TRANE™

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CENTRAVAC CONDENSING REFRIGERANT PRESSURE / WATER TEMPERATURE AND CENTRAVAC CONDENSER WATER TEMPERATURE CONTROL

This Engineering Bulletin provides information in four areas:

1) Reasons for specifying a condenser refrigerant pressure / water temperature.
2) Guidelines for condenser refrigerant pressure / water temperature.
3) Condenser refrigerant pressure / water temperature control.
4) Control systems for condenser refrigerant pressure / water temperature control.

1. Reasons For Specifying a Condenser Refrigerant Pressure / Water Temperature

The primary reason for specifying condenser refrigerant pressure / water temperature is to obtain optimum performance while maintaining a minimum pressure diferential between the condenser and the evaporator for controlled refrigerant flow through the refrigerant metering system, and to prevent pressure imbalance which could cause oil loss or motor overheating problems.

Although centrifiugal chillers become more efficient with an initial reduction in the condenser water temperature (see Figure 1), this trend does not continue into very low temperature ranges. As the condensing temperature continues to fall, the refrigerant begins to "hang-up" in the condenser due to the decreased pressure differential not pushing the liquid refrigerant through the refrigerant metering system. This liquid refrigerant in the condenser covers some of the tubes, thus causing this heat exchanger to operate less efficiently. Coincidentally, the evaporator begins to be "refrigerant starved", thus decreasing the efficiency of this flooded heat exchanger. Also, the compressor is operating less efficiently. As the condenser water temperature continues to fall, the chiller efficiency may begin to worsen, depending upon the particular application and machine.

For a chiller operating at 44 F leaving evaporator water temperature, this condition may begin to occur with entering condenser water temperatures at about 60 F.

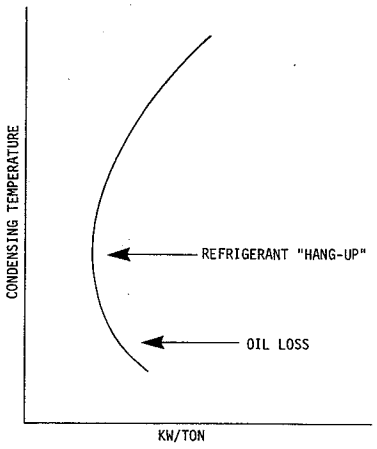

Figure 1 - KW/Ton Versus Condensing Temperature

Centrifugal chillers utilize differential pressure seals to separate lubricating oil from the refrigerant within the compressor. The pressure differential experienced at the oil seals decreases as the leaving condensing water temperature approaches the leaving chilled water temperature, so oil loss can occur. As long as the minimum refrigerant pressure differential is maintained, there is no potential for oil loss.

4. Control Systems

Two general control systems are available: the first sensing the condenser refrigerant pressure; the second sensing the difference between the condenser and evaporator refrigerant pressures. The second is particularly applicable for centrifugal chillers which have chilled water reset. Both control systems are discussed below.

A. Sensing Refrigerant Pressure

The control system can sense condenser refrigerant pressure to maintain a minimum condenser pressure. This system is applicable whenever there is no chilled water reset. This system can either be electric or pneumatic as shown in Figure 5. Typical control settings to the controlling valve, etc., are as shown in Figure 6.

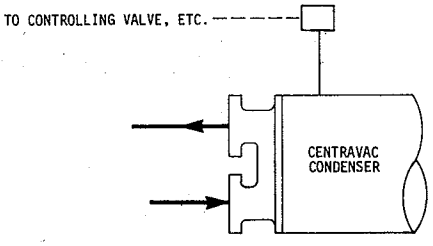

Figure 5 - Control of Minimum Condenser Pressure

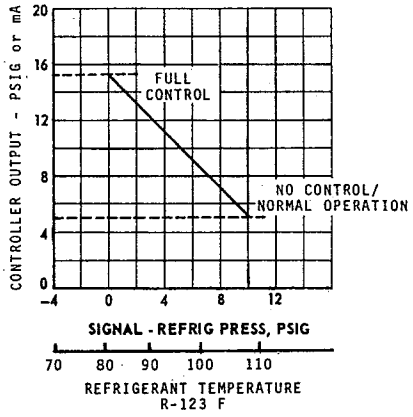

Figure 6 - Typical Control Setting - Sensing Condensing Pressure

B. Sensing Difference in Refrigerant Pressure

The control system can sense the difference in pressure beween the condensing and evaporator refrigerant pressures. This is particularly applicable when using chilled water reset. The minimum refrigerant pressure difference is 5 psid. The system can be electric or pneumatic as shown in Figure 7. Typical control settings to controlling valve, etc. are as shown in Figure 8.

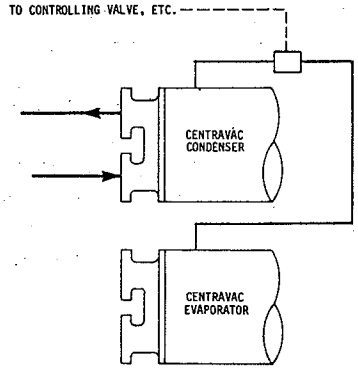

Figure 7- Control of Minimum Difference in Refrigerant Pressure, Condenser to Evaporator

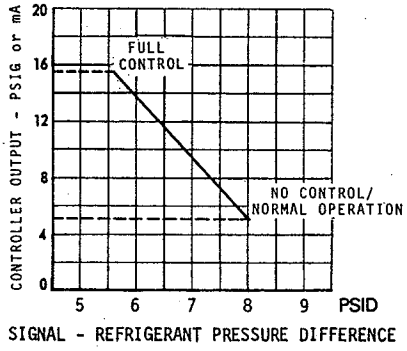

Figure 8 - Typical Control Setting - Minimum Difference in Refrigerant Pressure