APR Control — Benefits to the Design Engineer

APR Control – Providing Direct Expansion Modulation and Superior System Efficiencies

In the design of direct expansion systems, the APR Control gives the specifying engineer, contractor, or HVAC service organization the opportunity to select equipment based on maximum load. The addition of an APR Control to a new or existing unit increases system efficiencies and provides continuous system capacity modulation down to the minimum required system load.

The APR Control — System Benefits

- Modulates system capacity to match varying loads.
- Maintains the evaporator in a continuous dehumidifying mode.
- Prevents excessive compressor cycling.
- Eliminates direct expansion coil icing or freezing.
- Drives the system into a constant temperature and stabilized humidity mode by creating long operating cycles.

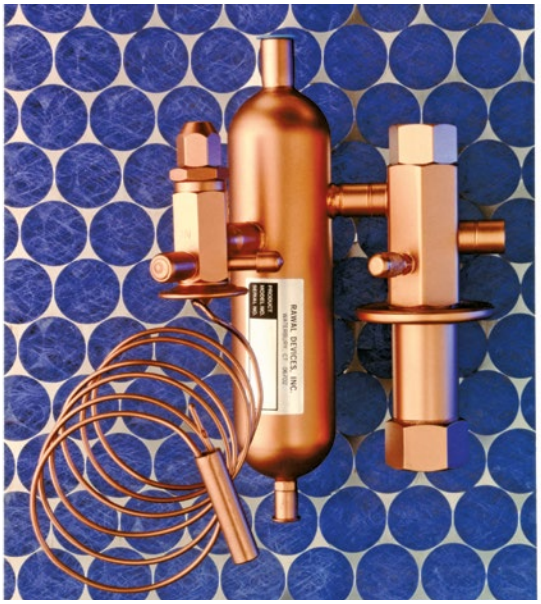
The APR Control — User Benefits

- Modulating capacity results in a constant area temperature.
- Continuous dehumidification equals stabilized humidity control.
- Excessive cycling elimination results in longer equipment life.
- Elimination of coil icing results in reduced likelihood of equipment failure.
- Constant temperature and stabilized humidity means greater comfort.
- Greater energy efficiency equals reduced operating costs.

The APR Control — Operational and Functional Description

The APR Control modulates refrigeration capacity to match any variations taking place in the BTU quantity of the existing load. The APR Control accomplishes this by reading the heat content of the system's return air. The system's return air changes the pressure of the suction gas, causing the APR Control to bypass a portion of the hot-gas discharge through its desuperheating chamber and into the suction inlet of the compressor. The hot-gas enters the desuperheating chamber at an angle creating a circular hot-gas path, wiping the walls of the desuperheating chamber and giving up excess system heat. The gas then travels up the mixed gas lift tube, losing energy as it returns to the system's compressor suction inlet.

The increase in suction pressure — resulting from the hot-gas and suction mix — reduces the compression differential in the compressor, causing a decrease in required compressor horsepower. At the evaporator (using R-410A), the APR Control holds the DX coil at 109 psi or above, while adjusting the dehumidification window of the evaporator coil by changing the rate of liquid refrigerant flow into the DX coil.



Simultaneously, the difference in system BTU capacity and the current BTU load is continually being bypassed, in the form of hot-gas, through the APR Control's desuperheating chamber and into the suction line at the compressor.

The APR Control senses the enthalpy of the return air, which changes the pressure of the DX evaporator. A reduction in the enthalpy of the return air causes a drop in the suction pressure. This triggers an instant response in the APR Control hot-gas bypass valve and causes it to bypass some of the compressor hot-gas discharge through the APR Control desuperheating chamber to the compressor suction return. This results in a decrease of liquid refrigerant to the evaporator coil. The overall effect is a reduction in cooling capacity of the DX coil corresponding to the reduction of the load.

Application Example #1 — Problem

An existing 5-ton split system air conditioner with a suction riser of 1 1/8-inch OD provides a high percentage of outside air for ventilation. The single circuit has no staging. The system cycles when the load on the unit drops below 5 tons, causing erratic temperature control, increased relative humidity, and excessive cycling.

Solution — Install an APR-410-2 (2.5-ton capacity control), which will react to any reduction in load (recirculated air or outside air). The APR Control will modulate the system from 5 tons down to 2.5 tons, and all points in between. The APR Control will maintain the evaporator coil in dehumidifying mode and continuously reduce the system's capacity as the room temperature approaches the thermostat setting. The 1 1/8-inch OD suction riser requires 1.5 to 2 tons of suction gas to assure proper oil entrainment up the suction riser. Because the APR-410-2 will not allow modulation below 2.5 tons, oil entrainment is assured.

Application Example #2 — Problem

A 20-ton RTU is installed for a manufacturing space. The unit has two 10-ton compressors in a tandem (manifold) configuration that provide the unit with two stages of 100% and 50%. The system has excessive compressor cycling from a two stage thermostat and is unable to maintain the conditioned area's relative humidity at 55%.

Solution — Install an APR-410-6 (6.5-ton capacity modulation) on the circuit where the common hot gas leaves the tandem, and the common suction returns to the tandem. This treats the tandem compressors as one compressor that has two stages. The APR Control will modulate the capacity of the first stage from 10 tons down to 3.5 tons, matching changing load conditions at all points in between. When load is above 10 tons, the second stage will come on 100%, and the first stage will again modulate capacity. This time the APR Control model APR-410-6 will provide capacity control from 20 tons down to 13.5 tons and all points in between. The APR Control will consistently maintain the single circuit evaporator in a dehumidifying mode throughout system modulation. Compressor cycling will be significantly reduced and the evaporator coil will stay above freezing.

Application Example #3 — Problem

A Variable Air Volume (VAV) system is designed and installed to condition and maintain an office space with five zones. The VAV boxes are all sized equally at about 20% of total system air flow. The system load is 30 tons and a package system is selected with two 15-ton compressors with independent refrigeration circuits. At low load conditions the control system can reduce airflow into the space to a low of 30% of designed airflow (or about 3500 cfm).

Solution — Install an APR-410-10 on the lead (first-on/last-off) circuit. The APR-410-10 will provide 10 tons modulation on both cooling stages, modulating the top circuit from 30 tons down to 20 tons, and all points in between. As capacity continues to fall, the system will satisfy the thermostat, and leave just the first stage active. That stage (referred to as "first-on/last-off") will be modulated by the model APR-410-10 from 15 tons down to a possible low capacity of 5 tons. Even at the lowest designed airflow, the APR Control can turn down the system capacity well within the range necessary. This ability to modulate capacity will provide better temperature control and stability, while maintaining humidity in the space.

Call with questions or for application assistance: 1-800-727-6447

Rawal Devices, Inc.

475 Wildwood Ave Suite S

P.O. Box 2058

Woburn, MA 01888-0058

Fax: 1-781-933-3306

Web Site: **www.Rawal.com**

Rawal and APR are trademarks of Rawal Devices Inc. or its subsidiaries and affiliated companies. All other brands may be trademarks of their respective holders.

© 2013 Rawal Devices Inc.
All rights reserved.

Printed in USA
13-81-003 3/13