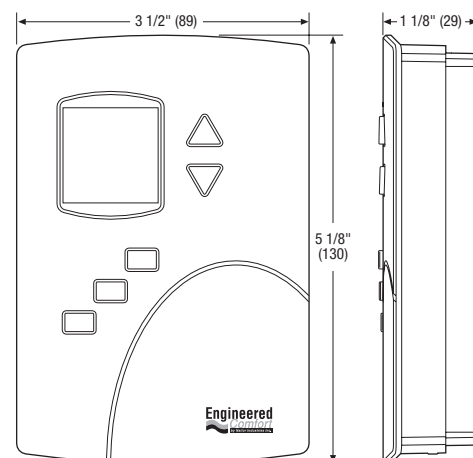


Fig. 5 Unit dimensions

## GENERAL NOTES:

1. Nailor only recommends chilled water valve control for Nailor Digital and Analog VAV control sequences where a constant discharge temperature is maintained and humidity is therefore controlled. Modulating cooling valve control with fixed fan speed electric controls can increase relative humidity in the space at part load conditions. Modulating heat valve control may result in low leaving air temperatures while the valves reduce flow as setpoint is approached. Nailor does not recommend their use with standard controls for either application.
2. All 39 Series Hi-Rise Units include two flexible stainless steel briefed hoses and full port ball isolation valves per coil. This hose/valve combination provides a "union" type connection to allow coil removal. Hi-Rise Units require a Nailor supplied piping package which is factory assembled, installed and wired.
3. 35F and 37F Horizontal Units with Nailor Digital and Analog VAV Controls require a Nailor supplied piping package. This package (less optional ball valve) is factory assembled, installed and wired in a full protective enclosure with access door. Ball valves when selected as part of the package ship loose for field connection.
4. All standard piping packages and components described in this catalog are for chilled and hot water applications. They may be also used with up to 50% ethylene and propylene glycol solutions.
5. Control valve actuators are removable and may be serviced or replaced without removal of the valve body. All control valves are piped on the return side of the coil (3-way control valves are mixing).
6. 2-position (spring return) chilled and hot water valve / actuators are piped normally closed to the coil as standard. For hot water coils, control valves are available normally open as an option. This must be stated clearly on schedule/order.
7. All ball isolation valves on the return line are furnished with an adjustable memory stop feature (when no other flow control device is selected) and may be used as a balancing valve.
8. Pressure/Temperature (P/T) ports when selected are supplied on the ball valves as standard. If it is required that P/T ports be located to monitor the pressure and temperature directly across the coil only, select PTO (other location) option.
9. Automatic fixed flow controls (FC, FCC) are available in the following flow (GPM) ratings. Individual coil GPM requirements must be specified on schedule/order.  
1/2" (13) valve: 0.5 to 4.0 GPM in 0.5 GPM increments. 5 to 9 GPM in 1 GPM increments.  
3/4" (19) valve: 3.0 to 4.0 GPM in 0.5 GPM increments. 5 to 12 GPM in 1 GPM increments.
10. 2-pipe system cooling and heating auto changeover systems using a 2-way control valve include a 1/4" (6.3) bleed line to assure proper changeover thermostat (AquaStat) operation.
11. The valve package piping and component details in the catalog are for standard valves and components. Performance ratings such as Cv, max. close-off pressure, operating temperature and pressure are shown in component specifications. Suitability for use must be based on individual application requirements determined by others. Nailor assumes no responsibility for selection and/or application of valve package and components.

