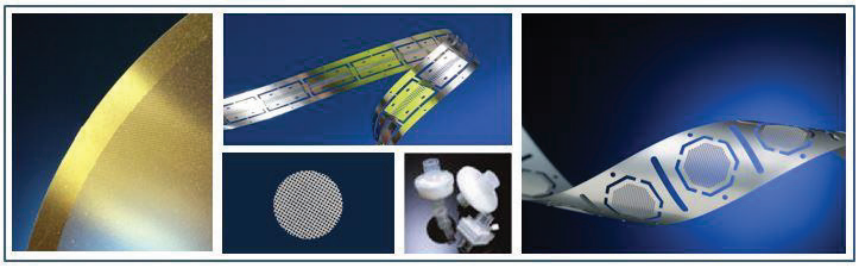
Interplex Chemical Etching Tech Bulletin

Chemical Etching Offers Unmatched Strength and Fine-mesh Capabilities for Advanced Fluid Filtration Applications

The requirements to remove smaller and smaller particulates from advanced fluid filtration systems grow larger and larger by the day. This Tech Bulletin provides an overview of these emerging fluid conditioning and filter media. It also discusses how chemical metal etching, a subtractive manufacturing process that uses baths of temperature-regulated chemicals to remove metal, enables creation of fine-mesh, high-strength filters with the desired features.

Topics addressed in this Tech Bulletin include:

- Fluid Conditioning
- Filter media
- Etched Metal Screens
- Filter Screen Design
- Design Example
- Emerging Appliance Industry Applications
- Summary



Fluid Conditioning

Fluid power circuits are designed in all shapes and sizes, both simple and complex in design, and they all need protection from damaging contamination. Abrasive particles enter the system and, if unfiltered, damage sensitive components like pumps, valves and motors.

Fluid Conditioning is the process by which particulates are removed from fluid in a system. Damage happens when key filtration points are ignored. It is the job of the filter to remove these particles from the flow to help prevent premature component wear and system failure. As the sophistication of systems increases, the need for reliable filtration protection becomes ever more critical.

Filter Media

Media is a term used to describe any material used to filter particles out of a fluid flow stream. The job of the media is to capture particles and allow the fluid to flow through. For fluid to pass through, the media must have holes or channels to direct the fluid flow and allow it to pass.

The filter media materials have changed over the years to meet evolving needs. Early designs used steel wool and wire meshes. As the size of the particulates to be filtered out have become smaller, many filtration systems utilize flat metal screens with various hole patterns, shapes and sizes.

Etched Metal Screens

Chemically etched screens are fabricated out of sheet metal alloys producing a structurally strong design for screen applications. The most common alloy is a flat stainless steel 300 series alloy full hard. However, other metals and alloys can be used depending on the corrosion proprieties of the fluid being filtered.

Chemically etched screens are superior to steel wool and wire mesh because they are capable of filtering out much smaller particulates. Etched screens will not fray, open or distort. In addition, the chemical etching process allows for a variety of mesh opening sizes as well as unique hole shapes, such as round, square and hexagonal holes. This enables designers to use whichever feature works best to meet the specific filtration requirement.

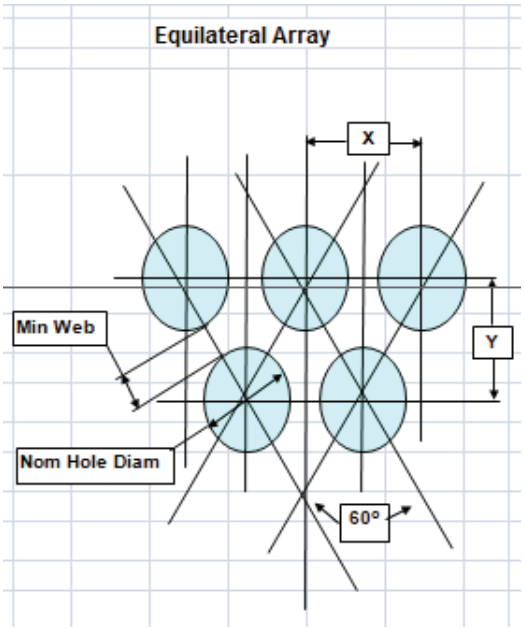
Filter Screen Design

When designing a filter screen, there are several considerations that must be addressed:

- Particulate Size: The size of the particulates that need to be filtered determine the hole size, or more specifically, the hole diameter.
- Liquid Flow: The velocity of the liquid flowing through the filter dictates the hole density – the number of holes required per square centimeter on the screen. This is defined by the X-Pitch, or the distance between the centers of the adjoining holes.
- Material Thickness: The particulate size and the liquid flow pressure together determine the material strength required for the filter. The strength is reflected in the thickness and temper of the material used. Material thickness can be calculated using a proprietary formula based on the X-Pitch and the hole diameter defined above.

Design Example

The image to the right shows an equilateral array of round holes for a particular filter screen. Key variables are the Nominal Hole Diameter and the X-Pitch. From there we can select our material thickness.



Using Interplex Etch Logic's Etched Screen Design Template, designers can calculate the Y-Pitch, the Material Thickness and the Hole Count Density.

Below, if we assume the Nominal Perforated Hole Diameter to be 0.076 mm and the X-Pitch to be 0.150 mm, the Maximum Material Thickness that can meet these requirements is 0.063 mm. Based on availability of common metals, 0.050 mm thickness is our best choice.

After inputting those variables, the design template reveals a Y-Pitch 0.1299 mm and a Hole Density of 5132 holes per square centimeter.

If we increase our X-Pitch to 0.160 mm, our Y-Pitch 0.1386 mm and our Hole Density reduces to 4511 holes per square centimeter.

Etched Screen Design Template - Round Hole Pattern — **Metric Units**

Design	Nominal Perf Hole Diameter (MM Input)	Area of each hole in mm²	Nominal Calc Percent Open Area	X Pitch (MM Input)	Y Pitch	Average Web Width	Max Material Thickness	Selected Material Thickness (MM Input)	Hole Count Density
A	0.076	0.0045	23.3%	0.150	0.1299	0.0740	0.063	0.050	5132
B	0.076	0.0045	20.5%	0.160	0.1386	0.0840	0.063	0.050	4511

Advanced chemical etching processes are already being used extensively to create filters for a variety of demanding applications in automotive, aerospace and medical industries. Now chemical etch processes are also being applied for many new filtration requirements in the appliance industry to implement water-saving environmentally-responsible features.

Some key considerations driving these new trends include:

- Appliance manufacturers *are* encouraging consumers to "go-green" and differentiating products by reducing their environmental impact
- Water scarcity is becoming a threat to social and economic growth in many countries.
- In recent years, private organizations have begun to consider both financial benefits and social responsibility in their attempts to meet the growing water needs.
- High-performance, water-efficient appliances, fixtures, water systems, and accessories that reduce water use in the home can significantly help preserve the water resources.
- Reducing water usage also offers the benefit of energy savings.
- For example, if all U.S. households installed water-efficient appliances, the country would save more than 3 trillion gallons of water and more than $18 billion dollars per year!

The highly controlled and efficient reel-to-reel etching processes that have already been proven out in other industries are being leveraged by forward-looking appliance makers to enable new water-saving innovations that both differentiate their products and help preserve precious water resources.

Summary

As the sophistication of systems increases, the need for reliable filtration protection becomes ever more critical. The filtering of smaller particulates requires smaller holes while increasingly high liquid flows require larger hole-count densities and filter strength.

To achieve all of these objectives with consistency, high-repeatability and cost-effective production, reel-to-reel chemical etching is the only process that offers a solution for today's requirements. In addition, it is the only alternative that can keep pace with new and emerging designs going forward.

Interplex Etch Logic is a world-class supplier of chemically-etched metal components and a division of Interplex, a global contract manufacturer of complex components. The company's advanced "Chemical Stamping" process utilizes a highly consistent and highly repeatable reel-to-reel chemical metal etching process. More information can be found on the web at http://www.interplex.com/etchlogic