SOFT SOLDERING FOR MODEL RAILWAY ETCHED KIT CONSTRUCTION.

By Bob Alderman. © 1997.

Introduction.

The techniques described below are derived from experience and are for soldering brass, nickel silver, steel and whitemetal components. They are not the methods for joining wires in layout wiring and are not recommended for electronic circuitry.

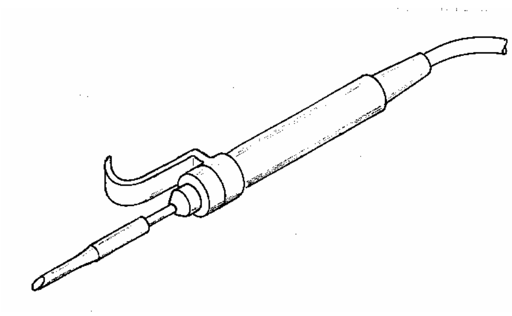
Soft solders are all based on various alloys of lead and tin, with additions of antimony. They have melting points below 200°C. The melting point is dependant on the variation in the quantities of the main materials, lead and tin, in the alloy. Within certain bounds increasing the tin content raises the melting point, whilst increasing the lead lowers it. The addition of the antimony takes its melting point below that of boiling water. (More on the selection of your solder later.) Hard solders are “silver solders and brazes”. These have melting points in the region of 600°C and above and require intensive heating from a source such as blowlamp.

The solder creates the joint by alloying with the surface of the base metal. The alloyed thickness is only microns thick. The remainder of the joint is made by the continuation of the solder to the next alloyed surface. Solder is not mechanically strong, therefore the thinner the thickness of solder at the joint, the stronger it will be.

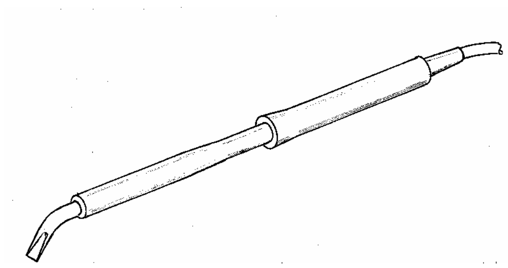
What iron?

The choice of soldering iron will be dependent on the work you wish to do. The more heat available, the easier it is to make a joint. The electric iron has superseded the plain copper bit in a gas flame for continuous operation. An iron is rated by its wattage. The lower the wattage the cooler it is and has less of a heat reservoir. The general range of electric irons runs between 15W to 120W.

The low wattage irons generally have a bit that sits over the heating element, whilst the higher wattage ones have a bit that sits within the element.



25W Iron.



75W Iron.

There is another type of iron that looks like a gun. On these the bit is instantly induction heated. I have found these are of little use for the type of jointing involved in kit construction.

There are temperature-controlled irons. They can do the whole range from low melt to the upper end of the soft solders. In size they are similar to a 25W iron. They are also expensive, about five times that of a 25W iron! Nice if you can get one, but is still limited as a heat reservoir.

Preparation and maintenance of the iron.

Before its first use, and subsequently during use, the bit of the iron must be "tinned". The tinning protects the copper of the bit from the flux and aids heat transfer. It is also necessary to tin a coated bit, that are those, which come apparently, tinned. It may be advisable to wash a new bit in soapy water to remove an oily coating before fitting it to the iron.

Tinning is the application of a coating of solder onto the bit of an iron. Allow the iron heat up and when it has reached temperature generously melt solder over the end of the bit and beyond with plenty of flux. The droplets of molten solder can be wiped around the bit with a damp rag to ensure an even cover. Once satisfied carefully shake off the excess solder.

Periodically during use it will be necessary to re-tin the bit, frequently if using acid fluxes. There are tip-cleaning products too which are useful. These are a solder /flux paste. The end of the bit is simply pushed into the compound every so often, re-coating the end with solder. The excess solder and flux is then wiped off with a damp cloth or pad.

Occasionally it may become necessary to reshape the bit by filing. This will expose bright copper that *must* be tinned immediately, or an oxide film will build up preventing heat conduction and re-tinning. If one of the high wattage irons is left on for a length of time the tinning will degrade, becoming dark. This can be revived with a wire brush (a brass bristled suede brush is ideal) and retinned. Ideally the working end of the bit should always be bright with a solder coating.

Surface preparation of components.

