

## How to Solder for Beginners

Soldering can be a daunting task for an untrained individual. This instruction set will go over some basics of soldering to get you started. A glossary can be found at the end of the document if you aren't sure of what a certain term means or what an item looks like. To get started you'll need a few materials.

- Soldering Station
  - Soldering Iron
  - Aluminum resting mount
  - Temperature control box
  - Cleaning device (sponge or cleaning wire)
- Solder (typically rosin core 60/40)
- Solder smoke absorber
- Wire stripper

*Optional:*

- Helping Hand
- Tweezers
- Solder Wick
- Isopropyl alcohol
- Q-tips

### 1. **Gathering and Understand Your Tools:**

- Acquire a soldering iron. Weller is a popular brand with a wide range of price options. A high-end model is not necessary, but it will usually make for an easier experience. A conical, pointed tip is best for most applications.
- A soldering station with a digital temperature display is the easiest and most reliable. A maximum temperature of no more than 650-700 degrees Fahrenheit is needed.
- "Tip cleaning wire" is preferable to a sponge. This is because repeatedly putting a hot iron tip to a cold sponge will quickly wear the tip out. Tip cleaning wire is usually coiled brass that removes excess solder.



- d. Solder is a metal with a low melting point that's used to join other metal together. It rapidly cools and quickly adheres to heated metal. There are many different types of solder, with varying thicknesses and compositions. While most industries use 60/40, there is starting to be more movement toward lead-free solder.

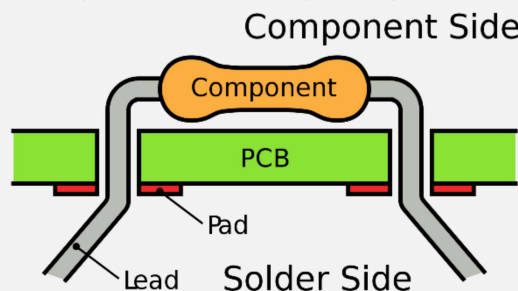
## 2. Preparing to Solder

- a. Turn on the soldering iron and give it time to heat up. If you have a soldering iron without digital temperature control,  $\frac{3}{4}$  of the maximum heat should be sufficient.



Warning: The tip of the soldering iron will be very hot and can lead to burns. Do not touch this tip if the iron has recently been turned on.

- b. Once the iron is hot, you'll either need to tin it if it's a new iron or clean it off if it's been used before. Tinning, as mentioned in the glossary, is simply putting solder on heated metal. You want to coat the tip of the iron so that it's shiny. At this point you should also turn on your solder smoke absorber if you have it.
- c. If soldering two wires together, strip the ends of the wires such that there is sufficient space away from the insulation. You want enough space that the soldering iron won't melt the insulation. Approximately 2-3 inches is fine. If you notice insulation melting, strip the wire back more. For soldering wires, see **Step 3**.
- d. If soldering through-hole components, place the component through the hole in the board. If the component has long leads (such as a resistor), bend the leads at a 45-degree angle so it is held in place. For soldering through-hole, see **Step 4**.



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Warning: Do not inhale fumes from soldering. Be sure that a solder smoke absorber is always on when using a soldering iron.



Warning: Be sure to always place the soldering iron back in the aluminum resting mount

## 3. Soldering Wires

- a. To solder two tinned wires together, twist the two stripped leads together. They should be twisted enough that if you let go they will hold together on their own. If your wire is solid and not braided, tin the wire instead.
- b. Grab your soldering iron and bring the tip up to the copper of the wire. Hold the tip there for 3-5 seconds to heat up the copper. Now, bring your solder over and press it to the copper near the soldering iron. If your iron is sufficiently hot, the solder will start to

melt and be absorbed by the copper. If this is not happening, bring the solder closer to the iron.

- c. You want enough solder to cover the copper and make it shiny, but not enough that there are excess globs hanging off. If you add too much solder, you can use the soldering iron to pull some of it off.
- d. Remove the solder strand from the wire and the soldering iron. Allow 5 seconds for solder to harden. Try to avoid moving the wire so as not to disturb the solder as it cools.



Warning: While solder does cool rapidly, it will still be hot for approximately 10 seconds.

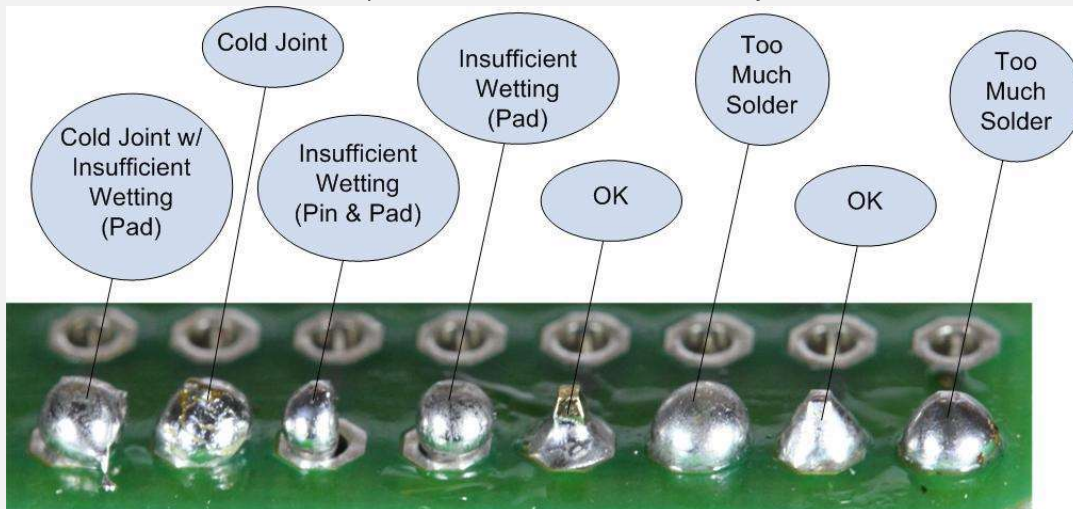
#### 4. Soldering Through-Hole Components

