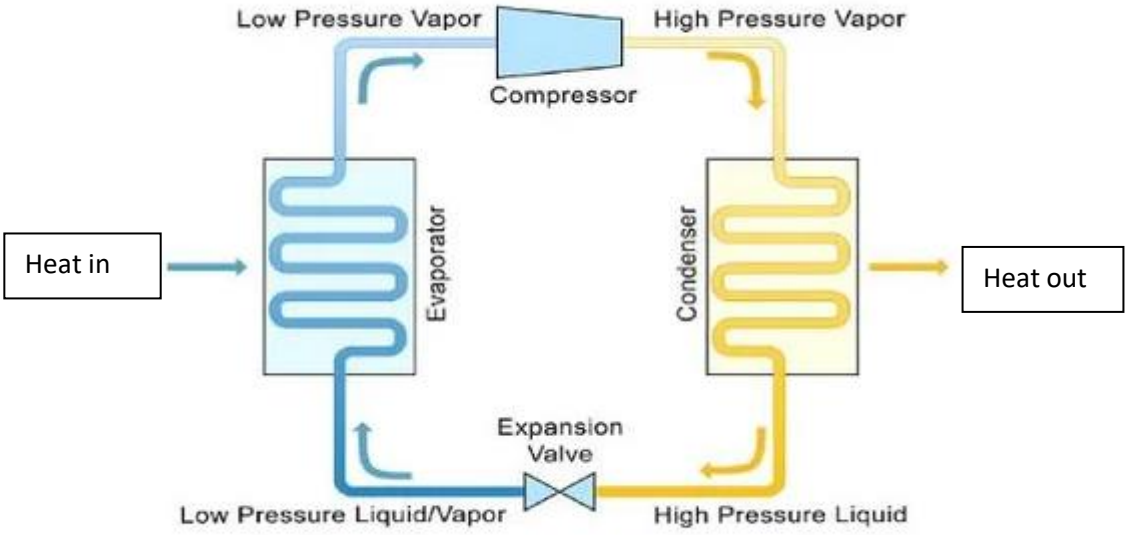
II REFRIGERATION SYSTEMS

Refrigeration cycle

Definition of Refrigeration

- Mechanical refrigeration is a process of lowering the temperature of a substance less than that of its surroundings.
- Capacity of refrigeration is expressed in tone.



COMPONENTS OF REFRIGERATION

Compressor

Its work is to control the flow of the refrigerant by acting as a motor and a pump. This allows it to pressurise the refrigerant and reduce its volume.

There are five types of compressors used in both commercial and domestic refrigerators. They include reciprocating, rotary, screw, centrifugal and scroll. Of the five, the reciprocating compressor is the most commonly used in home and commercial kitchen refrigerators.

Condenser

The condenser works by condensing the refrigerant. The refrigerant entering the condenser is hot and pressurised. The condenser then cools the refrigerant by converting it into a liquid state.

There are three types of condensers.

Air-cooled. you will find this in small refrigerators such as the ones used at home. They are ideal when the refrigerant quantity is small. The air-cooled condenser is also called coil

condenser because it comes with aluminium or copper coils at the back of the fridge. The coils increase the surface area for cooling the refrigerant.
Air-cooled condensers are further divided into two. The natural convection condenser which uses the natural flow of air to cool the refrigerant and the forced convection condenser which uses a fan to draw in cold air.

Water-cooled condensers. These are used in large plants where there is more refrigerant. They use water to provide the cooling effect on the refrigerant. Water-cooled refrigerants are further subdivided into three.

- Tube-in-tube or double pipe type
- Shell and coil type
- Shell and tube type

Water-cooled systems typically work better when operating in higher ambient temperatures.

Evaporative Condensers. These are used in ice plants and are a combination of water-cooled and air-cooled condensers. As such, they come with benefits from both types of condensers.

Expansion Valve

The expansion valve helps reduce the pressure and temperature of the refrigerant. The sudden drop in pressure and temperature produces a cooling effect.

The expansion valve also regulates the amount of refrigerant used in meeting the load requirements. The load, in this case, are the products that need cooling in the refrigerator.

There are various types of expansion valves. They include:

- Capillary Tube
- Constant Pressure or Automatic Throttling Valve
- Thermostatic Expansion Valve
- Float Valve

Evaporator

The evaporator absorbs heat inside the refrigerator. It acts as a medium of exchange for heat from the stored products (load) to the refrigerant. In most cases, the evaporator is the coldest part of the fridge or the freezer.

Here, the refrigerant is cold and moves at a slower pace in order to absorb as much heat as possible from the load. As it absorbs the heat, it gets hotter and turns into a gas. By vaporising the refrigerant more heat is absorbed from the load. The refrigerant, now hot and in gaseous form, is then pushed back into the compressor.

The refrigeration cycle starts and ends with the compressor. The refrigerant flows into the **Compressor** where it is compressed and pressurised. At this point, the refrigerant is a hot gas. The refrigerant is then pushed to the **Condenser** which turns the vapour into liquid and absorbs some of the heat. The refrigerant then proceeds to the **Expansion Valve** where it expands, losing pressure and heat.
The refrigerant coming out of the expansion valve is cold and slow due to the loss of pressure. It enters the **Evaporator** in a liquid state where the exchange of heat takes place

thus cooling the load inside the refrigerator. As the gas cools down the load, it absorbs the heat which turns it into a gas. The gas is then pushed back into the **Compressor** where it can start the cycle again.
During the refrigeration cycle, a build-up of ice around the evaporator may occur. Both commercial fridges and freezers will combat this build-up with some form of defrost system.

Working process of refrigeration cycle

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Application of Refrigeration

- Removal of heat in chemical reactions.
- Preservation of thermolabile substances (eg. Insulin, Hormones and vaccines)
- Liquefy processing gas
- Separation of vapours by distillation
- Freeze drying (Lyophilization)