Engineered Comfort

CONTROLS & PIPING PACKAGES

Direct Digital Controls
EZstat – The All-In-One Fan Coil Digital Controller

Control Options:

- Variable Air Volume (VAV) EPIC Fan Technology® with ECM
- Proportional 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 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.

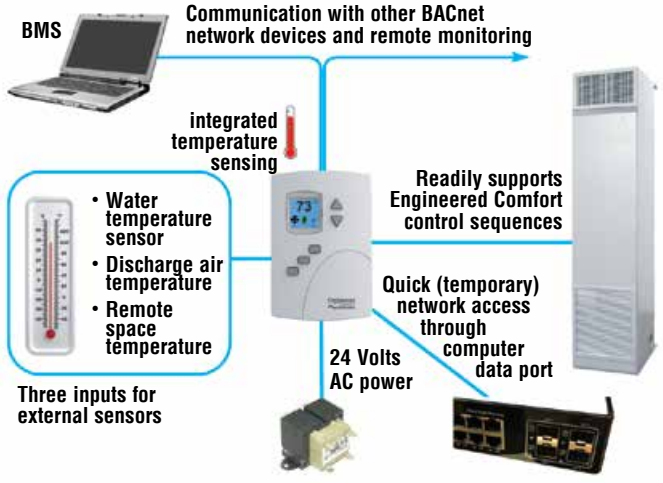


Fig. 2 Network setup

1-6-20

Direct Digital Controls (continued)

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).

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

EPIC ECM/Proportional ECM control sequences:

- 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

3-speed ECM/PSC control sequences:

- N540: On-Off Cooling/Heating
- N541: On-Off Cooling/Heating with Auxiliary Electric Heat
- N542: On-Off Cooling with Electric Heat
- N543: On-Off Cooling/Heating
- N544: Modulating Cooling/Heating
- N545: Modulating Cooling/Heating with Auxiliary Electric Heat
- N546: Modulating Cooling with Electric Heat
- N547: Modulating Cooling/Heating
- N548: Modulating Cooling with Proportional Electric Heat
- N549: Modulating Cooling & On-Off Heating
- N550: Modulating Heating Only
- N551: On-Off Heating Only
- N552: Modulating Cooling Only

EPIC ECM VAV Control for 4-pipe & 2-pipe Operation:

EPIC Discharge Air Temperature (DAT) Control

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 (continued)

The following are examples of two Engineered Comfort control sequences:

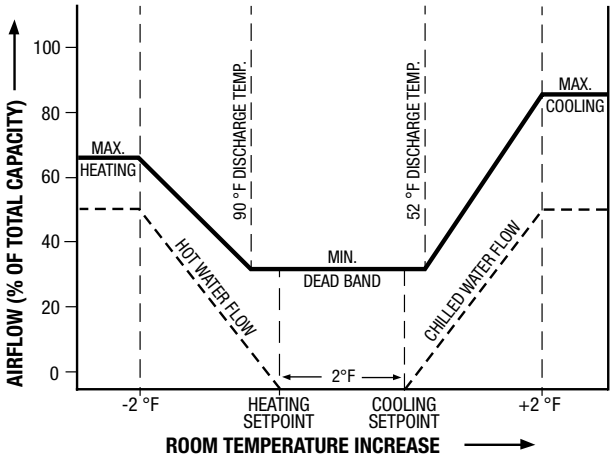
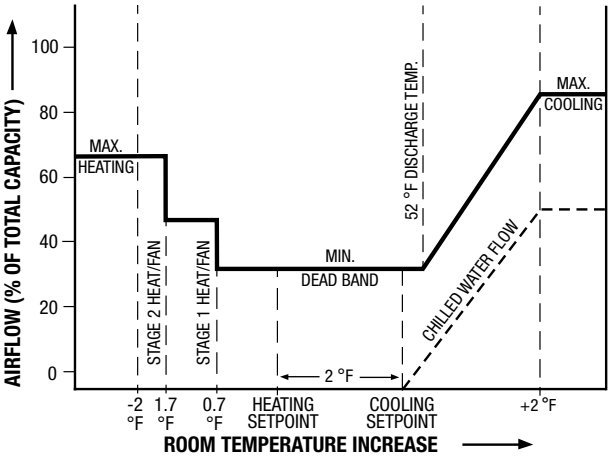


Fig. 3 EPIC Control Sequence Example: VAV Modulating Cooling and Modulating Heating (4-pipe and 2-pipe hydronic operation)



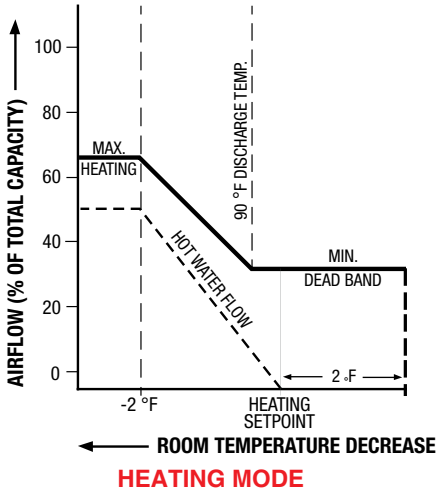


Fig. 4 EPIC Control Sequence Example: VAV Modulating Cooling/ Modulating Heating with Aux Staged Electric Heat

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.

Design	Indoor use only
Material	White flame-retardant plastic
Weight	Approx. 6 oz. (170 grams)
Supply Voltage	24 VAC (-15%, +20%), 50 – 60 Hz, 12 VA, non-supervised (all circuits, including supply voltage, are power limited circuits)
Wiring	Class 2 only
Inputs	0–12 volts DC with internal 10 k pull-up resistors
Relay Outputs	SPST, 24 volts, 1 amp AC or DC Maximum for all relay outputs is 3 amps
Analog Outputs	Short protected 10 mA 0-12 VDC
Environmental Limits	Operating Shipping Humidity
Regulatory	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.

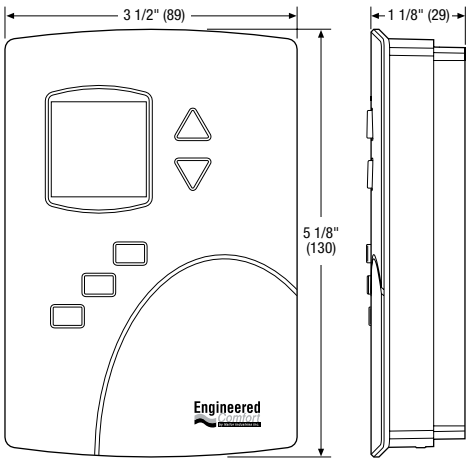
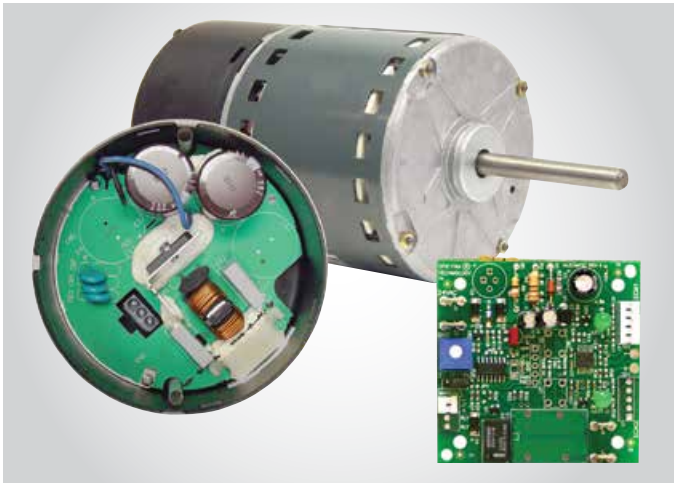


Fig. 5 Unit dimensions

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 turn down 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 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?

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, ECM/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 ECM/EPIC Fan Technology® versus PSC induction motors.

FEATURES AND BENEFITS

Soft starts and slewed speed ramps are programmed into the ECM 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 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 (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).

These features also extend the life of the ECM, 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.

ECM/EPIC FAN TECHNOLOGY®

In addition to the above standard features, Nailor Industries pioneered and developed ECM/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?

