

Lasers from Coherent Bring a Unique Vision to Reality

The founding of Austrian premium eyewear manufacturer Silhouette International in 1964 was based on a simple idea: glasses should not only be a practical visual aid, but rather an accessory for better vision and appearance. That idea still drives the company. It motivates them to seek out new production processes to enable the realization of cutting-edge designs that are functional and reliable. Silhouette International has not been afraid to adopt new manufacturing technologies to achieve their goals, and laser welding systems from Coherent enable the company to produce some of their most advanced designs.

Unique and Durable Eyewear Design

“Personal eyewear design is our top priority, because we want to create unique eyewear that fits the wearer’s face harmoniously.” This is how Silhouette CEO Thomas Windischbauer summarizes their design philosophy. This approach, in turn, necessitates several design imperatives. These include the requirement for easy adaptability to the individual needs of the wearer, as well as the use of materials that guarantee lightness and flexibility, but also stability.

Silhouette had a groundbreaking year in 1999. The 1.8 gram Silhouette "Titan Minimal Art" (TMA), the first screw-less and hinge-less eyewear made of titanium, revolutionized the eyewear market and was an instant success story. To date, over 12 million units have been sold worldwide.

Used in space

The Titan Minimal Art was approved for space flights in 2000. The absence of screws and hinges guarantees safety by minimizing the risk of free-floating objects inside space helmets, breathing apparatus, and within the spacecraft. To date, the TMA has been the faithful companion of astronauts on over 30 space flights.

Since 2017, Silhouette International has also been manufacturing its own glasses in the so-called Lens Lab, a specially constructed building on the factory premises. Frames and lenses are manufactured at the company's location in Linz to the highest technical standards and tailor-made for the Silhouette eyewear collections.

Since the introduction of the TMA, Silhouette has applied this same hinge-less approach to many other designs. In terms of manufacturing technology, this drives several requirements. First is the ability to join a variety of materials, including titanium and specialized alloys. Next, is the capability for producing joints that are aesthetically pleasing; specifically, this means virtually invisible and cannot be felt. Finally, it also necessitates joints which deliver excellent flexibility and high strength, plus the ability to be cycled (folded and opened) numerous times without a change in shape or degradation in mechanical strength.

Partnering for a Total Solution

With these technical requirements in mind, plus the market requirements to support production of several new collections every year, Silhouette searched for a supplier who would support both the development of the manufacturing processes and provide the actual production equipment. Early on, it was determined that Silhouette would transition from traditional resistance welding to laser welding in order to meet their stringent quality and throughput requirements.

During this search, Coherent emerged as a favorite among potential vendors for several reasons. First, Coherent was one of the few companies who could readily supply the entire package, that is, the laser, all associated optomechanics, part handling, and software. Also, Coherent was both capable and willing from the outset to participate in developing the process, lending its substantial laser expertise to a company that didn't have much experience with the technology.

The first Coherent laser welding systems acquired by Silhouette were manual models used for prototype construction and repair work; the success of those led to the purchases of the Coherent MPS Rotary (Modular Processing System) for laser welding, adapted specifically to Silhouette's needs. Coherent's willingness to perform this customization was another key factor in their selection by Silhouette.



Figure 1: Two MPS Rotary systems for laser welding of glasses in the production at Silhouette in Linz, Austria

MPS Rotary Benefits

The MPS Rotary is an automated, turnkey system for metal welding, cutting and drilling, in this case, incorporating a Coherent 200 W fiber laser (StarFiber 200). A combination of scanner optics and travel enable a variable working field. The system is completely enclosed (Class I laser) for operator safety. Various options, including integrated machine vision, are available. The system also uses a rotary indexing table to allow part loading/unloading while processing is being performed.

User-friendly software enables use by operators with minimal skill and training. For example, the system automatically detects the type of part that has been loaded, and then calls up the correct processing program. Silhouette engineers typically change job parameters on a daily basis to support their specific production requirements, and the MPS Rotary software has proven responsive enough to support this schedule. Silhouette runs the system five days a week, two shifts a day, and has found that machine availability and uptime is excellent.

