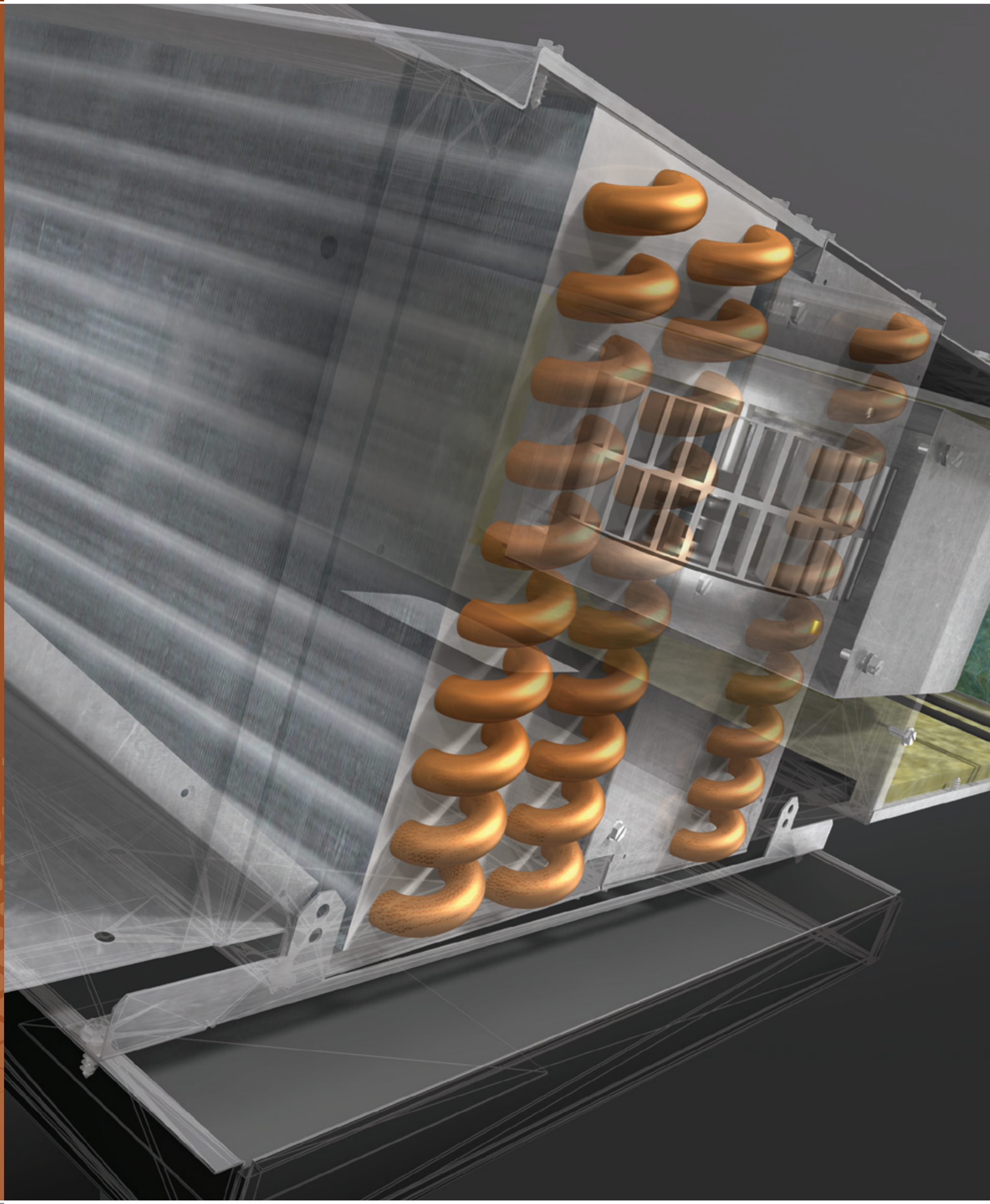
SECTION **F1**



Engineering Guide
Fan & Blower Coils

Please refer to the **Price Engineer's HVAC Handbook**
for more information on Fan Coils & Blower Coils.

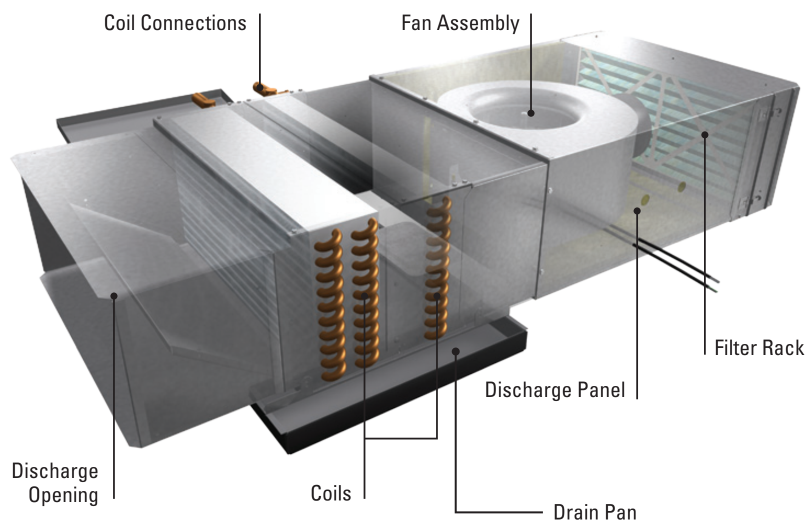
Product Fundamentals

Fan coils are a type of air handling unit designed to supply conditioned air to a room or zone. The basic components that make up a fan coil unit are a finned-tube heat exchanger, fan section and filter. The fan produces forced convection across the heat exchanger, which circulates either hot or cold water to provide conditioned air to the space. Individual zone thermostats are coupled to the fan coil's fan speed controller and hydronic controls to maintain room temperature. A well-designed fan coil unit will have low air and water pressure drops across the coil to reduce fan and pump power requirements as well as an efficient fan and motor assembly for quiet operation. Also, any fan coil unit equipped with a cooling coil should have a drain pan installed to capture condensate, regardless of whether or not the entering air is pre-conditioned. Fan coils are located in or near the space to be conditioned for free delivery of air into the zone or with minimal duct work. Units generally operate with a blow-through arrangement where the coil is downstream of the fan. Most fan coil units are supplied with a direct drive fan/motor assembly.

Most manufacturers certify their fan coil units' cooling performance to the Air-Conditioning, Heating, and Refrigeration Institute standard AHRI Standard 440-2008: Performance Ratings for Room Fan Coils. The purpose of the standard is to provide classifications, test requirements, and minimum data requirements for the published ratings of fan coil units delivering up to 1500 cfm.

Fan coils can be used in decentralized HVAC systems or in conjunction with a central air handling unit. The major advantages of using fan coil units are that they allow for local control of individual zones and reduce the overall footprint of the system by replacing ductwork with water piping in a large portion of the system. They also reduce the amount of cross-contamination between zones and allow for unused areas to be shut down. To receive ventilation air, fan coils can either be ducted to a central air handler or to a mixing plenum. When attached to a mixing plenum, care must be taken as fan coils do not typically have provisions for controlling the amount of outdoor air admitted, and the coil must be protected from freezing in cold climates.

