SOLDERING:

Dubious joints and how to cure them

Now you have the basics of how to solder under your belt, it's time to find out what to do when things don't go quite right, or what to do when repairs are necessary.

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THE SUCCESS of failure of a project can often depend on the quality of just one soldered joint. If it has not been prepared properly, or correctly soldered, then it's quite possible to have a 'no joint'. Identifying a bad joint can save you heaps of time wasted in trying to track down a fault. And there's nothing so frustrating as trying to track down faulty joints.

Bad joints and their cures

In some instances, the solder may not wet the joint evenly. The solder surface is not smooth and continuous, having irregular, round, non-wetted areas exposed. The solder may meet one surface abruptly in places. This condition is illustrated in Figure 13. It can often be remedied by reheating, although desoldering and cleaning may be necessary in some cases.

When a joint is not wetted at all, usually due to tarnish, the solder will not completely cover the surface and appears as droplets or balls (Figure 14). This is a bad joint mechanically and electrically and should be taken apart and properly prepared.

Sometimes during soldering, the molten solder will run along the metal and then withdraw towards the fillet when the iron is removed (Figure 15). This 'dewetting' is another problem caused by tarnish that the flux is unable to remove. The joint has to be desoldered and thoroughly cleaned before resoldering. Applying more heat and excess solder might make the joint look all right but it may conceal a bad joint.

A 'cold' or 'dry' joint is usually caused by movement of the parts during soldering or as the solder is solidifying. It is also caused by the solder running onto surfaces cooler than the soldering temperature. A cold joint has a frosty appearance, as shown in Figure 16, but may otherwise look like a good joint.

The trap with cold joints is that they may perform quite well for a considerable period and then suddenly become intermittent or go open circuit. They are repaired quite simply by reapplying heat or desoldering the joint and then resoldering.

If insufficient heat is applied to a joint, the solder solidifies before adequate wetting occurs, causing the angle of contact between the solder and the parts to be very large. The flux is not properly activated and the joint may tarnish. The solder can usually be pried loose. The surface of the solder may be smooth and continuous but it is not attached to the parts of the joint (Figure 17). Reheat the joint if tarnishing is not evident, otherwise desolder and clean before soldering.

In some cases, a resin bond is formed between the parts of the joint. In this case, the angle of contact of the solder is usually large and a layer of solidified resin forms the bond, as shown in Figure 18. There may be no electrical contact at all, the joint has little strength and may be prised apart. It may be caued by excess flux or solder running onto surfaces cooler than soldering temperature but hot enough to melt the flux. It is usually cured by reheating the joint, making sure that all parts are brought up to soldering temperature.

When soldering multi-strand hookup wire, excess solder or long soldering time

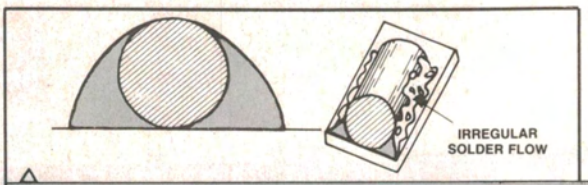


Figure 13. When poor wetting occurs, the solder meets one surface at an abrupt angle and the solder flows irregularly.

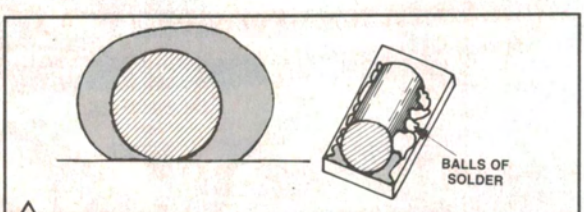


Figure 14. Tarnished surfaces prevent wetting altogether. Balls of solder sit on the surface. More flux and reheating may fix it, otherwise start again and clean the joint parts.

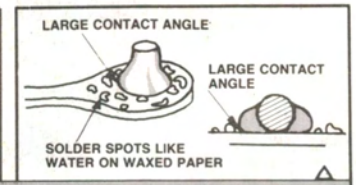


Figure 15. Dewetting. The solder appears to flow properly, then withdraws when the iron is removed from the joint. Reheating with more flux may effect a cure, otherwise start again and clean the joint parts.

