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THE BASIC SOLDERING GUIDE

Covers:

- Soldering Irons
- How to Solder
- Solder Grades
- Desoldering Methods
- Troubleshooting

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The Basic Soldering Guide

by Alan Winstanley

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This booklet has been specially written to help beginners, hobbyists, trainees and those involved in other industries to obtain effective results when soldering electronic components for the very first time. It is based on the author's popular *Basic Soldering Guide* which is now published on the World Wide Web and is recognised as one of the world's leading references of its type on the Internet.

Introduction

The first and most important aspect of assembling any electronic project is undoubtedly that of soldering, which is a delicate and precise skill that is only ever mastered with experience. There is no short cut to acquiring the necessary expertise and it takes a certain amount of practice in order to produce a consistently satisfactory solder joint. However, like riding a bicycle, soldering is an art which once learnt is never forgotten, and the purpose of this booklet is to outline the techniques of soldering and desoldering which we hope will set the hobbyist or novice technician firmly on the road to successful electronic assembly in the future.

The principle behind soldering sounds quite simple: the idea is to join components together to form an electrical connection, by using a mixture of lead and tin (solder) which is melted onto the joint using a soldering iron. If you have never picked up a soldering iron before, then this guide will show you everything to help you start soldering with confidence. We also hope that the guidance given will help those involved in other areas of industry – computer technicians, for example, who may be forced to undertake occasional electronic repairs or modifications, will benefit from the advice given in this guide.

Before embarking on any form of ambitious electronic project, it is recommended that you practice your soldering technique on some new components using clean strip board (or protoboard) or a printed circuit board, and select a simple and straightforward constructional design as a starting point. Become acquainted and comfortable with your chosen soldering iron, which is likely to become as familiar to you as a favourite pen. Learn how to balance it and apply it with precision. Try soldering an assortment of resistors, capacitors, diodes, transistors and integrated circuits.

By achieving success with a modest electronic project, as published in *Everyday Practical Electronics/ETI*, this will be a great confidence booster and more importantly it will introduce you to some of the manual soldering skills which ought to be mastered before proceeding to more ambitious assemblies.

Soldering irons

Pick up any electronics catalogue and you can be forgiven for being bewildered by the vast array of soldering equipment which is available, which includes irons, controllers, work stations and desoldering equipment too. A large range of soldering irons is readily obtainable – which one is suitable for you depends on your budget and how serious your interest in electronics is, but there is something for every pocket distributed by a variety of retail, industrial and mail-order outlets.

Electronics catalogues often include a selection of well-known brands of soldering iron, including the popular Antex range and also the well-established Adcola and Litesold makes, and Weller is an extremely popular brand used in industry and education. A very basic mains electric soldering iron can cost from under £5 (US$8), but expect a reasonable model to be approximately £10 to £12 (US$ 16 to 20) – though it's possible to spend into three figures on a soldering iron "station" if you're really serious about the subject!

The very cheapest irons tend to be less than precise in terms of providing pin-point accuracy for delicate soldering jobs: they can be slightly clumsy and the soldering iron tips (see later) are often imprecisely formed. Check some suppliers' catalogues for some typical types, though don't be tempted to over-spend on an elaborate workstation unless you are really very serious about becoming involved in electronics. You will usually obtain perfectly satisfactory results using a fairly modest model, which can help you to decide on the need to upgrade to a more sophisticated version later on should your needs change.

When choosing your soldering iron, certain factors which you need to bear in mind include:

Voltage: for the British market, ''mains'' irons run directly from the mains at 230V a.c. or will obviously be set for other voltages (110V a.c.) depending on the country. However, low voltage types (e.g. 12V or 24V) generally form part of a ''soldering station'' and are designed to be used with a special controller made by the same manufacturer (see later).

Wattage: typically, irons for general electronics work may have a power rating of between 15 to 25 watts or so, which is fine for most electronic assembly tasks. It should be noted that a higher wattage does not mean that the iron runs hotter – it simply means that there is more power in reserve for coping with larger joints. This also depends partly on the design of the ''bit'' (the tip of the iron).

Consider a higher wattage iron simply as being more ''unstoppable'' when it comes to heavier-duty work, because it won't be drained of its heat so quickly. This can be very useful when a large variety of soldering tasks may be undertaken, as the higher wattage will assist with producing large solder joints successfully. This brings us to the next consideration:

Temperature Control: the simplest and cheapest types don't have any form of temperature ''regulation''. Simply plug them in and switch them on! Thermal regulation is ''designed in'' (by physics, not electronics!): sometimes they are described as ‘‘thermally balanced’’ as they have some degree of temperature ‘‘matching’’ – in other words, they warm up as quickly as they lose heat during use, so in a primitive way they maintain roughly a constant temperature. This type of iron is perfectly acceptable for hobby or less demanding professional use.

Unregulated irons form an ideal general purpose iron for most users, and they cope reasonably well with printed circuit board soldering and general interwiring. However, most of these ‘‘miniature’’ types of iron will be of little use when attempting to solder large joints (e.g. very large terminals or very thick copper wires) because the components being soldered will draw or ‘‘sink’’ heat away from the tip of the iron, cooling it down too much and preventing solder from flowing properly. This is where a higher wattage may prove more useful.

