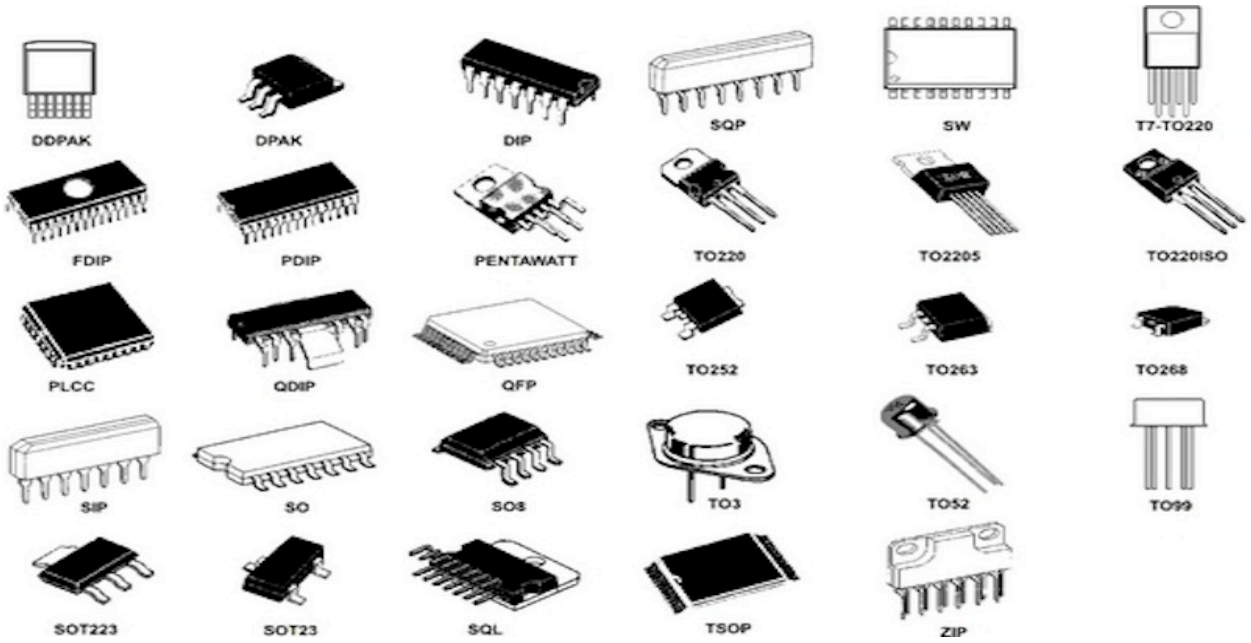
Surface Surface-mount technology (SMT):

is a method in which the electrical components are mounted directly onto the surface of a printed circuit board (PCB). mount technology:

SMp term	Expanded form
SMD	Surface-mount devices (active, passive and electromechanical components)
SMT	Surface-mount technology (assembling and mounting technology)
SMA	Surface-mount assembly (module assembled with SMT)
SMC	Surface-mount components (components for SMT)
SMP	Surface-mount packages (SMD case forms)
SME	Surface-mount equipment (SMT assembling machines)

Packaging Types:

the leading standardization body is JEDEC



SMD vs Through hole

Through-hole Technology: Advantages and Disadvantages

PRO	CON
Easier for prototyping	Higher board cost due to drilling
Strong physical connections	Takes up more board real-estate
Heat tolerance	PCB assembly process is more involved
Power handling capability	Slower speeds

Surface Mount Technology: Advantages and Disadvantages

PRO	CON
Small size → Denser boards	Weaker physical connections to the PCB
Reduced parasitics → reliable at higher speeds	Lower heat tolerance
Faster & cheaper assembly	Lower power handling capability
No drilling → Cheaper board fabrication	DFM: tombstone, pop cornering, etc

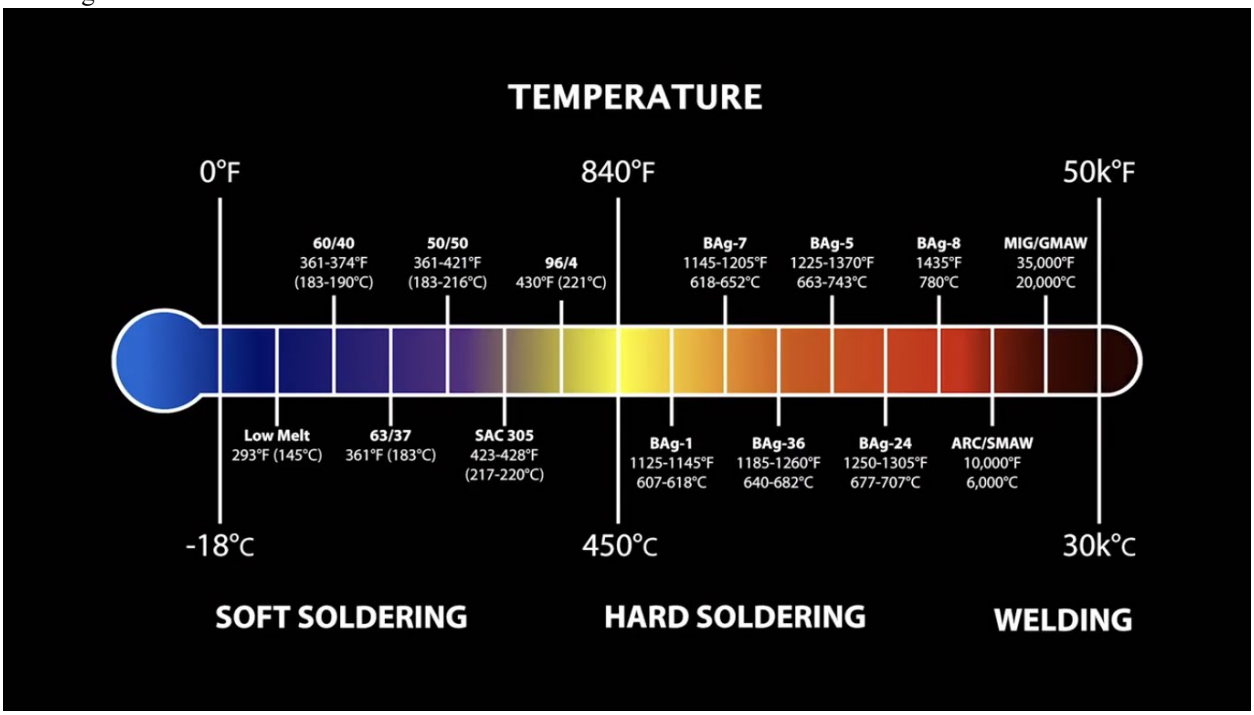
Types of soldering

a-by hand:

0- Types of soldering
Soft Soldering(-18degreec to 450degreec)
Can be done by normal soldering iron or heat gun.