Etched brass and nickel silver components are coated with an etch resist as part of the manufacturing process. This is generally removed after the etching process, but can sometimes remain locally. If it is evident as a coating it can be easily removed by lightly abrading with a fine Garyflex block or fibreglass brush. Personally I do not like the latter. I always seem to get the broken glass fibres in my skin and it itches like fury! The acid in perspiration can leave a dark oxide coating on brass that needs to be removed.

Generally it is not necessary to flux and tin all parts before assembly, but it is easier sometimes if small parts are "tinned" before removing them from the fret. (See later.)

As components are removed from the fret you will, of course, file off the residual tags and, if necessary, the etching cusp on the edges.

Solders.

There are a variety of solders available for assembling etched kits. They are usually described by their melting points in degrees C, 188 or 144. The higher the melting point the greater the tin content and the easier it will flow. These solders will not readily form an obvious fillet on joints, except when an excess amount has been used. In general these are supplied in stick and wire forms. There are solder paints available too. These consist of fine particles of solder suspended in a flux. I have tried the type supplied for plumbers and have found it less than satisfactory, possibly due to coarseness of the solder particles. Carrs 188 Solder Paint is my preferred one. Until recently I have found difficulty in dispensing economic quantities of solder paint. I have now resorted to decanting it into a hypodermic syringe with a blunted needle and can now apply precise amounts.

The advantage of the different melting point ranges is that, as assembly progresses, lower temperature solders can be used without fear of an earlier joint becoming undone. Whilst any solder joint is not as mechanically strong as other heat based jointing systems, the higher temperature joints should be stronger than the lower. You will find that the parts become smaller and the amount of heating reduces too.

The low melt solders (70° C) for whitemetal are quite strong enough for the duty they are used. Note that should you wish to undo a low melt joint it will remelt at a higher temperature (about 100° C) as the solder has re-alloyed with the whitemetal. This is unlike normal solder that retains its original melting point.

The solder with a resin based flux in the core should be confined to electrical work

Fluxes.

Fluxes for model work currently seem to be legion. Generally all the liquid fluxes are solutions of Phosphoric acid in different strengths. It is an excellent flux for brass and nickel silver. As applied you can often see the metal change colour as the oxide coating is removed. It is ***the*** flux for whitemetal.

An alternative flux for brass and nickel silver is “Fluxite”, a paste containing zinc chloride, also the basic flux material in some solder paints. Recently “Fluxite” has been superceded by “Powerflow” flux for plumbers lead free solder. This has the advantage of washing off in hot water. I now use this as my general flux.

The liquid flux is applied by a small paintbrush, the paste by a cocktail stick, or better still from a hypodermic syringe. This I find more economical and less messy. Both types of flux produce a vapour when heated. Breathing it should be avoided. I recommend the use of a small fan to blow across the work place to remove the fumes. I generally use to “Powerflow” for all my joints except when soldering whitemetal, as I find it more tolerable than the acid fumes.

No matter what flux you use the residues should be neutralised and washed away. Acid fluxes should be washed off initially with a solution of sodium bicarbonate (baking powder!), and then plain hot water (not too hot or you can undo whitemetal joints! Fluxite residues should be initially be wiped off with a rag or tissue. Then the model washed off with white spirit. A soak in this for a couple of hours or overnight does not come amiss. The model should be then washed off in hot soapy water and well rinsed. This can come later as part of the preparation of the model before painting. Ideally “Powerflow” should be cleaned off at the end of a soldering session as bright green residues will appear overnight! They do wash off easily and I have had no problems with them remaining on a model for a few weeks.

Soldering.

Having introduced the preliminaries, now for the act. To some, great mystery seems to surround it. *There is none*. The essentials of creating a good joint are having sufficient heat available and a clean joint. The latter is achieved with the flux and the former requires an iron that is large enough.

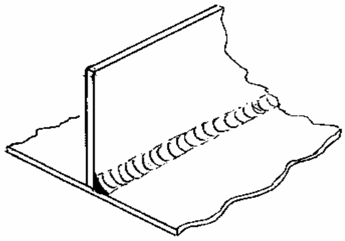
In general most of my work is done with a 75W iron. (40W for 4mm. work) This heats the job quickly and has a reserve of heat. If the iron is too small you spend ages heating a joint without the solder melting satisfactorily and end up with a model that is too hot to handle! With a large iron the solder melts and flows before the heat travels into the model, material only an inch or so away will only feel warm.

