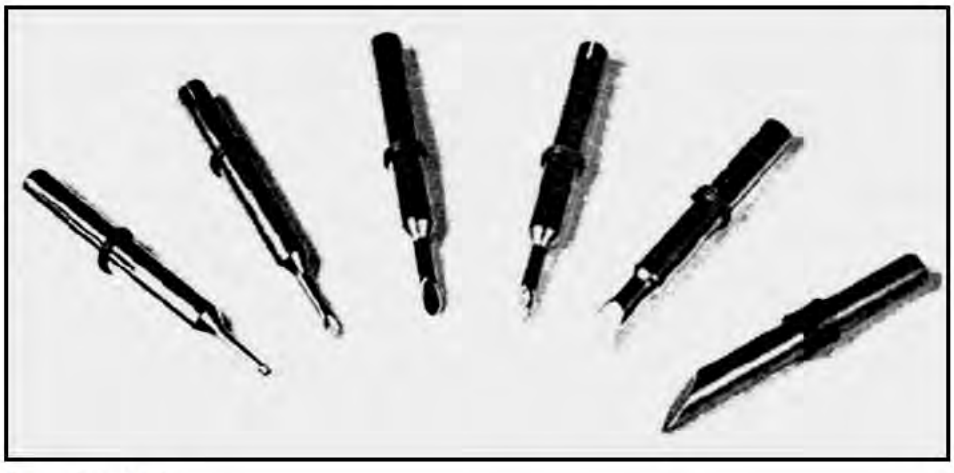
HOW TO SOLDER

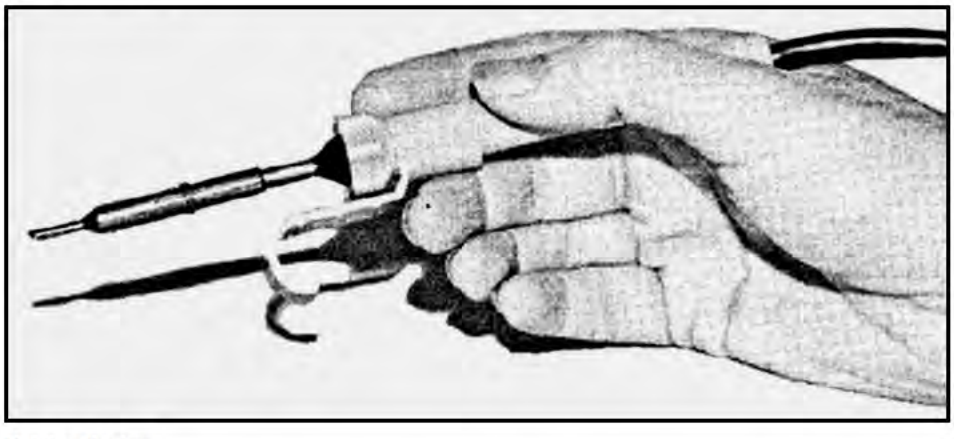
by Richard Bushell

Soldering is a term applied to an alloying process in which the applied solder combines with the metals to be joined together. To achieve this it is essential that the surfaces to be joined are clean. It is not sufficient, however, solely to clean the surfaces and then hope to make a joint with solder. It is necessary to apply - during the soldering operation - a wetting agent or flux, which removes the existing oxide film on the surfaces to be soldered, and prevents further formation of oxide.

The solder in common use is in wire form, ranging from 60/40 to 20/80 tin/lead composition, with a core of activated resin to provide the correct proportion of flux.



A selection of bits.



Holding the iron.

Soldering Irons

Soldering irons are available in numerous shapes, sizes, power consumption and bit temperatures; the following factors should be considered when choosing an iron:

1. Supply voltage available.
2. Heat capacity, depending on size of joints required to be soldered.
3. Temperature required to ensure that the solder flows freely.
4. Size and shape of tip for adequate contact with joint.

In general, for circuit wiring and similar work, the smallest types are the most useful. These are usually described as miniature or sub-miniature irons. A miniature type iron weighs 55-85 grams and enables useful finger tip control; it is also less tiring to use than the heavy types which usually have to be held in the palm of the hand. Miniature irons are available in power ratings from 8-40 watts.

The temperature at the tip of the bit must be high enough so that the heat transferred to the joint permits the solder to flow freely. One should remember that there is always a loss of temperature when making a joint because the heat transfer to the jointing metals, melting the solder. Therefore, the bit temperature should always be approximately 100°C higher than the melting point of the solder, or, for continuous work, 150°C higher.

These bit temperatures apply to miniature soldering irons and allow for a drop in "tip" temperature as it is applied to the joint. The tip temperature is closely related to the size of the tip; the smaller the tip, the lower the temperature at the tip for a given power consumption. The size of the tip is, of course, determined by the size of the joint requiring to be soldered and should be large enough to match as precisely as possible the size of the joint. This way, adequate conduction of heat from tip to joint is ensured.

