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The Art of Low Melt -Soldering

By Al Cutmore

General

Over the years many and varied kits have been produced by an endless number of manufacturers worldwide in what is commonly called white metal. White metal as it was known then was a combination of tin and lead. Kits are still being manufactured today in a similar medium of pewter for all scales of model railways and they range from scenery items to locomotives and cover all scales. Pewter is used because of the extremely low or nil lead content. The only perceived drawback to these kits was the method of construction.

Once, the accepted practice to assemble kits was using Araldite and then superglue. Not only were they messy to use but the strength of the joint was questionable. The mention of the word solder was unthinkable because in the modeller's eye all they could see was a vision of gaping holes and the loss of dollars they would incur while the remainder of the kit is eaten up by the too hard drawer. If white metal kit construction was such a problem why would so many manufacturers past and present, throughout the world, use this medium.

When I first started a select few had the answers to the problem but they would not share their secrets with others in the modelling fraternity. All is now revealed but with a word of caution as some manufacturers now use extreme low, melt solder (60deg C) to make castings in and effort to reduce pirating of their product.

History

The use of solder dates backs some two thousand years and is another military invention converted to civilian use. It was discovered that the mixing of two base metals, namely tin and lead, formed an alloy, which could be used to join other base metals. This allowed the armorers to make bronze swords and the like and join them with brass hand pieces. Soldering evolved through the ages and today we see it used by plumbers all the time. Over the years the methods of soldering has also changed from the open hearth to the soldering iron. More recently soldering has been subjected to the rigors of space travel and electronics. One of the groups to benefits from soldering was the model railway industry and this is where we enter.

Solder

The soldering process for white metal is called soft soldering. Solder as we generally know it is made up of tin and lead which is defined by weight and expressed in percentages, e.g. tin/lead solder is usually expressed as 60/40 or 60% tin and 40% lead. Pure tin has a melting point of 232deg C, whilst pure lead has a melting point of 327deg C. When combined as an alloy the melting point of 63/37 solder has a melting point of about 183deg C. The melting point of solder is called the eutectic point but the actual melting (eutectic) point has never been firmly established. A very basic soldered joint is shown at Figure 1.

Figure 1

With the introduction of other metals (such as Antimony, Bismuth, Cadmium, Indium and Silver) solders can be made to suit specific purposes. From a combination of these base metals with tin and lead low melt solder is produced.. White-metal, normally has a eutectic point about 180 deg C the same as solder so we now have to look for a solder which has: a eutectic point lower than white metal. I prefer a safety factor of about 100% most times when using low melt solder and use 90 deg C as my base line. There are imported products you can use or locally produced products, which perform just as well.

Flux

When everything is exposed to the atmosphere it oxidizes. This includes our skin. We often refer to the exposure of metal to the air as tarnish. Tarnish interferes with the solder bonding to the metal so to counteract this we have to clean the surface. Flux is the component we use for this process. Flux is normally an acid based liquid painted on the surface of the item to be soldered. The cleaning takes place when the flux is boiled leaving the surface chemically clean and excluding the atmosphere at the same time. It also reduces the surface tension of the materials and allows the solder to flow. This is called wetting. Wetting is visually evident as the solder surface looks shiny and like "Water Wet".

As most fluxes are acid based if they are not neutralized after the solder process they will eventually corrode the joint. Most washing detergents have an alkaline base but be careful not to use ones based on animal fat as it will leave a fatty residue in the pores of the metal and ruin the surface for painting. I like to use the spray detergents, i.e. Flash Double Magic, which is available from your local supermarket. You can also make your own by dissolving baking soda in water and wash the model after soldering in the solution. Scrubbing the item with an old toothbrush and the solution after each stage of the construction will also aid the cleaning process. Resin cored solder uses the resin as the vehicle for the flux and the flux is activated by heat just before the solder melts. If the resin residue is not removed the flux remains encapsulated and when the resin breaks down over time the flux will re-activate and cause corrosion.