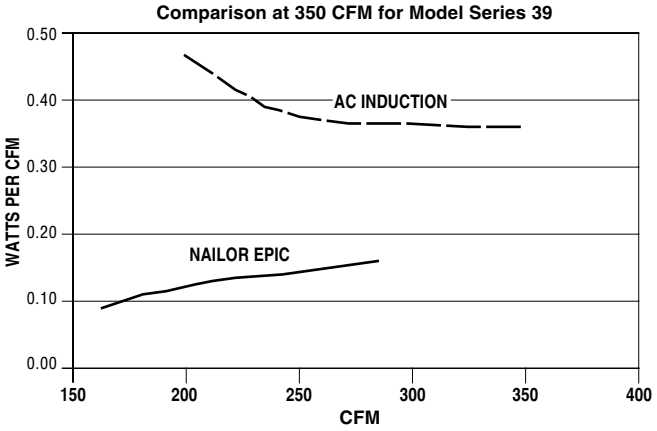
Pre-setting the fan airflow (CFM) has not been an issue with fan coil manufacturers because these units were either on at full load or off in normal operating conditions. With ECM/EPIC Fan Technology®, the fan coils can now be run as a VAV device with all of the requisite savings that VAV brings to other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

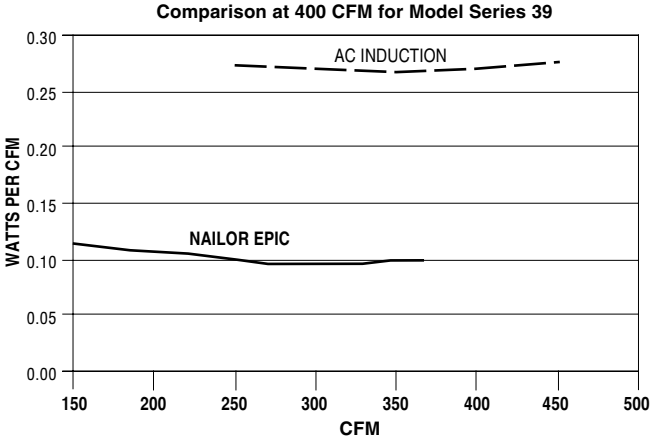
AC motors are not synchronous machines and the rpm, and consequently the unit CFM, changes when static pressure changes. The difficulty in pre-setting the fan lies in estimating the motor workload required at the job site in actual working conditions. The fan operated by an AC motor will not produce 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

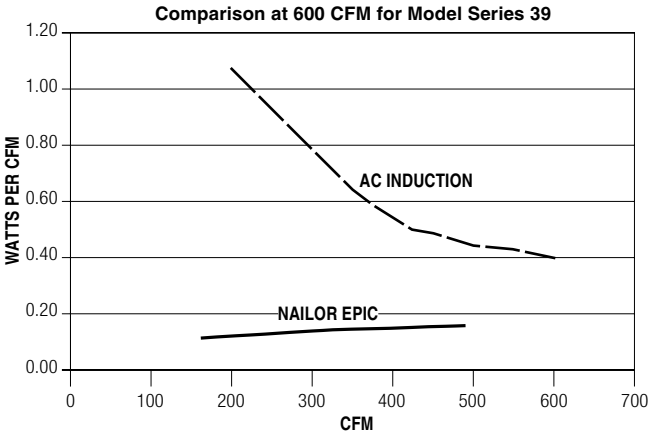
ECM Motors are DC and inherently synchronous machines. The motors are programmed to calculate the work they are doing and then compare the work accomplished to the CFM requirement. The integral microprocessor based controller automatically adjusts the speed and torque in response to system pressure changes 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.

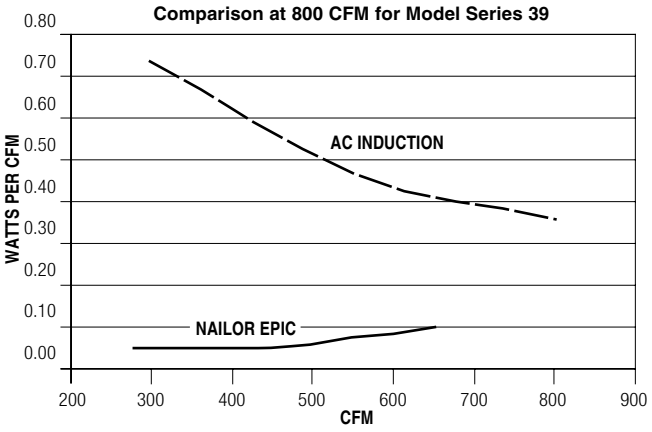
ENERGY SAVINGS

The following graphs show the energy savings of units with ECM/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 ECM/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 ECM/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 to 78°F). 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 psychometrics chart.

THE SOLUTION

The attached sequence of operation (See Figure 2) and psychometric 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 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 psychometric 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. 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.

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 psychometric chart.

2. Higher comfort level temperature Setpoint:

The lowered relative humidity allows the occupant to reset the room temperature higher by 1 to 4°F, 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)

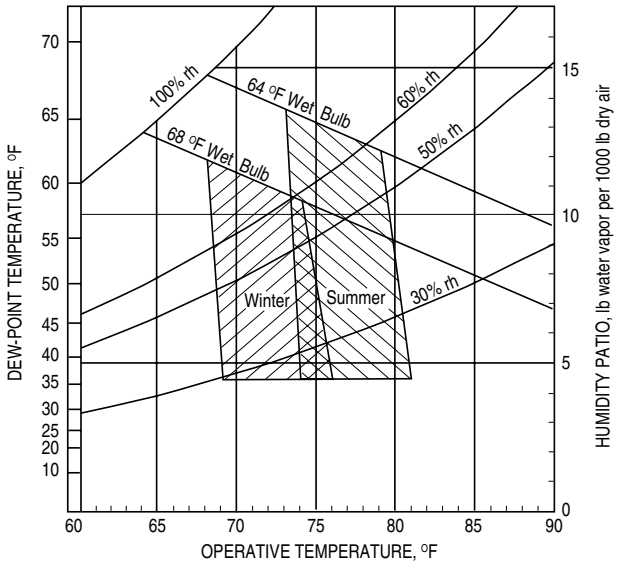


Figure 1: ASHRAE Summer and Winter Comfort Zones

(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 ΔT_1 = EAT – LAT for Std. FCU

CFM_2 = Airflow and ΔT_2 = EAT – LAT for EPIC FCU

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

Example 1:

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

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

Example 2:

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

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

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

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

Std. FCU (CFM_1)	=	300	400	600	800	1000	1200
EPIC FCU (CFM_2)	=	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.