So, step by step...

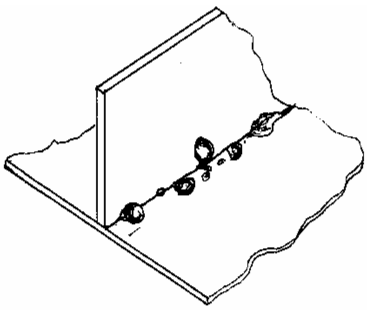
1. Clean your surfaces. They should be at least grease free.

2. Bring the parts together and flux the joint. Acid flux will run along by capillary action, or smear of paste flux along the joint will do the same when heated.

3. Apply the iron to the joint and at the same time introduce the solder. The flux will run, as will the solder. Again capillary action will pull the solder into the joint, but only in the heated zone. To make it run along a joint the heat must move along too.
A good joint will show by the solder obviously wetting the metal and it should show a thin concave fillet. There may be some slight over-runs onto the surrounding surface with negligible thickness.



A bad joint, often known as a "dry joint", will shows by the solder appearing as "balls" and not adhering to the surface. This can be as a result of either insufficient flux and/or heat.



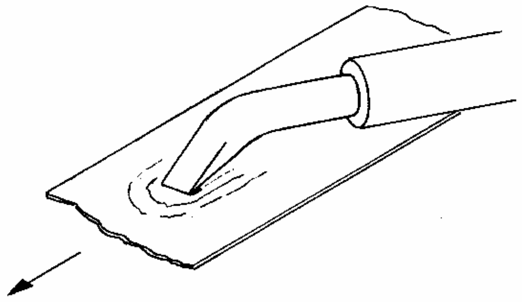
I do not usually carry solder to the joint on the iron. My practice is to introduce the solder to the joint next to the iron.

4. There can be an excess of solder on the iron after creating one or two joints. This should be removed with either a damp cloth, a damp sponge, as supplied on soldering iron stands, or a wooden handled brass bristled suede brush.

Basics over, now to elaborate.

Tinning.

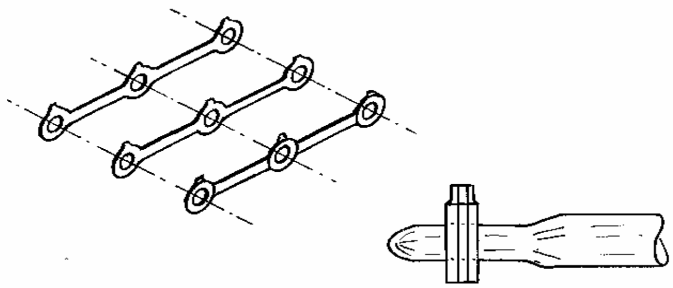
Sometimes before making a joint, especially a surface to surface one, or preparing small parts, it is advisable to "tin" the mating surfaces of each part. "Tinning" is coating the surface of the base metal with solder. Flux the surface, apply the iron and introduce a small quantity of solder. Slowly wipe the iron across the surface. The solder will follow the iron and be transferred to the part. The aim is create a coating a small fraction of a millimetre thick.



With each part tinned they can be brought together and heat applied. This process is known as "sweating". It is often used when scratchbuilding to laminate material and then cut it out to make identical parts, for instance chassis sides. The iron should follow a similar path as when tinning but is only providing the heat. Initially correctly locate the parts, as this type of joint can be difficult to undo. If you have to undo such joint then the use of a small gas blowlamp can make it easier. (More of the blowlamp later.)

Laminated parts.

Laminated parts in kits such as valve gear and motion respond to tinning before assembly. The parts can be located by a cocktail stick or sharpened matchstick, then joining them becomes easy. Motion parts are illustrated, but larger parts can also be similarly located if they have holes.

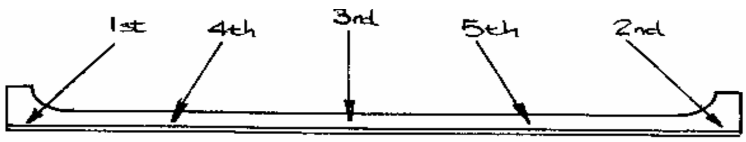


For small parts that are to be added to the top of another larger one, tinning in the fret is beneficial. If this is done off the fret the part can become attached to the iron!

