

Microlution

ML-5



Becoming better every day – since 1802

GF Machining Solutions

When all you need is everything, it's good to know that there is one company that you can count on to deliver complete solutions and services. From unmatched Electrical Discharge Machining (EDM), Laser texturing, Laser micromachining, Additive Manufacturing and first-class Milling and Spindles to Tooling and Automation, all of our solutions are backed by unrivaled Customer Services and expert GF Machining Solutions training. Our AgieCharmilles, Microlution, Mikron Mill, Liechti, Step-Tec and System 3R technologies help you raise your game—and our digital business solutions for intelligent manufacturing, offering embedded expertise and optimized production processes across all industries, increase your competitive edge.



+ We are Microlution.
We are GF Machining Solutions.

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Achieve excellent edge and surface quality

Machine perfect holes and other features in seconds, thanks to the industry-leading ML-5 ultrafast Laser micromachining platform's combination of part handling, motion control, and real-time positioning feedback. At the same time, achieve ultrahigh surface and edge quality, thanks to this solution's ability to machine a wide range of materials with no tool wear and no heat-affected zone.

Micro-scale machining, big productivity

From the automotive engine components making cars more environmentally friendly to the delicate medical devices that save lives every day and beyond, miniaturized technology has made life better every day for billions of people around the globe. But to hold the tight tolerances required on these complex, micro-scale parts at the speed of serial production, manufacturers need truly innovative solutions that deliver precision, reliability and performance. All of which is available in a scalable, automation-ready package thanks to the ML-5.

The ML-5 serves as a flexible platform for pushing the limits of laser micromachining thanks to its robust machine construction and state-of-the-art laser technology. Low part-to-part variability and the highest surface quality ensure outstanding accuracy. In-machine measurement systems, an advanced human-machine interface and wide-ranging optional features – in addition to industry-leading laser technology – extend its functionality and allow for fast cycle times.

In short, the ML-5 makes optimal micromachining performance accessible for any shop.



Precision from ground up

A rock-solid foundation

You need a quality tool to make quality products. That's why the ML-5 is built from the ground up for the precision and performance small-parts production demands. It starts with a granite base and a cooling system that supports the industry's best motors, rails and encoders. It's finished with the world's most advanced laser machining technology to enable manufacturers to meet the production challenges of tomorrow.



Optimized thermal stability

The granite base construction provides a high degree of thermal and inertial stability thanks to a low thermal expansion coefficient and moving-mass-to-stationary-mass ratio. To further improve reliability and keep part-to-part variability to a minimum, fans, heat exchangers and cooling circuits throughout the machine stabilize temperatures for steady axis motion.

Dynamic performance

The high-resolution HEIDENHAIN glass scale encoder provides ample feedback and super-precise machining. The 10 nm resolution and $\pm 1 \mu\text{m}$ ($\pm 0.00004''$) positional accuracy make it possible for shops to achieve true submicron repeatability for their small-part production.

Best-in-class linear axis accuracy

Mounted directly to the granite base for optimal stability, the linear motors and rails offer over 2G of peak acceleration along each axis of motion – without backlash, cogging or reversal errors. Paired with low-friction design for improved cycle times and performance, the linear axes of the ML-5 make accurate laser machining easy.

High-performance optics

The ML-5 has a high-precision beam delivery system for truly flawless laser drilling, cutting and micromachining application performance. Its fast z-axis movement and precise focus translation is further improved with 5-axis motion that can control laser tapering for the highest surface quality. That means no HAZs, no burrs and no post-processing.

A wide range of operations

On-demand production flexibility

From noncircular drilling to high-precision contouring, the ML-5 can perform a wide range of operations in virtually any materials with competitive cycle times.

Endless application and material possibilities

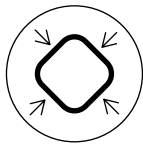
The five-axis scan head and motion platform available on the ML-5 enables revolutionary new point-and-shoot or continuous cutting strategies, all at highly competitive speeds. This, along with fully synchronized part and laser movement, enables extreme flexibility with hole shapes, such as features larger than the scan fields created through spinning lasers in tight circles as though it was an advanced end mill tool path. GF Machining Solutions' scanning system, as well as its easy-to-use HMI, gives operators and engineers all the tools they need to produce the next generation of precision parts.



