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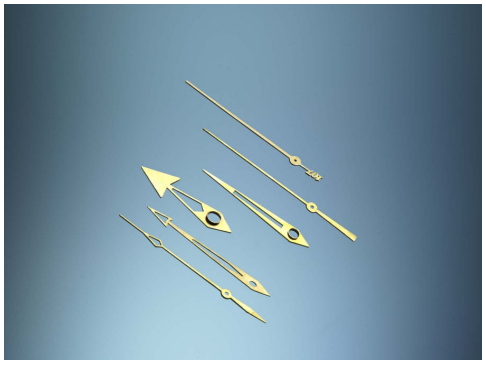
Application Note No. 122

Cutting of Watch Hands with SYNOVA Laser-Microjet®

Description of Product

The hands on today's watch mechanisms, either the pure mechanical or battery powered quartz driven varieties, are precision mechanical parts and place demanding requirements on the manufacturers, especially for items destined for the luxury markets.



Modern watch hands are produced in a great variety of styles, qualities and colours. High-grade parts are made of solid gold or tempered steel and have a polished pipe or head. Otherwise brass is generally used, protected and decorated either by a thin galvanized layer of gold or rhodium, or some kind of lacquer. There are many different types and shapes of hands, each adapted to the use as well as to the aesthetics of the watch.

Description of Material

The base materials used for this application are usually either brass or steel. The thickness of the materials varies typically from 150µm to 200µm.

Description of Manufacturing Task

Manufacturing parts such as watch hands places very high demands on the producer. The delicate parts are made from material, which is extremely susceptible to thermal effects possibly causing warping and or mechanical deformation due to its thinness. Post manufacturing requirements to remove contaminants, deposition or burrs, should be avoided or minimised to avoid unnecessary loss in parts yield due to the added handling processes.

Description of Conventional Manufacturing Process and Problems

Cutting such fine mechanical parts with conventional dry lasers does not produce good results, due to the resulting heating effects, burrs and deposition of ablated material. The alternative method of stamping the parts from the sheet metal is both inflexible (stamp dies required for each new or modified design) and leaves burrs, which require additional processing steps, before the parts can finally be used.

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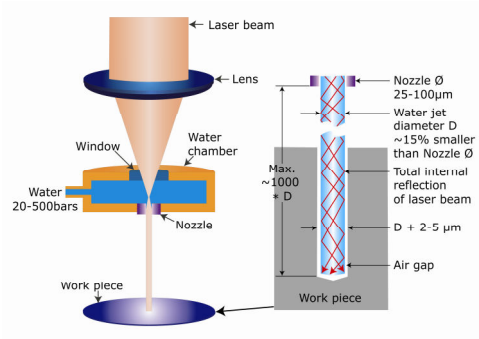
Water Jet-Guided Laser Technique

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

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

The low-pressure water jet emitted from the nozzle guides the laser beam by means of total internal reflection at the transition zone between water and air, in a manner similar to conventional glass fibre optics. The water jet can thus be referred to as a fluid optical wave-guide of variable length.



Principle and cutting with water jet-guided laser

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 wall, burr-free, clean cut kerf, with negligible thermal damage.

Laser Microjet® Solutions

Cutting Watch Hands with the Laser MicroJet®

As a "cold" and "wet' laser, the Laser MicroJet® is ideally suited for high-precision cutting of watch hand materials.

A highly stable and reliable technology, the Laser MicroJet® can precisely cut this complex shaped metal pieces from brass or steel, with clean sharp burr free edges, and ensuring a very low contamination level. Moreover, its high speeds enable optimal production rates (5 to 10 mm/s for 200-µm thick sheets) leaving no mechanical or thermal deformation. This eliminates the need for post-processing as is required with traditional processes such as stamping.

The Laser-MicroJet® can also process narrower kerf-widths, resulting in increased parts count from the sheet material.

The water jet-guided laser technology is ideally suited for flexible and versatile productions, such as luxury products where small- to medium-sized series are required, without compromising quality. It is also a perfect marketing tool, as your customers can submit several designs, and have the cut pieces in hand for evaluation just minutes later!

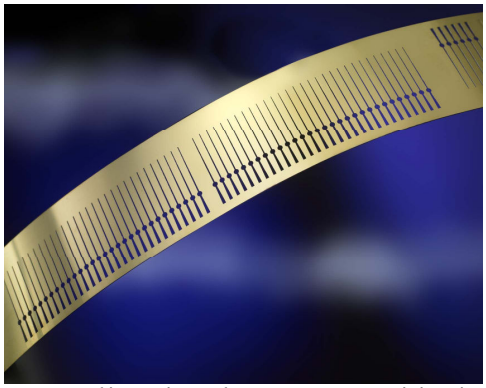
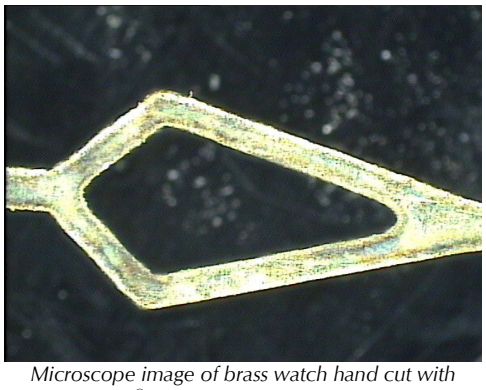


Image of brass sheet after continuous watch hand cutting operation with Laser-Microjet®



Microscope image of brass watch hand cut with Laser-Microjet® (front view) immediately after cutting

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Customer Benefits

Customers can obtain the following advantages when using Laser-MicroJet® technology:

- High speed cutting
- Excellent cutting quality with narrow and parallel-cut walls, and smooth and straight edges
- No burrs or depositions maintaining a very smooth surface
- No mechanical damage: water exerts very low (<0.1N) forces on the work piece
- No heating of the parts or thermal deformation
- No contamination or re-deposition
- Constant results
- Very flexible, new designs quickly prepared under CAD control, no new mechanical die stamps required for each new model
- Very low running costs; no tool wear
- Higher throughput and productivity with improved return on investment (ROI)
- Environmentally friendly process as only DI water is required, ablated materials are removed with the water for later filtering and disposal

Outcome of the benefits

Because of the significant advantages over other manufacturing methods, in particular the negligible thermal and mechanical stress, as well as the burr and contaminant free parts produced, the Laser-Microjet® process is proving to be the ideal method for cutting watch hand material today.

Laser-Microjet®[1] Cutting System for Watch Hand Applications

Synova offers a state-of-the-art, clean-room compatible machine, the LCS 300 laser cutting system illustrated at right, designed for the cutting of watch hands and other high precision mechanical or electronic parts.

LCS 300 Laser Cutting System

The system has a precision of ±3µm, a repeatability of 1µm and a usable working area of 300x300mm with a maximum axis speed of 1000mm/s. The system is equipped with a CCD camera and fast image treatment software, allowing automatic alignment and inspection. The operator interface is a flat colour screen with touch panel, and the machine software is based on Windows 2000®[2].

The LCS 300 can be connected to a LAN network for data transmission and remote diagnostic services. Adapted CAM software can convert all DXF data, quickly and economically, with no special knowledge or training requirements.

Options include water chillers, alternative laser sources (i.e. UV), water treatment system, 2D-reference scales and transformers. The CE and S2 certified Synova machines are field-proven and in use in 24/7 production environments.

A smaller model, the LCS150 with a working area of 150x150mm, is also available.

[1] Laser Microjet® is an internationally protected trademark of Synova S.A., Ecublens, Switzerland.
[2] Windows 2000® is a trademark of Microsoft Corp., USA.