ELTN 130

Soldering Wires and Components on PCB's

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What will be discussed:

- Background information
- Common Tools
- Common Practices
- Proper Technique
- Safety
- Basic repair

Background

- What is the purpose of soldering?
  - To provide an electrical connection and support for an electronic component (on a PCB).
- What is solder?
  - A blend of metals (alloy), designed to melt at a temperature lower than the metals being soldered.

Typical spool of solder

Solder

- Types of solder
  - Cored solders – have a “flux” material embedded in the core of the solder
    - Acid core – NOT for PCB – work – corrosive for soldering steel materials.
    - Rosin core – Used for electronic work
  - Solid core solders – require external flux to be applied.

So, what is Flux?

- Flux is usually *organic material* that is used to clean the surface of the PCB prior to applying the solder.

- Fortunately, we use solder that has flux already in the solder, so we don't need to apply it manually.

Types of Solder, continued

- Lead solder- typically 63% Tin / 37% Lead
  - Called “Eutectic” as it transforms from liquid to solid almost instantaneously and has a low melting point.
  - Provides an excellent, clean, shiny connection
- Lead-free solder.
  - Usually an alloy of tin, copper, and / or silver.
  - Higher melting point, not as smooth solder surface.

Soldering Irons

- In order to melt the solder, we need to apply a sufficient amount of heat. This is in the range of

  600 - 700° F, or 315 - 370° C.
- Choose an iron in the range of 40 – 100W
- Soldering irons come in various packages:

Soldering Station

Hand held Iron

Butane (non-electric)

Tinning the iron

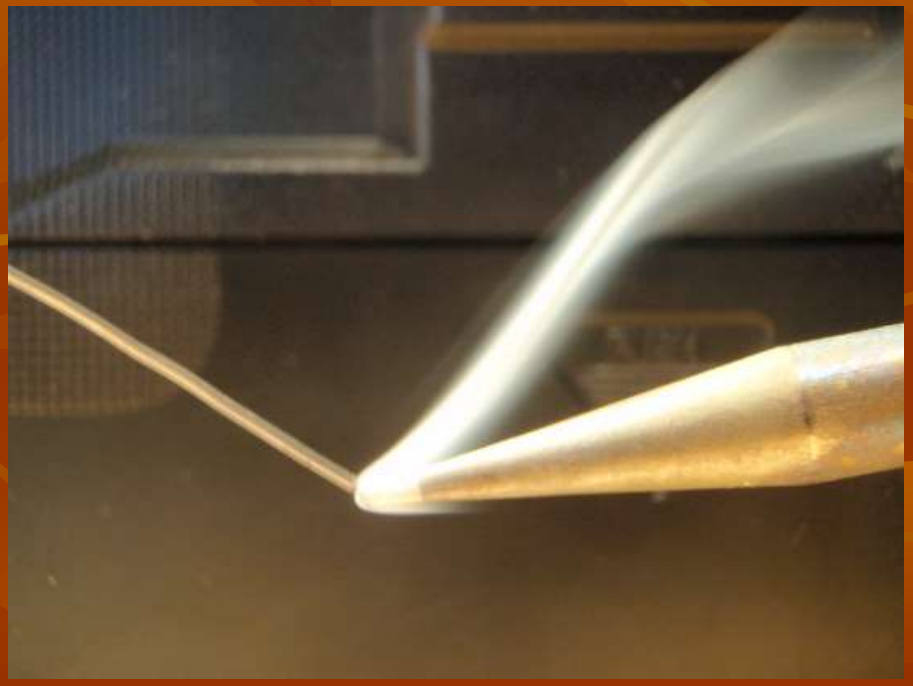
- If an iron has not been used before, or has oxides on it, it should be “tinned” prior to use.
- “Tinning” is the process of applying solder to coat the tip of the iron to prevent oxidation, or to help keep the tip protected. Cheap tips require this often:

Well maintained tip

Poorly maintained tip

Tinning the iron

- High quality irons, like the ones we use in class have coated tips that don't require as much tinning.
- The smoke you see in this picture is the flux burning off as the solder is applied.



Tinning wires

- Wires also can be tinned prior to soldering.
- This process allows better “solder-ability.”
- However, be careful not to heat it too long – this can lead to “wicking” where solder creeps up the wire under the insulation, and can make it brittle.