+GF+

Futuristic technology, better ROI

GF Machining Solutions is committed to helping manufacturers keep total cost of ownership low through superior engineering, and the ML-5 is no exception. The space-saving machine enclosure is ideal for shops that need to make the most out of every square meter, while the inherent advantages of laser technology eliminate the need for most consumables. Easy access to powerful automation completes the package – and allows shops to reach the lowest possible cost per part for virtually any material.



Compact footprint

The ML-5 is just 6.5 m² – perfect for fitting into any shop environment or incorporating into an automated cell.



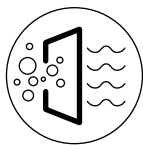
Low Consumables

No need to worry about ordering and replacing tools, just occasional refills for processing gasses, air filters and chiller fluid.



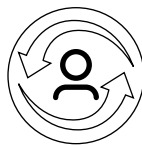
No more tools

Toss out your tool catalogs – with a femtosecond laser as your cutter, your tool geometry is whatever you need that day.



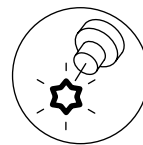
Keeping you clean and comfortable

A powerful debris vacuum maintains negative pressure in the machine and passes all exhaust through an advanced HEPA filtration system.



Made for easy operation

Maximize operator productivity with a comfortable, customizable user interface, extra-large safety window and other ergonomic features.



Prepared for anything

Cut precision parts from any material, whether it's easy-to-machine metals, tough carbides or exotic titanium superalloys.

Unparalleled precision and quality

Fast, reliable and secure production for precise parts

Small precision parts demand the highest degree of machining accuracy and quality. The speed of modern industry requires extraordinary agility and flexibility – and to keep up with the competition, production must be more reliable than ever. The ML-5 puts all of this within reach for any shop, along with the cutting-edge technology that will help manufacturers transform their capabilities and create the innovative parts of the future.

Precision from the ground up

You need a quality tool to make quality products. The ML-5 uses its robust granite structure as a platform for motors, encoders and cooling systems that provide stable, repeatable machining performance.

Lowest cost of ownership

Featuring an automation-ready, space-saving design that requires less consumables, the ML-5 is a truly cost-effective solution that can easily be integrated into any shop's manufacturing system.

Flexible control and exceptional quality

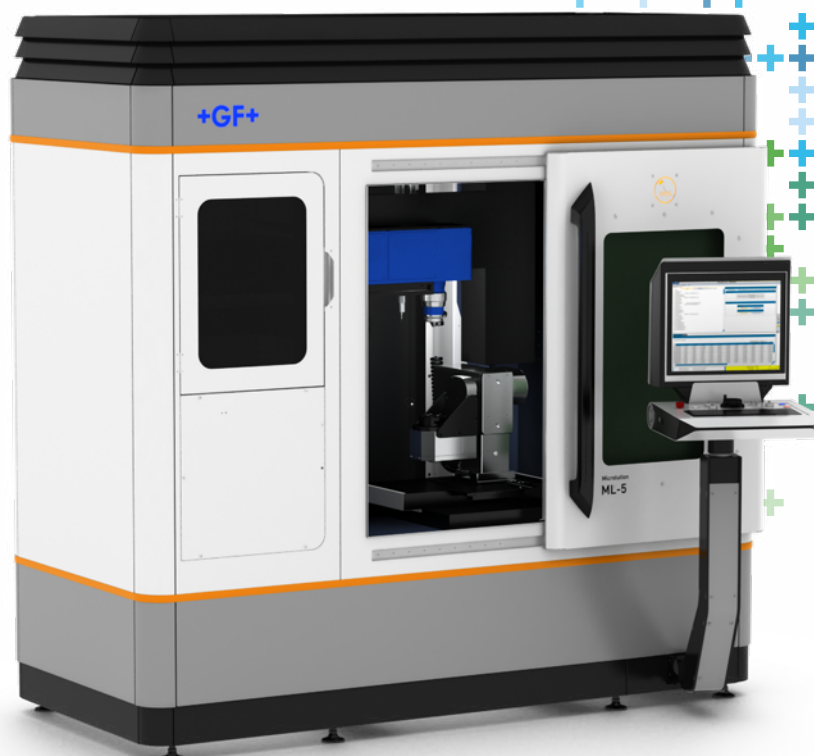
Ultrashort-pulse femtosecond laser technology and 5-axis scanning, as well as best-in-class accuracy and micron repeatability, give the ML-5 incredible part-processing versatility.

