The Conard Corporation

*Precision Photo Chemical Machining Since 1965*

An AS9100/ISO9001 Registered Manufacturer

# Engineering Design Guidelines for PhotoChemical Machining

**Presented by:**

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## PHOTO-TOOL DESIGN GUIDE

***<u>RULES:</u> When designing a working Photo-tool all of the following have to be considered.***

- ***Cost impact of sheet size***
  1. ***Sheet Size has largest cost impact on piece price.***
  2. ***Thicker material (.020+) with tighter tolerance (+/_10% of metal thickness) requires a smaller sheet with less pieces.***
  3. ***Thinner material (.019-) with broader tolerance (+/-15% to 20% of metal thickness) will determine larger sheet with more pieces per sheet.***
  4. ***The larger the sheet and the more pieces per sheet the lower the piece price to the customer.***
- ***Sheet size vs. metal thickness vs. required tolerance***
  1. ***Best tolerance available with etching is usually +/-.010% of metal thickness***
  2. ***Exception would be .001 to .004 thick metal, best tolerance would be +/-.0005.***
  3. ***Typical production tolerance would be +/-15% of required metal thickness by customer.***
  4. ***As discussed above tighter tolerance will also require smaller sheet size and wider tolerance will allow larger sheet size.***
  5. ***Location tolerance is routinely held to +/-.001 regardless of the metal thickness. Location dimensions can be held to tighter tolerance at the customer's request.***
- ***Compensating etch factors for tool design***
  1. ***When etching through the metal thickness, for every .001 etched down into the metal there is a lateral etch of .00025 per hole side (a hole has 2 sides). The compensating factor for designing the working photo-tool is thickness divided by 4.***
  2. ***Example: .020 Brass requires .062 hole etched through the metal thickness. The Photo-tool used for image transfer would have to be compensated for etch factor of thickness over 4 or .005 per side of the hole. The actual hole size on the tool would be 052. After etching form both top and bottom of the .020 brass sheet the finished hole size would be .062.***
  3. ***Only land area or physical tolerance has to be compensated. Center to center locations do not require compensation.***
- ***Metal thickness to slot/bar ratio***
  1. ***The etch process has limitations regarding slot to bar ratio or any dimensions that would be less then the actual customer required metal thickness.***
  2. ***Bars can be 20% thinner then the actual metal thickness, slots need to be 120% wider then the metal thickness. Example: for .010 Stainless steel, the required bar width can be .008 but the required slot would have to be .012 wide.***

3. *The same ratio is required for holes to bar width ratio.*

- ***Tab configuration, drop-outs vs. standard tabbing vs. recess tabbing and tab placement***
  1. *Most etched parts are made in sheet form.*
  2. *There are 3 techniques for processing parts in sheet form.*
  3. *Drop-outs: Parts are orientated in sheet form with a complete uninterrupted perimeter etch line around the outside profile of a part. When the part is etched it simply drops out of the sheet as a finished complete part. That advantage is no burr on the outside profile of the part. A disadvantage can be the amount of process time it takes to handle individual parts vs. parts that are tabbed into the sheet.*
  4. *Standard Tabbing: Most parts are processed in sheet form with the parts tabbed into the sheet. A round disc may require 2 to 3 connecting tabs holding the part into the sheet during the etch process. Once the etch process is complete the part would stay attached to the sheet by the 2 to 3 thin tabs connected to the OD of the part. The advantage is ease of handling through the process and offers an easy way for customers to store parts at their facility. A disadvantage is the parts will need to be clipped out of the sheet with a fine wire cutter and there will be a slight burr protruding from the OD of the part. If the tab burr is not desirable the parts can be clipped out and deburred at our Conard facility.*
  5. *Recessed tabbing: This is a tab that is actually recessed below the profile of your part. After the etch process is complete the part can be removed from the sheet with a simple twist and the profile has no protruding tab burr. It does leave small open notches in the outside profile that recess from the OD. Advantage is the ability to handle the parts in sheet form saving cost. The customer can receive the parts in sheet for easy removal or the customer can request removal of the parts by Conard.*
- ***Outside corner radius***

  *1. There is a process restriction for square corners internally or externally. The standard rule is .6x the actual metal thickness. Example: a .010 Copper part would have a corner radius of .006.*
- ***Use of serifs, limiting outside corner radius***

  *One way to restrict corner radius is to add a small serif to the corner. The serif will restrict the radius affect and limit the actual radius.*
- ***Half etch capabilities i.e. fold lines***
  1. *One of the many advantages of the etch process is the ability to use half etch lines. A line is placed strategically on one side of the photo-tool and omitted from the other side, when etching the line is only half etched from one side. By creating these half etch lines it makes it possible to create fold lines on one side of a part. Example: RF shielding, the part can be designed flat with fold lines and then simply folded into a 3 dimensional shape. This capability can save the customer expensive forming tool costs.*

2. ***The half etch technique can also allow part marking or orientation marking for identification purposes.***

- ***Ratio etch capabilities, 50/50, 60/40, 73/30, 80/20, & 90/10***
  1. ***Another advantage of the etch process is ratio etching. Most standard parts are etched to a 50/50 or 60/40 ratios and all the standard process rules apply.(50/50 ratio is 50% of the metal thickness etched from both sides of the metal sheet)***
  2. ***If a customer is requesting a smaller hole in a thicker material. Example: .012 holes in .020 metal thicknesses. This is achieved by a ratio etch. The part is etched 80% to 90% from one side and etched 20% to 10% from the other side. By using this technique you are able to hold the smaller hole dimension. The sidewall of the part profile will have a sloped or trapezoidal affect rather then perpendicular.***
- ***Double process capabilities***

1. ***The etch process allows for what we refer to as a double process. Example: a customer is requesting an etched through part with half etch graphics on each side, aligned top to bottom but they do not want it etched trough.***
2. ***Two photo-tools could be designed, the first tool would be printed and processed as a partial etch. Then the part would be reprocessed, aligned to a second tool and processed to its completion with the required etch trough pattern and the added feature of half etch graphics aligned top to bottom at a controlled depth per side.***

- ***Composite tooling***

1. ***Another great feature offered by our process is composite tooling. Example: a customer is prototyping a part and has several design types they want to evaluate. Conard can design the photo tooling to include several designs on one tool and produce the various style parts in a single sheet format. This saves the costing of several individual tools. Example #2, a customer has a small quantity of several parts but does not want to spend the money for individual tooling for each part type. Conard can create a composite photo-tool to include all the parts and save the customer tooling cost.***
2. ***The rule for composite tooling is all parts must share the same metal thickness.***