Cleaning the tip

- Once the correct temperature has been reached and the tip has been tinned, the tip should be cleaned with a wet sponge or metal sponge:

"Wire Sponge"

Water Sponge

Note: Both have pros and cons – the wire sponge is more abrasive, the water sponge can cool down the iron.

Important practices to follow!!

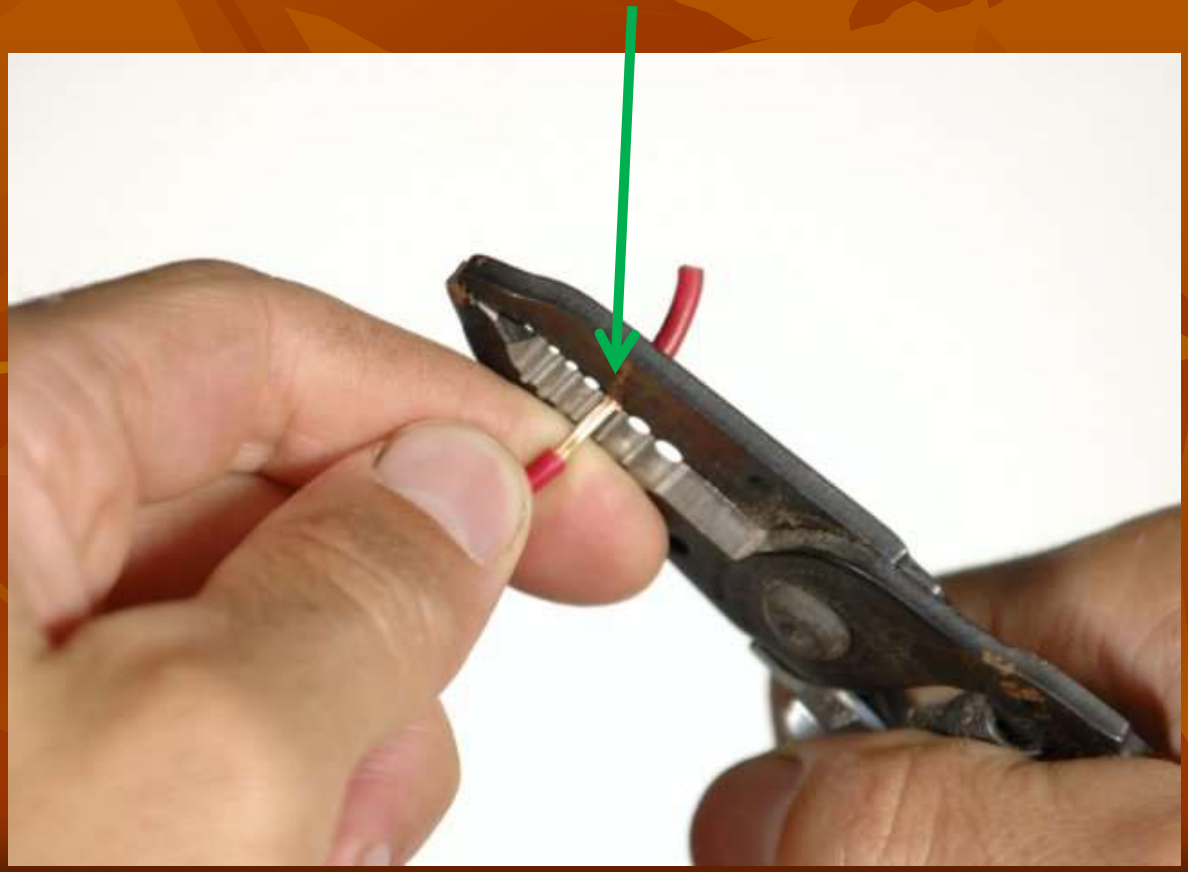
1. The iron MUST be hot enough to melt the solder almost instantly! Test by tinning.
2. Clean the tip regularly by wiping on the sponge before and after soldering leads.
3. Apply a small amount of solder to the tip before soldering the wires. This allows good thermal flow.
4. Never wipe solder on the connection. It is not glue. The flux must melt first!!

Time to solder!!