Expanded machine capabilities

From noncircular drilling to high-precision contouring, the ML-5 can perform a wide range of operations in virtually any materials with competitive cycle times.

Turnkey solution

In-machine touch probes, automated back doors and an advanced vision system, along with a comprehensive set of compatible automation options, make it simple to integrate the ML-5 into any production environment.



Push the limits of what's possible

Unlock new possibilities with GF Machining Solutions' ultrashort-pulse femtosecond laser technology.



Experience the 5-axis femtosecond difference

When combined with its 5-axis scanning solution, manufacturers can leverage advanced micromachining capabilities that can produce negative tapered holes and slots, drill arbitrarily shaped through-holes and contour with even smaller inside radii. With the click of a button, shops can easily achieve near-perfect machining quality, even for complex geometric features that were all but impossible to cut only a few years ago.

Keep parts cool

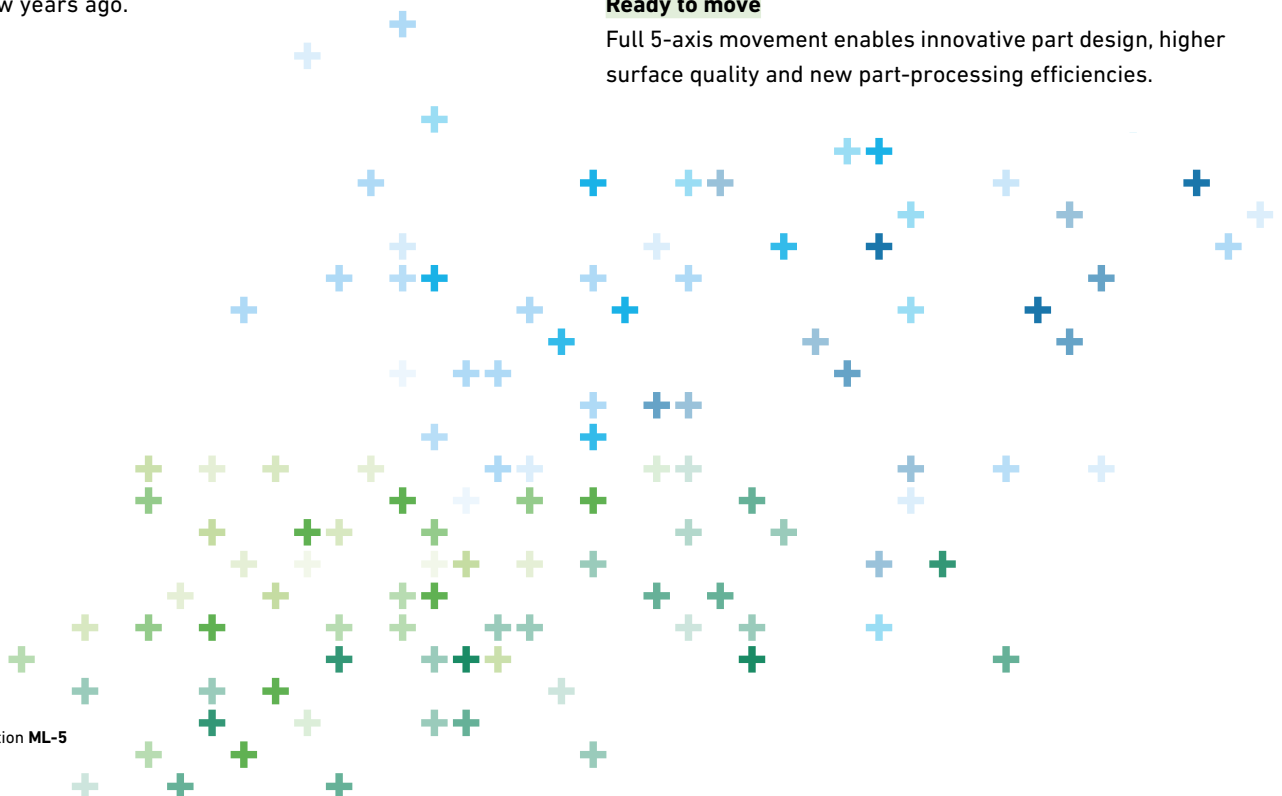
The ultra-short pulse of femtosecond technology allows for removing material without any thermal damage, fast.