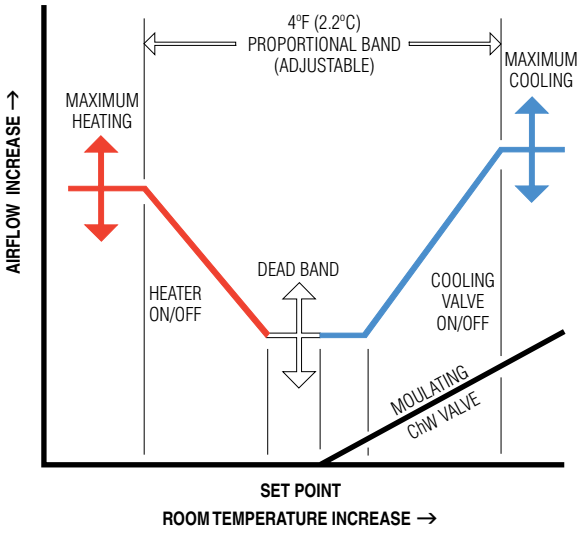


Figure 2. EPIC Fan Coil Unit Sequence of Operation

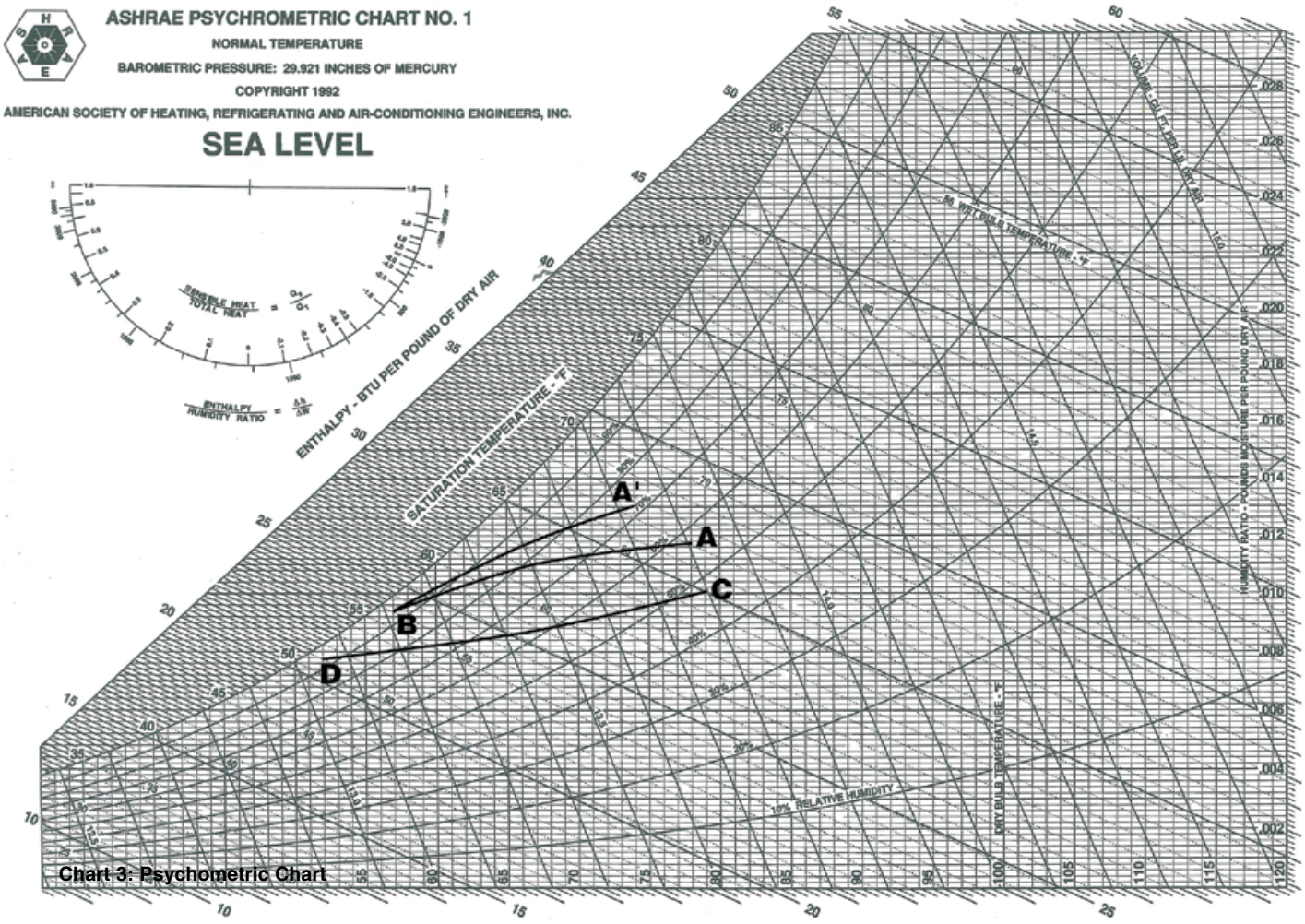


Chart 3: Psychometric Chart

Digital Display Thermostats for 3-Speed Fan Coil Units

The Engineered Comfort T1070 Series Thermostat represent great value for a wide variety of two and four pipe hydronic fan coil applications.

These thermostat controllers are available in both programmable and non-programmable models and are designed for standalone use in commercial buildings such as hotels and schools as well as residential condominium and apartment projects.

MODELS

T1070 Non-programmable 2 or 4-pipe
Normally closed - Chilled & hot water valves

T1075 Programmable 2 or 4-pipe
Normally closed - Chilled & hot water valves

T1075N Programmable 4-pipe Cold Climate
Normally closed Chilled water &
Normally open hot water valve

FEATURES

- 7-day programmable models with self-prompting programming.
- Auto 2-pipe changeover with thermistor sensor.
- 24 Vac low voltage.
- Electric heat ready (1-stage).
- 3-speed fan control (ECM or PSC).
- 2 position spring return on-off water valve control.
- Dry contact equipped for remote on-off occupied/ unoccupied control.
- Keypad lockout option.
- Large easy to read permanently illuminated digital display (°F or °C).
- Dual set point with adjustable deadband.
- Red / Green LED shows heating / cooling mode.
- All programming and set points stored in non-volatile memory and are never lost in power failure.
- Clock chip back up allows time to stay current for up to 48 hours during power loss for programmable models.
- Configurable display can show both heating and cooling set points and room temperature simultaneously.
- Includes exact fit locking cover.
- Optional wall plate for 2" x 4" (51 x 102) or 4" x 4" (102 x 102) electrical box installation.

AVAILABLE SEQUENCES OF OPERATION

2-pipe:

- Cool only – Thermostat is configured for cooling only operation. Cool and Off modes can be selected.
- Heat only – Thermostat is configured for heating only operation. Heat and Off modes can be selected.
- Heat/Cool with Auto Changeover – Thermostat is configured for operation with a changeover sensor, both modes are available for operation. Thermostat will measure water temperature and automatically lock out the incorrect mode. Heat or Cool modes may not be available, depending on water temperature.

Heat/Cool with Auto Changeover and Auxiliary Electric Heat - The Mode button selects the operating mode of the thermostat. If Off is selected, the thermostat will not enter Heating or Cooling mode. In heating mode, the thermostat will either enable the electric heat (if chilled water is in the coil), or open the coil valve (if hot water is in the coil) to maintain set point. In cooling mode, the thermostat will open the valve (if chilled water is in the coil). If Auto is selected, the thermostat will enter Heating or Cooling mode as needed to maintain set point.

4-Pipe & 2-pipe Cool With (Total) Electric Heat:

The Mode button selects the operating mode of the thermostat. If Off is selected, the thermostat will not enter Heating or Cooling mode. If Heat is selected, the thermostat will only enter Heating mode (if the room temperature is below the heating set point). If Cool is selected, the thermostat will only enter Cooling mode (if the room temperature is above the cooling set point). If Auto is selected, the thermostat will enter Heating or Cooling mode as needed to maintain set point.

FAN OPERATION

When Fan is in Auto mode, it will run continuously (unless thermostat mode is set to off or in unoccupied mode and heating or cooling are not active). The thermostat will increase or decrease the fan speed based on load conditions. Fan operation may also be set to always run at Low, Medium, or High speeds.

Digital Display Thermostats for 3-Speed Fan Coil Units (continued)

TECHNICAL SPECIFICATIONS

Power requirements: 20–30 Vac. 50/60 Hz. 3 VA@24V nominal.

Temperature adjustment range: 35–99 °F (2–36 °C).

Accuracy: 35–65 °F, +/- 3 °F. 66–79 °F, +/- 2 °F. 90–99 °F, +/- 3 °F. 100–104 °F, +/- 5 °F.

Deadband: Adjustable 1 to 6 °F first stage, fixed 1 °F for med/hi fan speeds.

Output rating (fan or valve): 20–30 Vac. 0.4A max. 0.01A min. 3A in rush.

Digital inputs: H_2O voltage free contacts, closed to signal chilled water supply.
CK1 voltage free contacts, closed to alter set points.

Local temp. sensor: Solid state. 10mV/°F.

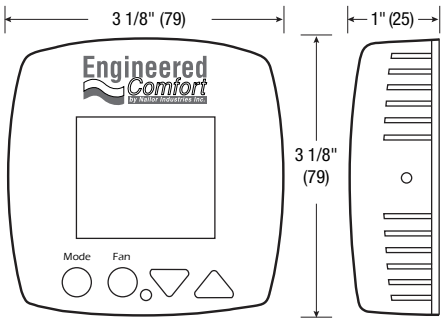
Remote temp. sensor: Digital communication. 5 ft. cable. Accurate to 1°F (–17.2 °C).

Wire size: 16 AWG (100 ft. max.) to 24 AWG (36 ft. max.)

Ambient conditions: Operating 35 –104 °F (2–40 °C). 5–95% RH non-condensing. 86 °F (30 °C) max. dew point.

Compliance: UL/CUL listed (file E162563), NEC Class 2.

Shipping weight: 0.5 lb (0.25 kg).



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Standard Control Sequences • Model Series 35FH, 37FH, 39, 40H and 41V EPIC ECM • Proportional ECM

EZstat Digital Controls

Type Z • Control Sequence N501 (2-pipe)

N501 BACnet Digital Thermostat 7-Day Programmable Schedule, Variable Air Volume, Modulating Cooling/ Heating • Auto Changeover • 2-pipe System

Auto Changeover

A thermistor type sensor measures entering water temperature and automatically changes controller from cooling mode to heating mode. At 10°F (6°C) below room temperature, the unit is in cooling mode. At 10°F (6°C) above room temperature, the unit is in heating mode. If the thermostat calls for cooling or heating and the controller does not sense that the 2-pipe system is in the correct central mode, the unit will remain at minimum airflow and valve will remain closed.

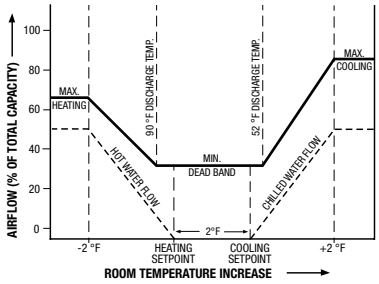
Discharge Air Temperature

The Discharge Air Temperature sensor (DAT) provides the controller with the coil leaving air temperature (LAT). This is used to control the modulating valve, to achieve the pre-set, but adjustable, discharge temperatures. On cooling, this controls humidity while on heating it controls occupant comfort.

SEQUENCE OF OPERATION:

Modulating Cooling

On a call for cooling, the chilled water valve will begin to modulate open. 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

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.

Modulating Heating

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.