Figure 1: View of Fan Coil Unit



Fan Coil Components

- **Access Panel** – Removable sheet metal section allows access to internal mechanical and electrical components.
- **Belt Drive** – The motor turns the blower by a belt connected to pulleys on each shaft end. Each motor revolution will usually not be equal to one blower revolution.
- **Blower/Fan** – Multi-bladed, driven rotor enclosed so that air from an inlet is compressed to a higher discharge pressure.
- **Casing** – Structural sheet metal box or shell to which all components are secured.
- **Coil** – A heat exchanger in which liquid is circulated to provide heating or cooling to the air which passes through the heat sink fins.
- **Control Enclosure** – Sheet metal shroud which houses the electrical connections, speed controller and transformer. The enclosure cover prevents accidental electrical shock as well as protects the contents from the environment.
- **Direct Drive** – The motor shaft is directly secured to the blower shaft. Each motor revolution is equal to one blower revolution.
- **Discharge Collar** – Rectangular fitting attached to the unit outlet allowing for quick attachment of downstream ductwork.
- **Drain Pan** – Pan located under the cooling coil to catch condensate formed during cooling.
- **Filter Rack** – Tray in which a filter can be pulled out for maintenance or replacement.
- **Liner** – Internal blanket adhered to the casing that is used to reduce the radiated and/or discharge sound levels. Materials used vary based on application and performance required.
- **Motor** – Electrical component of an air movement device that provides work to turn the blade assembly.

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Imperial dimensions are converted to metric and rounded to the nearest millimetre.

Fan Coils with Dedicated Outdoor Air Systems (DOAS)

Often fan coil units are applied in a dedicated outdoor air system (DOAS). In this configuration the air handler is selected to dehumidify and condition the outdoor air as well as to handle the space latent load. The fan coil unit provides sensible cooling or heating at the zone (**Figure 2**). This configuration has several advantages over a conventional VAV system. Decoupling the sensible and latent loads ensures proper humidity control at each zone. Additionally, the exact outdoor air requirements to each zone can be maintained, eliminating over-ventilation and ensuring compliance with ASHRAE Standard 62-2001—Ventilation for Acceptable Indoor Air Quality (IAQ). Energy savings can be realized due to reduced terminal reheat and reduced outdoor air. Additionally, the DOAS system can be turned off during unoccupied hours with the fan coils maintaining local zone temperature control.

In **Figure 2** the outdoor air is delivered directly to the space through a separate diffuser, independent of the fan coil unit. This allows the fan coil unit to be turned off or run at low speed during part load conditions. Note that if a low supply air temperature (less than 55 °F) is required for dehumidification, a high induction diffuser should be selected to prevent drafts. Another option is to duct the outdoor air into the fan coil unit (**Figure 3**). In this case the fan coil must run during part load, however ductwork is minimized.

Figure 2: Outdoor air ducted through separate diffusers

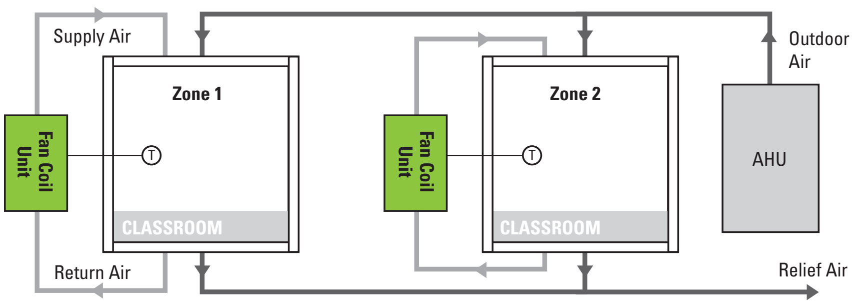
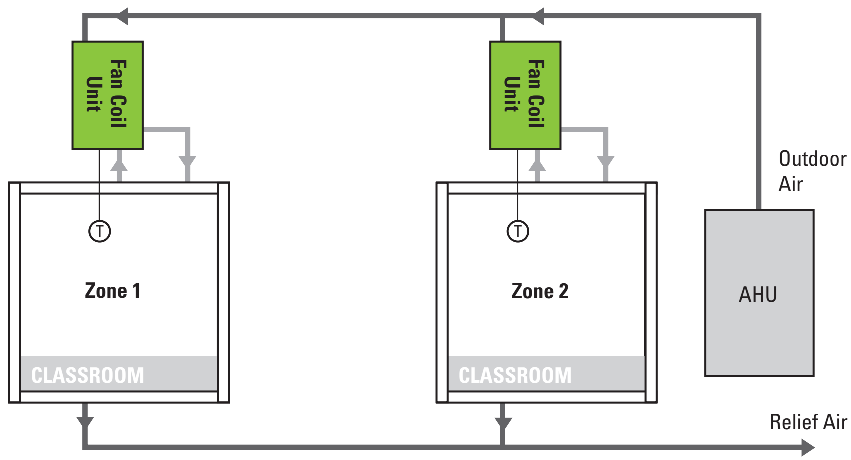


Figure 3: Outdoor air ducted into fan coil unit



ENGINEERING GUIDE - FAN COILS & BLOWER COILS

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Fan Coil Unit Types

Low Pressure Fan Coils

Low pressure fan coils are generally located in or adjacent to the space to be conditioned. They are usually selected for free delivery of air into the zone or with minimal ductwork having a static resistance of less than 0.25 in. w.g. A well-designed unit should be equipped with an easily removable filter, drain pan and fan/motor assembly to reduce maintenance costs and improve indoor air quality. They are normally offered in nominal air flow sizes up to 1200 cfm and use multispeed, high-efficiency motors. Units commonly have single point power connections and three position (plus shutdown) fan speed controllers. Units are available in vertical or horizontal configurations for exposed and concealed applications as shown in **Figure 4** and **Figure 5**.

Concealed Units

Concealed units can be furred into a wall or installed in a ceiling plenum and then are typically ducted to a single discharge grille or diffuser as shown in **Figure 6**.

Exposed Units

Exposed units are generally installed in a visible location and therefore have an attractive painted finish and return and supply air grilles as shown **Figure 7**. Units use fully insulated casings to reduce the amount of noise delivered to the occupied space, and the footprint is designed to be small to minimize the amount of occupied space they require.

Typical Applications

Low pressure fan coils are ideally suited for applications where individual zone temperature control is required. This makes them an ideal candidate for hotels, apartment buildings and office buildings (ASHRAE, 2008a). In many cases vertical units are installed so that the supply air 'washes' the window and helps lower the thermal impact of the glass. Fan coils can be used in health care facilities, but care should be taken because of their low-efficiency filters and because they are designed mostly for re-circulated air which is not permitted in certain types of spaces.

