5 Workshop Notes

5.1 Soft Soldering (For Model Railway Etched Kit Construction).

5.1.1 Introduction

The techniques described below are derived from experience and are for soldering brass, nickel silver, steel and whitemetal components. They should not be used for joining wires in layout wiring nor are they recommended for electronic circuitry.

Soft solders are based on various alloys of lead and tin, with additions of antimony. They have melting points below 200°C, dependant on the quantities of lead and tin in the alloy. Within certain bounds, increasing the tin content raises the melting point, increasing the lead lowers it, while addition of the antimony takes its melting point below that of boiling water (For guides to selection see 5.1.5).

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. They are discussed in a further section.

Solder creates a 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.

5.1.2 Choice of iron

This depends on the work to be done. The more heat that is 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 The electric iron has superseded the plain copper bit in a gas flame for continuous operation.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 smaller its heat capacity. The general range of electric irons runs between 15W to 120W.

The low wattage irons generally have bits that sit over the heating element, whilst the higher wattage ones have bits that sit within the element.

Irons that look like guns have bits instantly heated by electrical induction; they are not recommended for kit construction.

Temperature-controlled irons can be used for the whole range of soft solders from low-melt to the upper end. In size they are similar to a 25W iron. However, they are expensive, about five times that of a 25W iron.

5.1.3 Preparation and maintenance of an iron

Before its first use, and subsequently during use, the bit of the iron must be 'tinned'. It may also be advisable to wash a new bit in soapy water to remove any oily coating before fitting it to the iron.

Tinning protects the copper of the bit from the flux and aids heat transfer. It is also necessary on coated bits, which come apparently already tinned. It is the application of a coating of solder on to the bit of an iron that prevents oxidation and aids heat conduction. Heat the iron, applying plenty of flux, until the solder melts freely over the end of the bit. Wipe the droplets of molten solder around the bit with a damp rag to ensure an even cover, carefully shaking off the excess.

Periodically, during use, it will be necessary to re-tin the bit; frequently, if using acid fluxes. Tip-cleaning products exist which can be useful, consisting of a solder/flux paste. The end of the bit is pushed into this compound as required, thus 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

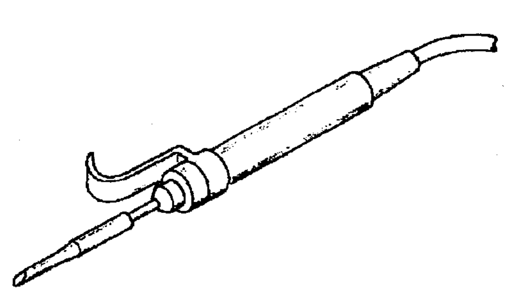

Figure 5.1 25 Watt Iron

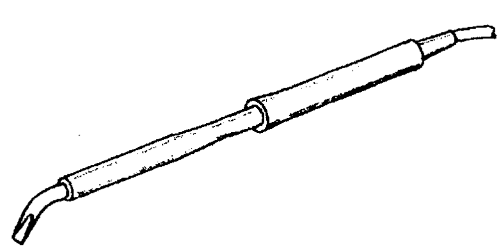

Figure 5.2 75 Watt Iron

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 re-tinned. Ideally, the working end of the bit should always be bright with a coating of solder.

5.1.4 Surface preparation of components

As part of the manufacturing process, etched brass and nickel silver components are coated with an etch resist. Though this has generally been removed after the etching process, it can sometimes remain locally. If it is evident, it can easily be removed by lightly abrading with a fine Garriflex block or fibreglass brush; if using the latter, beware of broken glass fibres getting into your skin. Handle etches with care, the acid in perspiration can leave a dark oxide coating on brass that should be removed.

Generally, it is not necessary to flux and tin all parts before assembly, but sometimes it is easier if small parts are 'tinned' before removing them from the fret. (See 5.1.9.) As components are removed from the fret, remember to file off the residual tags and, if necessary, the etching cusp on the edges.

