Almit Technology Ltd

- HAND SOLDERING TRAINING COURSE

Almit Technology Ltd

- Aim
  - Review the whole soldering process to improve soldering quality.
  - Aim for high first time pass rates.
- How to approach soldering
  - Regardless of what product an electronic assembler makes, we can say they really only make solder joints. It's the process that brings everything electrical together.
  - Every joint should be made with care. If not then you may be able to 'weed' out the poorest during inspection/test but some will pass and they will be the weakest bit of the product and will fail in service, especially in automotive products where temperature & vibration can be considerable
  - In service failures are expensive to repair and always have other negative effects on the business.
- All customers know the solder joint is potentially the weakest part of the product.

Contents

1. What is soldering?
2. Cored Solder Wire
3. Soldering Irons
4. Soldering Workstation
5. Soldering Process
6. Inspection +Handling
7. Practical Training

1-1. What is soldering?

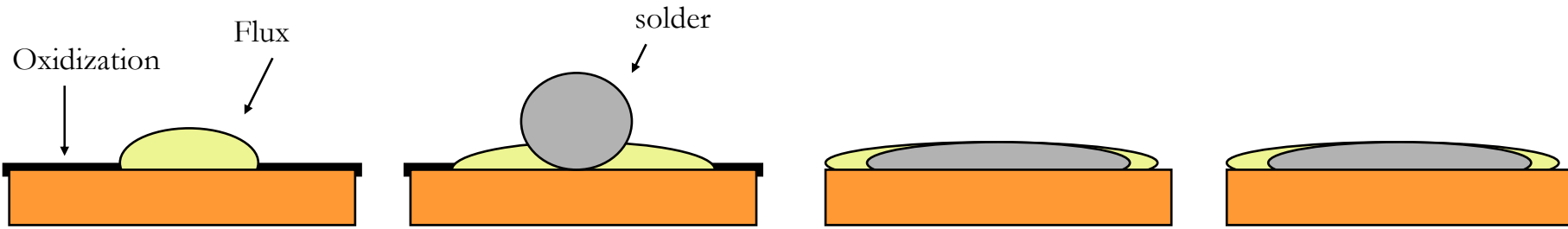
- Formation of a “metal to metal” joint using solder.
- The joint is made by alloy formation of base metal and solder.
- In soldering, there are three key elements :

  Heat , Solder , Flux , they are all important.

  Flux cored solder wire is used for hand soldering.

1-2. Flux Function

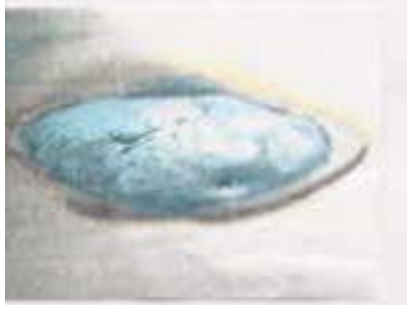
What does it do?

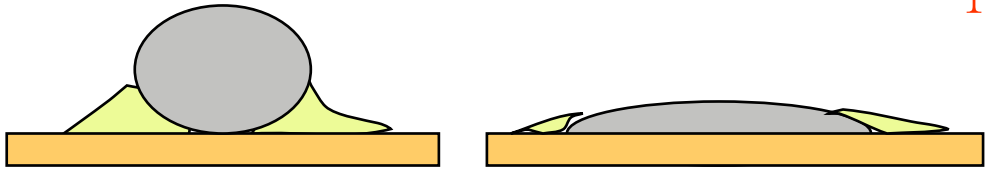


Remove oxide	Prevent from re-oxidation	Reduce surface tension	Solder finish
Remove metal oxide to support wettability of solder.	Coat metal surface to prevent from re-oxidation.	Reduce surface tension of solder to allow it to spread onto pad/lead.	Make smooth surface finish of solder and prevent solder bridges.

During soldering a chemical reaction takes place. The flux removes all the surface tarnish leaving clean metal underneath.

1-3. Solder Wetting





Not wetted

Not soldered

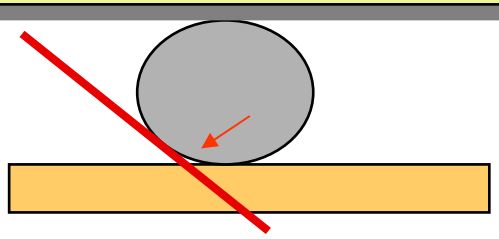
(dry joint)

Wetted

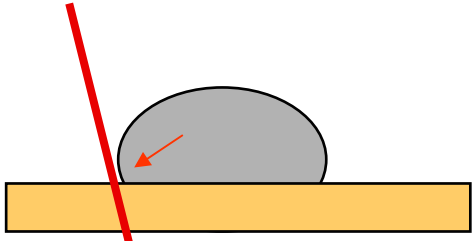
soldered

Check the wetting angle

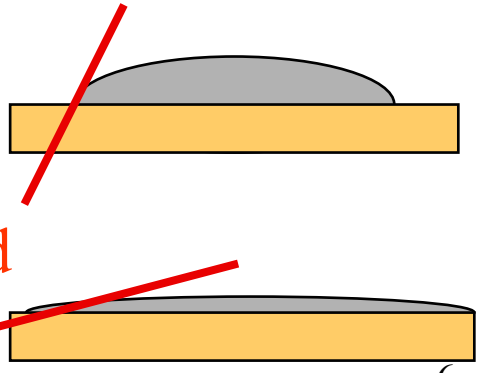
No good



No good



Good

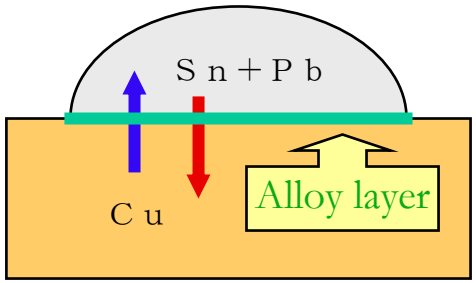


1-4. Melting and Diffusion

- Alloy is formed by melting and diffusion of metals
- Tin and copper alloy together

Alloy layer in good condition

Diffusion

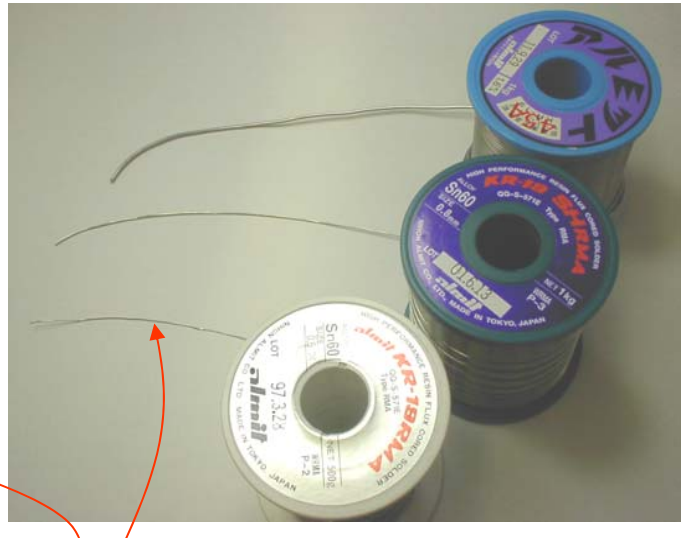


Melting

Thin and even thickness of alloy layer

It takes a certain amount of time to create the perfect solder joint. Too slow a process can damage pcb/components and too fast will not create a 'sound' joint.

2-1.Cored Solder Wire



Solder type
Solder name

Diameter
0.5 ϕ ~1.6 ϕ

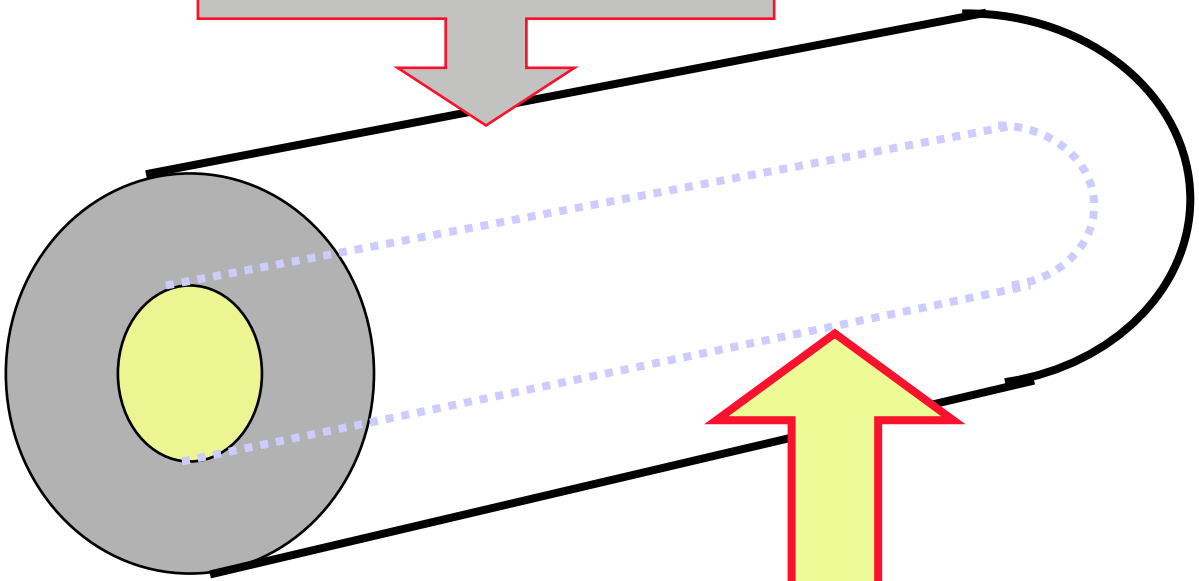
Alloy Composition
Sn60,Sn50,Sn45
PbFree Alloy(Sn-Ag-Cu)

Always confirm before use. (Use of different solders and diameters depends on the products being soldered)

2-2. Construction of Cored Solder

Attention
Sn-Pb series
PbFree series

Solder metal

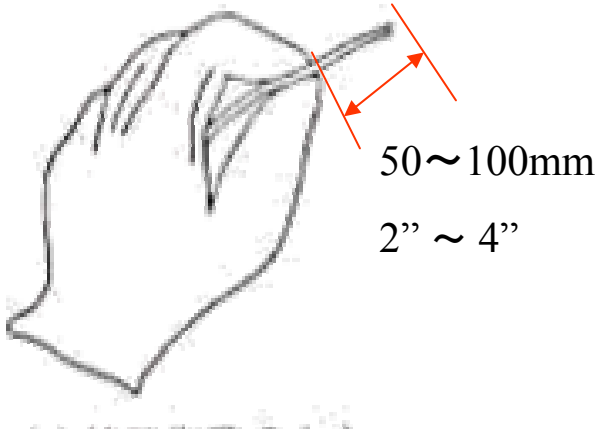


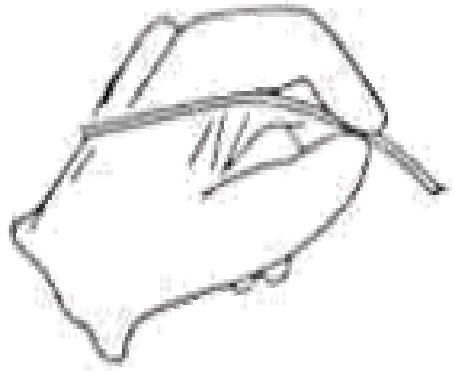
FLUX = Mix of resins, activators, wetting agents & corrosion inhibitors

2-3. Solder Wire Variables

- Solder Alloy
  - Most use Sn60/Pb40 or Sn62/Pb36/Ag2 or LEAD FREE
- Flux Type.
  - No-Clean RMA (ALMIT KR19 SH)
    - Flux residues are safe to leave on pcb. They will not cause corrosion or electrical breakdown of cct 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 job.
- Reel Size
  - Generally 500g

2-4. Handling method for cored solder wire





Easy feeding for continuous process.