- We will solder one red and one black wire together
- Before soldering the wires we need to strip off the insulation
- Watch the demo
- Have an instructor check each connection…

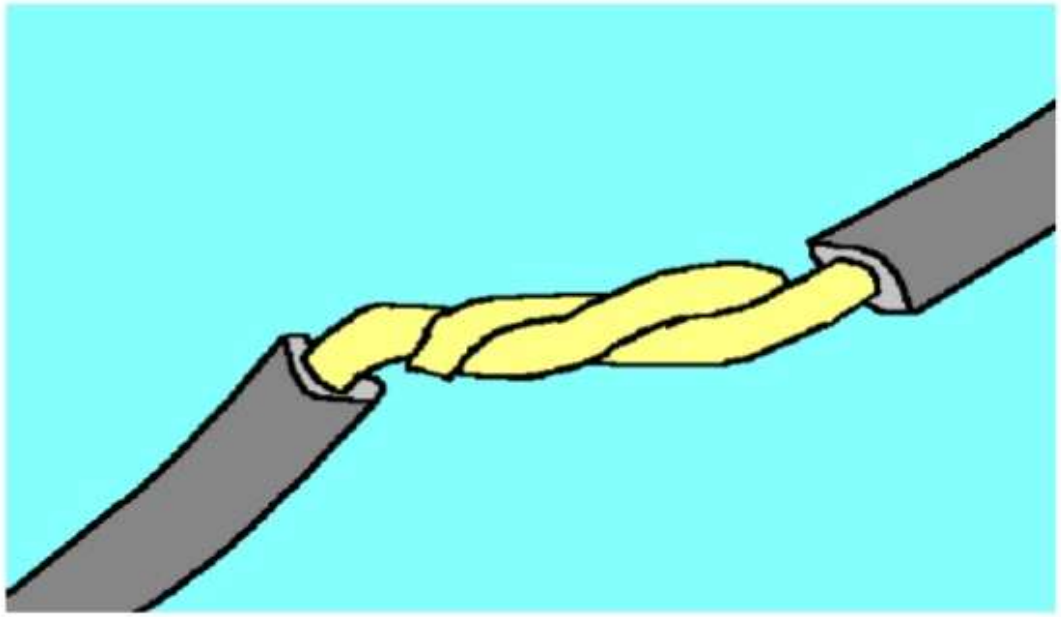
Stripping Wires

#1 : Using the wire stripper, strip approximately 2 inches off the end of each wire. Use the 20 AWG slot



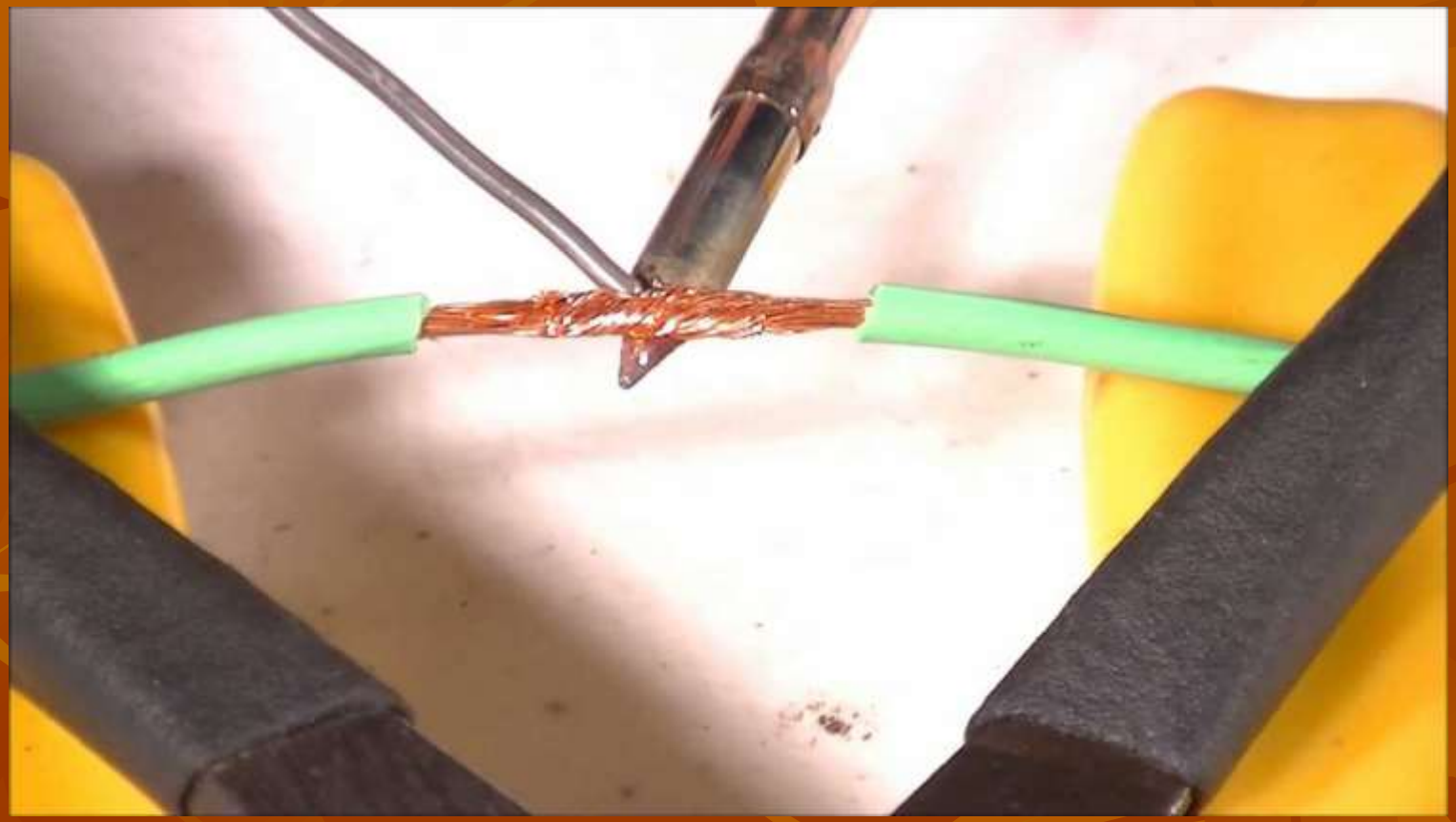
#2 - Twist the wires together:

Straight Twisted Splice



Step one: Strip wires & twist together

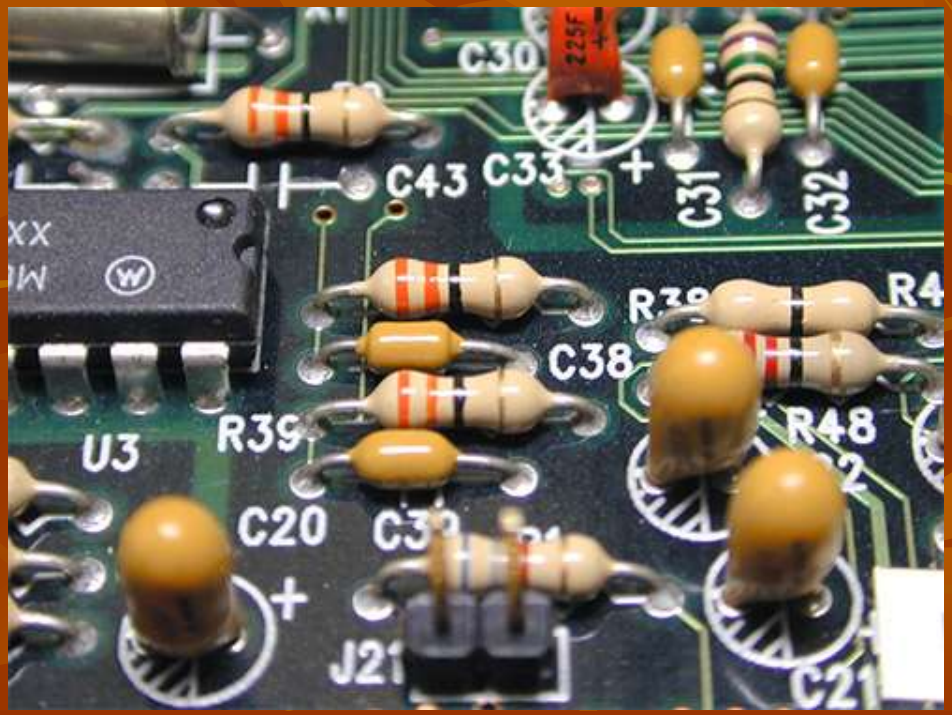
#3 – Solder the wires:



Finished soldered wires

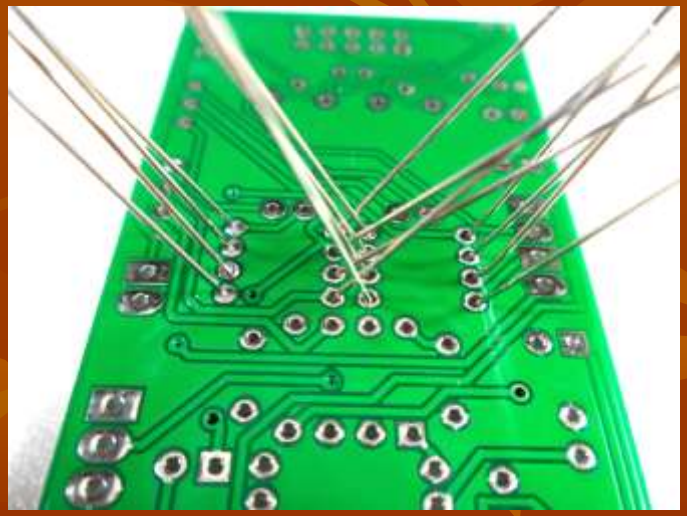
Soldering a circuit board

- Soldering a circuit board is a little different than soldering wires…



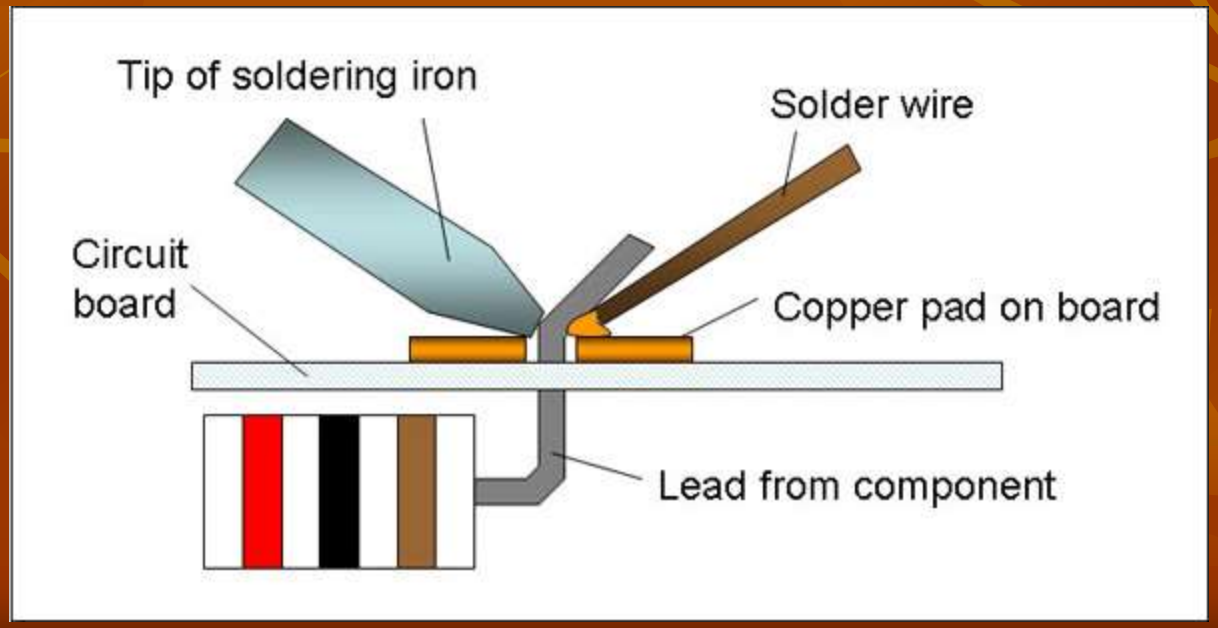
Important practices to follow!!

1. Keep your work steady. Use helping hands, or secure parts with tape.
2. Start with lower components (i.e. resistors) first, then move on to taller components.
3. Suggestion: Place and solder one component at a time. This prevents having a forest of wires to solder through, and helps make sure you don't miss anything!
4. Check your work as you go!