Type ZE • Control Sequence N502 (2-pipe)

N502 BACnet Digital Thermostat 7-Day Programmable Schedule, Variable Air Volume, Modulating Cooling/ Heating with Auxiliary Staged Electric Heat • Auto Changeover • 2-pipe System

Auto Changeover

A thermistor type sensor measures entering water temperature and automatically changes controller from cooling mode to heating mode. At 10°F (6°C) below room temperature, the unit is in cooling mode. At 10°F (6°C) above room temperature, the unit is in heating mode. If the thermostat calls for cooling or heating and the controller does not sense that the 2-pipe system is in the correct central mode, the unit will remain at minimum airflow and valve will remain closed.

Discharge Air Temperature

The Discharge Air Temperature sensor (DAT) provides the controller with the coil leaving air temperature (LAT). This is used to control the modulating valve, to achieve the pre-set, but adjustable, discharge temperatures. On cooling, this controls humidity while on heating it controls occupant comfort.

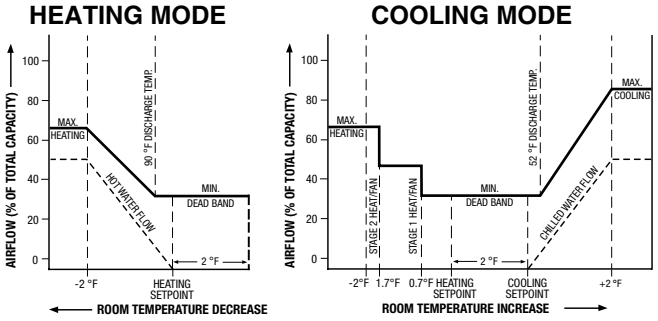
SEQUENCE OF OPERATION:

Modulating Cooling

On a call for cooling, the chilled water valve will begin to modulate open. 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

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 and electric heat relay will be off.



Modulating Heating

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 Electric Heat (in cooling mode)

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

NOTES: See page E12.

Standard Control Sequences • Model Series 35FH, 37FH, 39, 40H and 41V EPIC ECM • Proportional ECM

EZstat Digital Controls

Type ZE • Control Sequence N503 (2-pipe)

N503 BACnet Digital Thermostat 7-Day Programmable Schedule, Variable Air Volume, Modulating Cooling with Staged Electric Heat • 2-pipe System

Discharge Air Temperature

The Discharge Air Temperature sensor (DAT) provides the controller with the coil leaving air temperature (LAT). This is used to control the modulating valve, to achieve a pre-set, but adjustable, discharge temperature. On cooling, this controls humidity.

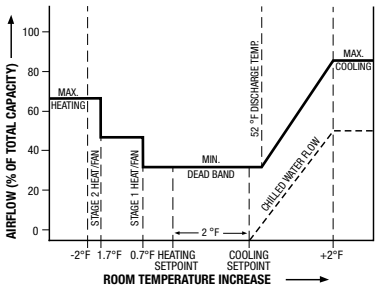
SEQUENCE OF OPERATION:

Modulating Cooling

On a call for cooling, the chilled water valve will begin to modulate open. 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

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 chilled water valve will be off. The hot water valve and electric heat relay will be off.



Staged Electric Heat

On a call for heating, the water valve is closed. The fan will step up to the stage 1 fan airflow setting and the first stage of electric heat will energize to achieve room set point. Units with electric heat may have an optional second stage available. Upon an increased call for heat, the fan will step up to the stage 2 fan airflow setting and the second stage of heat will energize. On a decrease in heating demand, the sequence will reverse.

Type W • Control Sequence N508 (2-pipe)

N508 BACnet Digital Thermostat 7-day Programmable Schedule, Variable Air Volume, Modulating Heat 2-pipe System

Discharge Air Temperature

The Discharge Air Temperature sensor (DAT) provides the controller with the coil leaving air temperature (LAT). This is used to control the proportional heat to achieve a pre-set, but adjustable, discharge temperature. On heating it controls occupant comfort.

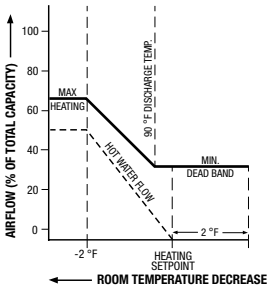
SEQUENCE OF OPERATION:

Modulating Heating

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.

Deadband

With no demand in the space, there will be no call for heating. The fan will be at a deadband set minimum airflow. The hot water valve will be off.



Type W • Control Sequence N509 (2-pipe)

N509 BACnet Digital Thermostat 7-day Programmable Schedule, Variable Air Volume, On/Off Hot Water Heat • 2-pipe System

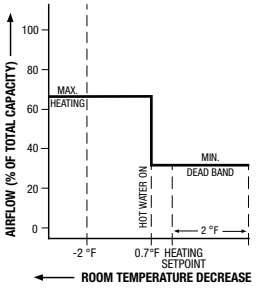
SEQUENCE OF OPERATION:

On/Off Hot Water Heating

On a call for heating, the fan will ramp up to the maximum airflow setting and the hot water valve will open to achieve room set point. On a decrease in heating demand, the sequence will reverse.

Deadband

With no demand in the space, there will be no call for heating. The fan will be at a deadband set minimum airflow. The water valve will be off.



NOTES:

1. EZstat is factory programmed for the specific sequence of operation.
2. EZstat is also factory calibrated when airflow settings are provided for easy start-up.
3. Field commissioning (password protected):
   a. Max. and Min. airflow settings are field adjustable between the ranges on the unit's ECM fan curve calibration chart.
   b. Deadband differential and other parameters are also adjustable.
   c. Refer to Fan Coil Controller-EZstat IOM.
4. Remote mounted 24 VAC thermostat is field wired (by others). Refer to application specific wiring diagram.
5. Thermostats baseplate mounts to a standard 2" (51) x 4" (102) vertical handy box.

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Standard Control Sequences • Model Series 35FH, 37FH, 39, 40H and 41V EPIC ECM • Proportional ECM

EZstat Digital Controls

Type Z • Control Sequence N510 (2-pipe)

N510 BACnet Digital Thermostat 7-day Programmable Schedule, Variable Air Volume, Modulating Cooling 2-pipe System

Discharge Air Temperature

The Discharge Air Temperature sensor (DAT) provides the controller with the coil leaving air temperature (LAT). This is used to control the modulating valve to achieve a pre-set, but adjustable, discharge temperature. On cooling, this controls humidity.

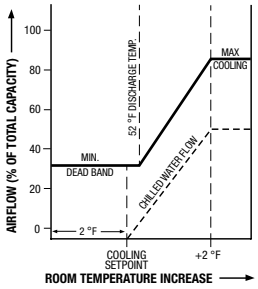
SEQUENCE OF OPERATION:

Modulating Cooling

On a call for cooling, the chilled water valve will begin to modulate open. 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

With no demand in the space, there will be no call for cooling. The fan will be at a deadband set minimum airflow. The chilled water valve will be off.



Type ZW • Control Sequence N505 (4-pipe)

N505 BACnet Digital Thermostat 7-day Programmable Schedule, Variable Air Volume, Modulating Cooling/ Heating • 4-pipe System

Discharge Air Temperature

The Discharge Air Temperature sensor (DAT) provides the controller with the coil leaving air temperature (LAT). This is used to control the modulating valve, to achieve the pre-set, but adjustable, discharge temperatures. On cooling, this controls humidity while on heating it controls occupant comfort.

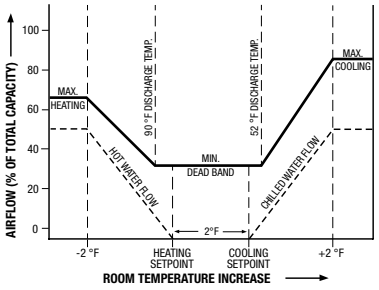
SEQUENCE OF OPERATION:

Modulating Cooling

On a call for cooling, the chilled water valve will begin to modulate open. 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

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 chilled and hot water valve will be off.



Modulating Heating

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.

NOTES:

1. EZstat is factory programmed for the specific sequence of operation.
2. EZstat is also factory calibrated when airflow settings are provided for easy start-up.
3. Field commissioning (password protected):
   a. Max. and Min. airflow settings are field adjustable between the ranges on the unit's ECM fan curve calibration chart.
   b. Deadband differential and other parameters are also adjustable.
   c. Refer to Fan Coil Controller-EZstat IOM.
4. Remote mounted 24 VAC thermostat is field wired (by others). Refer to application specific wiring diagram.
5. Thermostats baseplate mounts to a standard 2" (51) x 4" (102) vertical handy box.

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Standard Control Sequences • Model Series 35FH, 37FH, 39, 40H and 41V
EPIC ECM • Proportional ECM
EZstat Digital Controls

Type ZW • Control Sequence N507 (4-pipe)

N507 BACnet Digital Thermostat 7-day Programmable Schedule, Variable Air Volume, Modulating Cooling with On/Off Heat • 4-pipe System

Discharge Air Temperature

The Discharge Air Temperature sensor (DAT) provides the controller with the coil leaving air temperature (LAT). This is used to control the modulating valve to achieve a pre-set, but adjustable, discharge temperature. On cooling, this controls humidity.

