Etch Drawing Preparation

Introduction

Most etching companies prefer you to supply the drawing for your design in the form of a computer file. While some will still accept drawn or printed artwork, it is not a really safe option, as many things can go wrong in the process of transferring this artwork to the metal sheet. The format of the file can usually be a Corel Draw file or a standard CAD file with a .DWG extension, or a Drawing Exchange File, .DXF format.

You can use any drawing package you like to produce the design, as long as it can output one of these file standards.

From the beginning I would like to make it clear that there is no 'right way' to produce a drawing file for metal etching. Each etching company has their own preferences and rules, some will accept many types of files while others only accept one type. Each company also has distinct preferences about how the layers in the file are organised as well.

But as a general rule, if you work through the following example, you will produce a file that any of the companies should be able to accept and produce a component from. If they require changes to the format, you will at least be better equipped to understand what they require and make the necessary changes.

General Drafting Principles

When you create a design as a CAD drawing, you draw using lines, arcs and circles in the main.

The etching company, when they receive the file, are not interested in the lines you have drawn, they are only interested in the space ***enclosed*** by the lines, or the ***fill***.

But, at the same time, they do not want you to actually fill the area with solid colour, because the file becomes quite a bit larger if it contains fill information. Rather, they just want you to be certain that the area is properly ***closed*** and can be filled. When they process the file, they will fill the required areas prior to photo-plotting. More about this later.

Because they are not interested in the lines, the thickness of the lines is immaterial. Most CAD drawing packages create a line, which by default, has zero thickness, whereas most art packages require that a line has some thickness, otherwise it is meaningless. In short, zero thickness lines.

The process we are using is a two dimensional process, or 2D. Do not be tempted to draw an etch design in 3D, it achieves nothing and opens the way to problems when it is inserted in the master artwork.

Layers in the File

We will only be considering double sided etching, or two-layer etching for this example. Quad, or four layer etching may be the subject of a later paper if required.

This system uses the simplest method that actually mimics the way the real process works. Some designers use three layers, front, rear and full cut. The full cut layer contains any holes or otherwise that go all the way through the metal. However the simpler method uses only two layers, front and rear, and this is actually how the etching company produces their photo-tools.

If a section of etched area on the front is present on its own, then the pattern is etched half-way through the front layer. Likewise, if a section of etched area on the rear is present on its own, then the pattern is etched

half-way through the rear layer. If a pattern exists on both sides, overlayed each other, then a hole is created because the metal is half etched from each side, making a full etch through the thickness of the material. Although some people find this hard to work with in comparison with the previously mentioned three layer technique, this is an illusion, because if you overlay front and rear in the three layer method ***you still get a hole, irrespective of whether you have drawn it on the full cut layer.***

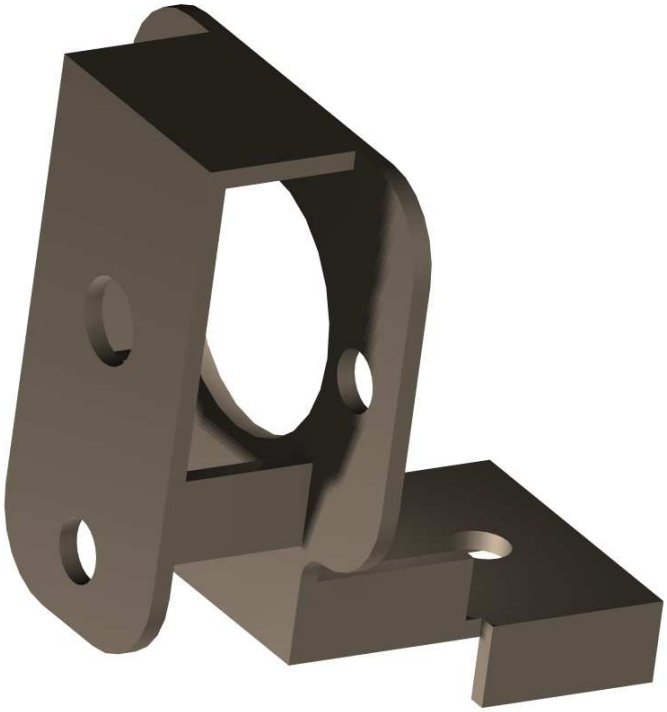
A further layer, called the ***Construction*** layer, can be present in the drawing to aid construction of the design and also to convey messages in text that will not be etched. The construction layer is completely ignored by the etchers.

The layer colours should be:

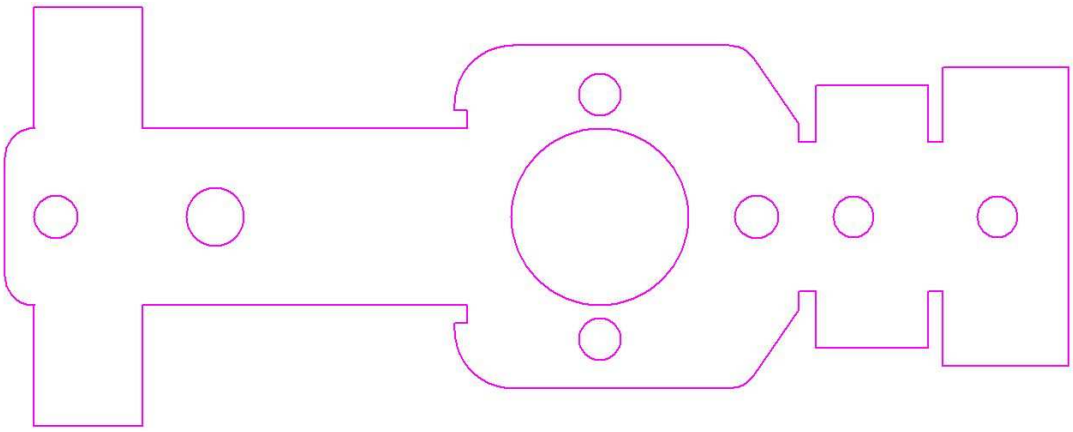
Layer named 'front' is RED
Layer named 'rear' is BLUE
Layer named 'construction' is PURPLE

