EDM - Precision tooling-

# What is 3D Laser machining?

What is 3D laser machining? First of all, laser ablation machining is not the same thing as laser cutting. What 3D laser machining does is, it uses ultra-fast laser pulses of very short duration to remove material in very thin layers from the surface of the workpiece. Material is removed layer by layer until the programmed geometry is achieved. This process is not designed for drilling or cutting through material, though this can be done in some applications, the benefit from the 3D laser machining process is at it´s best when it is used for the making of small filigree 3D cavities.

The laser is a Q-switched Nd:YAG. The Q-switch is an electro-optical interrupter located between the crystal YAG rod and one of two mirrors positioned at either end. The Q-switch controls the discharge of amplified light energy in the form of a pulsed laser beam. This pulse transfers so much energy to the workpiece that the majority of the material the beam strikes is directly vaporized, without transferring heat flow to the surrounding area. Vaporized/molten material is extracted by a built-in vacuum system.

The laser beam can move within an area of 65 x 65 mm through a deflection scanner system using two optical mirrors. This does not mean laser machining is limited to cavities of this size. The machine has a 300 x 400 mm XY-traversing table, and machining can be set up in smaller squares with automatical re-positioning of the workpiece. Thanks to the scanners 3:rd axis, the so called Z-shifter, the producing of vertical walls and defined wall angles is possible with the laser. Actually, this is the reason we call our process: 3D laser machining.

During the machining process the workpiece is at rest and the beam is moved by the optical mirrors, producing overlapping laser tarcks, this is called hatching. When a cavity has a wall draft angle below approx 10 degrees the walls has to be machined with an angled laser beam. In this case the central area of a layer is machined first using hatching, then the walls are machined from different directions by moving the working table automatically. When one layer is ready the machines moves to the next and so on.


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Laser machining is not programmed exactly like traditional CNC cutting/milling equipment requiring speeds and feeds, instead it´s driven directly from digital CAD data, from the STL file format. The operator determines appropriate parameters for the process, and the operating software automatically slices the volume that is going to be removed in thin slices between 1-5µm depending on the material and the application.

After the laser program is generated, the operator determines the machining zero point of the clamped workpiece, this can be done very precice thank´s to the machines CCD video measuring camera. Also the correct height of the workpiece, starting point in Z-axis, has to be found precicely so that the laser is in focus on top of the starting surface of the workpiece. For this a built-in measuring probe is installed on the machine, the probe touches the surface and the starting cordinate is saved into the system. To have a focused beam is very important in order to have a correct beam diameter and a correct intensivity in the laser spot during the machining process.

Once the program has been started, the workpiece is finished without operator input. The touch probe is also used for in-process measuring and correction for machining depth at regular intervals during the entire process.

## Technical possibilities and limitations:

- Vertical walls are possible to machine in a width / depth ratio of **1 : 2.5**
- Laser spot diameter: 0.04mm or 0.10mm
- Laser scanfield area: 65 x 65mm
- Table movements: X400 Y300 Z500mm
- Maximum table load: 50kg
- Surface finish: Ra 0.6 possible to achieve
- Positioning of workpiece: < 0.01mm
- Tolerances: +/- 0.01mm in XY and +/- 0.005mm in Z possible


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