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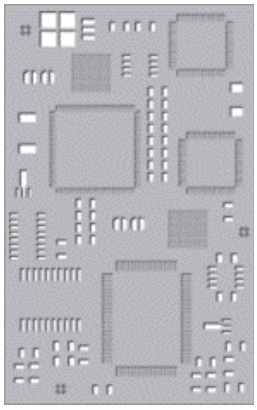
Application Note No. 103

Cutting of Metal Masks (Stencils) with SYNOVA Laser-Microjet®



Description of Product

In general, a stencil is a thin piece of plastic film or other impervious material with cut out design areas. It is placed flat against the surface to be stencilled allowing paint to pass through the cut out areas.
Solder mask stencils are metal or plastic perforated sheets used to apply solder paste to land locations where the paste will be re-flowed to attached electronic components. These stencils are used for screen-printing solder paste or conductive adhesives onto printed circuit boards.
Laser cut stencils are usually utilized for applying paste to boards containing fine pitch components. The precision of a laser cut stencil helps eliminate bridging, improves paste release as well as the consistency across the stencil.

Description of Material

Stencils are made of stainless steel or Polyimide (Kapton®). Thickness is typically between 50 microns and 200 microns.

Description of Manufacturing Task

A big number of small apertures has to be drilled in the metal or plastic sheet. The apertures have to be at slight angles allowing the paste to be easily detached from the mask. The apertures can be square or round and the radius of square/rectangular holes must be as small as possible. Precision, quality and speed are critical.

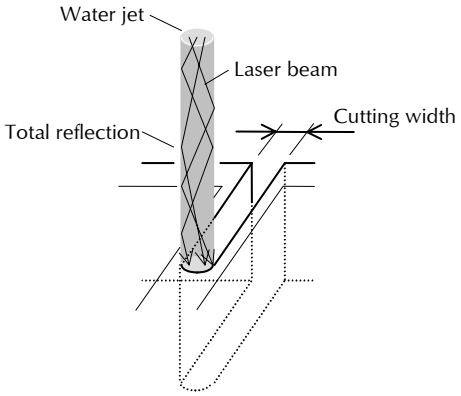
Description of Conventional Manufacturing Process (State of the Art) and Problem

The apertures can be made by punching, milling, etching, or laser cutting. The laser cutting has the advantage of high flexibility, speed, and is able to cut very small apertures. The actual problem of the laser cutting is the quality. In fact, the laser cutting needs a post-treatment to clean the stencil and remove burrs on the backside.

Water Jet Guided Laser Technique

In 1993, scientists at the Institute for Applied Optics at the Swiss Federal Institute of Technology Lausanne succeeded in creating a water jet guided laser, called by its inventors Laser-Microjet®.

The laser beam is focused in a nozzle while passing through a pressurised water chamber. The geometry of the chamber and nozzle are decisive to coupling the energy-rich laser beam in the water jet.