## Basic System Types and Application:

All types may use a 2-way or 3-way motorized control valve

### 2-Pipe System (One Valve Package)

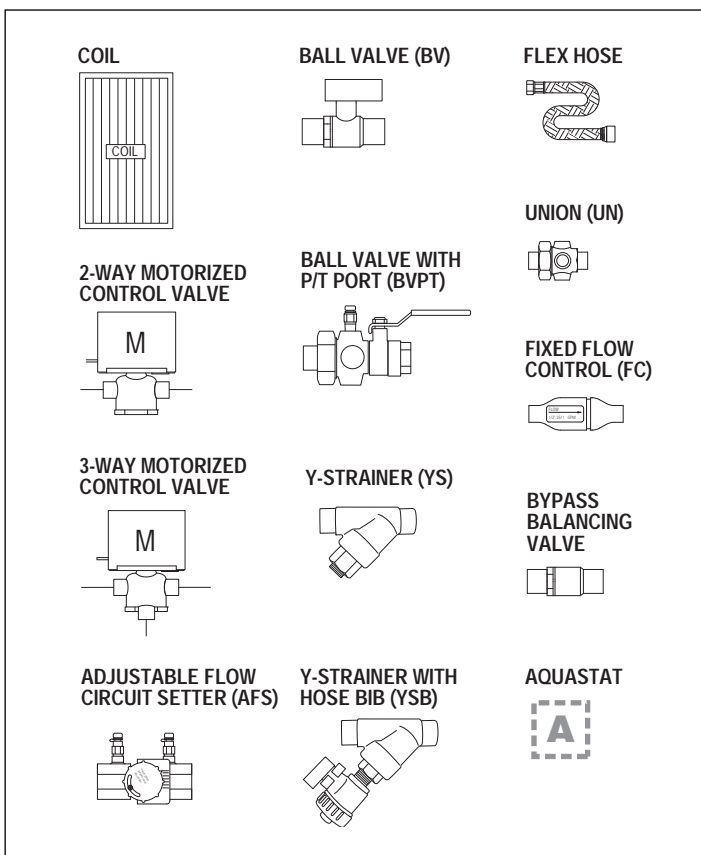
- A) Hydronic Cooling Only
- B) Hydronic Heating Only
- C) Hydronic Cooling and Heating (AquaStat required)
- D) Hydronic Cooling with Total Electric Heat
- E) Hydronic Cooling and Heating with Auxiliary Electric Heat (AquaStat required)

### 4-Pipe System (Two Valve Packages)

- A) Hydronic Cooling and Heating

## Legend:

- BV** Ball Valves (2). Memory stop where required.
- BVPT** Ball Valves (2) with Pressure/Temperature (P/T) Port. Memory stop where required.
- FC** Fixed Flow Control
- FCC** Fixed Cartridge Flow Control
- AFS** Adjustable Flow Circuit Setter
- YS** Y Strainer
- YSB** Y Strainer w/hose bib valve
- PTO** P/T Ports (other location)
- BPV** Bypass Balancing Valve



## Model Series: 39VH and 39L Vertical Hi-Rise Units • 2-Way Valves

2-Way Chilled / Hot Water Valve						
Basic Package Code		Components				
2-Position Actuator	Modulating Actuator	BV	BVPT	FC	FCC	AFS
202	402	•				
203	403		•			
210	410	•		•		
211	411		•	•		
212	412	•			•	
213	413		•		•	
214	414	•				•

Options			
Options Package Code	Components		
	YS	YSB	PTO
01	•		
02		•	
03			•
04	•		•
05		•	•

### Notes:

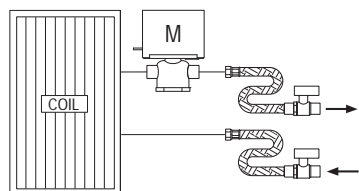
1. Select a Basic Package for each valve and an Options Package if required.
2. Nailor Electric Controls (PSC motor) require a 2-position actuator selection for both chilled water and hot water valves.
3. Nailor Digital and Analog VAV Controls (ECM motor) require a modulating chilled water valve actuator and a 2-position hot water valve actuator selection for 4-pipe systems.
4. A 1/4" (6.3) bleed line and Aquastat is furnished on 2-pipe cooling and heating auto changeover systems.
5. All Vertical Hi-Rise Units include two flexible hoses.

### Legend:

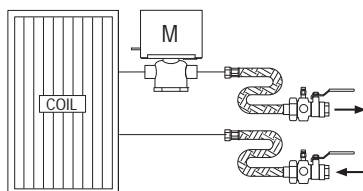
- BV** Ball Valves (2). Memory stop where required.
- BVPT** Ball Valves (2) with Pressure/Temperature (P/T) Ports. Memory stop where required.
- FC** Fixed Flow Control
- FCC** Fixed Cartridge Flow Control
- AFS** Adjustable Flow Circuit Setter
- YS** Y Strainer
- YSB** Y Strainer w/hose bib valve
- PTO** P/T Ports (other location)

### Examples:

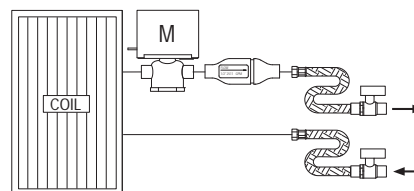
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BALL VALVES



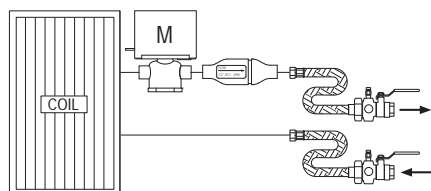
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BALL VALVES WITH P/T PORTS



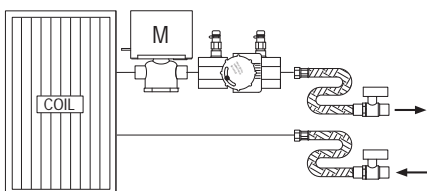
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BALL VALVES, FIXED FLOW CONTROL