Hard Soldering/Brazing/Silver soldering (if silver alloy is being used):
This type uses a torch or furnace:

Welding



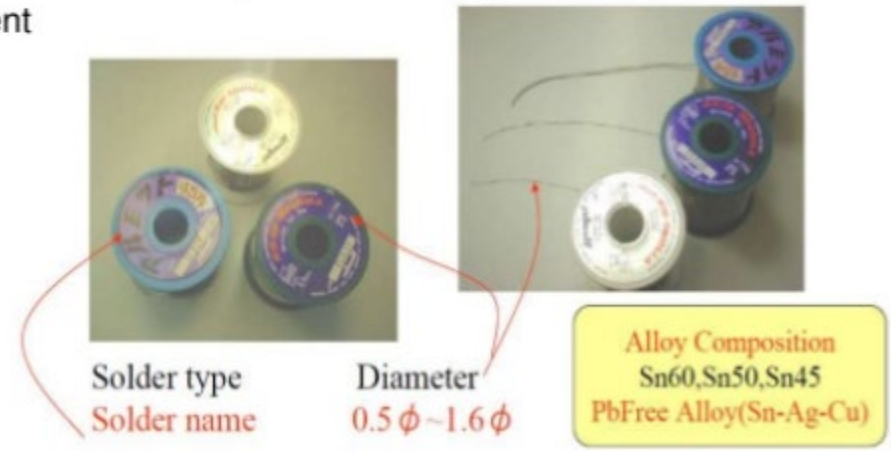
For soft and hard soldering the process is the same while the solder has a lower melting point than the metal being applied to while Welding As opposed to brazing and soldering, which do not melt the base metal, welding is a high heat process which melts the base material. Typically, with the addition of a filler material.

Heat at a high temperature causes a weld pool of molten material which cools to form the join, which can be stronger than the parent metal.

1- Solder Wire:

Solder is a fusible metal alloy used to create a permanent bond between metal and workpieces.

You should be aware of following while choosing solder wire –
Lead (Pb) Content
Flux Content
Wire Size



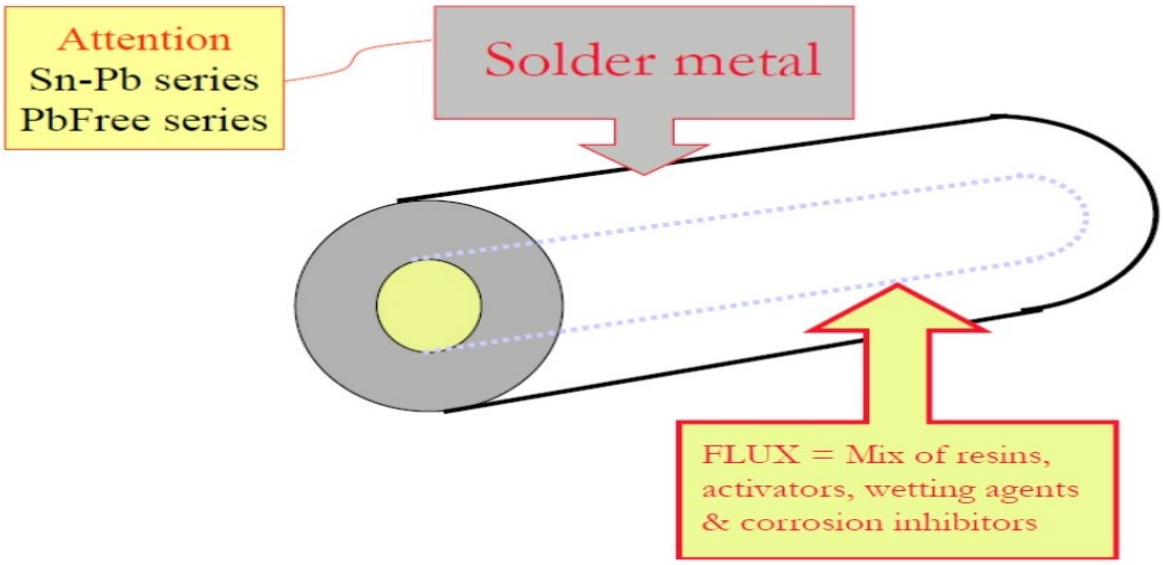
- Solder Alloy
  - Most use Sn60/Pb40 or Sn62/Pb36/Ag2 or LEAD FREE
- Flux Type
  - No-Clean RMA (Rosin Mildly Activated)
    - Flux residue are safe to leave on PCB. They will not cause corrosion or electrical breakdown of ckt during its lifetime.
- Flux %
  - 1, 2 or 3. Higher flux % makes soldering easier but can leave more flux residue which can make solder joint look cosmetically 'dirty'
- Wire Diameter
  - Select the right one for the required job
- Reel Size
  - Generally 500gm.

A- Types of Solder by Core Style

There are three primary types of solder that are used frequently, namely:

Acid core solder:
These solders are intended to be used for steel or other metals but require that the flux residue be cleaned after the soldering operation is completed to avoid corrosion. Acid core solders are most often used in plumbing applications to join metal pipes or sheet metal.

Rosin core solder:
is also fabricated with a hollow core inside the solder wire, but the flux used is a milder variety made of rosin, which is a solid form of resin derived from conifers such as pine. The flux residue associated with rosin core solder is non-corrosive and therefore is used for making solder connections in electrical applications where it may be difficult to remove the flux residue after the soldering operation has been completed.