Sample Drawing

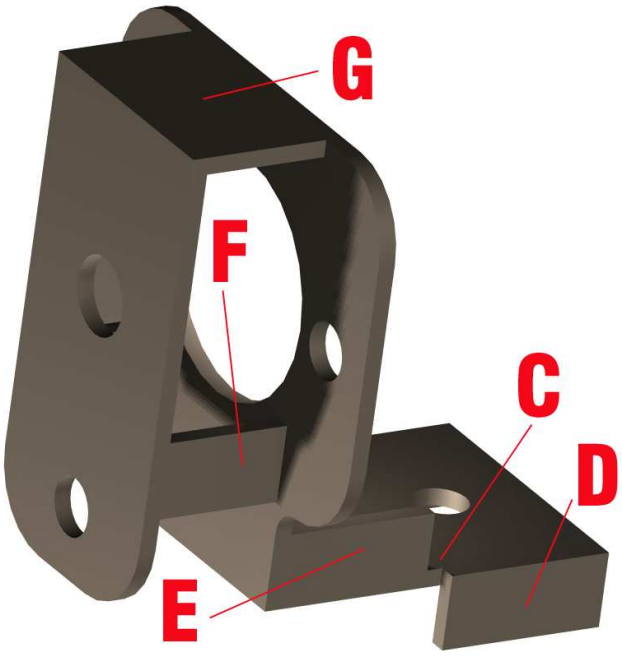
In order to provide an example that is not too simple, and exercises many of the things we need to know, I am going to use the gearbox section from a BullAnt. The astute among you will notice that the 3D version is not exactly the same as the drawing we will use, but it is close enough for our purposes. This is what the gearbox etch looks like as a computer 3D simulation.



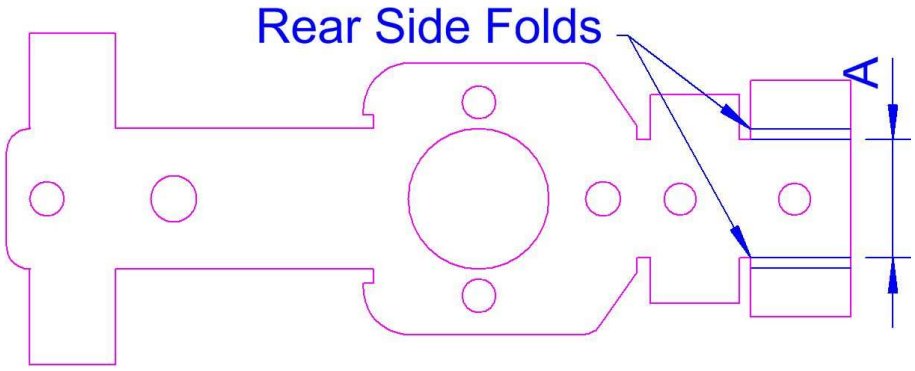
The gearbox is made up in 0.45mm nickel silver, and is folded into shape then soldered. When folded out flat, this is what it would look like:



So far, the design has been drawn in purple on the ‘construction’ layer. This layer can be used to rough out the design before it needs to be drawn on the two etch layers. All that has been done at this stage is to accurately draw the gearbox to its correct size, as we imagine it would be folded out flat. All dimensions are so far correct and all holes in the right position.
Looking again at the 3D view:

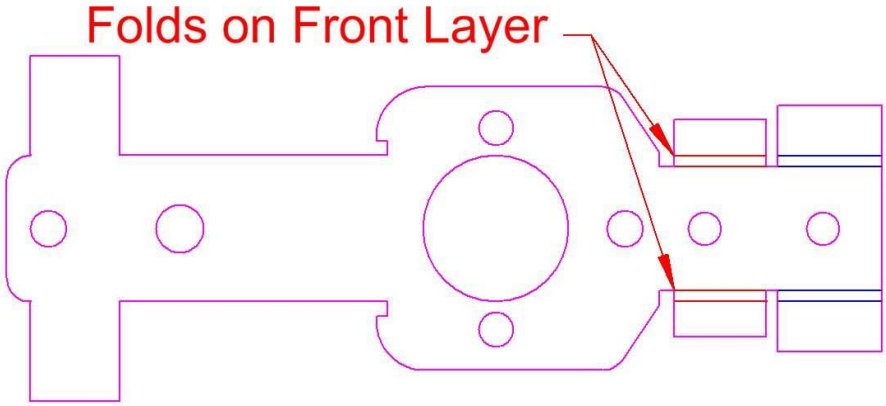


The locating tabs, shown as D above, need to be bent downwards as per our view. This means that a fold line needs to be drawn on the ‘rear’ or blue side of the drawing, bearing in mind our general rule of ‘All folds are inwards’. As the material thickness is 0.45mm, we create two fold lines at the fold point, 0.45mm apart, as per the following drawing:

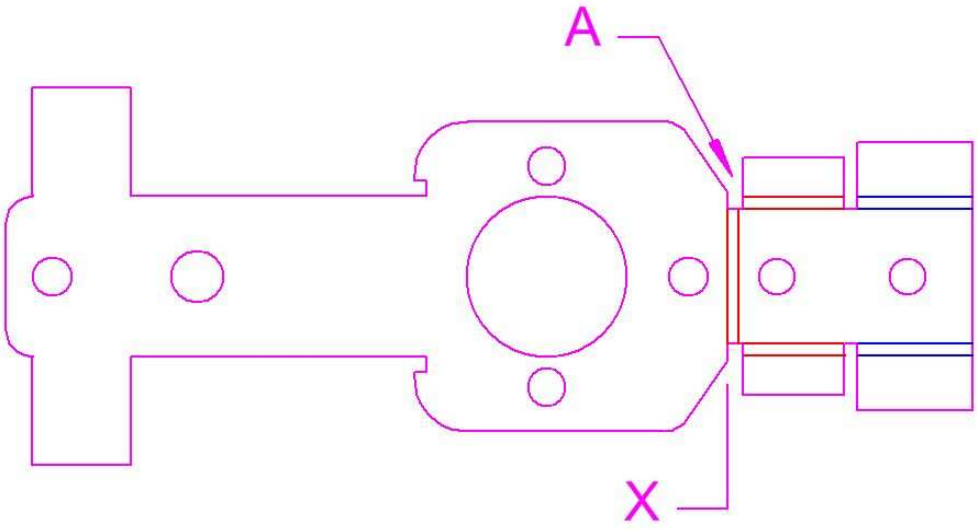


We need the dimension A to remain the same, as it is to locate the gearbox on the top of a brass channel, so the folds must be outside this width. The fold lines have been drawn in in blue on the rear layer.