Fully equipped

The integrated laser head unit includes multi-axis motion control, real-time measurement and part validation functionalities.

Ready to move

Full 5-axis movement enables innovative part design, higher surface quality and new part-processing efficiencies.

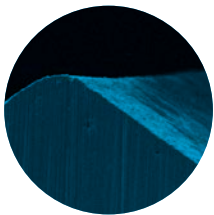


With a “program it and forget it” approach guaranteed by the ML-5’s perfect repeatability, any operator can get exceptional results. Greater versatility makes it easier to reduce consumables costs, and for appropriate applications, the material removal rate is fast enough for significantly lower cycle times.



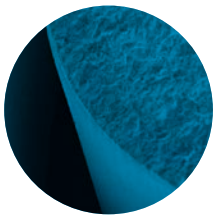
Drilling

Bring new designs to market. Achieve noncircular and negative tapers, cut holes with up to 10:1 aspect ratios, and make shapes ranging from squares and ovals to slots and curved slots.



Contouring

The ML-5 is the perfect tool for high-quality, high-precision contouring through advanced kinematics and a powerful, accessible HMI.

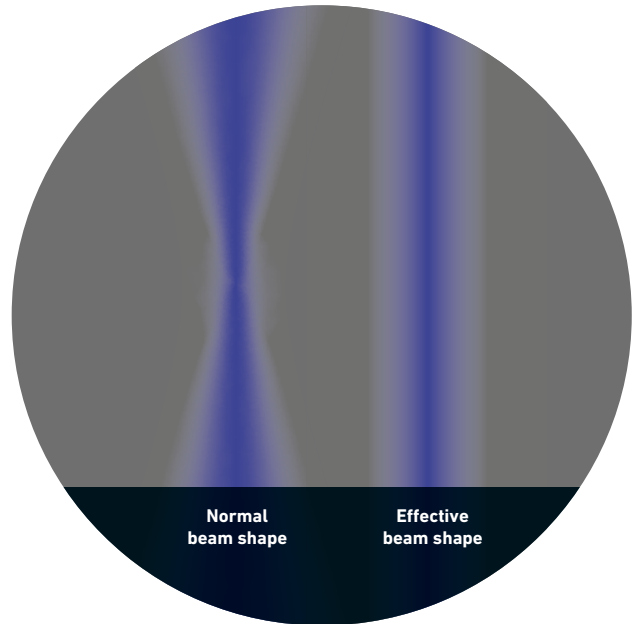


Finishing

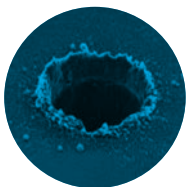
There’s no need for post-processing when most parts come out of the ML-5 with perfect sidewall surfaces and sharp edges.

Microlution know-how at your fingertips

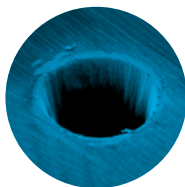
The advanced 5D scanning capabilities of the ML-5 make it possible to adjust the beam’s angle of attack, preventing the positive-taper shape to something more akin to an EDM machine’s straight wire. This technique, developed by the laser machining experts at Microlution, makes 5D femtosecond laser machining competitive with many fine-wire EDM applications.



