APR Control® Complies with Energy Codes

APR Control vs. Hot Gas Bypass

The APR Control is an external compressor unloader that reduces the compression ratio as it diverts refrigerant from the outlet of the compressor back to the suction inlet. As a continuous capacity modulation device, the APR Control externally unloads the compressor, thus reducing energy consumption of the system. Traditional hot gas bypass falsely loads the evaporator, thereby reducing the efficiency of the system. As an external compressor unloader, the APR Control is compliant with today's energy codes!

The APR Control provides continuous capacity modulation and dehumidification for direct expansion air-conditioning (DX A/C) systems. In 1993, Davis Rawal invented and patented the APR Control. The APR Control has proven to be a reliable solution for many performance issues that arise from commonly oversized systems. The APR Control is a mechanical device that maintains suction pressure, allowing the system capacity to match the ever-changing load and space requirements.

Since its introduction, the APR control has been referred to as a continuous capacity modulation device based on the theory of ***modulating*** the adiabatic process of a refrigeration system. The APR was an unprecedented offering with no equivalent in the market. As the APR Control was embraced by the industry, the most common and comparable reference was hot gas bypass. While both APR Controls and HGBP affect the compression ratio of the compressor, ***only the APR Control improves the "refrigeration effect"*** during part-load operation while reducing the compression ratio. Improving the "quality" (meaning ratio of liquid to gas) of the refrigerant in the evaporator during modulation, ***the APR Control improves the evaporator efficiency and the compressor performance.*** As energy codes continue to evolve and limit the use of hot gas bypass, it is critical to understand the differences between hot gas bypass and the APR Control.

Code: C403.4.6 (IECC) - Hot Gas Bypass Limitation

Table C403.4.6 (IECC)	
Maximum Hot Gas Bypass Capacity	
Rated Capacity	Maximum Hot Gas Bypass Capacity (% of total capacity)[7]
≤ 240,000 Btu/h	50%[8]
> 240,000 Btu/h	25%

Source: IECC § C403.3 "Hot Gas Bypass Limitation" (2018)

"Cooling systems shall not use hot gas bypass[1] or other evaporator pressure control[2] systems unless[3] the system is designed with multiple steps of unloading[4]or continuous capacity modulation[5] the capacity of the hot gas bypass shall be limited as indicated in Table C403.4.[6], as limited by Section C403.3.1[8]."

Legend:

1 The APR Control® is not "hot gas bypass".

2 "Other evaporator pressure control systems" would be referring directly to an evaporator pressure regulator valve (See Sporlan May 2007 / BULLETIN 90-20 page 3). An evaporator pressure regulator valve limits the mass flow to the compressor by restricting the suction line at the evaporator creating more lift (delta p across compressor).

3 Referring to the entire unit, not just the circuit. The term "unless" means that it is acceptable.

4 The APR Control® is an external modulating unloader. Also, multiple compressors satisfy this as multiple steps of unloading.

5 Since its inception, the APR Control is a continuous capacity modulating device.

6 Section C403.3.1 is for modulating air flow (Single Zone VAV, not VAV).

7 Maximum capacity of the total unit, not per circuit.

8 Typically, Rawal Devices recommends only putting the APR Control on one compressor (or circuit) and never at 100% of that compressor (or circuit) in standard applications that this code covers.

Traditional Hot Gas Bypass Limitations

Traditional hot gas bypass diverts high pressure refrigerant gas from the discharge of the compressor and injects it immediately after the TXV (thermal expansion or metering device) mixing it with low pressure liquid, thus raising the temperature of the evaporator. This process creates a false load on the evaporator. As a result, while active, hot gas bypass does not reduce the power consumption of the compressor. When the hot gas bypass is active, it will increase the evaporator coil temperature and can reduce the amount of dehumidification normally available from the system.

Evaporator Pressure Control Limitations

As mentioned in the code, "other evaporator pressure control systems" refers directly to an evaporator pressure regulator valve. This type of valve is vastly different from the APR Control. An evaporator pressure regulator valve limits the mass flow to the compressor by restricting the suction line at the evaporator creating more lift (Δp across compressor). Conversely, the APR Control is reducing lift, not creating more lift.

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The APR Control diverts refrigerant from the outlet of the compressor to the inlet. This continuous capacity modulation process decreases the load on the compressor by reducing the compression ratio; it does not create a false load on the evaporator. When active, the APR Control reduces power consumption and provides excellent dehumidification qualities.

COMPARISON

Hot Gas Bypass	The APR Control®	Evaporator Pressure Control
Falsely Loads the Evaporator	Unloads the Compressor	Restricts Evaporator Flow
Does Not Reduce the Power Consumption	Reduces the Compression Ratio of the Compressor	Does Not Reduce the Compression Ratio of the Compressor (Creates Lift)
Creates False Load	Externally Unloads	Limits Mass Flow
Not Energy Efficient	Reduces Power Consumption While Active	Increases Power Consumption While Active
Poor Latent Performance	Very Good Latent Performance	Good Latent Performance
Not Code Compliant	**Code Compliant**	**Not Code Compliant**

Summary

The APR Control has the ability to modulate system capacity to the ever-changing load conditions in the space, while eliminating or significantly reducing excessive cycling that leads to a rise in the space relative humidity. For any new or retrofit application with tight temperature and humidity requirements, please call us at **800-727-6447** for technical or application guidance.

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