

RESISTANCE SOLDERING – HOW TO DO IT

There is much controversy among various modellers about the uses of Resistance Soldering Units (RSU's) and many entrenched views of what they can, and cannot be used for. I firmly believe that if the methods you currently use work for you then you should continue to use them. However, one does need to be aware of technical innovations and changes or improvements to, what was once, accepted practice. Simply because some method has been in use in a particular way for 25 years is no reason to continue with it if a better method emerges. By 'better' I mean one that either, increases the quality of the model produced and or, makes the job easier or faster, thereby releasing more time for playing trains.

There are a number of myths floating about on resistance soldering; possibly even more so than there are about soldering with an iron, all of them complete nonsense. A controversial statement but one I am confident I can support with evidence.

I learned the 'black art' of soldering by reading what I could find on the subject, trying it out and comparing notes with other modellers. One aspect of soldering that I really dislike is cleaning off excess solder. It is a waste of time and solder and potentially dangerous. More than once has the scraper (usually broken and ground old needle files) embedded itself in my hand.

The following views are based entirely upon my own knowledge and experience and, naturally, reflect my own prejudices. However, if they help others to work faster with greater accuracy to gain greater enjoyment from their modelling, my efforts will be well rewarded.

A definition of soldering could be persuading two or more pieces of (frequently dissimilar) metal to stick together permanently at room temperature. Over time a number of ways have been devised to achieve this end. I have used for instance, gas torches, blow lamps, soldering irons of many and various types and an RSU. I have even heard of the gas hob being pressed into service, though I do not recommend this latter as is it likely to upset the domestic authorities!

Aside from the gas hob these methods require the effective use of a tool. Granted, neither an iron nor an RSU is necessarily a simple tool, but it is a tool nevertheless. To use a tool successfully, one needs to know how to use it; what it can, and cannot, do. A tool of itself can never be 'bad', only its usage (or possibly poor manufacture but I am assuming that you only buy good tools).

The only use I have for a soldering iron is electrical work. The tools I use exclusively for all other soldering work are an RSU, plus a gas torch for rare use with heavy metal sections.

Over the years many people have told me that an RSU cannot be used to perform this or that soldering task. I disagree totally; an RSU to my mind is simply a technological improvement upon the soldering iron, provided that one takes the trouble to learn how to use it, to discover of what it is capable.

The RSU is an improvement over the soldering iron for a number of reasons: No need of various shaped bits, no need for special cleaning of coated tips, the bits cannot get 'welded' to the iron, no need for the tinning of parts to be sweated together, little or no excess solder to remove. The method uses less solder and electrical power is required only when actually soldering therefore, no iron sitting on the bench all day (or all night because one forgot to turn it off!) burning the pennies and, blessedly, no more burned fingers!

The ideas for the base plate and magnets discussed later are based upon methods expounded by the late, lamented, Bernard Weller. I use a readily available RSU, 179% cream and wire lead solder and, at times, standard 12% phosphoric acid flux. Rare earth magnets are also effectively an extra pair of hands.

How does an RSU work? The box simply contains a transformer with several output windings that produce differing voltages. In mine the outputs are of 1, 1.5, 2, 3 & 4.5 volts. However, these voltages are generated at very high amperages, in the order of 40 amps for the higher settings. The power to the probe is controlled by an on/off foot switch.

The negative terminal is attached to a steel base plate on which the items to be soldered sit and the positive to a carbon probe. Aluminium is completely useless as a negative terminal as it oxidizes rapidly, preventing good conduction, and will not of course allow the use of magnets to hold parts in place. In use the probe is placed upon the work piece resting on the steel plate and the foot pedal depressed. This completes an electrical circuit that produces a high temperature almost instantaneously, but much localised, around the point of the probe due to the inherent resistance at the point of contact. This is the reason why there must be no loose connections in the circuit, which would create local resistance spots and reduce the output where it is needed.