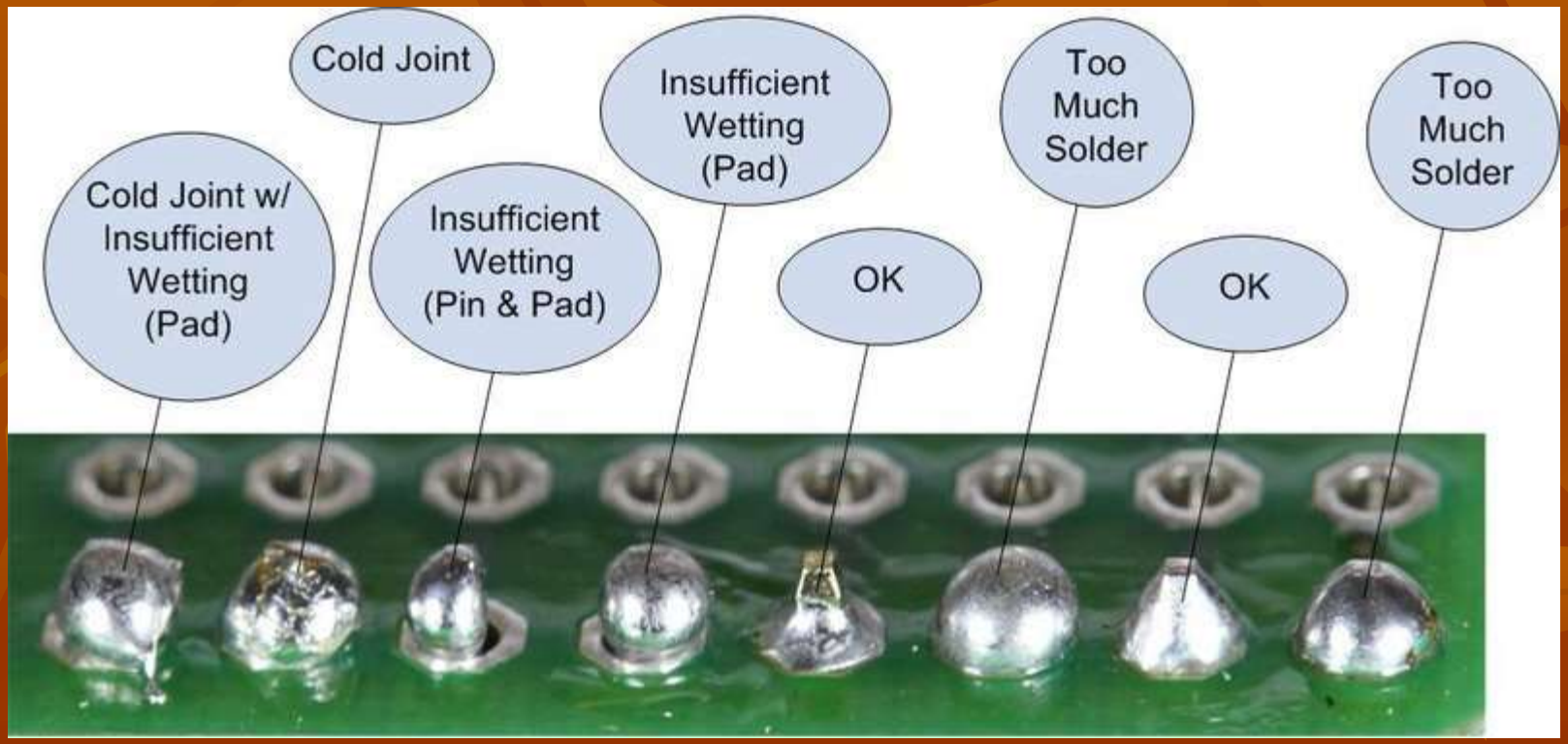
How to apply the iron

- Apply the tip to the contact point to allow maximum thermal flow (surface contact area).
- Allow the joint to heat enough to melt solder (~1 second).
- Apply the solder to the connection. (~1 second).
- Remove the solder, then the iron.
- To help transfer heat, you can apply more solder to the tip of the iron.