Long joints.

For long joints you can run into problems with the parts expanding under the heating. What should be straight becomes a banana. To overcome this, the heat from the iron should be distributed along the joint. Typical of this is fitting a valance to a footplate. Initially it should be located, or "tacked" in position. To do this flux the whole joint, then at one end make the joint with a small amount of solder. Check for position *now*. Leave it if satisfied, otherwise correct it.

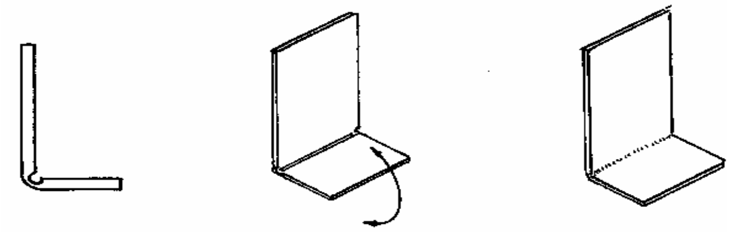
Next tack the opposite end, and then tack the middle. Then, between the middle and the first tack make another joint, then again between the middle and the second joint make the fourth joint and so on, halving between each joint distributing the heat.



Once you have a virtually continuous joint it is then possible to run the iron *slowly* from one end to the other to complete the joint. By moving the iron slowly only the solder local to it will melt, the remainder keeping the joint mechanically straight.

Half etched corners.

The half-etched fold line is a particular feature of etched kits. When the metal is folded on these lines it undergoes a process known as “work hardening”, especially true in brass. In its harder state the material is less ductile and more brittle. Repeated bending is likely to cause it to fracture. To overcome this it is usual to run a fillet of solder into the half-etched line. This serves to reinforce the corner and the heat will remove the hardening effects. Apply the iron to one end of the fold and allow the solder to run down the fold, following it with the iron if necessary. Check the geometry of the fold afterwards though. On small components there is enough surface tension in the solder to pull a corner tighter, 90° becoming 87° or thereabouts.



The corner as formed. Unsupported free to bend. Solder filling the corner to lock it up.

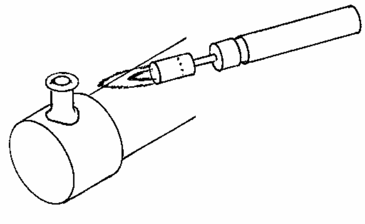
If you are particularly concerned that, in spite of reinforcing the corner with solder, it may still be vulnerable then add a length of brass wire to the corner, 0.7 or 0.9mm. diameter.

Using a gas blowlamp.

The small pencil blowlamps that run off gas lighter fuel can be used effectively with care.

As mentioned earlier it is useful for separating parts that have been joined to make multiple components. It can also be the heat source for making the initial joint. If a serious error has occurred it can be applied to undo joints. **ITS HEAT WILL DESTROY WHITE METAL PARTS.**

Its best use is for heating the larger brass components such as chimneys and domes. Get the best fit for the part on the boiler; tin the base and then position with flux on the joint. Apply the heat from the blowlamp and watch the tinning solder melt. Remove the heat and allow it to cool. Do not touch until it is cool, as the model will have become much hotter than with an iron. The benefit here is that only the heat reaches the parts, there is no physical contact that could dislodge the part and result in a chimney fixed at one o-clock!

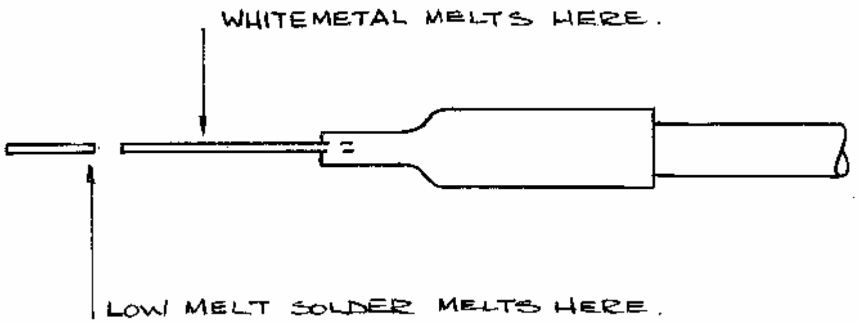


SOLDERING WHITE METAL.