Solder wires usually have a core inside the wire containing flux. Flux is designed to improve electrical contact and mechanical strength in solder joints.

There are mainly two types of flux cores –

- Acid core - Used for plumbing
- Rosin core - Used for electronics.

So use rosin core only, But there are four types of Rosin Flux –

- R – Rosin
- RMA – Rosin Mildly Activated (Preferably used)
- RA – Rosin Activated
- AC – Non-Rosin Activated

Solid core solder:
unlike the acid core or rosin core varieties, do not have a hollow core that is filled with a flux material. Instead, these solders consist of a solid wire comprised of the solder alloy or material. Flux must be applied separately in the case where solid core solder is used.

B- Types of Solder by Alloy or Material

There are two main types of solder:

- Lead-based solder
- Lead-free solder

*The main practical difference between the two is the melting temp.

Lead-based solder: It was made of a mixture of tin and lead. Usually a 60/40 (tin/lead) mix, that melts at around 180-190 degree C.

Because lead has some damaging effects to our health. The industry is moving away from lead and towards lead-free solder.

Lead-free solder: It is solder without lead. Now it is recommended to use lead-free solder (RoHS) because of the health hazards of lead.

It has a higher melting point, so it is bit harder to work with, but usually not a problem.

Most solders are alloys of one or more elements. For example, a lead-free alloy such as silver solder might be by composition 94% tin and 6% silver. Other examples of alloy solders not using lead include:

tin-antimony (95/5)
tin-copper (97/3)
tin-silver (95/4)

Lead-based solders use a numbering system that specifies the percentage of lead as well as the mixed metal in the alloy, called the lead alloy ratio (where the first number is the % of tin, the second the % of lead). Common alloys that are tin solders include:

63/37
60/40
50/50
30/70
10/90

C- Wire Size:

For basic electronics work, a solder wire between **0.711 mm to 1.63 mm** diameter is good enough. However, solder diameter is determined by the gauge number.

Gauge Number	16	18	20	21	22
Diameter (mm)	1.63	1.22	0.914	0.813	0.711
Diameter (inch)	0.064	0.048	0.036	0.032	0.028

- For restoring antique computers for the museum, and repairing vintage circuits that have huge solder tags, normally gauge 16 used.
- For PDIP and through-hole packages that have a standard pin spacing of 0.1-inch, gauges 18, 20, and 21 is preferred.
- For SMD components such as SOIC packages where the pin spacing is much closer, then a fine tipped soldering iron with a 22 gauge solder wire works well.

2- Types of used Flux:

So use rosin core only, But there are four types of Rosin Flux –

- R – Rosin
- RMA – Rosin Mildly Activated (Preferably used)
- RA – Rosin Activated
- AC – Non-Rosin Activated

Soldering Process		Flux Application
Wave Soldering	The circuit board is passed over a molten wave of solder which wicks up into the holes soldering the component leads in those holes.	Sprayed on prior to being soldered.
Solder Reflow	Solder paste is applied to the pads on a circuit board using either a jet application or a stencil. This paste holds the component leads in place and then reflows when passed through an infrared oven that heats it creating a solid joint.	A thick flux chemical combined with solder powder to form the solder paste.
Selective Solder	This is an automated system that applies solder to individual holes or pads on the board. The system will either deposit molten solder through a nozzle or use a laser to melt solid solder that is fed to the joint.	Sprayed on, or dispensed as single drops on the surfaces to be soldered.
Manual Solder	A technician using a soldering iron to melt solid solder that is fed to the joint.	A solid core within the solid solder wire used by the technicians.

How to make rosin flux : https://www.instructables.com/Rosin/

3- Soldering Iron:

Differences in power capacity, size and ability.

Use one depending on the type of work . 80 W

Weller better for Pb Free or large joints

Iron tip

Iron tip shape is different for each process.

Choose correct iron tip for application.

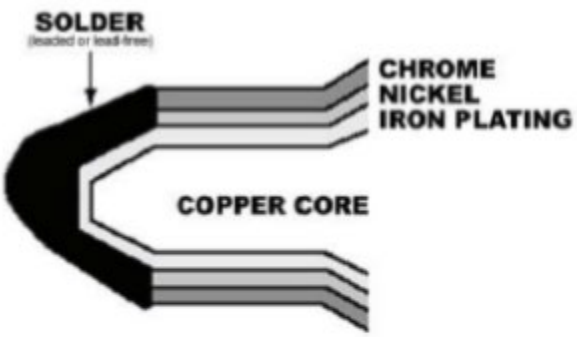
Internal part of soldering iron

Ceramic heater

Weak to impact / shock.

Use goot 30 watts for normal soldering for wire connecting or heating large area surface of copper use 60 watts goot soldering iron for example lead free solder require 80 W solder iron

A- Construction of the tip :



A tip is mainly made up of Copper core, to ensure good heat transfer.