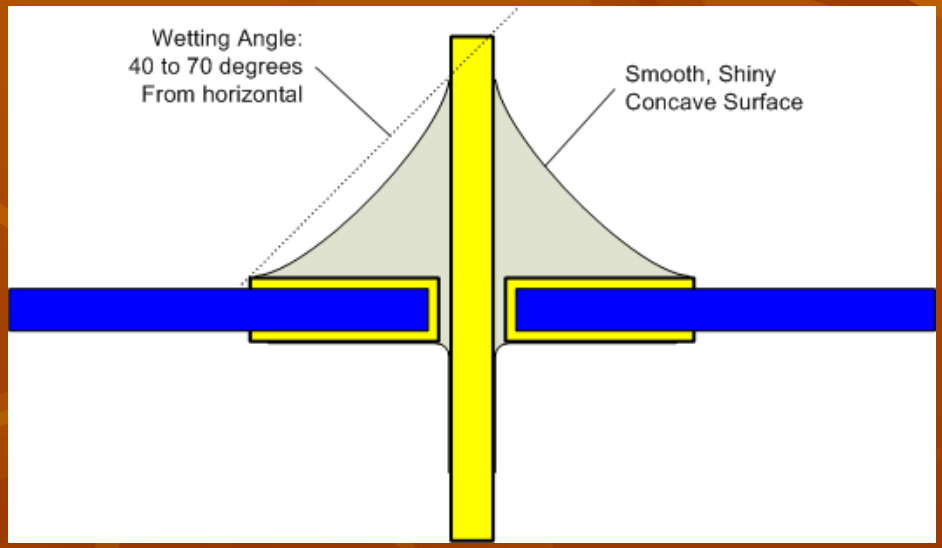
Good / Bad soldering examples

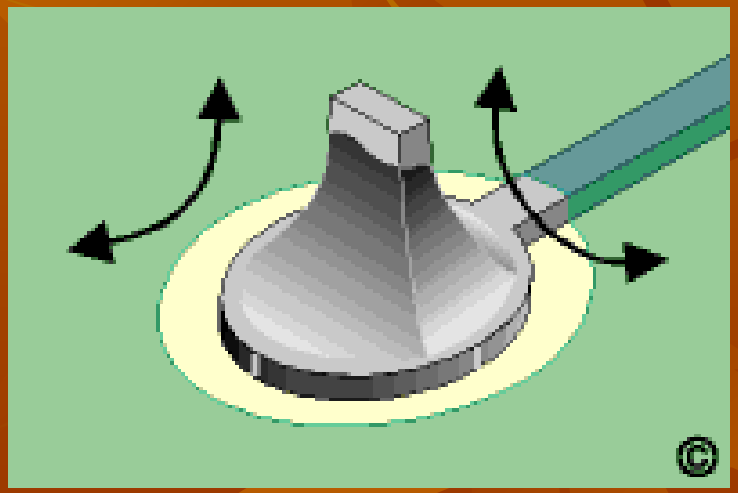
- VISUAL inspection is key to determining a good quality solder joint:



A good soldering joint:

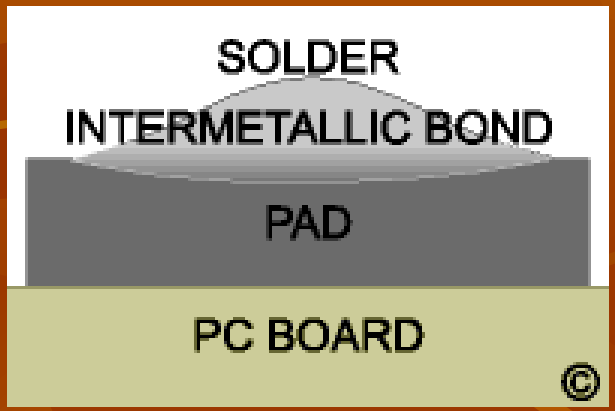
- VISUAL inspection is key to determining a good solder joint:





Wetting action

- *Wetting* refers to the "mixing of the molecules" between the solder and the metal wires or pads being soldered. Solder is NOT glue!!



Safety

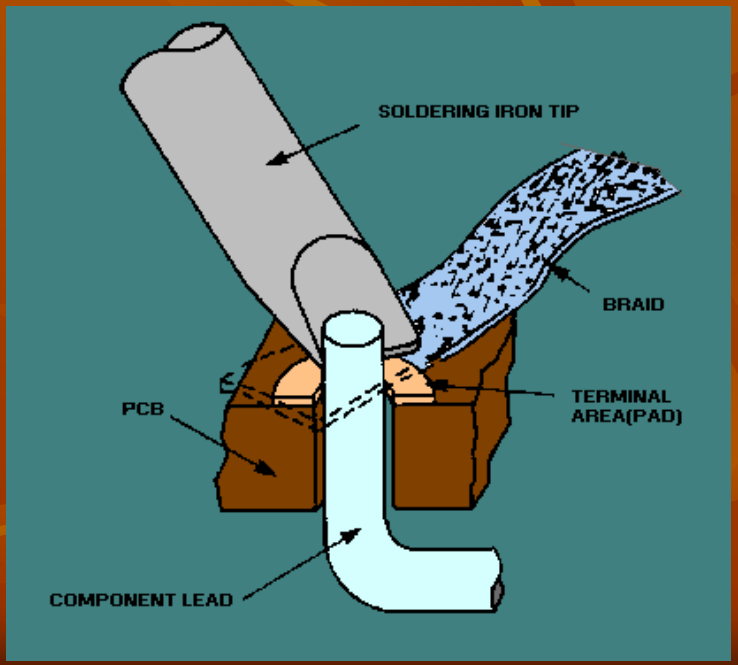
- The main issue is preventing burns.
  - Always assume the iron is hot!
  - Never test by touching.
  - Always grab by the handle.
  - Keep in a safe place when not using.
  - Solder over a surface where the solder splatters will not hit exposed skin or clothing
- Use goggles or glasses to prevent solder splatter from hitting your eyes.

