

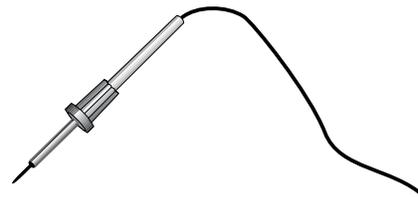
# ICE Devices

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## Appendix: Soldering

This appendix provides background information on these facets of soldering:

- Equipment
- Soldering Procedure—Soldering wire leads to a PC board, soldering wire leads to a wire, and soldering wire leads to multistrand wire
- Wire Stripping



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## Appendix: Soldering

Text by Carl Houtman, Illustrations by Christine L. Cargille

### NOTE

To see a useful video about soldering, go to:

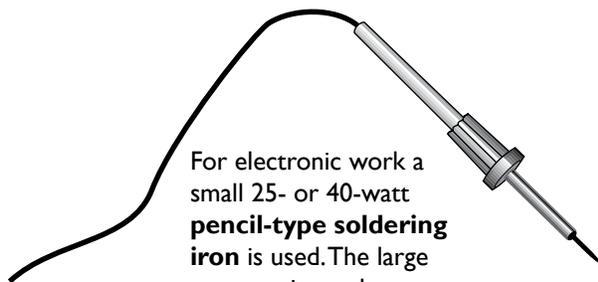
[www.youtube.com/watch?v=BLfXXRfRIzY](http://www.youtube.com/watch?v=BLfXXRfRIzY)

### ⚠ CAUTION ⚠

The tip of a soldering iron is extremely hot. Soldering is inherently a three-hand job: you need to hold the soldering tool and both pieces to be joined. However, it is best to use a vise or a clamp for the third hand, rather than a human assistant.

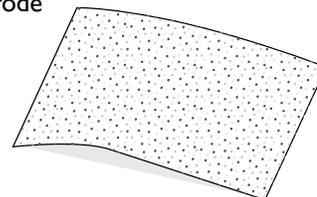
### The equipment

Soldering is a way to join two metal surfaces. For the “glue”, one uses a low-melting-point alloy. For electronic or electrical work an alloy that is 40% tin and 60% lead is best, in contrast to the 50/50 solder that is used for plumbing connections. **Electronic solder** often has a rosin core to act as a flux to improve the “wetting”, or coating, of the metal surfaces to be joined.



For electronic work a small 25- or 40-watt **pencil-type soldering iron** is used. The large gun-type irons do not have a fine enough tip.

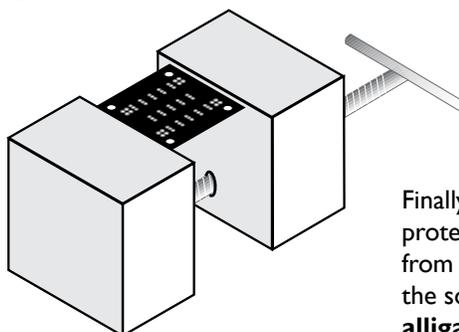
To clean and re-tin the soldering iron tip, use **tip cleaning paste** for electronic work from an electronics store. Do not use acid cleaners or acid flux—they will corrode your work. You can also gently **sand** the surface of the soldering iron tip until you have exposed the base metal.



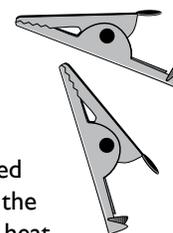
You will need **tweezers or pliers** or some other tools to hold small, very hot, delicate objects.



It will infinitely simplify your task if you have a **vise** or a **C-clamp** to hold one of the parts that you will be soldering—either the printed circuit (PC) board, if you are soldering components to it, or one of the wires, if you are soldering to a wire.



Finally, you may need to protect certain components from overheating during the soldering process. Small **alligator clips** can be clamped between the component and the joint to be soldered to act as heat sinks.



## Soldering procedure

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1.  Clear away a work space on a flameproof surface. **Put on safety goggles** to protect your eyes from hot rosin which might spatter.
2. **Take a sponge, or fold a paper towel** into quarters or eighths and **wet it**; place it next to the soldering pencil.
3. Plug in the soldering pencil and allow it a few minutes to get hot. **Check the tip:** Touch the tip of the soldering pencil to some solder. It should melt and coat the tip. If the solder rolls off the tip and does not coat it at all, you may need to clean the tip as described above. Then the solder will wet the tip surface.

While soldering, **wiping the tip** on the damp paper towel (or sponge) will help clean it by removing the oxide that forms on the surface of molten solder. Wiping on a damp towel also keeps the tip from overheating and oxidizing. To wipe the tip, simply stroke it over the folded paper towel that is lying on the table.