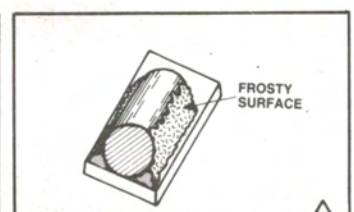
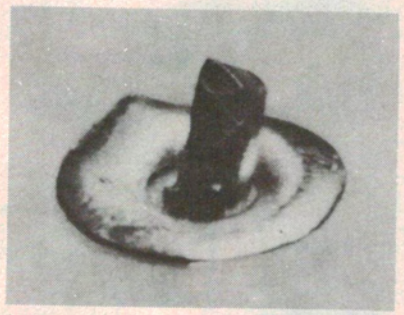


Figure 16. A cold joint can be deceptive. The joint may look good in other respects, but the solder surface will have a frosty appearance (see accompanying picture). Reheating the joint usually fixes it.

Resin joint. Too little heat.

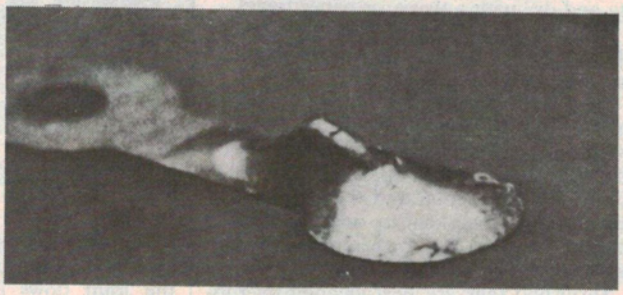


Cold joint 1. Solder beads like water on wax.

Cold joint 2. 'Frosty' surface on the solder.

Disturbed joint. Moved when solder solidifying. Solder looks chalky.

Overheated joint. Don't overdo it, there may be another problem.



(Pictures from Pace Training Manual, courtesy of Coltronics P/L)

RECOGNISING BAD JOINTS

This group of pictures shows the typical appearance of common bad joints. A **resin joint** results when too little heat is applied or an iron tip with insufficient heat capacity is employed. A quantity of resin solidifies between the component lead and the terminal. Flux may sometimes appear on the solder surface itself. **Cold joints** occur when the heat is withdrawn too soon or the joint is otherwise cooled too rapidly. The solder does not properly liquify and may form beads like water drops on a waxed surface. Often, the solder surface has a 'frosty' appearance. A **disturbed joint** may also have a frosty appearance but the solder is generally lumpy or granulated and may show cracks. Movement of the parts during cooling causes the problem. The solder on an **overheated joint** has a dull, chalky or crystalline appearance. It usually results from repeatedly trying to heat a joint that won't wet properly.

can cause solder to run along the strands behind the insulation. This is called 'wicking' (Figure 19) and can be reduced by soldering faster or by using a heatsink on the wire. Wicking makes the wire brittle and liable to break when it is moved.

When the soldering iron is withdrawn from a joint a spike of solder, called an 'icicle', is sometimes left behind, usually pointing in the direction in which the iron was removed (see Figure 20).

Icicles may be caused by a variety of problems, including tarnished joints, too short soldering time, low soldering temperature or excess solder on the iron. Reapplication of the soldering iron usually remedies the problem, but make sure that there is not some other problem with the joint. If the joint is otherwise sound, small icicles are nothing to worry about.

Preparing leads and components

Most modern components have leads which are tin-plated to aid soldering. The tin is readily absorbed into the solder, allowing rapid wetting and reducing soldering time. The plating will tarnish with time and handling. Unplated leads and unprotected printed circuit boards are partic-

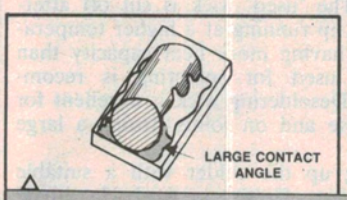


Figure 17. Too little heat. The solder forms a large contact angle with the surface and may be prised loose. Reheat the joint to fix this one.