Not suitable for continuous process.

3-1. Soldering Irons

Soldering station

Temperature setting differs depending on application.

Necessary to check the temperature before starting the process.

Iron holder

Soldering Iron

Sponge for cleaning soldering iron tip.

The soldering iron is critical to good soldering. It must provide all the heat to heat up the joint which in turn must heat up the solder wire/flux

3-2. Soldering Irons

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

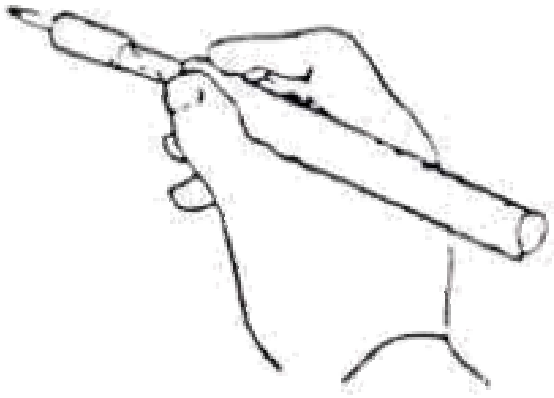
Iron tip shape is different for each process.
Choose correct iron tip for application.

Internal part of soldering iron

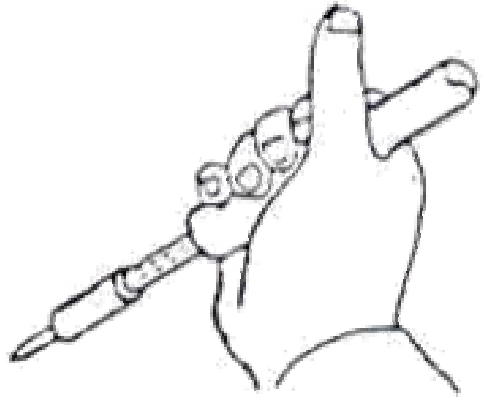
Ceramic heater

Weak to impact / shock.

3-3. How to hold Soldering Iron



Pen-holder type
For normal operation

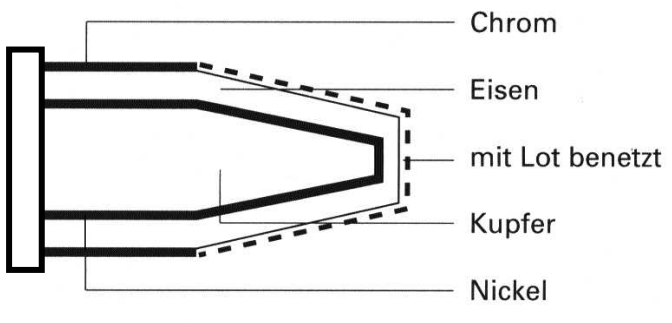


Grip type
For large component

3-4. How the tip is made

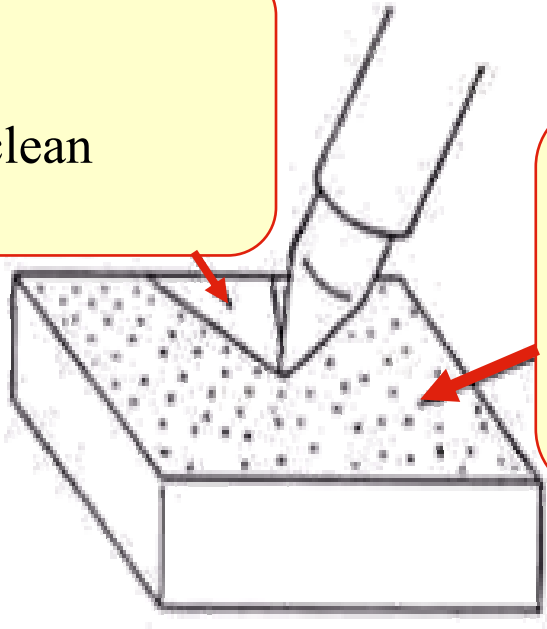
The most important part of the soldering iron is the TIP.
The main part of the tip is made of copper. To extend the lifetime of the tip, it is iron coated .
Before the iron is added the copper is nickel plated. The non wettable part of the tip is chrome plated. The chrome stops the solder flowing up the tip. The tip is pre-tinned with lead free solder.

Nickel coating: ca. 10 - 20µm
Iron coating: ca. 150 - 300µm
Chrome Coating:ca. 3 - 6µm



3-5. How to clean Soldering Iron

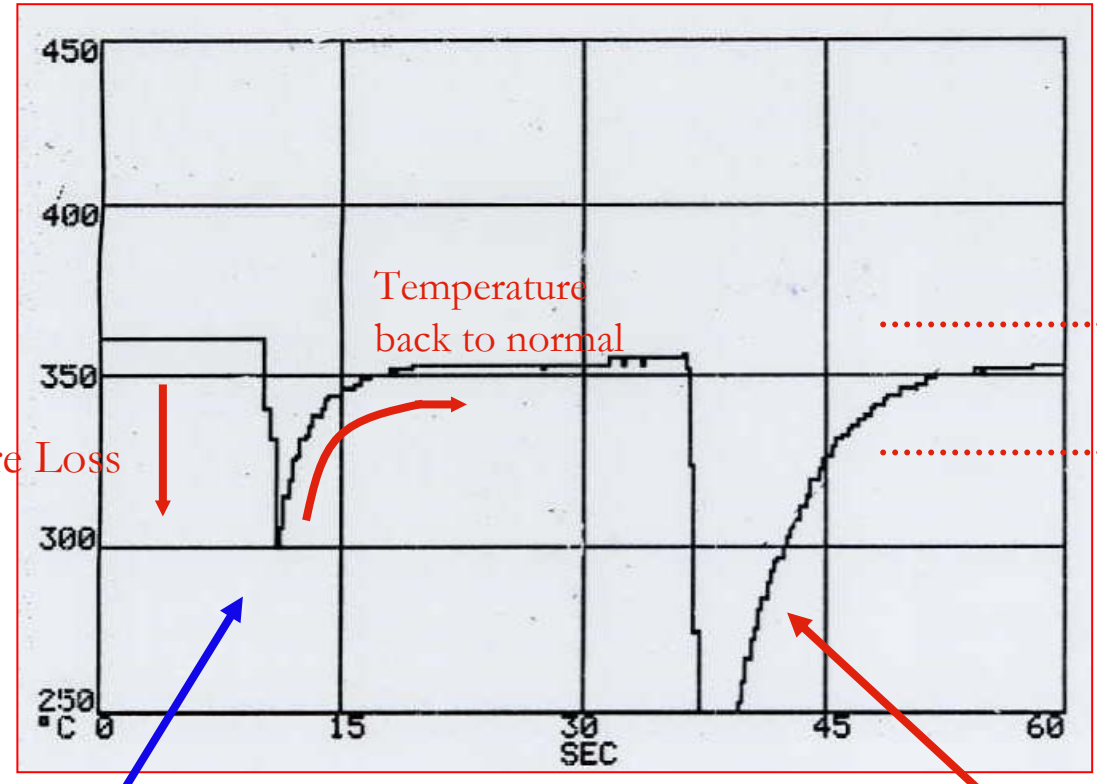
Cut sponge in V.
Use the cut part to clean



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.

3-6. Temperature when cleaning



Temperature Loss

(Ex)