- a. Place the soldering iron on the pad that you are soldering to for 3-5 seconds. A pad is typically a square or circular area of exposed copper. It will be the noticeable ring around the hole you placed your component through.
- b. Bring the solder up to the pad and slowly bring it toward the soldering iron. The solder should start to melt and surround the lead. Pull the solder away and then the soldering iron. Allow 5 seconds for solder to harden.



Warning: The pins and wires being soldered will heat up quickly depending on how long the iron is held to the pad. This typically lasts 15-20 seconds.

- c. Snip the excess leads that don't have solder on them. You want to cut it down enough such that there is very little lead outside of the solder joint.



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#### 5. Cleanup

- a. Place some solder on the tip of the soldering iron before shutting off the soldering station. You always want to leave some solder on the tip before storing the iron. This will help prevent oxidation and increase the lifespan of the solder tip.
- b. Shut off the soldering station.
- c. Spool up solder and clean up any cut components or stripped wire.

- d. Give the soldering iron at least 5 minutes before attempting to touch it or the aluminum resting mount.



Warning: Wash hands immediately after soldering. Solder typically contains lead and could get into your food or drink via hand contact. Lead-free solder does exist, but it is a good idea to wash your hands after soldering regardless.

- e. If you notice that the board is messy and there is a lot of clear fluid surrounding your solder points, you can use isopropyl alcohol and Q-tips to clean it. That clear fluid is melted flux. It is non-conductive and won't affect your board if you leave it there.

## 6. Tips

- a. When soldering, occasionally clean the tip of the soldering iron off in the tip cleaning wire or on the sponge. You should clean the tip if you have excess solder on it or if you see noticeable black residue. Cleaning the tip helps the solder flow and allows for stronger connections.



Warning: If using a sponge, be sure that it is moist before touching the iron to it. If it is not, it could cause smoke or catch fire.

- b. Try to keep the solder attached to the spool. It is easier to keep unspooling the solder roll rather than constantly cutting off small pieces. It is also safer because you can always have sufficient space for your hands to hold the solder.
- c. Never place solder on the soldering iron with the intention of using that to solder. Solder can burn, and flux can evaporate. Trying to solder like this will result in low quality connections.
- d. Always tin wires before trying to solder. Tinning is one of the best ways to make soldering easier.
- e. Tweezers are helpful for holding wires together. They won't get stuck to the solder and they help with holding components that quickly get hot.

## 7. Troubleshooting

- a. Most soldering mistakes are easily fixable. If you used too much solder, it can be removed with the soldering iron or solder wick. To remove with a soldering iron, clean the tip, then try to heat and wipe the solder. This might take a few tries. If that doesn't work solder wick will get the job done. To use, simply place part of the wick on top of the solder you want to remove. Then put the soldering iron on top of the wick to heat it up. This will melt the solder and allow it to flow into the wick. Be sure to use tweezers to hold the solder wick as it quickly gets hot.
- b. To fix a cold joint, simply reheat the solder until it flows and then remove the soldering iron.

## Glossary:

60/40: The most common ratio of tin-to-lead found in industry solder.

Cold Joint: Characterized by a rough, lumpy, or cracked surface, cold joints are solder points where the solder wasn't fully heated. These connections are often weak.

Helping Hand: Clips with adjustable arms that can be used to hold components. While not necessary, they are often helpful with soldering wires together.

Lead: The tinned copper coming off a component. Typically several inches in length and very flexible.

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Rosin: A chemical added in the core of most types of solder. Flux is the most common, and it helps the solder flow more easily to bond with components.

Solder wick: Braided copper that uses capillary action to absorb solder. You would use this if you accidentally add too much solder to a pin or if solder gets in a through mount hole that it shouldn't be in.

Tinning: Coating a wire in solder before soldering it to a wire/pad. This makes it easier to make a connection and helps the solder flow. Can also refer to putting solder on a soldering tip to reheat it evenly heats solder.



[5]

## References

- [1] WJS 100 High Power Soldering Station with TD-100 Iron. Pace Worldwide, [www.paceworldwide.com/sites/default/files/WJS100-high-power-soldering-station\\_0.jpg](http://www.paceworldwide.com/sites/default/files/WJS100-high-power-soldering-station_0.jpg).
- [2] Why Use Through-Hole Technology in PCB Design? Altium, <https://resources.altium.com/pcb-design-blog/why-use-through-hole-technology-in-pcb-design>.
- [3] Adafruit Guide to Excellent Soldering. Adafruit, <https://learn.adafruit.com/adafruit-guide-excellent-soldering>.
- [4] Helping Hand, Low Cost, with Cast Iron Base. Circuit Specialists, <https://www.circuitspecialists.com/helping-hand.html>.
- [5] Solder Wick. Delphi Glass, <https://www.delphiglass.com/soldering-supplies/supplies-accessories/solder-wick>.