AlpinePure Dehumidification:

Hot Gas Reheat & Hot Gas Bypass Application Guide

WaterFurnace®

Smarter from the Ground Up™

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Dehumidification Overview

Dehumidification - The Need for Reheat

With tighter construction and more and more ventilation air being introduced into buildings, there is more need now than ever for proper humidity control. Ensuring dehumidification can provide; consistent employee comfort, a reduction in mold liability, a reduction in cooling costs. Reduced humidity also provides an improvement in indoor air quality (IAQ) thru lower humidity levels which can reduce allergen levels, inhibit mold and bacterial growth, and provide an improved computer environment. ASHRAE 90.1 speaks of an acceptable humidity range in all commercial buildings.

Typical Reheat Applications

Reheat can be used wherever moisture is a problem. In schools, high latent auditorium and theaters, makeup air units*, computer rooms, indoor swimming pool rooms are typical applications. Although reheat equipped watersource heat pumps (wshp's) can condition limited amounts of outdoor air, the percentage of this outdoor air should never exceed 50% of the return air to the unit limiting the mixed return air temperature to a minimum of 50°F. When cold entering air conditions are anticipated, hot gas bypass option should be considered to prevent air coil freeze up.

*A dedicated outdoor air system (DOAS) should be investigated for 100% outdoor air applications.

The Design of Reheat Equipment

Hot gas reheat can help maintain specific humidity levels and neutral air in a building. ASHRAE recommends a relative humidity range of 30-60% with levels greater than 65% making mold growth a possibility. The dehumidification relative humidity set points of 57% (on) and 52% (off) are recommended. During reheat the leaving air temperature (LAT) will approximate neutral air. The included chart (Figure 1) shows the LAT vs entering water temperature (EWT) to the unit at differing entering air conditions. At 86-90°F EWT the unit will provide nearly neutral air.

Moisture Removal Capacity

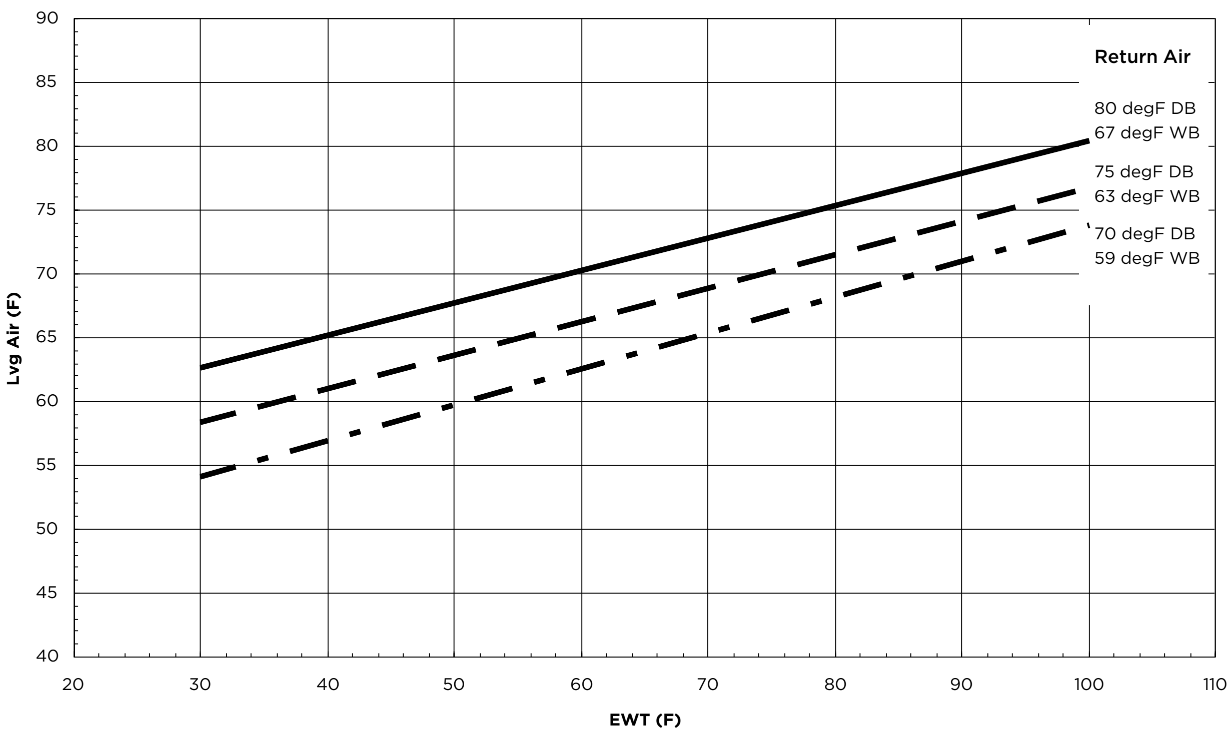
The amount of moisture removal may be calculated by subtracting the sensible cooling capacity from the total cooling capacity in the equipment performance data of the specifications catalog or submittal data. An example is shown below:

Model ND*049 High Capacity, 1320 cfm, 12 gpm, 90°F EWT

TC – SC = LC
46.2 – 31.4 kBtu/hr = 14.8 kBtu/hr

Where TC = total cooling capacity, SC=sensible capacity, LC=latent capacity

Figure 1: Leaving air temperature vs. entering water & air conditions



Dehumidification Overview

Btu/hr may be converted to lbs/hr or grains per hour as shown in the equations below.

14,800 Btu/hr / 1,069 Btu/lb of water vapor
at 80/67 DB/WB°F = 13.84 lbs/hr

13.84 lbs/hr x 7,000 grains/lb = 96,880 grains/hr

Performance with a reheat coil installed will be approximately 5% less than ARI performance.

External Static Pressure Adjustment

With a reheat coil option installed an adjustment for external static pressure (ESP) needs to be made. The following table will show the reduction in ESP for any model relating coil air velocity and ESP.

Figure 2: ESP vs. coil velocity

Coil Velocity (fpm)	250	300	350	400
ESP Increase (in. wg.)	0.10	0.14	0.17	0.20

ECM models will generally compensate up to their maximum ESP of 0.5 in. wg. for 1/2 hp and 0.75 in. wg. for 1 hp.

Model NDH049 High Capacity, 1,550 cfm,

H x W = SA
20 x 40 = 800 in.^{2} = 5.56 ft.^{2}

Where H=fin height of air coil, W=fin length of air coil, SA=fin surface area

Adjustment must be made for dehumidification mode, 85% of cfm,

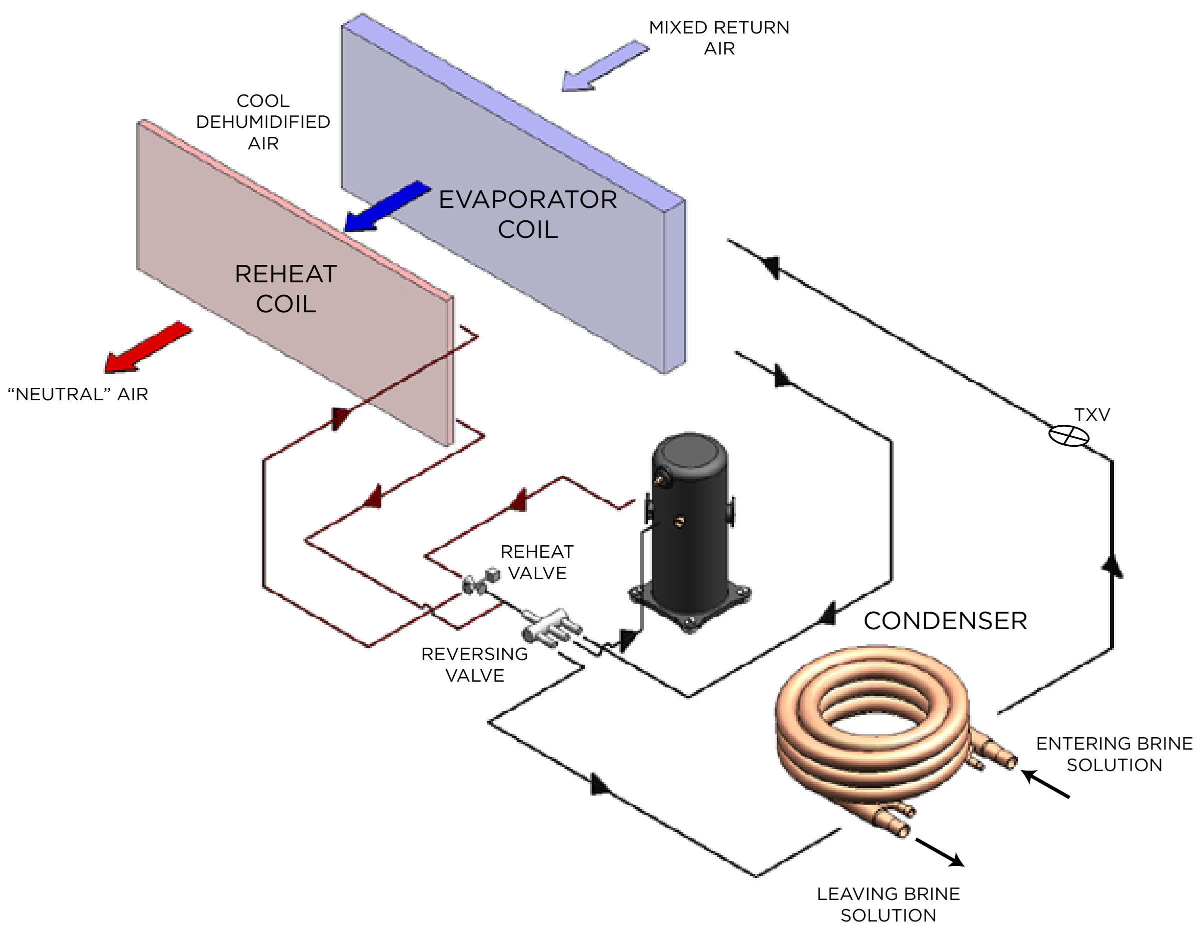
1,550 x 0.85 ffi 1,320 cfm

Calculate air velocity, fpm, cfm / SA

1,320 cfm / 5.56 ft.^{2} = 237 fpm

Refer to Figure 2 and look up the fpm to find ESP increase. If air velocity is below 250 cfm assume 0.10 increase in ESP. Interpolation of data within the table is permitted.

Figure 3: Hot Gas Reheat Layout



Hot Gas Reheat - Controls

The reheat option is only available with the FX10 control. With this control we have three control schemes available:

Room wall dehumidistat
An optional room wall dehumidistat that controls the reheat mode thru a 24VAC 'Hum' input (On or Off). Setpoint and deadband is determined by the dehumidistat.