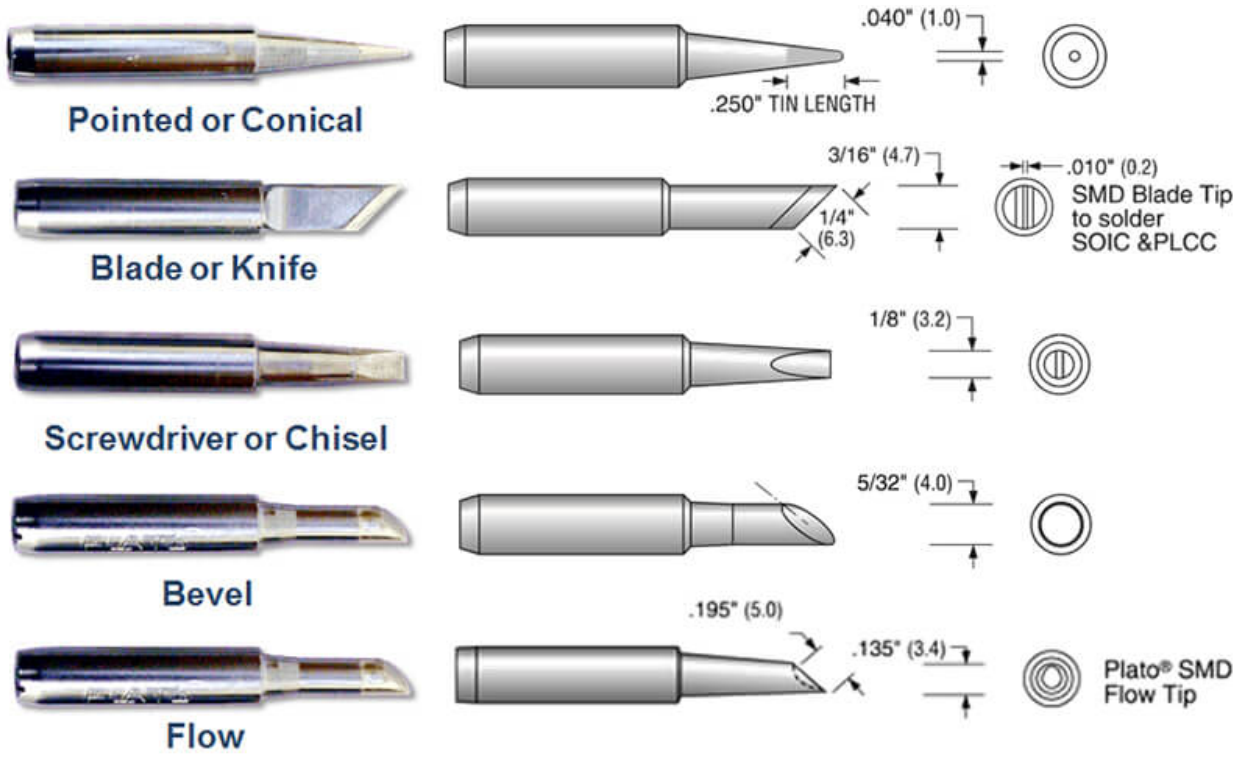
- Iron plating is done on copper core to make it thermally insulative (Heat should be transferred in proper way)
- Nickel layer is plated after iron to make non-wetting to keep solder wicking away from the tip.
- Chrome plating is done at last as a protective layer.

Pointed or conical(used for point to point SMD soldering) – The end of the soldering tip comes to either a point or around the flat area. The size is specified by the diameter of the end, so can be as small as 0.1mm or larger than 1mm. These tips are generally used when pin-point accuracy is needed, like with very fine leadless surface mount components. They may be long for greater reach in dense board design, or a shorter microtip to reduce the amount of tip metal that needs to be heated. This can improve heat recovery. The ends of the tips may also be bent to avoid interfering with other components or contact areas.

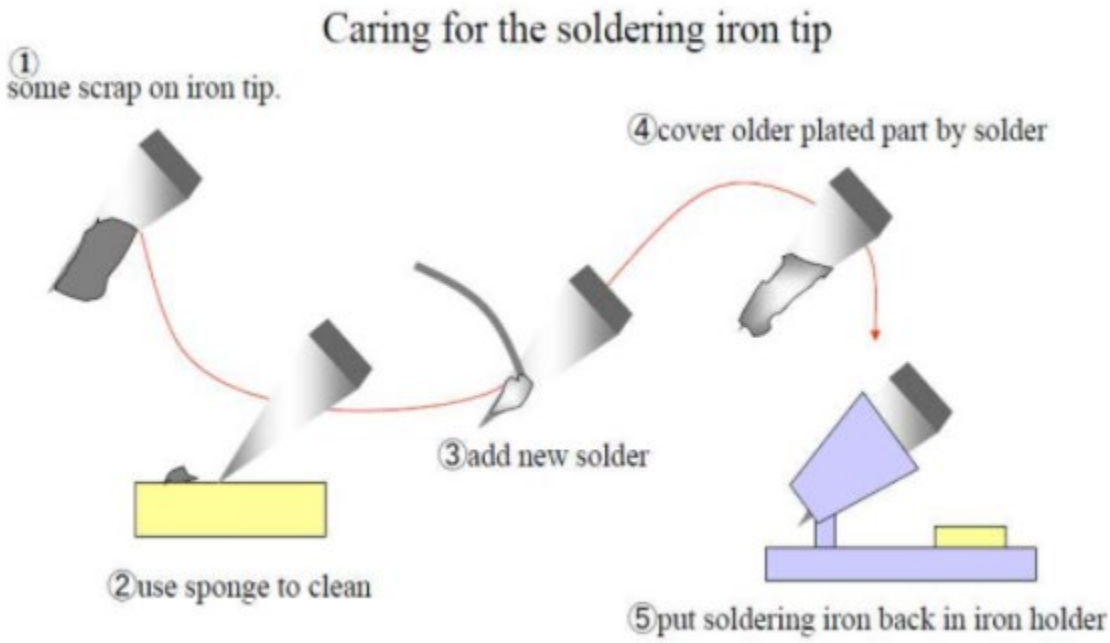
Blade or knife (FOR DRAG SOLDERING SMT) – A blade tip is usually used for drag soldering when the solder is drawn across multiple contact pads. This is common when soldering surface mount technology (SMT) components. The size is measured along the length of the blade and can be 6.3mm (1/4") or larger.

Chisel or screwdriver(FOR THROUGH HOLE) – A chisel allows you to heat a larger contact area, so useful for thru-hole solder joints. Lengths may vary and can also be bent, like with a conical tip. The size is mainly specified as the length of the flat area, but the depth or thickness of the tip may also vary. These can be so small they almost look like a point, like under 1mm, and as wide as 5 or 6mm.

Bevel(PRELOADING IRON) – used for soldering jobs that require preloading iron with solder A beveled tip has a flat oval end set at an angle. Picture a metal rod that is a cross section at an angle. The size is specified by the diameter of the "rod" or shaft and sometimes the angle of the bevel. A bevel can be as small as 1mm or 4mm or larger.
Flow tips (DRAG SOLDERING)– A flow tip looks similar in design as a beveled tip, but instead of a flat area, it is a little indention or cup. This is also called a "mini-wave tip", and is commonly used for drag soldering, as explained above.