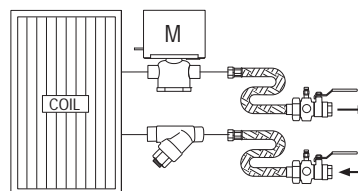
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BALL VALVES WITH P/T PORTS,  
FIXED FLOW CONTROL



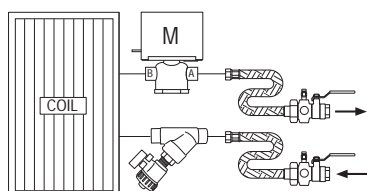
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BALL VALVES,  
ADJUSTABLE FLOW CIRCUIT SETTER



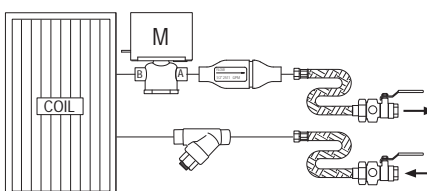
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BALL VALVES WITH P/T PORTS,  
Y-STRAINER



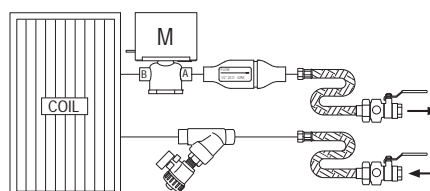
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BALL VALVES WITH P/T PORTS,  
Y-STRAINER W/HOSE BIB



CODE: 211/411-01  
BALL VALVES WITH P/T PORTS,  
FIXED FLOW CONTROL, Y-STRAINER



CODE: 211/411-02  
BALL VALVES WITH P/T PORTS, FIXED FLOW  
CONTROL, Y-STRAINER W/HOSE BIB





## Model Series: 39VH and 39L Vertical Hi-Rise Units • 3-Way Valves

3-Way Chilled / Hot Water Valve						
Basic Package Code		Components				
2-Position Actuator	Modulating Actuator	BV	BVPT	FC	FCC	AFS
302	502	•				
303	503		•			
310	510	•		•		
311	511		•	•		
312	512	•			•	
313	513		•		•	
314	514	•				•

Options				
Options Package Code	Components			
	YS	YSB	PTO	BPV
01	•			
02		•		
03			•	
04	•		•	
05		•	•	
06				•
07	•			•
08		•		•
09	•		•	•
10		•	•	•

### Notes:

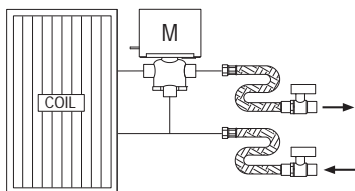
1. Select a Basic Package for each valve and an Options Package if required.
2. Nailor Electric Controls (PSC motor) require a 2-position actuator selection for both chilled water and hot water valves.
3. Nailor Digital and Analog VAV Controls (ECM motor) require a modulating chilled water valve actuator and a 2-position hot water valve actuator selection for 4-pipe systems.
4. An Aquastat is furnished on 2-pipe cooling and heating auto changeover systems.
5. All Vertical Hi-Rise Units include two flexible hoses.

### Legend:

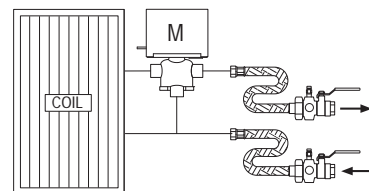
- BV** Ball Valves (2). Memory stop where required.
- BVPT** Ball Valves (2) with Pressure/Temperature (P/T) Ports. Memory stop where required.
- FC** Fixed Flow Control
- FCC** Fixed Cartridge Flow Control
- AFS** Adjustable Flow Circuit Setter
- YS** Y Strainer
- YSB** Y Strainer w/hose bib valve
- PTO** P/T Ports (other location)
- BPV** Bypass Balancing Valve

### Examples:

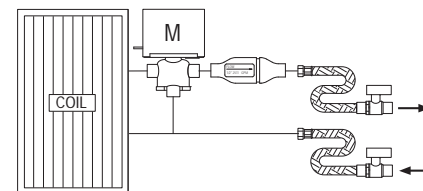
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BALL VALVES



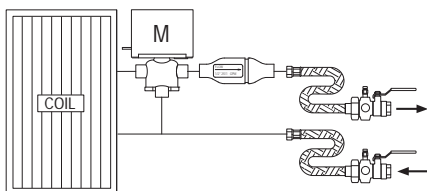
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BALL VALVES WITH P/T PORTS



