LENNOX

ROOFTOP UNITS

Energence®

HOT GAS BYPASS SYSTEM
CONSTANT AND VARIABLE AIR VOLUME

APPLICATION AND DESIGN GUIDELINES

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This document pertains to the Lennox line of Energence 35-50 ton constant (CAV) and variable air volume (VAV) packaged units. This document defines variable air volume units as those that include a variable frequency drive on the supply fan.

Please note that at the date of publication for this application guide, Lennox only offers the hot gas bypass system on Energence 35-50 ton units. For a complete listing of available products featuring this option please reference Lennox' Engineering Handbook bulletins or contact a Lennox field sales representative.

HOT GAS BYPASS SYSTEM OVERVIEW:

In applications where light load conditions can cause low coil temperatures and compressor suction pressures, system run time may be limited as the unit cycles off to prevent coil freezing and low suction pressure. Hot gas bypass (HGBP), when properly applied, can provide better control of space conditions (temperature and humidity) by allowing the system to condition the space by stabilizing system operations.

HGBP maintains evaporator and compressor loading which maintains operation and run time of the unit, by preventing coil freezing, low suction pressure, and other related performance issues. In cases where the system is equipped with a freeze-stat and/or a low-pressure cutoff switch, HGBP will prevent the system from excessive cycling, thereby extending compressor life.

OPERATION OF LENNOX HOT GAS BYPASS SYSTEM:

For Energence 35-50 ton rooftop units, HGBP diverts high-pressure, high-temperature refrigerant discharge gas exiting the compressor directly into the low-pressure, low-temperature compressor suction line. The amount of refrigerant diverted through the bypass loop varies inversely with suction side pressure (i.e. the lower the suction pressure, the more high-pressure, high-temperature refrigerant gas is diverted). The valve modulates in a linear fashion, with valves opening at operating pressures of 105 psi for R-410A.

The diverted hot refrigerant maintains loading on the compressor, which in turn maintains or increases the evaporator temperature. This prevents evaporator coil freezing, low suction pressure, and other related performance issues that in turn permits continuous operation of the system. To prevent excessive compressor inlet temperatures with the hot gas that is bypassed from the compressor outlet, condensed refrigerant can be mixed in with the discharged hot gas to lower the superheat temperature. Operating based on the suction temperature, the de-superheater valve allows liquid refrigerant to mix with the hot gas between the hot gas bypass valve and the manual shut off valve. Reference the diagram on page two for a more detailed view of the HGBP system for both the CAV and VAV systems (differences in evaporator coil and circuit arrangement).

CONDITIONS FOR HOT GAS BYPASS:

Light evaporator loading can occur under the following conditions:

- Low mixed air temperature entering the evaporator and/or
- Low airflow conditions across the evaporator.

Low Mixed Air Temperature
Low mixed air temperature conditions can occur in both constant (CAV) and variable air volume (VAV) systems as part of normal operation. Low mixed-air temperature can be caused by a high ratio of low-ambient temperature mixed in with the return air or low return-air temperature resulting from the bypass of supply air directly to the return air of a bypass zoning system. Low ambient temperature has the additional effect of exaggerating the low evaporator loading condition by lowering the condensing temperature, or increasing the system capacity.

Low Airflow Across Evaporator
Low airflow conditions primarily occurs in VAV systems since CAV systems maintain the same airflow across the evaporator under all operating conditions. In VAV systems, airflow is significantly reduced under the following conditions:

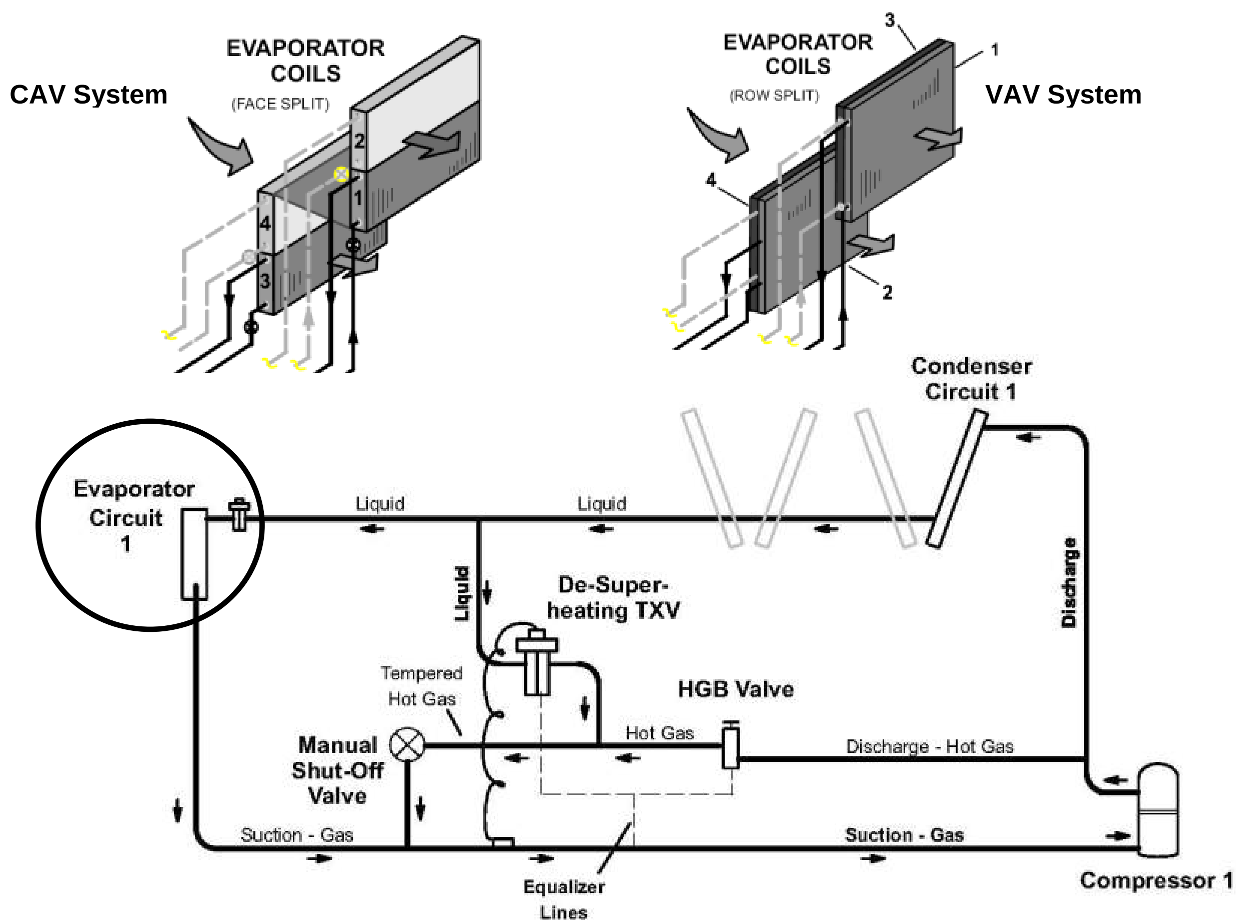
- Only one or just a few zones are calling for cooling
- Zones are calling for minimal cooling (dampers open at minimal positions)

During reduced or low air volume conditions, less heat is available to be absorbed by the evaporator, lowering the coil temperature. HGBP will keep the coil above freezing and maintain unit operation. There are instances where CAV systems can experience low airflow conditions that cause coil freezing and low suction pressure. For example, when a designer specifies a low airflow to meet demands for increased latent capacity, coil temperatures can then drop to near freezing temperatures during less than design conditions. Therefore, HGBP provide more benefits with applications requiring VAV systems.

CAPACITY CONTROL USING HOT GAS BYPASS:

HGBP should not be designed to provide additional stages of cooling (on the low end) for oversized equipment. HGBP should not be intended for capacity control, by adding a cooling stage on the low end. The goal of HGBP is to maintain loading on the evaporator so the system can continue to operate when there is a demand to condition air. Lowering the system capacity is a result of bypassing hot gas to maintain loading.

For example, in the case of a CAV unit, HGBP should not be used to lower the system capacity so the unit can continue to run at low space load conditions. The reason is that the evaporator loading never changes and the unit will cycle off once space conditions are satisfied. The return air temperature will never be low enough for the coil to freeze therefore HGBP will yield no benefits in this situation. However, for a VAV system, low space load conditions may translate to low airflow across the evaporator. A HGBP system in this case will maintain evaporator loading, keep the unit running, and provide more precise temperature control.



Lennox Energence Hot Gas Bypass System (CAV and VAV)