



Case Study

Cross-Jet Unit to Protect Welding Lens from Spatter



Reduced assembly construction to reduce costs using the SLM® technology

3D-Printing Success Story

IMPROVED FUNCTION

increased flow performance and 70% weight reduction

EFFICIENT PRODUCTION

45% manufacturing cost reduction



REDUCED ASSEMBLY

18 individual components combined into one

Part Data

| | |
|------------------|----------------------------|
| Designation: | Cross-Jet Unit |
| Industry: | Welding |
| Material: | AlSi10Mg |
| Layer Thickness: | 60 µm |
| Build Time: | 20h (full load, 10 pieces) |
| Machine: | SLM®280 |



SLM®280

Current Situation

Additive manufacturing in the welding process

The heart of the welding process is the hybrid welding head with both an integrated GMA welding torch and laser optics. Fronius uses the cross-jet unit to protect the laser optics from contamination during the welding process.

For this purpose, air flows through the bore via a connecting flange and is led into the laval nozzle, where the air is accelerated and flows at high speed past the laser. As a result, the air jet deflects spatter from the welding process and protects the laser optics from contamination. The laval nozzle is the core element of the assembly and was previously manufactured using wire EDM, a very precise method, but one which led to large assembly and maintenance efforts, requiring

18 individual components to be assembled. Utilizing the design and construction freedom afforded by selective laser melting, Fronius realized a reduced assembly construction. The new development of the part manufactured with the SLM® technology in one component saved Fronius costs by considerably reducing assembly efforts.



Fig. 1
The Laser Hybrid process joins aluminum and steel parts at high speeds

Innovations with Selective Laser Melting

Reduced assembly time together with material and cost savings

The additive manufacturing process made it possible to combine an 18-piece assembly into a single component with optimized properties. The functional part is produced in the aluminum alloy AlSi10Mg in series on the SLM®280 selective laser melting machine. Fronius builds 10 cross-jet units in one build job with a manufacturing time of two hours per part. This makes production much more efficient compared to the conventional means and reduces assembly costs.

By using the SLM® technology, the cross-jet's geometry could be altered and optimized, shortening the part to improve accessibility into narrow gaps. In addition,

there need to maintain the seal is eliminated and the weight of the component was reduced by 70%. Compared with the previous conventional design, the pure manufacturing costs were reduced by a total of 45% through the use of additive manufacturing, not including the reduced assembly costs and those costs associated with the storage of components, which are eliminated by demand-oriented production.

Stefan Kammerer, Research & Development Technologies & Mechanical Engineering at Fronius, stated his satisfaction with the results: „The production of the component showed us the possibilities of

Optimization of the cross-jet unit build orientation using Additive.Designer®

selective laser melting and gave us the go-ahead to use this technology in-house.”

To produce the Cross-Jet Unit successfully in serial production using the SLM® process, the development process was followed by reorientation and positioning of the part with the aid of the Additive.Designer® software. Since the Additive.Designer® also accepts native Creo files, the data could be transferred without any quality loss. The individually adaptable software from SLM Solutions, Additive.Designer® supports the user in the placement and positioning of the part on the build plate and enables alignment according to criteria

such as surface quality, thermal stresses or minimization of support structures.

Fronius optimized the support structures of the cross-jet unit to guarantee easy support removal and thus low post-processing costs. In addition, a much more precise production of the nozzle geometry could be achieved to improve the function of the component. Fronius succeeded in increasing the flow performance due to the 100% tightness of the assembly and the optimized flow guidance of the component - despite greater surface roughness in the nozzle.

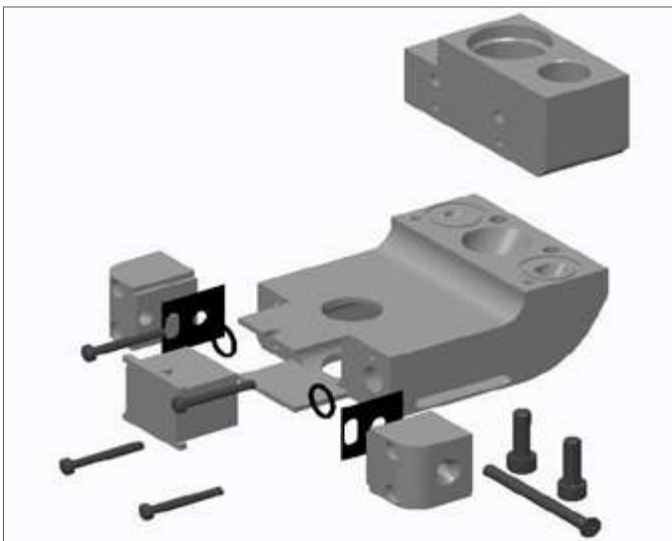


Fig. 2-3

The cross-jet unit was reduced from 18 individual components (left) to a single component (right) with the aid of selective laser melting

Summary

Additively manufactured welding cross-jet unit

- Welding unit for guiding and accelerating compressed air to protect laser optics from contamination
- Reduction of 18 individual components in one, considerably reducing assembly effort and costs
- 70% weight and 45% manufacturing cost reduction compared to conventionally produced part
- Reliable serial production despite complex geometry
- Increased flow performance, despite greater surface roughness in the nozzle, due to 100% tightness of the single-piece assembly and optimized flow control
- Minimizing of support structures using optimized orientation guided by Additive.Designer®



Fig. 4
Optimal component orientation was achieved with the Additive.Designer®

Fronius International GmbH

Fronius develops and implements innovative methods for monitoring and controlling energy for welding technology, photovoltaics and battery charging. In the Fronius LaserHybrid system, the company combines laser GMA and laser beam welding processes.

Fronius LaserHybrid combines the outstanding gap bridging capability and simple seam preparation of MIG/MAG welding with low heat input, deep penetration and high welding speed of laser. The system enables the automated joining of various aluminium and steel parts at up to 8 metres per minute with first-class quality.

SLM Solutions - Technology Pioneers, Innovation Leaders

SLM Solutions helped invent the laser powder bed fusion process, was the first to offer multi-laser systems and all selective laser melting machines offer patented quality, safety and productivity features. Taking a vested interest in customers' long-term success in metal additive manufacturing, SLM Solutions' experts work with customers at each stage of the process to provide support and knowledge-sharing that elevate use of the technology and ensure customers' return on investment is maximized. Optimal paired with SLM Solutions' software, powder and quality assurance products, the SLM® technology opens new geometric freedoms that can enable lightweight construction, integrate internal cooling channels or decrease time to market.

A publicly traded company, SLM Solutions Group AG focuses exclusively on metal additive manufacturing and is headquartered in Germany with offices in China, France, India, Italy, Russia, Singapore and the United States and a network of global sales partners.



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