Safety, continued

- Lead solder contains….lead!
- Lead is toxic, however the vaporizing point is much higher than a soldering iron tip - 1100° F. So, you will not breathe in lead fumes.
- However, it gets on your skin! Wash hands, avoid touching eyes or mouth when soldering!
- Avoid breathing the flux fumes. They are not carcinogenic, but can be irritating to the throat.

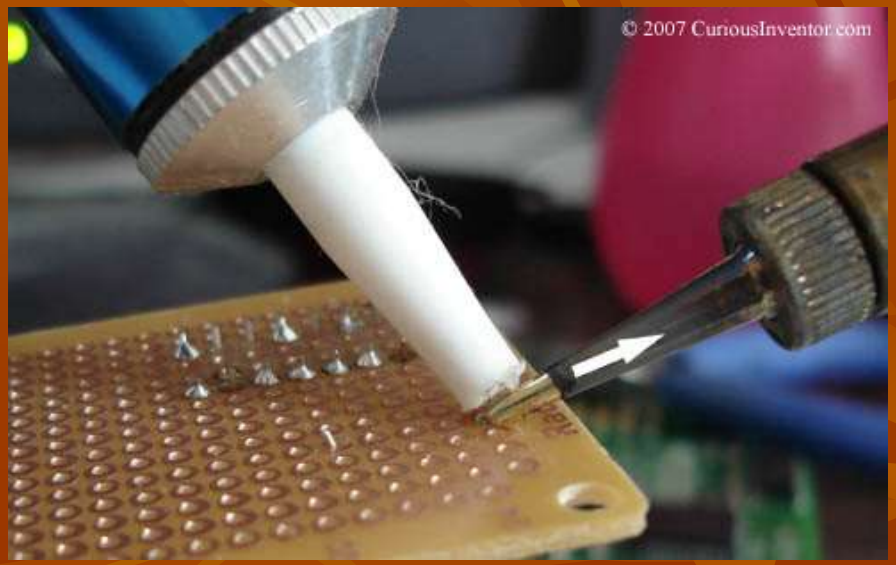
Basic repair

- Most repair focuses on removing and replacing a component. Solder must be removed from both the pad and the hole in order to remove the component.
- Method 1 - solder braid
- Works OK, but takes time, and can damage the PCB.



Basic repair

- Method 2A – Hand Solder Sucker
- Advantages – cheap! (< $10)
- Disadvantages – cannot create a continuous vacuum – works OK



Basic repair

- Method 2B – Powered De-soldering station
- Includes a heated tip and vacuum system – much more efficient and effective, but costs more ($100 - $500).

Web sites / Videos

- OLD SCHOOL PACE video - but explains a lot! (start at 3:40)
- https://www.youtube.com/watch?v=vIT4ra6Mo0s
- http://www.makeuseof.com/tag/learn-solder-simple-tips-projects/
- FSE Learning – through hole soldering:
- https://www.youtube.com/watch?v=AqvHogekDI4

- Sparkfun:
- https://learn.sparkfun.com/tutorials/how-to-solder---through-hole-soldering/soldering-your-first-component-
- Collin's lab:
  - https://youtu.be/QKbJxytERvg

References

- Wonderfulengineering.com
- Electriciantraining.tpub.com
- Sciencebuddies.org
- www.sparkfun.com
- www.buildelectroniccircuits.com
- www.themusicespionage.co.uk
- Aliexpress.com
- Us-tech.com
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