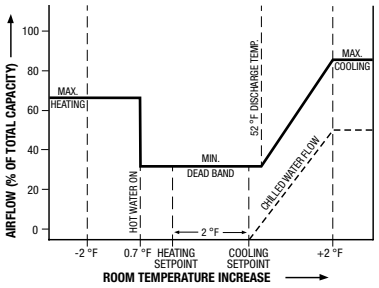
SEQUENCE OF OPERATION:

Modulating Cooling

On a call for cooling, the chilled water valve will begin to modulate open. 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

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



On/Off Heating

On a call for heating, the fan will ramp up to the maximum airflow setting and the hot water valve will open to achieve room set point. On a decrease in heating demand, the sequence will reverse.

Standard Control Sequences • Model Series 35FH and 37FH • EPIC ECM
EZstat Digital Controls

Type ZE • Control Sequence N506 (2-pipe)

N506 BACnet Digital Thermostat 7-Day Programmable Schedule, Variable Air Volume, Modulating Cooling with Proportional Electric Heat • 2-pipe System

Discharge Air Temperature

The Discharge Air Temperature sensor (DAT) provides the controller with the coil leaving air temperature (LAT). This is used to control the modulating valve to achieve the pre-set, but adjustable, discharge temperatures. On cooling, this controls humidity while on heating it controls occupant comfort.

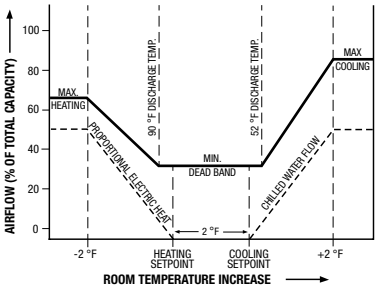
SEQUENCE OF OPERATION:

Modulating Cooling

On a call for cooling, the chilled water valve will begin to modulate open. 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

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 chilled water valve will be off. The hot water valve or the electric heat relay will also be off.



Proportional Electric Heat

On a call for heat, the SCR controlled electric heater will proportionally increase the heat output to maintain a discharge air temperature of 90°F (32°C). Simultaneously, the fan will modulate from minimum airflow to maximum airflow in response to room demand. Upon a decrease in heating demand, the sequence will reverse.

NOTES:

1. EZstat is factory programmed for the specific sequence of operation.
2. EZstat is also factory calibrated when airflow settings are provided for easy start-up.
3. Field commissioning (password protected):
   a. Max. and Min. airflow settings are field adjustable between the ranges on the unit's ECM fan curve calibration chart.
   b. Deadband differential and other parameters are also adjustable.
   c. Refer to Fan Coil Controller-EZstat IOM.
4. Remote mounted 24 VAC thermostat is field wired (by others). Refer to application specific wiring diagram.
5. Thermostats baseplate mounts to a standard 2" (51) x 4" (102) vertical handy box.

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BACnet TESTING LABORATORIES BTL

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Standard Control Sequences • Model Series 35FH and 37FH • EPIC ECM

EZstat Digital Controls

Type E • Control Sequence N508

N508 BACnet Digital Thermostat 7-day Programmable Schedule, Variable Air Volume, Proportional Electric Heat

Discharge Air Temperature

The Discharge Air Temperature sensor (DAT) provides the controller with the coil leaving air temperature (LAT). This is used to control the proportional heat to achieve a pre-set, but adjustable, discharge temperature. On heating it controls occupant comfort.

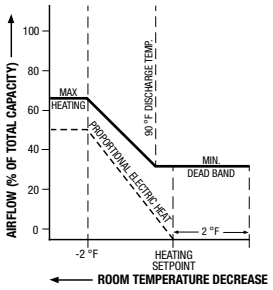
SEQUENCE OF OPERATION:

Proportional Electric Heat

On a call for heat, the SCR controlled electric heater will proportionally increase the heat output to maintain a discharge air temperature of 90°F (32°C). Simultaneously, the fan will modulate from minimum airflow to maximum airflow in response to room demand. Upon a decrease in heating demand, the sequence will reverse.

Deadband

With no demand in the space, there will be no call for heating. The fan will be at a deadband set minumum airflow. The hot water valve will be off.



Type E • Control Sequence N509

N509 BACnet Digital Thermostat 7-day Programmable Schedule, Variable Air Volume, Staged Electric Heat

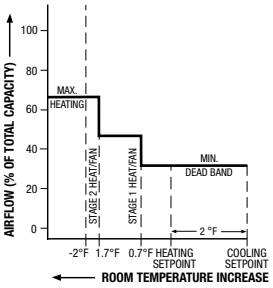
SEQUENCE OF OPERATION:

Staged Electric Heat

On a call for heating, 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 heating, 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.

Deadband

With no demand in the space, there will be no call for heating. The fan will be at a deadband set minimum airflow. The electric heat relay will be off.



Standard Control Sequences • Model Series 35FH, 37FH, 39, 40H and 41V

3 Speed ECM/PSC control sequences

- **N540** On-Off Cooling/Heating
- **N541** On-Off Cooling/Heating with Auxiliary Electric Heat
- **N542** On-Off Cooling with Electric Heat
- **N543** On-Off Cooling/Heating
- **N544** Modulating Cooling/Heating
- **N545** Modulating Cooling/Heating with Auxiliary Electric Heat
- **N546** Modulating Cooling with Electric Heat
- **N547** Modulating Cooling/Heating
- **N548** Modulating Cooling with Proportional Electric Heat
- **N549** Modulating Cooling & On-Off Heating
- **N550** Modulating Heating Only
- **N551** On-Off Heating Only
- **N552** Modulating Cooling Only

NOTES:

1. EZstat is factory programmed for the specific sequence of operation.
2. EZstat is also factory calibrated when airflow settings are provided for easy start-up.
3. Field commissioning (password protected):
   a. Max. and Min. airflow settings are field adjustable between the ranges on the unit's ECM fan curve calibration chart.
   b. Deadband differential and other parameters are also adjustable.
   c. Refer to Fan Coil Controller-EZstat IOM.
4. Remote mounted 24 VAC thermostat is field wired (by others). Refer to application specific wiring diagram.
5. Thermostats baseplate mounts to a standard 2" (51) x 4" (102) vertical handy box.

General Notes:

1. Nailor recommends modulating chilled water valve control for Nailor Digital 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 braided 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. 35FH and 37FH Horizontal Units with Nailor Digital 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, contact factory if this is desired.
7. All ball isolation valves on the return line are furnished with an adjustable memory stop feature and may be used as a balancing valve.
8. 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.
10. 1/2" (13) valve: 0.5 to 4.0 GPM in 0.5 GPM increments. 5 to 8 GPM in 1 GPM increments.
11. 3/4" (19) valve: 3.0 to 4.0 GPM in 0.5 GPM increments. 5 to 12 GPM in 1 GPM increments.
12. 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. If the thermostat or controller includes a purge function the bleedlne will not be necessary.
13. 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.

Coil and Valve Package Pressure Drop:

The following CV factors table is used to determine the pressure drop of various factory furnished piping package components and accessories.

C_v FACTORS FOR 39 SERIES VALVE PACKAGE COMPONENTS					
Port Diameter	**Ball Valve**	**2-way valve**	**3-way Valve**	**Flow Control** (Fixed or Auto)	**Strainer**
1/2"	21	2.5	2.5	2.12	9.13

NOTES:

C_V factors are based on Engineered Comfort standard valve package components.

