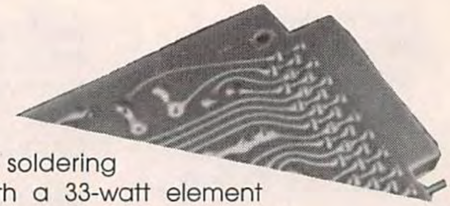
How To Succeed In Soldering

Using the right soldering tools along with tried and proven techniques are the keys to getting great solder joints every time.

SKIP CAMPISI, JR.



With proper techniques and just basic equipment, an individual should be able to achieve a perfect solder joint each and every time. What's more, that joint should be formed in about three to four seconds after applying the iron. That said, many fail to achieve this ideal, even with expensive gear and hours of practice. If that describes you, don't despair—help is on the way!

By now I'm sure you'll all be asking, "Who does this guy think he is, trying to tell ME how to solder?" A fair question, to which I can give a fair answer: I have been an electronics hobbyist for over thirty-five years and have used most types of soldering systems at one time or another. This includes about twenty-five years as an electronics professional.

What I'll be describing in this article is based on my past experience with soldering: how to select the correct tools and solder, and techniques to use that guarantee success. Note that a lot of what follows goes against the "book" or conventional wisdom, so if you are already successful and happy with your own soldering methods—and they work well—don't change them! However, for those who aren't happy, this is for you.

Getting Hot Over Heat. The first thing we need for a good joint is HEAT, and plenty of it, to achieve a quick joint. For standard through-hole circuit boards I use only one iron: a soldering pencil with a 33-watt element running "flat-out" with no control (except for demanding jobs, I've found that temperature-controlled irons are often more trouble than they are worth). The tip is a standard 1/8-inch chisel style.

I can hear you all grumbling already: "Too much heat! You'll destroy your components!" This is not true at all. The secret lies in the tip: use only iron-clad soldering tips and keep them well tinned throughout the job. Mine always last for at least a year, and I do a lot of soldering!

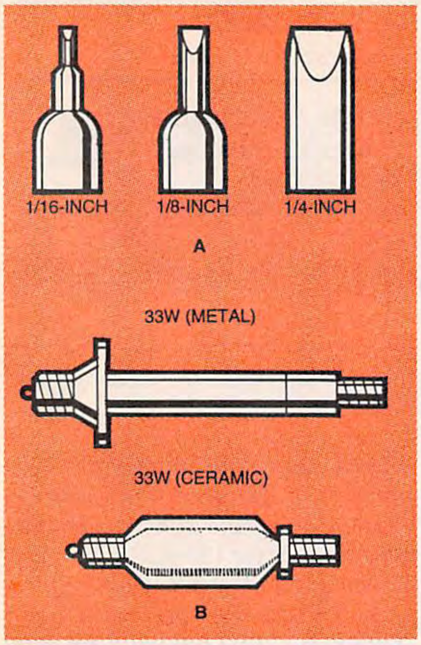
So, how about surface-mount devices? I still use the same heat element, this time with a 1/16-inch or smaller chisel tip. I know, still too much heat! In some cases, this can be true; however, judicious use of heat sinks on component leads is 100% effective. I'm definitely NOT talking about "grasping the lead with needle-nose pliers," as is so often mentioned in soldering tutorials. Have you ever tried that method? Whew!

In my experience, standard, "micro-gator" clips are extremely effective as heat sinks on components or component leads. Those are the clips that have flat jaws as opposed to the serrated jaws found in alligator clips. Sensitive devices such as precision resistors, capacitors, and of course all semiconductors can be soldered without damage using micro-gator clips, which are available from many sources including RadioShack. For tiny SMD transistor packages and the like, a clip snapped right onto the package itself is quite effective.

Your next question might be: "What element should I use for heavier joints, such as those involving wires and terminals?" Again, the 33-watt element is perfect for wires up to about 14 gauge, using the 1/8-inch chisel tip. For really heavy work, I switch to a 47-watt element with a ¼-inch tip for faster heat transfer.

Heat transfer is the number-one factor for successful solder joints. The faster it is accomplished (within reason!), the better your joints will be. Period. More components are damaged by applying lower-heat irons to joints for long time periods, as opposed to higher heat irons for the three or four seconds mentioned previously. And, of course, use of a soldering gun is definitely overkill! I don't even own a gun.

Solder. So then, what's the best all-around solder to use? The absolute BEST solder I've ever used is: KESTER "44" resin-core solder, with their #66 core. For general circuit-board soldering, I use their 60/40 alloy in 0.031-inch (1/32-inch) diameter. For SMT soldering, I switch to 0.015-inch or 0.020-inch diameter. Note, there may well be equivalent solder out there by another manufacturer, but this is what works for me so I stopped looking.



