

U-3ARC WEBINAR TRAINING #19



Vapour Compression Refrigeration Cycle

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LEARNING OUTCOME/OBJECTIVE

- Definition of vapor compression refrigeration cycle
- Difference between refrigeration and Air-Conditioning
- Basic working of a vapor compression refrigeration cycle
- Definition of phase changes
- Four major components of vapor compression refrigeration cycle
- Types of accessories
- Application of VCR, short description and refrigerants used.
- F-Gas
- Recaps of the main points.
- Q & A



Definition of vapor compression refrigeration cycle

- **VCR** - Is the process of compressing vapor inside the system using the compressor to achieve cooling and refrigeration.
- **Refrigeration** – Is the process of lowering the temperature by removing the unwanted heat from an object, substance or an enclosed space.
- There are four (4) major components that form the VCR.
- **Compressor**
- **Condenser**
- **Expansion device**
- **Evaporator**



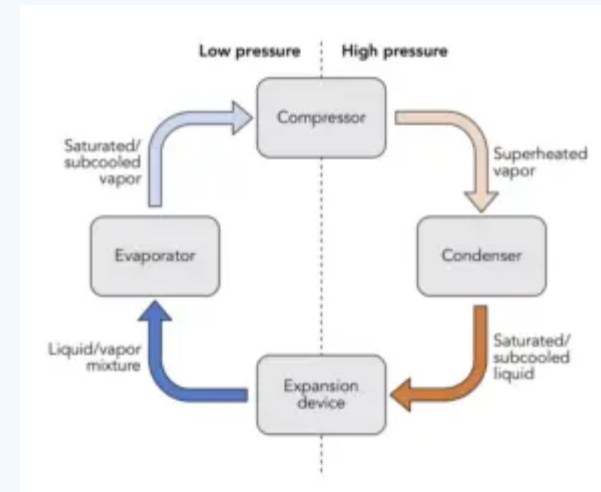
DIFFERENCE BETWEEN REFRIGERATION & AIR-CONDITIONING

- Refrigeration keeps the Air closed, Air-Conditioning pushes it out.
- Refrigeration uses coolant alone; Air-Conditioning uses the Air from outside.
- Refrigeration deals with cooling and freezing, Air-Conditioning deals with cooling and dehumidifying the Air.



Basic working of a Vapour Compression REFRIGERATION CYCLE.

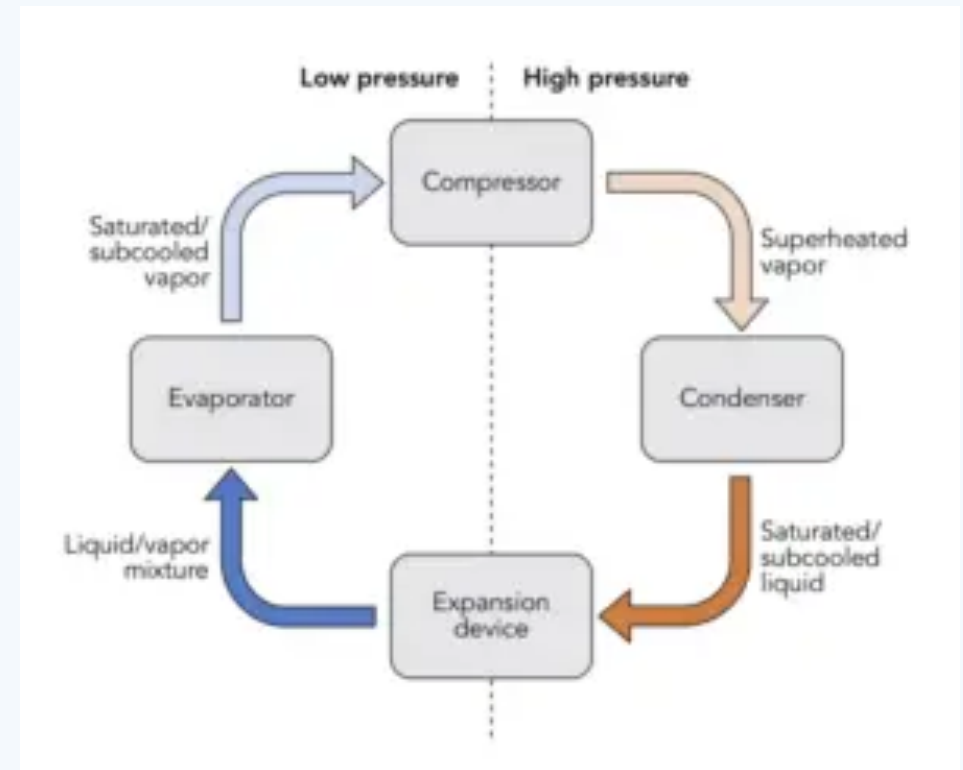
- **Compressor** - compresses the vapor refrigerants inside the compressor chamber. **Note** – if pressure increases it also increases temperature. The vapor will be squeezed so tightly, and it will heat up to a **high pressure & high temperature vapor** than leaves the compressor to the condenser.
- **Condenser** – when the high pressure & temperature vapor enters the cold condenser it absorbs the heat from the vapor refrigerant and completely convert it into a liquid. Then high pressure and temperature liquid leaves the condenser to the expansion valve
- **Expansion** – The high-pressure liquid refrigerant will be expanded from this valve. When the expansion occurs the pressures between the molecules decreases and leads into temperature falls. Then it leaves to the evaporator has a low pressure and temperature. Liquid + vapor.





