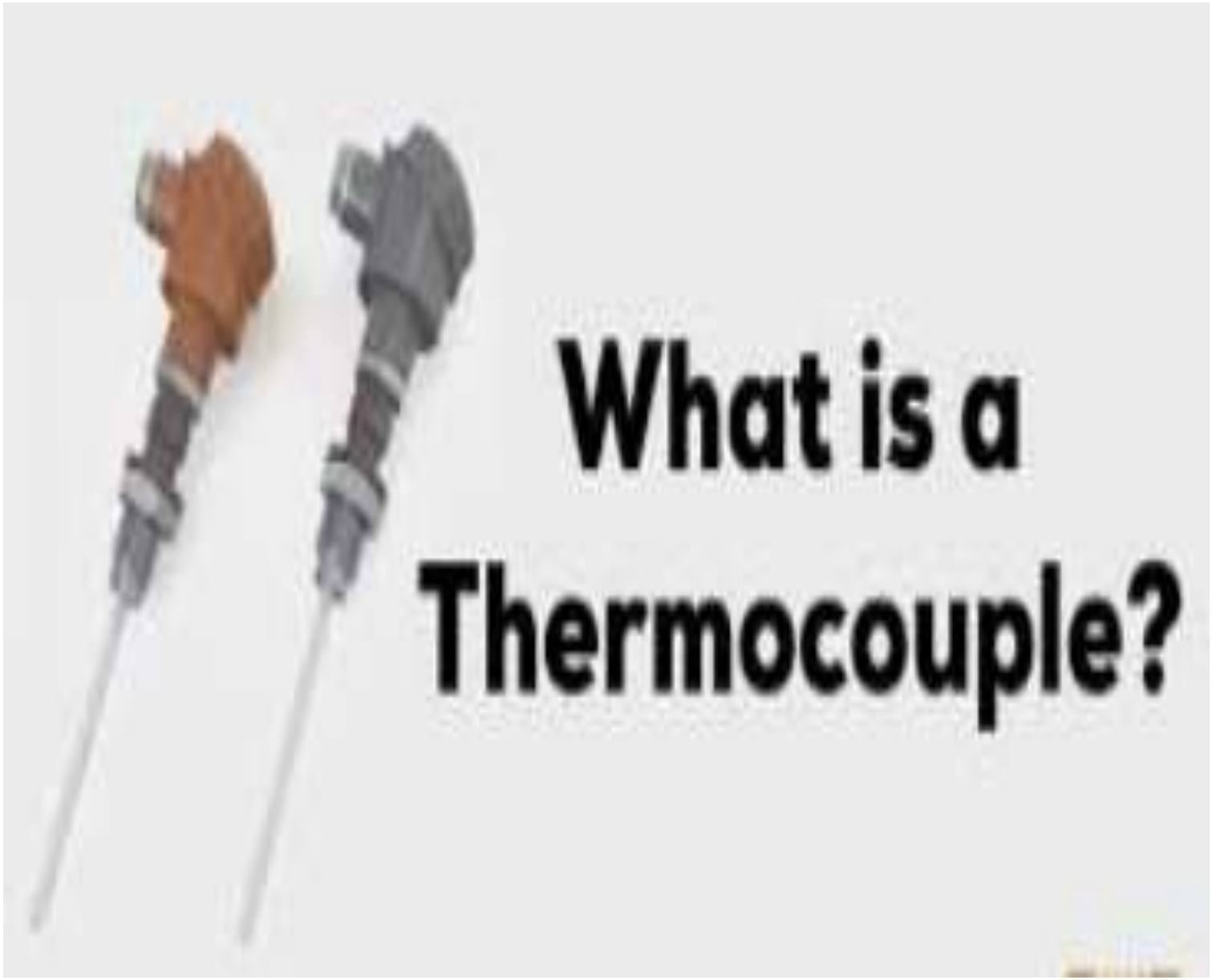
CHAPTER-7

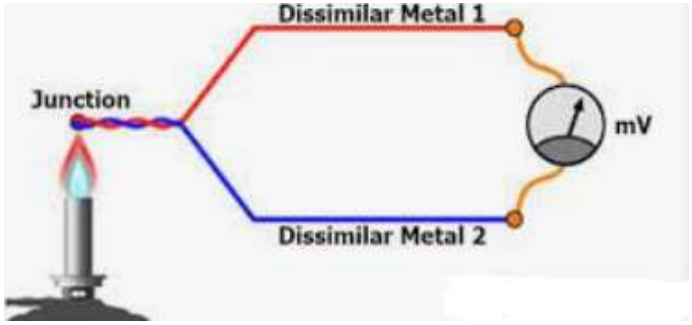
TOPICS TO BE COVERED

- Thermocouple
- Bimetals
- Soldering
- Fuses
- Applications

- Some materials are useful for functions other than conduction, insulation and magnetization
- Such materials are classified as materials for special functions or purposes called Special materials


What is a
Thermocouple?