Duct humidity sensor
An optional duct humidity sensor is installed. The FX10 control reads the humidity from the sensor and determines operation mode. Setpoint and deadband are internally set by the FX10 control and are adjustable. Continuous fan operation is a requirement for this mode to accurately measure relative humidity during the off cycle.

Room wall humidity sensor
An optional wall humidity sensor is installed. The FX10 control reads the humidity from the sensor and determines operation mode. Setpoint and deadband are internally set by the FX10 control and are adjustable. Continuous fan operation is NOT a requirement for this mode.

The unit will cycle thru a 'flush cycle' to purge refrigerant and oil from the idle heat exchanger once every 24 hours when in cooling mode. The FX10 control will provide an option to set back reheat to an adjustable unoccupied humidity set point during unoccupied time periods. This option is factory set to "OFF" so reheat will control to one set point at all times. If set back is required during unoccupied times the option must be set to "ON" in the field by the building automation system or a user interface. The dehumidification set back will only work when using a duct humidity sensor or room wall humidity sensor.

Mode of Operation

Please refer to the refrigeration circuit diagram below.

Heating Mode Operation
Upon a call for heating (Y), blower relay is energized immediately, and the compressor contactor will be energized after a 90 second delay.

Cooling Mode Operation
Upon a call for cooling (Y, O), blower relay and reversing valve coil are energized immediately, and the compressor contactor is energized after a 90 second delay. If there is a call from the de-humidistat or the internal control logic see the humidity sensor has reached set point the fan cfm will be reduced by 15% to increase the unit's latent capacity.