Basic working of a Vapour Compression REFRIGERATION CYCLE

Evaporator – main cooling effects always occurs in the evaporator. When the **low liquid and vapor** enters the evaporator coils it absorbs all the heat present in the surface of the evaporator coil by absorbing all the heat from the surrounding regions of the evaporator coil. It turns completely into a **low-pressure vapor refrigerants** inside the coil and the surrounding region will become cold by losing the heat to this liquid. That's how the cooling and refrigeration effect occurs. Then the low pressures vapor leaves the evaporator to the compressor and the all process starts again.

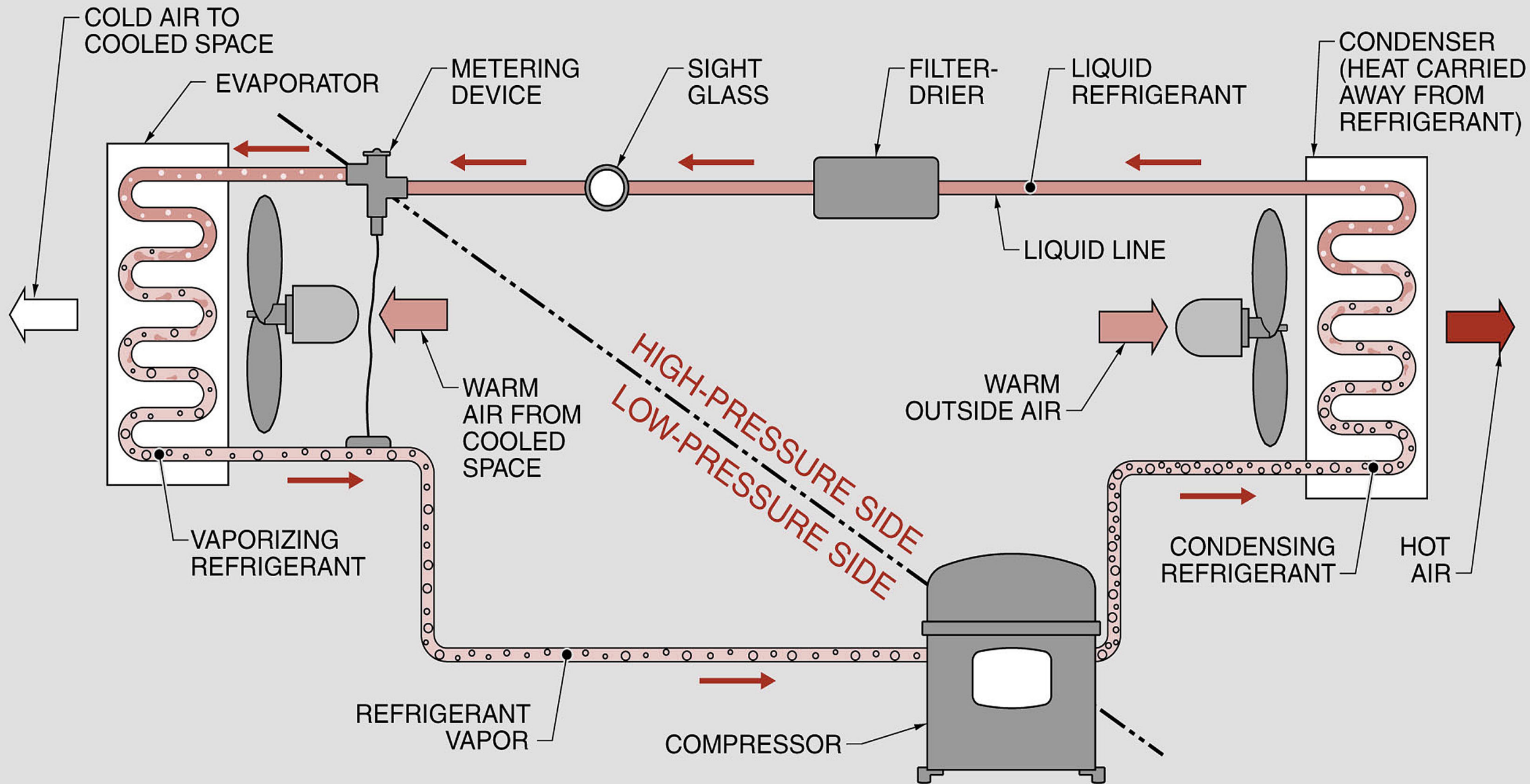




Definition of phase changes

- **Super heated** – is when the temperature of a gas rises above the boiling point.
- **Saturated liquid** – is a liquid that is about to vaporize.
- **Subcooling liquid** – is a liquid whose temperature is below its saturation point.
- **Saturated vapor** – it is the substance at which is fully (no liquid)