The reinforcement tabs, shown as E in the 3D view, fold upwards as per our view, so they are drawn on the front layer in red.

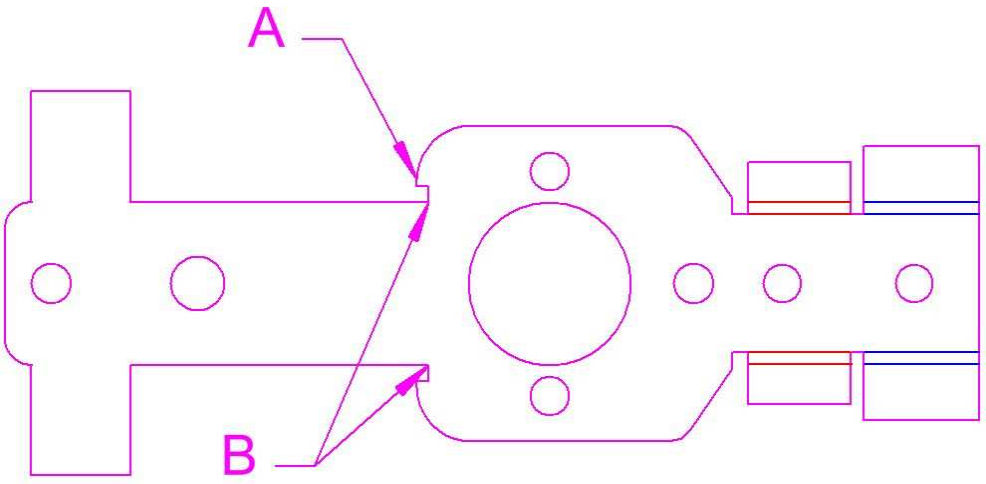


Next, the section forward, or on the left of X in the following picture needs to be bent upwards to stand at 90° to the section on the right. Therefore we need to create a fold across the part as shown at A. Because the fold is upwards, and the fold always closes the fold gap, it must be in red.

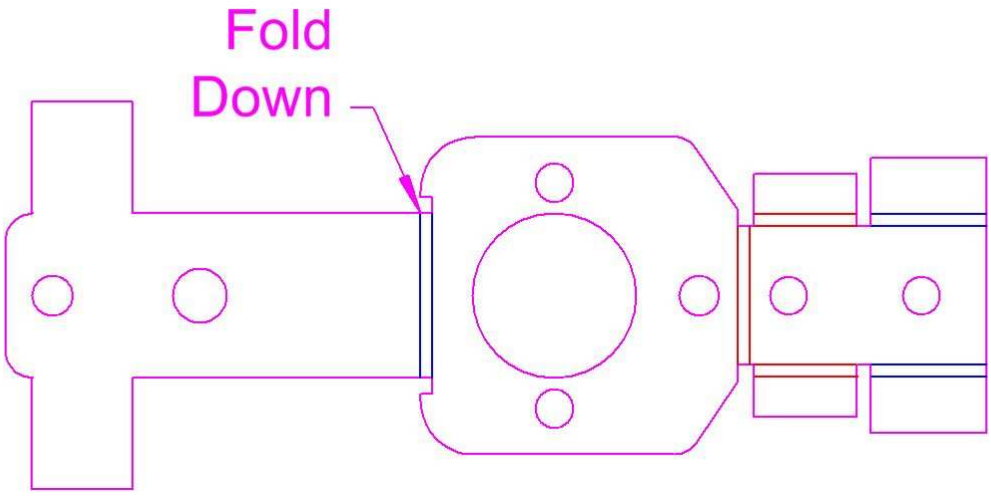


The next fold is at the top of the gearbox, where the spacing section shown as G in the 3D view, needs to fold down again.

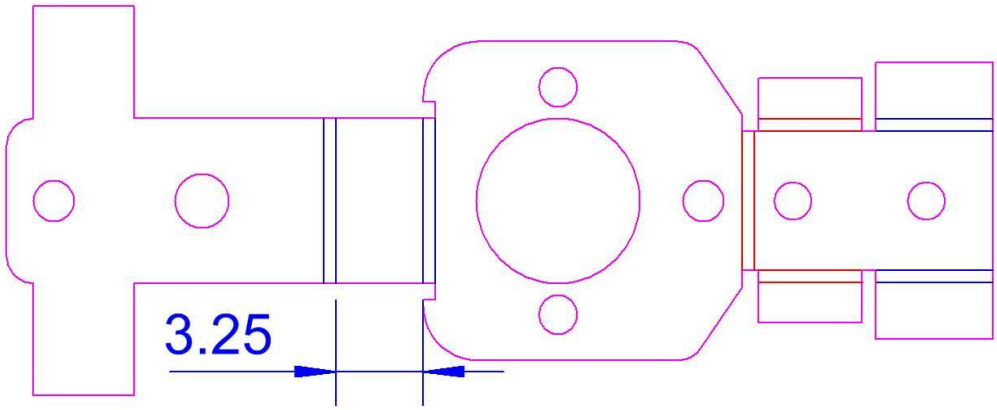
Note that because G must line up with the top of the gearbox at A, the fold requires two notches at B to prevent metal distortion. This technique was explained in 'Metal Etching Principles & Rules' and shown in Figure 11A.