Ideal range of operation

350℃±15℃

Good condition

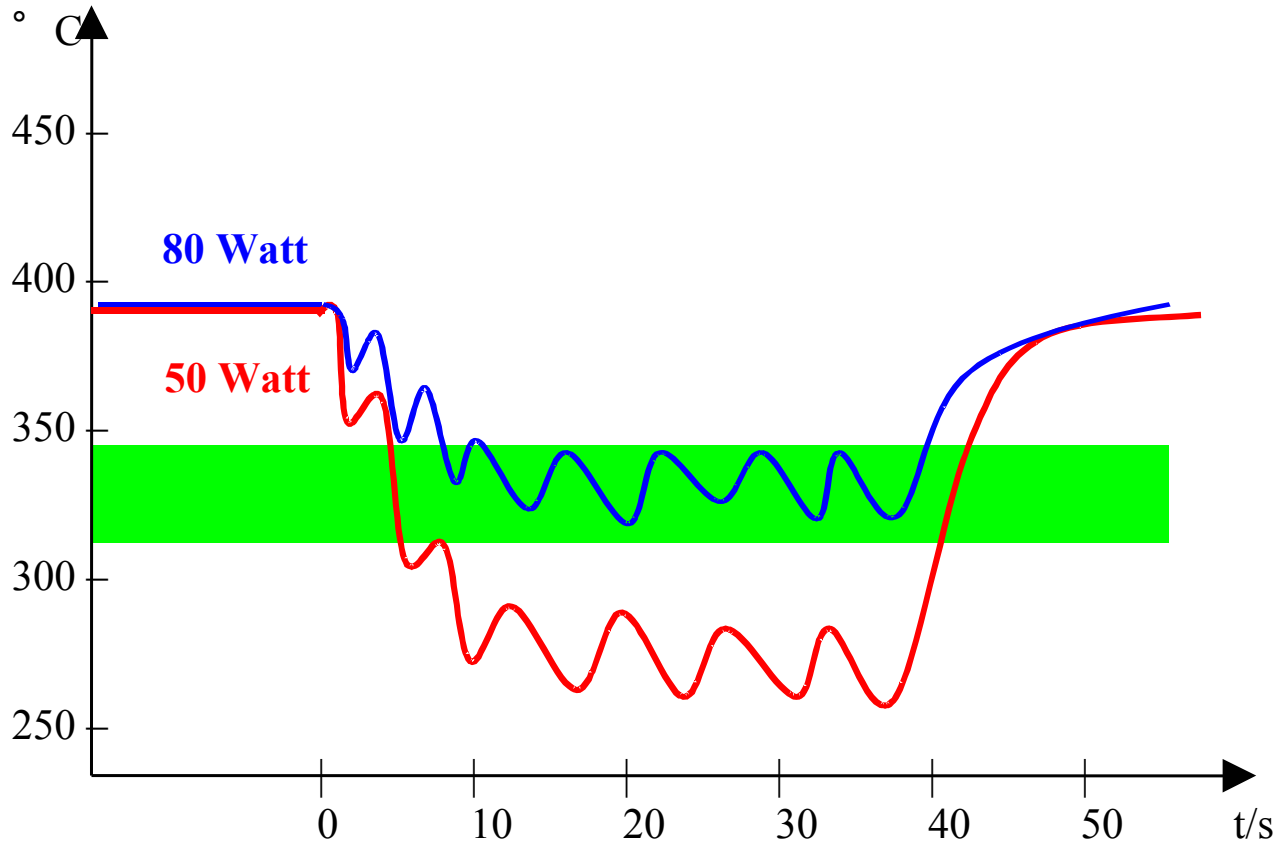
To start operation after temperature back to normal and consistent..

Too much water

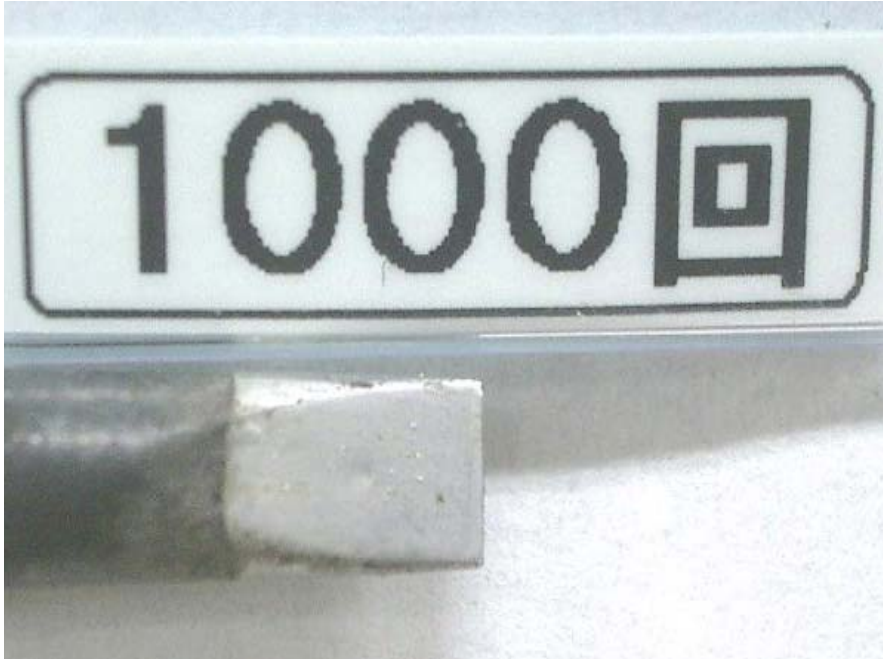
Need longer time if temperature reduce too much.

3-7. Temperature Stability

Each time a solder joint is made the heat in the soldering iron is depleted especially if joints are made ‘quickly’



3-8. Solder Iron Tip Condition



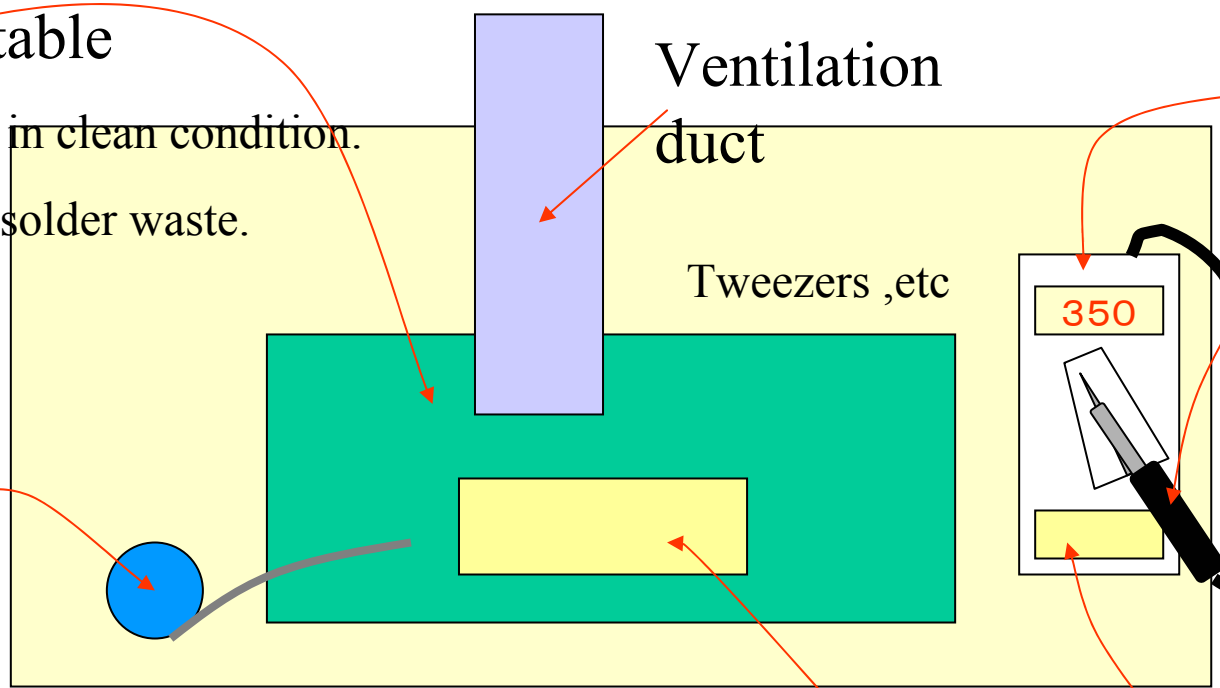
This tip has soldered 20000 joints. Still in perfect condition

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

3-9. Solder Iron Tip Condition 2

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.

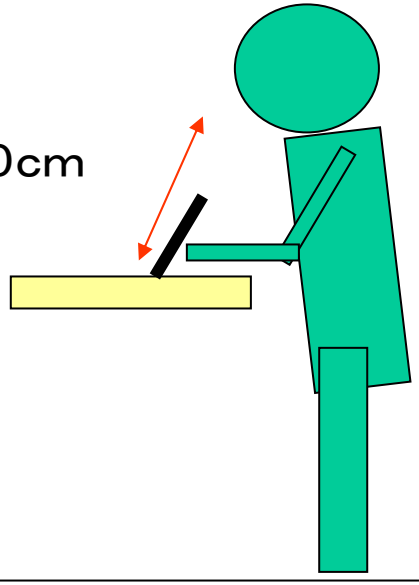
4-1. Soldering Workstation



4-2. Correct posture when soldering

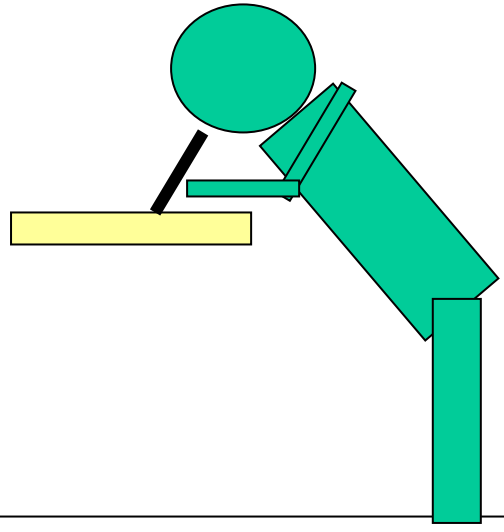
Correct

Above 20cm



Must have clear view of work. Feeding in wire and iron movement must be smooth and easy.

Bad



Not suitable. Poor position for ‘back pain’. Flux fumes could be inhaled.

4-3. Considerations to create best workstation

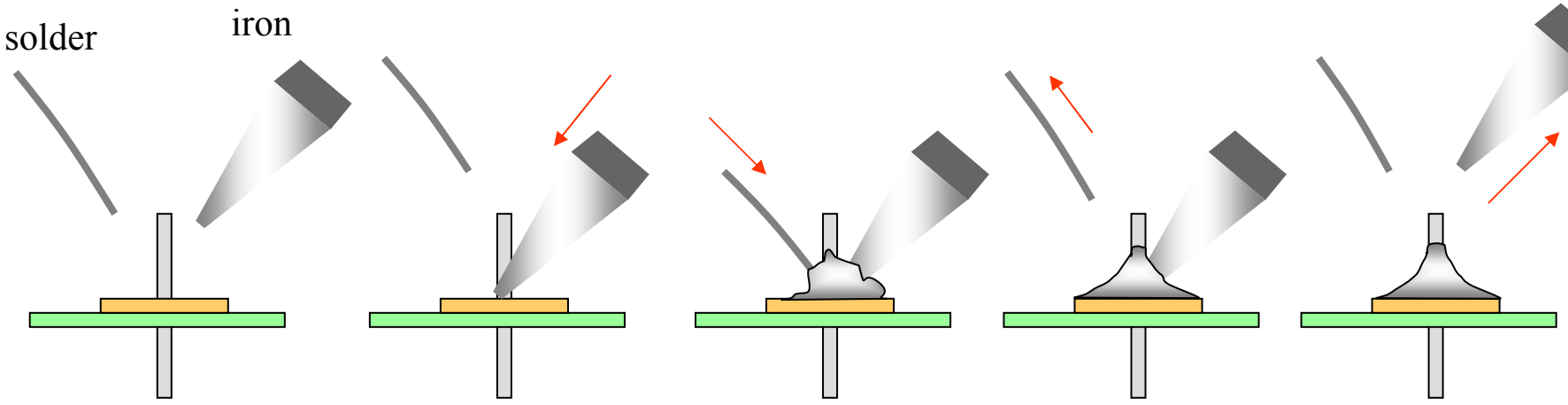
- ESD Bench
  - Must be ESD safe to eliminate static
  - Keep it clean/tidy
- Lighting
  - Keep it as natural as possible.
- Fume Extraction
  - Keep the filters clean
- Iron/wire Position
  - Must be positioned to allow smooth access to solder joint area.
- Work Jig
  - Must be free from flux residues etc

4-4. Summary so far..