Dehumidification Mode Operation
Upon a call for dehumidification, the blower relay and reversing valve coil are energized immediately, and the compressor contactor will energize after a 90 second delay. The reheat valve coil will energize once the compressor has been operational for 30 seconds.
If a call for space heating is received during reheat operation the compressor will shut down for 5 minutes and the unit will restart in the heating mode. Once the requirement for space heating has been satisfied the unit will shut down for 5 minutes and re-start in reheat mode.

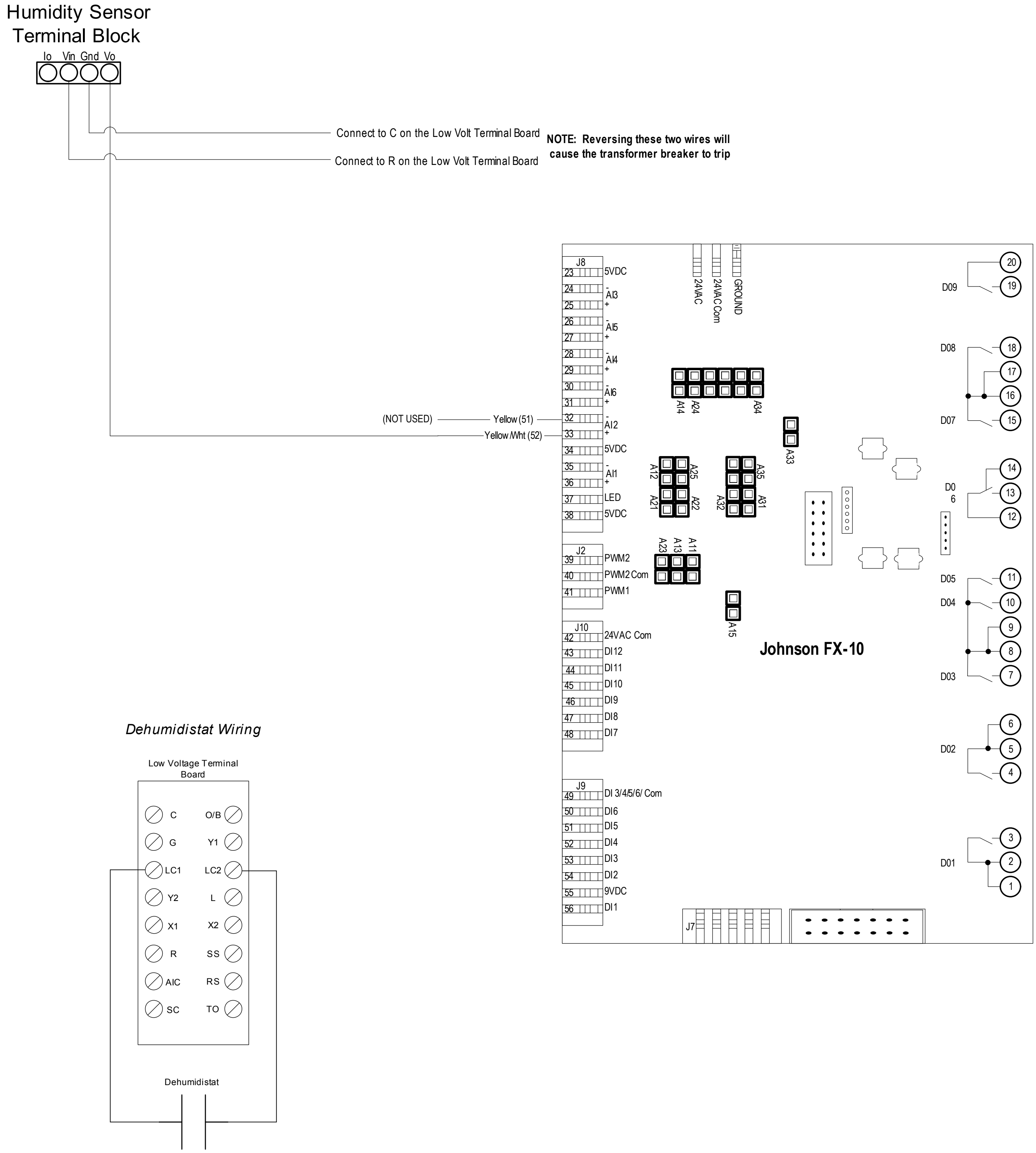
If a call for space cooling is received during reheat operation the reheat valve coil will be disabled until the space cooling requirements have been satisfied. Once the space cooling requirements have been satisfied the reheat valve coil will be energized with out shutting down the compressor.