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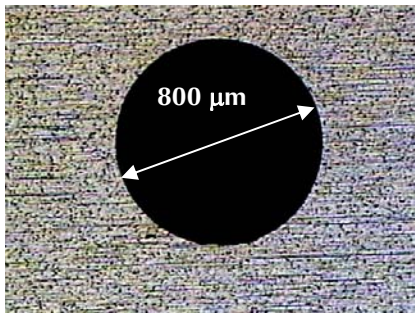
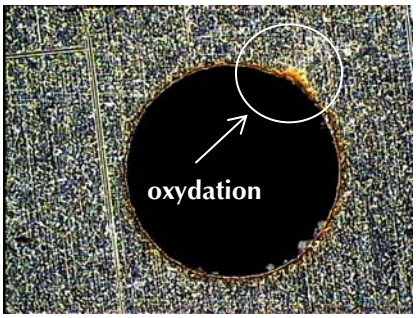
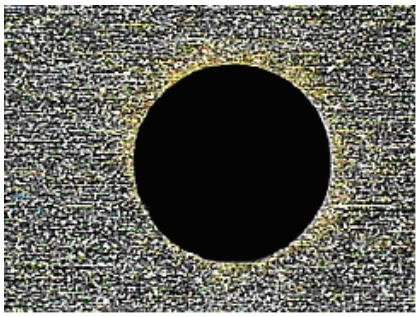
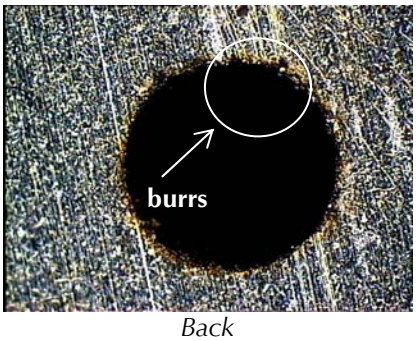
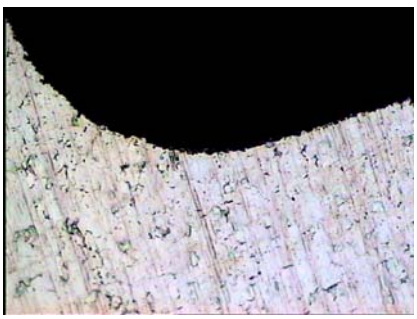
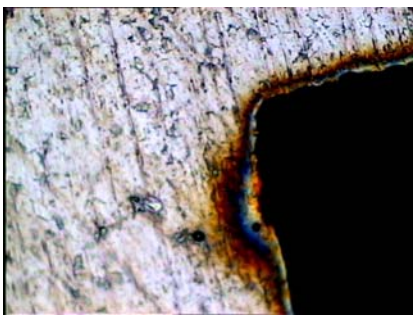
The low-pressure water jet emitted from the nozzle guides the laser beam by means of total reflection at the transition zone between water and air, in a manner similar to conventional glass fibres. The water jet can thus be referred to as a fluid optical wave-guide of variable length. Because a pulsed laser is used, the continuous water jet is able to immediately re-cool the cut, resulting in only a very slight depth of thermal penetration. The result is a very narrow, parallel, burr-free, clean cut, without any thermal damage.

Solution with Laser-Microjet® Process

Using a short pulse laser, a burr-free, clean cut can be reached. The water jet avoids any thermal damage and furthermore, there is no oxidation.

	Laser Microjet®	**Conventional laser**
In comparison with the conventional laser, the difference is at the very least, quite remarkable.	 *Front*	 *Front*
The backside is completely burr free, without any **post-treatment**.	 *Back*	 *Back*
The Laser-Microjet® can cut between 60 and 120 apertures per minute in a standard 150 micron thick stainless steel stencil. In resume, excellent quality is not achieved at the expense of speed.	 *300 x magnification*	 *300 x magnification*

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Benefit for the customer

The customer obtains now the following advantages:

- Excellent cutting quality
- Burr free
- No post-treatment necessary
- Very low tolerances
- No heating of the sheet, neither warping nor thermal deformation
- No mechanical damages, no scratching
- Machine laser class1, completely closed, clean room compatible
- Very compact machine due to gantry axes (fixed stencil – moved laser head)
- No cutting gas
- More ecologically conscientious process, because particles are absorbed in the water

Consequence of the benefits

Because of the important improvement in quality compared to conventional laser stencil cutting, the Laser-Microjet® process will be the best choice for stencil cutting in the future.

Machine for Laser-Microjet®[1] Cutting of Stencils

Synova offers a state-of-the-art machine, especially adapted for the cutting of Stencils. Optimum cutting parameters are preloaded. The machine designation is LSS 800. Due to the gantry axes system, the machine size is very small, the stencil does not move. Water jet diameter can be from 30 to 75 microns

The machine has a precision of +/- 5 microns, a processing area of 700 x 900 mm, a maximum axis velocity of 1000 mm/s. The system is equipped with a CCD camera and fast image treatment software, allowing automatic alignment and inspection.

The operation interface is a 15-inch flat colour screen with touch panel, the machine software is based on MS Windows NT®[2]. The machine can be connected to a LAN network for data transmission. The integrated modem allows remote diagnostic service. Adapted CAM software can convert all DXF and Gerber data, fast and easy without any special programming.

A complete list of options is available such as chiller, alternative laser sources, water treatment system, reference scales, and transformers.

The Synova machines have been repeatedly field proven and are used for 24h industrial production.

[1] Laser-Microjet® is an international protected trademark of Synova S.A, Switzerland.
[2] Windows NT® Is a trademark of Microsoft Corp.

