

## Technical Topic

### Low Ambient Refrigeration Applications

#### Condenser Fan Cycling

Unlike most Air Conditioning Applications, Refrigeration Systems must be designed to operate effectively and efficiently even under the most adverse low ambient conditions.

Factors, which influence the Field System Design and Use of Available Options, are:

- Winter Design Temperature
- Local historical tendencies regarding wind direction and velocity relative to the equipment location
- Low load conditions resulting in long winter off cycles
- Condenser design and liquid sub cooling circuits
- Minimum operating limits of the Nozzles and Expansion Valves reference liquid pressure and temperature
- Location of the liquid line solenoid valve
- Line run connecting the high side to the low side
- Standard receiver capacity verses optional receiver capacities
- Evaporating temperature
- Local customs and regulations

In mild climates simple condenser pressure fan cycling will meet most requirements for head pressure and liquid temperature control. If the condenser is equipped with multiple condenser fans, these fans can be staged using pressure cycling controls or simply turned off using an ambient temperature thermostat leaving one or more fans to cycle as required.

Under no circumstances should all condenser fan motors be allowed to cycle off on one control or all condenser fans to cycle off on condensers having more than one fan while the compressor is running.

Condensers equipped with multiple fans require the fan nearest the inlet header to run continuous. This is to prevent wide condenser temperature fluctuations causing excessive expansion and contraction above design limits leading to leaks due to metal fatigue from improper operational procedures.

Typically the condenser fan will be set up using a minimum 50-PSI throttling range with the Cut in Set at 200 PSI and Cut Out at 150 PSI. Although this is the most economical method of head pressure control it is the most inefficient from an energy consumption point of view.

Liquid pressure is one of the opening forces of a Thermal Expansion Valve. As the condenser fan cycles within the 50-PSI throttling range so does the liquid pressure in the liquid line. This fluctuation in liquid pressure and presence of flash gas in the liquid line has an equal effect on Mass Flow. If the fluctuation in mass flow is wide enough the expansion valve may begin to hunt.

If the condenser fan throttling range is widened either by physically adjusting the fan cycling pressure switch or by the effects of the prevailing wind and / or ambient sub cooling at the condenser the severity of expansion valve hunting will also increase to a point that adversely affects system capacity and electrical efficiency expressed in Kilowatts Per Ton of Refrigeration.

In a mild climate the effects of fan cycling are acceptable because these ambient conditions are infrequent. Colder climates require a more manageable method of head pressure control in order to prevent these fluctuations