MECHANICAL COMPRESSION REFRIGERATION SYSTEMS

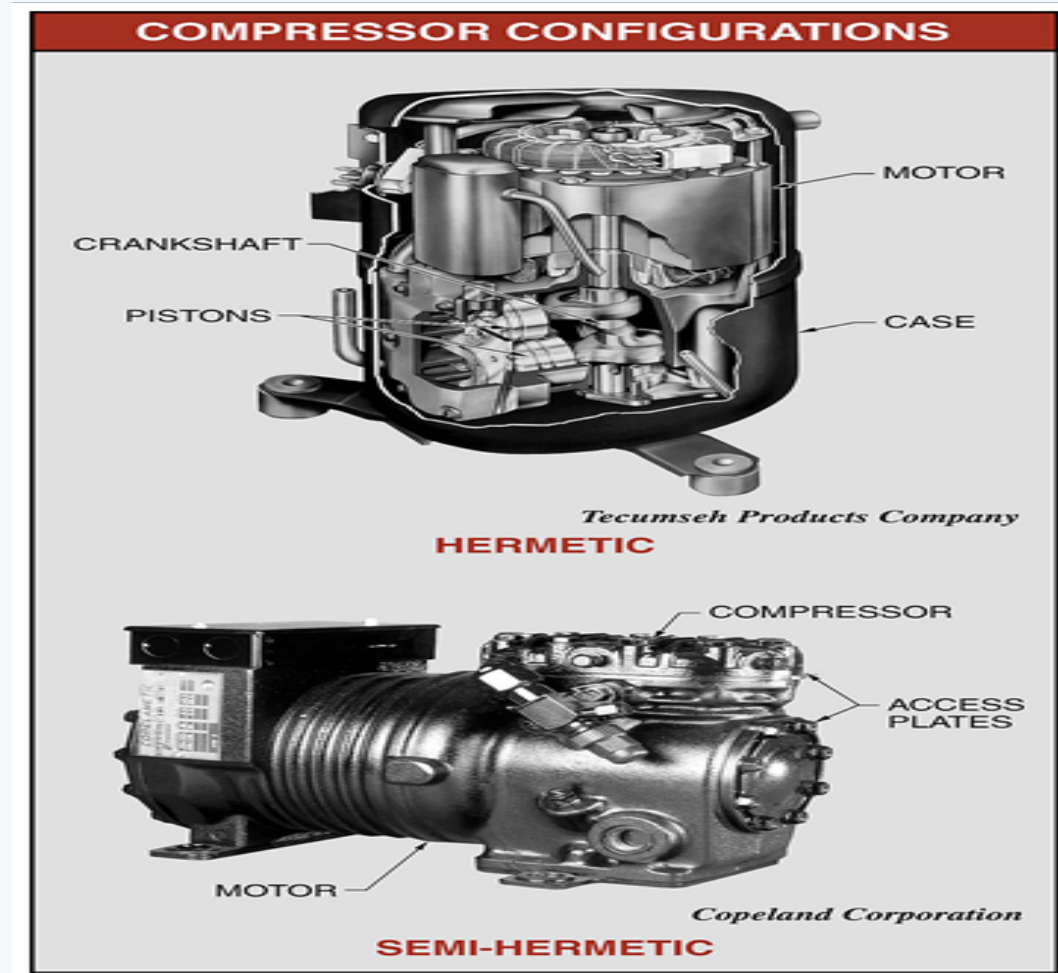




Major component's of vcr / OPERATIONS

Compressors

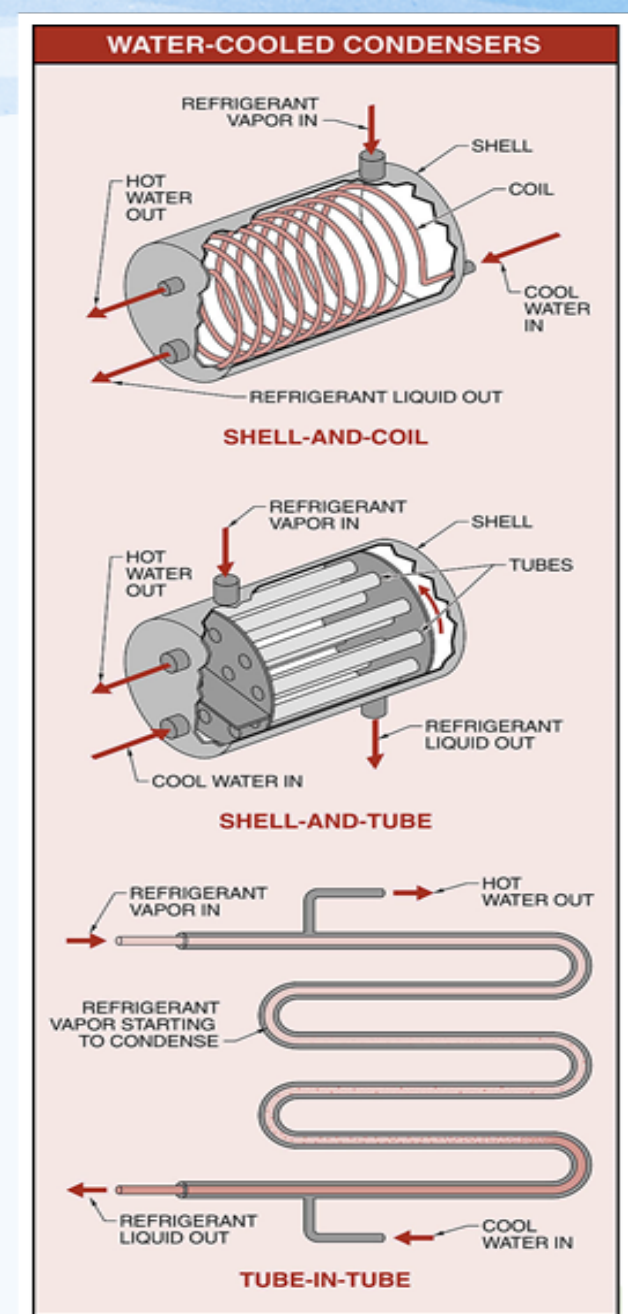
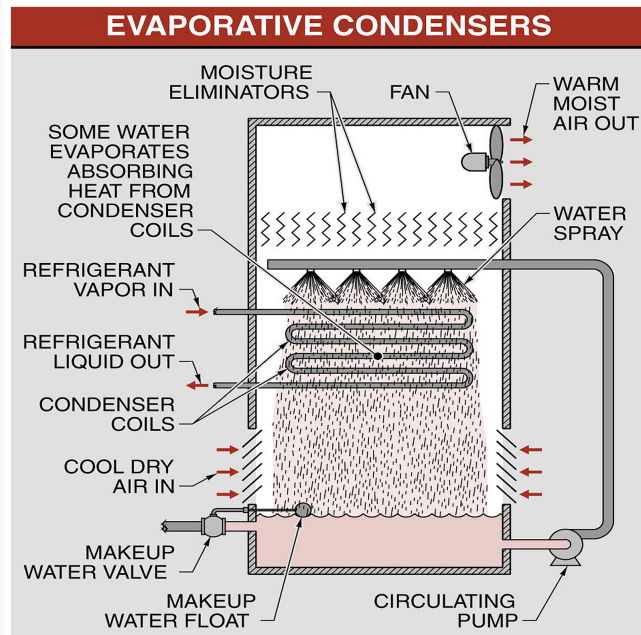