- Check the solder type
- Check the solder iron
- Check the cleaning sponge
- Soldering posture

5-1. Soldering

5 step method



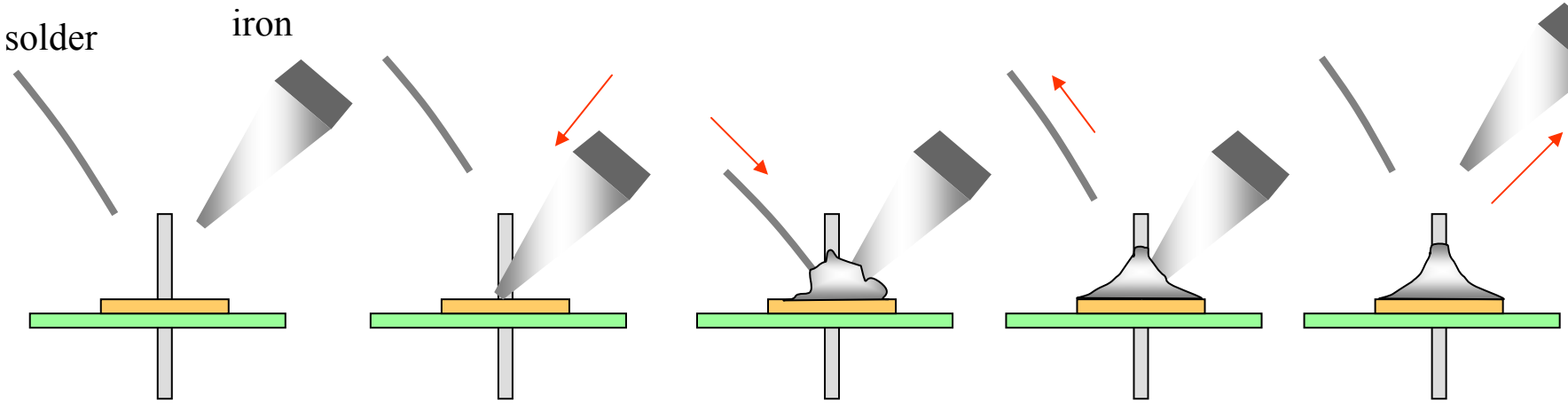
preparation	heat	Insert solder	Pull out solder	Pull out iron tip
	Use iron tip to heat the soldering part.	Melt properly		

Solder will not alloy if the parts and solder are not fully heated.

The soldering iron is not just to heat and melt the solder, but to heat the part being soldered.

5-2. Soldering

5 step method



preparation

Heat up to @ over 100°C.

May take @ 2 secs

Insert solder to hot joint area. Flux melts and covers joint. Flux helps melt solder and it flows over clean pad/lead. Solder area @ 230-240°C.

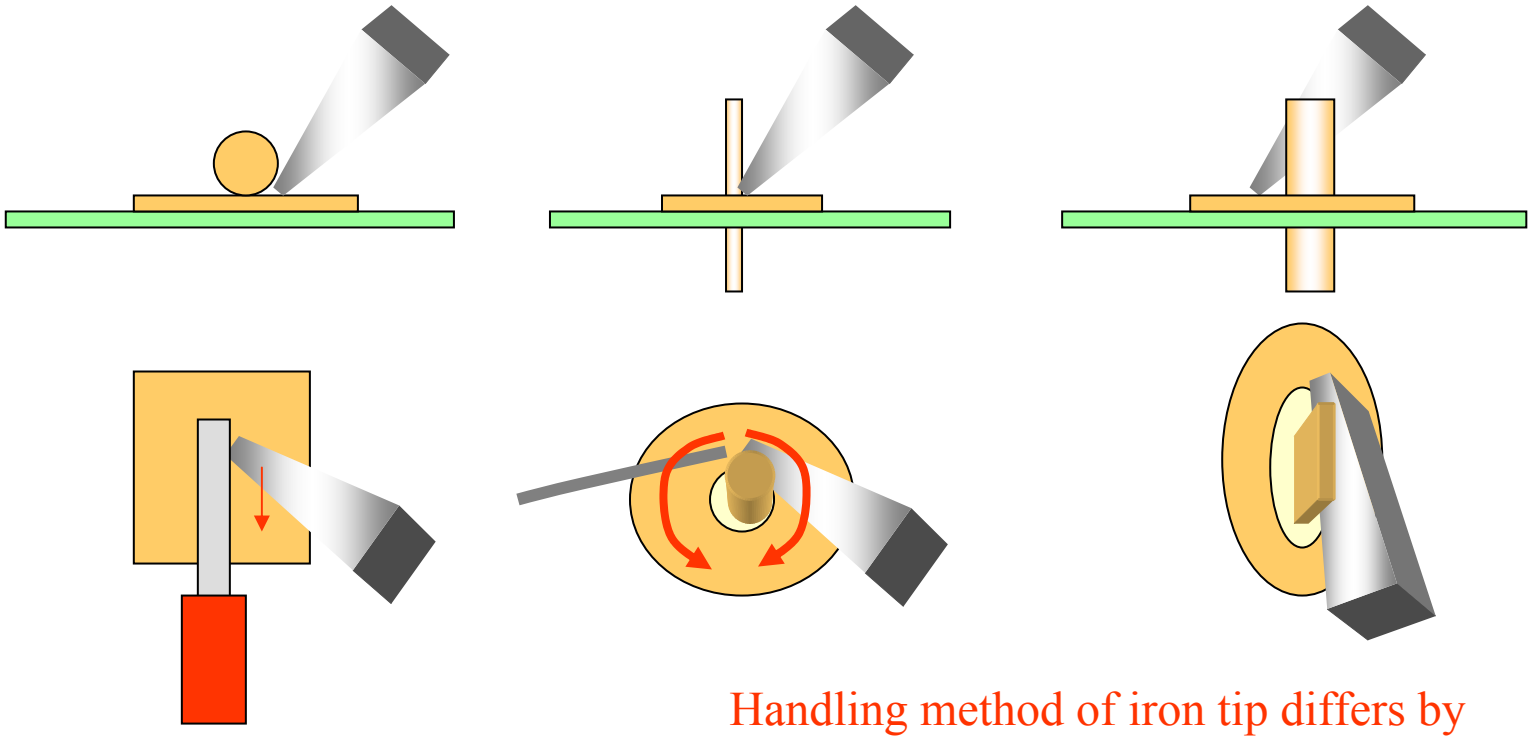
Pull out solder

Pull out iron tip

5-3. Heating Large Joint

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

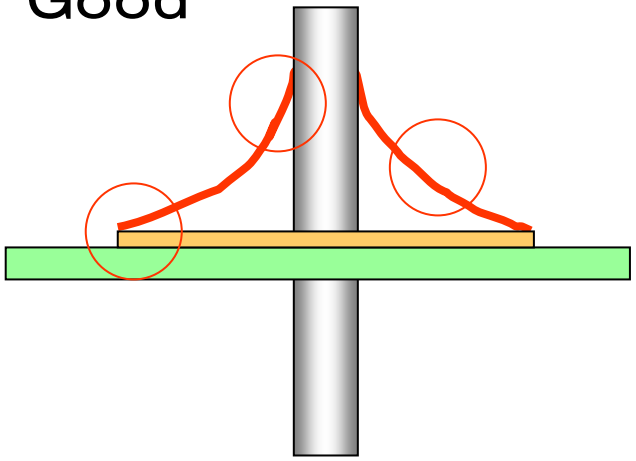
Solder large terminal/area by moving iron tip



Handling method of iron tip differs by shape of terminal.

5-4. Solder Wetting

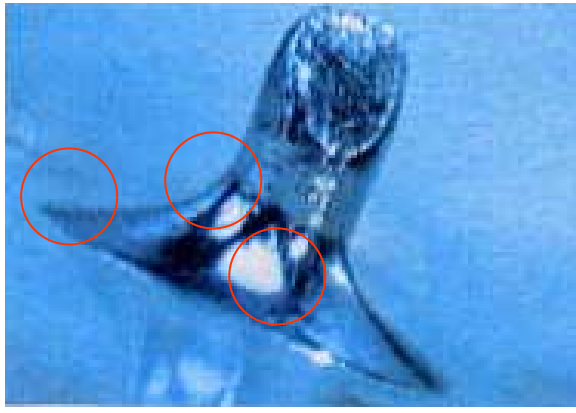
Good



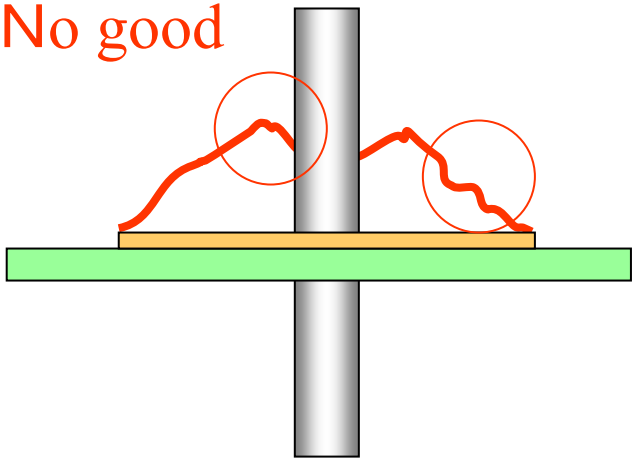
Solder wets to lead and land.

Smooth and shiny surface.

No holes, no spikes.



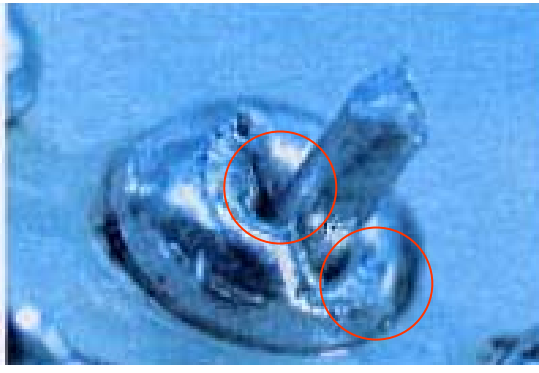
No good



Poor wetting to lead.