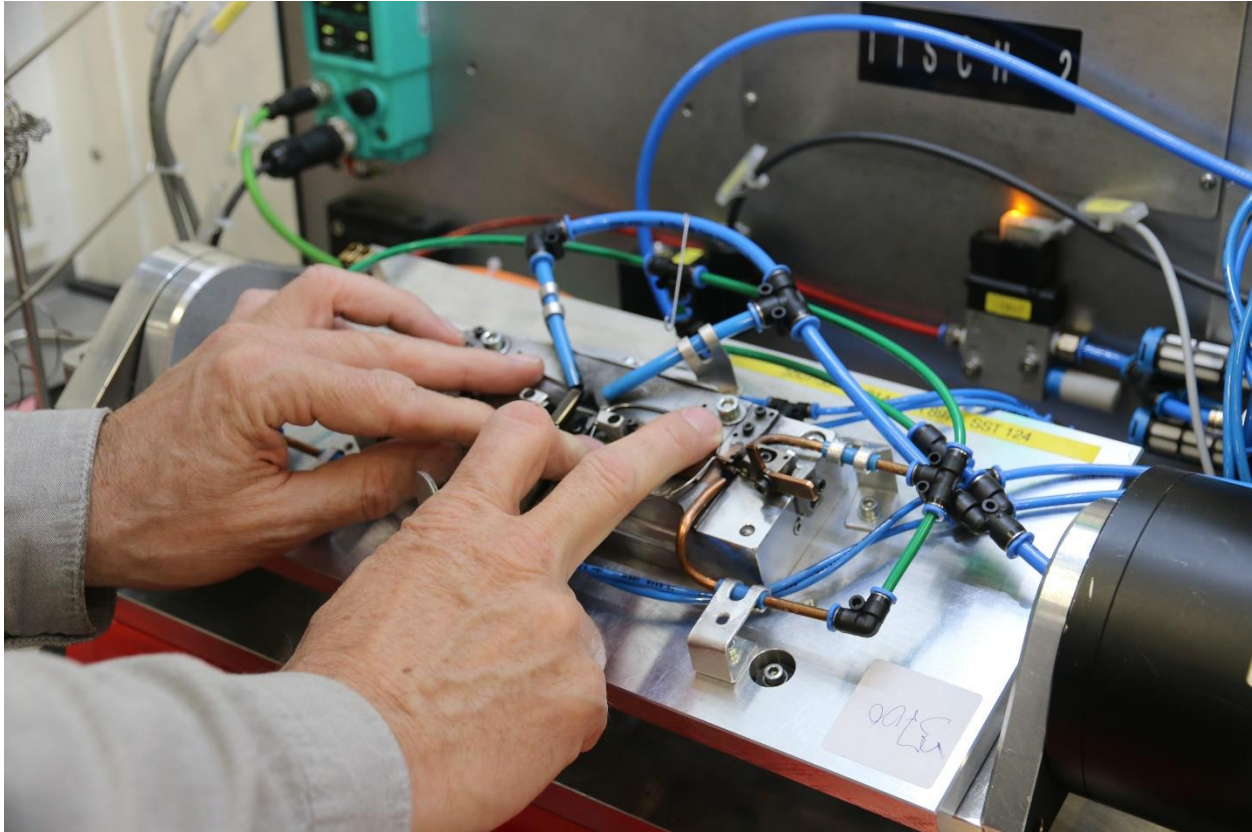


Figure 2: Customized part holder for welding of glasses

More Flexible and Cost-Effective Production

In terms of economics, the move from resistance to laser welding has been a tremendous success, delivering an overall cost savings in the range of 80%. Specifically, laser welding has proven better suited to automation, and delivered a substantial increase in production throughput. Part of this is due to decreased setup times. Overall, the Coherent MPS Rotary has reduced tooling and manufacturing costs because multiple process steps are now performed in one machine, resulting in improved energy savings, sustainability, and productivity. Just as important is the superior weld quality; the welded parts themselves demonstrate high strength due to lower heat input into the part, and the elasticity of the welded joint is better. The MPS Rotary also supports Silhouette's need quickly insert new designs into production to support the quarterly sales cycle, as well as to efficiently run limited lots sizes (typically 150 - 300 pieces).

"While we're always striving to produce more unique and fashionable designs, wearer comfort remains a top priority," notes David Illitz, Process Manager Raw Part Production. "This creates engineering challenges for us in terms of material limitations. Laser welding, which delivers highly

precise and very repeatable results, has been a key factor in enabling us to bring these cutting-edge designs into production successfully. Plus, the flexibility of laser processing gives us confidence that we'll be able to keep utilizing this approach for many years to come. The enormous versatility of the MPS Rotary system, in particular, ensures that we'll be able to bring anything our designers create into production in a cost-effective way."



Figure 3: David Illitz, M.Sc. (Head of Raw-Part-Manufacturing) and Raimund Öhlinger (Head of Department Connection Technology) – fully satisfied with the performance of the Coherent MPS welding systems

SmartWeld

Another key advantage of the MPS Rotary is that it includes Coherent's SmartWeld™ technology. SmartWeld incorporates an advanced implementation of "beam wobble," that is, rapid motion of the beam during the welding process. Specifically, instead of simply moving along a weld seam, the beam may trace out circular, elliptical or even zigzag patterns, executing motion both along and perpendicular to the weld seam. These patterns are easily programmed into the MPS Rotary using the integrated software.



Figure 4: Glasses laser welded with the Coherent MPS Rotary system

One key benefit of SmartWeld is that it produces a higher quality and more reproducible weld. This is because the beam motion enables more flexible and precise control of the heat distribution produced by the laser. For example, a relatively large SmartWeld pattern can be used to preheat the material before it is completely liquefied, or to cool it down slowly after melting. The former can prevent bubbling and turbulence in the melt pool, which produce spatter and inconsistent results, while the latter can eliminate cracking as the material cools. SmartWeld can also be used to alter the normal Gaussian distribution (highly peaked in the center) of the applied laser energy. Lowering the effective intensity at the center of the laser pattern can reduce melt pool turbulence by allowing vapor expansion to occur in a more controlled manner, again leading to improved process consistency. Here, Silhouette can draw on a wealth of experience at Coherent in optimizing SmartWeld for different materials and weld geometries.

Another benefit of SmartWeld is that it allows bridging of larger gap widths in the welded parts. This reduces fit-up tolerance, which speeds production and lowers costs.

“Silhouette currently produces about 2.2 million glasses per year,” reports Illitz. “We need production equipment that supports this volume, and which delivers the quality we need in a way that still keeps us cost competitive. Plus, our production methods must be flexible enough to support our rapid and relentless design cycle that is a prerequisite to maintaining market success in any type of wearable fashion. The MPS Rotary has proven itself capable on all these fronts. And, just as important, Coherent has consistently partnered with us to provide the application and process know-how necessary to take full advantage of their machine’s capabilities.”