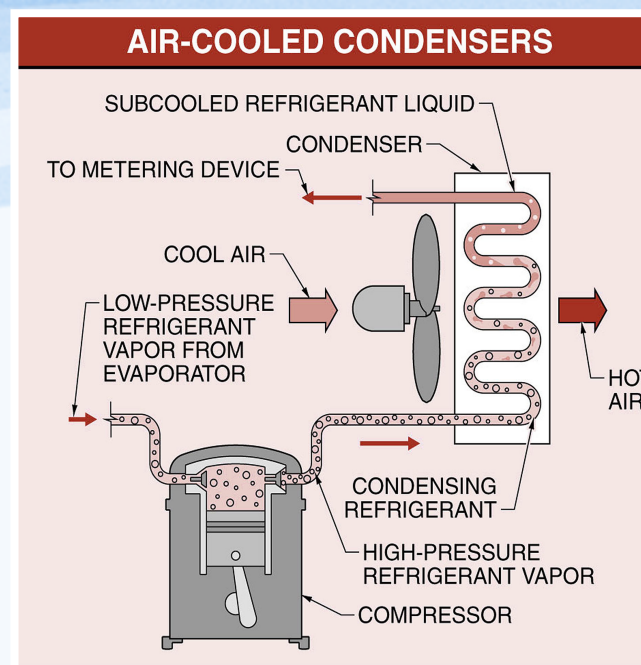
- In a mechanical compression refrigeration system, a compressor is used to produce the refrigeration effect
- Refrigerant compressors are available in hermetic and semi-hermetic configurations.



