Class: 2nd Stage
Subject: air conditioning and refrigeration lab
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EXP. NO. 8

Applications to pressure and enthalpy of refrigerant media

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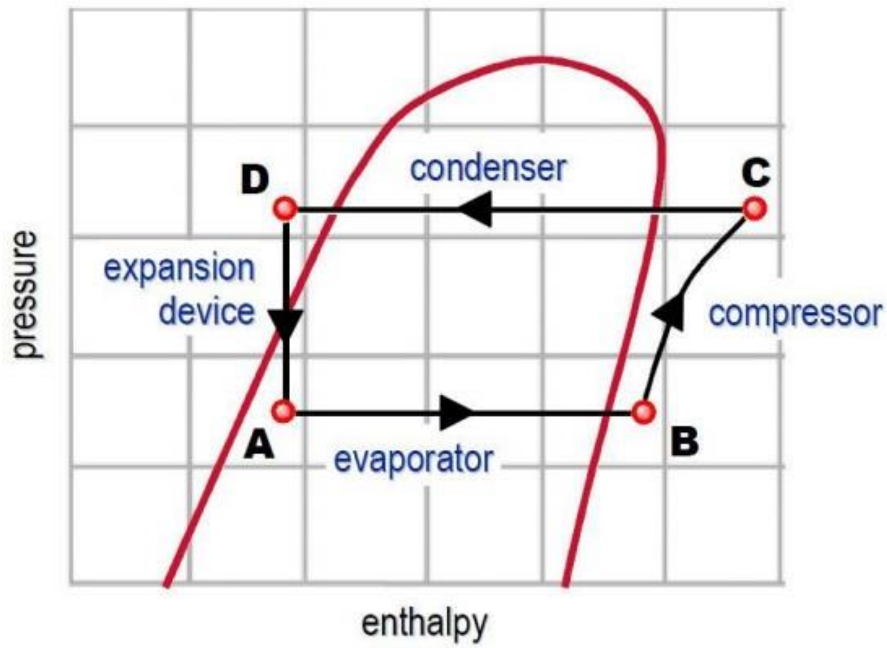
Object:

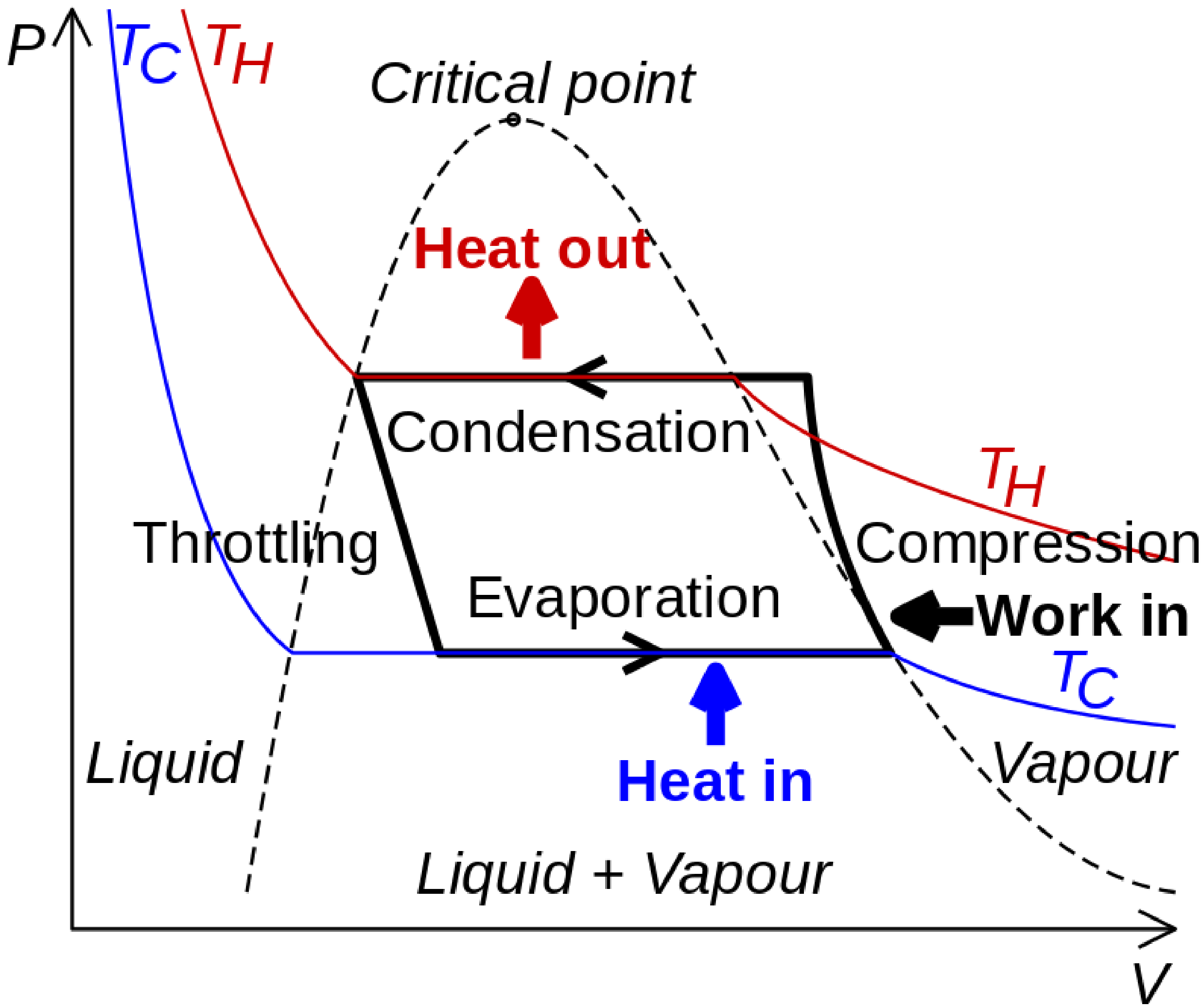
Find the relationship between pressure and enthalpy on a P/H chart

Vapor-compression refrigeration

Vapour-compression refrigeration or vapor-compression refrigeration system (VCRS), in which the refrigerant undergoes phase changes, is one of the many refrigeration cycles and is the most widely used method for air-conditioning of buildings and automobiles. It is also used in domestic and commercial refrigerators, large-scale warehouses for chilled or frozen storage of foods and meats, refrigerated trucks and railroad cars, and a host of other commercial and industrial services. Oil refineries, petrochemical and chemical processing plants, and natural gas processing plants are among the many types of industrial plants that often utilize large vapor-compression refrigeration systems. Cascade refrigeration systems may also be implemented using 2 compressors.

Refrigeration may be defined as lowering the temperature of an enclosed space by removing heat from that space and transferring it elsewhere. A device that performs this function may also be called an air conditioner, refrigerator, air source heat pump, geothermal heat pump, or chiller (heat pump).


condenser
D
C
expansion
device
compressor
pressure
A
evaporator
B
enthalpy



Vapor-compression uses a circulating liquid refrigerant as the medium which absorbs and removes heat from the space to be cooled and subsequently rejects that heat elsewhere. Figure 1 depicts a typical, single-stage vapor-compression system. All such systems have four components: a compressor, a condenser, a metering device or thermal expansion valve (also called a throttle valve), and an evaporator. Circulating refrigerant enters the compressor in the thermodynamic state known as a saturated vapor[2] and is compressed to a higher pressure, resulting in a higher temperature as well. The hot, compressed vapor is then in the thermodynamic state known as a superheated vapor and it is at a temperature and pressure at which it can be condensed with either cooling water or cooling air flowing across the coil or tubes.