Rough surface.

Holes.

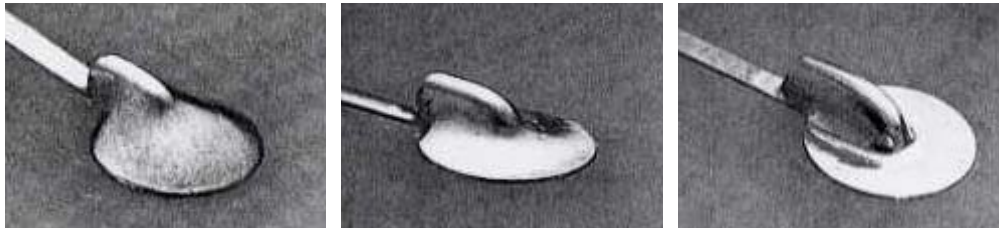


5-5. Solder Quantity

No good

Excess amount

Unable to confirm whether solder is wetted.



OK

Apply correct solder amount.

No good if too much or too little.

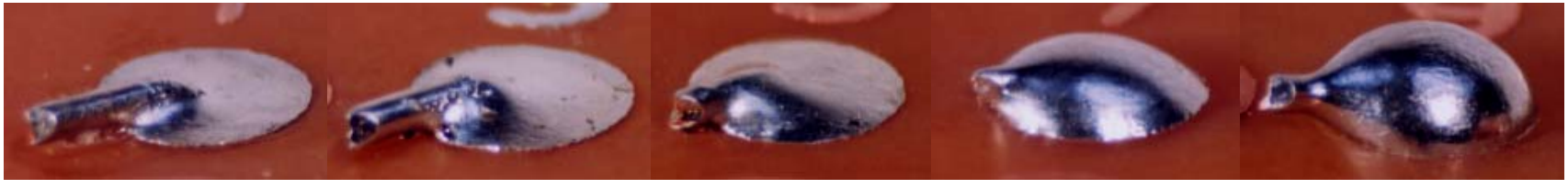
No good

Lack of solder

Solder joint is weak, and leads to crack.

5-6. Solder Quantity and Surface Condition 1

Sn60

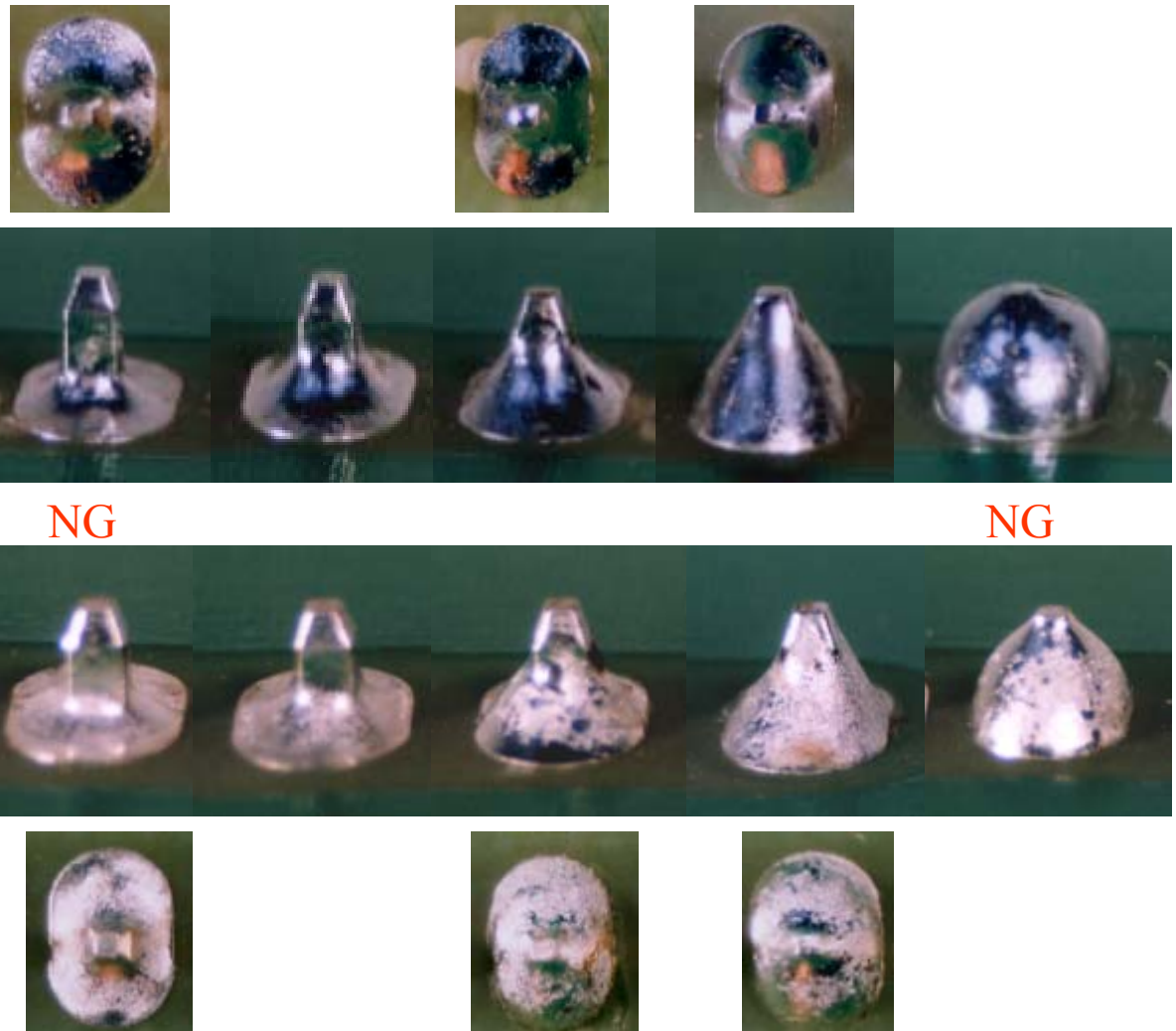


Pb Free

Small amount

Large amount

5-7. Solder Quantity and Surface Condition 2



5-8. Key Points for Heating

What is the appropriate temperature for soldering?

Joint area temperature = The M.P of solder alloy+40~50 Degree C

Sn60% Solder (190Degree C) +40~50 Degree C =230~240 Degree C

However the iron will be set much hotter @350-450 ℃

- **The hotter the iron the 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**.

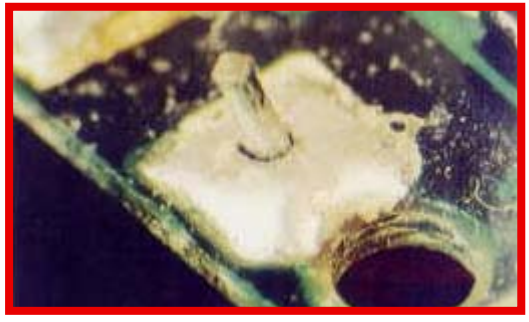
If it is difficult to do this then evaluate special solder iron tips.

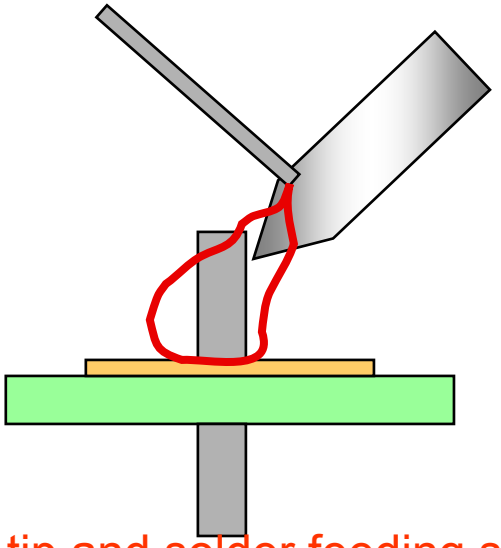
Heating up more than needed, will cause **overheating defects**.

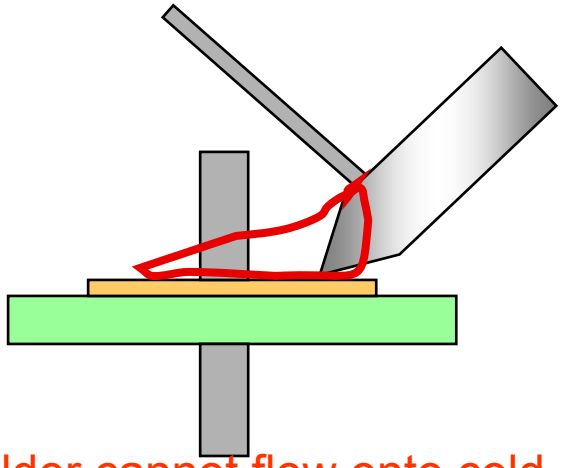
- Using a very hot iron will increase the risk of soldering defects an component damage. Soldering is a balance of time/temperature.

5-9. Incorrect Heating

No wetting



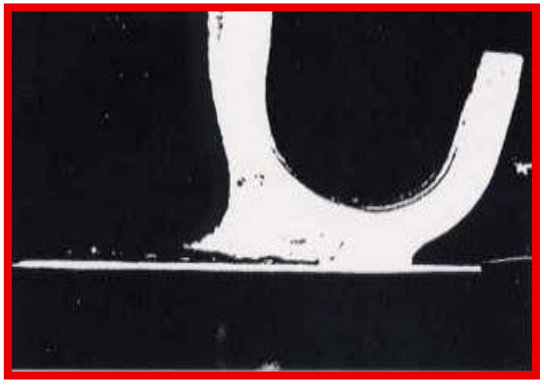




Locate iron tip and solder feeding spot carefully. Solder cannot flow onto cold areas or areas not cleaned by flux. Here flux has been used up on iron.

5-10. Movement before solder solidifies

- Crack occurs when soldering point moves.



Crack due to vibration before solidification.

Crack due to movement before solidification.

Do not move parts until solder has solidified. Liquid solder has no strength. Large parts may take a few seconds to cool.