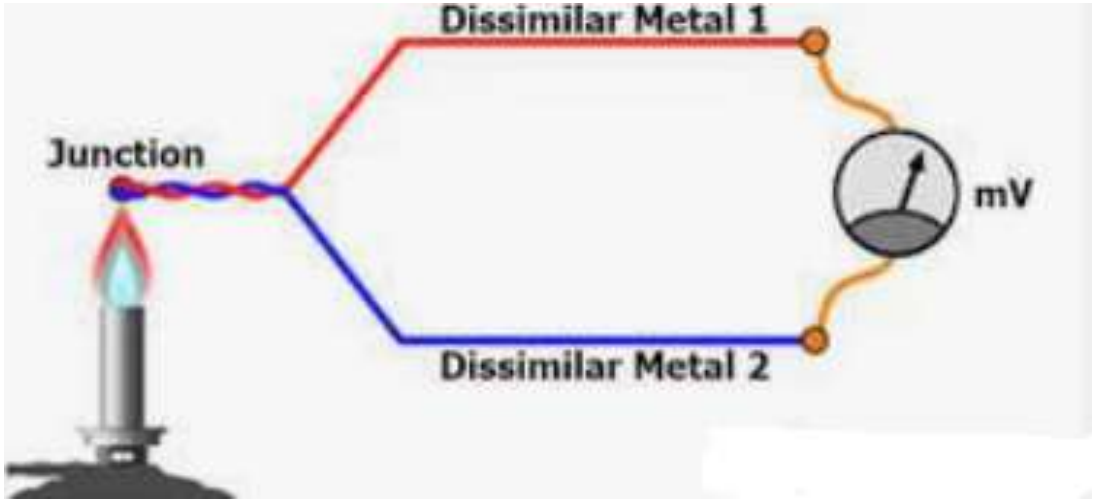
Thermocouple



- Thermo+ couple
- Thermo means heat and couple means joining of two
- It is a coupling of two materials joined together to work on the principle of heat.
- It is used to measure temperature (generally very high temp of furnaces)