5.1.5 Solders

There are a variety of solders available for assembling etched kits. They are usually described by their melting points in degrees C, e.g. 188 or 144. The higher the melting point the greater the tin content and the easier it will flow. Such solders will not readily form an obvious fillet on joints, except when an excess amount has been used. In general they are supplied in stick or wire form. Solder paints are also available, consisting of fine particles of solder suspended in a flux. The type supplied for plumbers can be less than satisfactory, possibly due to the coarseness of the solder particles; Carr's 188 Solder Paint is to be preferred. To dispense economic quantities of solder paint, decant it into a hypodermic syringe fitted with a blunted needle; precise amounts can thus be applied.

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 no solder joint is as mechanically strong as other heat-based jointing systems, joints made with higher temperature solder will in general be stronger than those using lower. As assembly progresses, parts tend to become smaller and consequently the amount of heating reduces.

The low-melt solders (70° C) for whitemetal are quite strong enough for the duty for which they are used. Note, if a low-melt soldered joint involving whitemetal has to be undone the solder will remelt at a higher temperature (about 100° C) as it has formed a new alloy with the whitemetal. In general however, higher temperature solders retain their original melting points.

Though easily obtained and readily used, resin-cored solder cannot be recommended for modelling work. The solder itself flows easily and makes adequately strong joints but the resin creates a deposit on the assembly which must be very thoroughly removed before paint is applied. This product should be confined to electrical work.

5.1.6 Fluxes

There are many fluxes for model work currently available. 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 especially good for whitemetal. Carrs supply a range of strengths to suit different metals.

An alternative flux for brass and nickel silver is Fry's 'Fluxite', a paste containing zinc chloride, which is also the basic flux material in some solder paints. This has recently been superseded by Fry's Powerflow flux designed for use with plumber's lead free solder. It has the advantage of washing off in hot water and can be recommended as a general flux. Fry's also supply a liquid zinc chloride based flux, Bakers Fluid No 3, which also needs to be washed off after use.

The liquid flux is applied by a small paintbrush and the paste by a cocktail stick, or better still from a hypodermic syringe. The latter allows just the right amount to be dispensed and is economical.

Both types of flux produce vapour when heated. Avoid breathing the fumes. A small fan, set to blow across the work-place to remove the fumes, is strongly recommended. Fluxite, Powerflow and similar paste fluxes are preferred, except when soldering whitemetal, as their fumes tend to be more tolerable than those of the liquid acid fluxes.

All flux residues should be neutralised and washed away after assembly is complete. Those from acid fluxes should be washed off initially using a solution of sodium bicarbonate (baking powder) followed by rinsing in warm water (not too hot, or whitemetal joints may be loosened). First, wipe off all Fluxite residues with a rag or tissue. Then, wash the model in white spirit, soaking it in this for a couple of hours or even overnight. Thereafter, as part of the preparation before painting, wash it in hot soapy water and rinse well. Ideally Powerflow should be cleaned off at the end of a soldering session, as bright green residues can appear overnight. However, they do wash off easily.

5.1.7 Soldering

To some modellers, soldering seems to be surrounded by a great mystery. As experience will show, there is none. The essentials of creating a good joint are having sufficient heat available and clean surfaces to be joined. The latter is achieved with the flux and the former requires an iron that is large enough.

When working on 7mm kits a 75W iron will generally suffice, though for smaller assemblies a more suitable wattage would be around 40W. The bigger iron heats the job quickly and has an adequate reserve of heat for all but the largest assemblies. With an iron that is too small, heating a joint until the solder melts satisfactorily results in a model that is too hot to handle and a joint that may still be imperfect. 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. Distortion is also kept to a minimum.

Basic Steps

1. Clean the surfaces to be joined. They should, at the least, be free of grease.
2. Bring the parts together and flux the joint. Liquid Acid flux will run along by capillary action, a 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-run onto the surrounding surface with negligible thickness. (Figure 5.3)

A bad joint, often known as a 'dry joint', will show by the solder appearing as 'balls' and not adhering to the surface. This can be a result of either insufficient flux and/or heat. (Figure 5.4)

