Industrial Chillers.

Types of Industrial Chillers

A chiller is rated between one to 1000 tons of cooling energy. There are three different types of chillers:(1) air, (2) water, and (3) evaporative condensed chiller. There are four subcategories in each of the above categories for industrial chillers: (1) reciprocating, (2) centrifugal, (3) screw driven (4) and absorption chillers. The first three types are mechanical chillers which are powered by electric motors, steam, or gas turbines. An absorption chiller is powered by a heat source such as steam and uses no moving parts.

Components of an Industrial Chiller

The mechanical compression cycle has four basic components through which the refrigerant passes: (1) the evaporator (2) the compressor (3) the condenser (4) the expansion valve. The evaporator in the chiller will operate at a lower pressure and lower temperature than the condenser.

How an Industrial Chiller Works:

In an ideal cycle, the condenser serves as a two fold component. Before any condensation occurs, the high pressure vapor must be first brought to a saturated condition (de-superheated). Enough heat must be transferred from the refrigerant to lower its temperature to the saturation temperature. At this point, condensation can begin. As heat continues to be transferred from the refrigerant vapor to the air (or water, if a water condenser is used), the quality of the refrigerant (% of the refrigerant in the vapor state) will continue to decrease, until the refrigerant has been completely condensed. In the ideal system, this occurs at the outlet of the condenser. In the real world, some subcooling would be expected at the condenser outlet. Subcooled liquid provides insurance against liquid flashing as the refrigerant experiences pressure losses in the tubing and components.

The refrigerant is in the liquid state now, and at a high pressure and temperature. It must undergo one more change before it becomes a useful heat transfer medium; a reduction in temperature. This is accomplished by reducing the pressure. You can count on the refrigerant's pressure – temperature relationship to be an infallible law. If the pressure of a saturated liquid is reduced, the law governing its existence requires it to assume the saturation temperature at the new pressure.

So, in order to reduce the temperature, the pressure has to be reduced, and some sort of restriction is required for this to occur. It would be preferable if the restriction could regulate itself as the system load demands change. This is exactly what the thermostatic expansion valve does; it is an adjustable restriction which causes a reduction in liquid refrigerant pressure, yet will modulate in an effort to maintain constant superheat at the evaporator outlet. The thermostatic expansion valve is a superheat control, and will not maintain a constant vapor pressure. It only provides the restriction necessary to reduce the pressure to some level, which will be determined by compressor size, thermostatic expansion valve, size load, load demand and system conditions. If a constant evaporator temperature is required, it can be achieved very simply by maintaining the pressure corresponding to the saturation temperature required. This is accomplished by adding an evaporator pressure regulating valve to the system.

Our ideal cycle has experienced a pressure drop in the thermostatic expansion valve. Subcooling or superheat cannot exist where there is a mixture of liquid and vapor. Therefore any place in the system where the refrigerant exists in two states, it will be at the saturation temperature for its pressure.

Some of the liquid refrigerant is required to boil as a means of removing the heat necessary to achieve this lower temperature. Yet another heat transfer process, which yields a lower liquid temperature. The liquid that is sacrificed in the boiling process explains the increase in refrigerant quality. The greater the difference between the liquid temperature and evaporator temperature, the more liquid will have to be boiled in order to achieve the new saturation temperature. This results in an even higher refrigerant quality.