The fold is then drawn as:

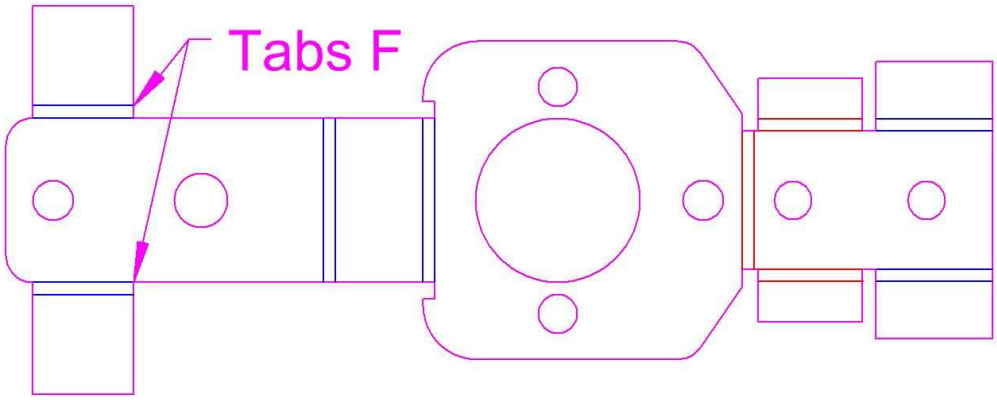


A further fold is required 3.25mm away from the last fold. The dimension 3.25mm sets the gap between the two cheeks of the gearbox where the gears and bearings will fit. This further fold is also downwards:

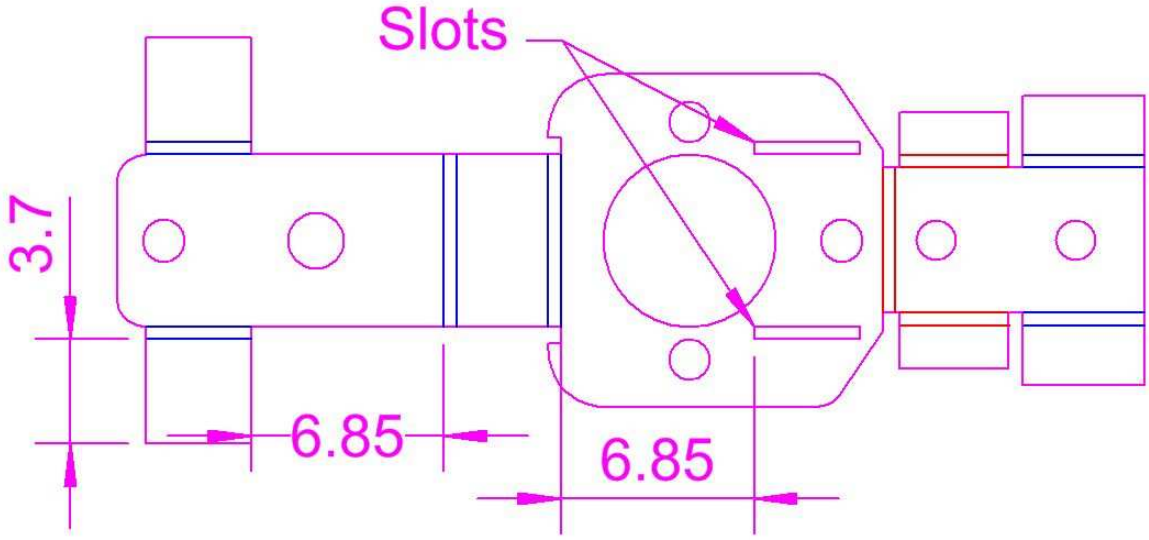


The final set of folds are the two tabs at F in the 3D picture. These tabs hold the front section of the gearbox a precise distance apart to allow the gears to sit in between.

These tabs are folded down:



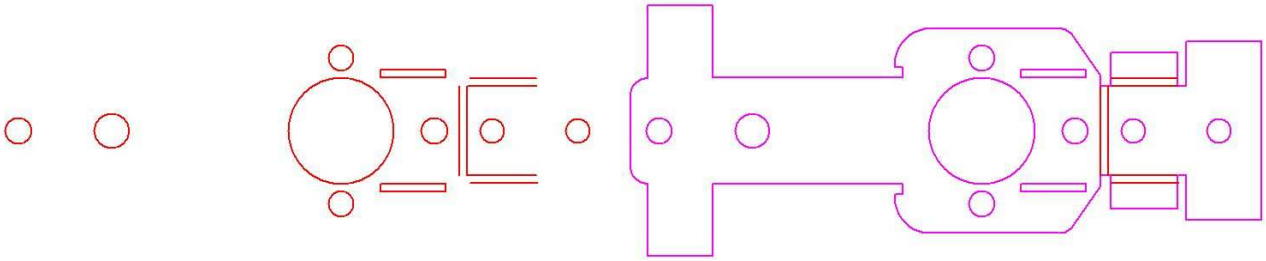
This completes the drawing of the folds in the gearbox. In order to positively locate the two tabs F in the drawing above, the best method is to create two slots for them to fit into. They can then be soldered into the slots to form a rigid cage for the gears.