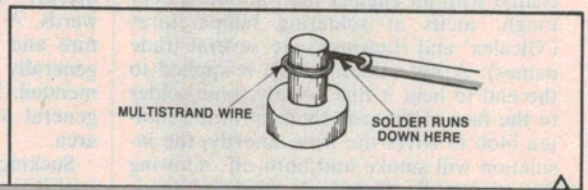


Figure 19. 'Wicking' is caused by solder running back up the strands of multi-strand hookup wire. This makes the wire brittle at the joint and movement may break it.

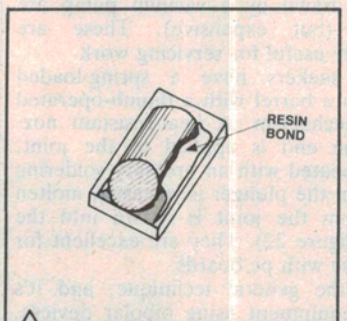


Figure 18. A resin bond (see accompanying picture). There may be no electrical contact at all. It can be cured by reheating the joint.

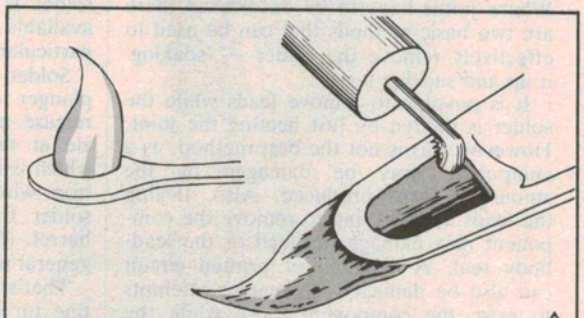


Figure 20. 'Icicles' sometimes form on a joint when you remove the iron. Reheat the joint with a clean iron to get rid of them.

ularly affected as oxidisation is quite rapid.

It is always a good practice to tin the parts of a joint before putting them together. Component leads can be tinned by simply heating them with the iron and then applying a little solder. Only tin that part of the lead that is actually going to make the joint as component leads are usually trimmed after the joint is made.

If the lead is tarnished, it can be cleaned by pulling it through a doubled-over piece of emery cloth or plain steel wool. Printed circuit board tracks do not need tinning. If the tracks are tarnished, clean the board with an abrasive powder cleanser (such as Ajax) and a moist cloth. Wash the board in clean water after cleaning and dry with a tissue or paper towel.

A light spray of clear lacquer, such as "PC lacquer", will prevent tarnishing and can later be soldered through.

Stranded hookup wire is best prepared in the following manner. Strip away about 6-7 mm of insulation from each end. Twist the strands together, apply the hot iron for about one second and then a touch of solder. Don't overheat or apply too much solder. Solid hookup wire is prepared the same way as component leads.

Tarnished tags are best cleaned by rubbing with emery cloth or lightly scraping them with a penknife. Thoroughly heat the tag with the iron before applying a little solder to tin it.

Enamelled coil wire can be prepared by stripping the end back about 6-10 mm using a penknife, cutting blade, emery cloth or steel wool until the bright copper wire shows. Tin it quickly.

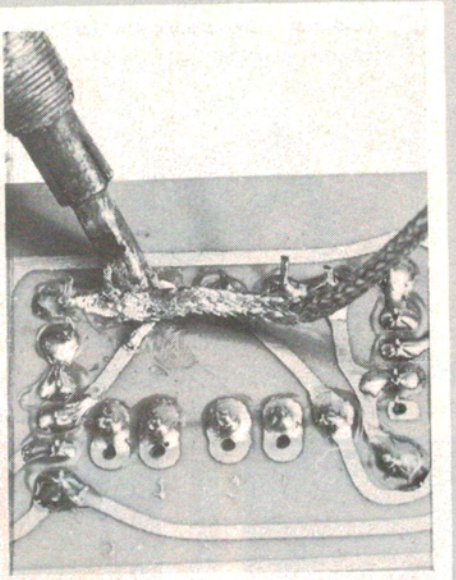
Some modern coil winding wire is coated with an enamel that, although very tough, melts at soldering temperatures ('Bicalex' and 'Lewmex' are several trade names). A hot soldering iron is applied to the end to heat it first. Apply some solder to the face of the iron then to form a molten blob to cover the wire. Shortly, the insulation will smoke and burn off, allowing the wire to be tinned. A good hot tip is necessary for this operation.

