

Soldering Safety and Technique

A soldering iron is a simple direct electrical heating element designed to melt solder alloys. Inexpensive soldering irons plug directly into a wall outlet and heat to a set temperature. More elaborate soldering systems allow the user to vary the power or set the maximum temperature. Different size and shape tips are available for soldering various types of components.

The hot tip exposed to air tends to build up an oxide coating that is detrimental to forming a good quality solder joint. Therefore, it is necessary to practice good tip cleaning habits and proper soldering technique. When a hot tip is sitting in the soldering iron stand it should be coated with solder to prevent oxidation of the tip. This is called “tinning” the tip. Always leave the tip tinned when the soldering iron is not in use. A tinned tip looks shiny like a silver mirror. Prior to making a solder joint, the excess solder is wiped from the tip using a damp sponge. Most soldering iron stands come with a small piece of sponge and a tray to keep the sponge in place.

When making a solder joint it is important to heat both the copper conductor line and the component lead so that the solder will make good contact with both surfaces. Hold the tip firmly against both the copper and the lead, and then bring the solder wire in to the joint area. Allow a small amount of solder wire to melt onto the tip, copper and lead. Pull the solder wire away first, and lastly remove the soldering iron tip from the solder joint. (If you pull the iron away first, the solder joint will solidify with the solder wire attached to it. The soldering iron can be used to remelt the solder to detach the solder wire.) Continue on to make another solder joint or tin the tip and place the iron back on the stand. You will see and smell a small amount of smoke when the solder wire melts. The smoke comes from the flux material in the solder wire. The molten solder at the solder joint quickly cools and becomes a solid piece of metal.

Soldering Steps

1. Wipe excess solder onto the damp sponge.
2. Hold the tip against the copper conductor line and the component lead.
3. Bring the solder wire into the hot copper, lead and soldering iron tip.
4. Melt a small amount of solder.
5. Remove the solder wire from the joint area.
6. Remove the soldering iron from the joint area.
7. Make another solder joint using steps 2-6 *or* tin the tip and place the iron in the stand.
8. Wash your hands when you are done soldering to prevent ingestion of lead.

Inspecting Solder Joints

A good solder joint makes a cone shape around the component lead and covers the via hole “donut” area on the copper conductor line. Too much solder at the joint will have a ball shape and may form a bridge to other solder joints nearby. Solder bridges are short circuits that will change the performance of the circuit and must be repaired. Too little solder at the joint will not make the smooth cone shape and may not make a complete connection between the copper and component. Inadequate heating of the copper and lead results in a “cold joint” that may look alright but be an open circuit.



Repairing Solder Joints

One of the simplest debugging tools is to touch up the solder joints. Cold joints can be repaired by remelting the solder at the joint using a hot soldering iron tip. Solder can be added to the joint by repeating the soldering steps. Solder bridges can be broken by remelting the solder. Excess solder can be removed using a solder wick (see desoldering below).

Desoldering

Sometimes it is necessary to remove a soldered component in order to replace it with another component or to reverse the orientation of a misplaced component. In order to remove a component, the solder joints must be eliminated by melting the solder with a soldering iron and removing the molten solder. Two common techniques for removing molten solder are solder wick and desoldering pumps. Solder wick is a braid of copper wire with flux that will attract the molten solder away from the joint. Solder wick is used by laying the solder wick over the solder joint and heating the wick and joint with the soldering iron. The copper colored braid will turn to the silver color of the solder as the molten solder is drawn up into the braid. Remove the braid and iron to inspect the joint. After a section of braid has been used it can be cut off with wire cutters and discarded. A desoldering pump sucks the molten solder away from the joint. The solder is heated with the iron, then the pump opening is brought close to the joint and triggered to pull up the molten solder. Manual desolder pumps operate by depressing a spring-loaded plunger and then releasing the plunger to create a short burst of suction. The pump has to be reloaded for each joint that needs to be desoldered. Electric pumps reload themselves automatically or use a small vacuum pump to generate the suction.

Resoldering

Copper surfaces and components can be soldered several times before the copper is destroyed or the component is damaged by excessive heat. Once the copper conductor line is damaged, it is necessary to add a jumper wire to connect the remaining copper line to the component lead. A damaged component must be replaced with a new one.

About Solder Joints

Solder joints serve two important purposes in electronic circuits. On the one hand, the solder joint works as an adhesive bonding the components to the circuit board. On the other hand, the solder joint forms a short circuit connection between the copper conductor line and the component lead to complete the circuit path. Both jobs are critical to the performance of the circuit. If components fall off the board or are not electrically connected, then the circuit fails. A third job performed by solder joints in more advanced circuit assemblies is heat transfer. Heat generated by the integrated circuit travels through the solder joint to the circuit board to keep the IC cool. The choice of a solder alloy and the soldering technique involve careful study of the properties of the solder, such as, mechanical strength, thermal conductivity, electrical conductivity, and melting point. All of these properties vary with different alloy compositions depending on the specific elements and proportions of the elements in the alloy. The most common solder alloys are combinations of lead (Pb) and tin (Sn). Since lead is known to be toxic, many new alloys have been developed which are lead free.