What is Flux.

Flux is generally speaking "Killed Spirit of Salts" or killed Sulphuric Acid. By its nature it is very corrosive and will burn your skin or corrode just about anything by a chemical reaction with the air and the object. Flux is generally watered down and the product you buy in the hardware is about 50% water. Even then it is still quite strong. To use flux in low melt soldering I had tried and tested Baker's Soldering Flux and have found that general use for flux I again mix the flux 50:50 with water to achieve a favorable result. You can still get a result by mixing the flux further to ratios 40:60 water/flux, 30:70 water/flux, 80:20 water/flux and 90:10 water/flux. I use these ratios in areas depending on how easy it is to clean the item afterwards. If it is extremely difficult to clean the item afterwards I would use 90:10 water/flux ratio as the acid content would mostly burn away when boiled. But in saying that I am not saying that the area does not have to be cleaned, all I am saying is that most of the acid residue would have been used and the area would be easier to clean.

Tools

The main tool used in the Soldering process is the **soldering iron**. Today we have a choice of irons with the old copper/tinned fire heated soldering bit being relegated to the drawer. With low melt soldering we need to have a temperature controlled iron. Modelers are the most ingenious people and have devised ways of controlling the temperature by the use of bulbs, light dimmers and the like. Even so all these measures still work on a hit a miss principal. I much prefer to use a temperature controlled iron with the most readily available model being the Dick Smith T2250. I use the fine point bit as it saves having to change bits all the time. You can also have a number of bits for each temperature class of low melt solder.

Most of the other tools required are normally found in the modeler's toolbox. The following is a usable list but as we gain more experience and visit the tool shop our list will grow.

Temperature Controlled Soldering Iron
Chalk (for coating files)
File card or steel wire brush (cleaning files)
Brass Bristle Brush (Burnishing the white metal)
Tip Cleaning Sponge
Flux Bottle
No2 Paint Brush
Work Pad
Eyewash
Safety Glasses
Files (Cheapies)
Small piece of galvanized iron.

Health and Safety

Health and safety should be paramount in our mind as we do everything. White metal contains lead, which is a cumulative metal that builds up in the body and can cause serious health problems. The aim is to minimize exposure to lead and the possibility of ingesting it. You can eliminate most of the risk by working in a well ventilated area, wash your hands frequently, wear protective clothing and don't inhale flux vapors. Flux vapors not only contain lead particles but also acid and it can bum the inside of your nose and cause permanent damage to your respiratory system.

When using a Dremel or other fast moving tools protect your eyes with safety glasses. Be careful with soldering irons as they bum skin and fingers. Flux being an acid burns skin and continues to bum until well washed with water. Eyes can also suffer the same consequences with careless use of flux. Always remember **Safety First**.

The Soldering Process

A picture is worth a thousand words. Figure 2 shows how the soldering process takes place.