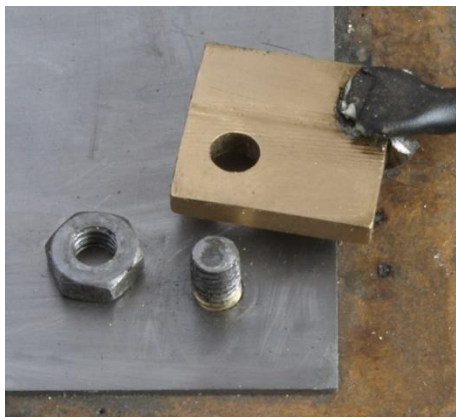
Some units are provided with a negative lead having a large crocodile clip at one end. I *never* use clips of any kind to transmit electricity to a model because I have in the past burned some neat sets of teeth marks into models. When using the chassis jig I have an extra negative lead bolted to the jig and am seriously considering making another to bolt to the bench vice for soldering laminated rods together.

At its simplest one holds items to be joined on the plate with the probe and apply heat using the foot switch. The solder cream between the parts melts very rapidly and joins the parts. As soon as the solder has flashed silver and or has stopped smoking, switch off the power, still holding the parts together. With good quality solder cream the joint will 'go off' in seconds and the joint will be strong (I strongly advise against coarse grained solder pastes; having used them and found that often the joint fails after a very few years).

It is normal in using an RSU to produce joints that have little or no solder visible, making cleaning up almost redundant. The lead solder cream I use was designed for use in the electronics industry, it has no acid based flux but contains 2% silver to aid the flow.



Cleanliness is important and it is critical that no power is lost in the chain from the unit to the work piece, so electrical joints must be tight. Here you can see that the plugs that go into the unit are cleaned to a bright shine. It is also important to keep the springs opened out to ensure that they fit in the sockets tightly.



firmly.

The negative terminal for my RSU is a piece of 1/6th inch steel plate screwed to a piece of MDF. A bolt is passed through one corner so that the heavy brass tag with the negative lead firmly soldered into a pre-drilled hole (ironically, of course, with a heavy soldering iron, but then this is electrical soldering!) can be bolted tightly to the steel plate. Notice that all metal parts are bright before clamping together. The tag is then bolted down

For the probe, which is a piece of brazing rod about 4 inches long, most of the copper is stripped back and the carbon sharpened in a mechanical pencil sharpener. It is kept clean with a coarse file until it needs re-sharpening again.



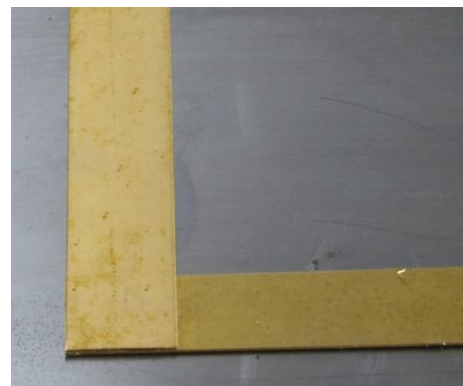
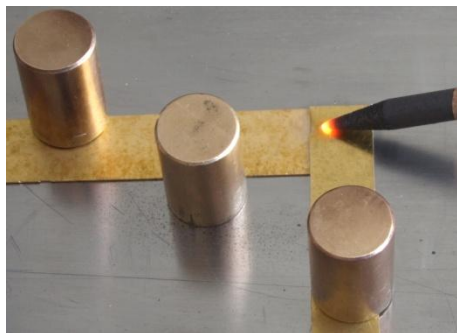
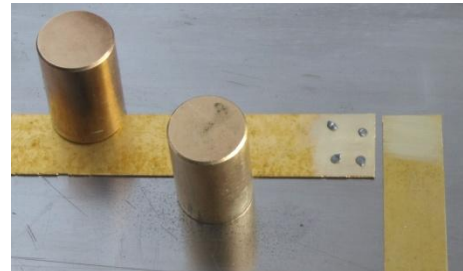
The flux from the solder cream does

cause a build up of dirt that tends to reduce conductivity. Use a fibre glass brush to buff up the remaining copper to ensure good conductivity. The rod is pushed well down the holder and the brass ferrule forced down hard so that there is no wobble in the probe.

Beginning with absolute basics: soldering together two pieces of metal. Here I am using a couple of pieces of scrap.



Clean the surfaces to be bonded. One part is anchored to the plate with magnets and a few tiny spots of solder cream added. The other piece is laid on top and anchored with another magnet. All that is required is



heat, applied until the solder flashes silver and stops smoking. Once the power is switched off the solder goes 'off' in seconds, then the probe can be removed.

Finally, we have 'two pieces of metal persuaded to stick together, very securely, at room temperature'.