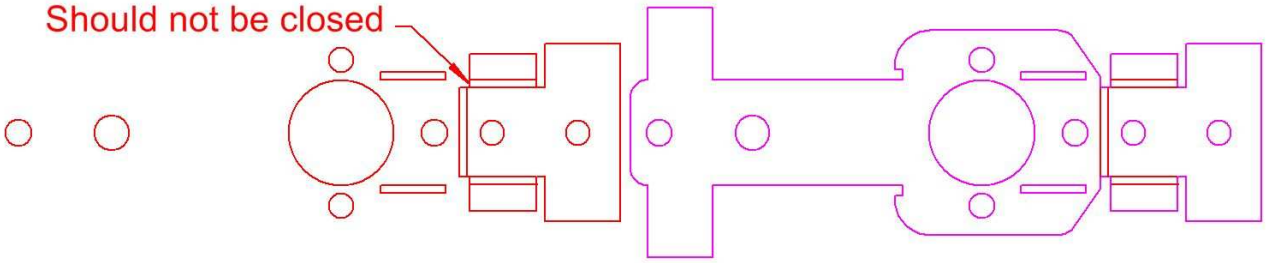
Note that the length of one of the tabs is 3.7mm, yet the gap set between the faces two steps earlier was 3.25mm. Well, 3.7 – 3.25 = 0.45, or the thickness of the metal. This gives us the necessary 0.45mm to insert the tabs into the main body to locate the tabs. The two slots are shown drawn in position in the large body section, with their distance being set from the outer edges of the two earlier blue folds. The distance of 6.85mm is the correct position to place the slots so that the structure remains square when assembled.

Now all the folds are in place, it is time to create the rest of the drawing layers from the rough outline. We will begin by drawing the front, or red, layer. The drawing below shows the rough drawing on the right hand side, while on the left we have the front or red layer only shown. This can easily be done in all CAD packages by switching off the rear blue layer and the purple construction layer.

All holes go right through the material, so they must be present on both front and rear layers. Therefore, all we have on the front layer so far are 8 round holes, two slots and the three upward folds drawn earlier.

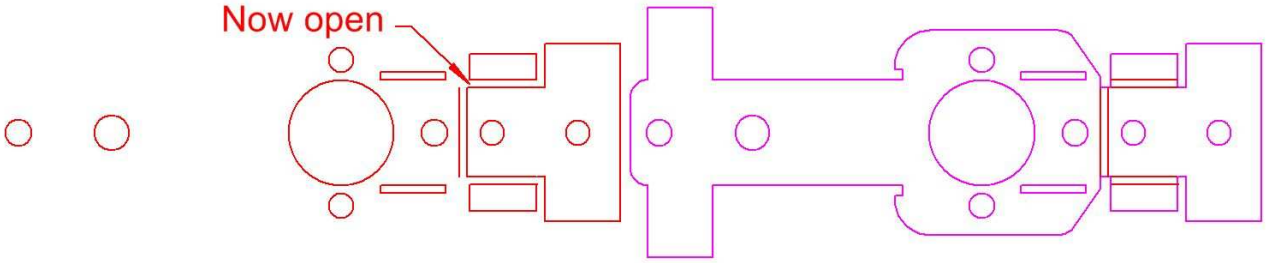


We can begin by drawing in the outline of the gearbox on the front layer, at the right hand end. This can simply be drawn over the top of the construction layer, using it as a guide. The left hand side would then look something like this:



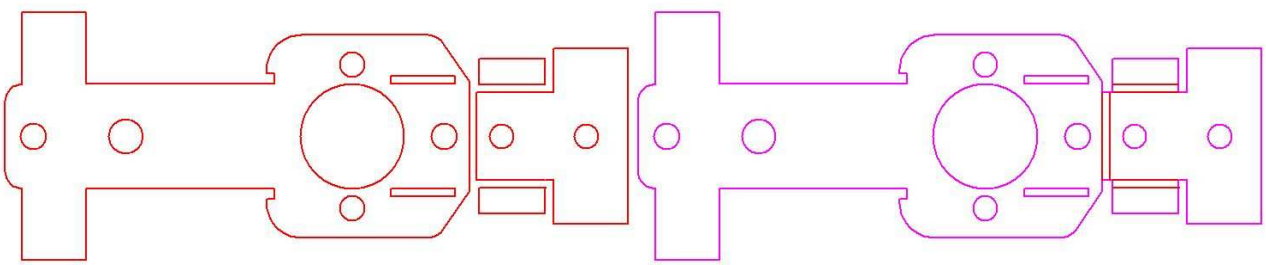
In drawing the outline of the part, we have closed the ends of the fold lines. This creates a number of intersecting lines that all end in a ‘T’ intersection. This T intersection will cause the Fill command to fail when the etching company tries to fill it later on. The reason is that Fill only recognises complete closed polygons, and does not like it when those polygons are connected to each other, as they are here.

The simple answer is to open the ends of the folds and make all items separate entities thus:

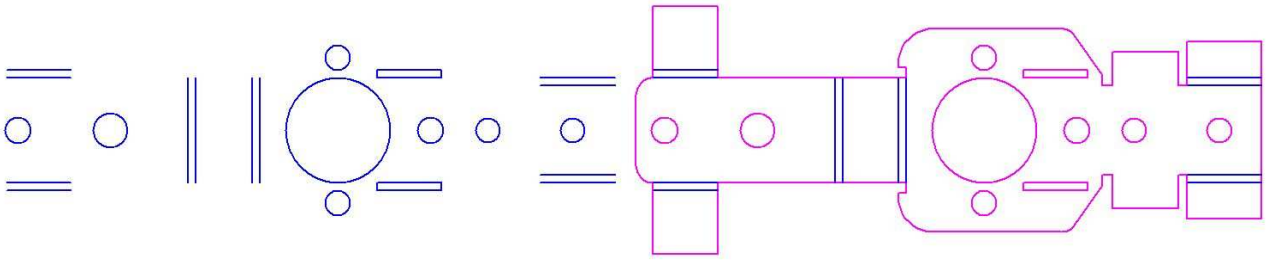


The ends can be opened by either removing the lines at the ends or by using the ‘stretch’ command to re-position the ends of the lines to their correct place. Another possibility is to use the ‘trim’ command to cut the ends out of the fold lines. Whatever works for you.