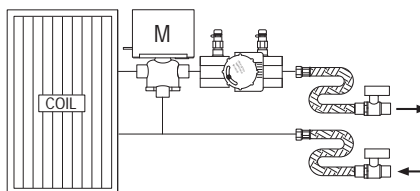
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BALL VALVES, FIXED FLOW CONTROL



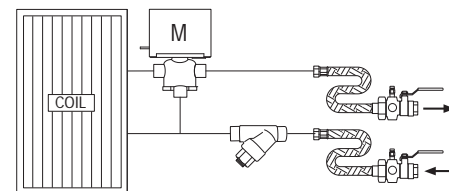
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BALL VALVES WITH P/T PORTS,  
FIXED FLOW CONTROL



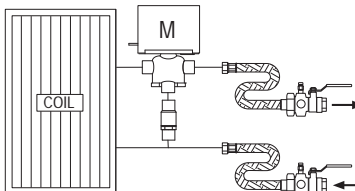
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BALL VALVES,  
ADJUSTABLE FLOW CIRCUIT SETTER



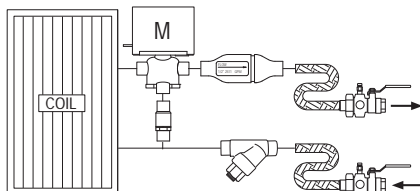
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BALL VALVES WITH P/T PORTS,  
Y-STRAINER



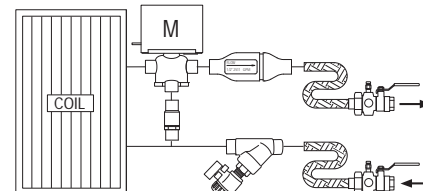
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BYPASS BALANCING VALVE



CODE: 311/511-07  
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Y-STRAINER, BYPASS BALANCING VALVE



CODE: 311/511-08  
BALL VALVES WITH P/T PORTS, FIXED FLOW CONTROL,  
Y-STRAINER W/HOSE BIB, BYPASS BALANCING VALVE



## Model Series: 35F and 37F Horizontal Fan Coil Units • 2-Way Valves

2-Way Chilled / Hot Water Valve						
Basic Package Code		Components				
2-Position Actuator	Modulating Actuator	BV	BVPT	FC	FCC	AFS
201	401					
202	402	•				
203	403		•			
204	404			•		
205	405				•	
206	406					•
210	410	•		•		
211	411		•	•		
212	412	•			•	
213	413		•		•	
214	414	•				•

Options			
Options Package Code	Components		
	YS	YSB	PTO
01	•		
02		•	
03			•
04	•		•
05		•	•

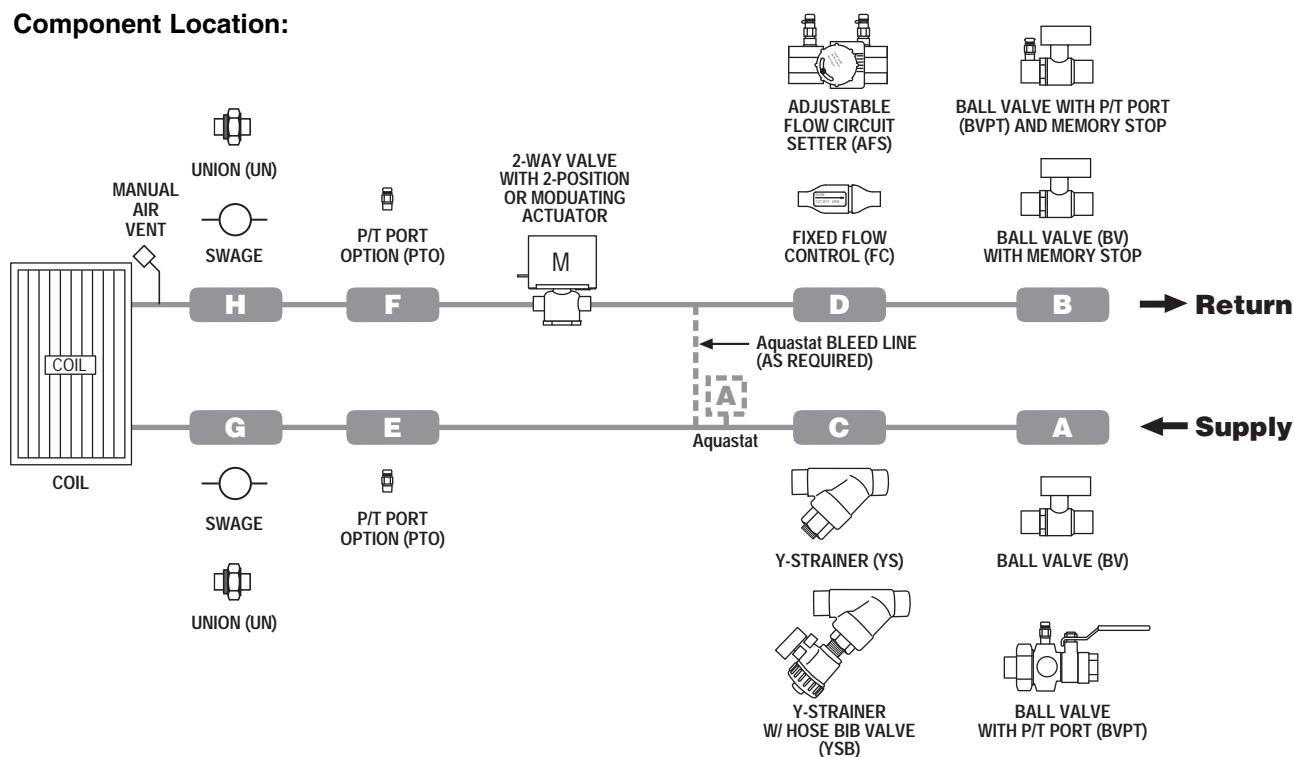
### Legend:

- BV** Ball Valves (2). Memory stop where required.
- BVPT** Ball Valves (2) with Pressure/Temperature (P/T) Ports. Memory stop where required.
- FC** Fixed Flow Control
- FCC** Fixed Cartridge Flow Control
- AFS** Adjustable Flow Circuit Setter
- YS** Y Strainer
- YSB** Y Strainer w/hose bib valve
- PTO** P/T Ports (other location)

### Notes:

1. Select a Basic Package for each valve and an Options Package if required.
2. Nailor Electric Controls (PSC motor) require a 2-position actuator selection for both chilled water and hot water valves.
3. Nailor Digital and Analog VAV Controls (ECM motor) require a modulating chilled water valve actuator and a 2-position hot water valve actuator selection for 4-pipe systems.
4. A 1/4" (6.3) bleed line and Aquastat is furnished on 2-pipe cooling and heating auto changeover systems.

### Component Location:





## Model Series: 35F and 37F Horizontal Fan Coil Units • 3-Way Valves

3-Way Chilled / Hot Water Valve						
Basic Package Code		Components				
2-Position Actuator	Modulating Actuator	BV	BVPT	FC	FCC	AFS
301	501					
302	502	•				
303	503		•			
304	504			•		
305	505				•	
306	506					•
310	510	•		•		
311	511		•	•		
312	512	•			•	
313	513		•		•	
314	514	•				•

### Notes:

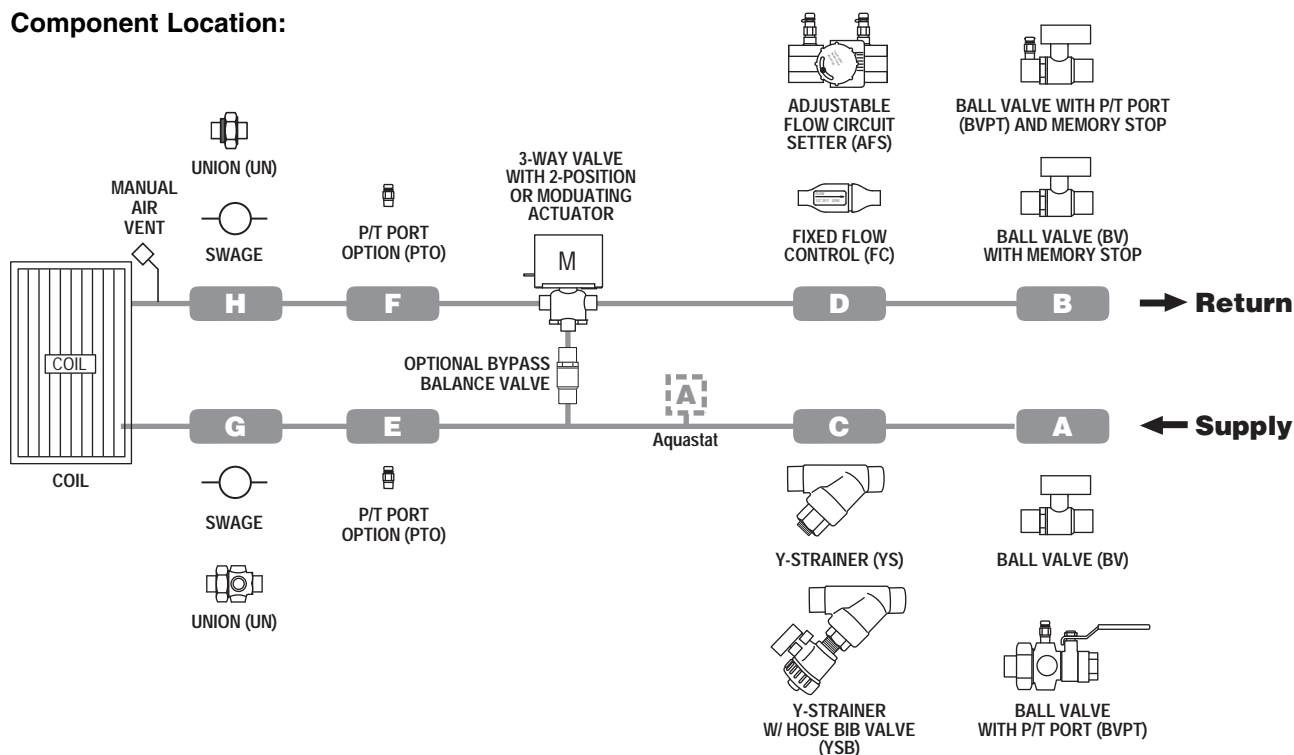
1. Select a Basic Package for each valve and an Options Package if required.
2. Nailor Electric Controls (PSC motor) require a 2-position actuator selection for both chilled water and hot water valves.
3. Nailor Digital and Analog VAV Controls (ECM motor) require a modulating chilled water valve actuator and a 2-position hot water valve actuator selection for 4-pipe systems.
4. An Aquastat is furnished on 2-pipe cooling and heating auto changeover systems.