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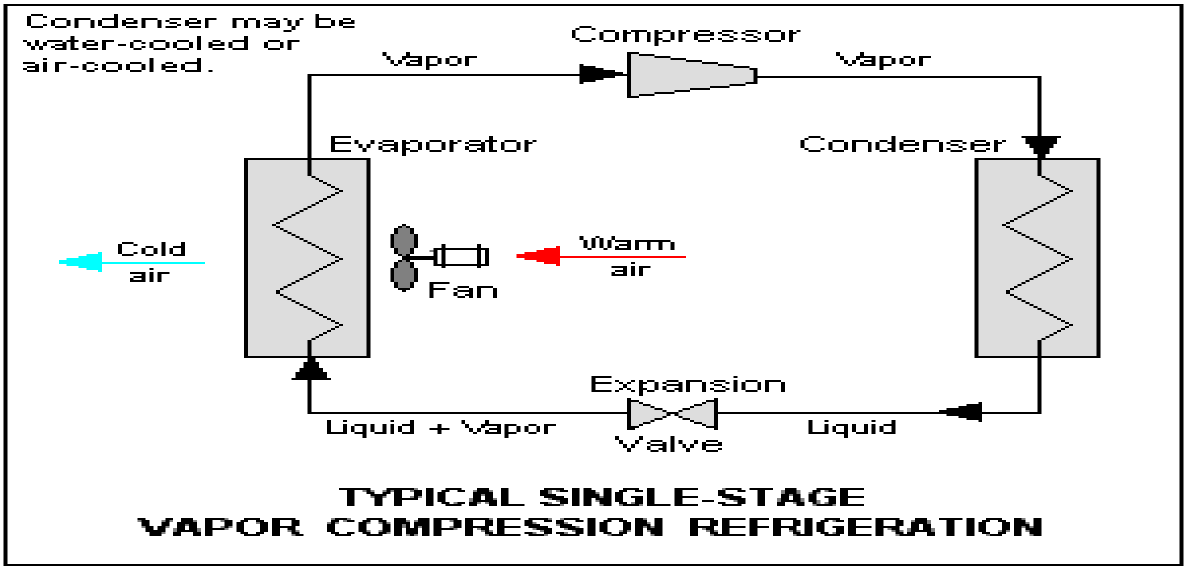
The superheated vapor then passes through the condenser. This is where the circulating refrigerant rejects heat from the system as it cools and condenses completely. The rejected heat is carried away by either the water or the air (whichever may be the case).

The condensed liquid refrigerant, in the thermodynamic state known as a saturated liquid, is next routed through an expansion valve where it undergoes an abrupt reduction in pressure. That pressure reduction results in the adiabatic flash evaporation of a part of the liquid refrigerant. The auto-refrigeration effect of the adiabatic flash evaporation lowers the temperature of the liquid and vapor refrigerant mixture to where it is colder than the temperature of the enclosed space to be refrigerated.

The cold mixture is then routed through the coil or tubes in the evaporator. A fan circulates the warm air in the enclosed space across the coil or tubes carrying the cold refrigerant liquid and vapor mixture. That warm air evaporates the liquid part of the cold refrigerant mixture. At the same time, the circulating air is cooled and thus lowers the temperature of the enclosed space to the desired temperature. The evaporator is where the circulating refrigerant absorbs and removes heat which is subsequently rejected in the condenser and transferred elsewhere by the water or air used in the condenser.

To complete the refrigeration cycle, the refrigerant vapor from the evaporator is again a saturated vapor and is routed back into the compressor. Over time, the evaporator may collect ice or water from ambient humidity. The ice is melted through defrosting. The water from the melted ice or the evaporator then drips into a drip pan, and the water is carried away by gravity or by a pump.



p/h chart

It is a diagram to draw the relationship between the pressure and the thermodynamic quality of the refrigerant, as it contains several properties of the cooling fluid (pressure, enthalpy, temperature, saturated media line, saturated gas line, entropy)

Used equipment

A cooling system operated by a cooling medium R22 (split), pressure gauge, scheme R22

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Procedure

First turn on the cooling system for ten minutes until it reaches a steady state. After that record the pressure readings through a pressure gauge (condenser pressure and evaporator)