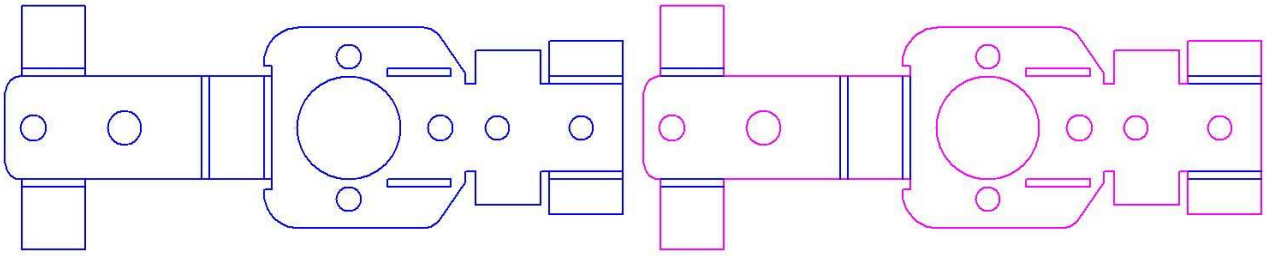
At this stage there are no other tricky bits to deal with, so the remainder of the outline can be drawn on the front or red layer:



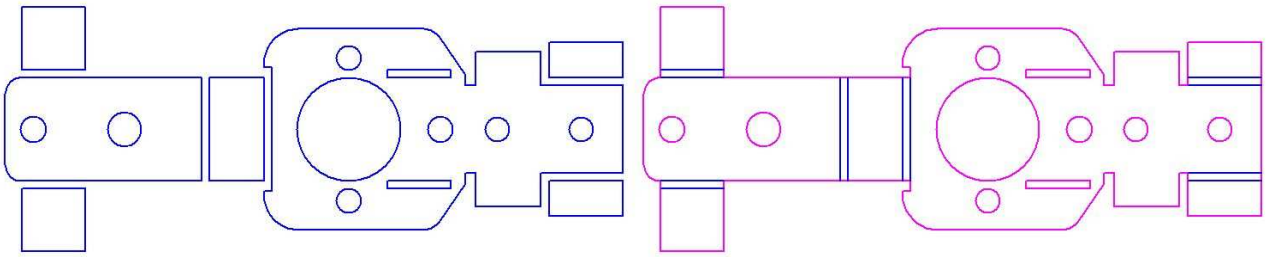
Next, we do much the same for the rear layer:



Again we begin with only the fold lines, the six round holes and two slots. We then draw in the outline so:



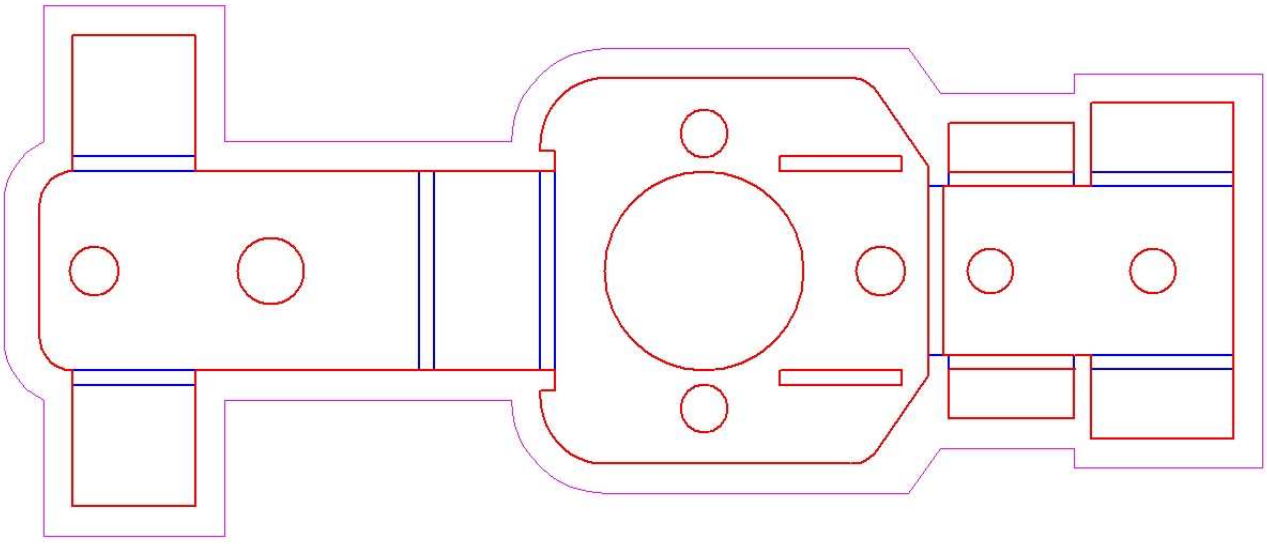
And again we end up with the ends closed in on the blue fold lines. Trimming them as we did on the front layer produces the final product:



Now that we have a fully drawn object, it needs to be placed in the sheet for etching. This sheet is usually referred to as the fret. You may want to simply produce a lot of the components, as I would normally do, or you may want to incorporate it is a larger fret with other components.

So we need to draw a ‘moat’ around the component so it can be etched free from the larger sheet.