A proper temperature-controlled iron will be quite a lot more expensive – retailing at say £40 (US$60) or more – and will have some form of built-in thermostatic control, to ensure that the temperature of the ‘‘bit’’ (the tip of the iron) is maintained at a fixed level within reasonable limits. This is desirable especially during more frequent use, since it helps to ensure that the temperature does not ‘‘overshoot’’ in between times, and also guarantees that the output will be relatively stable. Some irons have a bimetallic strip thermostat built into the handle which gives an audible ‘‘click’’ in use, and some may include an adjustable screwdriver control within the handle as well.

Yet more expensive still, soldering stations cost from £70 (US$115) upwards (the iron may be sold separately, so you can pick the type you prefer), and consist of a complete mains powered bench-top control unit into which a special low-voltage soldering iron is plugged. Some versions might have a built-in digital temperature readout, and will have a control knob to enable the setting to be varied. The temperature could be boosted for soldering larger joints, for example, or for using higher melting-point solders (e.g. silver solder). These are designed for the most discerning users, or for continuous production line or professional use. The best soldering stations have irons which are well balanced, with comfort-grip handles which remain cool all day, and cables which are burn proof. A thermocouple will be built into the tip or shaft, which monitors temperature.

Anti-static protection: if you're interested in soldering a lot of static-sensitive parts (e.g. CMOS chips or MOSFET transistors), more advanced and expensive soldering iron stations use static-dissipative materials in their construction to ensure that static does not accumulate on the iron itself, which could otherwise accidentally damage certain electronic components. You will see these irons listed as "ESD safe" (electro-static discharge proof). The cheapest irons are not ESD-safe but never-the-less will usually perform perfectly well in most hobby or educational applications provided you take the usual anti-static precautions when handling the components. The tip would need to be well earthed (grounded) in these circumstances.

Bits: it's often useful to have a small selection of manufacturer's bits (soldering iron tips) available with different diameters or shapes, which can be changed depending on the type of work in hand. You will probably find that you become accustomed to, and work best with, one particular shape of tip for the majority of your work. Usually, tips are iron-coated or nickel-plated to preserve their life and to maintain good tip "hygiene".

Spare parts: it is always reassuring to know that spare parts are likely to be available in the future if required, so if the element blows, you don't need to replace the entire iron. This is especially the case with expensive irons. Check through some of the larger mail-order catalogues to see whether spare parts are listed. One drawback is that you may need the services of another soldering iron when exchanging a broken heating element!

Other Varieties of Iron

You will occasionally see gas-powered soldering irons which use butane propellant rather than mains electricity to operate. They often include a built-in piezo or flint lighter to ignite them, and have a catalytic element which, once warmed up, will continue to glow hot when gas passes over them. Field service engineers use gas-powered irons for working on repairs where there may be no power available, or where a joint is tricky to reach with a normal iron, so they are really for occasional "on the spot" use for quick repairs, rather than for mainstream construction or assembly work. Other gas-powered irons are nothing more than miniaturised blowtorches, which may or may not be useful for occasional heavier duty soldering but in the author's experience they can be difficult to use in confined areas.

A solder gun is a pistol-shaped iron, typically running at 100W or more, and is completely unsuitable for soldering modern electronic components: they're too hot, heavy and unwieldy for micro-electronics use (nor are they designed for that). Plumbing, maybe..!

Soldering irons are best used along with a heat-resistant bench-type holder, so that the hot iron can be safely parked inbetween use. It is extremely important that a hot soldering iron is always safely "parked" ready for action, and a bench stand is really a necessity. Soldering stations already have such a feature, otherwise a separate soldering iron stand is essential, ideally one with a location for holding a damp tip-cleaning sponge. Consider making a home-made holder from a length of copper pipe screwed firmly to a wooden base.

Other equipment which may be worth considering includes the use of fume extractors, which are compulsory in the industrial workplace. A basic fume extractor consists of a small bench-top fan which draw fumes and smoke away from the operator's face and filters out the more noxious elements, before expelling the remaining air back to the atmosphere through the fan vent. The carbon-impregnated foam filters used are replaceable. Such devices are extremely effective and users soon find them indispensable, but they can be somewhat noisy at close range.

Professional fume extraction systems draw the pungent fumes directly from the work area via a clip-on tube fitted to the soldering iron, then vent the fumes away through a large filter pump. Such systems are for production use, though it is definitely worth considering purchasing a small bench top unit for regular hobby or occasional professional use.

Hand Tools

A variety of hand tools are available to assist with preparation before and during soldering, and a good supplier's catalogue will offer a range of small brushes, scrapers and cleaning tools in a handy kit, together with the usual types of wire cutters, pliers and so forth, which are necessary for manipulating components and tidying up as required.

Now let's look at how to use soldering irons properly, and later on we will describe the techniques for putting things right when a joint somehow goes wrong – and don't worry, even the experts get it wrong sometimes!

How to Solder

Turning to the actual techniques of soldering, firstly it's best to secure the work where possible so that your accuracy isn't affected should the work happen to be moved accidentally. In the case of a printed circuit board, various holding frames are fairly popular, especially when densely populated boards are being soldered: the idea is to insert all the parts on one side (a process often known as "stuffing the board"), hold them in place with a suitable foam rubber pad to prevent them falling out, turn the board over and then snip off the wires with cutters before soldering the joints (see photos).