1. Flow control C_V at full open position.

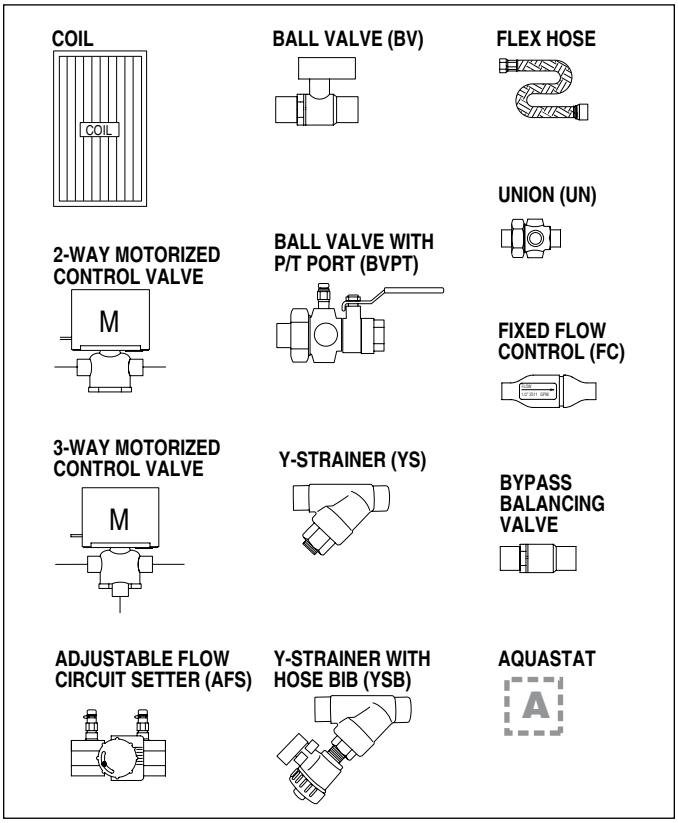
Example:

Find the pressure drop in feet of head (ft - H_2O) for a size 10 unit at 7.5 GPM with the following:

4 Row Coil, Two – 1/2" ball valves, One – 1/2" strainer, One – 2-way valve

- (GPM ÷ C_V 1/2" ball valve)^2 x 2 + (GPM ÷ C_V Strainer)^2 + (GPM ÷ C_V 2-way valve)^2 = PD (PSI)
- (0.13 x 2) + 0.67 + 9.00 = 9.80 PSI
- 9.80 PSI x 2.31 ft./PSI = 22.64 ft-H_2O
- 22.64 ft - H_2O + 11.7 ft - H_2O (from coil data) = 34.34 ft - H_2O

Answer is 34.34 ft - H_2O



Chilled/Hot Water Valve Packages • Vertical and Horizontal Fan Coil Units

All Model Series	Code Chilled/Hot Water		Components
2-way 2-position Valve Packages	C201/H201	2W2P	2-way 2-position **(Not available for Model Series 39)**
	C202/H202	2W2P, BV	2-way 2-position + Ball Valves (2)
	C203/H203	2W2P, BVPT	2-way 2-position + Ball Valves (2) with Pressure/Temperature Ports
	C210/H210	2W2P, BV, FC	2-way 2-position + Ball Valves (2) + Fixed Flow Control
	C211/H211	2W2P, BVPT, FC	2-way 2-position + Ball Valves (2) with Pressure/Temperature Ports + Fixed Flow Control
	C212/H212	2W2P, BV, FCC	2-way 2-position + Ball Valves (2) + Fixed Cartridge Flow Control
	C213/H213	2W2P, BVPT, FCC	2-way 2-position + Ball Valves (2) with Pressure/Temperature Ports + Fixed Cartridge Flow Control
	C214/H214	2W2P, BV, AFS	2-way 2-position + Ball Valves (2) + Adjustable Circuit Setter with Pressure/Temperature Ports
3-way 2-position Valve Packages	C301/H301	3W2P	3-way 2-position **(Not available for Model Series 39)**
	C302/H302	3W2P, BV	3-way 2-position + Ball Valves (2)
	C303/H303	3W2P, BVPT	3-way 2-position + Ball Valves (2) with Pressure/Temperature Ports
	C310/H310	3W2P, BV, FC	3-way 2-position + Ball Valves (2) + Fixed Flow Control
	C311/H311	3W2P, BVPT, FC	3-way 2-position + Ball Valves (2) with Pressure/Temperature Ports + Fixed Flow Control
	C312-H312	3W2P, BV, FCC	3-way 2-position + Ball Valves (2) + Fixed Cartridge Flow Control
	C313/H313	3W2P, BVPT, FCC	3-way 2-position + Ball Valves (2) with Pressure/Temperature Ports + Fixed Cartridge Flow Control
	C314/H314	3W2P, BV, AFS	3-way 2-position + Ball Valves (2) + Adjustable Circuit Setter with Pressure/Temperature Ports
2-way Modulating Valve Packages	C401/H401	2W mod	2-way Modulating **(Not available for Model Series 39)**
	C402/H402	2W mod, BV	2-way Modulating + Ball Valves (2)
	C403/H403	2W mod, BVPT	2-way Modulating + Ball Valves (2) with Pressure/Temperature Ports
	C410/H410	2W mod, BV, FC	2-way Modulating + Ball Valves (2) + Fixed Flow Control
	C411/H411	2W mod, BVPT, FC	2-way Modulating + Ball Valves (2) with Pressure/Temperature Ports + Fixed Flow Control
	C412/H412	2W mod, BV, FCC	2-way Modulating + Ball Valves (2) + Fixed Cartridge Flow Control
	C413/H413	2W mod, BVPT, FCC	2-way Modulating + Ball Valves (2) with Pressure/Temperature Ports + Fixed Cartridge Flow Control
	C414/H414	2W mod, BV, AFS	2-way Modulating + Ball Valves (2) + Adjustable Circuit Setter with Pressure/Temperature Ports
3-way Modulating Valve Packages	C501/H501	3W mod	3-way Modulating **(Not available for Model Series 39)**
	C502/H502	3W mod, BV	3-way Modulating + Ball Valves (2)
	C503/H503	3W mod, BVPT	3-way Modulating + Ball Valves (2) with Pressure/Temperature Ports
	C510/H510	3W mod, BV, FC	3-way Modulating + Ball Valves (2) + Fixed Flow Control
	C511/H511	3W mod, BVPT, FC	3-way Modulating + Ball Valves (2) with Pressure/Temperature Ports + Fixed Flow Control
	C512/H512	3W mod, BV, FCC	3-way Modulating + Ball Valves (2) + Fixed Cartridge Flow Control
	C513/H513	3W mod, BVPT, FCC	3-way Modulating + Ball Valves (2) with Pressure/Temperature Ports + Fixed Cartridge Flow Control
	C514/H514	3W mod, BV, AFS	3-way Modulating + Ball Valves (2) + Adjustable Circuit Setter with Pressure/Temperature Ports
	Options Code Chilled/Hot Water		Components
Options	OC01/OH01	YS	Y Strainer
	OC02/OH02	YSB	Y Strainer with Hose Bib Valve
	OC03/OH03	PTO	Pressure/Temperature Ports (2, other location)
	OC04/OH04	YS, PTO	Y Strainer, Pressure/Temperature Ports (2, other location)
	OC05/OH05	YSB, PTO	Y Strainer with Hose Bib Valve, Pressure/Temperature Ports (2, other location)
	OC06/OH06	BPV	Bypass Balancing Valve
	OC07/OH07	YS, BPV	Y Strainer, Bypass Balancing Valve
	OC08/OH08	YSB, BPV	Y Strainer with Hose Bib Valve, Bypass Balancing Valve
	OC09/OH09	YS, PTO, BPV	Y Strainer, Pressure/Temperature Ports (2, other location), Bypass Balancing Valve
	OC10/OH10	YSB, PTO, BPV	Y Strainer with Hose Bib Valve, Pressure/Temperature Ports (2, other location), Bypass Balancing Valve
	ABL	ABL	Aquastat Bleed Line **(Only for 2-way Valve Packages)**

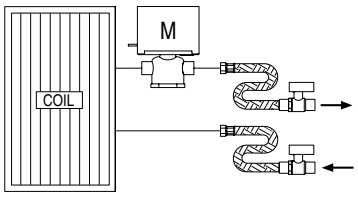
NOTES:

1. When applicable, a 1/4" (6.3) bleed line and Aquastat is furnished on 2-pipe cooling and heating auto changeover systems.
2. All Vertical Hi-Rise Units include two or four flexible hoses.
3. An Aquastat is furnished on 2-pipe cooling and heating auto changeover systems.

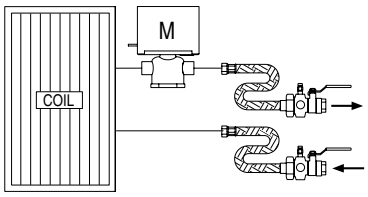
Model Series: 39VH and 39L Vertical Hi-Rise Units

2-way Valves Examples:

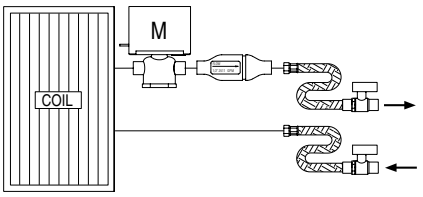
CODE: 202/402
BALL VALVES



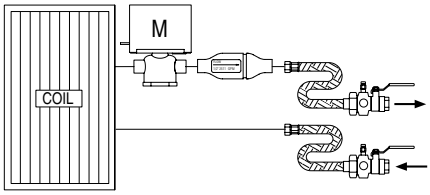
CODE: 203/403
BALL VALVES WITH P/T PORTS



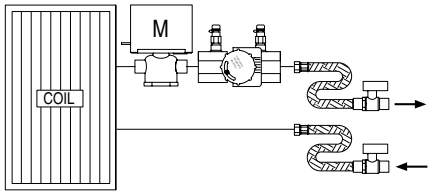
CODE: 210/410
BALL VALVES, FIXED FLOW CONTROL