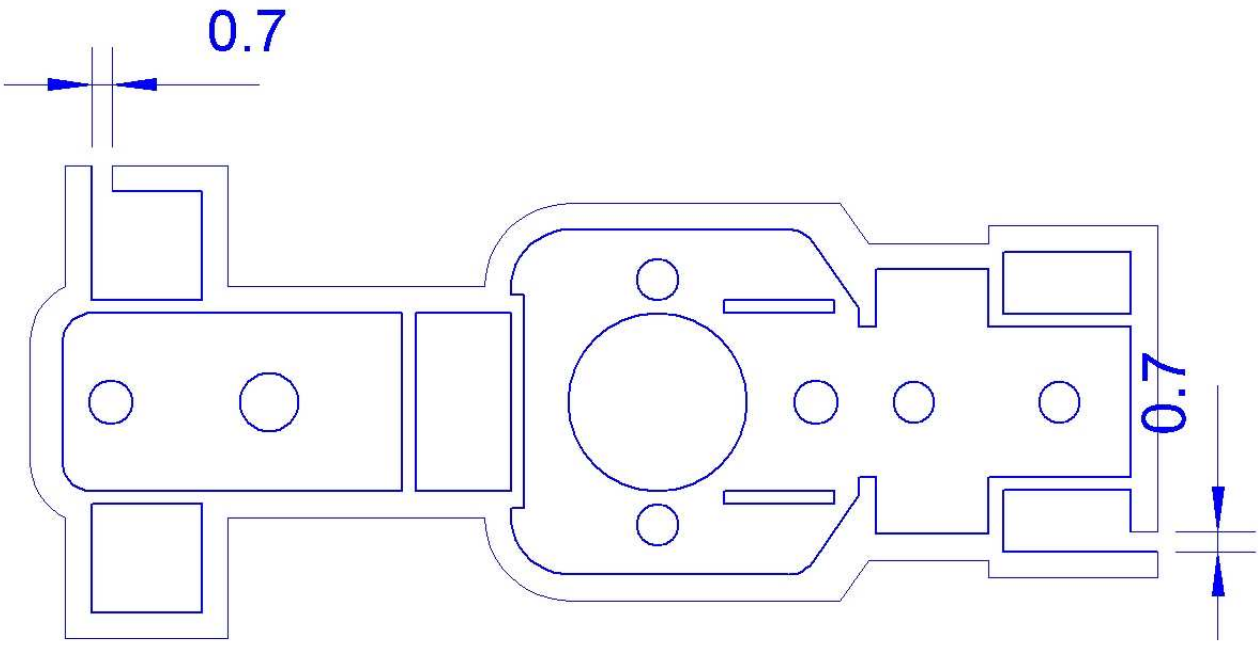
In the following drawing, the moat has been drawn around the component on the construction layer. The moat needs to be twice the thickness of the material, so in this example it is sitting 0.9mm away from the edge of the component all the way round. You do not have to use rounded corners on the moat if you wish not to, I do it out of habit.



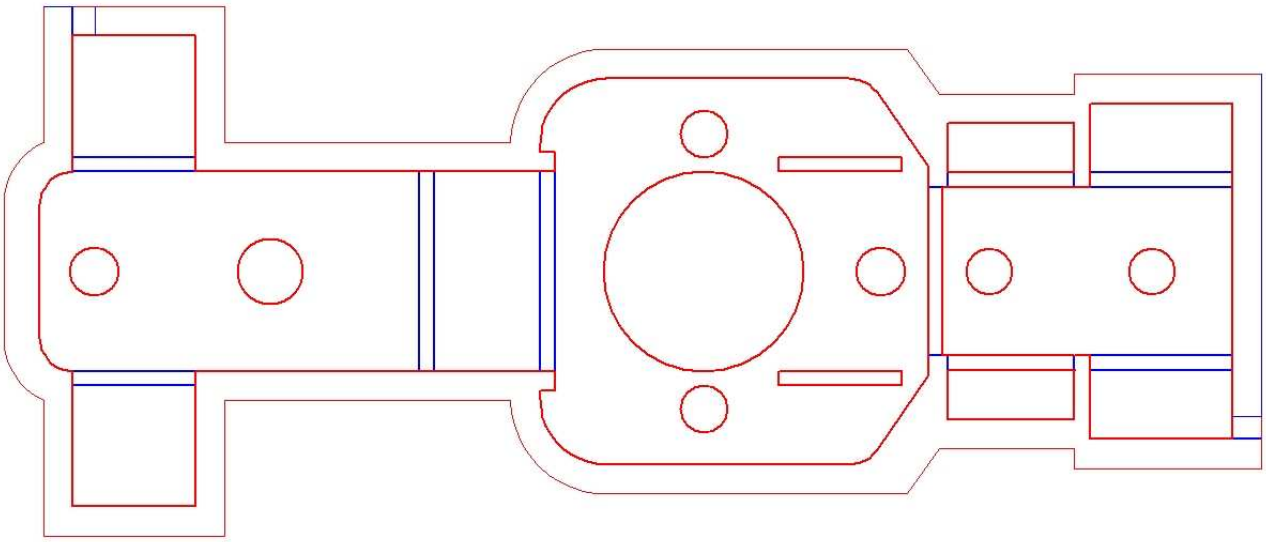
Having drawn the moat, duplicate it then assign one copy to the front layer and the other to the rear layer. Place the copies over each other in perfect registration. Switch off the red or front layer, leaving only the blue or rear layer.

Now we need to create some small tabs to secure the component in the middle of the moat, otherwise it will etch itself free of the fret and drop into the bath and be lost forever. For 0.45mm thick material, I make the tabs approximately 1.5 times the material thickness, or near enough to 0.7mm.

You can make them thicker if you like, but when you cut the component out of the fret later, you will find it is not easy to do without damaging or distorting the metal, so thinner tabs are better. I also use only the absolute minimum number of tabs necessary to do the job, in this case two.