The frame saves an awful lot of turning the board over and back again, especially with large boards: all the soldering can be performed in one "pass". Hence not only is the printed circuit board held firmly, the individual components being soldered cannot move either. However, only the more serious constructor is likely to go to the expense of purchasing a holding frame, and it is not uncommon for hobbyists to retain parts in place by improvising in a variety of ways – including adhesive tape or blobs of Blu-Tack! Other parts could be held firm in a modeller's small vice, for example.

Solder joints may need to possess some degree of mechanical strength in some cases, especially with wires soldered to, say, potentiometer or switch tags, and this means that the wire should be looped through the tag and bent over before any solder is applied. The down-side of this is that it will be more difficult to de-solder the joint (see later) to remove the wire afterwards, if needed. Otherwise, in the case of an ordinary circuit board, components' wires can simply be bent to the correct pitch (distance apart) to fit through the board, the component inserted flush against the board's surface, the leads splayed outwards a little so that the part grips the board, and then soldered.

In the author's view – opinions vary – it's generally better to snip off the surplus wires leads first, to make the joint and any neighbouring joints more accessible and also to avoid applying a mechanical shock to the p.c.b. after soldering. However, in the case of diodes and transistors the author tends to leave the snipping until after the joint has been made, since the excess wire will help to sink away some of the heat from the sensitive semiconductor junction. Integrated circuits can either be soldered directly into place if you are confident enough, or better, use a dual-in-line socket to prevent heat damage. The chip can then be swapped out at a later date if needed.

Parts which become hot in operation (e.g. some resistors), are best raised above the board slightly to allow air to circulate. Some components, especially large electrolytic capacitors, may require a mounting clip to be screwed down to the board first, otherwise the part may eventually break off due to vibration. In the case of these or, say, p.c.b. mounting power transistors, it is a good idea to bolt such components firmly into place before soldering their terminals, in order to avoid placing a strain on the soldered joints or the components when fasteners are tightened.

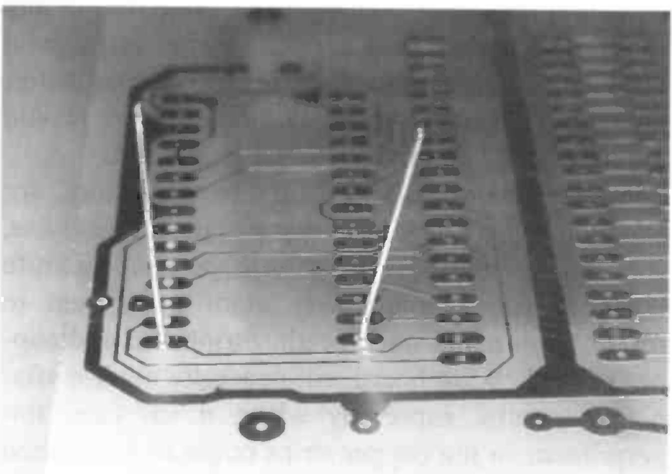
The Perfect Joint

As you will read later, the perfectly soldered joint will be nice and shiny looking, and will prove reliable in service. In general, the key factors affecting the quality of the joint are:

- **Cleanliness** – dirt or impurities drastically hinder good solder coverage
- **Temperature** – the right level to enable the solder to flow freely!
- **Time** – apply heat for just the right amount of time!
- **Adequate solder coverage** – enough to form a good joint without touching neighbouring areas

A little effort spent now in soldering the perfect joint may save you – or somebody else – a considerable amount of time in troubleshooting a defective joint in the future. Let's discuss the basic principles outlined above in more depth.

Copper clad boards should be cleaned using an abrasive rubber block, for example, in order to remove tarnishing and contamination. Wipe over with a solvent cleaner afterwards and avoid touching the copper.



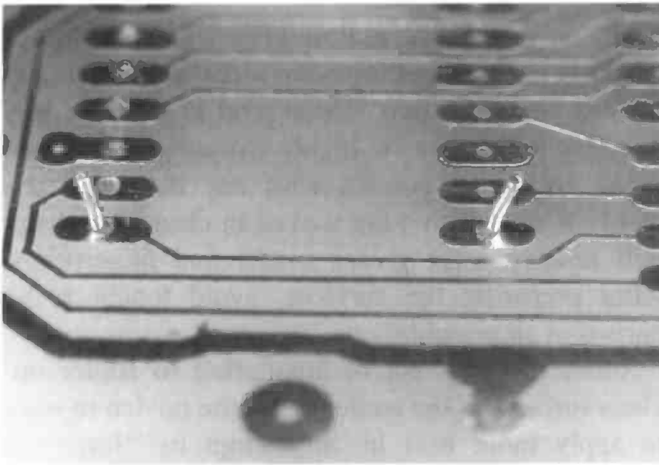
Component leads can be splayed out in order to help retain them in position.

Really Clean

Firstly, and without exception, all parts – including the iron tip itself – must be clean and free from contamination. Solder just will not "take" to dirty parts! Old components or copper board can be notoriously difficult to solder because of the layer of oxidation which builds up on the surface of the leads. This repels the molten solder and this will soon be evident because the solder will "bead" into globules, going everywhere except where you need it!

Dirt and contamination are the enemies of a good quality soldered joint! Hence, it is an absolute necessity to ensure that parts are free from grease, oxidation and other contaminants. Note that in any case, some materials or surface finishes just cannot be soldered using ordinary tin/lead solder, no matter how hard you try – e.g. aluminium parts would require special aluminium solder to be used.