Options				
Options Package Code	Components			
	YS	YSB	PTO	BPV
01	•			
02		•		
03			•	
04	•		•	
05		•	•	
06				•
07	•			•
08		•		•
09	•		•	•
10		•	•	•

### Legend:

- BV** Ball Valves (2). Memory stop where required.
- BVPT** Ball Valves (2) with Pressure/Temperature (P/T) Ports. Memory stop where required.
- FC** Fixed Flow Control
- FCC** Fixed Cartridge Flow Control
- AFS** Adjustable Flow Circuit Setter
- YS** Y Strainer
- YSB** Y Strainer w/hose bib valve
- PTO** P/T Ports (other location)
- BPV** Bypass Balancing Valve

### Component Location:



## Components and Specifications

Engineered Comfort Vertical Hi-Rise fan coil units are supplied as standard with a factory supplied and installed valve package for the main cooling coil and optional heating coil. This assures all components are compatible with the application and install with the physical restrictions of the cabinet for ease of maintenance and service.

Engineered Comfort Horizontal fan coil units have standard valve packages available as a factory installed or "ship loose"

option for field connection.

Valve packages consist of a variety of components and selection is dependent upon the application. The following section provides a detailed description of each of the components. Photos are for general representation purposes only. Vendors and models are subject to change without notice.



### Manual Ball Valve with Memory Stop (BV)

Ball valves, also known as end valves, allow the unit to be cut off for servicing purposes. They are often used for water balancing. These full port ball valves have a compact handle that rotates 90 degrees. The return side valve is supplied with an adjustable memory stop position lever to limit

travel of the on/off handle where required. This allows the ball valve to be closed and returned to the balance setting position without re-testing the system.

Nominal size: 1/2" or 3/4"  
Body material: Forged brass  
Ball: Chrome plated brass  
Ball seal: Teflon

Shaft seals: Viton O-Rings  
Temp. rating: 325°F max.  
Pressure rating: 600 psi max.  
Cv: 17 (1/2"), 40 (3/4")

### Manual Ball Valve with P/T Port (BVPT)

Same use as BV above except in addition, the supply and return side valve includes a Pressure / Temperature (PT) Port to allow testing of water pressure,

different pressure or water temperature across the coil/valve package assembly. The return side valve is supplied with an adjustable memory stop where required for balancing.

Nominal size: 1/2" or 3/4"  
Body material: Forged brass  
Ball: Chrome plated brass  
Ball seal: Teflon

Shaft seals: Viton O-Rings  
Temp. rating: 325°F max.  
Pressure rating: 600 psi  
Cv: 21 (1/2"), 42 (3/4")



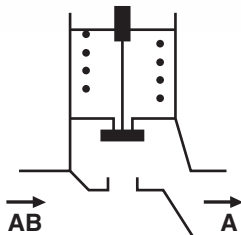
### 2-Way, 2-Position Control Valve / Actuator

All valves are piped on the return side of the coil. Figure 3 shows the valves in the open position or full flow position. The valve spring provides the necessary force to hold the stem in the raised or Normally Open (NO) position.