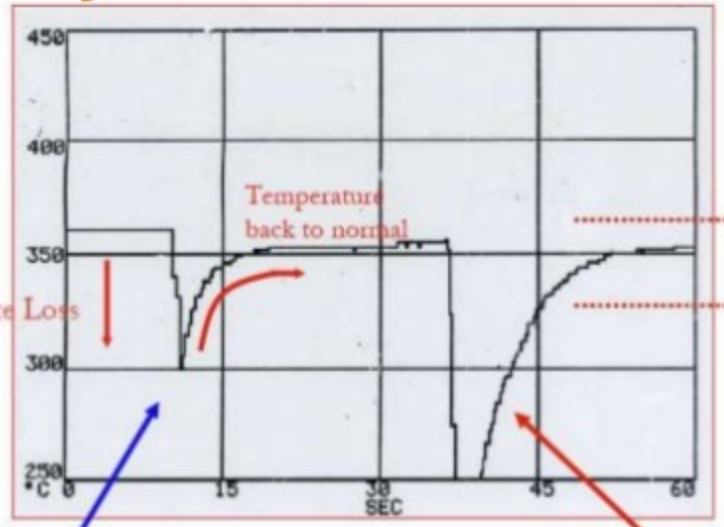
How to clean the tip:



Cut sponge in V.
Use the cut part to clean

Use water or Tip Cleaning Fluid to clean.
Do not use to much or to little. Keep tip tinned with Tip Cleaning Tin.

If tip not properly cleaned this can cause flux splatter, solder waste and poor heat conduction to joint area which can cause defects.
May need to increase the number of cleaning times when using Pb Free solder.



(Ex)
Ideal range of operation
350°C±15°C

Good condition
To start operation after temperature back to normal and consistent..

Too much water
Need longer time if temperature reduce too much.

This tip has soldered 20000 joints. Still in perfect condition

This tip has soldered 1000 joints. The tinned area is still shiny and smooth. There is no charged flux adhering to it. Only use the tinned area to heat up Joint area. It helps the heat to be transferred quick/consistently. Using the none Tinned area of the iron will cause soldering problems.

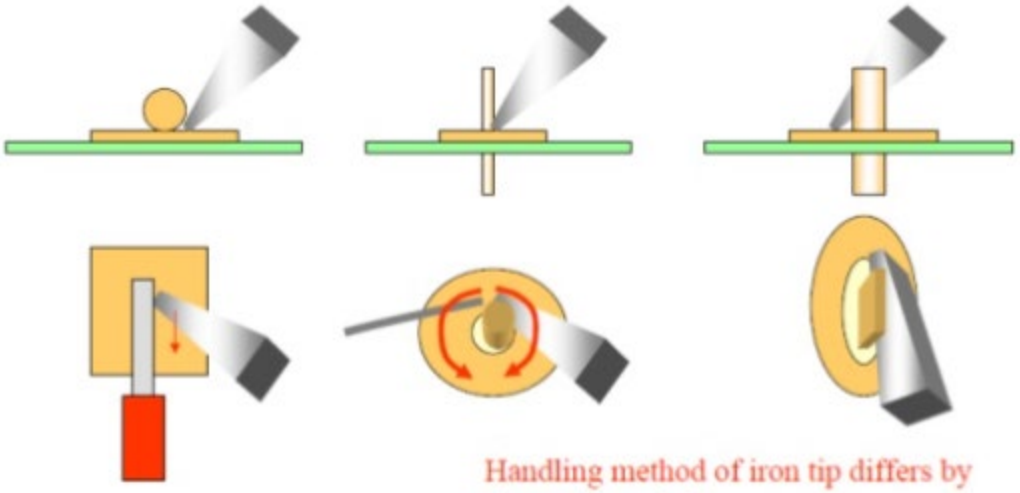
The tinned area is dull and inconsistent and there is lots of charred flux adhering to it. The ability of this tip to transfer heat to the solder joint is significantly impaired by its poor condition.

4- Soldering Tips for soldering station:

7.9 Heating Large Joints

Use iron tip body to heat up the joint, but the area in contact with the joint must be tinned and clean.

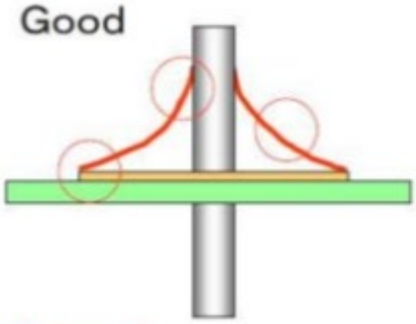
Solder large terminal/area by moving iron tip



Handling method of iron tip differs by shape of terminal.

7.10 Solder Wetting

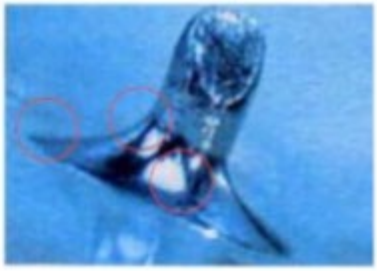
Good



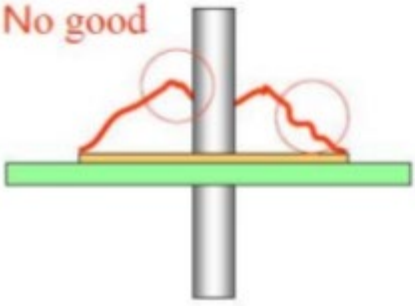
Solder wets to lead and land.

Smooth and shiny surface.

No holes, no spikes.



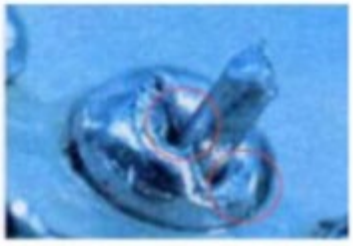
No good



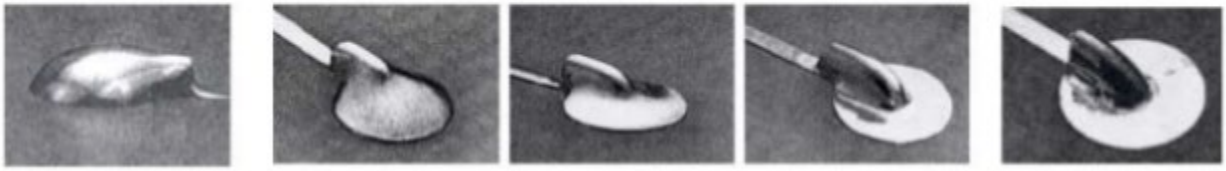
Poor wetting to lead.