Thermocouple

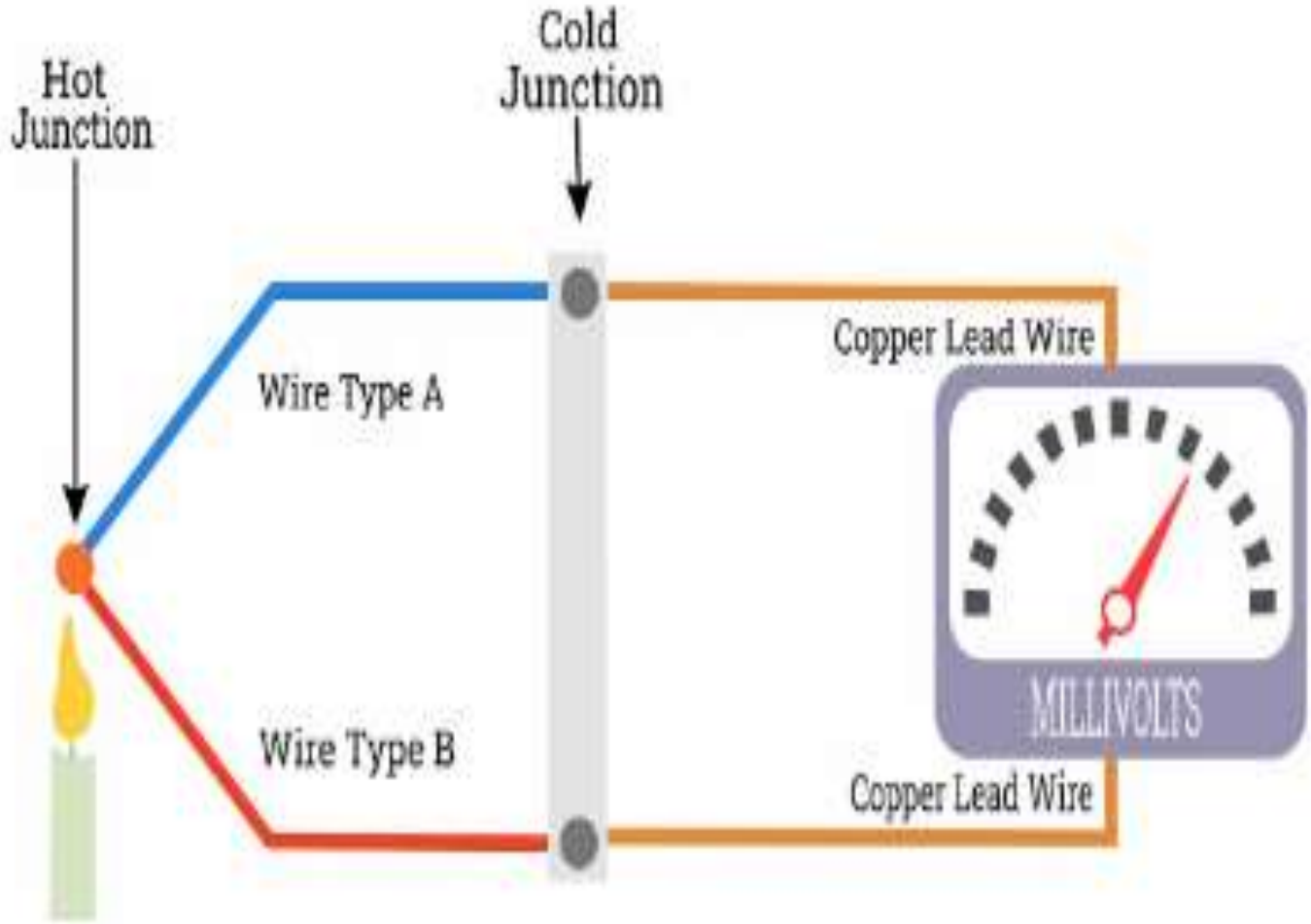
- It consists of two dissimilar metals to form two junctions
- One junction is kept at constant temperature (cold junction , reference junction) and other junction is heated (hot junction, measuring junction)



Principle involved in Thermocouple

- It is based on Seeback effect
- When two different materials are joined together forming a close circuit and two junctions made are kept at different temperatures , then an emf is induced between the two materials (even without applying electricity)
- I will start flowing in the circuit
- I proportional to $\Delta T \rightarrow$Measurement of I will measure T