In the open position, water can flow through the coil to heat or cool the space. In the closed position, water cannot flow. Actuators are 2-position spring return operation. The Normally Open (NO) or Normally Closed (NC) valve position (relative to water flow through the coil) on power failure is determined by the actuator model selection. NO / NC action must be compatible with the thermostat / control package selection.

Actuator are available for line and 24 Vac low voltage applications.

Nominal size: 1/2" or 3/4"  
Body material: Brass  
Pressure rating: 125 psi max.  
Temperature rating: 230°F max.  
Max. close off pressure: 44 psi  
Cv: 2.5 (1/2"), 4.1 (3/4")  
Actuator power consumption: 10 VA max.



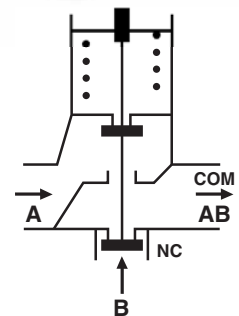
**Figure 1. 2-way Valve**  
(Normally open to coil flow)

### 3-Way, 2-Position Control Valve / Actuator

3-Way valves are piped on the return side of the coil as mixing valves. In the open position, water can flow through the coil to heat or cool the space and the bypass port is closed. (Flow is A to AB). In the closed position, water cannot flow through the water coil and is diverted to flow through the bypass line (Flow is B to AB) maintaining full flow through the bypass port. Actuators are 2-position spring return operation. The NO / NC valve position on power failure (relative to water flow through the coil) is determined by the actuator model selection and must be compatible with the thermostat / control package selection.

Actuator are available for line and 24 Vac low voltage applications.

Nominal size: 1/2" or 3/4"  
Body material: Brass  
Pressure rating: 125 psi max.  
Temperature rating: 230°F max.  
Max. close off pressure: 44 psi  
Cv: 2.5 (1/2"), 4.1 (3/4")  
Actuator power consumption: 10 VA max.



**Figure 2. 3-way Valve**  
(Normally open to coil flow)



## 2-Way Modulating Control Valve / Actuator

Valve operation is described above. Actuators use a 0 – 10 Vdc control signal, are fail-in-place design (non-spring return) and provide proportional control from minimum to maximum water flow through the coil in response to room demand from a compatible controller. Modulating valves are standard on Nailor analog and digital EPIC control package chilled water valves.

Actuator are 3-wire 24 Vac only (2.5 VA).

## 3-Way Modulating Control Valve / Actuator

Valve operation is described above. Actuators use a 0 – 10 Vdc analog control signal, are fail-in-place design (non-spring return) and provide proportional control from minimum to maximum water flow through the coil in response to room demand from a compatible controller. Modulating valves are standard on Nailor analog and digital EPIC control package chilled water valves.

Actuator are 3-wire 24 Vac only (2.5 VA).



## Flexible Hose Kits (FH)

See full description elsewhere in catalog. Standard on all Vertical Hi-Rise Units.

Core: Fabric reinforced EPDM  
Braid: Stainless Steel  
Fitting: Brass OT58  
Ferrule: Stainless Steel  
Gasket Seal: Fiber / EDPM  
Cv: 3.5 (1/2"), 12.8 (3/4")

## Fixed Flow Control (FC)

A pressure compensated automatic fixed flow device, designed to limit the flow GPM through the coil. This inline version comes with a fixed flow rate in a tamperproof housing. Desired GPM must be specified.

Nominal size: 1/2" or 3/4"

Flow Range: 0.5 – 20.0 GPM options

Body material: Copper

Pressure differential range: 2 – 80 psid

Temperature rating: 220°F max.

Cv: Variable with inlet pressure



## Cartridge Fixed Flow Control (FCC)

A pressure compensated automatic fixed flow device, designed to limit the flow through the coil. This model features a changeable flow cartridge. Y-design allows changing the flow rate without dismantling the piping.

Nominal size: 1/2" or 3/4"

Body material: Forged brass

Flow Range: 0.5 – 8.0 GPM options

Pressure differential range: 2 – 80 psid

Temperature rating: 220°F max.

Cv: Variable with inlet pressure

## Adjustable Flow Circuit Setter (AFS)

A pressure dependent ball type flow control device, precisely calibrated for use as a presettable balance valve, variable orifice flow meter and positive shut-off service valve. Furnished with a calibrated nameplate and memory stop indicator and built in P/T ports.

Nominal size: 1/2" or 3/4"

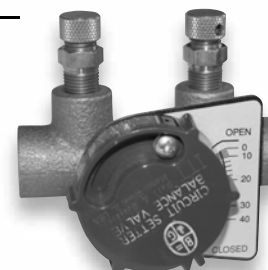
Pressure rating: 200 psig max.

