Design Guidelines for Photochemical Machining

When designing or specifying photo-etched / chemically machined parts, there are certain guidelines which will help expedite your project. In the sections that follow, data is given for a variety of metal thicknesses.

This data is generally applicable to the equipment, processes, metals and configurations. They do not however, define the ultimate capabilities of photochemical machining.

Dimensions & Tolerances

For dimensions such as slots, corners etc., there are a few guidelines for designers which express practical limitations when the dimensions under consideration approach the thickness of the metal. The most common rules are as follows:

Relationship of Hole Diameter & Features to Metal Thickness

Generally, the diameter of a hole (D) cannot be less than the metal thickness (T). This relationship however, varies as the metal thickness changes. A more exact relationship is illustrated below.

Metal Thickness (T)	Smallest Hole Diameter (D)
0.0003 in. - 0.0040 in. (0.00762 mm - 0.1016 mm)	0.0050 in. (0.1270 mm)
0.0050 in. (0.127 mm) or over	At least 110% of the metal thickness

Some practical hole sizes attained from sample thicknesses are shown in the table below.

Metal Thickness (T)	Smallest Hole Diameter (D)
0.001" - 0.006"	0.008" Ø
0.007" - 0.012"	≈1.2xT
0.013" – 0.020"	≈1.4xT
0.021" – 0.040"	≈1.6xT
0.041" or over	≈1.8xT

Basic features such as length and width follow similar rules. When in doubt, consider 1. 2 x T for dimensions and 15% of T for tolerance. Tighter tolerances can be achieved. Call the PEI Sales Department for more information.

Relationship of Line Width to Metal Thickness

The width of metal between holes is not a particular problem in chemical machining. However, when this space is the remaining surface area in a large field of slots or holes, there are limitations as to how small the metal width between the holes can be. This relationship is shown to the right.

Metal Thickness (T)	Space Between Holes (W)
Less than 0.0050 in. (0.127 mm)	0.005 in. (0.127 mm) or over
At least the metal thickness	At least 120% of the metal thickness

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Design Guidelines Continued

Relationship of Inside Corner Radius to Metal Thickness

The smallest corner radius is approximately equal to the thickness of the metal (i.e., for metal 0.002 in. [0.0508 mm] thick. the corner radius would be 0.0020 in. [0.0508 mm]).

Relationship of Outside Corner Radius to Metal Thickness

Outside corners tend to etch more sharply than inside corners. Therefore, radii less than the metal thickness can be obtained. As a general rule, outside radii are considered to be at least 75% of the metal thickness (T). At PEI however, artwork can be created that will produce outside corner radii approaching zero, if required.

Relationship of Feather to Metal Thickness

Etchant attacks the material laterally as well as vertically, Assuming that the material is being etched equally from two sides, a feather is produced. As a general rule, when etching from two sides, the feather (F) is approximately 10% of the metal thickness.

Center-to-Center Dimensions

Chemically machined parts will duplicate the center-to-center dimensions which exist on production art work. Due to the nature of artwork preparation, there are some practical center-to-center dimension tolerances for finished parts, as shown below

Center-to-Center Dimensions	Tolerances
1.0 in. - (25.4 mm) or less	+\-0.0002 in, (0.00508 mm)
1.0 in. - 3.0 in. (25.4 mm - 76.2 mm)	+\-0.0002 in. (0.00508 mm)
3.0 in. - 6.0 in. (76.2 mm - 152.4 mm)	+\-0.0003 in. (0.0762 mm)
6.0 in. - 10.0 in. (152.4 mm - 254.0 mm)	+\-0.0003 in. (0.0762 mm)

Thicknesses

Alloys with thicknesses of 0.0005 in. (0.0127 mm) to 0.125 in. (3.175 mm) are chemically machined at PEI

Controlled Depth Etch (CDE)

PEI can control Z axis to different depths. Tolerances dependent on amount of material removed. Call the PEI Sales Department for more information regarding your specific project.

Cross-sectional view

Figure 2

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