Figure 4: Vertical Updraft Fan Coil Arrangement

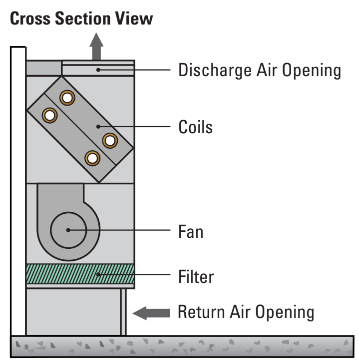

Figure 5: Horizontal Fan Coil Arrangement

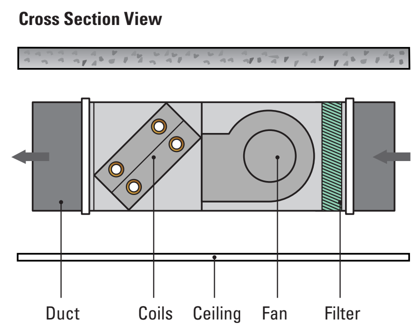

Figure 6: Horizontal Concealed Fan Coil

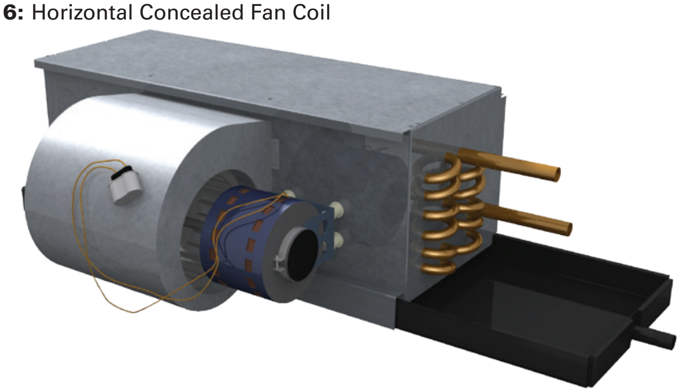

Figure 7: Vertical Exposed Fan Coil

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Fan Coil Unit Types

High Performance Fan Coils

High performance fan coils are designed for higher air volumes, higher static pressures, low noise levels and better room temperature control. To achieve the lower sound levels the high performance fan coils typically utilize larger fan blowers to reduce outlet velocity and fully enclose the fan/motor assembly in an insulated casing. They are normally offered in a horizontal concealed configuration as shown in **Figure 9** and are ducted to one or more supply air grilles. Because of their higher static pressure capabilities, high performance fan coils can be equipped with higher efficiency filters and more rows of heating-cooling coils. A well-designed unit should still be capable of quietly and efficiently delivering maximum flow when fully equipped with coils and filter at 0.5 in. w.g. of external static resistance. Another benefit of the higher static pressure capability is that the unit can accommodate longer discharge duct runs with multiple air outlets. This allows the fan coil to be mounted farther from the occupied space reducing acoustic concerns. As an example for a classroom application, the fan coil unit can be located above the hallway where noise levels are less critical. Additionally, the longer length of downstream ductwork can be acoustically lined for further noise reduction. Due to their higher air flow capacity and static pressure capability, larger rooms or spaces can be supplied with high performance fan coil units.

To achieve the higher flows and static pressures and still maintain efficiency, high performance fan coils are often equipped with electronically commutated motors (ECM). ECMs also allow for full range digital speed controllers and constant flow programming. Full range speed control allows the fan speed to be optimized at the setting which meets the room load and acoustic design goals. Constant flow programming ensures the fan flow will be maintained even as the filter resistance increases due to dust buildup.

When coupled with electronic or DDC controls ECMs can also be operated to provide variable volume of both cooling and heating fan flows, contributing to further energy savings and enhanced comfort. See page 608 for details.

High performance fan coils can be performance certified up to 1500 cfm under the AHRI Standard 440-2008. Units operating beyond the scope of this standard should still be tested and rated under the same conditions to ensure reliable performance in the field.

Figure 8: Classroom installation

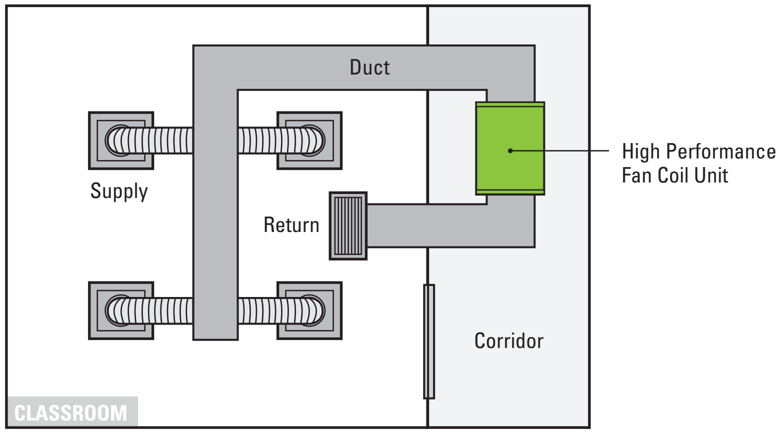
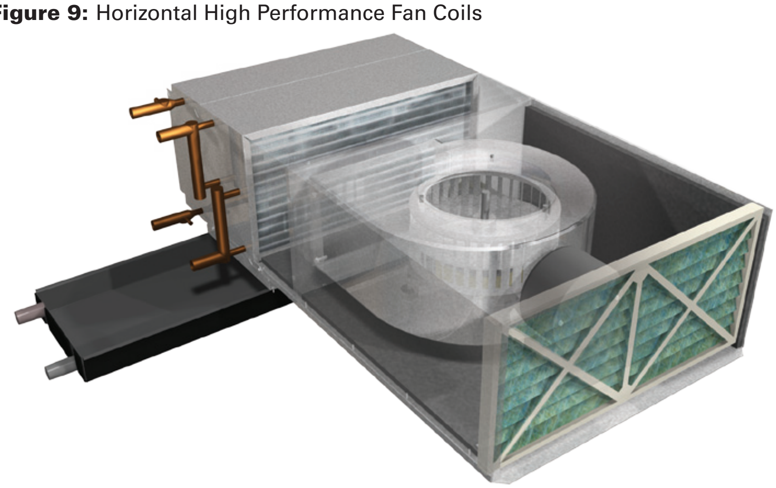


Figure 9: Horizontal High Performance Fan Coils



Typical Applications

High performance fan coils are an excellent choice for applications where a high level of individual zone temperature control and low noise is required. This makes them an ideal candidate for schools, hotels, apartments and office buildings. Higher air volume and static pressure capability also make them ideal for larger spaces and applications requiring longer duct runs and multiple air outlets such as labs, meeting rooms, halls, lecture theaters, etc.

The high cooling capacity available with high performance fan coils meets the needs of high load spaces such as labs, perimeter zones with high solar loads, and high occupancy spaces. High performance fan coils are also well-suited for hospitals and laboratories because of their constant flow programmability and their ability to use higher efficiency filters. The high efficiency and VAV capability of ECM technology, coupled with the energy efficient benefits of hydronic cooling or heating and the IAQ benefits of a DOAS system lends well to LEED certification and green building design.