5-11. How to release the iron tip

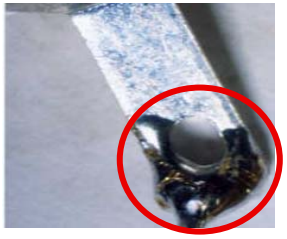
- Common defects caused by iron tip releasing

Projection/solder spike

Too slow release speed of iron tip

Solderball

Wrist twisting



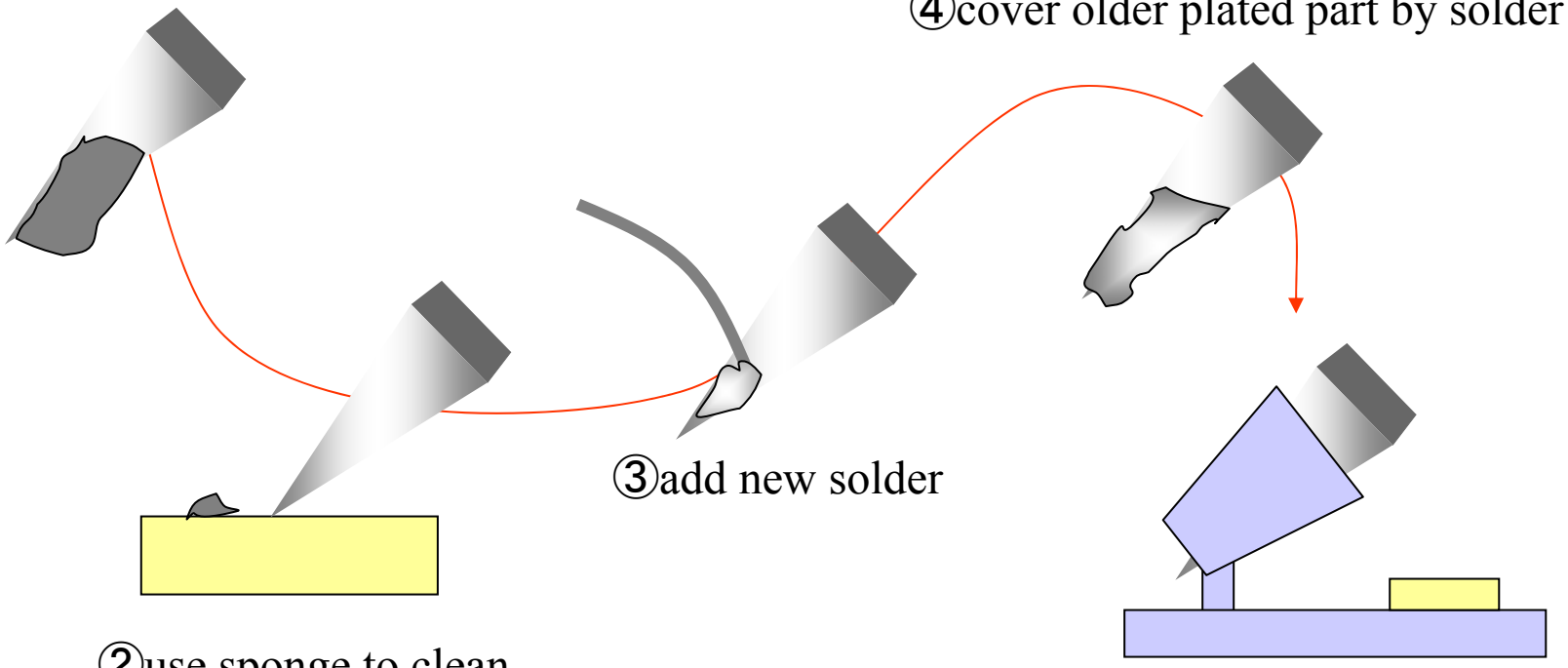
Adhesion of scrap/flux residue

Bad direction when releasing iron tip

5-12. Process Completion

Caring for the soldering iron tip

①some scrap on iron tip.



②use sponge to clean

③add new solder

④cover older plated part by solder

⑤put soldering iron back in iron holder .

5-13. Soldering Summary

- No success in soldering with poor heating,
- Heat all parts at once.
- Apply correct amount of solder
- Don’t move part until solder has solidified.
- Pay attention when releasing iron.
- Visual check to confirm soldering quality.

6-1. Inspection + Handling

Has soldering process been done well?
Take responsibility and do your own inspection.
Be able to make the correct judgment.

Inspection point

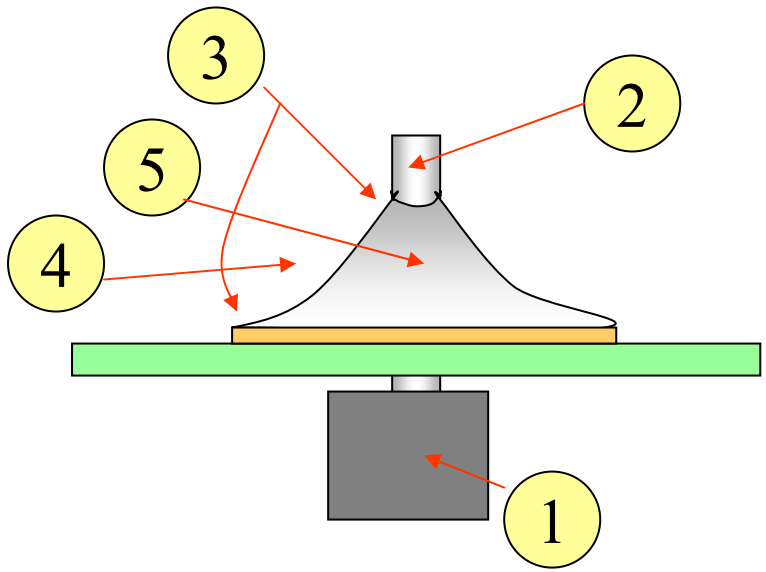
(1) Correct position (part, lead etc)

(2) Correct shape (part,lead etc)

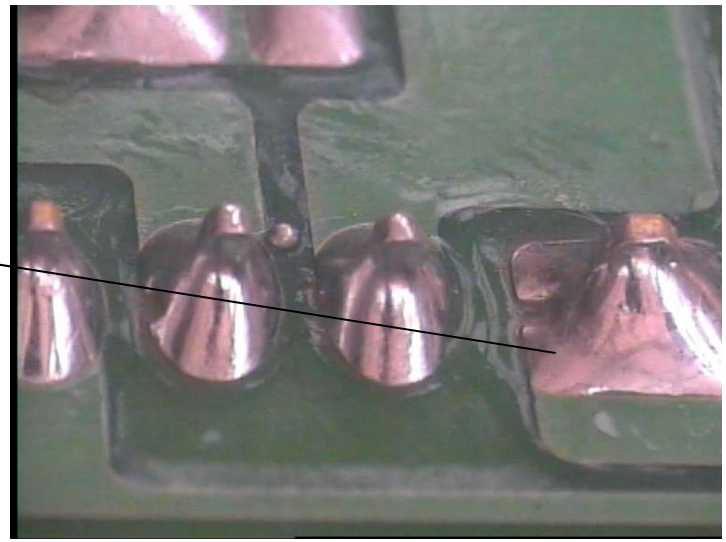
(3) Wetting (lead, land)

(4) Solder amount (qty)

(5) Solder surface (smooth,shiny,no-hole,etc)

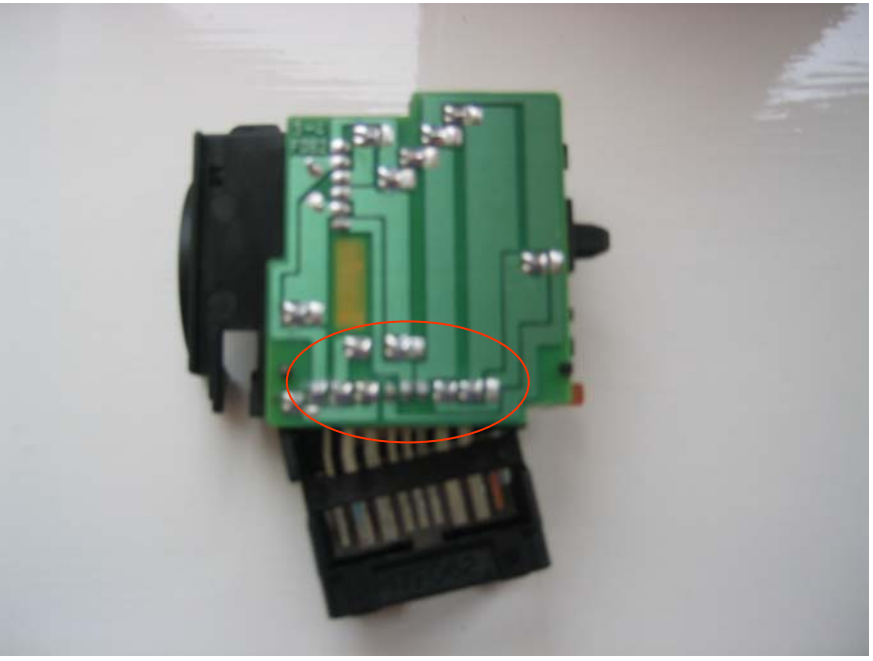


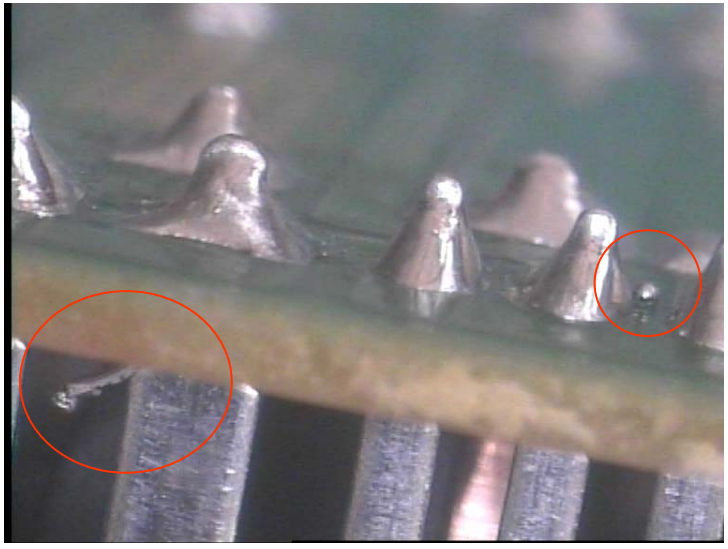
6-2. TRB Product

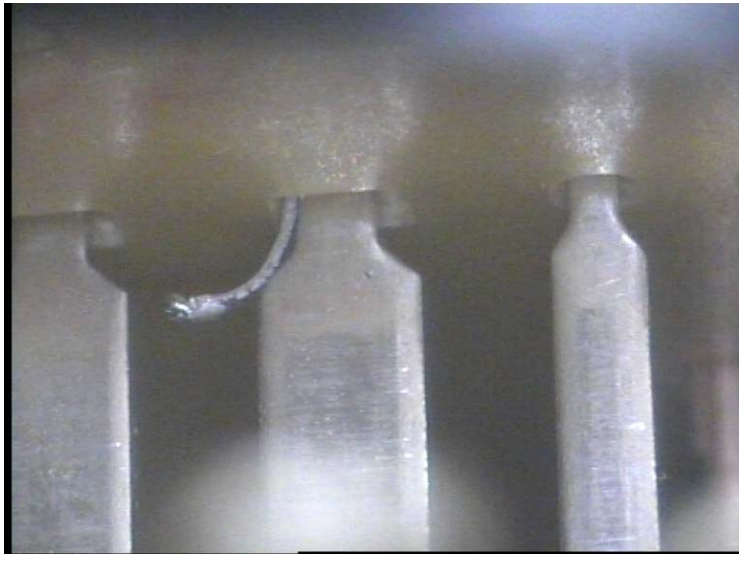


Inspection of this part; Solder has wet well to pcb pad and to pin. This shows the flux has cleaned the pad/lead well. The wetting angle is good. The solder surface is smooth/shiny. There is no charred flux or noticeable flux residue. The solderability of pcb and component seems good.

