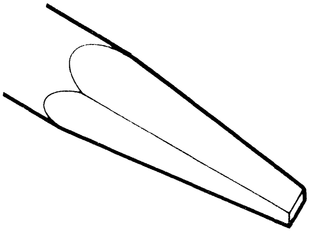
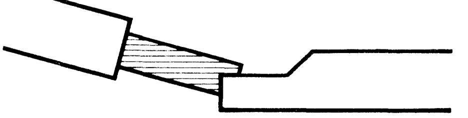
APPENDIX F

How To Make Good Soldered Connections

Although crimping is in many ways superior to soldering contacts onto wires, solder-type contacts are better for a few applications. The following suggestions provide reliable soldered connections with great production efficiency.

Frequently overlooked in good soldering is the importance of *cleanliness*. A contaminated contact or wire simply cannot be joined with any real success to a clean wire or contact. This problem of contamination is too often left for the flux to correct. A cleanser such as Ketone, Toluene, or Alcohol is highly recommended. Kerosene should be used only when other cleansers fail to remove a particular contamination. After using kerosene, recleaning with a different solution is necessary. Care must be exercised in the use of any of these *cleaners*. Do not soak the parts. A gentle brushing should be used instead.





Iron

An electric soldering iron with a rating of from 60 to 100 watts has been found best. The 60-watt iron is recommended for size 20 contacts and the 100-watt for larger size contacts. Any iron of less wattage is usually lacking in heat reserve, and continuous production soldering is slowed while the operator waits for the iron to heat to correct temperature. Then too, with a cold iron the operator is prone to hold the iron too long on the connector's solder cup actually introducing excess thermal energy which "soaks in" during the long engagement. A solder joint that cannot be made in less than five (5) seconds has something wrong with it. In other words: Any iron that cannot heat the solder cup and wire to a soldering temperature in less than five (5) seconds either is not hot enough or lacks adequate heat reserve. Also, any contact or wire which won't tin after less than five (5) seconds of proper heat application is either too dirty or inadequately fluxed.

The tip of a soldering iron should be filed flat, thin, and long enough to fit between the connector's contacts and touch but one solder cup at a time. (see Figure F-2)

Copper alloys developed for solder tips give better performance than plain copper. The special alloys reduce scaling, and increased hardness allows longer usage between tip filing.

Flux

The only recommended flux for soldering electrical connectors is rosin. Rosin is the only known flux that will not corrode the copper wire or components. The flux has an important role in soldering. It not only removes oxides present, it also prevents the formation of new oxides during soldering. Finally, flux allows the solder to flow evenly, and unite firmly with the surfaces.

The ideal solder is composed of 63% tin and 37% lead. Called *eutectic solder* it melts and flows at 361°F (183°C). It is more expensive than other tin-lead alloys. A good economical compromise for electrical installations is 60% tin and 40% lead and melts at approximately 370°F (188°C). All other compositions melt through a range shown in the Tin-Lead Fusion Chart below.

A short study of the chart will show that the use of any solder other than 63-37 requires additional heat. This should be avoided.