Blower Coil Unit Types

Blower Coils Overview

Blower coils are a type of air handling unit that can be used to provide one or multiple zones with conditioned air. They consist of a finned-tube heat exchanger, fan, and filter in a draw-through configuration as shown in **Figure 10**. The heat exchanger usually consists of a water coil for hot or chilled water, but steam coils and direct expansion coils may also be used. Regardless of the type of coil, all the conditioned fluid must be piped to the unit from another piece of localized equipment such as a boiler or chiller. Unlike fan coil units where the fan is directly coupled to the motor, blower coils typically use a belt drive system to transmit power from the motor to the fan. This allows the fan to run at whatever speed is required simply by changing the pulley set in the unit. A well-designed blower coil unit should be compact, have low air and water pressure drops across the coil to reduce fan and pump power requirements, be an efficient blower and belt drive system, and provide good access to all of the unit's components for regular maintenance. It should also have a fully insulated casing to reduce heat loss to/from the conditioned air and a tight filter rack to eliminate filter bypass.

Blower coils are a compact solution to a variety of ducted applications that require flexibility between the traditional fan coil unit and a central station air handling unit. They are generally capable of handling at least 1 in. w.g. of external static resistance and can be equipped with more rows of coils and higher efficiency filters than fan coils. This allows them to be used as a central station air handler for constant volume systems or to be coupled with a variable frequency drive and used for a variable air volume (VAV) system. Their small size also allows them to be used as a constant volume fan coil to condition only one room if required. Because of the large flow and static pressure ranges, blower coils are available with single and three phase motors ranging from 1/3 hp up to 10 hp. They are typically located outside the conditioned space in an area such as a service room or basement, but they can be installed in the area if conditions permit. Blower coils come in vertical and horizontal configurations as shown in **Figures 11** and **12**, depending on if they are to be installed on the floor or hung from the ceiling.

Figure 10: Draw -Through Unit

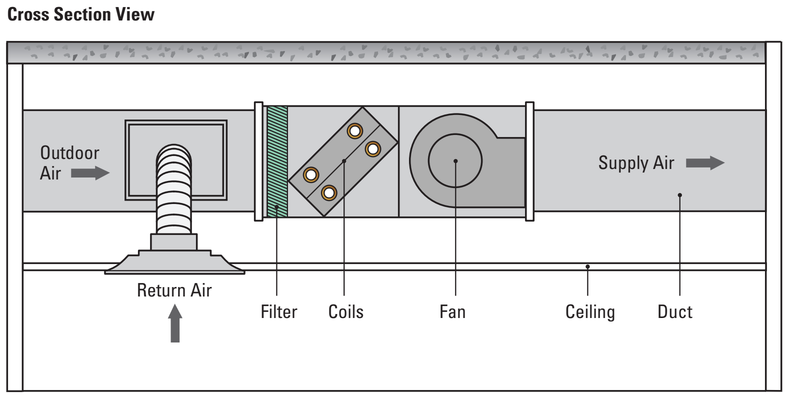
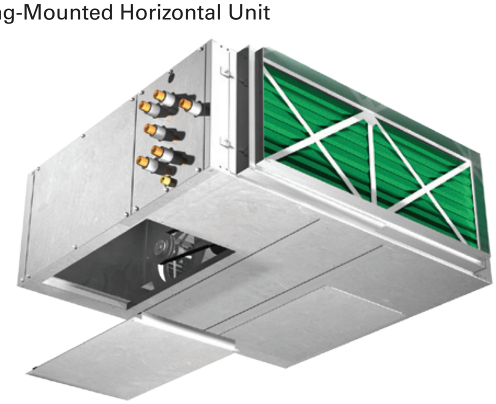


Figure 11: Floor-Mounted Vertical Unit

Figure 12: Ceiling-Mounted Horizontal Unit



Blower Coil Unit Types

While blower coils may be rated for a nominal flow, they are not restricted by a limited number of incremental motor speeds. They are capable of operating at any flow and static pressure within their operating range. This ability, coupled with a large number of coil combinations and accessories such as electric reheat, mixing plenums and UV lights, means that blower coils, like other air handlers, can be more complicated to specify or order.

The design engineer needs to specify many parameters such as supply air temperature and volume, outside air requirements, fluid temperatures and flow rates, external static resistances and more, before an equipment supplier can provide the proper blower coil unit.

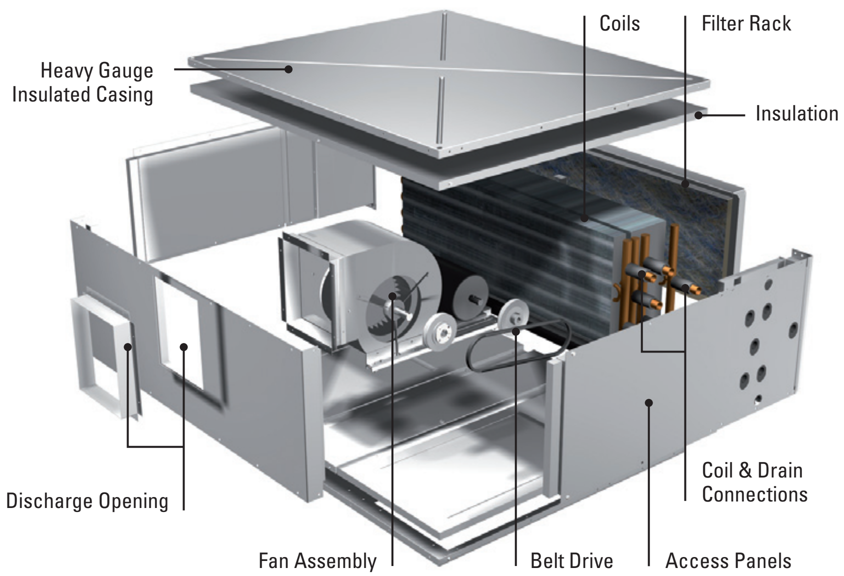
Manufacturers can certify their blower coil units fan performance to the AHRI Standard 430-2009: Performance Rating of Central Station Air-Handling Units. The purpose of the standard is to provide classifications, test requirements and minimum data requirements for the published ratings of central station air-handling units. Water coils used in blower coil units should also be AHRI certified to AHRI 410-2001: Forced Circulation Air-Cooling and Air-Heating Coils. By using equipment that is certified to these standards, the design engineer can be confident that units will function properly under the conditions that are specified.

Typical Applications

Blower coils are an excellent choice for applications where high cooling capacities or external static pressures cannot be met with standard or high performance direct drive fan coil units. This makes them an ideal candidate for schools, hotels, apartments and office buildings. Also, with their ability to operate with up to 100% outdoor air and a variety of options such as mixing boxes, UV lights and solid metal liner, blower coils are also well-suited for hospital and laboratory application.

