The Unico System®

TECHNICAL NOTE

PROVIDING OUTSIDE AIR

General

The *Unico System* is designed to handle up to 100 percent outside air. To accommodate outside air, the amount of required airflow must first be established in accordance with all local codes or *ASHRAE Standard 62*. Outside air is normal based on occupancy, square footage, and use. Some older methods determined the amount of outside air based on a percentage of the system airflow, but this leads to errors since the *Unico System* uses less air than a conventional system.

The outside air can be pulled directly from the outside or through an air-to-air energy recovery device, provided the pressure drop of the return system is not over 0.15 inches of water column (37 Pa).

Special Consideration for Water Coils

If water coils are used in climates with below freezing temperatures, special provisions must be taken to ensure that the water coils are not damaged. The most failsafe method is to use an anti-freeze solution, such as glycol mixed with water. Just be certain to use the correct percentage and allow for any degradation of performance because of the glycol. Consult with the water coil bulletins for performance information. An alternate method is to continuously circulate the water making sure it is always warm along with an air damper that closes automatically upon power failure or if the air temperatures after the coil are below freezing (this prevents problems if the water is not circulating properly). If none of these solutions are practical, you should not use 100% outside air.

Effect on Capacity

The introduction of fresh air *always* increases the required equipment load, no matter what type of system is installed. Therefore, you must add the fresh air heating and cooling load to the building load. With the *Unico System*, so long as the equipment is sized to match the heat gain and heat loss, including the load from the outside air, the system will work properly.

In most locations, the outside air also brings humidity into the space. This can burden a conventional system, especially the higher SEER rated equipment. However, this is not a problem with the Unico System since it operates at lower coil temperatures and is better able to remove more humidity, keeping the space at a more comfortable condition.

Installation

The easiest method to introduce outside air is to construct a mixing or economizer box that combines both the outside air stream and the return air stream. Dampers can be used to balance the amount of outside air percentage. Be sure that the outside air is also filtered. Either filter the combined air stream through a common filter or use separate filters for both air streams. As for any *Unico System* return duct system, size the duct for a maximum 0.15 inches of water column (37 Pa) pressure drop using conventional methods and provide some means of acoustical dampening.

Example

As an example, consider a 3000 sq.ft. (278 m^2) office located in Southern California with the following specifications:

- 25 occupants.
- summer design conditions:
  outdoor: 89°F dry bulb, 70°F wet bulb
  [32°C dry bulb, 21°C wet bulb]
  indoor: 75°F [24°C] and 50% relative humidity
- heat gain (not including outside air):
  total gain = 56,000 Btu/hr [16.4 kW]
  sensible gain = 40,000 Btu/hr [11.7 kW]
- winter outdoor design conditions:
  outdoor: 40°F [4°C]
  indoor: 72°F [22°C] and 50% relative humidity
- heat loss (not including outside air):
  45,000 Btu/hr [13.2 kW]

Step 1. Determine the outside airflow requirement per *ASHRAE Standard 62*. In this example it is 15 CFM [30 L/s] per person so the total required fresh air is 375 CFM [177 L/s].

Step 2. Determine the total and sensible load created by introducing the outside air into the room using the following equations:

$$q_t = \dot{m}\Delta h$$

$$q_s = \dot{m}c_p\Delta T$$

At standard conditions, where the density of air is 0.075 lb/ft^3 (1.20 kg/m^3) and the specific heat is 0.240 Btu/lb-°F [1.0 kJ/kg-°C], this equation can be simplified as follows:

In English units: $q_t = 4.5(Q_a)(\Delta h)$ Btu/hr

$q_s = 1.08(Q_a)(\Delta T)$ Btu/hr

[In SI units: $q_t = 1.2(Q_a)(\Delta h)$ W]

[$q_s = 1.2(Q_a)(\Delta T)$ W]

where,

q_t = Total load (latent + sensible), Btu/hr [W]
q_s = Sensible load, Btu/hr [W]
qQ_a = Airflow, CFM [L/s]
Δh = Enthalpy change, Btu/hr-lb [kJ/kg]
ΔT = Temperature change, °F [°C]