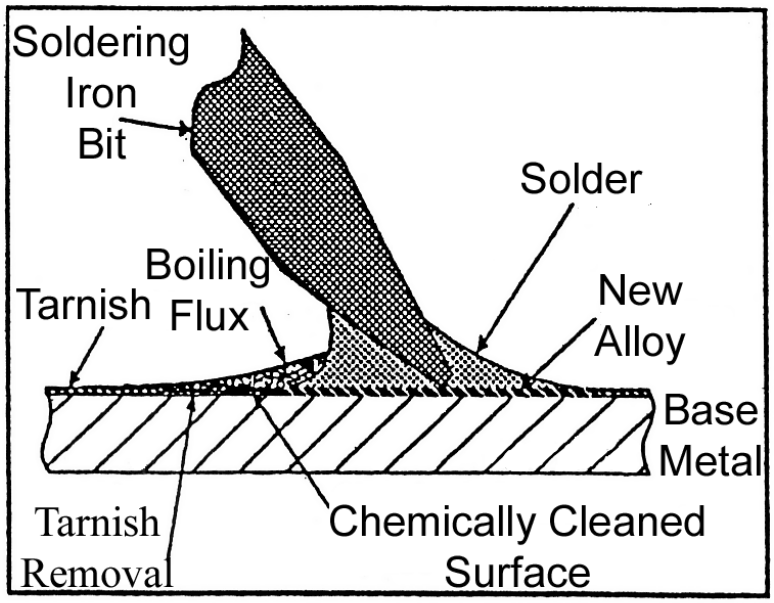

Figure 2

The soldering process is used most times to bond two surfaces in close proximity with the space in between being filled with a solder fillet. Most applications result in a concave fillet. See Figure 3.

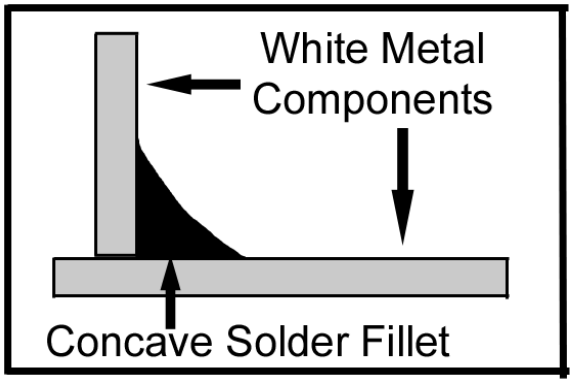

Figure 3

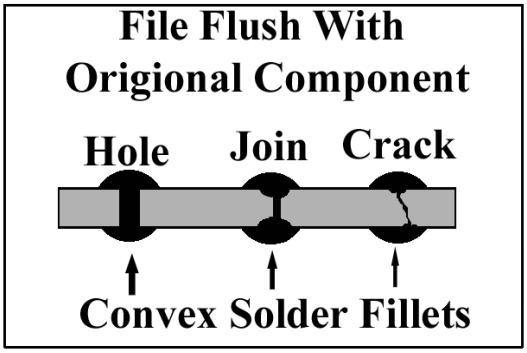

Figure 4

However, convex fillets may be required to fill cracks, fill holes; or butt join two pieces of metal. See Figure 4.

Because of the reduction of lead in low melt solders they are less pliable than 60/40 solders and should not be used where there is the possibility of constant movement. For example the soldering of the brass chassis or when wiring. When joining two sections of white metal it is best to ensure that both sides of the join are soldered. This will prevent the join from being weak. An outside fillet can be filed flush to maintain the integrity of the model. Sometimes a small angle can be filed on the edges to be joined to get a better bond and a stronger join as this increases the area being bonded by solder. See Figure 5.

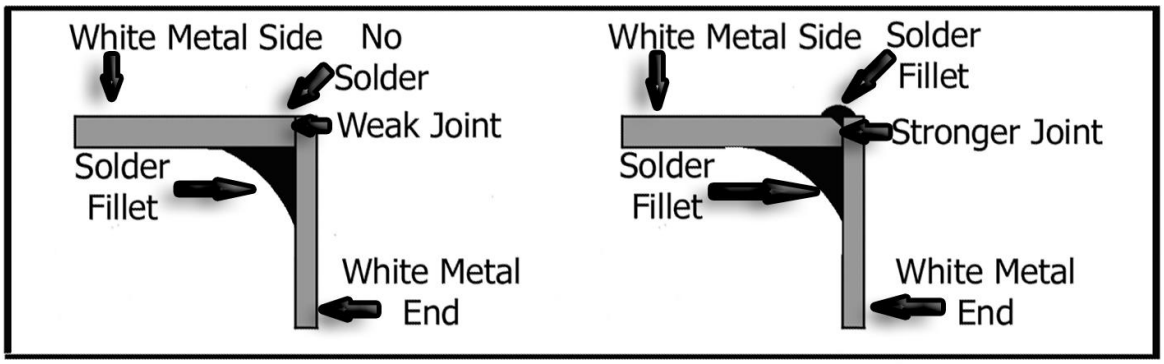

Figure 5

Preparation

The one most important part of kit preparation is to read the instructions. This will normally warn you of any pitfalls you may encounter.