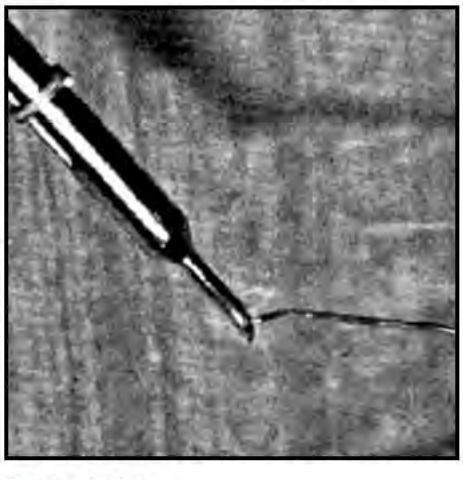
Tips and Bits

A feature of the modern soldering iron is the material and finish or coating deposited on it. The most important of the many material combination features are the following:

1. Bits made of high conductivity copper coated in iron, nickel or chromium.
2. Bits made of copper alloy, usually chromium copper, or beryllium copper and nickel, or cadmium coated to prevent scaling.
3. Copper bits fitted with iron or nickel tip.

The use of a high copper content provides the most efficient bit, but scaling occurs at a comparatively low temperature and the bit will be subjected to pitting in use.

These objections are overcome by coating both the bit and the tip with other materials. Iron coating is usually employed which prevents loose scaling and considerably increases the life of the bit, the latter being dependent on the thickness of the coating applied. Here again, a compromise is necessary, as a thick coating on the tip impairs the efficiency. The copper bit treated in this way may be used at considerably higher temperatures but care must be taken to keep the tip tinned or a rough oxide coating will build up and so prevent further use.

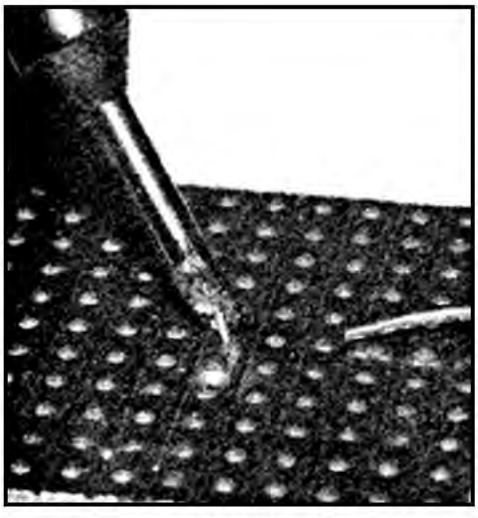


Tinning the bit.

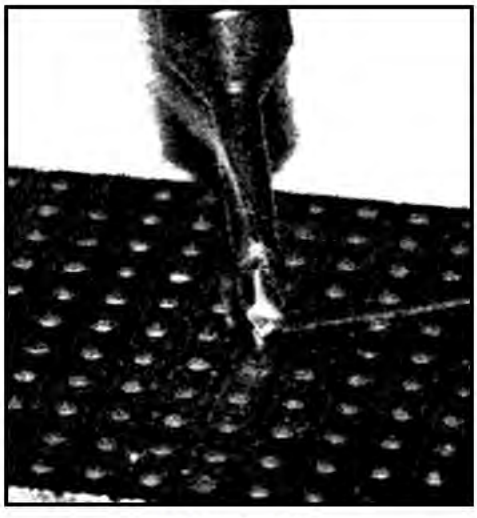
Using the Soldering Iron

The iron must be correctly connected to the power supply before use. The circuit to which it is connected should provide adequate protection for the operator in the event of a fault occurring, or, for example, as a result of damage due to dropping the iron. This protection is usually provided by the fuse.

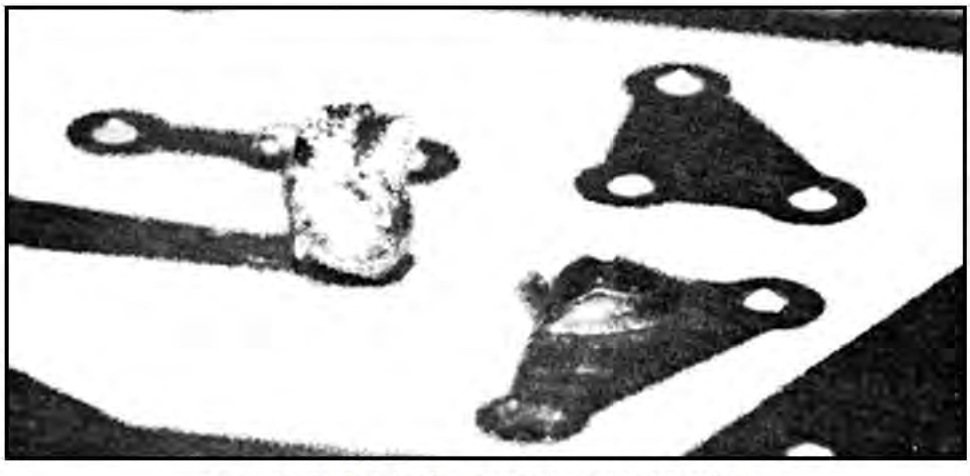
Surplus solder should be wiped from the tip of the iron. Do not shake the iron free of solder. This action is not only dangerous to the operator but may damage the work being soldered and/or the soldering iron. The iron should never be knocked on the bench in order to remove surplus solder. This will inevitably cause damage to the iron and may



Heating the joint before applying solder.