Typical chisel tips shown here (A) are used for SMT, general work, and heavy-duty work. They should all be of the "iron-clad" variety and threaded to fit the correct heat element. The heat elements shown (B) are made in two styles: metal cased or ceramic cased. Both thread right into a handle, with a "cool-grip" handle being the best choice.

The reason I consider this solder to be the best is due to the resin core itself. This is one brand of flux that you do NOT have to remove from your finished circuit board! Honest! I have many projects from over twenty years ago that are still functioning 100% correctly despite the fact that the boards are still "swimming" in the original flux residue. No type of corrosion or other type of damage was ever found in those units due to flux residue.

So, what's the big deal about de-fluxing a board? Well, if you've ever tried to de-flux a board, you already know what a messy job that can be. No matter what you do, all that you'll end up with is diluted flux residue spread over the entire board and its components. You can readily feel that as a sticky residue on everything. Erratic component and board functioning is often the direct result of this mess.

While hobbyists try to do it anyway, the proper method of de-fluxing boards is just not practical for the average hobbyist. To do it right requires industrial-strength flux-removing chemicals, a hot-soap ultrasonic cleaning, a thorough water rinse, some time baking in an oven to dry the board, and finally applying a chemical sealant to the finished board to prevent further contamination. If you can't do all of this, de-fluxing a board is just a waste of time. So, a flux that is inactive at normal ambient temperatures is obviously quite desirable.

Of course, there are situations where leaving even an inactive flux on the board could cause problems, such as when dealing with sensitive nodes at very low current levels where leakage through flux paths can be greater than the signals. The trick in those situations is to create an air-gap or use a Teflon-insulated standoff terminal to keep the joint off of the surface of the board. This is 100% effective.

Speed Does Not Kill. So, now we know what solder and iron to use, what's the REAL trick to making a "quick" joint? This is where you have to develop the proper techniques in using a "hot" iron. That will take some practice to really get up to speed, especially if you've already developed some bad soldering habits.

Tip maintenance is extremely important when using a "hot" iron with an iron-clad tip. As already mentioned, the tip must be kept tinned at all times for protection of its surface. When first using a new tip, allow it to heat up while attempting to tin it every few seconds with the proper solder until you achieve a complete coating. DON'T allow the tip to overheat without any tinning to protect it!

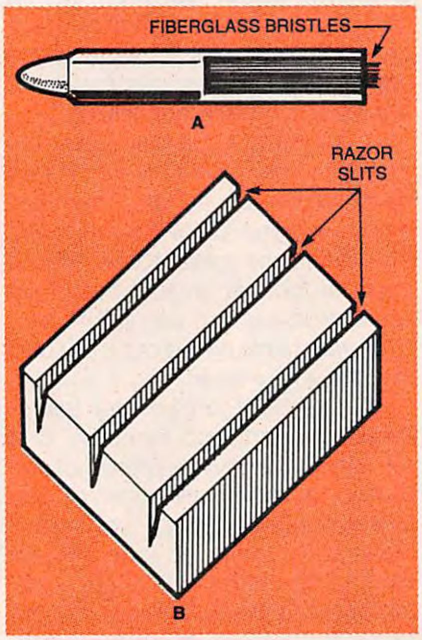
Once you have it completely tinned, shake off the excess solder with a quick flip of your wrist. I keep a standard "paper plate" on the floor next to my bench to catch the solder splats. After a few more seconds, apply more solder to the tip, shaking off the excess once again. Repeat until you're satisfied with the tinning job. (After completing your soldering job, re-tin the entire tip again before removing power from the iron.)

Before applying the tip to any joint, it has to be wiped properly to expose fresh, un-oxidized solder. The best method of doing this is to use a damp sponge. Obtain a standard soldering sponge and before applying water to it, use a razor blade or hobby knife to slit it lengthwise. Cut in about three or four slits without cutting through the sponge material, going down about only half-way through its thickness.