Thermocouple



Points to be noted

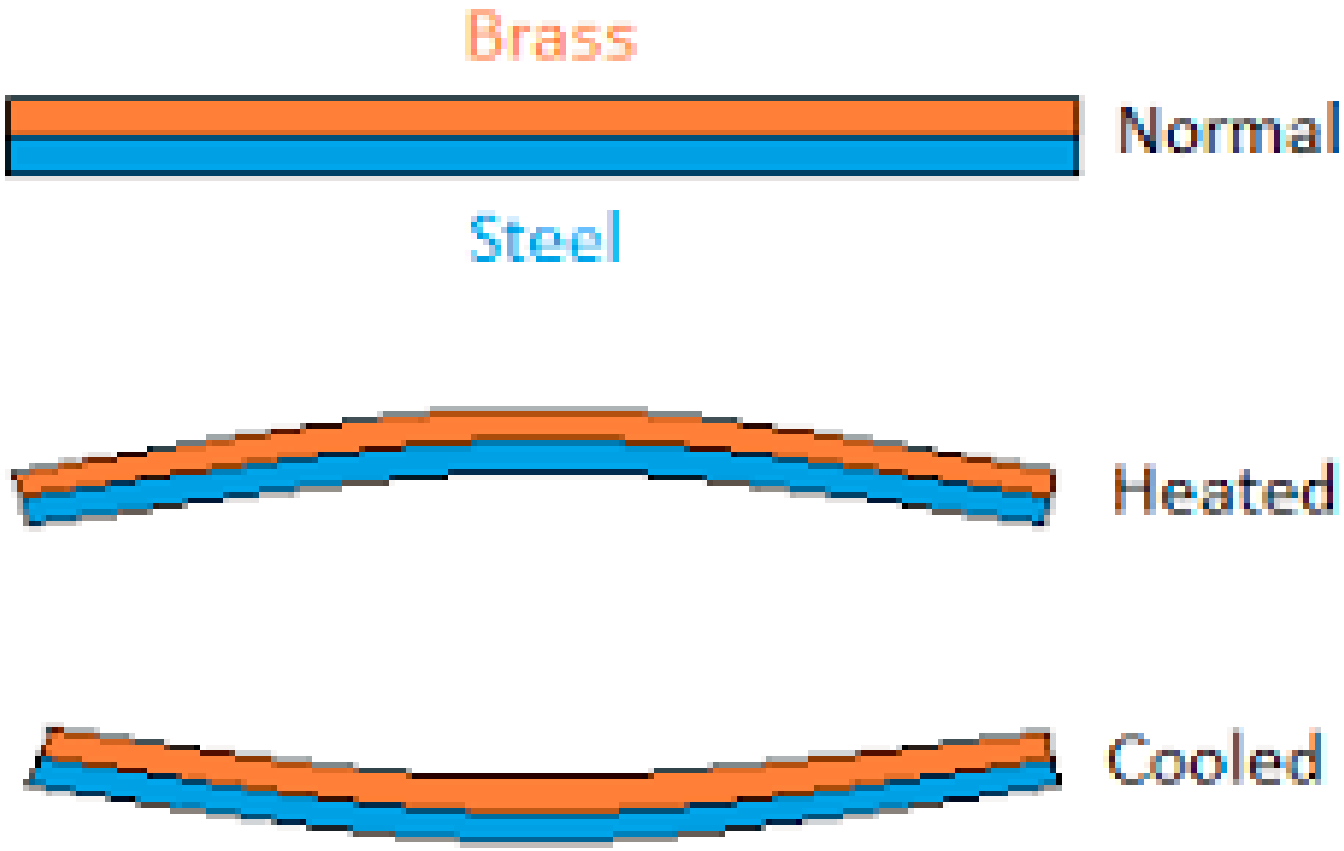
- While making thermocouple, proper selection of two metals may be made → selection determines range of the temperature for measurement
- Practically cold junction is kept at constant temperature and hot junction is kept at varying temperature

Examples of Thermocouple

Thermocouple combination	Temperature range
Copper-constantan	400 ° C
Iron-constantan	800 ° C
Platinum-Chromium	1100 ° C
Platinum-Iridium	1400 ° C
Platinum-Rhodium	>1400 ° C

Applications of Thermocouple

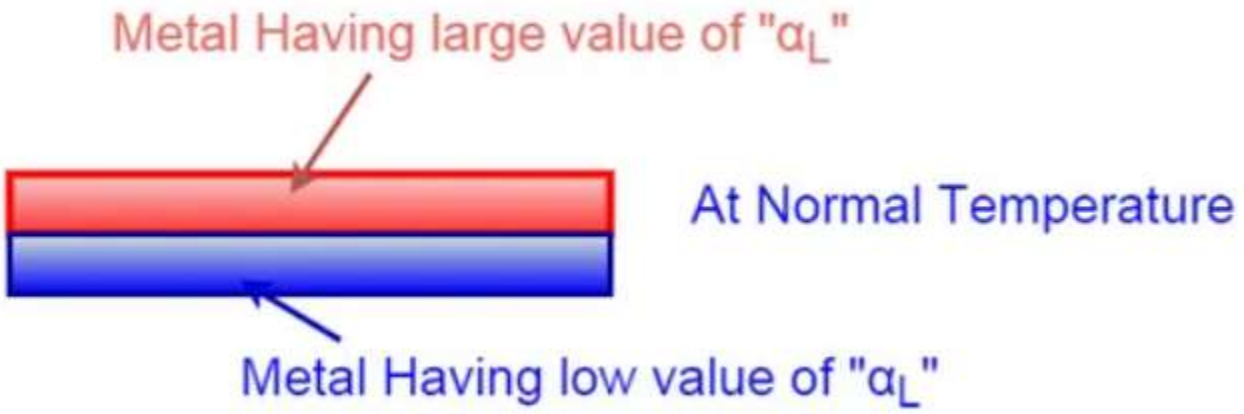
- Used in industrial furnaces
- Used in gas fed heating appliances like microwave/ovens and water heaters
- Extensively used in steel and iron industry to monitor temperature
- In the testing of prototype electrical and mechanical apparatus