Soldering white metal is a little different from normal soldering. Low melt solder is essential. A lower temperature iron is necessary too. BEWARE, overheating low melt solder can drive off “heavy metal” fumes. These can be particularly noxious.

There are several ways to achieve a lower temperature iron. An expensive way is to purchase a temperature-controlled iron. Alternatively a 25W iron can be used in series with a light bulb. Some experiment with different wattage bulbs may be needed. A light dimmer can also be used, sometimes in conjunction with a bulb in the circuit as some cannot cope with low wattage's.

A really cheap way is to use an old 25W iron bit. Drill the end to accept a length of copper wire used as the "earth" core in 30 Amp cable. The wire has must be clamped in the bit. The length of the wire is determined by heating the bit, and with a piece of scrap white metal and find the position it melts on the wire. Similarly, with a piece of low melt solder, determine where it melts. Cut the wire at a point between the two.



White metal oxides quickly on its surface, the grey colour. It can also have mould release compound remaining on the surface. Cleaning the surface to be soldered with a file or wire brushing (brass bristles) is usually sufficient. Tinning it is not usually possible.

Locate the component and add flux. Flux the solder stick, collect a bead of solder on the bit and carry it to the joint. The lower temperature makes it difficult to introduce low melt solder to the joint as you would other solders. Therefore this is virtually the only occasion when the solder is carried to the job on the iron. The flux should boil away cleaning the joint and the molten solder will penetrate the joint. AVOID THE FLUX FUMES. Sometimes additional solder is required to complete the joint. The same characteristics of good and bad joints apply as with normal soldering.

To solder white metal to brass or nickel silver or vice versa, tin the brass or nickel silver with normal solder. Use an acid flux. Introduce the white metal component and proceed as before. The melting point of the low melt solder is too low to effect an alloyed joint with the brass or nickel silver, hence tinning them.

Remember that undoing a white metal soldered joint can require a higher temperature than to make it. The solder re-alloys with the white metal and its melting point rises.

It is possible with care to solder white metal components to brass and nickel silver with a conventional iron, even 75W! To do this carry on as before tinning the surface, then re-tin that surface with low melt. Place the white metal component with flux and then position the iron carefully alongside the joint to be made and allow the heat to be conducted into the joint. You can see the melt front move across the surface of the low melt. Once it has passed the part remove the iron, however, due to the higher temperature it will take longer for the low melt to re-solidify.

Exceptionally with thick white metal parts, say 1/8” can be joined with a normal 25W iron. Surface preparation as before, apply flux and then carefully apply the iron and melt the parts together, welding rather than soldering. Do not let the iron dwell too long or a “melt down” can occur.

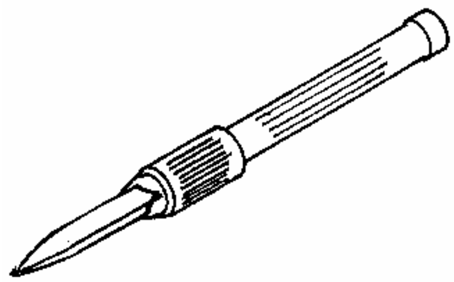
Tools.

Besides the iron and a means of applying flux a number of other tools are useful.

Prime among these is a dental probe that can be used to hold down small parts instead of fingers. Clothes pegs are also useful for holding parts together. Being wooden it is easy to customise the ends to particular jobs. They are cheap too!

A hardwood block, 4”x 1.5” x 1” with good sharp right angle corners is a handy aid to supporting components whilst soldering. Your local carpenter or cabinet maker should be able to come up with one of these for a small fee. If they have mechanical sanders then the square corners can be quickly produced.

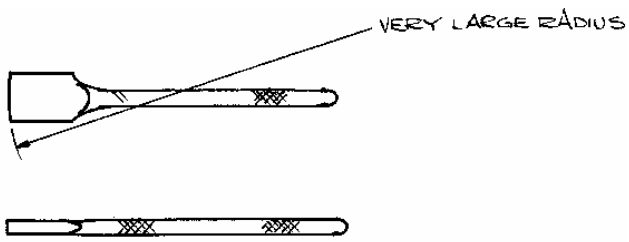
Tools to remove excess solder will also probably be needed. In particular I use two scrapers, one purchased and the other homemade. The purchased one is a three-sided tungsten carbide blade in a handle.