Dehumidification Set Point
(used only with a humidity sensor)
The factory default set point for dehumidification is 52% this is field adjustable from 30% to 60%. In addition there is a factory default differential of 5% field adjustable from 5% to 15%. The control will enable re-heat when the space humidity rises above the set point plus the differential. Depending upon the environmental conditions within the building and the operating parameters of the water source heat pump, the unit may not be capable of maintaining the lower control limit of 30% relative humidity over extended periods of time.

Reheat operation during periods of un-occupancy
This unoccupied set point is useful to reduce energy use in dehumidification. Many system designs greatly reduce or even eliminate fresh air makeup during the unoccupied hours and the need for reheat is lessened. The control logic contains an unoccupied set point that can be used for periods of un-occupancy if desired. The factory default for the set point is 60% and is adjustable from 30% to 60%. The unoccupied setback must be enabled either through a building automation system or with a user interface. Factory default for unoccupied setback is off.

Space Humidity High and Low Alarm Limit
(building automation system only)
The control has a high and low alarm limit that can be enumerated over a building automation system. The factory default set point for these alarm limits is 0% for the low alarm and 100% for the high alarm limit. These limits can be adjusted though a building automation system. Caution should be used in selecting these limits so as not to cause nuisance alarms.

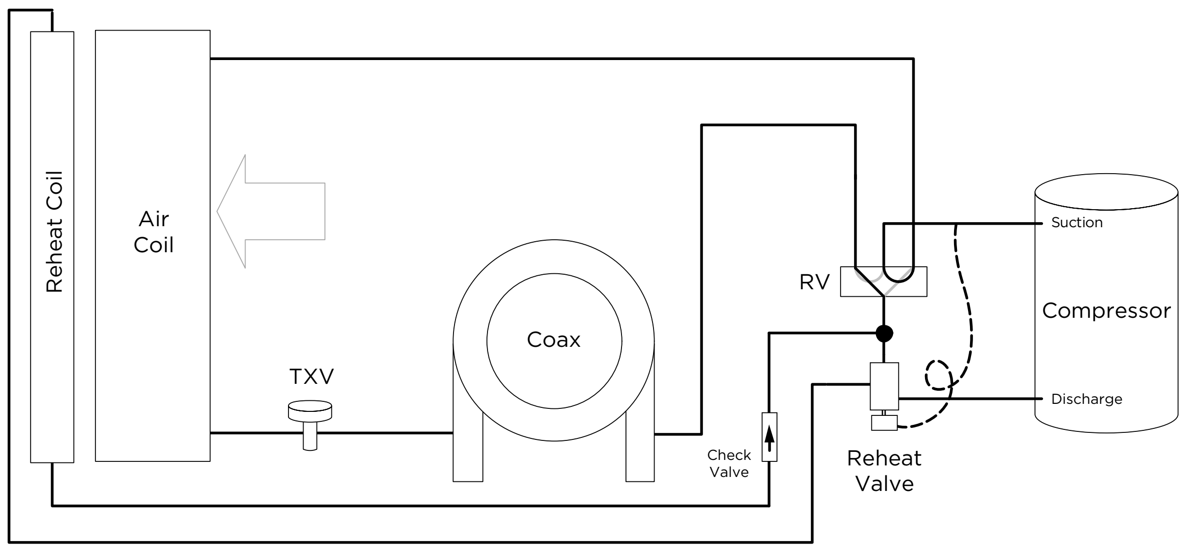
Hot Gas Reheat - Wiring Schematics



Hot Gas Reheat - Refrigerant Circuit

Description

The refrigerant flows in normal heat pump path in heating and cooling mode. During the Reheat mode, the operation begins with superheated vapor leaving the compressor going through the reheat valve to the reheat air coil. In the reheat coil the high temperature high pressure gas reheats the air exiting the unit to near neutral. Next, the refrigerant exits the reheat coil and passes through a check valve, which is used to prevent refrigerant flow into the reheat coil during normal heating and cooling operation. The refrigerant passes through the check valve and is then diverted to the coaxial heat exchanger by the four way reversing valve. The hot gas enters the coaxial heat exchanger which will condense the gas to a high pressure liquid due to heat being rejected to the loop fluid. The high pressure liquid leaves the coax and enters the inlet of the TXV. After passing through the TXV the low pressure mixture of liquid/vapor refrigerant expands in the air coil evaporating into a low pressure low temperature gas and moves back through the reversing valve and into the compressor suction. The cycle then starts again by compressing the low pressure low temperature gas into a superheated vapor. A small copper bleed line is located on the reheat/reclaim valve to allow refrigerant that has migrated to the reheat coil to escape.