In the case of old resistors or capacitors, for example, where the leads have started to oxidise, use a small hand-held file or perhaps scrape a knife blade or rub a fine emery cloth over them to reveal fresh metal underneath. Stripboard and copper printed circuit board will generally oxidise after a few months, especially where it has been fingerprinted, so the copper strips ought to be cleaned using an abrasive rubber block, like an aggressive eraser, to reveal shiny copper underneath.



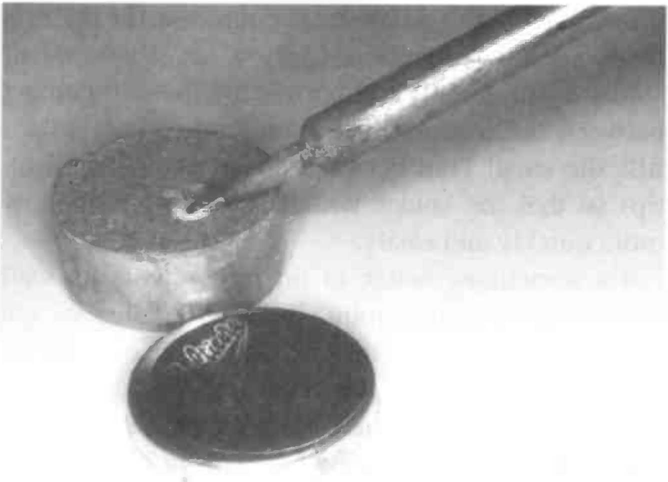
Snip any component leads to length ready for soldering.

Wipe the tip of a hot soldering iron on a damp sponge to remove debris from the bit, which should be shiny before applying to the components.

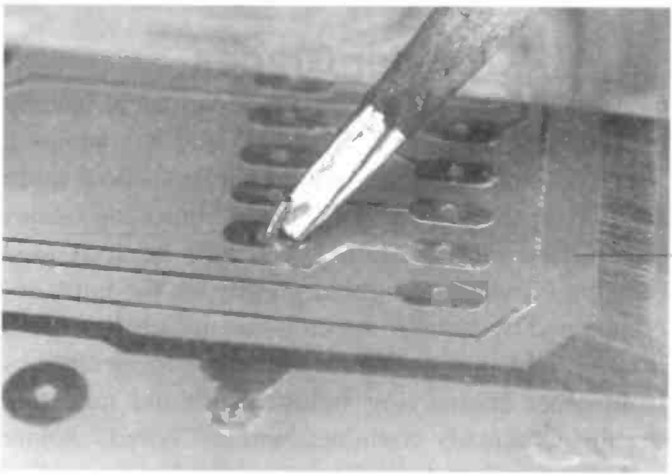
Also available is a fibre-glass filament brush, which is used propelling-pencil-like to remove any surface contamination. These tend to produce tiny particles which can be highly irritating to skin, so avoid accidental contact with any debris. Afterwards, a wipe with a rag soaked in cleaning solvent will remove most grease marks and fingerprints. After preparing the surfaces, avoid touching the parts if at all possible.

Another side effect of attempting to solder unclean surfaces is the tendency for the novice to want to apply more heat in an attempt to "force the solder to take". This will often do more harm than good because it may not be possible to burn off any contaminants anyway, and the component or the printed circuit board may be overheated and damaged in the process. In the case of semiconductors, temperature is quite critical and they may be harmed by applying excessive heat for more than a few seconds. Furthermore, extreme heat applied to printed circuit board tracks may also cause irreparable damage, because the tracks will be lifted away from the substrate underneath, especially on a delicate or badly designed board. If you are lucky, you may be able to bypass the damaged part of the board by soldering in some wires.

Before using the iron to make a joint, the hot tip must be "tinned" by applying a few millimetres of solder, then wiped on a damp sponge in order to prepare it for use: you should always do this



A worthwhile product is Multicore "Tip Tinner and Cleaner" which performs two jobs in one.



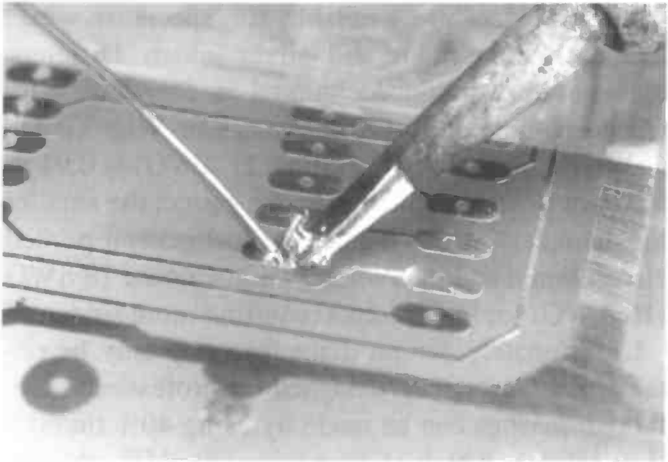
Apply the hot iron tip in order to heat both the lead and the copper solder pad at the same time.

immediately with a new bit, being used for the first time. Some old hands re-apply a small amount of solder again, mainly to improve the thermal contact between the iron and the joint (the molten solder fills the small void between the parts and the iron tip) so that the solder will be encouraged to flow more quickly and easily.

