



## Introduction to Metal Etching

Metal etching, also known as Chemical Milling, Photo-Chemical Machining, has been in existence for quite a long time, first being used for the production of metal 'frames' for holding electronic integrated circuit chips in place and allowing connection to be made to the external pins. Nowadays, it is used to create minute implantable surgical devices, micro machines and, most importantly, railway models.

### ***The Principles***

The principles of metal etching are very similar to those used to produce printed circuit boards, except that it uses a simpler set of processes. In fact, metal etching could quite easily be done on the premises of a PCB manufacturer, as they have all the required machines to do the job. Reducing the process to its simplest, it is analogous to using acid to selectively eat away the metal.

Metal etching can produce the most exquisite models if used creatively and consideration is given to appropriate metals and material thicknesses. A good model created from etches these days may employ three or four different metal types, and may have two or three different material thicknesses.

### ***Materials Suitable For Etching***

The most common metal used in railway modelling is brass. Brass is relatively cheap, easy to bend and form and solders well. It has good structural qualities and is frequently used in two thicknesses, 0.25mm and 0.5mm for model construction.

Nickel silver (NS) is often used as well, frequently in a thicker form of 0.45mm or 0.5mm, for locomotive frames, gearboxes, and other heavier structural items. Nickel silver actually contains no silver at all; it is an alloy of copper, nickel and zinc. NS is just that little bit harder than brass and this explains its use in locomotive frames, where structural rigidity is important. Some modellers create their entire model in NS because they like the appearance. NS is approximately 1.5 times the price of brass, and indications are that it will become more costly in the near future due to worldwide scarcity.

Phosphor bronze is an alloy of copper, tin and phosphorous that has good electrical conductivity, resistance to corrosion and is springy. It's most common application is in musical instrument strings, but in the modelling field, is primarily used for electrical pick-ups on models.

Stainless steel (SS) is an iron/carbon metal with chromium added. It is corrosion resistant, can be quite hard and springy. The most common use for etched SS is in fine etched grilles on model locomotives, primarily diesel models. The advantage of SS is that its hardness makes the grilles less prone to damage during normal handling. On the other hand, it is not able to be soldered to other metals easily, so is more difficult to deal with.

Copper is also offered by some etching companies, however it is too soft for most applications in modelling and therefore, rarely used.

### ***Etching Types***

Most etched products that we come in contact with in the modelling field utilise double-sided etching, that is, the material is etched from both sides of the metal at the same time, producing etched patterns on both sides of the material and also cutting completely through the metal, forming holes. The patterns produced using double layer etching are primarily holes and fold lines.

There are a very small number of companies that also offer quad or four layer etching that produces two distinct layers on each side of the metal. This can be very advantageous in producing slightly raised detail on both sides of the metal. However, it requires considerable planning to achieve good results, and the results can also be less crisp and precise as good two layer work. It is also more expensive than two layer etching.

### ***What Artwork Do I Need To Supply?***

Etching companies used to accept hand drawn artwork for producing metal etches, but nowadays these companies prefer drawing files, and in some cases will *only* accept files.

Unfortunately, almost every company has a different requirement as to what files they accept. Some prefer Computer Aided Drafting (CAD) files, and some prefer the files produced by Corel Draw.

The most common files types are those produced by the various CAD software packages. These are the Autocad file format .DWG or the .DXF or Drawing Exchange Format. Most CAD programs can output their files in either of these two formats.

A separate document will deal with how to produce drawings and the various hints and tips.

If you are not familiar with CAD programs or are not willing to get personal with one of them, then you will need to find someone who can turn your sketches or hand drawn artwork into a .DWG or .DXF file. The Compiler cannot do this work as it can be very time intensive and usually requires constant interaction with the person who designed the part.

### ***How Does It Work?***

The etching company takes the artwork supplied by us and creates a photographic negative of the design using a photo-plotter. This is essentially a specialised Laser printer that produces photo negatives.

The sheet of material to be etched has previously been scrupulously cleaned in preparation for the processes. It is then coated with a light sensitive photo-resist material and dried. The negative is placed in register with the sheet and exposed to a light source. Once both sides have been exposed, the sheet is developed in a bath, much like a sheet of film. This development process allows the exposed part of the photo-resist to be washed away in the developer, leaving the metal bare in that region.

The sheet is then immersed in an etchant solution, most commonly ferric chloride, that eats away the bare exposed metal. The etching bath is controlled very closely in temperature and the etchant is sprayed onto the metal sheet so that the etchant at the metal surface is constantly being refreshed, and the dissolved metal is carried away.

The etching process eats its way through the metal, increasing in depth the longer the process goes on. The timing of the process therefore has to be precise, in order to only etch the metal half way. This control over the etching process is vital if the resultant part is to be as exact as the designer intended. Factors such as etchant temperature, etching time, strength of the etching solution, freshness of the solution, spray pressure and residue filtering all come together to affect the quality and depth of the etch.

Once the etching is deemed to be finished, the metal is removed from the bath and washed to terminate the etching process. The photo-resist on the metal surface is removed, then sheet is cleaned once again, and it is ready to be packed and despatched to the customer.

Even the packing and despatch is a critical process. Our supplier wraps the sheets individually in acid-free tissue paper, then securely tapes them down on a sheet of masonite. The sheet of masonite then has pine edge strips added, poly foam sheets are laid over the etches to form a sandwich around 25mm thick, and another sheet of masonite is nailed over the top. Hopefully, this package will then survive the trip via several postage institutions and shipping companies, and arrive with the etches unharmed.

### ***If Only It Were That Simple..***

Like most processes, there are limitations to what can be achieved using metal etching, and some factors in the process that are not entirely desirable. As the great philosopher Jagger once said: **“You don’t always get what you want”**. More in the next document in this series.