Hot Gas Reheat - Application Notes

Geothermal and open loop applications

Some earth loops may exhibit lower entering water temperatures in early spring during cooling and may cause an increase in cooling capacity resulting in low discharge (10 – 13°F see chart) temperature differential during reheat mode. Open loop systems may act similarly with cold well water temperatures.

Swimming pool room dehumidification

The air temperature in a pool room should be maintained a minimum of 2-3°F above the pool temperature to limit ‘runaway’ dehumidification. All air coils should be suitably coated for swimming pool use.

Makeup air in cold climates

In cold climates, the makeup air should be limited in the cooling mode to a mixed temperature of 50°F Entering Air Temperature (EAT) with no more than 50% outside air*.

When cold entering air conditions are anticipated, hot gas bypass option should be considered as well to prevent air coil freeze up.

*A dedicated outdoor air system (DOAS) should be investigated for 100% outdoor air applications.

Troubleshooting Notes

Is the reclaim valve working?

1. Use MUI to check fault status.
2. Check for 130-145°F hot gas at reheat coil or valve.
3. Check 24VAC at valve
4. Activate HUM input with 24VAC to ‘rock’ back and forth for operation.

Reheat - Application Notes (cont.)

Zone has too high of humidity?

1. Check dehumidification setpoint either on dehumidistat or in FX10?
2. Cooling/reheat runtime?
3. Check unit using troubleshooting sheet.
4. Excessive cooling operation with high airflow (lower latent removal).
5. Lower cooling airflow to 325 cfm per ton

Delivers cold air in reheat mode?

1. Check and make sure the reheat valve is energized
2. Check entering water temperature is not too cold.
3. Check the return air temperature.

Hot Gas Reheat - Engineering Guide Specifications

Optional AlpinePure Hot Gas Reheat

An optional hot gas reheat coil shall be available to allow dehumidification only operation. The internal reheat system shall be factory installed and include a high efficiency reheat coil located downstream of the evaporator coil, a reclaim valve and integral controls to allow heating, cooling and reheat/dehumidification modes. The reheat coil shall be sized so that during reheat/dehumidification mode the unit will produce neutral air (78 3 3°F DB @ 50-58% relative humidity) with typical 80 DB/67 WB°F entering air and 90°F entering water temperature. The reheat coil shall be sized to restrict airflow by no more than 0.17 in wg at 350 feet per minute airflow velocity. The reheat coil shall have FormiShield electro-coated air coil for maximum protection against formicary corrosion.