A tad more complex is joining laminated parts to make a component in this case a wagon spring. Wasting time applying, in this case, six layers of tinning is, for me, not an option. Here the steel plate has two



holes drilled in it to take lengths of 0.5mm wire at the spacing required for the spring.

The laminates are threaded onto the wires, with the etched leaves face down. A few tiny spots of solder cream are placed between the layers as they are threaded into place. Once done, the parts will stay in place thus releasing my hands for other tasks.



Heat is then applied with the probe. I would normally hold this down with a scalpel or similar as well but the other hand was operating the camera. The discolouration is normal and will disappear with normal cleaning ready for painting. The



finished article, as you can see, needs no excess solder removing and can be fitted to the underframe immediately.

Now let us see how to go about edge soldering two pieces of metal at right angles using a seam joint.



For this the job we will need an engineer's square, solder cream, magnets, wire solder and flux. The parts to be joined



should be clean. The back of the piece that will lie on the plate should also be relatively clean. It is important to ensure that there is as little resistance as possible in the path so that the probe will heat up the metal thoroughly and rapidly.

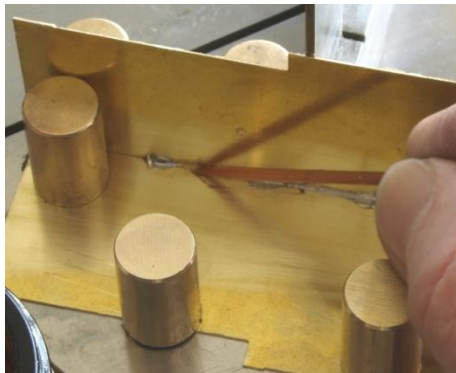


The magnets hold the base down flat and the support upright, which is also kept vertical by the engineer's square. The magnets ensure the right angle is maintained while we work.

To this we add a few small blobs of solder cream in the angle.

The solder cream is I suppose relatively expensive (about £20 a tube but, one tube will suffice for at least half a dozen engines or a myriad wagons) but one uses very little. I have been quite generous with this joint because later, I want the solder to run through the joint.

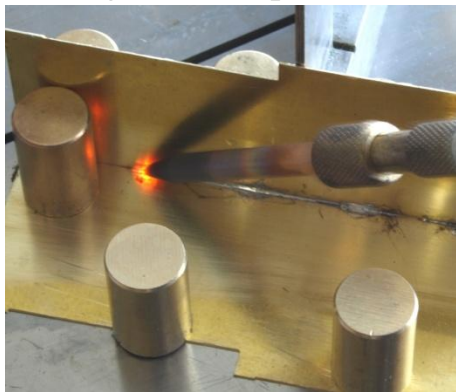
Here you can see that the probe is in action, set at 3 volts so producing a lot of heat. For the best result the tip must touch both pieces of the work and the heat is kept on only long enough for the solder to join both pieces. Once this is done - it takes seconds - let it cool, remove the magnets and check for square. If it is not square, it is a simple matter to



unsolder and start again. When one is happy with the joint, set it up again on the plate to finish the seam joint.

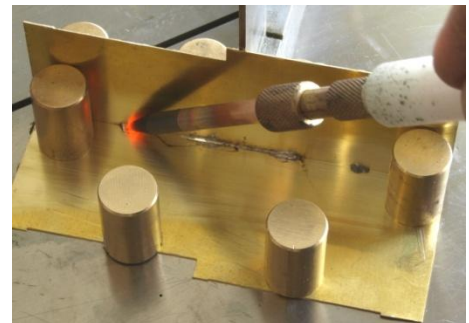
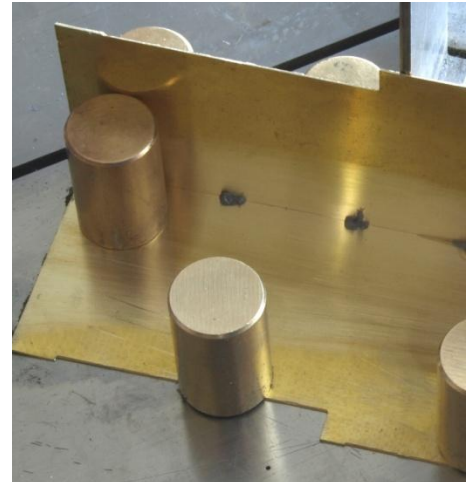
Run a generous bead of flux along the whole of the joint area.