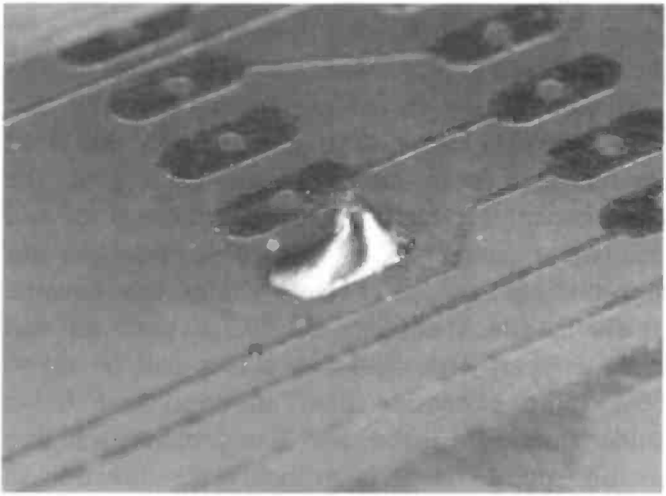
It's sometimes better to tin larger parts as well before making the joint itself, but this is not generally necessary with p.c.b. work. (Note that all *EPE/ETI* printed circuit boards from the *PCB Service* are "roller-tinned" to preserve their quality and to help with soldering.) A worthwhile product is Tip Tinner & Cleaner, a small 15 gram tinlet of paste onto which you dab a hot iron – the product cleans and tins the iron ready for use.

Solder Grades

General purpose electronics grade solder is usually 60% tin and 40% lead ("60/40") and it contains a "flux" which helps the molten solder to flow more easily over the joint. It does this by removing oxides which arise during heating, and will be seen as a pungent brown fluid bubbling away on the joint, accompanied by some fume emission which some will find a slight irritant. Those coming into electronics from other engineering industries should note that the flux is already contained within "cored" solder and ***on no account*** should any acidic flux be applied separately before using the soldering iron.



Then melt a few millimetres of solder to flood the joint with molten solder. Remove the iron and allow the joint to cool naturally.

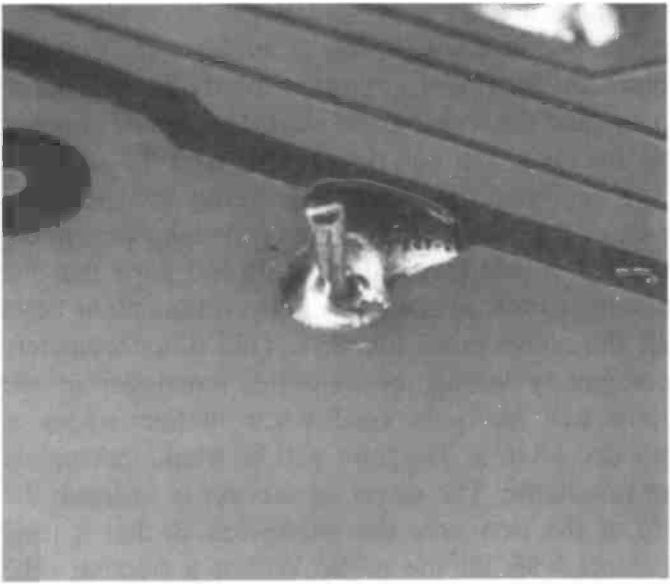


A good solder joint will be quite shiny and smooth.

Other solders are available for specialist work, including aluminium and silver-solder. Different diameters are produced, quoted in Standard Wire Guage (Imperial SWG) or American Wire Gauge (AWG) – 20 to 22 SWG (19 to 21 AWG) is 0.91 to 0.71mm diameter (the higher the gauge, the smaller the diameter), which is fine for most general printed circuit board and interwiring work. Choose 18 SWG (16 AWG) for larger joints requiring more solder.

Unfortunately certain diameters may only be obtainable in large reels designed for professional use, though savings can be made by using 40% tin/60% lead (40/60) which is approximately 15% cheaper than 60/40, but has a higher melting point. (Tin is eight times more expensive than lead, which explains the price difference.) For many constructors the difference in performance will be negligible.

In view of the increasing focus on health and environmental issues these days (namely, the need to reduce human contact with lead, plus the environmental effects which the disposal of old equipment containing lead/tin solder have on our surroundings), a "lead-free" solder has become available which consists of 99.7% pure tin and 0.3% copper. This lead-free solder can be up to 50% more expensive than an equivalent 60/40 solder (metre for metre) and also demands a higher melting point, but it is probably the direction in which solders will ultimately be forced to steer in future years for environmental reasons.



An example of a "dry joint" – the solder failed to flow into the component lead because of impurities and grease present on the lead. It would need to be desoldered, removed and cleaned.

Another solder variant which finds favour amongst professionals is "Smart" wire which contains a small degree of silver. It produces very clean results and is often associated with SMD (surface mount devices), though some engineers use it for routine printed circuit board work for producing the best possible finish by hand.

Temperature

The next step to successful soldering requires that the temperature of all the parts is raised to roughly the same level, before solder may be applied. Imagine, for instance, trying to solder a resistor into place on a printed circuit board: both the copper p.c.b. and the resistor lead should be heated together so that the solder will flow readily over the joint.

