Case Study

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Shop shines at the submicron level with laser machining

For the production of its small parts, the US job shop Sunlight-Tech requires extremely precise laser micromachining and micro-milling – the ideal tasks for its Microlution ML-5 and ML 5100 from GF Machining Solutions.

Most job shops would consider part tolerances of 7.62 micron (0.0003”) to 12.7 micron (0.0005”) to be tight. At Sunlight-Tech Inc. in Mokena, Illinois (US), however, a routine job can involve exacting tolerances tighter than one micron (0.001 mm, 0.00003937”), which are often impossible to achieve with conventional CNC machining or even Electrical Discharge Machining (EDM). In addition to these challenging tolerances, many of the shop’s parts are extremely tiny – almost microscopic – or require miniscule, intricate features. According to Sunlight-Tech President Grzegorz (Greg) Nowobilski, such work is only achieved with laser micromachining and micro-milling technology on machines that can move just as precisely as the submicron part tolerances the shop needs to hold.

The 22-person shop started in 2010 as an engineering consultant focused on designing machinery and automation. In 2018, Sunlight-Tech decided to expand beyond consultancy and diversify into micro-laser and micro-milling machining. As a result, it now serves a wide array of sectors that include the automotive, food, consumer goods, aerospace and defense, electronics, communications and medical industries.

With its laser micromachining capabilities, Sunlight-Tech fulfills such customer job requirements as generating 3,200 holes, each 254 microns (0.01") in diameter at a 11:1 depth to diameter ratio, or producing features that are square at the top and round at the bottom with positive or negative tapers, along with other kinds of cavities and blind features. It also uses its laser technology for those parts that must not be contaminated or come in contact with foreign materials, a common risk during conventional milling operations involving cutting tools. Because most of the parts are extremely tiny and fragile, Sunlight-Tech can laser micromachine them without creating any damaging cutting forces.

Currently, Sunlight has two ultrafast laser micromachining systems, both of which are from GF Machining Solutions. One is a Microlution ML-5 five-axis machine, and the other is a Microlution ML-5 three-axis machine with a larger working envelope.

The Microlution ML-5 machines are capable of delivering ±1 µm (±0.00004") positional accuracy and ±0.5 µm (±0.00002") repeatability. The ML-5s' full five-axis laser movement is capable of “bending” the beam to generate highly complex shapes otherwise impossible to do so with conventional drilling, such as applications involving funnel-shaped holes with demanding surface finish and tolerance requirements from top to bottom.

Precision-ground natural granite bases and granite-mounted rails support the high-precision beam delivery systems on the machines. High-accuracy linear motors allow for peak acceleration with no blacklash and significantly reduced cycle times and

consumables. Other features include high-resolution glass scale encoders as well as in-line workpiece touch probes, integrated power meters and high-speed optical cameras.

Both Microlution machines' natural granite bases provide high thermal stability over extended production runs for exceptional part quality, and both use femtosecond laser technology. Femtosecond lasers have ultrashort pulses in the range of one quadrillionth of a second – a femtosecond. The ultrashort pulse duration of the laser prevents materials from entering a fusion state during machining, which makes it perfect for Sunlight-Tech's heat-sensitive parts. Femtosecond lasers also eliminate most burr formation and work at temperatures that cannot damage most parts.

On the micro-milling side, Sunlight-Tech's Microlution 5100 Micro Milling Center gives the shop the ability to produce highly precise parts with complex geometries possible only by using the high-speed five-axis micro-milling technology. Designed to handle manufacturing of the tiniest components while maintaining micron-level precision, the machine handles parts measuring up to 100 x 100 x 100 mm (4" x 4" x 4") using cutting tools ranging from 0.01 mm to 3 mm (0.0004" to 0.124") in diameter. With its ±1 µm (±0.00004") positioning accuracy, the high-performance, vertical bridge-style linear-motor machining center is well suited for Sunlight-Tech's high precision, small-part applications.

Many of Sunlight-Tech's laser micromachining jobs involve R&D work. According to President Nowobilski, since (ultrashort pulse) laser machining is less than a decade old, numerous companies are experimenting with how the technology can be applied to parts they are currently producing. Sunlight-Tech helps them prove out those concepts.

"A key factor of effective laser machining is determining the correct laser parameters," said Nowobilski, "and for that we worked with GF Machining Solutions' applications engineering support team." This support, combined with his previous laser experience, allowed Sunlight-Tech to quickly get up to speed in programming the Microlution machines. In fact, doing so was much easier than he expected. As he explained, "After only a few weeks, we understood the laser parameters and how they needed to change to generate specific part shapes and features."

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According to President Grzegorz (Greg) Nowobilski, there are features in the parts that Sunlight-Tech produces that can only be cut with laser technology.

The full five-axis laser movement of the ML-5 is capable of “bending” the beam to generate highly complex shapes otherwise impossible to do so with conventional drilling.

On the micro-milling side, Sunlight-Tech's Microlution 5100 Micro Milling Center gives the shop the ability to produce highly precise parts with complex geometries.

The femtosecond lasers inside the machines have ultrashort pulses in the range of one quadrillionth of a second.

Profile of GF Machining Solutions
GF Machining Solutions is the world's leading provider of machine tools, diverse technical solutions and services to manufacturers of precision molds and tooling and of tight-tolerance, precision-machined components. The key segments we serve include the aerospace, automotive, medical, energy, information and communications technology (ICT) and electronics industries. Our extensive portfolio ranges from Electrical Discharge Machining (EDM) solutions, three- and five-axis Milling machines and Spindles, 3D Laser texturing machines, Additive Manufacturing and machines for Laser micromachining to solutions for Tooling, Automation, Software and Digitalization—all backed by unrivaled Customer Services and support. GF Machining Solutions is a globally acting Division of the Georg Fischer Group (Switzerland) and maintains a presence at 50 locations worldwide. Its 3,358 employees generated sales of CHF 972 million in 2019. More information can be found at www.gfms.com

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