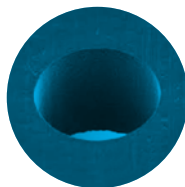
Laser performance compared



Nanosecond
HAZ
(Heat Affected Zone)
Melt zone adds variability



Picosecond
Less HAZ
Rough surface adds variability



Femtosecond
No HAZ
Low variability

5-axis scan head process capabilities

Typical material thickness	0.01–3 mm
Hole diameters	25–700 μm
Negative taper full angle	7°
Hole diameter accuracy	±1 μm
Hole position	<1 μm

Other laser and scanning solutions are available with varying parameters and cycle times. Contact your GF Machining Solutions representative to find the ML-5 model that is right for your needs.

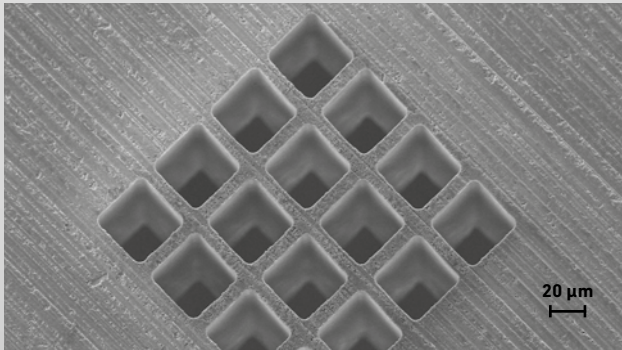
* The 15° full angle is the scanhead capability to tilt the beam. However, we can’t drill tapers as large.

Market segments and applications

Ultraprecise parts for unique applications

Unique solution for square holes

Drilling a square hole isn't simple to accomplish with conventional tools, but for a femtosecond laser? Creative new approaches to part production become possible – and unsurpassed productivity improvements become easy to achieve, as with the fast production of these complex probe cards.



Probe card

Performance Results

Market segment	ICT
Material	Silicone nitride
Laser (Type/Power)	Femto GR 16 W
Hole size	35 x 35 µm
Corner radius	3.5 µm
Wall thickness	6.5 µm
Cycle time	<2 sec/hole

Cutting process consistency

Each of the gear teeth on this ultra-precise watch gear is just 77 µm wide, with an overall cut-out radius of 2.01 mm. The straight-wall sides are critical to watch performance. And the ML-5 can produce these parts at the rate required for high-volume production, especially when paired with System 3R tooling.



Performance Results

Market segment	Watchmaking
Material	Steel
Laser (Type/Power)	Femto IR 40 W
Surface accuracy	± 2 µm
Surface roughness	Ra <0.2 µm

Clean, reliable machining processes

Lasers aren't carbide inserts, solid drills or EDM wire. They can drill and cut with equal ease – and without heat-affected zones (HAZ) or material-processing contaminants – up to three times faster than conventional processes, making them ideal for challenging medical applications.

Performance Results

Market segment	Medical
Material	Stainless steel
Laser (Type/Power)	Femto IR 40 W
Small tube:	
Small hole diameter	0.203 mm
Large hole diameter	0.305 mm
Wall thickness	0.152 mm
Large tube:	
Hole diameter	0.381 mm
Slot size	1.27 x 0.508 mm
Wall thickness	0.203 mm



Hole diameter:
0.305 mm

Medical micro tube

Production-optimizing precision

These fuel-injector nozzles need five incredibly precise spray holes with a surface roughness below 0.25 µm for the best performance. With five-axis movement and a femtosecond laser, the ML-5 can drill each hole with the required surface finish in less than two seconds.

Performance Results

Market segment	Automotive
Material	Stainless steel
Laser (Type/Power)	Femto IR 40 W
Hole diameter	0.203 mm
Hole length	0.305 mm
Taper	-3°
Machine time (per hole)	1.5 seconds



Hole diameter:
0.203 mm

Fuel injection nozzle

Automation

Designed with automation in mind



Measurement at every step of the process

Real-time, high-precision feedback throughout the machining process helps operators ensure part uniformity and optimize cycle times inside the machine. Validation can also take place during, before and after processing parts for total process security, including visual confirmation of geometric references to compensate for previous operations.