Fan coil system and zone piping can be configured in several ways to meet the requirements and priorities of the system designer. System efficiency, flexibility and first cost are the primary drivers of the system piping design. The entire system (fan coils, piping, pumping, chillers and boilers) needs to be considered to confirm that appropriate compromises are made to meet the system goals.

Figure 13: Fan Coil/ Blower Coil Product Components (Exploded View)



Access Panel

Removable sheet metal section allows access to internal mechanical and electrical components.

Belt Drive

The motor turns the blower by a belt connected to pulleys on each shaft end. Each motor revolution will usually not be equal to one blower revolution.

Blower/Fan

Multi-bladed, driven rotor enclosed so that air from an inlet is compressed to a higher discharge pressure.

Casing

Structural sheet metal box or shell to which all components are secured.

Coil

A heat exchanger in which liquid is circulated to provide heating or cooling to the air which passes through the sink fins.

Control Enclosure

Sheet metal shroud in which houses the electrical connections, speed controller, and transformer. The enclosure cover prevents accidental electrical shock as well as protects the contents from the environment.

Direct Drive

The motor shaft is directly secured to the blower shaft. Each motor revolution is equal to one blower revolution.

Discharge Collar

Rectangular fitting attached to the unit outlet allowing for quick attachment of downstream ductwork.

Filter Rack

Tray in which a filter can be pulled out for maintenance or replacement.

Liner

Internal blanket adhered to the casing that is used to reduce the radiated and/or discharge sound levels. Materials used vary based on application and performance required.

Motor

Electrical component of an air movement device that provides work to turn the blade assembly.

Fan Coil Piping

Series and Parallel Piping

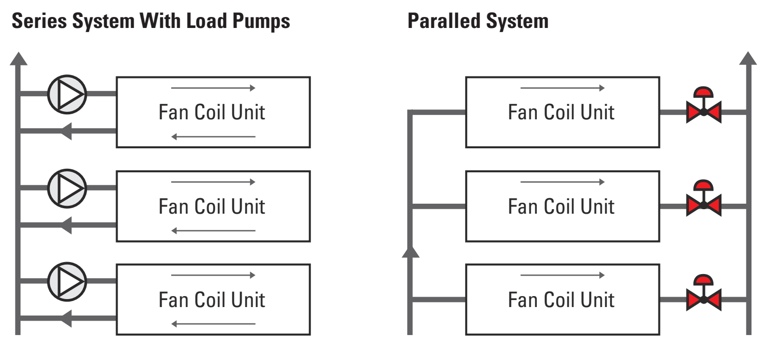
The piping system can be designed with two basic piping concepts – series or parallel piping. In a series type system, a single pipe loop is utilized to supply water in a loop. The individual fan coils take water from this loop and discharge back to the loop. As more fan coils take from and return water to the series loop, the temperature in the loop is changed. It progressively increases in a chilled water loop and progressively decreases in a hot water loop. The fan coils at the end of the loop see water temperatures that provide less potential capacity than the fan coil at the beginning of the loop. These fan coils at the end of the loop will require larger coils to provide similar capacity. The benefit of this type of system is the elimination of the return piping and the cost associated with it, but must be weighed against the cost of larger coils in the fan coils that are later in the loop.

In a parallel system, there is a supply pipe and a return pipe. Each fan coil unit receives water at the same temperature giving each the same capacity opportunity. Coils can be selected with similar temperature characteristics providing for more consistent smaller coils.

Load Pumps

In a series piping system, load pumps is a way to pull water from the water flow in the series piping and supply it to the coil in the fan coil unit. As capacity is required to meet the load, the pump pulls water from the loop to provide the heating or cooling capacity required. This type of design provides simple design and control of the loop and the loads. The loop piping experiences constant flow and pressure. The load pump and piping at each fan coil unit is designed to only meet the pressure and flow requirements of the loop. Each operates and is controlled independently of the other. In some cases, control valves are provided in the loop piping to confirm that there is no flow in the loop system when the loop system is shut down. See **Figure 14**.

Figure 14: Piping Systems



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Fan Coil Piping

Direct & Reverse Return

An important consideration in designing the system is ensuring that each fan coil can receive the desired chilled water or hot water flow rates during system operation. Two types of systems can be utilized—direct return or reverse return. In a direct return system, as shown below, the piping is run in the shortest method possible and balancing valves are used to manipulate the pressure drop through each piping zone to ensure each fan coil receives the required water flow. This requires the system to be 'balanced'. These valves must be set through an iterative process to verify the flow through each coil. As each valve is changed the rest of the system is affected and they must be adjusted until the system achieves steady state flow at each fan coil. **See Figure 15**.

In a reverse return system, the pipe length through each piping zone is laid out to be equal. This ensures that the pressure drop through the piping system is equal for each fan coil unit. This works well if the pressure drop through each coil and piping loop is very similar. This can be accomplished by using the same pressure drop criteria for the coils, and the same pressure drop criteria per foot of pipe. While more piping needs to be installed, the "balancing" requirement of the system is eliminated. **See Figure 16**.

2 Way and 3 Way Valves

The fan coil zone piping system can be designed for constant volume or variable volume water flow. A constant volume system would require 3 way type control valves to modulate the water flow through the coil or around the coil to provide a constant water flow through the zone piping. A balancing valve is installed in the bypass to maintain constant pressure drop as the water flow is modulated around the water coil. This type of constant flow system with 3 way control valves is very simple from a control and layout perspective, but continues to run the pump at full power during part-load conditions.

For a variable flow, 2 way control valves are required. In this type of system the pressure in the supply piping header is measured and the pump output is varied to control the constant pressure in the system. As 2 way valves are closed the system "rides" the pump curve. At lower flow the pump increases the pressure in the system. The pressure control then slows the pump down to provide a lower flow at constant system pressure. As flow is lowered the pump requires significantly less power. A pump with a curve that has good predictive performance throughout the anticipated water flow rate should be selected. Pumps with very flat curves should be avoided as small changes in pressure would lead to large changes in flow, creating system control issues.