Rough surface.

Holes.



7.11 Solder Quantity



No good | OK | No good

Excess amount

Unable to confirm whether solder is wetted.

Apply correct solder amount.

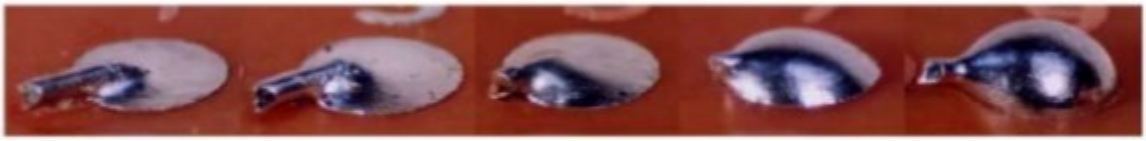
No good if too much or too little.

Lack of solder

Solder joint is weak, and leads to crack.

7.12 Solder Quantity & Surface Condition-1

Sn60



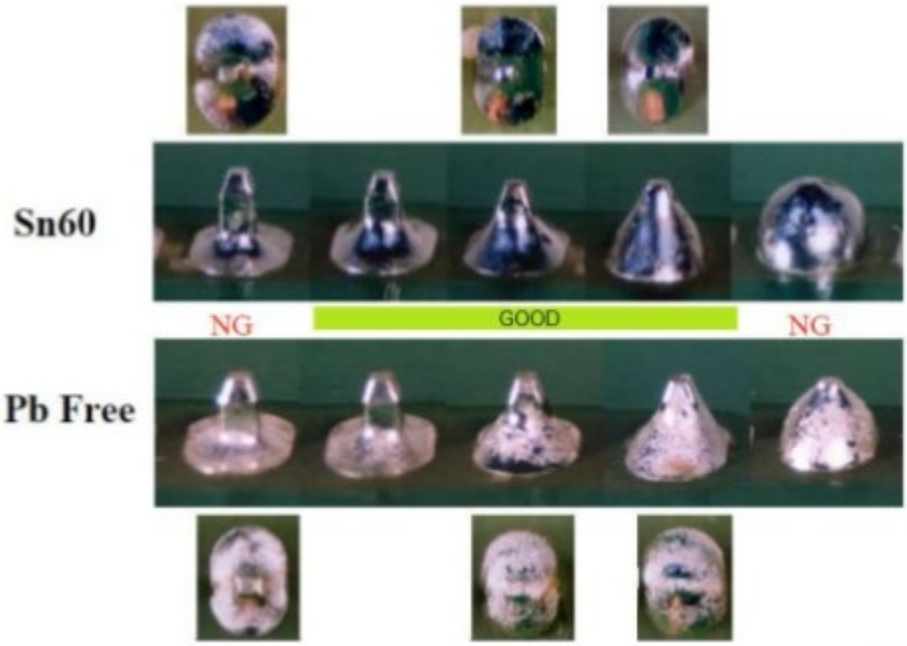
Pb Free

GOOD

Small amount

Large amount

7.12 Solder Quantity & Surface Condition-2



7.13 Key points for heating

What is the appropriate temperature for soldering???

Joint area temperature = The M.P. of Solder Alloy + 40~50DegreeC

For Sn60% solder

Joint area temperature = 190DegreeC+40~50DegreeC
= 230~240DegreeC

However the iron will be set much hotter at 350-450DegreeC

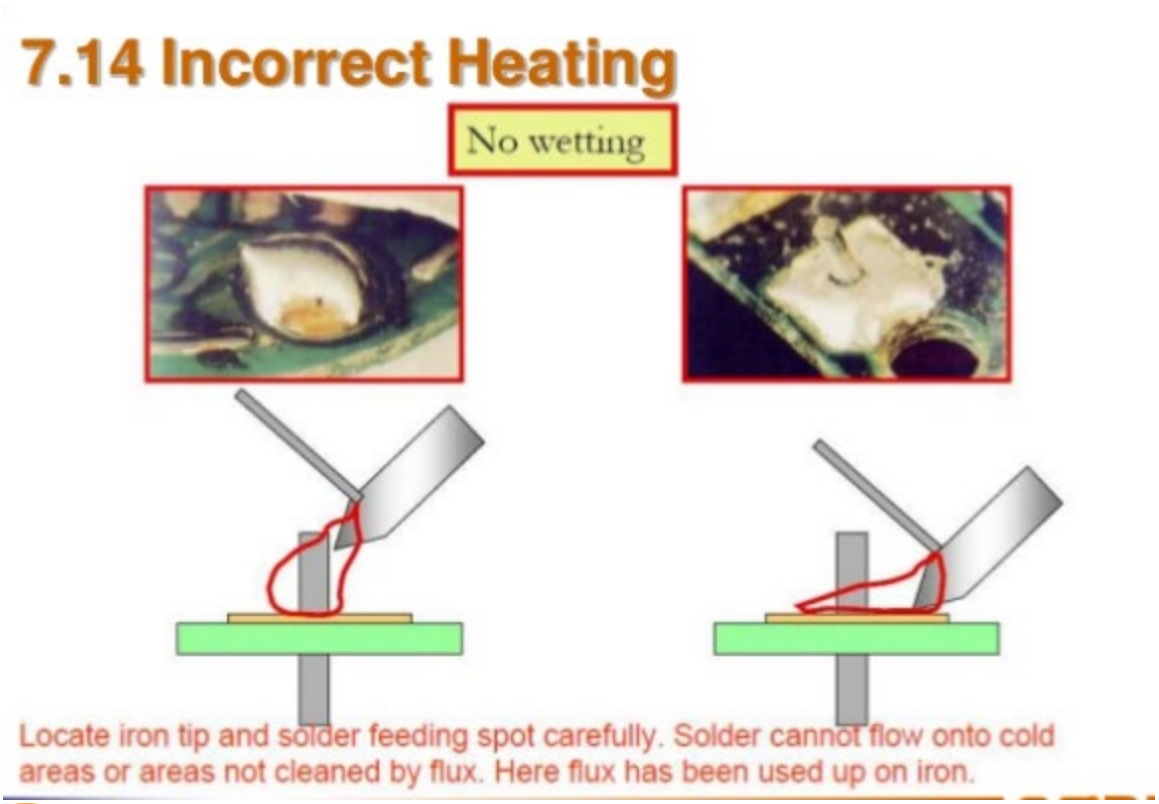
Note: The hotter the iron faster the joint can be made providing the heat transfer from it is good.