System 3R tooling solutions

The interchangeable System 3R tooling system uses hardened, precision-cast pallets and optimized pneumatic chucks to give operators the flexibility of setting up parts while others are being machined for higher productivity, faster part handling and accurate positioning.

Automated inside and outside for the highest productivity

Every GF Machining Solutions product comes ready for automation, and the ML-5 is no different. Whether it's automation designed for a single family of parts or a full production cell on the shop floor, this machine is ready for production – and easier to integrate with other equipment and automation than ever before. Even on its own, the ML-5 includes a complete range of features and options that make it easy to add simple automation for simplified, more reliable processes.

Technical specifications

ML-5

Machine

Machine dimensions *	mm (in)	2,010 x 2,450 x 2,720 (79.1 x 96.5 x 107.2)
Machine weight	kg (lbs)	2,730 (6,019)
Yb: KGW (Diode-pumped)	W	40 / 80
Accessory cabinet dimensions *	mm (in)	1,000 x 1,200 x 1,580 (39.5 x 47.1 x 62.2)

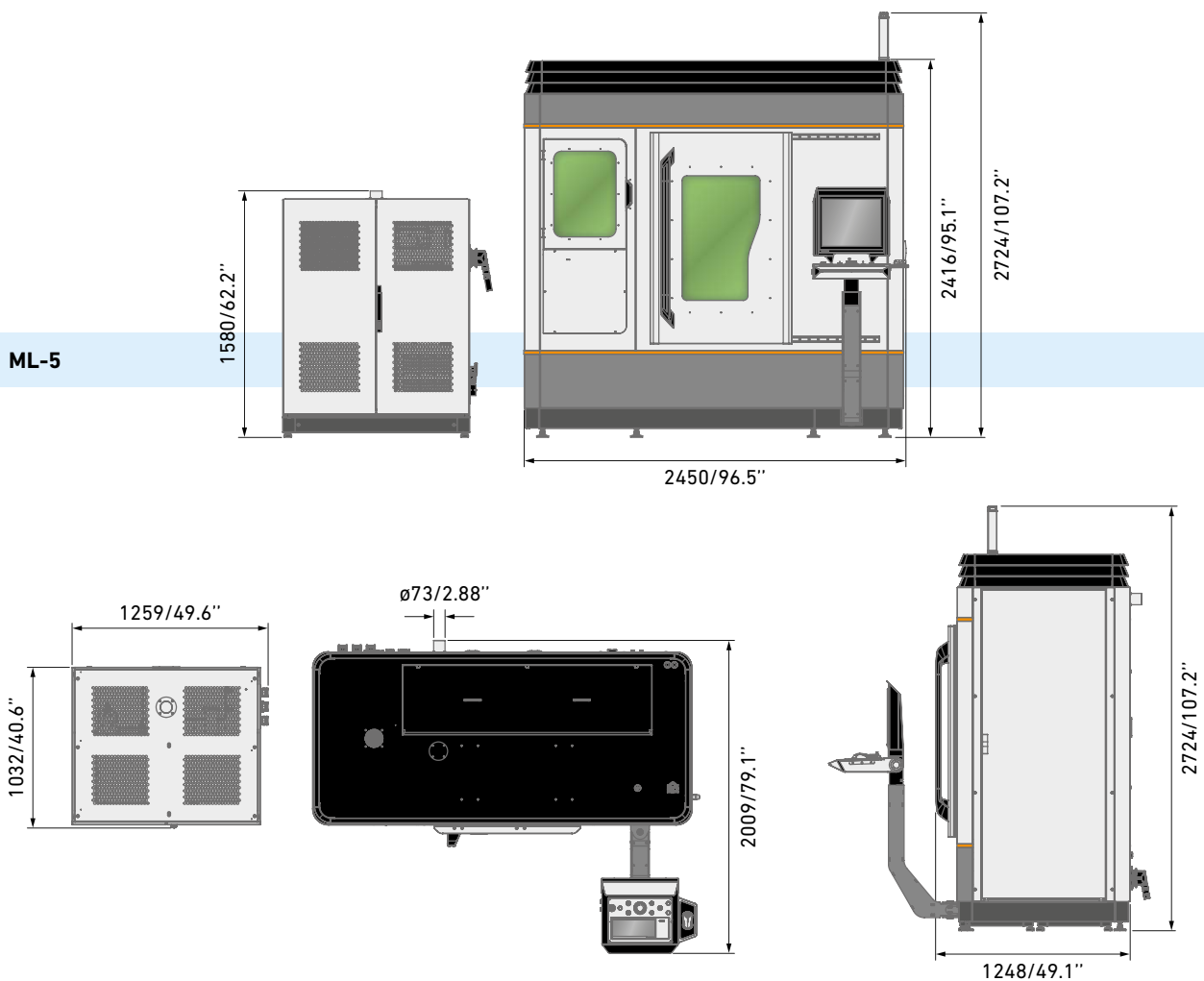
Electrical and Pneumatic supply

Nominal power	kVA	7.2
Air pressure	bar (MPa)	7 (0.68)
Required air output flow	l/min (gal/min)	280 (74.8)

Axes

X, Y, Z travels (3-axis)	mm (in)	280 x 350 x 260 (11.02 x 13.78 x 10.24)
X, Y, Z travels (5-axis)	mm (in)	120 x 350 x 260 (4.72 x 13.78 x 10.24)
A (tilt) travel	°	+95 to -125
C (rotary) travel	°	360 (continuous)

* Width x length x height



Our Service + Success range

We take you to new heights

Guiding your ascent

Whether it is Milling, EDM, Laser Texturing or Additive Manufacturing, our Service + Success experts guide you throughout the entire lifecycle of our Machining and Automation tools in order to help you reach your peak performance. Our trusted experts backed by our latest cutting-edge, intelligent Digital Solutions, provide a **full range of services**.



Operational steering
Hands-on and operational service interventions with supply of consumables and wear parts



Advanced diagnosis
Machine check-up, preventive maintenance and advanced services including original spare parts availability in all our hubs around the world



Certification
State-of-the-art reference by industry sector and on machining equipment



Upgrades