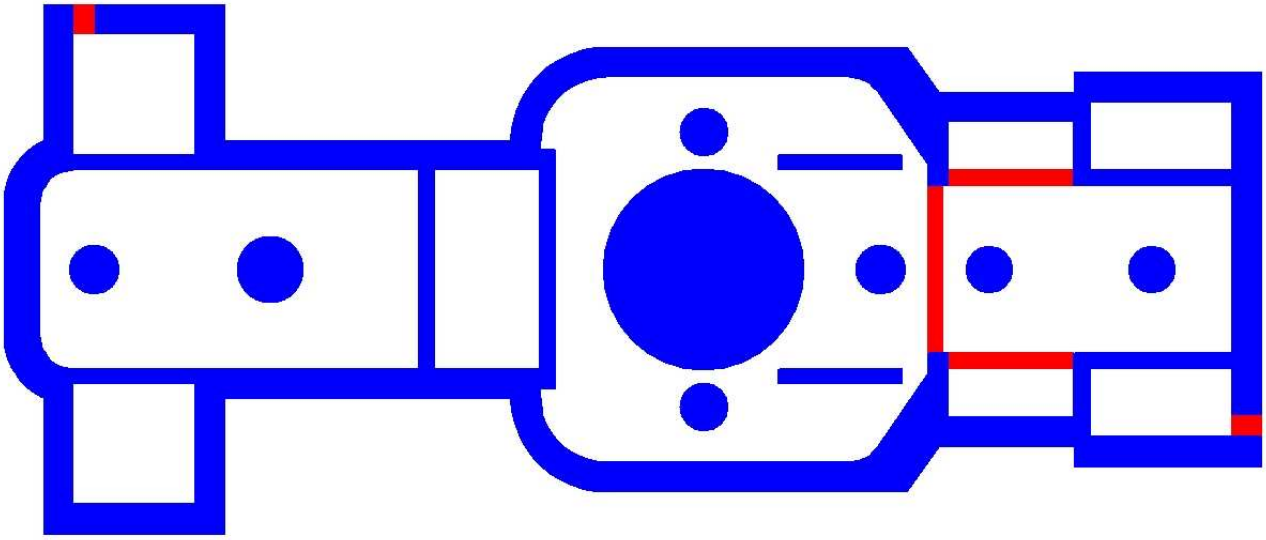


The tabs are not created on the top or red layer, as it is best if they are also half-etched, this makes them easier again to cut. The resultant drawing should now look like this with both layers showing:



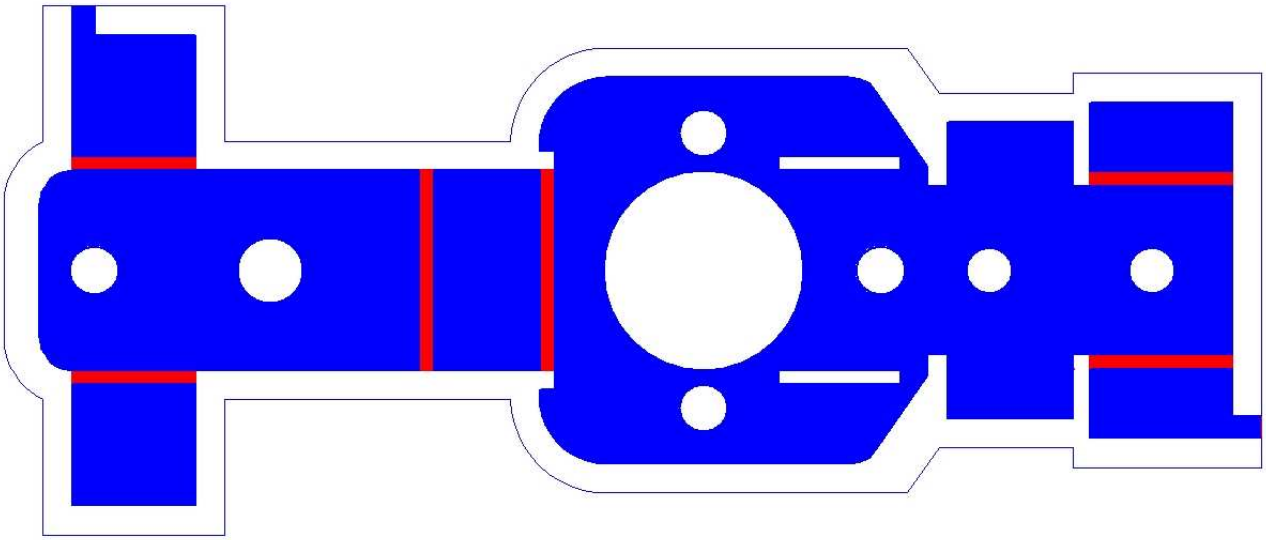
As a final test, before the completed component is inserted into the larger sheet of the fret, we should now fill each layer to make sure that all lines are joined properly. Switch off the front layer and apply fill to the rear layer, then switch the rear off, the front on and apply fill to the front layer.

If the fill command works, the fill should end up looking something like this:



If this is the result you see, delete both the fills as they were only used as a check. You can now go ahead and place the component in a larger fret.

Sometimes however, you may end up with something that looks like this:



This does not look anything like the drawing you expect to see, so what has gone wrong? The fact that the main component itself seems to fill OK is an important clue. The problem is in the drawing of the moat, there is a small opening in the moat that allows the fill to 'leak' out. In this particular case, there is a tiny break between one of the circle segments and the connected straight line.

Often these breaks can be too small to detect, even by zooming in on the drawing, but fortunately there is another method available to you to fix the problem.

AutoCad and TurboCad have a command called 'Fillet' that will join these two segments for you. Select a fillet radius of zero then fillet the two segments together. Try the fill command again and you should be rewarded with a proper fill.

With AutoCad, if there are duplicate lines overlayed over one another, then the fill command will fail. Early versions of AutoCad have no command that can detect these duplicates, but later versions do.

Now you have a finished component, you will next want to place it in the sheet size that the etching company will use. The etching company will do this for you, but it costs you and them time and money, so it is best to lay up all the parts in the fret yourself. For best results, place each part so that they are 2mm apart.

Ask the company what size their sheet is and also what the maximum work space size is. They usually prefer to have at least a 12mm border all the way around the sheet to keep everything together. This space also gives them some material to attach to the etching frame and to grasp the sheet with.

Finally

Keep the tools you use to the simplest. Lines, circles, arcs are fine, but please ***do not use ellipses or splines***. The peculiar photo-plotter translation software used by some etchers cannot recognise these objects, and the file will be returned to you.

Avoid duplicate lines overlayed each other. It is better to remove these as you are drawing the object than to try and find them later on when you have forgotten where you placed them.

Unless otherwise instructed, before sending the file to the etching company, remove any fills you have on the drawing, they just take up file space unnecessarily.

If sending by email, look at the file size and perhaps compress the file using a ZIP program. This makes it easier for the etching company to deal with.