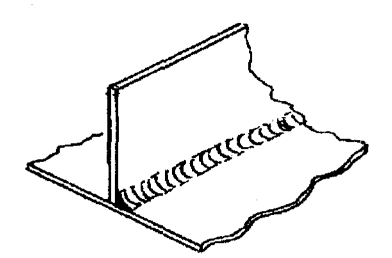

Figure 5.3

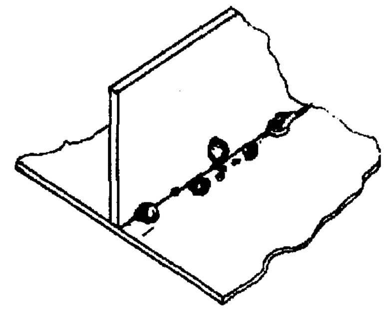

Figure 5.4

It is usual to feed the solder to the joint alongside the iron. Solder should not usually be carried on the bit to a joint, sometimes however, this may be necessary when access or handling are difficult.

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. Wiping the bit before making any joint is strongly recommended.

5.1.8 Tinning

Sometimes, before making a joint, especially a surface-to-surface one, or when preparing small parts, it is advisable to 'tin' the mating surfaces of each part. 'Tinning', in this case, 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 to create a coating a small fraction of a millimetre thick.

When the separate parts of a given assembly have each been tinned, they can be brought together and heat applied. This process is known

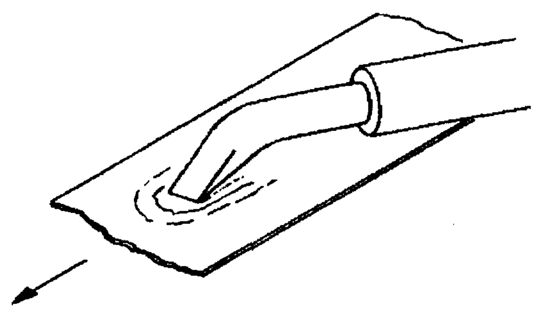

Figure 5.5 Tinning the surface.

as 'sweating'. It is often used in scratchbuilding when material has to be laminated before cutting out identical parts in one operation, for instance frames or the sides of cabs and tenders. The iron should follow a similar path as when tinning but is now only providing the heat. Initially, locate the parts correctly, as this type of joint can be difficult to undo. If you have to undo such a joint then the use of a small gas blowlamp can make it easier. (see 5.1.12)

5.1.9 Laminated parts

Laminated parts in kits, such as valve gear and motion, should be tinned before assembly. The separate parts can be located one to another by cocktail sticks or sharpened matchsticks, joining them together then becomes easy. Motion parts are illustrated, but larger parts can also be similarly located if they have holes.

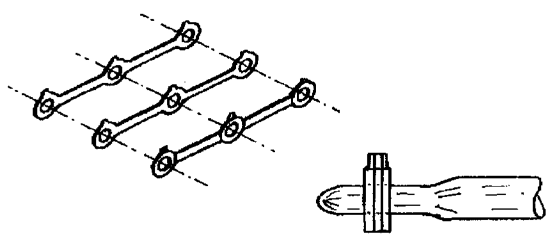

Figure 5.6 Joining laminations.

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

5.1.10 Long joints

When making a long joint the parts will tend to expand as they are heated and become banana-shaped. To overcome this, the heat from the iron should be distributed along the joint. A typical example would be the fitting of a valance to a footplate. Initially it should be 'tacked' in position. Flux the whole joint and then, at one end, begin the joint with a small amount of solder. Check it for position, correcting if necessary. Next, tack the opposite end, then the middle. Repeat between the middle and the first tack, then again, between the middle and the second joint, make a fourth joint and so on, halving the distance between each joint and thus distributing and minimising the input of heat to the whole assembly.

When the joint becomes virtually continuous, 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.

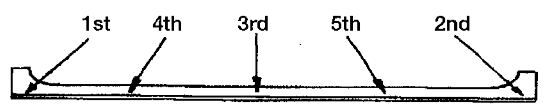

Figure 5.7 Sequence in soldering a valence.

5.1.11 Half etched corners

The half-etched fold line is a common feature in etched kits. When the metal is folded along these lines it undergoes a process known as 'work hardening', especially true with brass. In its harder state the material becomes more brittle, repeated bending would be likely to cause it to fracture. To overcome this it is usual to run a fillet of solder into the half etched line. The corner is thus reinforced while 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; on small components there can be enough surface tension in the solder to pull a corner tighter, a fold of 90° becoming 87° or thereabouts. If the material is thin it may be vulnerable, adding a length of 0.7 or 0.9mm brass wire to the corner can provide additional support.