Temp. rating: 250°F max.

Body material: Brass

Ball: Brass

Cv: Variable





## Y Strainer (YS)

An inline fitting designed to allow water to flow through a built in removable screen to filter debris or contaminants. With the water system isolated, the plug can be removed from the blowdown leg and the captured debris removed from the screen.

Nominal size: 1/2" or 3/4"

Pressure rating: 600 psig max.

Body: Forged brass

Temperature rating: 325°F max.

Screen: 20 mesh, 304 stainless steel

Cv: 5.5 (1/2"), 9.0 (3/4")

(Valve with the clean filter)

## Y Strainer with Hose Bib Valve (YSB)

A Y-Strainer with the addition of a manual ball valve installed on the blowdown leg. The valve has a standard 3/4" garden hose connection and cap to allow fluid to be piped to a container.

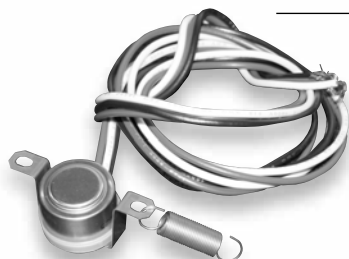


## Unions (UN)

An optional fitting used to provide a mechanical connection between the coil and valve package on horizontal fan coil units (not available on Hi-Rise units). Can be connected and disconnected without the need to cut piping or unsolder a joint.

## Bypass Balancing Valve (BPV)

A ball valve used to balance the water flow through the bypass circuit of a 3-way control valve. Manual adjustment is required. No calibration is provided at the valve.



## AquaStat (AQ)

The AquaStat, also called a summer-winter changeover switch or aqua thermostat, is a switch designed to automatically change a room thermostat from heating to cooling and back in a 2-pipe system to

be used for both heating and cooling. The switch is attached to the incoming water pipe with a spring and senses water temperature.

Switch action: Bimetal snap acting disc SPDT

Setpoint: 75°F (24°C) approx, fixed

Differential: 15°F (8°C) fixed

Switch rating: 120 Vac, 5.8 FLA, 34.8 LRA (inductive) Pilot duty 125 VA.

Wiring: White (common). Black-White close on temp. rise (82°F).

Blue-white close on temp. drop (67°F)

## Optional Pressure / Temperature Test Ports Location (PTO)

P/T ports allow testing of water pressure, differential pressure and water temperature without interrupting the waterside operation of the fan coil unit. P/T Ports when specified are located on the ball valves as standard (see BVPT). When P/T ports are required in another location, such as directly across the coil, this PTO option should be specified.

Nominal size: 1/4"

Connection: 1/4" MNPT

Body material: Brass

Pressure rating: 1000 psig max.

Temp. rating: 325°F max.



## 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) maximum 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 Engineered Comfort Fan Coil Units 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 coil units in a return air plenum. MBH can be converted to kW by using the chart or by calculation. There are 3413 BTU's in 1 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:

$$\text{cfm} = \frac{\text{kW} \times 3160}{\Delta T (\text{Discharge air temp} - \text{Inlet air temp.}) ^\circ \text{F}}$$

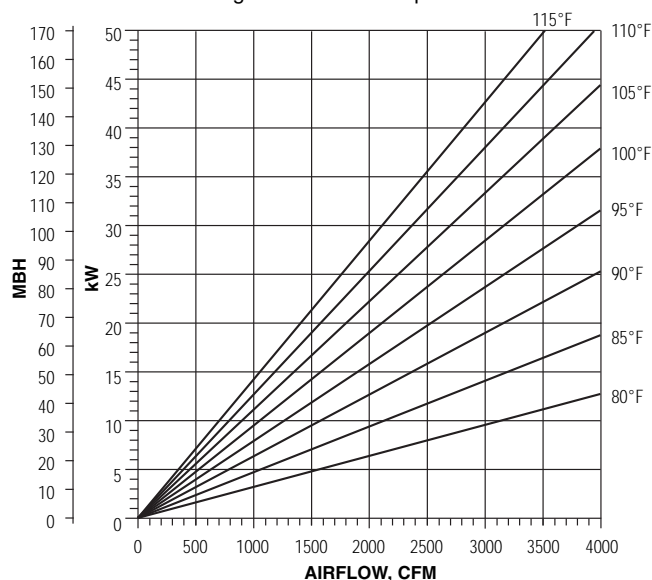
Assuming 70°F (21°C) supply air temperature to the heater, the room airflow can be selected directly from the chart. Start at the left at the design kW. Move horizontally to the desired discharge air temperature. Then, move vertically down to the cfm at the bottom of the chart.

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.