Tin-lead Fusion Chart

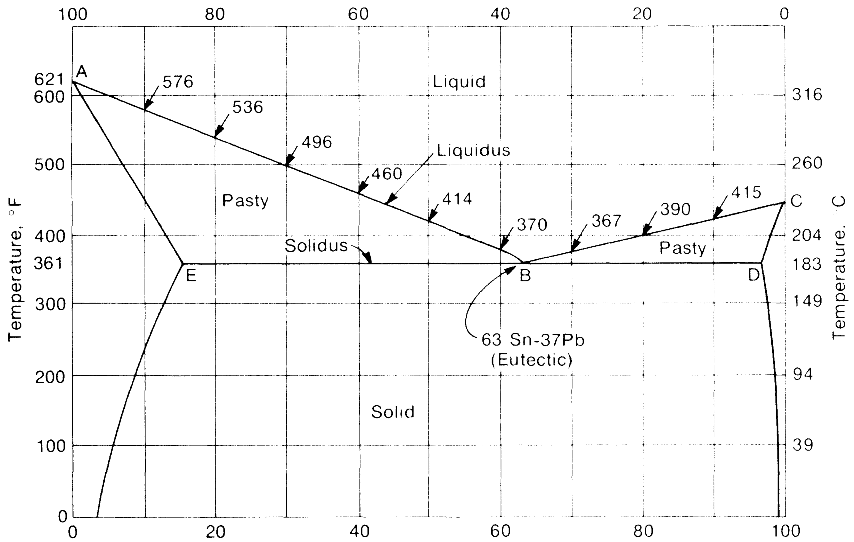


Figure F-1

Tinning

Whenever possible, the connector to be soldered should be placed in a suitable jig or fixture that will hold the connector securely with the solder pots' open, or cut-away, portion up, and the hole inclined slightly back down. This way the melted solder tends to run into the bottom of the solder cup. This first step is called "tinning the solder cup." The solder cup is tinned, and the solder cup loaded with the correct amount of solder for the actual soldering operation. The amount of solder depends on the size of the contact and the conductor's size. At this point too little solder is much better than too much. The hot iron, maintained at approximately 600°F by suitable controls, is first tested by applying a bit of solder to it and then the hot, wet, bright, clean tip is placed across the open or cut-away portion of the solder cup. (See Figure F-3.)

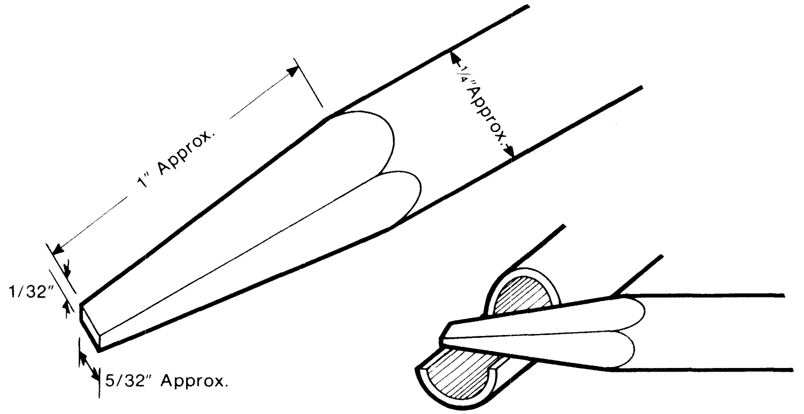


Figure F-2
Tip of soldering iron

Figure F-3
Hot tip placed across cut-away portion of the solder cup.

In 1-1/2 to 2 seconds the solder cup end of the contact should be hot enough to melt the solder now placed in it. Remove the iron as soon as possible. Here again it is cautioned that five seconds is the maximum time required or tolerated. After tinning, each connector should be allowed to cool to room temperature before soldering the wires in place.

Wire Stripping

The following few rules should help cope with most wire stripping problems:

When stripping 14, 12 or 10-gauge wires, use the next larger size cutting hole of the stripper to first crack the insulation and remove the outer insulation. Next use the proper size cutting hole to remove the inner insulation layer.

When stripping 16-gauge wires, one should first crack the insulation, then rotate the wire 90° and complete the stripping. When stripping Teflon insulated wire use a hot wire stripper.

When stripping 18 to 22-gauge wires, first crack the insulation with the correct size cutting hole and remove the insulation (or strip) with the next larger size hole.

When stripping a conductor composed of many fine strands, separation of the wire strands can be avoided if the operator does not remove the insulation completely, but pushes the insulation back only far enough along the wire to expose the conductors for tinning. After tinning, the wire can be cut to the correct length, and the soldering continued. This is illustrated in Figure F-4. Tinning is best accomplished by rolling the wire on a hot iron and adding a small amount of solder.

Next, cut the tinned wire to a length approximately 1/16" longer than the total solder cup depth. The wire is now ready for insertion into the tinned (and loaded) solder cup.

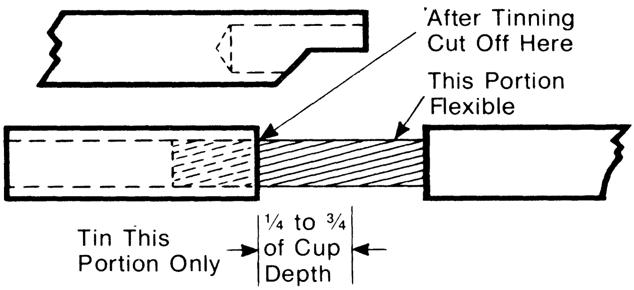


Figure F-4
After tinning, the wire can be cut off to the correct length and the soldering continued.