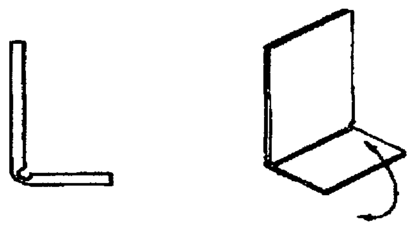

Figure 5.8 The corner as formed - Unsupported and free to bend - Solder filling the corner locking the joint.

5.1.12 Using a gas blowlamp

The small pencil blowlamp that runs off gas lighter fuel can be an effective tool, if used 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.

CAUTION: Heat from a blowlamp will destroy white metal parts.

These blowlamps are most useful 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! Don't knock the workbench either.

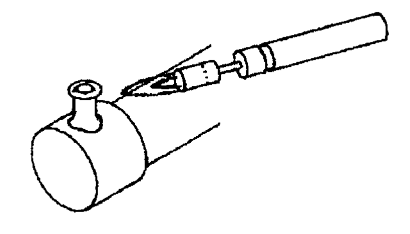

Figure 5.9 A pencil blowlamp

5.1.13 Soldering White Metal

Soldering white metal requires procedures somewhat different from normal soldering. The use of Low-Melt solder is essential, likewise an iron which will run at a lower temperature.

WARNING: If low-melt solder is overheated it can give off 'heavy metal' fumes that are noxious.

The Iron

There are several ways to achieve a lower temperature from a soldering 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 experimenting 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 dimmers are not able to control devices consuming low levels of power.

A really cheap way is to use an old 25W iron bit. Drill the end to accept a length of copper wire such as is used as the 'earth' core in 30 Amp cable. The wire must be clamped in the bit. Its length is determined by heating the bit and then testing with a piece of scrap white metal to find the position on the wire at which the white metal melts. Repeat this process with a piece of low melt solder to determine the position at which it melts. Cut the wire at a point between the two places.

1. Preparation

White metal oxidises quickly on its surface, indicated by the grey colour. Its surface can also be contaminated by mould-release compound.

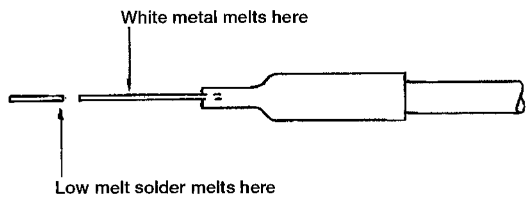

Figure 5.10 Modified bit for whitemetal

Cleaning the surface to be soldered with a file or wire brush (brass bristles) is usually sufficient to remove this. It is not usually possible to tin white metal.

2. White metal to white metal

Locate the component on the main assembly and add flux. Flux the solder stick. Collect a bead of solder on the bit of the iron and carry it to the joint. Because the temperature is low, it is difficult to introduce low-melt solder to the joint as you would other solders. This is one of the rare occasions when solder is carried to the job on the iron. The flux should now be boiling away, cleaning the joint and allowing the molten solder to penetrate the joint. AVOID THE FUMES OF THE FLUX. Sometimes additional solder is required to complete the joint. The same characteristics that identify joints good and bad apply, as with normal soldering.

3. 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 the need to tin the parts made of those metals.

Remember, undoing a white metal soldered joint can require a higher temperature than was used 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 one of 75W. To do this carry on as before, tinning the surface, then re-tin that surface with low melt. Place the white metal component, having coated it with flux, and then position the iron carefully alongside the joint to be made and allow the heat be conducted into the joint.

The melt front can be seen moving across the surface of the low-melt. Once it has passed the white metal part, remove the iron. However, due to the higher temperature being used, it will take longer for the low-melt to re-solidify. Practise this technique with some scrap components before risking a valuable component.

4. Thick white metal parts

Exceptionally, parts of say 1/8in can be joined with a normal 25W iron. Prepare the surfaces as before, apply flux and then carefully apply the iron and melt the parts together, welding rather than soldering.