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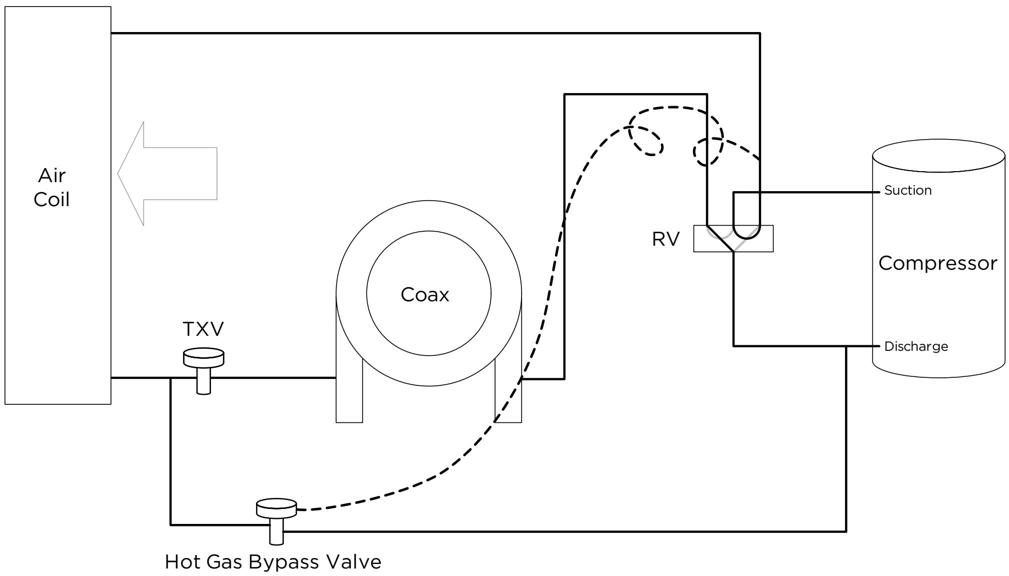
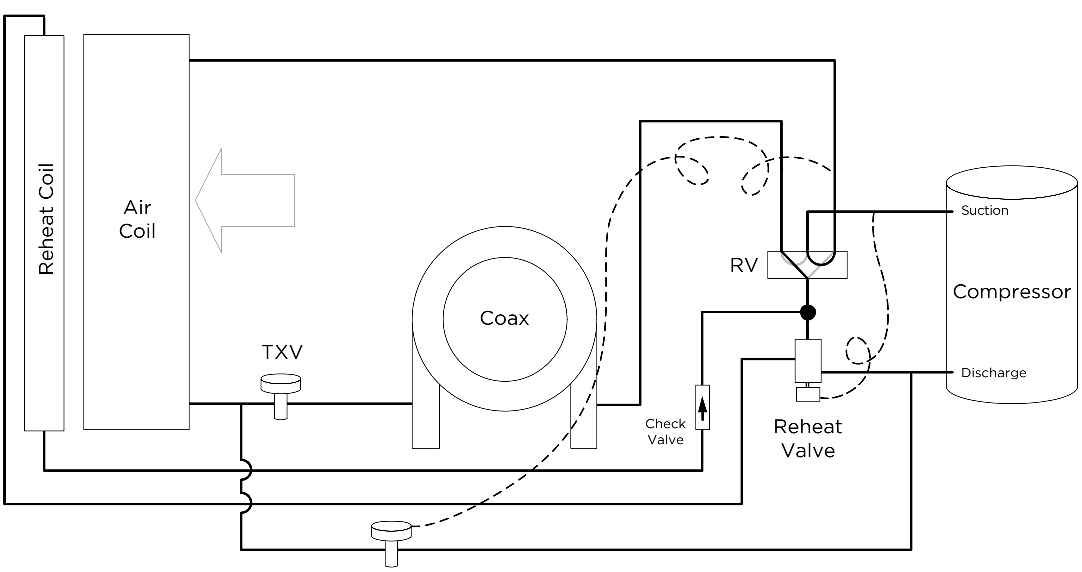
Hot Gas Bypass - Overview

Description

The hot gas bypass (HGB) option is designed to limit the minimum evaporating pressure in the cooling mode to prevent the air coil from icing. The HGB valve senses pressure at the outlet of the evaporator by an external equalizer. If the evaporator pressure decreases to 115 psig the HGB valve will begin to open and bypass hot discharge gas in the inlet of the evaporator. The valve will continue to open as needed until it reaches its maximum capacity. Upon an increasing of suction pressure the valve will begin to close back off and normal cooling operation will resume.



Hot Gas Bypass with Hot Gas Reheat



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