Figure 15: Direct Return

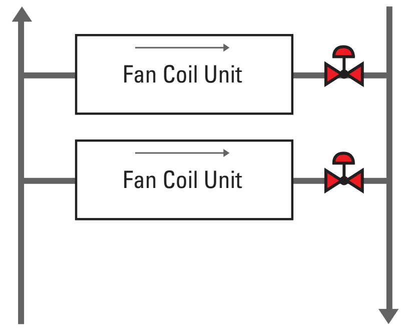


Figure 16: Reverse Return

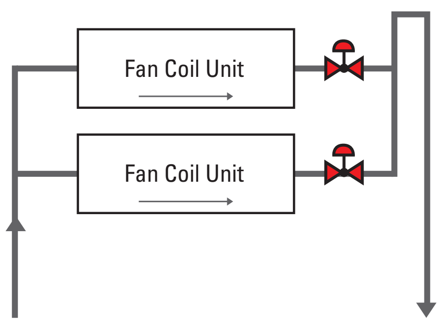


Figure 17: Constant Flow

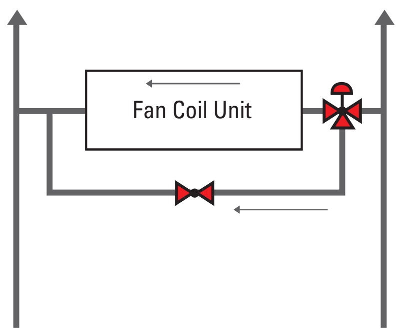
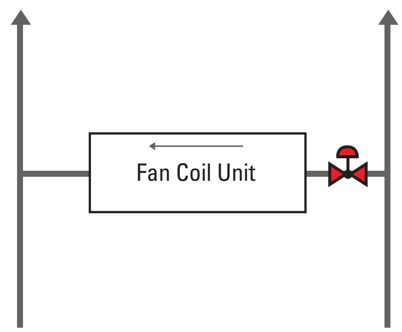


Figure 18: Variable Flow



Fan Coil Piping

Capacity Control

In each of the above system and control designs, capacity control can be on-off or modulation. On-off control would provide no water flow when the control system is satisfied. Often in a fan coil system the fan would also be turned off during this satisfied mode. When the control system calls for capacity, the water flow would be provided at full design flow and the fan would be energized to full air flow.

These systems can also utilize modulating control. Water flow would be varied to provide the desired amount. In systems designed to experience varying entering conditions, the flow can be varied to maintain a constant leaving air temperature based on a constant air volume. The water flow can also be varied to provide less capacity by changing the leaving air temperature based on a constant flow. Also, variable water flow and air flow can be provided. The air flow is decreased as the load decreases and the water flow is regulated to maintain a constant leaving air temperature. This is an uncommon control strategy for a fan coil system, but would provide enhanced dehumidification performance at low load conditions.

Separate or Common Cooling and Heating Coils

Fan coil units are readily available with either a single coil or with both a heating and cooling coils. When heating and cooling is required, they are most often provided with both heating and cooling coils. In this type of system, each coil is piped and controlled independently. Generally there is some type of dead band in the control system to eliminate the possibility of heating and cooling simultaneously.

In a single coil system, where it operates in either heating or cooling, the system can be a 2 pipe or 4 pipe system. In a 2 pipe system, either hot water or chilled water is supplied to the entire system depending on the season. The fan coils are controlled to maintain the required heating or cooling leaving air condition. In a 4 pipe system, each fan coil can be heating or cooling. This allows some parts of the system to provide cooling while other parts provide heating. This is often required in buildings with interior zones that require cooling all year in all seasons. In this case 3 way valves can be used to select either heating supply and return or cooling supply and return. This type of system provides the greatest flexibility while lowering the first cost of the fan coil units.

Figure 19: Separate Coils 4 Pipe System

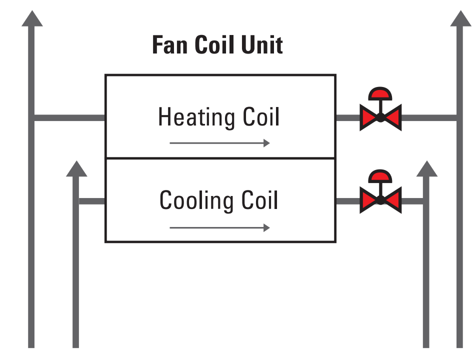
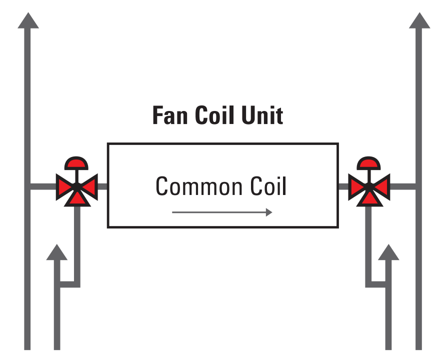


Figure 20: Common Coil 4 Pipe System



Fan Coil Controls

Generally fan coils are applied to control the space temperature of a room or zone. A typical control system would consist of a thermostat, multi speed fan, a heating coil with control valve and/or a cooling coil with control valve. Some systems may include cooling only and some heating only. Several levels of control sophistication are available depending on the accuracy of temperature control and energy efficiency required.

Basic Electric Control

The simplest and most basic control system would be manual adjustment of the fan flow and manual activation of the heating or cooling coil. In this case the thermostat has a temperature adjustment dial, a manual switch for fan operation at one of three speeds or off, and a manual switch for selecting either cooling or heating mode. **Figure 21** illustrates a typical manually switched thermostat. Generally the thermostats are powered by line voltage and directly connected to the fan and valve actuator (**Figure 22**).

Figure 23 illustrates the control sequence for a manually controlled heat-cool changeover fan coil control system. During cooling mode the cooling coil will be turned on if the room temperature rises above set-point. During heating mode the heating coil will be turned on if the room temperature drops below set-point. The operation of the cooling or heating coil is full on or off. Either a 2 pipe or 4 pipe water supply can be accommodated.

An enhancement to the above sequence is automatic control of heating or cooling by the thermostat. If a 2 pipe system is used a water temperature sensor is adhered to the supply water pipe to allow the thermostat to detect if hot or cold water is available and automatically switched between heating or cooling mode. With a 4 pipe system the thermostat will automatically activate cooling mode when the room temperature is above the thermostat set-point and heating mode when the room temperature is below set-point. A further enhancement to the same sequence is automatic control of the fan. The thermostat energizes the fan at the selected speed when there is a call for heating or cooling. The level of control enhancement will be determined by the thermostat model selected.

Figure 21: Manually Switched Fan Coil Thermostat

Figure 22: Typical Wiring Diagram - Basic Electric

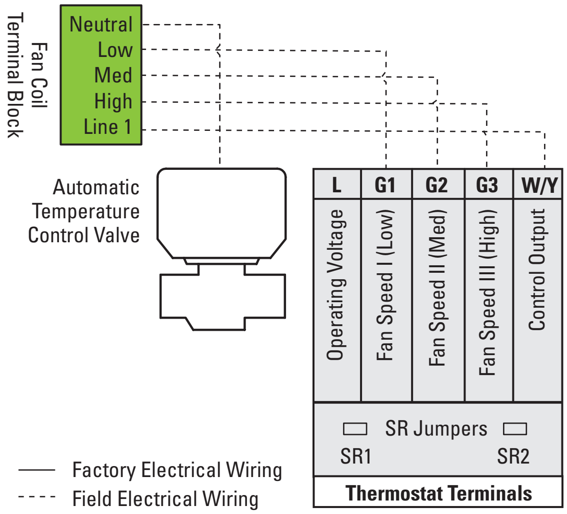
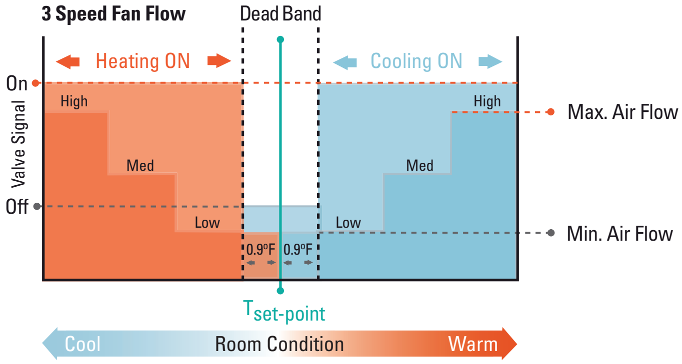