Now the solder blobs can be re-melted so that they will run into the length of the joint. Simply move the probe gently along, not too fast. One can go over it several times if necessary. Since the part is now securely held together, the problems of expansion are much reduced.

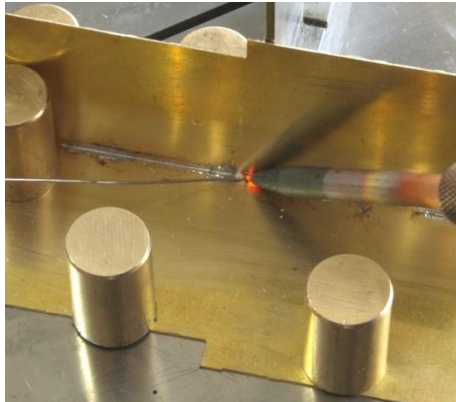


The solder has run along the joint, which, I agree, could be neater and usually is but the problems of operating the camera as well got in the way. The back of the joint is clean. For some joints this will be enough but often it will need to have a

strengthening fillet added.



The solder cream has little gap filling capacity. To add a fillet use wire solder and run the probe along it and into the joint.



There are two ways this can be done; with the wire being laid in the corner as the probe is advanced, as shown here or, cut short lengths and lay them in the corner and use the probe to melt them, letting the solder run along as you go.

It may be necessary to add some flux too but the silver in the solder ensures that it runs well and, as with the solder cream, it 'goes-off' within seconds of the power being switched off.

The finished joint, which is neat, accurate and strong.

I said earlier that I use an RSU for all my soldering and that includes white metal castings fitted to brass or nickel silver.

It is not nearly as scary as it sounds but I would suggest some practice with scrap castings, testing them to destruction, to get the 'feel' for how the process works.

Begin by cleaning the brass where the casting will go and the back of the casting with a fibre glass brush. Apply a few tiny dabs of solder cream to the



brass and a good helping of flux to the back of the casting.

Put the casting in place and manoeuvre into position; ensure that you can see some small fraction of the solder cream.

Now, holding the casting in place apply the probe to the *back* of the brass and apply power.



If it is not possible to apply the probe to the back, apply it to the side at the front, not to the casting itself. As soon as the solder flashes silver switch off the power. I generally blow on it as well to speed up cooling.

Check that it is fixed securely and move on to the next one. If necessary, use clamps made from aluminium hair grips to hold the piece in place because, unlike using low melt solder, one cannot remove this by dunking the whole thing in hot water. However, on occasion even I chicken out if it is a particularly fragile casting and use Loctite 408 instead. Take your choice, both methods work.

CONCLUSION: It is important to keep the work, the probe and the plate clean. The probe degrades with use and the flux in the solder builds up a film that will eventually stop current flow. Keep it clean and sharp. However, it is less onerous than keeping a soldering iron tip clean. If it is necessary to use high heat for thick material, round off the probe to spread the heat to both parts of the metal to be joined. Always apply power *after* the probe is in place and *before* removing it to avoid arcing. The result otherwise turns the RSU into a spark eroding machine.

Do practice on scrap material of varying thickness and determine the best temperatures to use without burning holes in the metal.

The steel plate can be cleaned with isopropyl to remove flux residues and a large fibre glass brush to remove rust and stains. Generally, I find that the plate needs a good scrub with 240 grit wet & dry about every three months. A combination of drilled holes in the plate together with the magnets allows the construction of a variety of jigs to hold work, thus releasing the hands for other duties.

Do ensure adequate ventilation; inhaling the fumes from solder and flux is not recommended.

I hope that that dispels some of the myths and disinformation circulating about the use of the RSU, lowered your resistance to using that heavy box you have lurking in a cupboard somewhere and also helps you better enjoy your modelling.

The unit I use is available from: Hobby Holidays, <http://www.hobbyholidays.co.uk>
Cream & wire leaded solder with 2% silver, plus 12% phosphoric acid flux, are available from: C&L, <http://www.finescale.org.uk/>
Rare earth magnets are available from: Magnet Sales, <http://www.magnetsales.co.uk/deep.htm> the reference is: deep pot SMDP00103
13mm diameter x 20 mm deep. I have no connection with any of these traders other than that of a satisfied customer.

Raymond Walley
March 2011 Bexhill on Sea.