1. We develop a relationship with our customers to solve their problems in a most cost-efficient way. We live in a world of short to medium run sizes at a high level of quality. Over the years we have developed a range of skills that allow all the manufacturing processes to take place under one roof.

2. We like to partner with our customers from early-stage prototypes to volume production, with continuous feedback on quality, manufacturability, and cost.

3. With effective production control, we are able to deliver on time, all the time, and cooperate with customer demand.

4. Our ISO 2001-2015 accredited quality system ensures 'process improvement' and inspection is carried out all the time, not some of the time.

5. Chemical milling is an ideal process for the manufacture of RF and EMI shielding. There is no change to the properties if the metal as it is removed atom by atom with no heat or mechanical distortion, so what goes in, comes out.

6. By etching a narrow line halfway through, a fold line can be created that accurately controls the position of bends, thus accurately controlling the placement of folds. This applies particularly to recumbent folds, for example a box with a tuck in lid, or a zig zag profile.

7. Edges are not sharp and have no rags or other distortions. Unlike laser cutting there are no splatters, oxidation rinds, or discoloration. The edge profile is usually slightly concave inwards.

8. Parts such as lead frames can be produced in long strips for subsequent folding and processing. Dowel holes can be etched in to allow placement in forming tools or assembly jigs.

9. Filter screens are best etched, as all the holes are made simultaneously instead of one at a time as with other processes.

10. We can work with metal thicknesses down to 0.02 mm. Some parts can float away on the breeze!

11. Chemical milling can produce extremely lightweight components by etching away all unwanted metal so that only functional parts are left. This is of interest to those industries that are sensitive to mass.

12. We can work with copper, brass, nickel silver, bronze, mu metal, stainless and mild steel. We do not work with beryllium copper due to the poisonous nature

of beryllium. To work with Aluminium and titanium requires a fluoride based etch, and all fluorides are poisonous. A note on mu metal; this alloy is particularly difficult to form in conventional machinery, particularly folding: an etched blank with fold lines well easily produce the desired form. and not cause palpitations.

13. After etching, we can plate with tin or gold in house to the required thickness.

14. Fabrication. This is a many faceted area, the work can be done with dedicated tooling, or generic tooling we have. We have an extensive range of tooling and accessories: tapping from M2, presswork to 13 tons in a power press, a 150 X 300 lathe, a 1200 mm. guillotine, Bridgeport mill, slitting attachment and a microprocessor-controlled oven. The part can be etched, and then additional engineering processes carried out.

15. We can etch solder paste stencils, print the solder, and reflow.

16. Shims and washers. We can make circular shim washers from all of the above metals to any diameter. The washer can have a flat profile in the usual way, or, have U, H, or W, section so that it may be crushed to shape during assembly, this will enhance RF and hydraulic capability. Similarly, shims can be made to any shape with any desired profile.

17. Files. We can work from engineering drawings expressed as a PDF file, or drawings from an Adobe file. It is always a good idea to show some dimensions so that the production film work can be checked.

18. The basic process in chemical milling is that the metal is coated with a chemically resistant film called a ’resist’, and then exposed to aggressive chemicals that dissolve away the exposed metal. This resist is then removed to expose the part.

CHEMICAL MILLING: A NEW PROCESS

Chemical milling is the term to describe the fabrication of metal parts by etching away unwanted metal by acid etching. A special ink called a 'resist' is printed onto a flat sheet on both sides in exact register, and this defines the shape of the part. It is then exposed to aggressive chemicals that react with the metal and it dissolves away. Chemical attack is from both sides and the result is a quick, clean edge free from burrs and rags.

The unique propositions of this process are speed, accuracy, metal utilisation, initiation costs, time, and part complexity. Etching rates do vary from job to job, and a rate of 0.025 mm. per minute is readily achievable, this multiplies out to 0.6 m^2 per hour on 0.2 mm sheet. As the resist pattern is generated by computer the initial image is 'perfect' and dimensional control is usually better that 0.1 mm. after etching on thin sleet (0.2 mm.). Thicker metal will have a slightly lower tolerance. As the initial drawings are done in a CAD programme, it is a simple task to turn the drawing into the required photographic imaging, advantage can be made of 'dovetailing' the parts together to achieve a high packing density and minimise scrap, very high yields can be achieved. The time taken to go from CAD drawing to production ready camerawork is as long as it takes on the keyboard! The same applies to drawing revisions.

The metals that can be etched are copper, brass, nickel silver, bronze, and some stainless steels. Nickel silver and bronze make good springs. By etching the sheet prior to resist application any thickness metal can be produced, thus solving the supply problem with metal merchants. If the sheet is etched more from one side than the other a profile can be made, and if different images are used on each side some very complex sections can be done. Metal as thin as 0.02mm. can be successfully worked.

All the usual metal fabrication processes can be used once the 'blank' has been etched: forming, presswork, plating, painting, screen printing, PEM inserts, etc.

The process is outstanding in producing very complex parts with high aspect ratios. As some of the costs are based on an area function the cost of doing a 10 mm. disc with 20 x 0.2mm. holes is about the same as doing a 10 mm. washer.

1. Chemical milling is a metal working process that produces parts by removing unwanted metal with chemicals.
   a. The first step is to clean the metal to remove foreign matter and oxides.
   b. A resist (ink) is printed on both sides that conforms to the shape and size of the part, leaving exposed metal to be etched away with appropriate chemicals.
   c. The resist is removed to leave the part, and it is cut out of the frame.

Commented [P1]: Etal working

The 'tooling' used is in the form of photographic film where usually, the black area represents the part and the clear area metal to be removed. This imaging is prepared from a PDF file and contains allowances for undercut (the etch goes sideways as well as down) and panelisation. It does not matter how complex the part is, it is all etched at once. 20,000 holes in a backplane etch as quickly as one. For 0.2 mm. nickel silver, a reasonable etching time is four minutes. This imaging is usually done in Adobe Acrobat and changes to the design can be easily made on the keyboard. The saving in time and cost of tooling is extraordinary when compared to press tools. We can partially etch from one side to form a fold line or a recessed area. The aspect ratio, the relationship between width and thickness can be less than one.

We can work metal as thin as 0.01mm, above 0.9 mm. there is some loss of detail. Edges are smooth and have no burrs or roughness. There is no change to the properties of the metal, (e.g., work hardening) during processing.

Depending on the job, dimensional control can be as high as +/- o,1mm. After etching the usual range of fabricating processes can be used.

We can work with copper, brass, bronze, stainless steel and iron alloys.