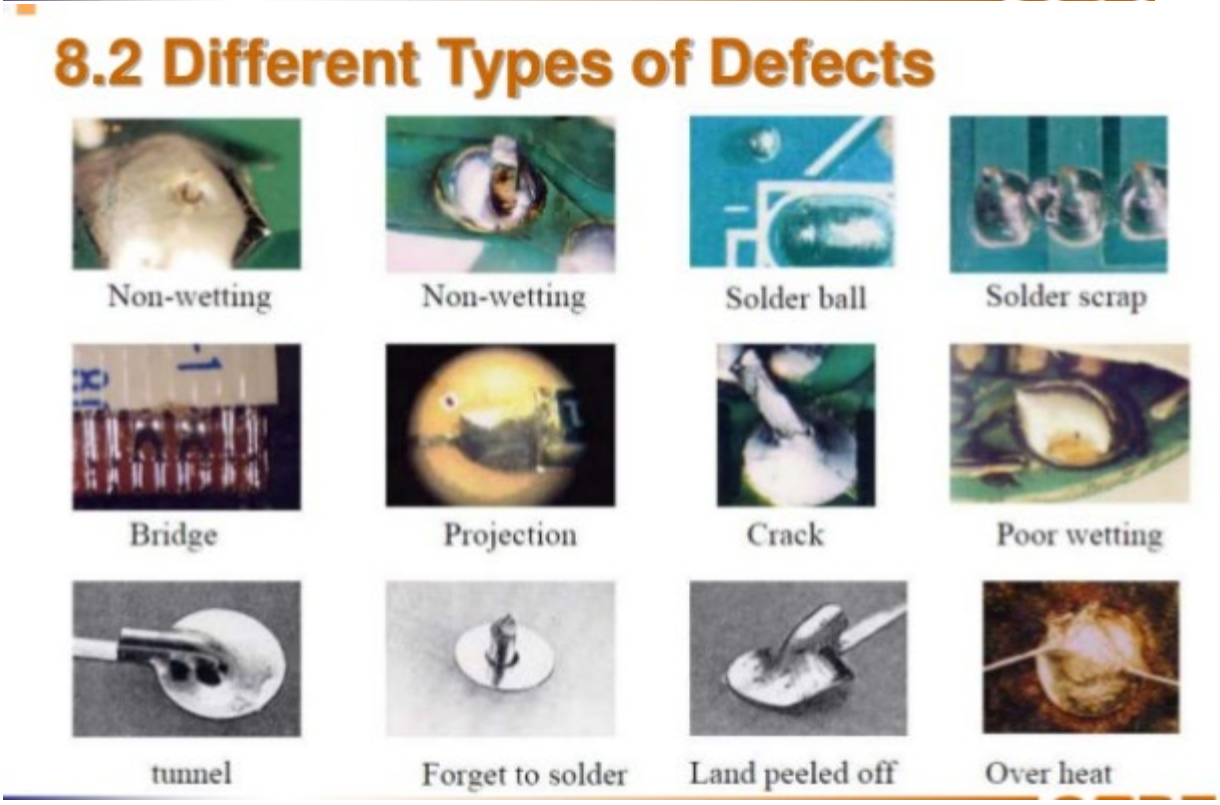
Must try to heat up both/all parts to be soldered **at the same time**

If it is difficult to do this then evaluate special solder iron tips

Heating up more than needed, will cause **overheating defects**

Note: Using a very hot iron will increase the risk of soldering defects and component damage. Soldering is a balance of time and temperature.





