# SOLDERING WITHOUT TEARS

SOLDERING is an art that can be perfected by practice and careful observation of a few basic rules. The pictorial series here is intended to show how to make and recognise good sound soldered joints, and how to avoid dry joints which can cause instability problems.

Before starting to solder, make sure that you have the right tools for the job; these (shown in Fig. 1) are a soldering iron, a pair of wire cutters, a pair of long-nosed wiring pliers, and solder. Wire strippers may be found useful (see later). Solder can be obtained in different grades according to the job in hand; this article will confine itself to the jointing of wires, tags, pins and copper laminate, found in most electronic circuits. Plastics-covered tinned copper wire is recommended for wiring of circuits.

## SOLDERING IRONS

Choose the right iron for the job. For most wiring work a 23–27 watt iron will suit most purposes. If soldering delicate wires or printed circuit boards a 15 watt pencil bit iron will prevent excessive damage to the insulation or bonded copper.

*Fig. 1. Tools for the job*

Until fairly recently most irons had pure copper bits which have to be tinned before use. If you have one of these you may find that the tip will tend to be eaten away into a saucer-like depression due to oxidisation after a long period of use. In this case the tip must be filed flat at an angle of about 45 degrees (see Fig. 2) while the iron is cold.

The iron should be tinned when hot, that is, given a thin coating of solder, to ensure maximum transfer of heat and prevention of dirt ingress (Fig. 2). New irons are usually supplied with the tip already shaped and tinned. Some iron tips are shaped to a point or some other form for special purposes.

More recently soldering iron tips have become available which are treated with iron plating to obviate corrosion; these should not need to be tinned or filed, although they will acquire a coating of solder when used.

It is well worth investing in a stand for your iron to guard against accidental burning when not in use (Fig. 3). Never hook an iron on to the nearest convenient nail or chassis, or the penalty may be the cost of a new jacket or shirt (Fig. 4).

Soldering irons can be dangerous tools if not treated with care, but with controlled handling can give many years of successful soldering as found in industrial equipment.

## SOLDER

There are two basic classes of soft solder: the type sold in bar form that has no flux inside is intended for sheet metalwork in conjunction with a flux paste; modern solders with flux inserted inside are suitable for all electronic wiring and light metalwork. This is often called "cored solder". The flux is injected during manufacture of Ersin Multicore solder into five tubes inside the solder in the correct proportion to the amount of solder alloy. No additional flux is required;

*Fig. 2. The tip must be flat and tinned*

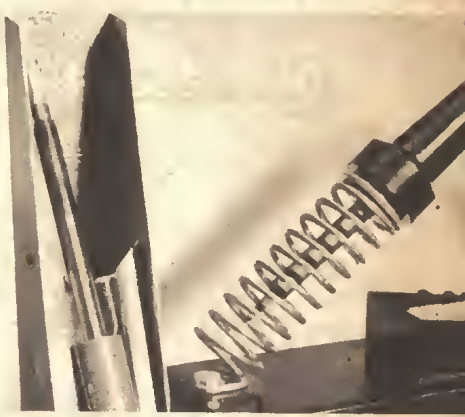

*Fig. 3. Invest in a protective stand*

*Fig. 4. Never hook an iron on a chassis*

in fact the use of flux paste for wiring is detrimental and should be avoided.

Solder is a metal alloy composed of tin and lead. The proportions of this mixture are carefully controlled, different ratios being applied for different grades of solder according to their application. The most suitable grade for high quality wiring where a low melting point alloy is required is 60/40 (60% tin, 40% lead). The recommended minimum bit temperature for this grade is 248 degrees C.

A specially prepared alloy, containing a small amount of copper, is made which slows down the process of copper bit corrosion. This is Multicore Savbit which is made in a variety of alloy ratios, but grade No. 1 is generally the most widely used for wiring applications. The alloy in this type of solder contains a small amount of copper which is transferred to the solder joint, preventing the deposit of copper from the bit of the soldering iron.

## OTHER TOOLS

The other tools which will be most useful are wire cutters and thin long-nosed pliers; both should have insulated handles if working near live equipment.

A pair of wire strippers may be found useful for cutting wire and baring the ends, the cutting notch being adjustable according to the size of wire being stripped.