Desoldering

Where joints have to be desoldered there are two basic methods that can be used to effectively remove the solder — 'soaking' it up and sucking it up.

It is possible to remove leads while the solder is molten by just heating the joint. However, this is not the best method, as a component may be damaged by the amount of heat produced. Also, flexing the leads whilst trying to remove the component may damage the lead or the lead-body seal. A terminal or printed circuit can also be damaged by heat or attempts to prise the component loose while the solder is molten. It is much better to use a desoldering aid.

Desoldering 'wick' can be used to soak up molten solder from a joint. This consists of a copper braid impregnated with resin. When applied to a joint and heated with a soldering iron, molten solder from the joint flows into the fluxed braid by capillary attraction, effectively clearing the joint of solder. Figure 21 shows how it's done.



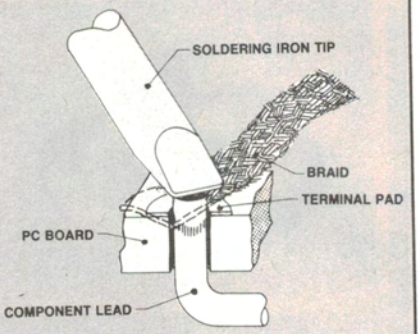


Figure 21. How to use desoldering 'wick'. Lay it over the joint and appaly the iron tip to the braid, using a little pressure. The solder will be drawn into the braid. When this happens, remove the iron and braid. Cut off the used braid.

You lay the wick over the area to be desoldered. The iron is applied to the wick and some pressure applied. As the wick heats up it activates the flux in it, which flows onto the joint, and as the solder on the joint melts it replaces the flux in the wick, flowing into the braid quite quickly. The 'used' wick is cut off afterwards. A tip running at a higher temperature and having more heat capacity than generally used for soldering is recommended. Desoldering wick is excellent for general use and on joints having a large area.

Sucking up the solder with a suitable tool is a very effective method. Hand-held 'solder suckers' are inexpensive and popular but a variety of desoldering irons having a hollow tip through which the molten solder is drawn by a vacuum pump are available (but expensive). These are particularly useful for servicing work.

Solder suckers have a spring-loaded plunger in a barrel with a thumb-operated release mechanism. A heat-resistant nozzle at one end is applied to the joint, which is heated with an ordinary soldering iron. when the plunger is released, molten solder from the joint is drawn into the barrel. (Figure 22). They are excellent for general use with pc boards.

That's the general technique, and it's fine for equipment using bipolar devices, but it can be extremely dangerous for MOS devices. Standard plastic solder suckers have been found to produce a static surge of 5 kV to 10 kV at the tip. This is invariably in contact with the device's leads when the surge occurs and may damage or destroy the device. To obviate the problem, static-free metallised plastic nozzles may be obtained. Otherwise, use desoldering wick or a vacuum-operated desoldering iron.

Practise makes perfect

That should get you started on soldering. Don't expect perfect or consistent results at first. It takes time to get the hang of it. And, as they say, practise makes perfect.

Don't leap into a full-blown computer or hi-fi system as your first project, tackle a few smaller ones at first until your soldering improves and you're able to find your way around electronic components with confidence. Kits are generally supplied with all the required parts, saving you the hassle and confusion of shopping around. Go to it, then! ●

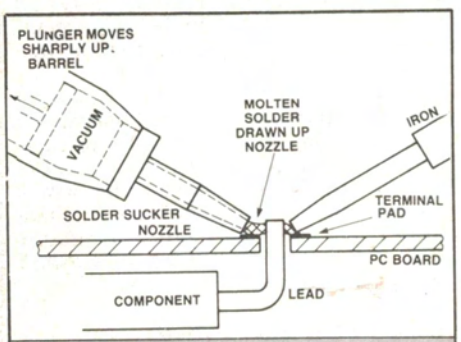


Figure 22. Using a solder sucker. First heat the joint until the solder melts. Then apply the solder sucker nozzle and release the plunger to suck up the molten solder. It is sometimes best to remove the iron before releasing the plunger. The solder sucker's nozzle and barrel has to be cleared of the solid solder 'dags' periodically.