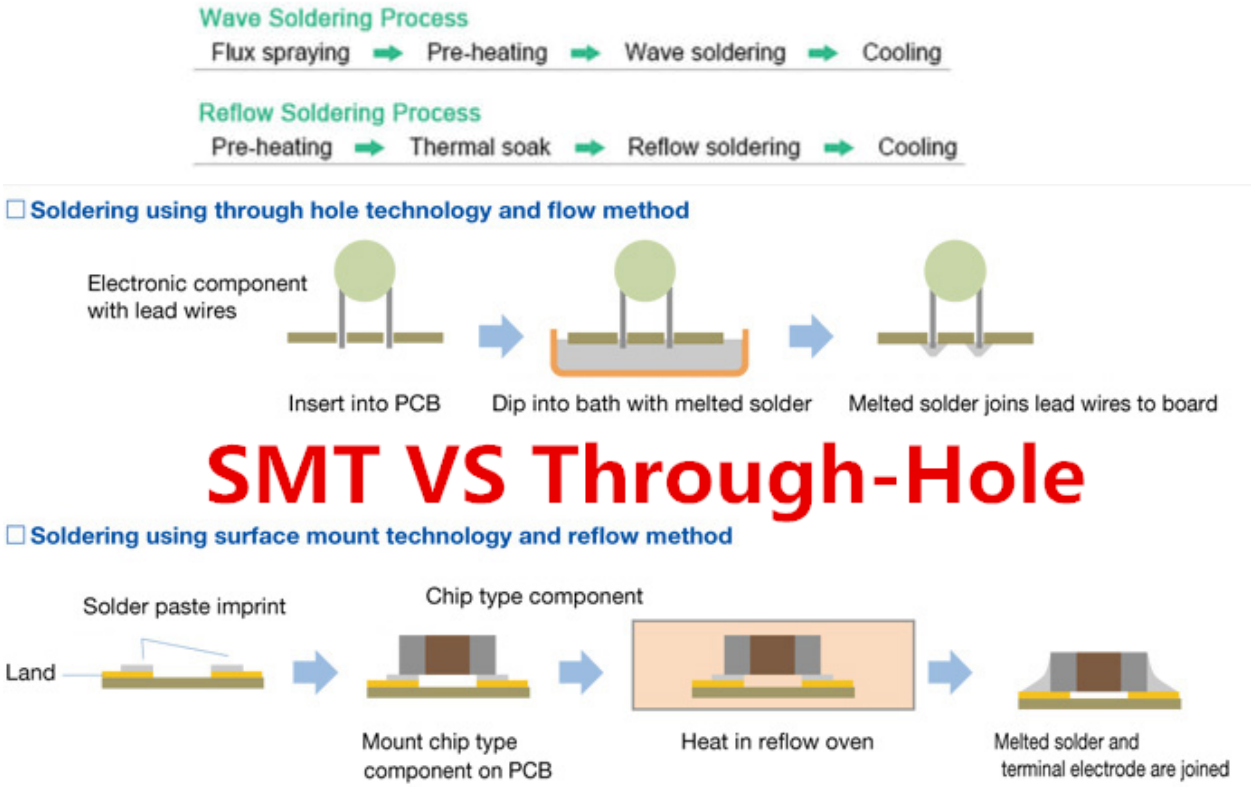
5- Soldering Techniques:
Tip to tip

Drag soldering

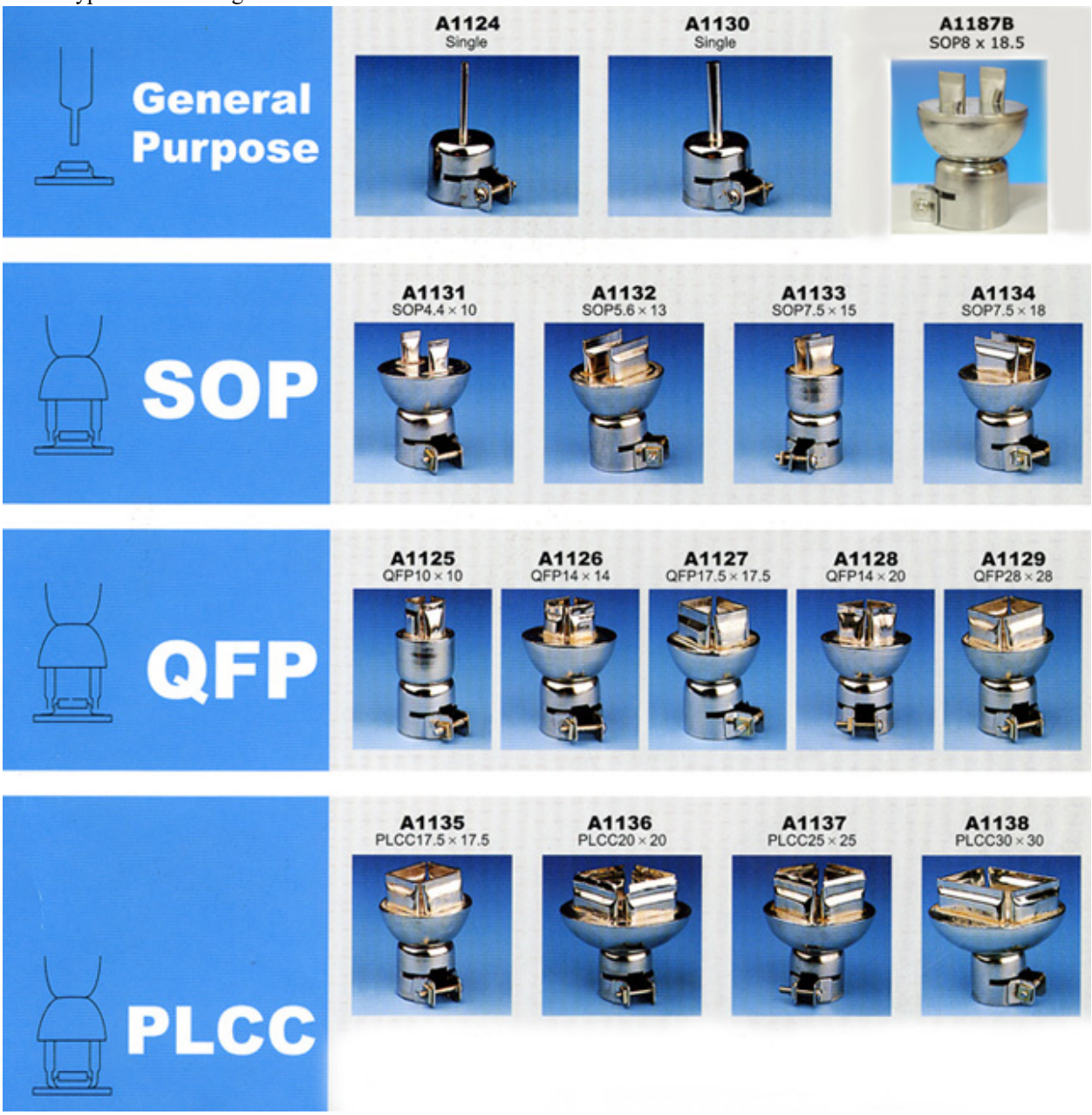
Heat from bottom

b-machine:

0- Wave soldering
1- Furnace soldering



6- Important notes:
nozzle types for soldering station:



Adjust the Air Flow and Temperature control Knobs:
Note: always check the used soldering station instruction manual.
Example: after adjusting the knobs wait for the temperature to stabilize for a short period of time for single nozzle use set temperature to around 300-degree c to 400-degree c (never set the temp. Control knob to higher than 6) and for air flow control set it to around 1 to 3 in other nozzles set it from 4 to 6.

How to Calibrate the tip of soldering iron :
some times we need to recalibrate the tip of soldering station after changing tip or heating element