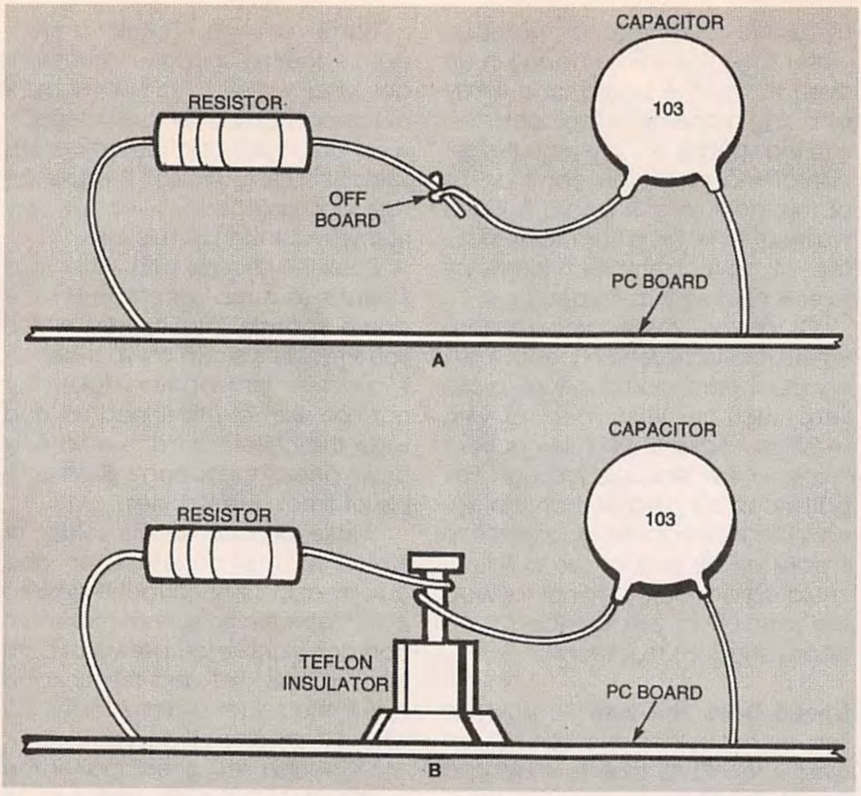
Soak the sponge with water, and squeeze out the excess. Insert the damp sponge into its tray, which you should tie down on your bench in a convenient location. Take your hot iron with its pre-tinned tip and wipe the chisel part of the tip only down one of the sponge slits a couple of times until it shines.

Shake off any excess solder or flux onto the paper plate, and quickly apply the tip to the desired joint. Place the tip so that maximum contact is achieved between both parts of the joint and the tip, and apply the solder directly to the tip where it contacts the joint.

Of course, this goes against the textbook techniques that say to apply the solder to the joint, never to the tip of the iron! Well, that's perfectly fine, if you don't mind cooking everything while waiting for the solder to melt. As I've already stated, I'm showing you



A fiberglass eraser (A) is excellent for removing tarnish and rust. Note the brush full of fiberglass bristles which can be retracted when not in use. The sponge block (B) illustrates the slits made with a razor blade to facilitate proper cleaning of the chisel section of the tip.



To avoid signal leakage through flux residue on the PC board, create an air gap between the joint and the board as shown in A or use a Teflon-insulated terminal as shown in B.

how to make a perfect joint quickly, without damaging anything. By applying the solder directly to the tip where it contacts the joint, it immediately melts, forming a pool of molten solder between the tip and joint. That allows additional solder to flow by quickly wetting the entire joint. (Remember fast heat transfer is what we are after.)

Once that happens, you can shift the solder feed to the joint itself for complete coverage if needed. If you've done all of this correctly, the entire process takes about three or four seconds. It may take some practice, but you'll note that all of your joints come out shiny and smooth, every time!

What about cold-solder joints? These can and do happen, and are almost always the result of oxidation or contamination of the metals in the joint. If you can't achieve a "wet" on a particular joint within about five seconds, remove the heat and select your favorite solder removing tool. I prefer a large, vacuum-type "solder-sucker" over solder-wicking materials. Re-tin the chisel tip, apply it to the joint, and remove the solder you first put on the joint. Be careful not to overheat the joint in this step!

Now take a standard, fiberglass "eraser" (found in office supply stores or at RadioShack) and use it to scrub the entire metal surface of the joint area. The fiberglass "brush" of the eraser does an excellent job in polishing the joint. It is also useful in removing rust from any ferrous materials. Now you may proceed to re-solder the joint; it should wet easily. By the way, it's a wise idea to polish any suspect metal with the eraser before attempting to apply solder; darkened areas of tarnish on switch contacts and some component leads are easily spotted beforehand.

So, there you have it: the quick and perfect solder joint. Sounds easy enough, doesn't it? I know a lot of you out there probably won't agree with my methods, but they DO work well! Why not fire up your old pencil iron and give it a shot. With a little practice, you too can make that perfect joint in under five seconds. Ω