A Primer on Soldering

by Paul Discher

Soldering is actually a chemical alloying action created by the application of soft solder and heat to the joint or surface of another metal to be soldered. The intent of soldering is to form both a good electrical connection as well as a mechanical bond that exhibits characteristics completely different than the solder or the conductors (metals) by themselves. Solder itself can be designed to meet the varying needs of both the physical and electrical demands of an application.

Solder liquefies at temperatures between 361° and 621° F (183° to 327°C). The exact melting temperature of solder is controlled by the mixture ratio of tin to lead contained in the solder. Pure tin melts at 450°F(232°C) and pure lead at 621°F(327°C). When mixed at a ratio of 63% tin and 37% lead, solder melts at an extraordinary low temperature of 361°F(183°C). Solder used in our type of electronic work is 60/40 ...60% tin and 40% lead. A metal such as copper, which has a melting point of 1981°F (1083°C), can be successfully alloyed with solder at temperatures well below this value because of the solvent action of solder when it is liquefied.

Unfortunately the chemical interaction of earth's atmosphere with metals causes thin layers of oxides to form on their surfaces. The first bad news is that oxides generally are not good conductors and since in electronics we are primarily seeking a bond that provides good electrical conduction we have to overcome the oxide problem. The other bad news is that oxidation increases as metals are heated, and this oxidation degrades the performance of the solvent action of melted solder. Therefore, chemical fluxes are used with solder to abate the oxidation process by removing the oxide film. The addition of chemical flux also reduces the surface tension of the metals, thereby improving the "wetting" action of the solder. Most electronic grade 60/40 solders today incorporate a flux-core. Think of the flux in flux core solder as jelly is to a jelly donut!

Making good solder joints is neither a well guarded secret nor does it require any artistic skill. The first and best step is to start with the correct tools, and consideration for the work surface in which the soldering is to be performed.

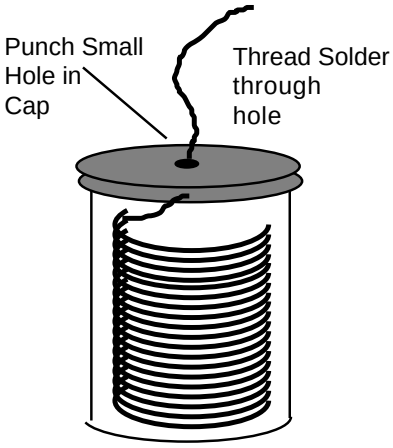
A 40 watt or lower wattage soldering pencil is the best unit for small electronic work. There are certain times when the mass of the area to be soldered will require the brute force of a 100 watt or greater iron. Take care to identify when you need the extra power rather than trying to "sap heat" from a low wattage solder pencil. The latter practice just makes very bad solder joints. The point here is you really need both types of soldering irons if you want to be prepared for all types of electronic work.

Another important item that is needed is a moist cleaning sponge. This sponge is used to "wipe" the excess solder and burned flux from the soldering iron tip between joints, and the cleaning action helps the solder iron to develop all of its rated heat to the tip for best performance. If you are lacking a sponge, a wet folded paper towel works well.

Any soldering iron that has previously been abused can be cleaned and burnished with a curled piece of 120 grit sandpaper. Immediately after sanding, tin the tip with solder, that is, apply a liberal amount of solder to the tip and immediately wipe it on the sponge. The remaining tip should be shinny and clean.

At some point you may need to replace the soldering tip, or if the tip cannot be replaced you may need a new soldering pencil. You should also invest in a holder for the soldering pencil so it will not burn you, your work counter, or start a fire. Many commercial soldering iron holders also have a sponge tray attached to the base combining both items in one unit.

Consider next, the solder. Most solder is sold on spools or in dispensers. You should select a 60/40 flux core solder for electronic work. An excellent use for surplus 35mm film canisters is a solder dispenser. To make and fill the dispenser simply coil a length of solder around a pencil or other cylindrical object making a layered solder coil that will fit the insides of a 35mm film canister. Punch a small hole in the lid of the canister and feed the solder from the center of the coil through the hole in the lid. Now attach the lid to the canister and you have an excellent solder dispenser. The solder dispenser is of particular interest if you have a fleet of soldering stations you need to equip for any group, and have only one large roll of solder.



35mm Film Canister used as a Solder Dispenser

The table or counter where you solder should be well lighted and covered with a protective board so as not to be burned by the soldering pencil or stray melted pieces of liquid solder. Some type of holder for your work is very helpful. I have wrapped rubber bands around the handgrips of pliers to make spring tension clamps to hold my work. You can buy commercial "soldering vices" for holding your work as well. Once you ever use the right equipment you will never want to work without it, and the "soldering vice" is one of my favorite tools when I do printed circuit board soldering.

Once you have the tools and the work surface prepared you are ready for soldering. Locate the joints you wish to solder, and make sure they are clean and in good mechanical contact. Apply a small amount of solder directly to the soldering iron tip. I try to use this initial ball of solder, on the tip, as a heat transfer medium to the joint to be soldered. The smoke from the soldering tip is mostly the flux burning.

Flux is an important medium of soldering, don't let it burn away without getting some action with the joint to be soldered. Use the ball of solder and melting flux to warm and lubricate the joint. Once the joint is sufficiently warm, apply more solder directly to the joint, not to the soldering tip. Immediately after completing the joint wipe the soldering tip on the sponge. I don't think it possible to "over clean" a soldering tip. A good solder joint should be bright and shinny, and solder should completely surround the conductors. Happy soldering!