

Soldering

Soldering is forming an electrical and mechanical connection of metal parts using a molten alloy of lead and tin to join the parts under the application of heat. Solder joins two or more other conductors at a temperature below their melting point. Solder creates a metal solvent between the metal(s) being joined. The metal solution creates an intermediate alloy that provides a low resistance electrical connection.

Tools

Temperature controlled soldering iron with proper tip

The Weller WCTCP iron we supply in the labs is temperature controlled. It operates by using a magnetic tip. Below its rated temperature, the tip holds a magnetically actuated switch in the *on* position. When the tip reaches its rated temperature, it loses its magnetism. The switch is then released and the heating element begins to cool. This action is what causes the soft ticking sound when the iron cycles between heating and cooling. The temperature of the tips we supply you is 700 degrees. The tips we supply are *screwdriver* or *chisel* style tips.

Solder

There are many types of solder. The one we want to use is a mildly active rosin-core solder with a tin/lead ratio of 63/37 or 60/40. The proper diameter can vary from 0.020" (0.5mm) to 0.035" (.98mm). The smaller .020" size is preferred for working on printed circuit boards.

The most preferred solder is probably Kester type RA (activated rosin) type flux core types "44" and "285", 60/40 or 63/37 Sn/Pb content respectively in the .020" (0.5mm) diameter. This solder is available from Mouser Electronics. Do not use *Kester 245 No-Clean*, *Kester 331 Water-Soluble* or any other *No Clean* or *Water Soluble* types. Also, do not use *No-Lead* solders.

Damp Sponge

Your soldering station should have a damp sponge. The sponge is used to clean the tip. It should be dampened with water and oriented so that the tip is drawn through and not across the grooves in the sponge.

Making the Joint

Tinning the Tip

When using a new soldering iron tip, it needs to be *tinned*. Tinning the tip is the process of heating up the tip and applying a thin coat of solder. The thin coating of solder helps to achieve maximum heat transfer to the items you are trying to solder and protects the tip from oxidation.

Clean the Tip

Just before making the joint, quickly draw the tip through the grooves in the sponge. A slight twisting action helps clean the entire surface. Wipe the tip quickly, so as not to cool the tip excessively. Then apply just a little bit of solder to the tip.

Clean all Surfaces

All parts including the iron tip itself must be clean and free from oxide contamination as solder will not flow readily onto contaminated metal. Oxidized metal repels molten solder. This condition is evident when solder beads up into little balls, and refuses to flow into the joint. You can use a knife blade to scrape oxidized leads or fine sandpaper to clean printed circuit board traces. A rubber eraser also works well to clean printed circuit board pads.

Steady the joint

Find some way to secure the work so that it doesn't move during soldering. Movement of the joint while soldering will produce a crystalline joint. These are hard to see and create very *interesting* problems.

Apply the Solder

Position the soldering iron tip firmly against the surfaces to be soldered to thermally connect all the surfaces in the joint. If the tip has been tinned, the residual solder on the tip will wick to the surfaces providing an efficient transfer of heat to the joint. Push firmly against the joint as you would with a pencil on paper. Applying sufficient pressure will ensure an efficient and rapid heat transfer to the joint. The longer you are heating the joint, the more likely damage to the parts will result.

Once the thermal connection is established, push the end of the solder into the joint. You want the pieces in the joint to melt the solder, not the iron. If the joint pieces cannot melt the solder, then they are not hot enough. When the solder begins to melt, feed it into the joint until there is just enough to fill any gaps. More solder is not better. Use just enough.

Remove the iron, being careful not to shake or bump the joint which will cause a crystalline or *cold joint*. The whole process from application of the tip to a joint to the removal of the tip is typically two to four seconds. The time it takes to make a joint depends on the temperature and wattage rating of your iron and thermal mass of the joint. Semiconductors, some capacitors and plastic connectors are sensitive to heat and should be soldered with care.

After the joint has cooled, return the iron to the holder **WITHOUT CLEANING THE TIP**. The residual solder is left on the tip to protect it and to aid in heat transfer for the next joint.

To recap the steps:

- Ensure all parts are clean
- Secure the work
- Wipe the tip
- Apply small amount of solder to tip
- Heat all parts of the joint
- Continue heating, and apply sufficient solder to make the joint
- Remove the iron
- Return the iron to its stand without cleaning it
- Do not move parts until the solder has cooled

Check the joint

A good joint will be shiny and smooth. Solder will not completely cover all the wires, but encase them, leaving concave surfaces between them and the wire tips sticking out. A bad solder joint will look dull, more gray than silver. If you need to redo a joint, start from scratch, removing most of the solder you can.

Desoldering

Desoldering is most easily done with desoldering braid or *solder wick*. Solder wick is a fine copper braid soaked with flux. When heated and applied to a joint, the solder is sucked away from the joint by capillary action into the wick.

To use the braid, press a short length of braid down onto the joint with the tip of the iron. The iron will heat the braid, which will subsequently melt the solder, which is drawn up into the braid. Do not *scrub* the board with the wick. You will tear the traces off. Be careful to heat the braid, not the solder, allowing the heat to transfer from the braid to the solder.

Use of a desoldering pump *solder sucker* must be used with care. The jumping action of the pump can completely remove a pad from a printed circuit board. When heated to 500-700 degrees, the adhesive holding the copper to the board loses 80% of its strength.