A beginner will often mistakenly just heat one part of the joint (e.g. a component wire protruding through a printed circuit board) and hope that the resultant blob of solder will be sufficient to bond all the components together. This is unfortunately completely wrong, because the remainder of the joint will be quite cold when molten solder is flooded on to it. The joint will be weak, incomplete or unreliable. The secret of success is to touch the tip of the iron onto the workpiece so that it is in contact with all the parts. Within a fraction of a second, heat will conduct from the iron and raise the temperature of the entire joint, after which solder can be applied.

The melting point of most solder is in the region of 188°C (370°F) and the iron tip temperature should be set for typically 330 to 350°C (626-662°F). Many soldering iron workstations have a control which permits adjustment of the tip temperature. Depending on the alloy used, some solders require higher temperatures, and indeed at least one type of solder is specifically designed for use in equipment which operates at high temperature; it requires a tip temperature of well over 400°C (752°F).

Now is the time

The joint should be heated with the bit for just the right amount of time – during which a short length of solder is applied to the joint. The heating period depends on a combination of factors, including the temperature of the iron, the size of the tip and the size of the joint – larger parts need more heat than smaller ones – but some components (semiconductor diodes, transistors and i.c.s), are sensitive to heat and should not be heated for more than a few seconds. An average printed circuit board joint can be made within roughly two seconds or less. A common mistake is to use a soldering iron to carry molten solder over to the joint – don't do this!

Until they have gained some practice, novices sometimes buy a small clip-on heat-shunt, which resembles a pair of aluminium tweezers. In the example of, say, a transistor, the shunt is attached to one of the leads near to the transistor's body. Any excess heat then diverts up the heat shunt instead of into the transistor junction, thereby saving the device from any possibility of thermal damage. Beginners find heat shunts reassuring until they've gained more experience, but modern semiconductors are more forgiving in this respect anyway.

In due course a novice can judge how much solder should be applied to any particular joint. An excess is just an unnecessary waste and may cause short circuits with adjacent pads or tracks, especially on densely-populated boards. Professionally-produced p.c.b.s have a green solder resist coating which helps to ensure that solder does not stray onto adjacent pads. If too little solder is used, the result may be an incomplete joint which may become the source of an intermittent fault later on.

There are a small number of components which can create hazards during a soldering operation.

Coin cells if heated excessively will ultimately explode due to the build-up of internal pressure. It is not uncommon to need to solder wires to such a cell but depending on their size this should be done as quickly as possible. Similar dangers exist with other types of battery, although an increasing number of cells are designed for p.c.b. mounting and have solder tags fitted for this purpose.

Some memory back-up capacitors or electrolytic capacitors may retain an internal charge. Molten solder makes a perfect liquid electrical conductor and in some cases a technician could accidentally short the component's contacts during the soldering (or desoldering) operation. If the device is suddenly discharged (e.g. a short to the 0V rail, or molten solder shorts it out) then molten solder globules can be spattered outwards, ***possibly inflicting eyesight damage***. Always take care to ensure that such components are electrically inert before they are installed. Capacitors or memory back-up caps should be discharged first. ***Take care with cells, batteries and battery packs to ensure they are***

not accidentally shorted for any reason during the soldering process.

After the soldering is complete, many assemblers tidy up the joint by snipping any excess wire or solder away from the joint using a pair of "end cutters". These have blades specially angled to help snip the joint flush against the circuit board. It is worth taking time out to inspect the work closely, looking for any possibilities of whiskers of solder or swarf shorting out any solder pads, and all such potential problem areas should be dealt with prior to testing the board. Lastly, there is nothing more infuriating than finding that a joint has been missed just as the final interwiring and testing is about to be performed, so double check to see that no joints have been overlooked!

Desoldering methods

A soldered joint which is improperly made is likely to be electrically "noisy", unreliable and will probably become worse over time. It may even not have made any electrical connection at all, or could work initially and then cause the equipment to fail at a later date! Noisy joints can also introduce intermittent problems which can be maddening to locate and resolve. By following the guidelines given and putting in some practice, there is no reason why you should not obtain perfect results and eliminate most potential problems.

A joint which is poorly formed is often called a "dry joint". Usually it results from dirt or grease preventing the solder from melting onto the parts properly, and is often noticeable because of the tendency of the solder not to "spread" but to form beads or globules instead. Alternatively, if it seems to take an inordinately long time for the solder to spread, this is another sign of possible dirt and that the joint may potentially be a dry one.

A moderately complex circuit board can easily require 1,000 solder operations or more and it is inevitable that occasionally one or two joints may be made imperfectly. They may appear to be adequate given a cursory inspection but a closer look under a magnifier may reveal that some joints will have to be re-made. Consequently there will undoubtedly come a time when you need to remove the solder from a joint, possibly to replace a faulty component or fix a dry joint. Naturally, there are tools and techniques which help with such tasks.

The usual way of removing solder from a joint is to use a desoldering pump. These work like a small spring-loaded bicycle pump, only in reverse! A spring-loaded plunger is pressed down until it locks into position. It can be released with a thumb-press on a button which sucks air back up through a pointed nozzle and any molten solder is drawn up into the pump. It may take one or two attempts to clean up a joint this way, but a small desoldering pump is an invaluable tool especially for p.c.b.

Underside of the commercial printed circuit board: the two joints bottom left will be desoldered ready for a new component to be fitted.

Apply a hot soldering iron to the joint to be desoldered.

work. More demanding users using CMOS devices might need a pump which is ESD safe.