Condenser

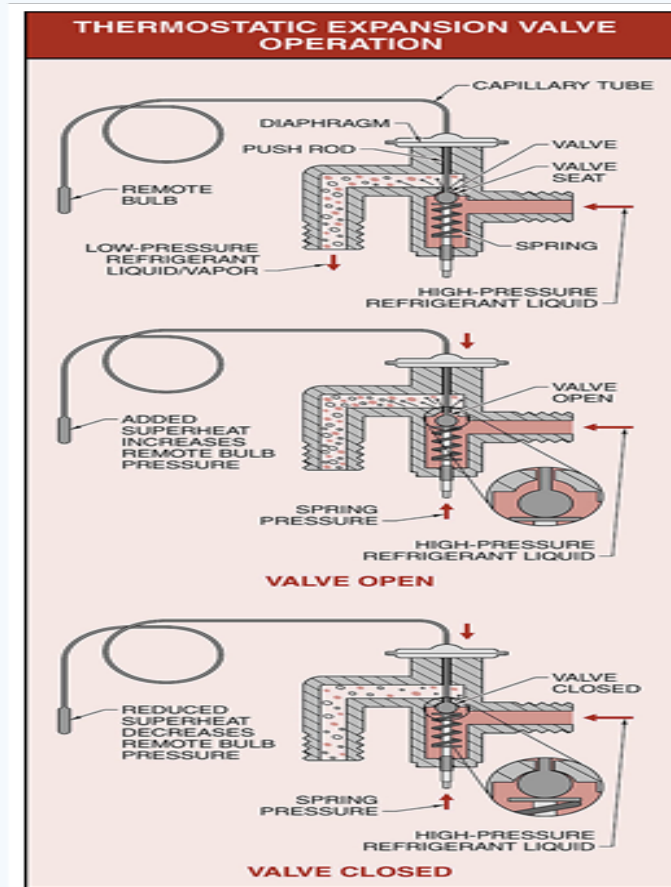
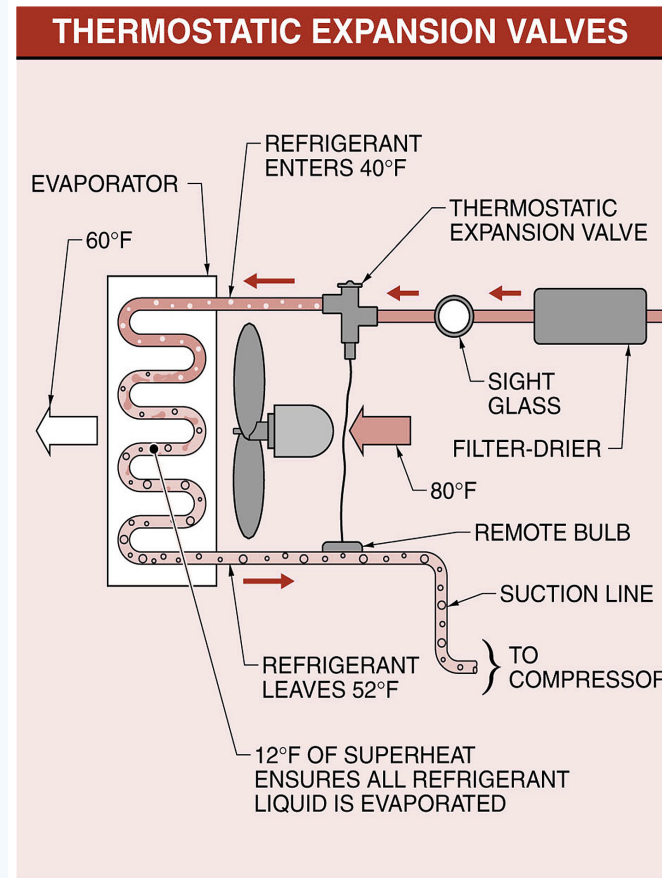
Three types of condenser