When installing wires into the connector it has been found that working from the lower left hand corner, from left to right and bottom to top, is the best for a right-handed person.

Hold the prepared wire (per the previous instruction) between the thumb and forefinger of the left hand. Support the hand on the jig or fixture holding the connector with tinned solder pots. Touch the flat face of the hot-bright iron to the cut-out side of the solder cup. The solder in the cup will become liquid almost at once. The iron is then tilted slightly to act like the top of the cut-out portion of the solder cup. This causes the iron to aid in "funneling" the wire which is now inserted into the contact. (See Figure F-5.)

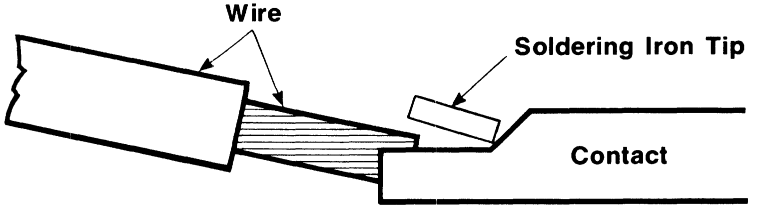


Figure F-5
Positioning during installation of wire into connector.

Immediately remove the iron, but do not move the wire as this will result in a cold solder joint.

This entire operation of heating the solder cup end, inserting the wire, and removing the iron should never result in the iron being in contact with the solder joint longer than (5) seconds.

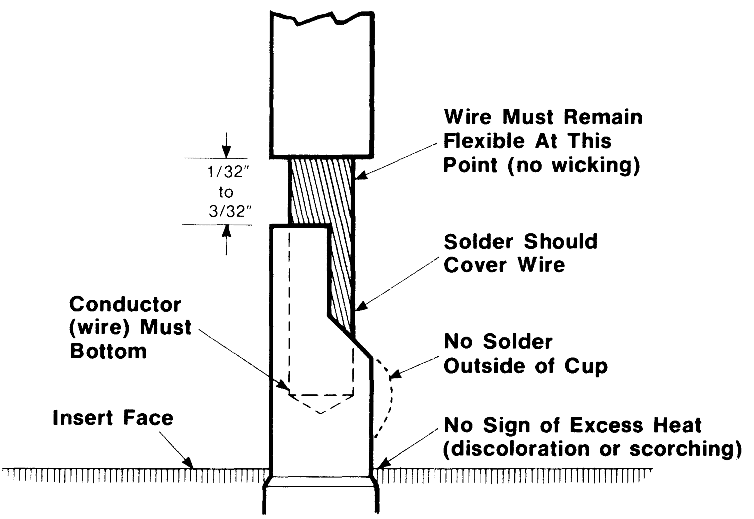


Figure F-6
Check-list of good wire connection.

Theoretically, if all of the steps have been followed exactly, you now have a perfect solder joint. However, since we are not always perfect the solder joint must be checked. If there isn't enough solder in the cup prior to inserting the wire (solder should cover wire but the contour of the wire should still be visible), more solder can be added.

If, however, there was too much solder in the cup before inserting the wire, you now have solder running down the outside of the solder cup. This is a serious flaw for this solder can cause a direct short between two contacts and will most certainly cause a loss of mechanical spacing plus a degradation of electrical high potential resistance.

If the wire is stiff above the solder cup the iron was held in contact with the wire too long or the wire was not tinned to a proper length.

Figure F-6 illustrates a few of the points to watch for, and should serve as a sort of check list of what constitutes a really good wire connection.

It must also be pointed out that the accumulative heat occurring when soldering twenty or more contacts in a short period of time is detrimental to the functioning of the connector.

Therefore:

1. Solder only one-half of the wires into a connector with 20 to 40 contacts. Allow connector to cool, then
2. Solder remaining wires into the proper contacts.

When soldering a connector with 40 to 60 contacts, break the soldering sequence into three steps with two cooling periods.