Making the joint.



Example of a dry joint (left) and a good solder joint (right).

result in serious burns or shock to the operator.

Before the soldering iron can be used, the tip of the bit must be tinned and this operation is best carried out using the resin cored solder. It is essential to tin the tip before the oxidisation temperature of the bit material is reached. To ensure this, apply the solder to the tip immediately the iron is switched on and, as the solder melts, apply it over the whole surface of the tip. Some surplus solder will remain, this can be removed carefully with the wiping pad.

The iron should then be used immediately - prolonged heating of the bit may result in the solder forming a film of oxide which will impair the strength of the solder joint. Before the iron is left idle, some surplus solder should be applied to the tip to prevent oxidisation of the basic metal of the tip.

If the iron is not to be used for a considerable time, it should be switched off. Modern irons heat up quickly so little time will be wasted in taking this precaution.

When the iron is heated up and the tip properly tinned, it is ready for use. All miniature and sub-miniature irons are intended to be held as one would hold a pencil, between the fingers and thumb, with the handle projecting between the first finger and thumb and the connecting lead resting over the wrist.

When soldering a joint, first apply a small amount of fluxed solder to the tip of the bit. This will ensure a better heat transfer to the joint since .the interface will be a molten solder which can cover a greater surface area. Place the tip on the joint and keep it in contact until the joint reaches the melting point of the solder, then apply sufficient solder to the joint (not the tip!) such that the whole joint is embraced by solder. Leave the tip in contact with the joint to ensure complete solder flow around the joint. A joint that is dirty or heavily oxidised cannot be soldered with normal resin cored solder; it is therefore essential, before attempting to solder a joint, to see that it is clean.

It is common practice to pre-tin all components and wires before assembling them ready for jointing. An excessive amount of solder should not be applied, either to the tip or the joint. It is difficult to remove surplus solder from a joint, and excessive application of solder to the tip causes premature tip wear.

Inexperienced operators usually use far too much solder which results in excessive operating costs and premature erosion of the tip of the bit. Also, more often than not, they apply the solder to the tip instead of the joint, usually well before the joint has reached the required temperature.

In continuous soldering processes it should not be necessary to remove any surplus solder from the tip. If it is necessary, too much solder is being used. In mass production, an operator usually solders only one or two joints on an assembly and uses a soldering iron fitted with the correct size and shape of bit for the size of joints to be soldered. In batch production work, however, it is necessary for the operator to solder several joints on an assembly which could be of different sizes. This type of work requires different size tips and often different size irons; the operator often has two or three irons, each fitted with the type and size of bit for the corresponding size joint. This method is usually more economical than continually changing the bits. In an experimental laboratory, it is usual to find at least three different sizes of soldering iron because the work is so varied.

Soldering Joints on Transistor Circuits

Special problems arise when soldering circuits involving joints near transistors because these delicate components are easily damaged by the application of too much heat to the connecting wires. This is overcome by using a heat shunt, clipped on to the wire between the joint and the transistor. It is necessary to solder the joint as quickly as possible, and it is therefore essential that the tip of the bit is hot enough to melt the solder quickly and that the wires to be jointed are cleaned and, preferably, pre-tinned.

The wiring in transistor circuits should always be earthed correctly and the circuit board disconnected from any test gear and power supplies, otherwise an earth loop may be created when the bit is applied to the joint, creating a potential difference across the electrodes of a transistor in excess of its maximum rating.

Care and Maintenance of Soldering Irons

In common with all tools, the soldering iron has to be maintained in good condition. Two categories of maintenance are necessary:

1. Re-conditioning the bit and cleaning the iron.
2. Replacement of worn or broken parts.

The bit should always be kept in good condition and well tinned on the working surface. Excess solder on other parts of the bit should be quickly removed as this may cause rapid pitting of the surface and so shorten the life of the bit.

Prepared or coated bits should not be filed to shape or cleaned with any abrasive material. The coating is applied in order to prevent or reduce the effect of pitting and considerably increases the life of the bit.

If the soldering iron is fitted with a removable bit, this should be removed at intervals and any loose oxide film removed from the iron and bit. This will prevent the oxide building up and eventually fixing the bit to the iron shaft, making removal of the bit difficult if not impossible.

All parts of the iron should be kept clean and free from grease or moisture. The connecting lead should be regularly inspected for burns and cuts.