Figure 23: Sequence of operation for manually selected fan speed and manual heat-cool changeover



Fan Coil Controls

Analog Electronic Control

Analog electronic control systems offer several advantages over the basic electric package, including more precise proportional integral (PI) control of room temperature, optional modulating control of the cooling and heating coil, and an optional LCD display for user-friendly monitoring and selection of control parameters. Figure 24 illustrates a typical analog thermostat with LCD display. Generally the thermostats are powered by 24 VAC from a control transformer (Figure 25). Figure 26 illustrates the control sequence for an automatic heat-cool changeover fan coil system with modulating control of heating and cooling.

GREEN TIP
During occupied hours the fan should be operated to maintain ventilation air to the space.

GREEN TIP
PI control and modulating water valves minimize room temperature overshoot providing energy savings.

Figure 24: Analog Thermostat with LCD display

Figure 25: Typical Wiring Diagram - Analog Electronic

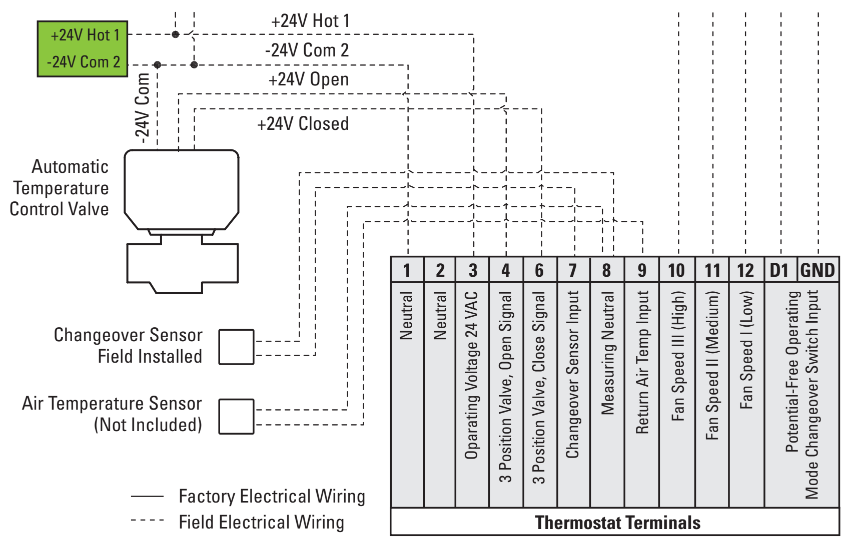
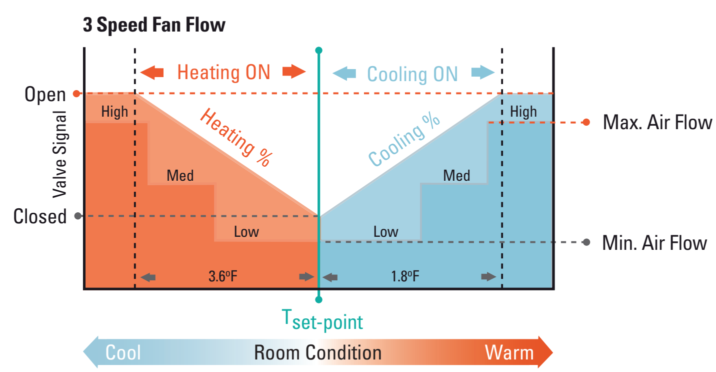


Figure 26: Sequence of operation for automatic heat-cool changeover and modulating control of heating and cooling



All Metric dimensions ( ) are soft conversion.
Imperial dimensions are converted to metric and rounded to the nearest millimetre.

Fan Coil Controls

Digital Programmable Control

Similar to the analog control system, the digital thermostat includes proportional integral (PI) control of room temperature, modulating control of the cooling and heating coil, and an optional LCD display. However the addition of an on-board microprocessor provides enhanced functionality and flexibility. Digital thermostats typically are shipped pre-programmed for the desired sequence of operation but can be easily reconfigured in the field if required. **Figure 27** illustrates field configuration of the programmable thermostat with a laptop PC and interface module.

More custom or specialized control sequences can also be accommodated. One example is control of discharge air temperature to a selectable set-point with the addition of a discharge temperature sensor. During cooling a minimum discharge air temperature may be desired to maintain control of humidity. During heating a maximum air temperature may be desired to prevent stratification in the room if ceiling mounted outlets are utilized. **Figure 28** illustrates the control sequence for automatic heat-cool changeover and modulating control of heating and cooling, with discharge air temperature control of the cooling flow.

GREEN TIP
Reducing the supply air temperature during overhead heating will limit stratification and improve indoor air quality.

If the fan coil is supplied with an ECM the digital thermostat can be programmed to provide modulating control of the fan flow during both heating and cooling modes of operation. This enhanced function provides superior comfort control, energy savings and improved acoustics. Figure 29 illustrates the control sequence for automatic heat-cool changeover, modulating control of heating and cooling with discharge air temperature control of the cooling and heating flow and variable fan speed.

GREEN TIP
ECMs consume considerably less power at part load operation than standard PSC motors, providing further energy savings.

Figure 27: Field Programmable Thermostat

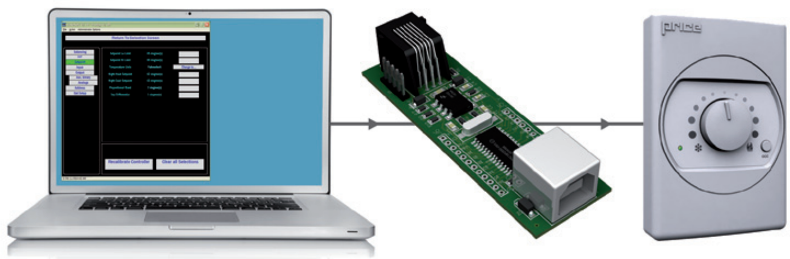


Figure 28: Sequence of operation for automatic heat /cool changeover and modulating control of heating and cooling, with discharge air temperature control of the cooling flow.