For soldering heat sensitive components, particularly subminiature resistors, diodes, transistors, etc., a useful tool is the heat shunt clip. This can be made by using a crocodile clip and soldering solid copper faces to the jaws. By clipping this to the component wire, both hands are left free to carry out the soldering process. Having selected the tools for the job in hand, a few notes are worth inserting here before getting down to soldering.


*Fig. 5. (a) Good tinned end (b) bad blob and melted plastics*


*Fig. 6. (a) Stripped insulation by hot iron (bad) and (b) with strippers (good)*

*Fig. 7. The bare wire end may be tinned*

## TIPS ON THE METHOD

The soldering iron is subject to temperature changes according to environmental conditions. If working out of doors the heat from the iron will tend to be reduced by a cool atmosphere or breeze. If working in the garage or workshop do not allow draughts from open doors or windows to come into contact with the iron; again the temperature may drop. Such a loss of heat will result in difficult soldering and bad joints.

If the iron is in good condition and properly prepared with a smooth flat tinned tip, maximum heat transfer will take place. Remember that the iron is supposed to heat the wires as well as melt the solder.

When holding the iron, grip the handle like a pen; gain control of the iron—be firm but careful and do not let the iron become your master.

To make a soldered joint between two pieces of metal a small amount of 18 s.w.g. solder is made to run between them in a molten state. The solder must clearly melt at a lower temperature than the pieces of metal to be jointed which in electronic work are usually a wire and tag.

For the joint to be firm and sound the fluid solder must "wet" the surface of each part of the joint, just as a drop of water wets a piece of dry wood and spreads out to form a damp patch. The solder must penetrate a little way into the surface of the components being jointed. When that happens a sound joint results; on cooling down, the harder metals are firmly locked together by a thin and now solid layer of the softer metal laying between them, that is rooted into their surfaces. Inefficient soldering where the two parts are not electrically sound, are called dry joints.

When any soldering is being undertaken the parts that are to be joined must be clean. However, even that is not sufficient because when metals are heated, an oxide forms and makes it difficult for the solder to penetrate into the surface of the metal. Consequently a flux is used, and an efficient one will not only remove the surface oxide which already exists but will prevent it forming when the metal is heated.

When undertaking the soldering of electronic or electrical equipment it is essential to ensure that the flux is not corrosive, that is, the flux residue must not absorb moisture from the air which may subsequently cause the joint or the metal to be "eaten" away by corrosion. Liquid or paste fluxes which can be used effectively for non-electrical joints are quite unsuitable for this reason.

## SOLDERING WIRES TO TAGS

Insulated wires and component wires require the same treatment. Fig. 5 shows a plastics-covered tinned copper wire which has to be connected to a tag strip. Strip about ¼in of insulation from the end with strippers, wire cutters or knife. Make sure the actual copper wire is not nicked at this point or it may fracture at a later date. If it is, cut the wire and try again. Do not strip plastics insulation by melting with a soldering iron; this will spoil the appearance of the wiring and make the iron tip contaminated, making subsequent soldering more difficult (Fig. 6).

Next, the bare wire end may be tinned, that is, a thin coating of solder deposited on the wire. This will help to achieve a sound joint. Fig. 7 shows this being done. Hold the iron on the wire just long enough to melt the solder and make it flow along the wire. If the iron is held on the wire too long the insulation may melt back along the wire (Fig. 5b). If there is excessive solder on the wire in the form of a blob, reheat the solder and quickly wipe off the surplus with a piece of rag.