CAUTION: Do not let the iron dwell too long or a 'melt down' will occur.

5.1.14 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 their ends to particular jobs. They are cheap too!
- A hardwood block, 4in x 1.5in x 1in 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 he has mechanical sanders then the square corners can be quickly produced.
- Tools to remove excess solder: in particular, scrapers will also be needed. Some of these can be purchased; others made from existing material. A useful one available from tool shops is a three-sided tungsten carbide blade in a handle.

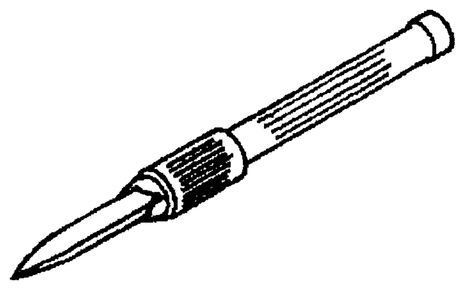

Figure 5.11 Commercial Scraper

A home made one can be made from a broken flat Swiss file modified as follows. The teeth are ground off and the edges sharpened with a whetstone till the corners are sharp. A large radius across the end, as shown, seems to help. Make sure that there are no residual file teeth left as they can scratch the surface.

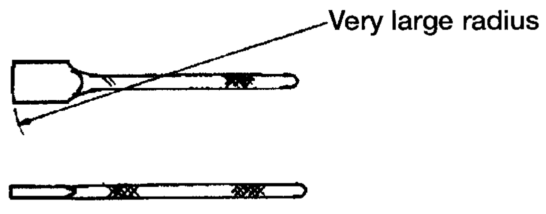

Figure 5.12 Home made scraper

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 which will jam the edge of the scraper.

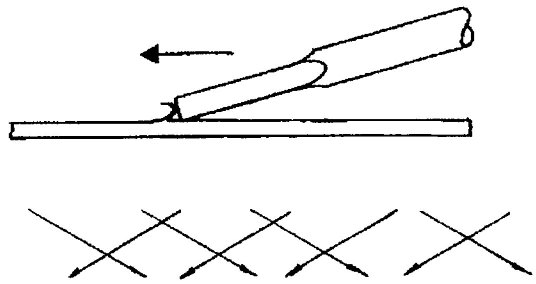

Figure 5.13 Using the scraper

- 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

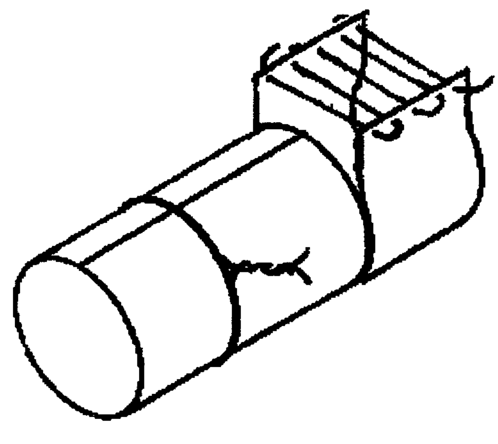

Figure 5.14 Tying and stitching with iron wire

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 fit the modelling drill and carry an abrasive that can be used to burnish away solder. These can be particularly effective.
- Soft iron wire sold by florists, is useful 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. It can even used 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.

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 might need.

Remember! For the best results get the parts to be joined 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 their sources.

Soldering Irons	Antex or Weller	Hardware shops and some Model shops
Solders	Carrs, etc	Hardware shops and D-I-Y Stores
Fluxes	Carrs, Fry's etc.	Hardware shops and D-I-Y Stores
Blowlamps		Specialist Craft shops, some D-I-Y Stores
Wood Block		Locally sourced
Wire brushes	Brass and steel	Hardware shops, shoe shops for brass suede brushes
Dental picks		Specialist Craft shops
Scrapers		Specialist Craft shops or locally made
Abrasive Rubber Discs		Specialist Craft shops
Soft Iron Wire	0.7 or 0.9mm dia.	Local Florist

The Tools Section of the Guilds Trade Directory lists a number of specialist suppliers who provide a Mail Order service and cater for modellers needs.