- **An air-cooled condenser** removes heat from high-pressure refrigerant vapor by air blown across the condenser coils.
- **Water-cooled condensers** transfer heat from refrigerant vapor to water.
- **Evaporative condensers** reject heat through the evaporation of water.
- **Phase change**



Expansion device

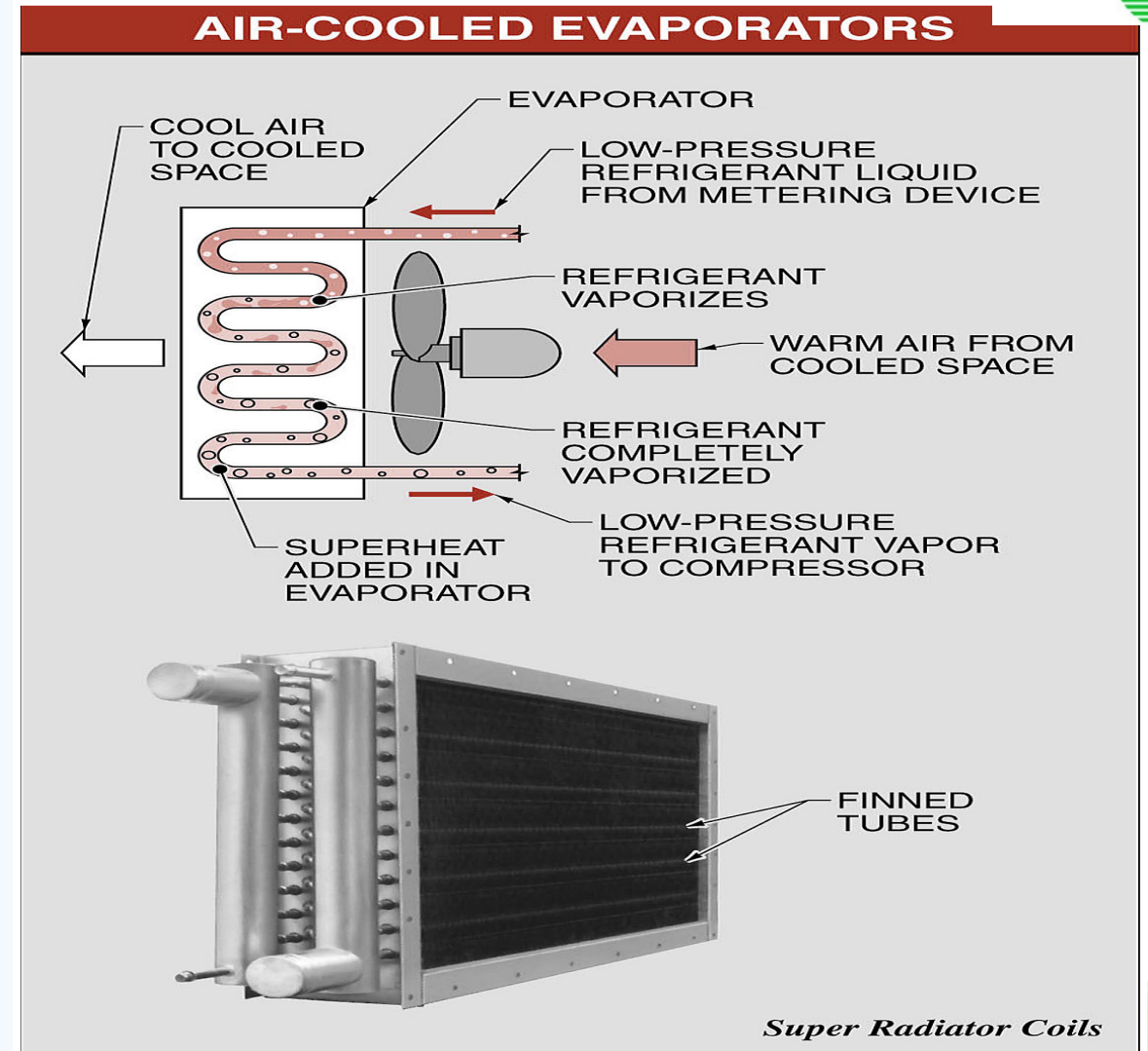
- A thermostatic expansion valve uses temperature readings at the evaporator outlet to control the rate of refrigerant flow into the evaporator.
- The opening and closing of a thermostatic expansion valve is controlled by the pressure in the remote bulb.