Bimetallic strip

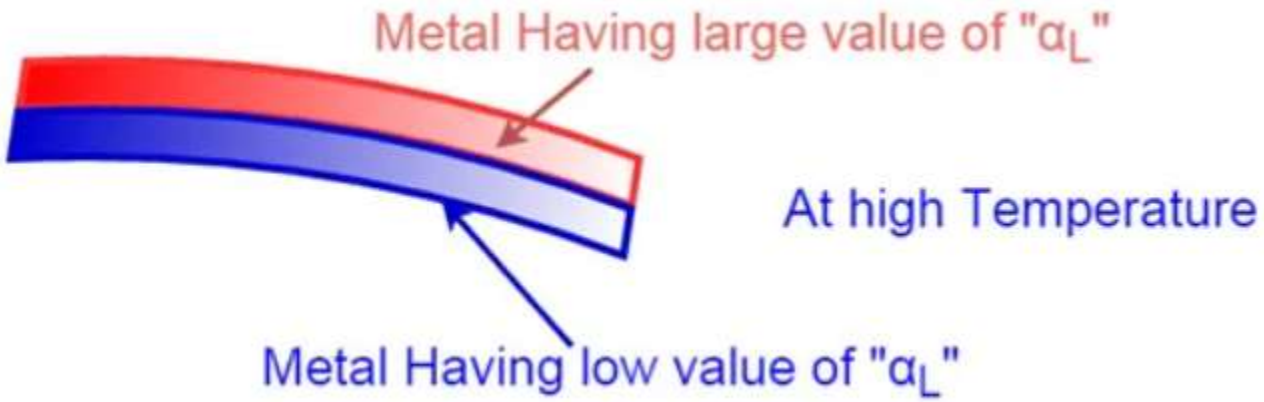
Bi-Metals

- Also known as Bimetallic strip
- It is a combination of two metallic strips of different metals (or metal alloys) with different coefficients of thermal expansion



Principle involved

- When two different metals of different ‘α ‘ are joined together and then heated, the strip will bend in one direction and when cooled down it comes back to its original position
- On heated metals expand and on cooling it contracts



Working of Bimetallic strip

- When two different metals of different ‘ ὰ ‘ are joined together → current is made to flow through it → heat losses it gets heated → one metal end (having low ‘ ὰ ‘)will bend in one direction → tripping of circuit → on cooling, strip comes back to original position → closing of circuit → circuit can be automatically ON or OFF depending upon temp

Materials used for making Bimetals

- Alloys of iron and nickel having low ‘ὰ’ forms one element of bimetallic strip
- Other element of high ‘ὰ’ are Iron, nickel, constantan , brass etc

Applications of Bimetals

- Used in thermal overload relays and thermal switches for protection of electric circuits/machines against overloading
- used for making bimetallic thermostat for automatic switching of circuit to control the temperate of certain appliance such as, Electric heater, Electric irons, refrigerators, electric ovens etc
- Used in direct indicating type thermometers.


What Is
Soldering?

Soldering

- It is a process in which two or more metals are joined together.
- In electrical or electronics circuits when connections are tobe made with max strength but minimum possible contact resistance, soldering is done
- Three parts- base metals + solder wire+ solder flux

Base metals

- Which are need to be soldered
- They do not melt , only heated and joined by solder wire

Soldering wire

- The alloy used for joining the metals is called solder (or solder wire)
- It is made of Lead and tin
- Lead and tin mostly used as low Melting temp and wide availability
- It is heated by using soldering iron

Properties of Soldering wire

1. Should be highly fusible (than the base metals)
2. Should be Heat resistant, machinable, good strength
3. Melting points of solder should be lower than that of the base materials
4. Not reactive to solder flux
5. Good conductivity

Solder Flux

- During soldering process, an external medium is used to increase the flow properties of molten solder such a medium is called flux
- While soldering, a layer of oxide is formed on the surface of base netals , to make joints properly strong, this oxide layer is removed with the help of flux.
- Flux used -Zinc chloride , Aluminium chloride

Properties of Solder Flux

- Should be capable to dissolve any oxide layer on the base metals or on solder
- Residues should be removable after soldering

Solder Flux:

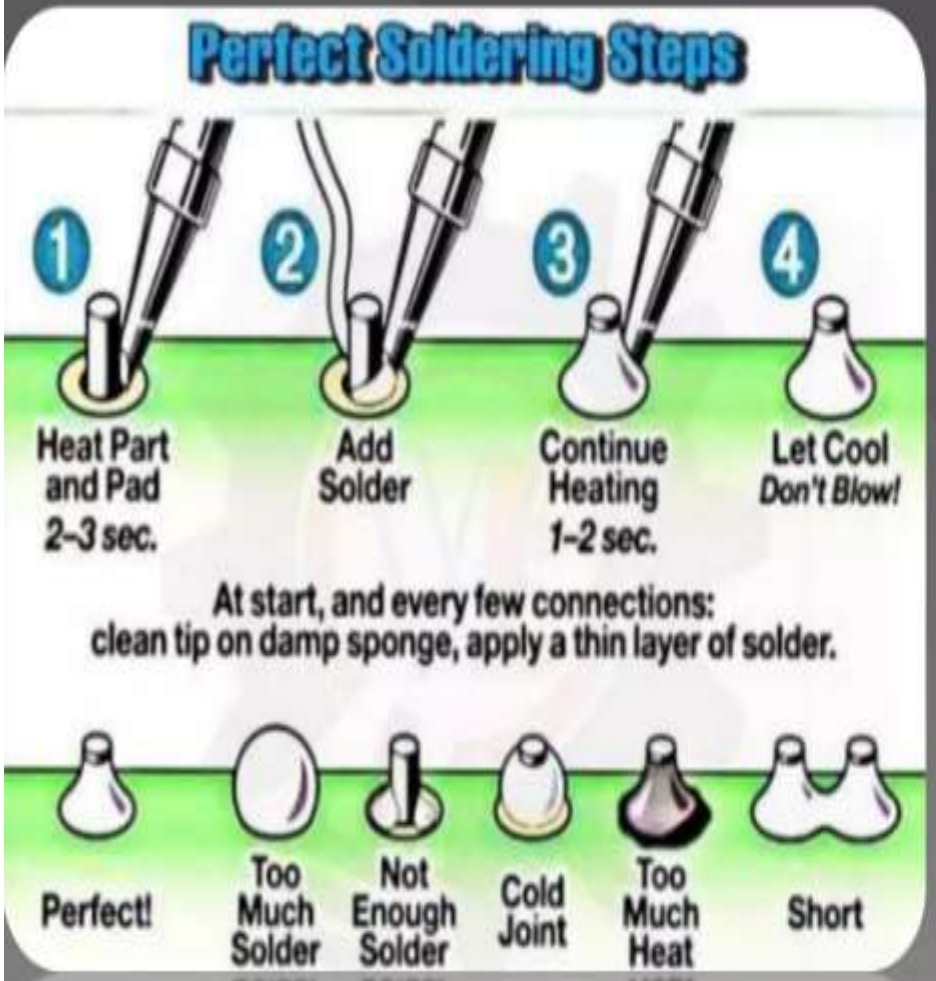
- It is a purifying agent.
- It is used for easy soldering. it helps as follows:
  - It stops oxidation of the base metal.
  - It helps in the easy flow of molten solder on the base metal.
  - It cleans the joint.
  - It helps in transferring heat quickly to the job.