6-3. TRB Solder Defect

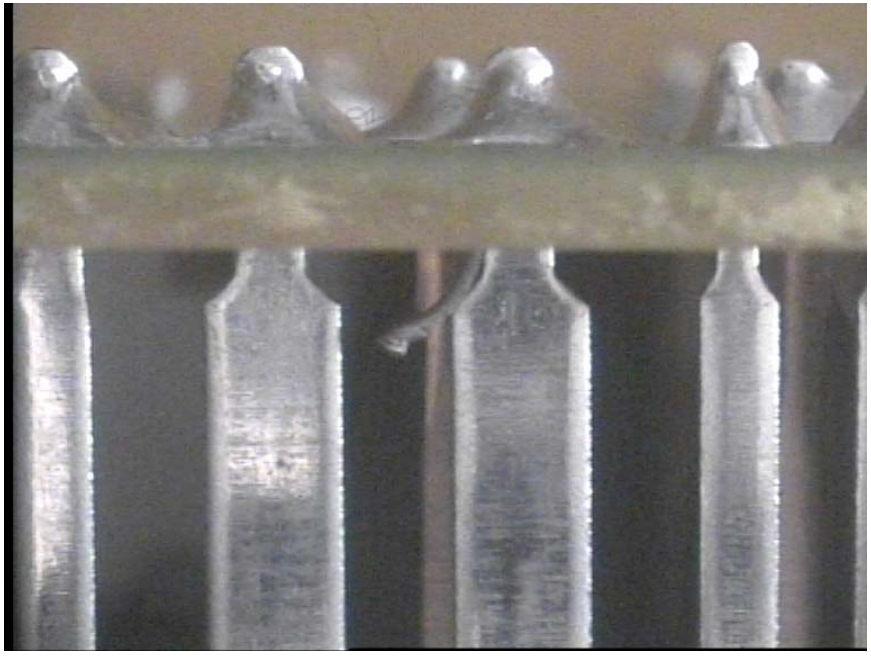






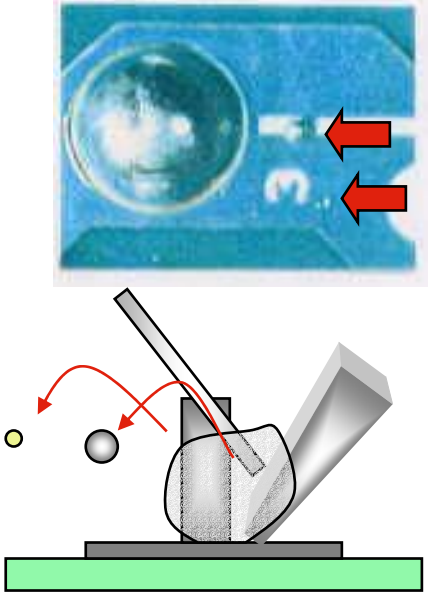
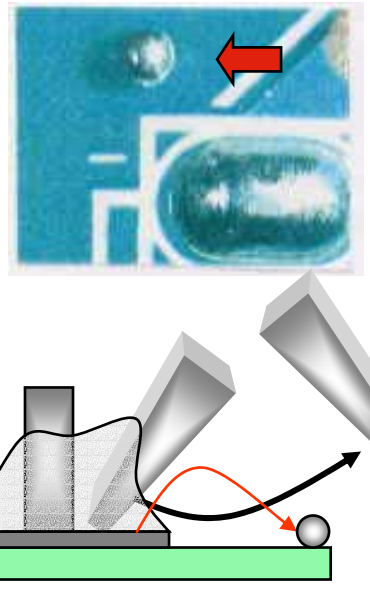
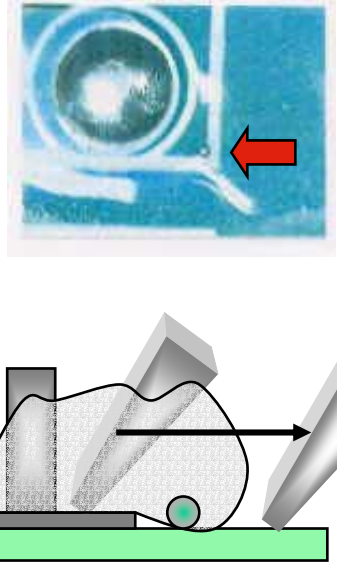
Pin 5 from right has solder slither on.
Solder ball on pcb resist.

6-4. TRB Solder Defect



Solder process starts on right. First 2 pins are thick and soldering iron is at its Peak temp. As iron is moved onto pins 3,4,5, which are thinner pins, the iron temperature falls but is still hot enough to heat joint and solder. As it reaches pin 6, which is a thicker pin, the iron is quite a bit cooler than its' ideal temp. and does not heat up the joint area before the solder is fed onto joint. The 'warmed' solder wire is squeezed through pcb hole and onto pin shoulder.

6-5.Solder Ball

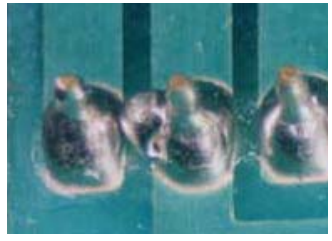
Solder ball and flux spattering	Large solder ball	Solder ball in flux
		
Apply solder material forcibly while the base metal is heated insufficiency.	Speed of withdrawing solder-iron too fast.. Withdraw solder-iron with smooth sweeping movement.	When iron-tip “slip” on to PCB

6-6. Other Defects that require attention

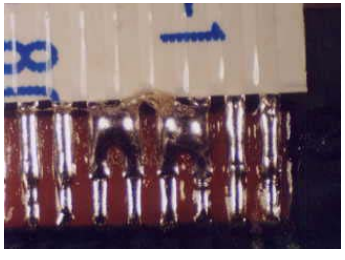
Non-wetting

Non-wetting

Solder ball



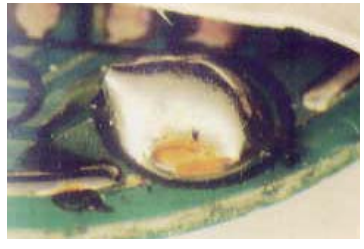
Solder scrap



Bridge

Projection

Crack



Poor wetting

tunnel

Forget to solder

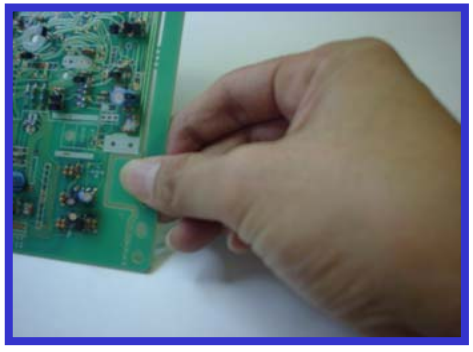
Land peeled off

Over heat

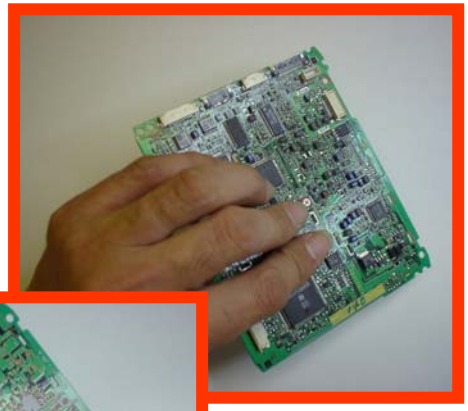
6-7. Reminder ①

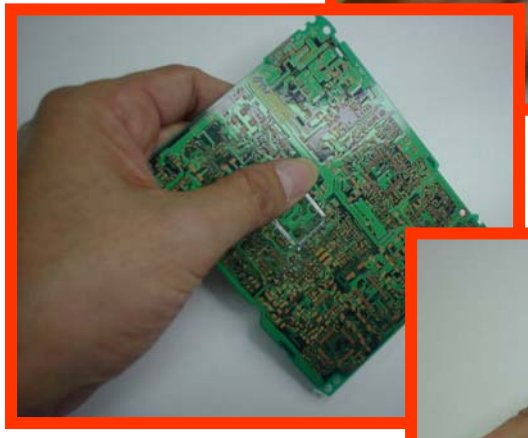
Handling PWB

Good



No good

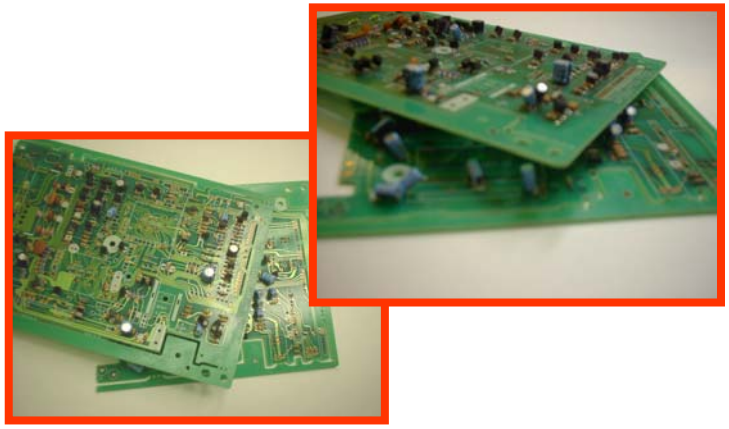




Do not touch the solder pad side of the PCB before it is soldered.