Evaporator

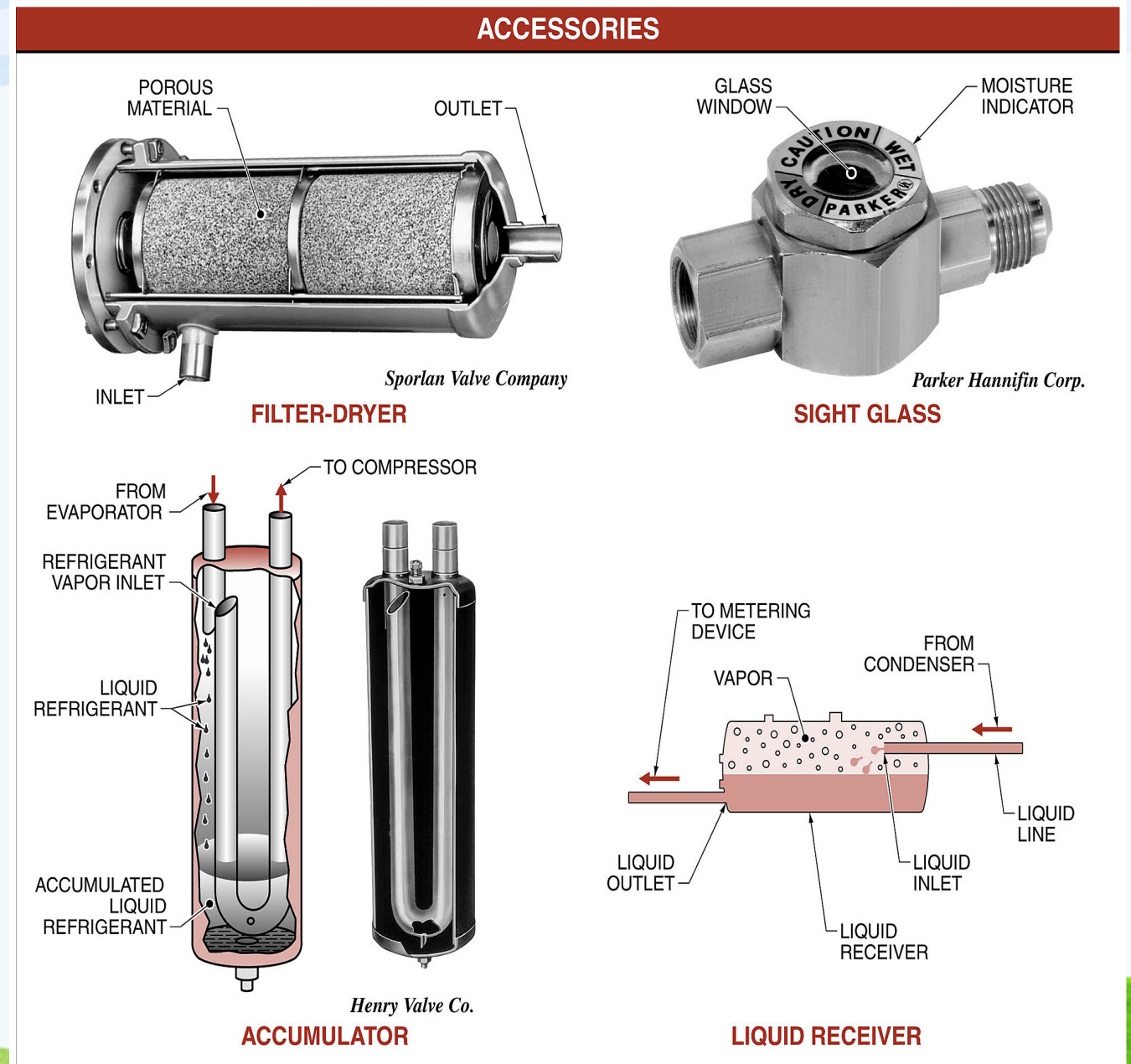


An evaporator vaporizes low-pressure refrigerant liquid into a low-pressure vapor.