Fig. 8. Tinned cleon tags ond wire fitted

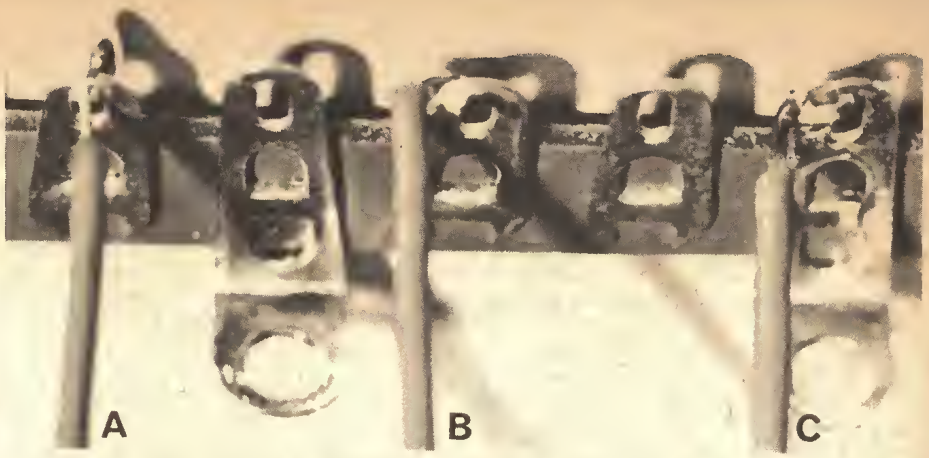


Fig. 10. (o) Lock of solder, Insulotion melted BAD JOINT; (b) Even flow of solder, Insulotion maintained GOOD JOINT; (c) Wire not gripping tog, quick solder blob BAD JOINT

Fig. 9. Apply iron to tag ond wire, then the solder

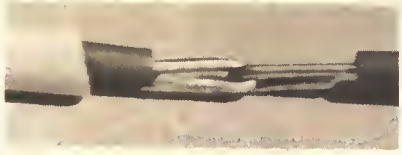

Fig. 11. Two wires bent ond squeezed

Fig. 12. Even flow of solder, insulation mointoined

Fig. 13. Allow the solder to flow evenly over copper ond wire

Fig. 8 shows the tag. Most tags are supplied already tinned but if they are a dirty grey colour or untinned a thin coating of solder must be applied in the same way. Sometimes the tags can be so badly soiled that the solder will not adhere at all. Then all the dirt and oxide on the tags must be cleaned off with fine emery paper or scraped with a knife first. This also applies to some component wires that have been in store for a long time.

The wire is now fitted to the tag (Fig. 8). Bend the wire and pass it through the taghole (if there is one) or wrap round the tag once only. Squeeze the wire with pliers so that it grips the tag firmly. Apply the iron tip to the tag and wire, then the solder (Fig. 9). Do not obtain a blob of solder on the iron and carry it to the joint, or the flux will not perform its duty in making the solder flow over the joint. Do not use too much solder, just enough to coat the wire and tag evenly. The solder should not settle as a blob or a "dry" joint is very likely to result.

Fig. 10 shows a good joint in the centre and bad joints on either side. On the good joint, you will also see that the plastics sleeving is maintained right up to the tag. Surplus solder is carried away by the iron then removed with a piece of rag. Some constructors tend to shake the iron to remove the surplus solder, but it could finish up on your clothing and soil it.

A hot iron held too long on a component tag or wire, particularly transistors, can cause the component value to change completely. Make sure your iron is at the correct temperature to heat the parts to be soldered without any delay whatsoever. Any deposits of dirt or excess solder on the iron tip can be wiped off with a piece of rag.

## JOINING TWO WIRES

The example given here shows two pieces of plastics-insulated wire jointed and sleeved. The same rules about preparing the wire apply as before.

Fig. 11 shows the two wires bent and squeezed ready for soldering. A piece of sleeving is passed over the wire ready for fitting firmly over the joint.

Fig. 12 shows the finished soldered joint, again not in blob form. Finally slide the sleeve right over the joint.

## WIRING PRINTED BOARDS

With the advent of microelectronics, there is an ever increasing need for the use of smaller soldering irons with careful heat control and fine cored solder (22 s.w.g.) in order to make a perfect electrical soldered joint. A suitable alloy for this purpose is 60/40 or Savbit due to its melting properties. Extra care must be exercised in preventing too much heat reaching the heart of components such as transistors, diodes and miniature resistors. Maintain as long a length of the component lead as possible to facilitate re-use later and to help to apply a heat shunt as mentioned before.

Again the rules are the same. Pass the bare tinned wire end through the hole in the board and allow the solder to flow evenly over the wire and copper (Fig. 13). Trim off any surplus wire with cutters. When wiring to printed circuit boards or Veroboard it is best to use an iron with a smaller bit (as found on 15 watt models) so that heat is not excessively spread over a wide area, at the risk of loosening adjacent joints.

Finally to check that the joint is good, grip the wire with the pliers and give a gentle pull. If a loose joint is evident, clean and resolder. ★