The pumps themselves have a heatproof P.T.F.E. nozzle which may need replacing occasionally. Every time the button is pressed, this action clears the nozzle but sometimes solder particles and swarf will be ejected in the process, and it's a good idea to direct the nozzle into a small pot or old aerosol top to catch the debris. Remove the spout and clean out the pump from time to time.

With particularly stubborn joints where the last traces of molten solder cannot be shifted, it can sometimes prove effective to actually add more solder and then desolder the whole lot again with a pump. Care is needed, though, to ensure that the boards and parts are not damaged by excessive heat. It is easy to apply so much heat in the desoldering operation that the adhesive which holds the conductors onto the p.c.b. can eventually fail, causing the copper track to lift away. If this should ever happen, remove the iron immediately and permit the area to cool (a freezer aerosol is valuable at such times). It may well be possible to repair the lifted track using a droplet or two of Super Glue.

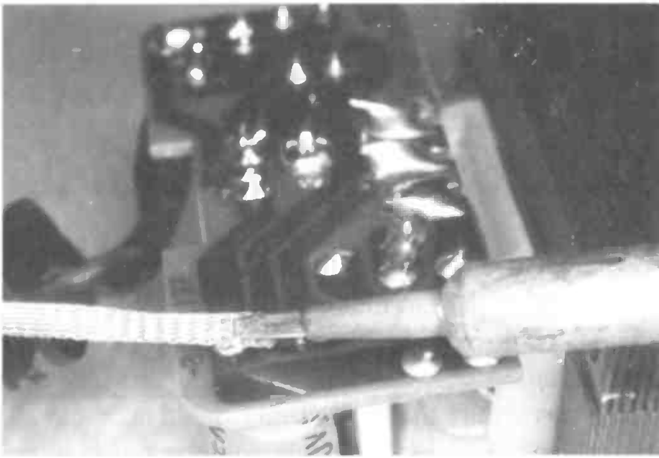
An excellent alternative to a pump is to use desoldering braid, including the famous "Soder-Wick" (*sic*) which is packaged in small dispenser reels. It is a flux-impregnated fine copper braid which is applied to the molten joint, and the solder is then drawn up into the wick by capillary action with

Position the nozzle of a desoldering pump by the molten solder and release the button.

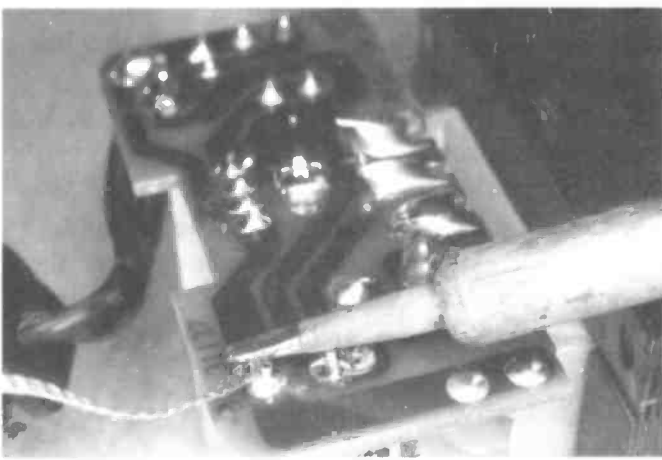
The component solder pad with the solder removed.

remarkable effectiveness. For certain tasks, the action of braid can be more thorough than a desoldering pump and it is recommended that a small reel is bought, especially for larger or difficult joints which would take several attempts with a pump. The correct way to use the product is to press the end of the braid down onto the joint using the tip of an iron, and let the solder melt underneath: the braid will then absorb the solder.

However, be aware that it is possible to damage a printed circuit board accidentally when removing the desolder braid if it is not removed quickly. The solder can soon harden which effectively solders the braid to the printed circuit board! A careless tug may cause copper tracks or pads to be lifted away, stuck to the braid. You can also drag solder "whiskers" onto neighbouring pads unless the braid is removed cleanly. Why not practice with some surplus components?



Solder braid is very effective and is used by pressing it onto the solder joint with the tip of the iron.



Continue heating until as much solder as possible has been drawn up into the wick. Remove the wick immediately before the solder hardens.

Quick Summary Guide

To round off our practical guide to soldering, here's a summary of how to make the perfect solder joint.

1. All parts must be clean and free from dirt and contamination.

2. Try to secure the work firmly to aid accuracy.

3. Clean the tip of the hot soldering iron on a damp sponge.

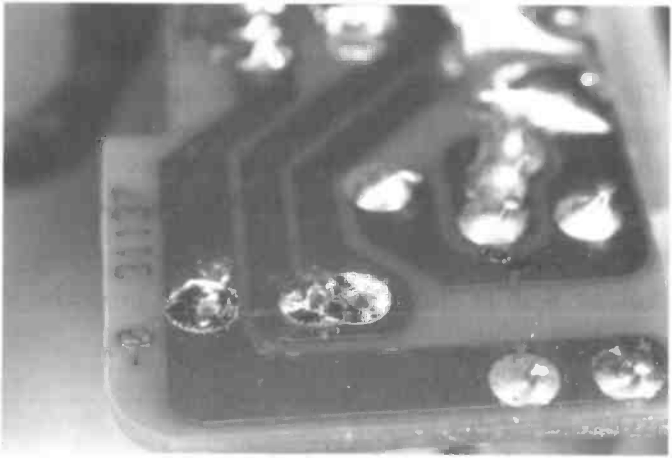
4. "Tin" the iron tip by applying a small amount of solder. Do this immediately with new tips being used for the first time.