We determine pressure readings on a chart and extend a horizontal line from the car to the right

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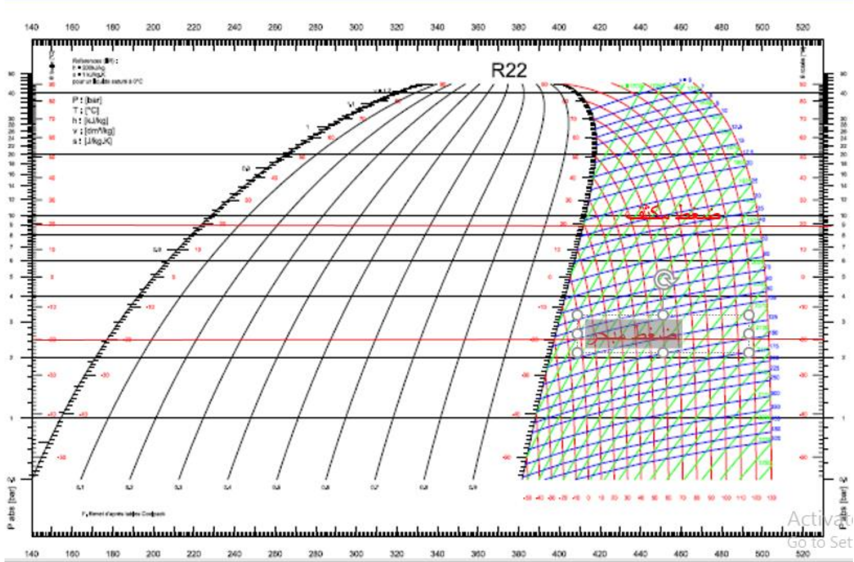
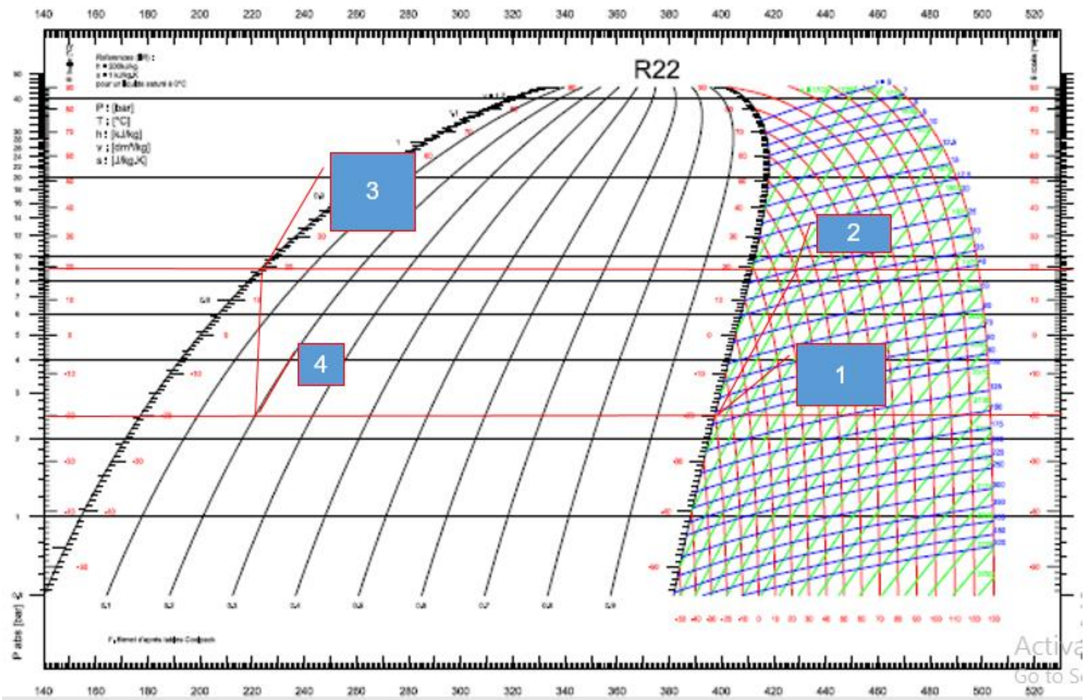
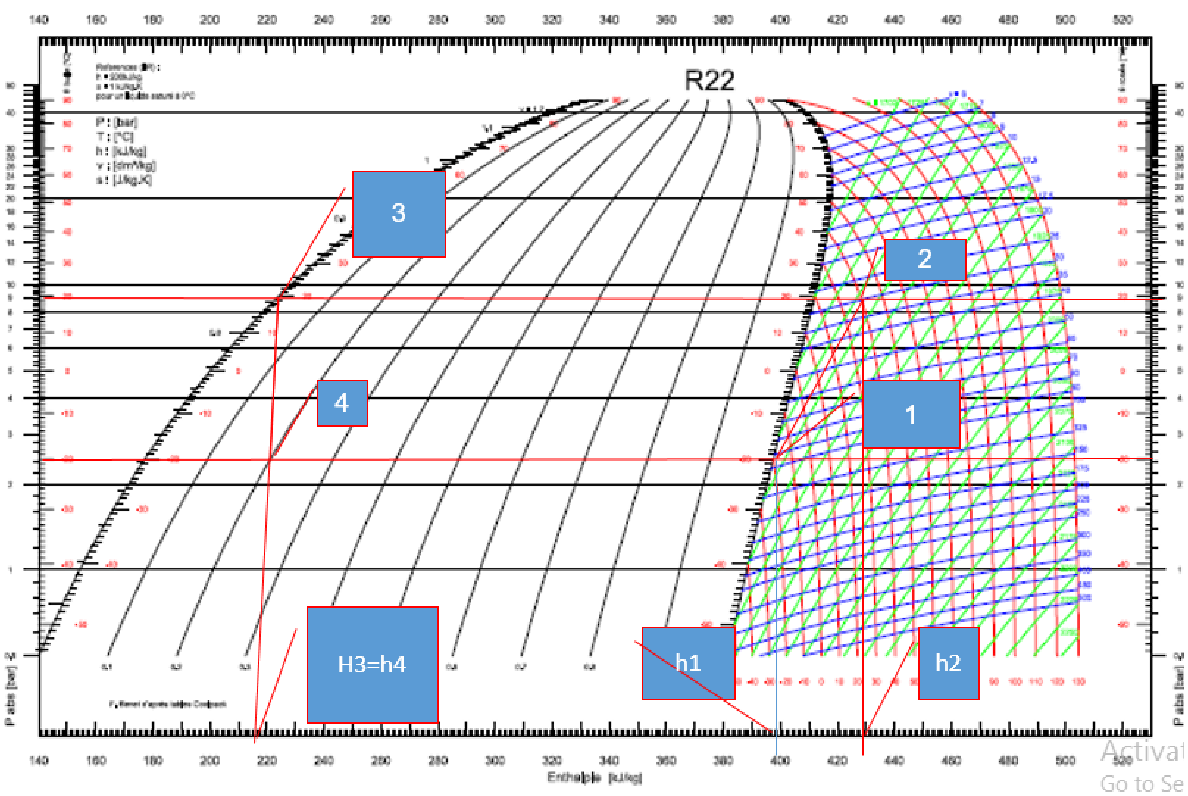


When an evaporator pressure line intersects with a saturated vapor line, zone No. 1 (the entry point of the evaporating medium to a compressor) we extend a line parallel to the entropy line and when it intersects with a condensate pressure line, a point 2 (the exit point of a cooling medium from a compressor) and at the intersection of a capacitor pressure line with a line A saturated liquid forms Zone No. 3 (the area where a coolant enters into an expansion valve) and extends a vertical line downward, and when it intersects with an evaporated pressure line, it is in Zone No. 4 (the exit point for a coolant from an expansion valve)



We extend a line from each point to the chart where the enthalpy readings are



NO	P COND	P EVAP	H 1	H2	H3=H4