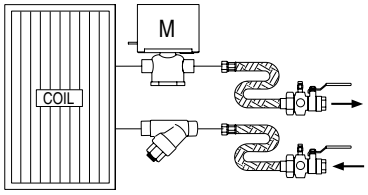
CODE: 211/411
BALL VALVES WITH P/T PORTS,
FIXED FLOW CONTROL



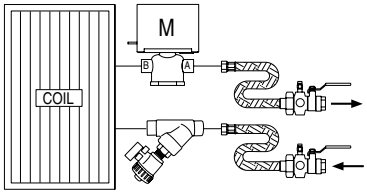
CODE: 214/414
BALL VALVES,
ADJUSTABLE FLOW CIRCUIT SETTER



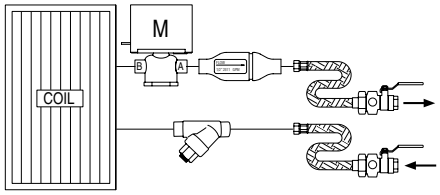
CODE: 203/403-01
BALL VALVES WITH P/T PORTS,
Y-STRAINER



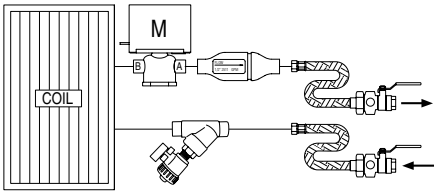
CODE: 203/403-02
BALL VALVES WITH P/T PORTS,
Y-STRAINER W/HOSE BIB



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

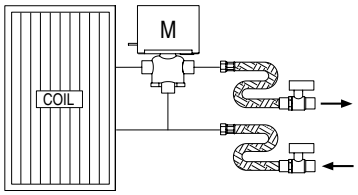


CODE: 211/411-02
BALL VALVES WITH P/T PORTS, FIXED FOW
CONTROL, Y-STRAINER W/HOSE BIB

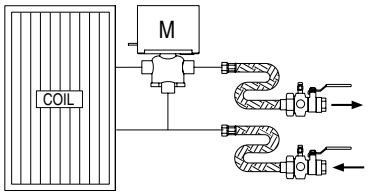


3-way Modulating Valves Examples:

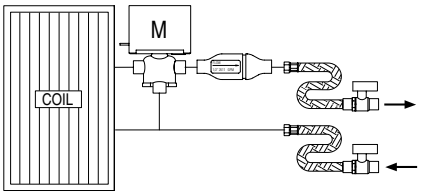
CODE: 302/502
BALL VALVES



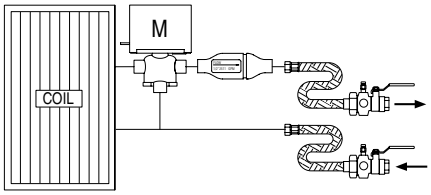
CODE: 303/503
BALL VALVES WITH P/T PORTS



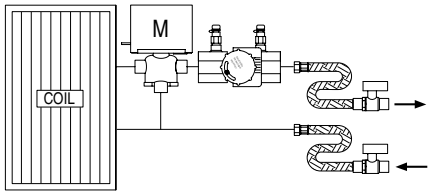
CODE: 310/510
BALL VALVES, FIXED FLOW CONTROL



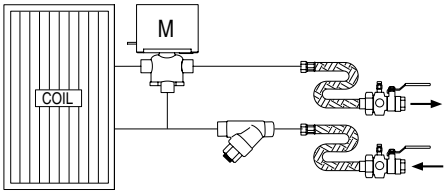
CODE: 311/511
BALL VALVES WITH P/T PORTS,
FIXED FLOW CONTROL



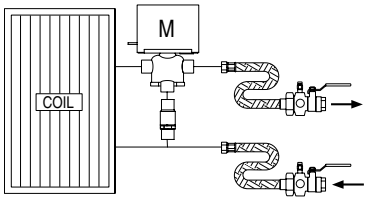
CODE: 314/514
BALL VALVES,
ADJUSTABLE FLOW CIRCUIT SETTER



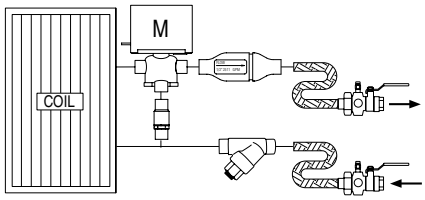
CODE: 303/503-01
BALL VALVES WITH P/T PORTS,
Y-STRAINER



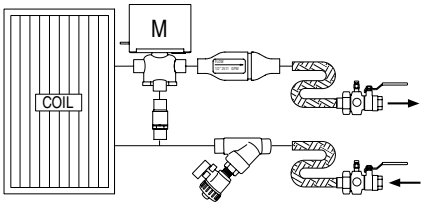
CODE: 303/503-06
BALL VALVES WITH P/T PORTS,
BYPASS BALANCING VALVE



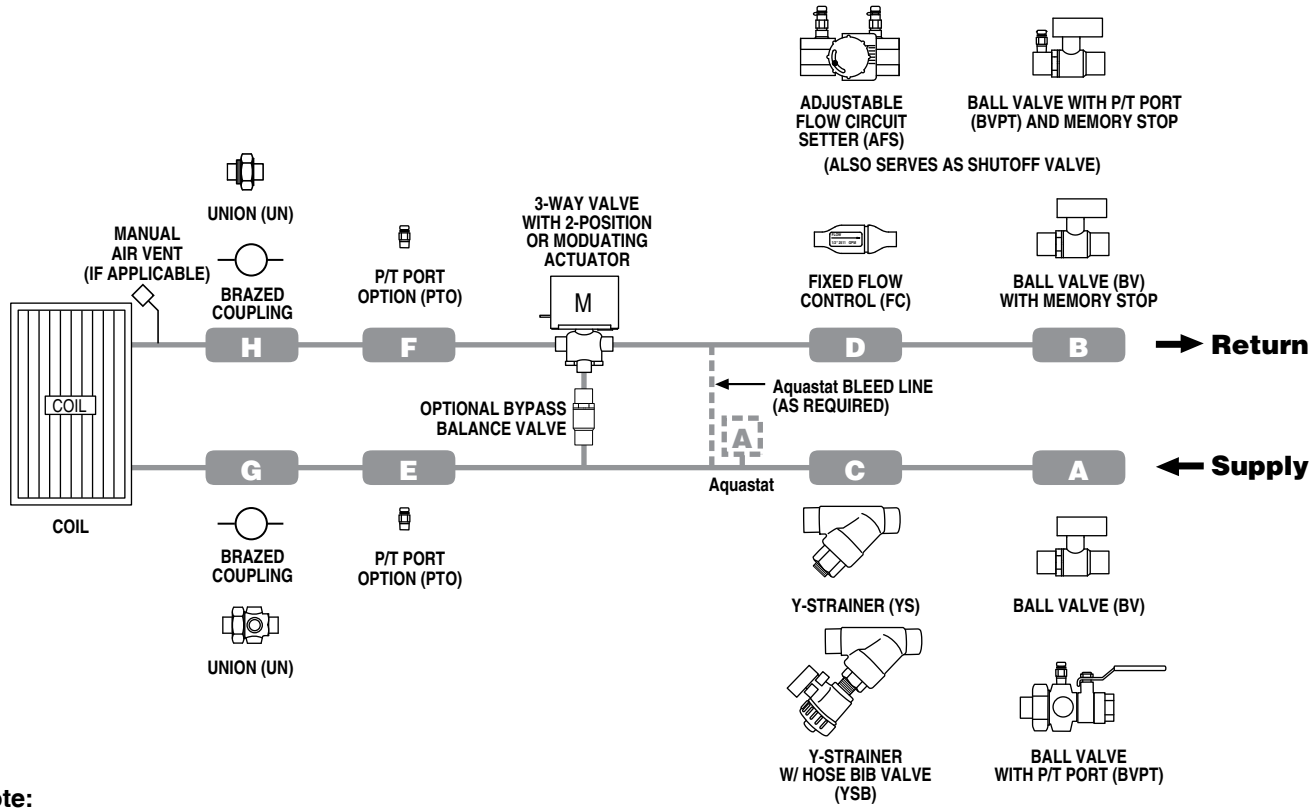
CODE: 311/511-07
BALL VALVES W/ P/T PORTS, FIXED FLOW CONTROL,
Y-STRAINER, BYPASS BALANCING VALVE



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



Valve Packages • Vertical and Horizontal Fan Coil Units



Note:

Ball Valves may be field installed or factory mounted. Currently, the 39 Series is the only model that is factory installed.