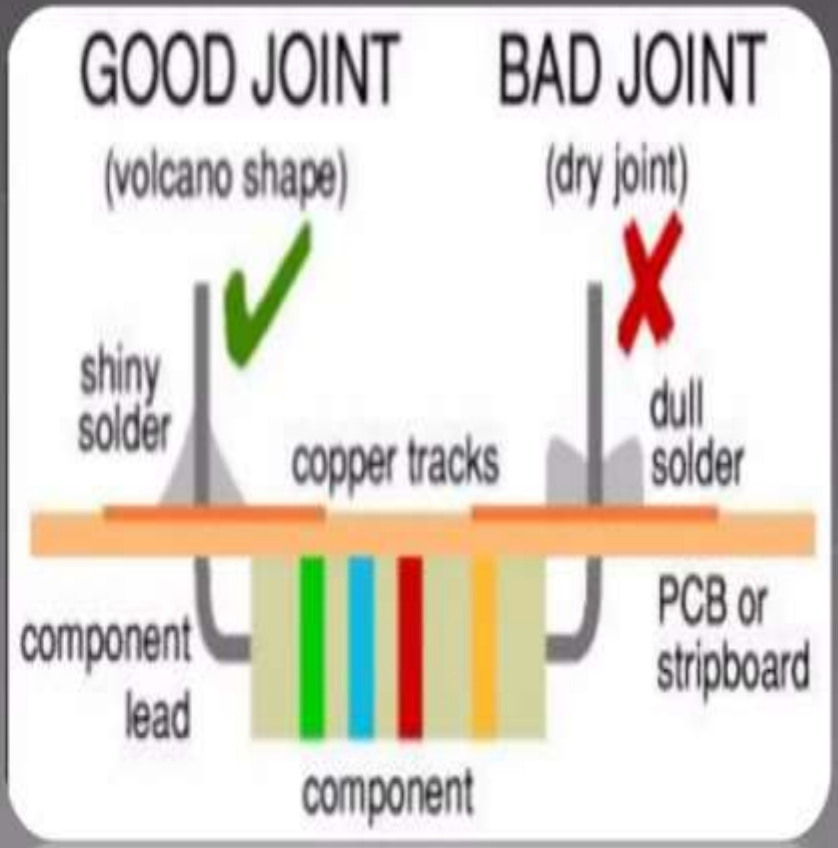
Soldering process-4 steps

1. Base materials to be soldered is cleaned at the joint and then apply flux
2. Melting of solder at the joint
3. Allowing diffusion of solder at the joint
4. Cleaning the residues at the joint

https://www.youtube.com/watch?v=cd3vn8GsmzA

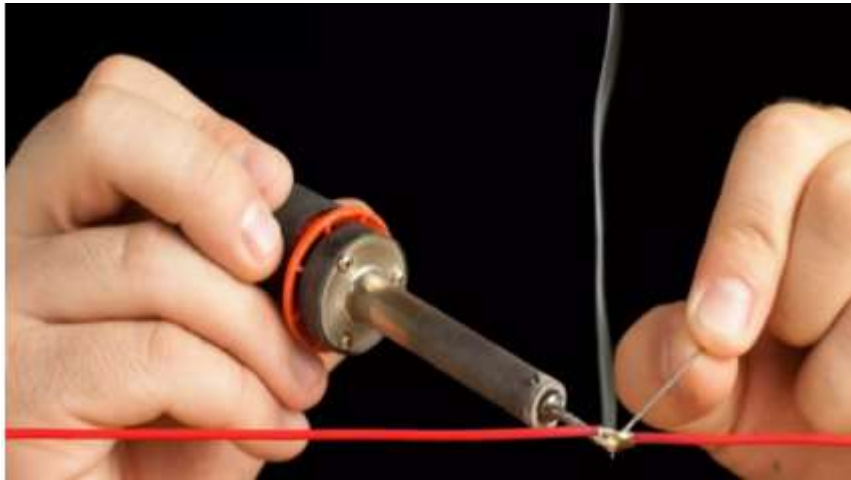
How to solder??





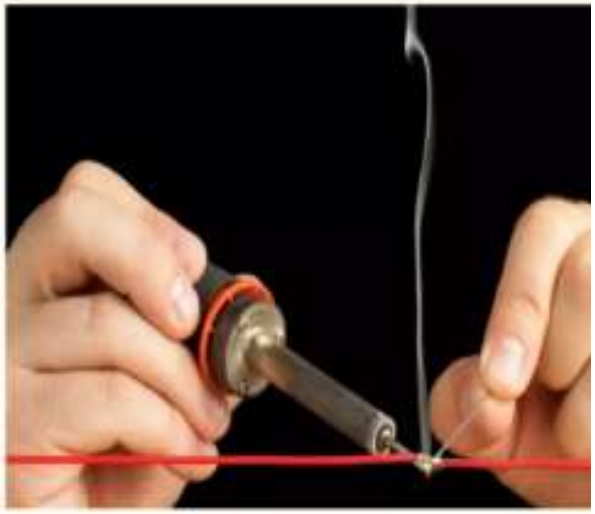
Applications of Soldering

- Soft solders are used to make joints in electronic devices such as TV, telephone , radio internal circuits, armature winding with commutator
- Hard solders are used to make joints in power apparatus



APPLICATIONS

- Electronic industry.
- Jointing automobile radiator cores.
- Plumbing and fittings.
- Electrical industry for joining wires.



Lead Soldering

- Tin lead solders are also called soft solders

- They are used for joining copper, bronze, brass etc
- Due to poor mechanical strength, joints made by such solders should not be subjected to mechanical stresses
- Increased % of iron will increase cost
- Increased % of tin decreases the resistivity, increases the tensile strength