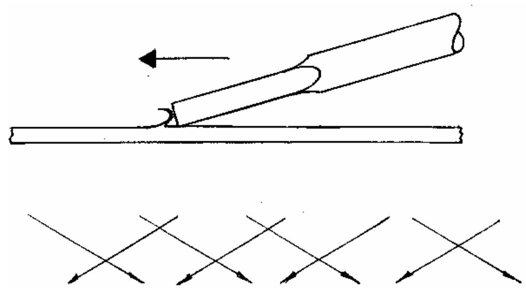
The other is a broken flat Swiss file modified as follows. The teeth are ground off and the edges whet stoned to sharp corners. A large radius across the end, as shown, seems to help. Make sure there are no residual file teeth left as they can scratch the surface.

Both types of scraper are *pushed* across the surface to remove solder. If a criss-cross pattern is used it is less likely to create a step in the solder that will jam the edge of the scraper.

The modified file.



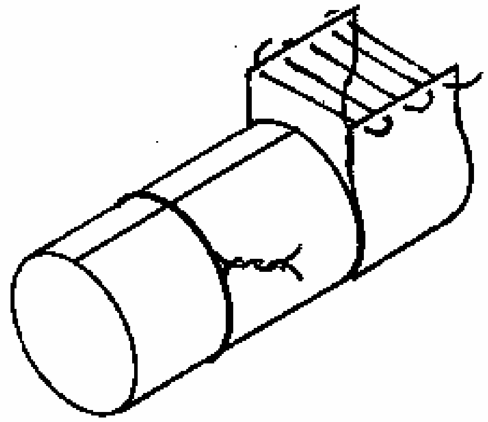
Pushing the scraper.



Small steel wire brushes can be used in two ways to scrub off excess solder. One way is to heat an area with the iron, locally melting the solder and then immediately brushing the area. Alternatively they can be used at a later stage to vigorously, but carefully, burnish the metal and remove solder. Always try to brush in line with an edge, not across it. A cup shaped wire brush in the modelling drill can also be used for the same purpose. All methods will find out your poor joints!

There are also rubber discs that carry an abrasive that fit the modelling drill and are used to burnish away solder. These can be particularly effective.

Finally, soft iron wire sold by florists, is a useful tool for holding parts together. For instance it can be "tied" around a boiler to hold it to shape whilst making the joining seam or attaching it to the smokebox and firebox. I've even used it to stitch the hidden edge of a smokebox wrapper whilst soldering in position. The particular benefit of this wire over, say, copper wire, is that it is not springy and does not solder well.



Tying and stitching with iron wire

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In addition to these particular tools several of the specialist modelling tool suppliers offer a variety of other tools specifically to aid soldering. Examine their catalogues and decide what else you may need.

Hopefully I have covered most of the points that arise when questions are raised about soldering etched kits. Doubtless I've missed something, so if it is a burning issue for you I apologise. Remember, for the best results get the parts clean and hot.

Remember your safety!
You are dealing with hot items, fumes, sharp edges, points and unpleasant chemicals.
Don't be careless. Take appropriate steps to minimise their effects.

Summary of materials, tools and sources.

IRONS	ANTEX or WELLER	SQUIRES, GOOD HARDWARE SHOPS SOME MODEL SHOPS
SOLDERS	CARRS ,	DIRECT or LOCAL MODEL SHOP
FLUXES	CARRS, POWERFLOW FLUXITE	DIRECT or LOCAL MODEL SHOP. HARDWARE SHOP.
BLOWLAMP		SQUIRES LOCAL MODEL SHOP
ABRASIVE RUBBER DISCS		SQUIRES
WOOD BLOCK	LOCALLY RESOURCED	
WIRE BRUSHES		SQUIRES
DENTAL PICKS		SQUIRES
SCRAPER	LOCALLY RESOURCED	SQUIRES
ABRASIVE RUBBER DISCS		SQUIRES
SOFT IRON WIRE	0.7 or 0.9 mm. dia.	LOCAL FLORIST

* *Squires recommended from a satisfied customer, usual disclaimer, but they do stock nearly everything you will need, plus a bit! Addresses below.*

Squires Model and Craft Tools
100 London Road
Bognor Regis
West Sussex
PO21 1DD
Tel. 01243 842424 Web catalogue site coming on-line Summer 2001

Bob Alderman
4 Yeovil Road
Montacute
Somerset
TA15 6XG

01935 825379   e-mail: bob@montacute.free-online.co.uk