Types of Accessories

- Accessories are used for maintaining and controlling the flow of refrigerant in a refrigeration system.
- Filter Dryer**- It captures any moisture and contamination present in the system
- Sight Glass**- monitors whether the moisture contents of refrigerant is within the acceptable range & also indicates whether liquid refrigerants is always present for at the expansion components.
- Accumulator** – prevent the sudden surge of liquid refrigerant that could enter the compressor from the suction line. It's a temporary reservoir for vapor, liquid refrigerant and oil.
- Liquid receiver** – holds excess liquid that would otherwise backup in the condenser coil and reduces the size of the condenser coil.





Application of VCR/SHORT DESCRIPTION/ REFRIGERANTS USED

Refrigeration application	Short descriptions	Typical refrigerants used
Domestic refrigeration	Appliances used for keeping food in dwelling units	R-600a, R-134a, R-22,
Commercial refrigeration	Holding and displaying frozen and fresh food in retail outlets	R-134a, R-404A, R-507
Food processing and cold storage	Equipment to preserve, process, and store food from its source to the wholesale distribution point	R-123, R-134a, R-407C, R-410A, R-507
Industrial refrigeration	Large equipment, typically 25 kW to 30 MW, used for chemical processing, cold storage, food processing, building, and district heating and cooling	R-123, R-134a, R-404A, R-407C, R-507, R-717
Transport refrigeration	Equipment to preserve and store goods, primarily foodstuffs, during transport by road, rail, air, and sea	R-134a, R-407C, R-410A
Electronic cooling	Low-temperature cooling of CMOS circuitry and other components in large computers and servers ^[10]	R-134a, R-404A, R-507
Medical refrigeration		R-134a, R-404A, R-507
Cryogenic refrigeration		Ethylene, propane, nitrogen, helium



Vapour Compression cycle – F-Gas

- **Chemical**

- Stable for the life of the system

- **Health and safety**

- No/minimal flammability
- Low toxicity

- **Environmental**

- Zero/de minimis ODP
- Low GWP
- Minimal secondary environmental impacts (for example, water and local air pollution)
- Maximum energy efficiency

Thermodynamic

- Properties matched to the application and system

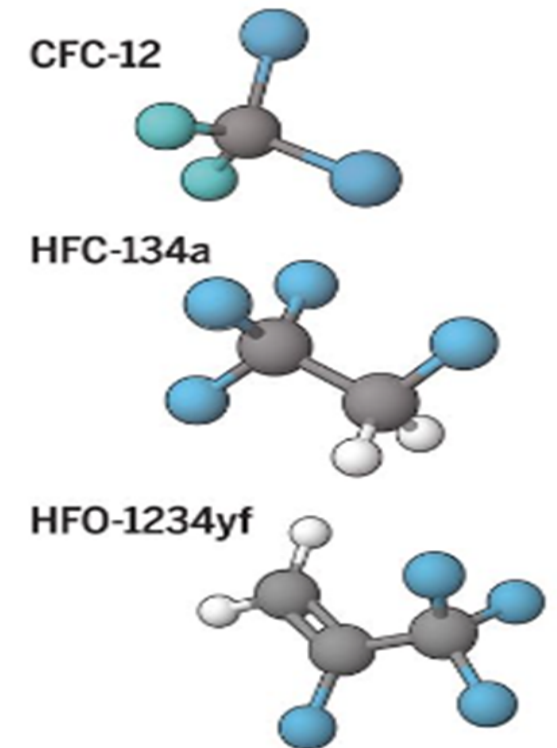
Product sustainability

- Long operational life
- Maximize recyclable content
- Minimize material use

Practical

- Materials compatibility

Reasonable cost





Recap of main Points

- VCR – Is the process of compressing vapor inside the system using the compressor to achieve the cooling and refrigeration.
- Phase Changes.
- VCR four(4) main components. (1) Compressor (2) condenser (3) expansion valve (4) evaporator.
- Types of Accessories – filter dryer, sight glass, accumulator, and Liquid Receiver. Etc.
- VCR Application
- F-Gas.

THE END



THANKS FOR LISTERNING