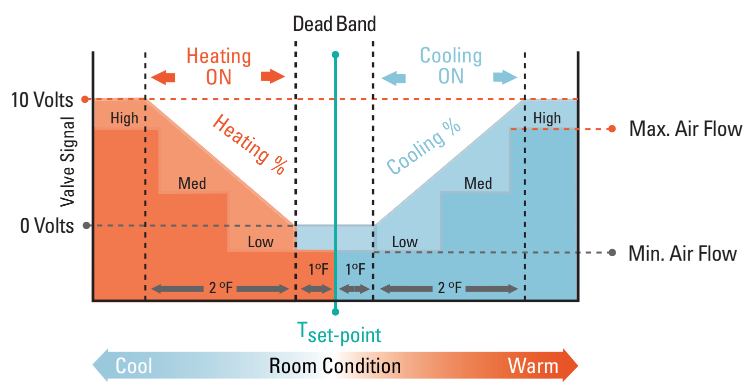
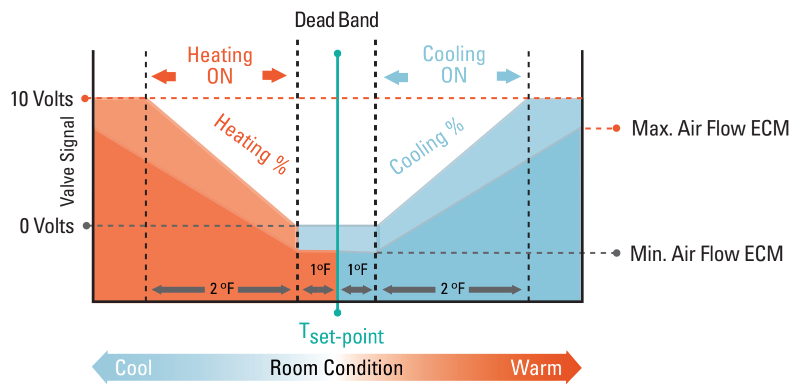


Figure 29: Sequence of operation for automatic heat /cool changeover, modulating control of heating and cooling with discharge air temperature control of the cooling and heating flow and variable fan speed.



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Application of Fan Coil and Blower Coil Units

While blower coils and fan coils are fundamentally very similar, deciding which type of unit to use and in what configuration is not always straightforward. Consultations between the designer and owner may be required to weigh the benefits of performance, flexibility and maintainability versus cost.

Capacity

Blower Coils are capable of higher air flows and static pressures than Fan Coils. For this reason, Fan coils are typically smaller and are used to condition the room in which they are located, whereas Blower Coils are moderate-sized and can be ducted to condition several rooms. This is not always the case though as High Performance Fan Coils have filled the gap between the two products by offering capacities close to those of blower coils while still retaining the small size of a fan coil unit.

Controls

Fan coils are typically controlled by either a thermostat or fan speed switch in the room that they are conditioning (ASHRAE, 2008a). This makes them well-suited for applications where a high level of individual control is desirable, such as hotel rooms, or where there are infrequent loads, such as a meeting room. Blower coils on the other hand are typically operated as constant air flow units. If required, they can be equipped with variable frequency drives for VAV control, however the cost will be higher. High performance fan coils can be equipped with ECMs programmed to deliver constant air flow within a range of static pressures.

Noise

Both fan coils and blower coils generate a significant amount of fan noise so their application and location needs to be carefully considered. Fan coils tend to be quieter so they can be located in the conditioned space as an exposed unit or directly adjacent to the space in a ceiling plenum or wall cavity. Exposed units should be fully lined with fiberglass insulation to reduce radiated noise.

Fan coils by design are intended to be located in or directly adjacent to the occupied space. They can be installed in walls, ceiling plenums, closets, and many other areas close to the room they serve. Noise is a large concern as there is often limited ability to provide sound attenuation techniques in the building material between the unit and the space or in the supply and return ductwork. The location of the fan coils needs to be reviewed to confirm that the sound level in the adjacent space is acceptable.

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Application of Fan Coil and Blower Coil Units

Locating the fan coil unit in or over spaces with higher sound criteria is often used to minimize the occupant objections. Locating them above a bathroom ceiling would be an example of this technique. Selecting the units at lower than the maximum air flow the unit can produce is a method of lowering the noise produced by the fan coil unit.

Larger fans running at slower speeds often provide improved noise characteristics, but will require greater first cost of the unit. Sound data from the manufacturer should be reviewed with options to reduce the noise levels to achieve acceptable space noise design.

Blower coils can be equipped with integral silencers to significantly reduce their discharge noise. They can then be located away from the noise sensitive space and ducted to the room.

Contaminant Control

Most fan coils and blower coils are equipped with a filter, but the level of filtration varies greatly. Low pressure fan coils are typically only equipped with MERV 3 filters because they are not capable of overcoming the large pressure drop caused by higher efficiency pleated filters. High performance fan coils can be equipped with medium efficiency filters up to MERV 13. If a high degree of contaminant control is required, blower coils can be equipped with high-efficiency filters (up to MERV 15) and UV lights. Blower coils can also be equipped with HEPA filters if special care is taken to seal the unit casing against infiltration of non-filtered air.

Outdoor Air

Fan coils should not be used to condition outdoor air as they are not designed to handle high levels of humidity. They do not typically have deep enough coils to provide the level of dehumidification required, and condensate carryover can occur in high humidity locations due to high face velocities on coils caused by the typical blow-through configuration. Blower coils on the other hand have the static pressure capabilities required to use deep coils and can be equipped with mixing boxes to combine re-circulated air with outdoor air. One notable exception is that fan coils are well-suited for heating only applications where there are high infiltration rates of outdoor air such as using an exposed vertical fan coil to heat a vestibule or lobby (ASHRAE, 2008a).

Table 1: Fan Coil Configurations

Type	Fan	Cabinet	cfm	Ext Static
Horizontal	Direct	Exposed / Concealed	< 2,000	<0.5 in.
Horizontal-Hi press	Direct	Exposed	< 4,000	1.0 in.
Vertical	Direct	Exposed / Concealed	< 2,000	0.5 in.
Hi-rise	Direct	Concealed	< 2,000	0.5 in.
Ext Static is external static pressure, in. w.g.				

Table 2: Blower Coil Configurations

Type	Fan	Cabinet	cfm	Ext Static
Horizontal	Belt	Exposed	< 8,000	1 in. to 3 in.
Vertical	Belt	Exposed	< 8,000	1 in. to 3 in.
Ext Static is external static pressure, in. w.g.				

Table 3: Application Guidelines

Unit Type	Office Space, Educational Facilities		Hospitals, Clean Rooms, Laboratories		
	Large Buildings	Small Buildings	Patient Areas	Operating Areas	Laboratory Spaces
Low Pressure Fan Coils	✓	✓	×	×	×
High Performance Fan Coils	✓	✓	-	×	-
Blower Coils	✓	✓	✓	✓	✓

Unit Type	Noise Sensitive Applications		Other Facilities		
	Broadcast Studios	Theaters	Public Use	Shopping Centers	Hotels, Multi Residential
Low Pressure Fan Coils	×	×	×	×	✓
High Performance Fan Coils	-	-	-	-	✓
Blower Coils	-	-	✓	✓	✓

✓ Often Used for this application × Not Recommended for this application
- Sometimes used for this application (restrictions may apply)

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