4.  Do **NOT** pick up the towel and rub it over the tip! If you do, you will severely burn your fingers.
4. The most important step in obtaining good solder joints is to **clean all the surfaces** carefully. Solder does not wet oxidized surfaces. When working on a printed-circuit board, rub the metal surfaces with fine steel wool. Other electronic components typically have non-oxidizing wires that don't need cleaning. Copper wires may need to be stripped to expose fresh metal. For help in wire stripping, see the relevant section below.

The next few steps will describe how to solder a wire lead of an electronics component to a printed-circuit (PC) board and how to solder a wire to a post or to another wire. An important point to remember when soldering *any* joint is that it is not sufficient to melt the solder and drip it all over the joint as one might do with glue. The pieces to be joined must be at the same temperature as the molten solder in order for the bond to be strong. Thus, *the soldering iron is used to heat the pieces to be joined, which in turn heat the solder.*

### A. How to solder wire leads to a PC board

5. **Insert the wire leads** of the electronics component into the appropriate sockets of the PC board.
6. **Secure the board** in a vise or clamp.
7. If necessary, **clamp an alligator clip** between the joint and the (heat-sensitive) electronics component to minimize the heat transferred up the wire lead.
8. A *small* amount of solder should be on the tip of the soldering pencil to aid the flow of heat to the surfaces. Hold the soldering pencil in one hand and the solder in the other. Touch the hot tip of the soldering pencil to one side of the wire lead and to the soldering trace on the board. When the surfaces are hot (after about 30 seconds or so), touch the solder (not the pencil) to the other side of the wire lead. Do not let the solder touch the soldering pencil directly.

After about 25 seconds, the heat from the soldering pencil should penetrate through the wire lead and melt the solder. The solder will flow onto the wire and onto the copper trace. The solder only flows onto hot surfaces.

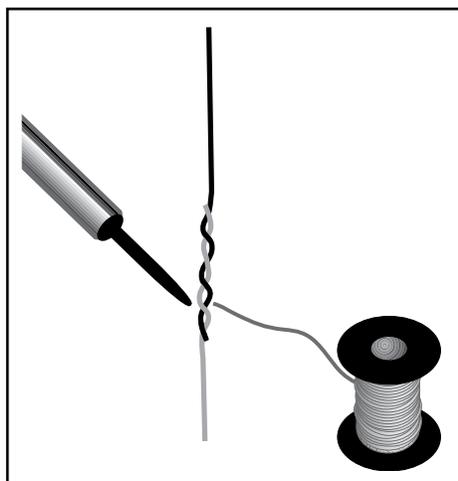
9. Do not use too much solder or it will overflow onto adjacent leads or traces, creating a “solder bridge”. If you make a solder bridge, first rub off any excess solder from the pencil tip on a damp paper towel. Reheat the joint to melt and remove the bridge. If this does not work, heat the joint until *all* the solder is molten and then tap the board on the table. If the solder is molten you should be able to shake it from the board.

### B. How to solder wire leads to wire

10. Make a **firm mechanical connection** by twisting or crimping the wires together. Then, follow instruction number 8 above.

If you do not make a good mechanical connection, you may make what is called a “cold solder joint”.

Cold solder joints form when the wires are moved as the solder is cooling. One can spot cold solder joints because they often have a rough surface while good joints have a smooth surface. Simply reheating a cold solder joint will correct the problem.



### C. How to solder wire leads to multistrand wire

11. Strip 1–1.5” of insulation from the multistrand wire. Twist the strands so that they spiral together. “Pre-tin” the strands: Hold the tip of the soldering pencil to one side of the wire and the solder to the other side. When the wire is hot enough, the solder will melt and penetrate among the strands. Allow to cool. Then, follow instruction number 10 above.

## Wire Stripping

“Stripping” a wire refers to removing the insulation casing and exposing the copper wire. The easiest way to strip wire is to use wire strippers. These are designed to cut the insulation but leave the metal wire intact—they are like scissors with a small notch in the cutting edge. Care is required, however, since many wires are bigger than the notch.

Place the wire in the jaws of the stripper at the position where you want to remove the casing. Squeeze the stripper carefully. [If you are uncertain about how hard you need to close down the stripper, practice by trying to remove a very short piece (1 cm) of insulation.] You may want to rotate the stripper around the whole wire to get an even cut all the way around the insulation.

Once the insulation is cut, shove the stripper along the wire towards the end to push the casing off the bare wire inside. This is like taking off a sock by pushing it down from the top instead of pulling it by the toe.