Basic System Types and Application:

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

2-pipe System (One Valve Package)

1. Hydronic Cooling Only
2. Hydronic Heating Only
3. Hydronic Cooling and Heating (Aquastat required)
4. Hydronic Cooling with Total Electric Heat
5. Hydronic Cooling and Heating with Auxiliary Electric Heat (Aquastat required)

4-pipe System (Two Valve Packages)

1. Hydronic Cooling and Heating

Valve Packages Component Notes:

Component Sizing: 1/2" nominal (for 5/8" O.D. copper tubing) or 3/4" nominal (for 7/8" O.D. copper tubing)

Manual Air Vent: Standard component - Brazed into high point of hydronic cooling and/or heating coil circuit.

Coil Connections (G & H): When isolation valve only is added to supply or return line, the isolation valve will be factory brazed to the coil stub-out. Addition of any other component or connection to the supply or return line will change the respective coil connection(s) to one of the following:

1) Standard: Swag fitting for brazed coupling.

2) Option: Union(s) added by factory for field connection.

Service Fitting (E & F): Optional P/T Ports (PTO) in supply and return lines.

Water Flow Balancing (B & D): Only one device per total valve package to be used for balancing water flow through the coil. When isolation valve (ball valve with memory stop or ball valve with P/T ports and memory stop at position B) is used for water flow balancing, do not specify additional balancing device at position at position **C** or **D**.

Adjustable flow circuit setter: May serve as a positive shut-off valve in lieu of isolation valve at position **D**.

Fixed flow control: No balancing required. When there are more device on the supply line of the valve package than on the return line, the factory may move this device to position **C2** to fit valve package within allotted space. Consult your Sales Representative to match the available fixed flow control to your job requirement.

Y-strainer (C): Does not include blow down fitting and should not be used in lieu of main pipping strainers.

Isolation valve (A): Normally requires one each on supply and return line.

Ball valve: Shut-off/balance, No memory stop.

Ball valve with P/T ports: Shut-off/balance.

1-6-20

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.

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 digital EPIC control package chilled water valves.

Actuator are 3-wire 24 Vac only (2.5 VA).
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
C_V: 2.5 (1/2"), 4.1 (3/4")
Actuator power consumption: 10 VA max.

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 minimum to maximum water flow through the coil in response to room demand from a compatible controller. Modulating valves are standard on Nailor digital EPIC control package chilled water valves.

Actuator are 3-wire 24 Vac only (2.5 VA).
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
C_V: 2.5 (1/2"), 4.1 (3/4")
Actuator power consumption: 10 VA max.

2-way, 2-position Control Valve / Actuator

All valves are piped on the return side of the coil. Figure 1 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.

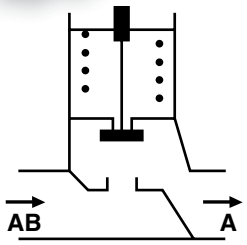


Figure 1. 2-way Valve
(Normally open to coil flow)

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
C_V: 2.5 (1/2"), 4.1 (3/4")
Actuator power consumption: 10 VA max.

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.

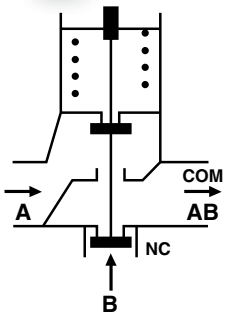


Figure 2. 3-way Valve
(Normally open to coil flow)

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
C_V: 2.5 (1/2"), 4.1 (3/4")
Actuator power consumption: 10 VA max.

Components and Specifications (continued)

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" Shaft seals: Viton O-Rings

Body material: Forged brass
Ball: Chrome plated brass
Ball seal: Teflon
Temperature rating: 325°F max.
Pressure rating: 600 psig max.
C_V: 17 (1/2"), 40 (3/4")

Manual Ball Valve with P/T Ports (BVPT)

Same use as BV above except in addition, the supply and return side valve includes a Pressure / Temperature (P/T) Ports 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"
Shaft seals: Viton O-Rings
Body material: Forged brass
Pressure rating: 600 psig max.
Temp. rating: 325°F max.
Ball: Chrome plated brass Pressure rating: 600 psi
Ball seal: Teflon C_V: 21 (1/2"), 42 (3/4")

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
C_V: 3.5 (1/2"), 12.8 (3/4")
Pressure rating: 400 psig max.

Fixed Cartridge 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 psig
Pressure rating: 600 psig max.
Temperature rating: 225°F max.
C_V: Variable with inlet pressure

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 rating: 522 psig max.
Temperature rating: 225°F max.
C_V: Variable with inlet pressure

Adjustable circuit setter with P/T ports (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: 300 psig max.
Temp. rating: 200°F max.
Body material: Brass
Ball: Brass
C_V: Variable

Components and Specifications (continued)

Y Strainer (YS)

An inline fitting designed to allow water to flow through a built in removable screen to filter debris or contaminates. 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"
Body: Forged brass
Screen: 20 mesh, 304 stainless steel
Cv: 5.5 (1/2"), 9.0 (3/4")
(Valve with the clean filter)
Pressure rating: 600 psig max.
Temperature rating: 325°F max.

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.

Pressure rating: 600 psig max.
Temperature rating: 325°F max.

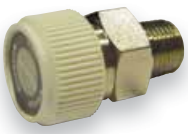
Manual Air Vent(s) (ZWC, 2-pipe and ZWD, 4-pipe)

Threaded Brass needle valve with screwdriver slot for adjustment.

Application – Body brazed into high point of heating and cooling coils for bleeding air from coil. Should not be used in lieu of main system air vent(s).

Standard: 39, 40 and 41 Series
Optional: 35 and 37 Series
Body: Forged Brass
Pressure rating: 400 psig
Temperature rating: 300°F

Automatic Air Vent(s) (ZWA, 2-pipe and ZWB, 4-pipe)



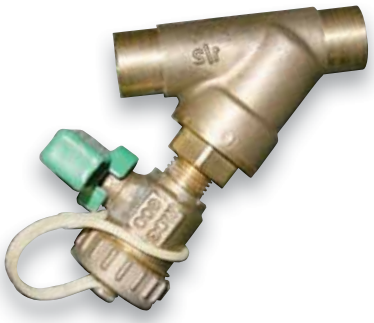
Nickel plated brass valve, fiber disk type, with positive shut-off ball check and quick vent feature via knurled vent screw.

Application: Optional replacement for manual air vent. Automatically passes minute quantities of air through the fiber disk which expand upon contact with water, completely sealing the valve. As air accumulates, the fiber disk dry and shrink, repeating the cycle. Not recommended for removing large quantities of air encountered during initial start-up or subsequent draining and refilling. Should not be used in lieu of main system air vent(s).

Body: Nickel Plated Brass
Pressure rating: 150 psig
Temperature rating: 212°F

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.



Pressure rating: 600 psig max.
Temperature rating: 325°F max.

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.

Pressure rating: 600 psig max.
Temperature rating: 325°F max.

Pressure / Temperature Ports (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: 600 psig max.
Temperature rating: 325°F max.

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
Wiring:
(common)
White-Yellow Normally Open
White-Orange Normally Closed
Open @ 83°F (+/-5°F)
Close @ 65°F (+/-5°F)

Basic System Types and Application:

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

2-pipe System (One Valve Package)

1. Hydronic Cooling Only
2. Hydronic Heating Only
3. Hydronic Cooling and Heating (Aquastat required)
4. Hydronic Cooling with Total Electric Heat
5. Hydronic Cooling and Heating with Auxiliary Electric Heat (Aquastat required)

4-pipe System (Two Valve Packages)

1. Hydronic Cooling and Heating

Valve Packages Component Notes:

Component Sizing: 1/2" nominal (for 5/8" O.D. copper tubing) or 3/4" nominal (for 7/8" O.D. copper tubing)

Manual Air Vent: Standard component - Brazed into high point of hydronic cooling and/or heating coil circuit.

Coil Connections (G & H): When isolation valve only is added to supply or return line, the isolation valve will be factory brazed to the coil stub-out. Addition of any other component or connection to the supply or return line will change the respective coil connection(s) to one of the following:

1) Standard: Swag fitting for brazed coupling.

2) Option: Union(s) added by factory for field connection.

Service Fitting (E & F): Optional P/T Ports (PTO) in supply and return lines.

Water Flow Balancing (B & D): Only one device per total valve package to be used for balancing water flow through the coil. When isolation valve (ball valve with memory stop or ball valve with P/T ports and memory stop at position B) is used for water flow balancing, do not specify additional balancing device at position at position **C** or **D**.

Adjustable flow circuit setter: May serve as a positive shut-off valve in lieu of isolation valve at position **D**.

Fixed flow control: No balancing required. When there are more device on the supply line of the valve package than on the return line, the factory may move this device to position **C2** to fit valve package within allotted space. Consult your Sales Representative to match the available fixed flow control to your job requirement.

Y-strainer (C): Does not include blow down fitting and should not be used in lieu of main pipping strainers.

Isolation valve (A): Normally requires one each on supply and return line.

Ball valve: Shut-off/balance, No memory stop.

Ball valve with P/T ports: Shut-off/balance.