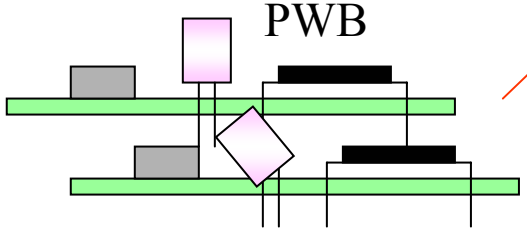
6-8. Reminder ②

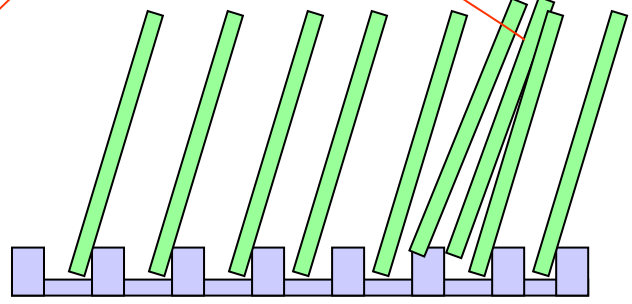
Handling PWB



The crack occurs at the solder interface even with small impacts.

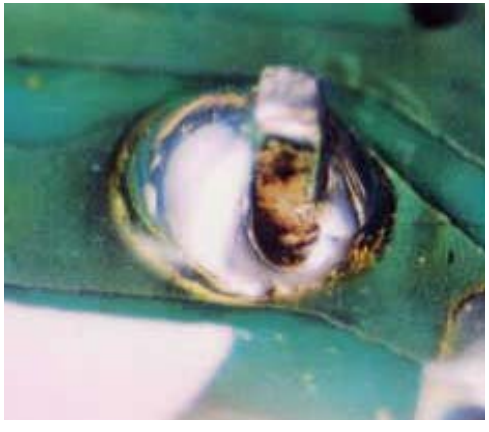
Do not ; pile up PWB





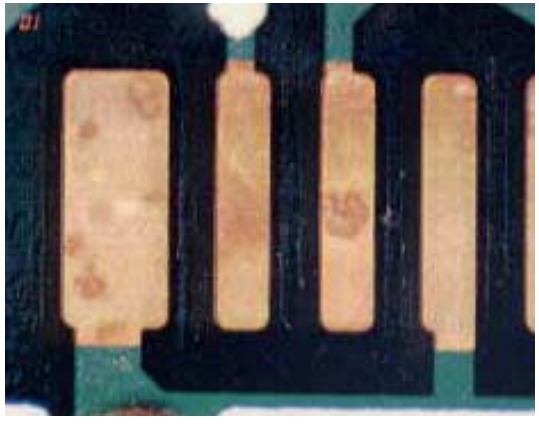
6-9. Cleanliness

Parts to be soldered must not be contaminated.



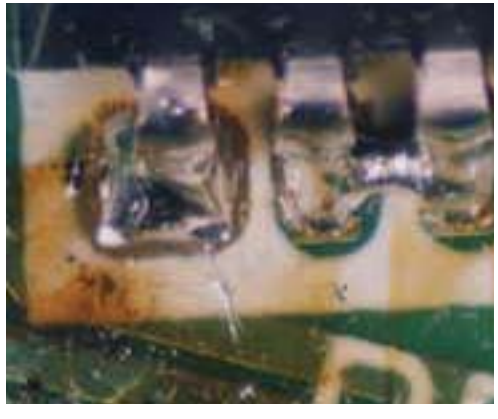
Contaminated lead

Didn't wet on the pollution.



Dirty substrate

The pad on substrate was polluted by touching it with bare hands.



Poor cleaning of iron tip

Working with poorly cleaned iron tip causes soldering defects.

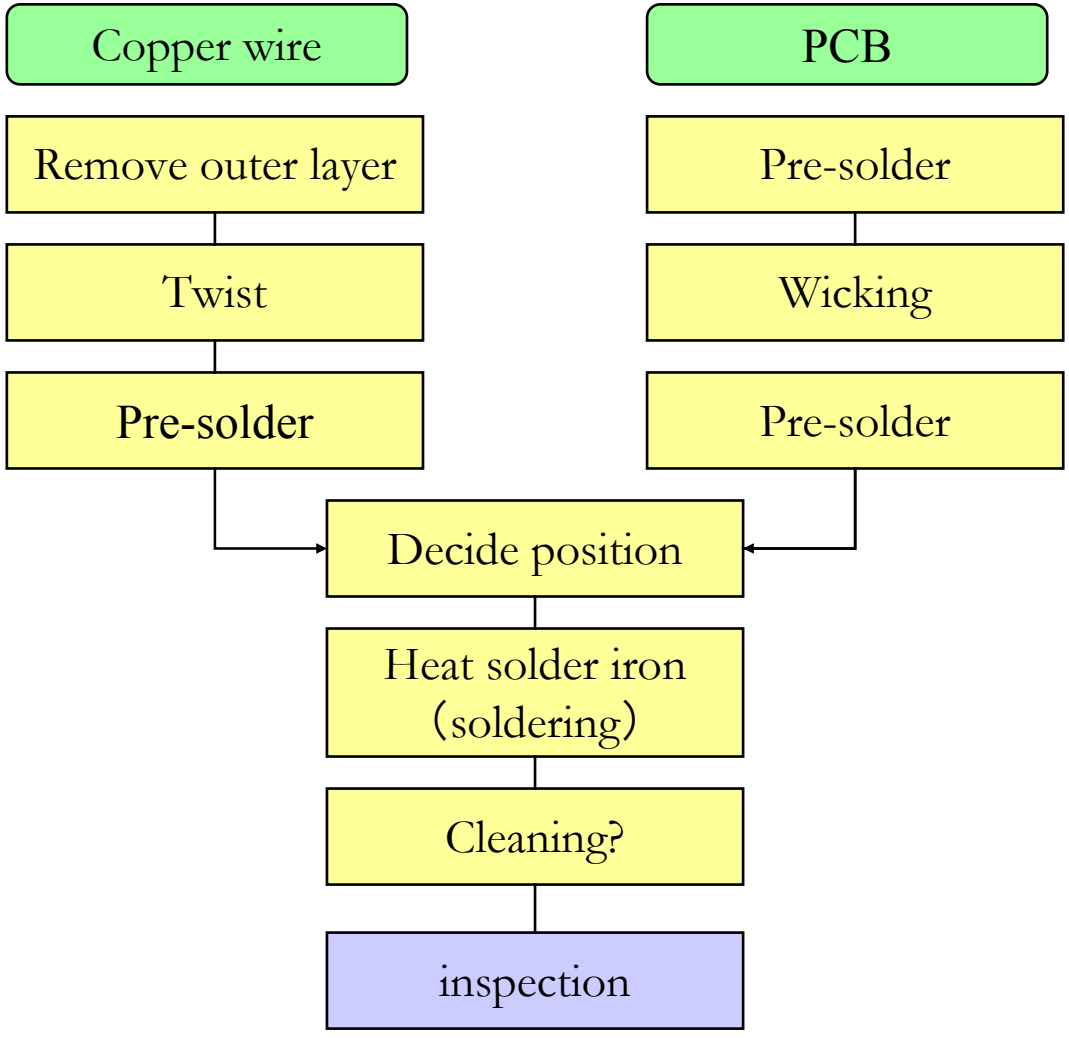
7. Practical training

Training 1

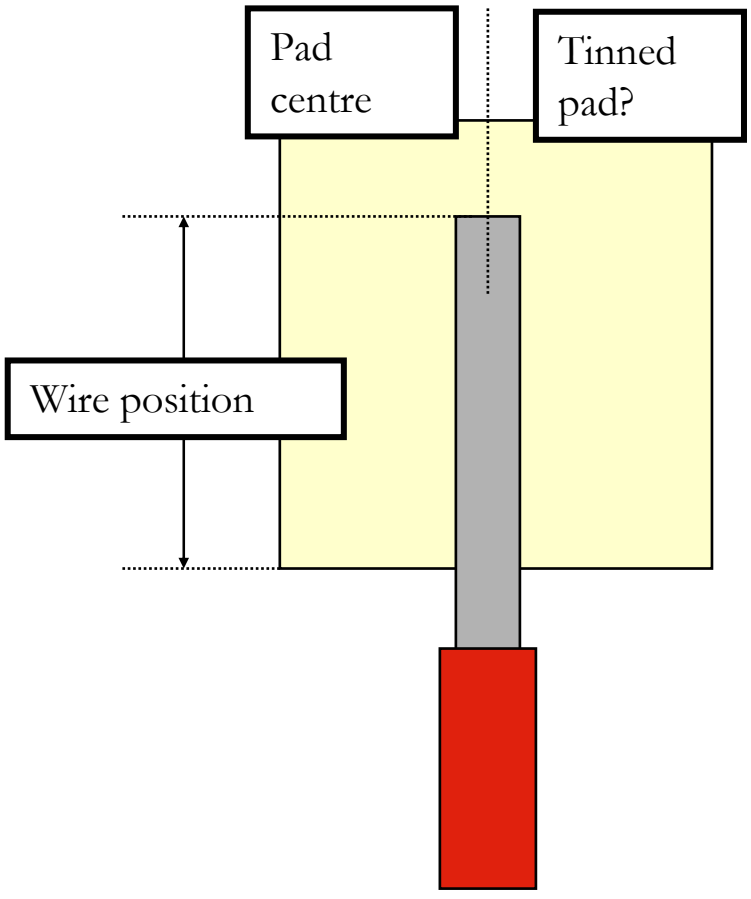
Soldering copper wire to pad

Inspection

7-1. Operation procedure



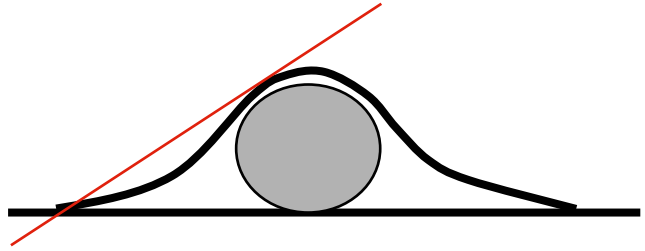
7-2. Practical Training



①solder qty, must be able to see wire outline/shape

②fillet curve in shape of a bow

③smooth and shiny solder surface without holes and spikes etc



①correct position

②correct shape

7-3. Surface of copper soldering

Good sample of Sn60

Condition of Pb Free

Poor wetted parts occur because spreadability of lead free is poor.

7-4. Soldering Wire to Metal Pad

Poor example of Sn60 solder

Poor wetting occurs because
insufficient heat on pad


Thank you