For this example, h_{a1} = 28.16 Btu/lb [65.5 kJ/kg], h_{a2} = 33.93 Btu/lb [78.9 kJ/kg]. Therefore, the heat gain from the outside air is

$$q_t = 4.5(375)(33.93 - 28.16) = 9770 \text{ Btu/hr}$$

$$[\ q_t = 1.2(177)(78.9 - 65.5) = 2846 \text{ W}\ ]$$

Similarly, the sensible load is

$$q_s = 1.08(375)(89 - 75) = 5670 \text{ Btu/hr}$$

$$[\ q_t = 1.2(177)(32 - 25) = 1486 \text{ W}\ ]$$

And the winter heat loss is

$$q_s = 1.08(375)(72 - 40) = 12960 \text{ Btu/hr}$$

$$[\ q_t = 1.2(177)(22 - 4) = 3823 \text{ W}\ ]$$

Step 3. Select the equipment based on the combined loads for the building and the fresh air. In this example, the required equipment heat gain is 65770 Btu/hr [19.3 kW], which is greater than our largest capacity unit. Therefore, two systems are required. For refrigerant based systems the AHRI unitary directory (www.ahri-net.org) will provide the rated capacities of the Unico air handlers matched to different condensing units. For chilled water and hot systems, refer to the Unico specifications for those products for the capacity.

ERV/HRV

Consider the effect of an energy recovery ventilator (ERV) or a heat recovery ventilator (HRV) if installed. These products will reduce the equipment required load by exchanging energy between the fresh air supply and the exhaust air. Capacity or effectiveness should be available from the manufacturer of these products.

An HRV is typically a flat-plate air-to-air heat exchanger (diamond shape usually) that transfers temperature between the two air streams. It is a very simple device and easy to install.

An ERV will exchange water vapor as well as temperature. It is usually a "heat wheel" and some amount of air will leak between the two air streams. It is generally more costly than an HRV but it has the advantage of reducing the latent capacity and not just the sensible capacity.

There are several ways to integrate these products into the system. The easiest is to draw the exhaust from the Unico return duct and then to add the fresh air immediately downstream. This is shown in Figure 1.

The best system though is to have a separate return system for the exhaust air (as shown in Figure 2). This will minimize any short circuiting of air between the fresh air and exhaust, and optimize the location of the exhaust returns, which are best located in bathrooms.

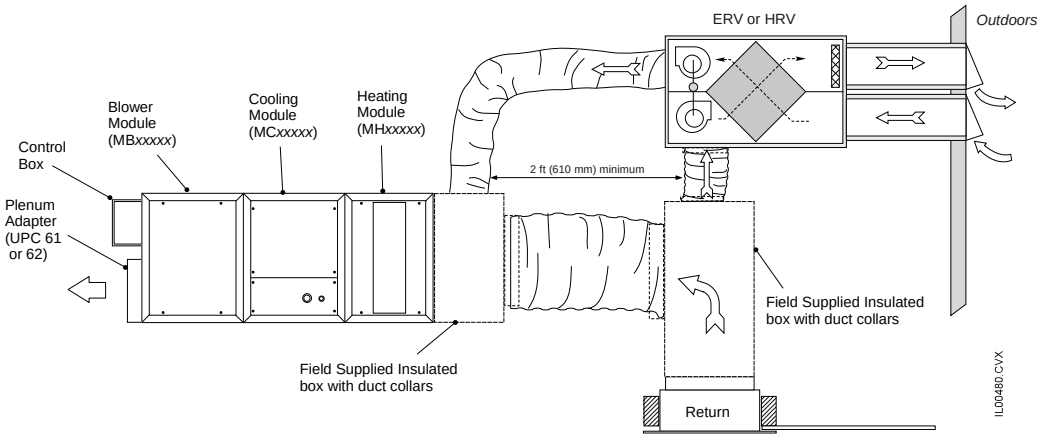

Figure 1. Installation of an ERV or HRV with common return.

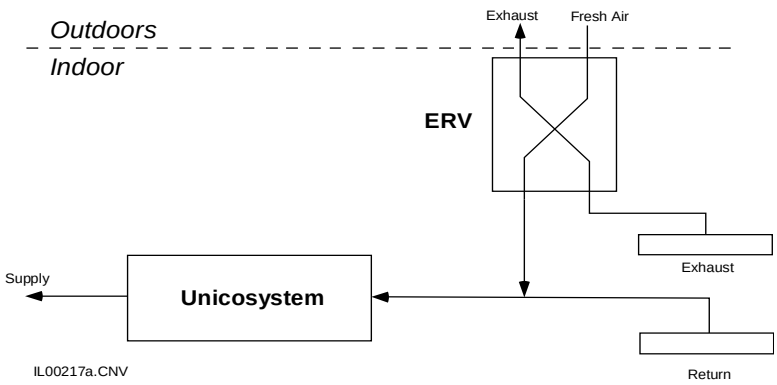

Figure 2. Installation of ERV or HRV with separate return systems