5. Try to heat all parts of the joint with the iron for under a second or so, to bring them up to the same temperature.

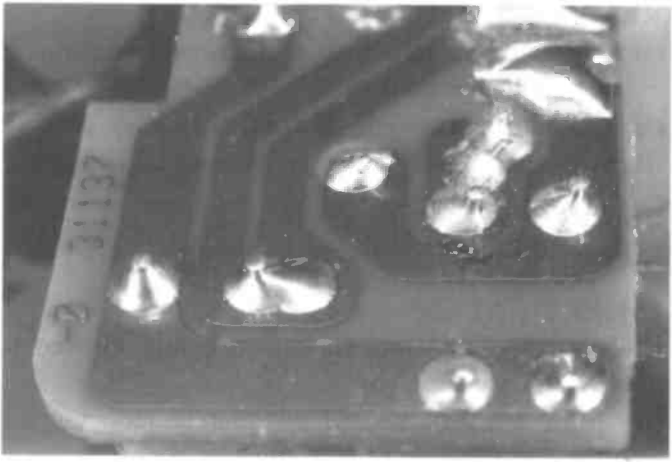
6. Continue heating and apply sufficient solder to form an adequate joint. It only takes two or three seconds at most, to solder the average p.c.b. joint.

7. Remove the iron and return it safely to its stand.

8. Do not move parts until the solder has cooled.



With both component joints now desoldered, the component immediately fell out and the new device could then be inserted and re-soldered.



An example of commercial mass-produced solder joints, note how smooth and shiny they are.

Troubleshooting Guide

The perfect solder joint should be quite shiny and smooth after cooling down. Here is a quick troubleshooting guide to help resolve any problems encountered with troublesome solder joints.

SYMPTOMS

Solder won't "take" or won't flow properly to cover the joint

LIKELY CAUSES

(i) Grease or dirt present

(ii) Material may not be suitable for soldering with lead/tin solder

REMEDY

(i) Desolder and treat parts with solvent or abrasive cleaners etc. as required

(ii) Use alternative type of solder alloy, or perhaps file away any plating to reveal base metal beneath

SYMPTOMS

Joint is crystalline or grainy-looking

LIKELY CAUSES

(i) Joint has been moved before being allowed to cool naturally

(ii) Joint was not heated adequately (too large a joint and/or the iron temperature or power rating is too low)

REMEDY

(i) Desolder and remake

(ii) Use a more appropriate iron for the task, also check the temperature settings

SYMPTOMS

Solder joint forms a "spike" and applying the iron again makes it even worse!

LIKELY CAUSES

Probably overheated, burning away the flux. The iron, when removed, would cause the solder to stand up in a spike

REMEDY

It is usually best to desolder and remake the joint properly.

Potential Hazards and Simple First Aid

It is very seldom that soldering iron operators receive any burns or other injuries from the use of hot soldering irons. The technique is perfectly safe provided that common sense precautions are taken during the soldering operation. Here are a variety of precautions worth bearing in mind:

- Components are obviously very hot after soldering, so let them cool before handling them to avoid skin burns.
- Beware of splashes of molten solder caused by careless handling of a hot soldering iron.
- Always park a hot iron safely on a stand in between use – never hang it vertically next to the bench.
- Beware of wire offcuts flying off (danger to eyesight) when snipping wires to length before or after soldering.
- Avoid the inhalation of fumes if at all possible as they can irritate the eyes or respiratory tracts.

If you are unlucky enough to receive a more serious skin burn which requires attention, the very first thing to do is cool the affected area immediately. Use plenty of cold running water, or use anything cold – ice cubes, an ice pack or a bag of frozen peas from the freezer, for example. Remove any objects which may prove constrictive before any swelling starts (rings, watches, bracelets). Apply cold water for at least ten minutes and seek medical attention.

Project Building

Finally, why not try your hand with one of the constructional projects described every month in *Everyday Practical Electronics/ETI?* Assembling a project successfully using your own bare hands (plus a soldering iron!) is immensely satisfying and there is usually something for everyone in each monthly issue and constructing prototypes at home is an excellent way of gaining valuable experience in the art of soldering. Start with something simple if you have no experience of soldering or project construction.

On Line

The on-line version of the Basic Soldering Guide (with colour photo gallery) can be accessed at:
http://www.epemag.wimborne.co.uk/solderfaq.htm

Other useful web sites:
http://www.antex.co.uk – Antex soldering irons

http://www.multicore.com – Multicore Solders' American web site has some background to their products

http://www.metcal.com – considerable advice on reworking, presented by Metcal Inc.

http://www.citiweb.net/berto – French language version of the *Basic Soldering Guide*

The author can be contacted by E-mail to
alan@epemag.demon.co.uk

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ESM

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ESM, the Electronics Service Manual, is a unique publication which aims to provide clear and concise instructions on how to test and diagnose faults on a wide range of electronic equipment, providing users with the level of knowledge and confidence required to tackle even the most complex faults. A principal editorial objective is that of ensuring that ESM is comprehensive, informative and up-to-date. It is a living publication and ideal for use by technicians, engineers, students and hobbyists.

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