Check the **contents for completeness and thoroughly inspect the components**. Remove all flash by cutting, filing or scraping. Ensure that all sides and ends are equal in length and height where they have to be. Add to the short side or remove from the long side to square up the kit. Sometimes this may not be possible and other compromises may have to be made or in the case with **AR Kits** products return the two items for a replacement.

Before filing chalk your file to prevent it from clogging with white metal residue. To chalk the file rub the chalk against the file until the teeth are filled. If you are unable to prevent the file from clogging sometime the file can be cleaned with a stiff wire brush or by scraping across the file with the piece or galvanized iron. The galvanized iron works because it is softer than the file and harder than the solder so it will penetrate the grooves and scrape out the solder.

To assist the metal to flow into the moulds during the casting process they are dusted with talcum powder. The talcum powder residue remains on the surface of the white metal castings and has to be removed. Residue removal and pre-etch of the components is completed by briskly brushing the surface of the components with a soft brass bristle brush until it is shiny and looks clean. The brass bristles will not damage the surface detail. The components of the kit are now ready for a sequential assembly.

If you are required to assemble brass and white metal components together tin the side of the brass surface first with 60/40 solder as this will make amore compatible soldering surface for the low melt solder to bond *to.* **What you are doing is making a double bond.**

When soldering brass to brass use only 60/40 solder as low melt solders joints can be brittle and will not accept flexing.

When assembling small components side by side and in close proximity use different temperature solders and solder them in order from the highest temperature to the lowest. This will ensure that you do not disturb the previously soldered component.

Complete as much soldering as possible from the hidden side or the inside of the components.

Kit Completion

Most kits to-day are very well detailed but you can be rest assured that, they will not have all the detail you are looking for. Plans, photographs and personal knowledge always play a big roll in all of this and will allow you to individualize your model.

Using brass, copper and other after market items will enable you to construct the detail you are looking for. Set yourself a target because the detailing spiral never finishes and in the end you may as well have constructed the model from scratch.

After you have completed all the construction and before you have installed the motor give the model a final wash with and alkaline and rinse off with white spirits or at least methylated spirits.

Painting

Although this article deals primarily with the construction of white metal kits through the art of low melt soldering it would not be complete without a few tips on painting. Put your model aside after cleaning. Try not to put your hands on the surfaces to be painted. A pair of rubber gloves is suitable for handling finished models and they also keep the paint off your hands. Prime the surface with an etch primer. Either light grey or white will do the trick. Let dry and harden for at least 24 hours. This will depend on the ambient temperature. I try not to use enamel paints for finishing as they lack the shrink back that lacquers give and tend to hide fine detail. Once you have applied the final colour coat leave aside to harden for at least five days. Hand paint the areas to be highlighted (gauges, sight glasses, brake cylinder rods etc) with small brushes no larger than a O. Apply the appropriate decals and after they have dried coat with a satin or flat clear Lacquer.

Repairs and Kit bashing

Repairs can be made around affected areas after the model has been completed. Strip the paint back to base metal (just as they do in panel shops). Reassemble the component or repair the damaged area. When completed wash the affected area and re-spray.

Kit bashing is done in the same way as you would with plastic kits except you are using white metal as the basis instead of plastic and you are using solder to bond as opposed to liquid cement.

Conclusion

The hobby of model railways has numerous facets and knowledge gained will only come to those with an inquiring mind. It took me a long time and a lot of research to give me the confidence I have with handling white metal kits. I had to learn it by trial and error because those who were in the know would not share or did not know how to share the information they had acquired. I hope that by sharing this knowledge your confidence will increase at a greater rate than mine and you are able to construct great models.

Your Notes