Designed to add value to the original machine investment in order to achieve higher sustainable productivity



Training
Performance oriented academy with a human-centric approach of knowledge transfer in order to realize the full potential of our solutions



Transformation
Strategic partnership from made-to-measure advice on business model evolution to industrial implementation



Financial solutions
For the optimization of operating costs featuring minimal initial expenditure programs and leasing options

Our Success Packs

As a long-time partner, since 1802 we have been serving various industrial segments and have been dedicated to providing you with a first-in-class combination of services.

We have conceived our new Success Packs range for maximizing **your return on investment**, empowering you in your quest for success whatever your industrial profile.



Silver +
Secure
your future



Silver
Set the foundation
for growth



Bronze +
Achieve flawless
production



Bronze
Get back on
track fast



About GF Machining Solutions

Multi-technology solutions provider

Our commitment to you and your specific applications is proven by the value-adding intelligence, productivity and quality delivered by our multi-technology solutions. Your success is our chief motivator. That's why we are continuously advancing our legendary technical expertise. Wherever you are, whatever your market segment and whatever the size of your operation, we have the complete solutions and the customer-centric commitment to accelerate your success—today.

EDM (Electrical Discharge Machining)



Wire-cutting EDM

GF Machining Solutions' wire-cutting EDM is fast, precise and increasingly energy efficient. From ultraprecise machining of miniaturized components down to 0.02 mm to powerful solutions for demanding high-speed machining with respect to surface accuracy, our wire-cutting EDM solutions position you for success.

Die-sinking EDM

GF Machining Solutions is revolutionizing die-sinking EDM with features like iGAP technology to dramatically boost machining speed and reduce electrode wear. All of our die-sinking systems offer fast removal and deliver mirror finishes of Ra 0.1 µm (4 µin).

Hole-drilling EDM

GF Machining Solutions' robust hole-drilling EDM solutions enable you to drill holes in electrically conductive materials at a very high speed—and, with a five-axis configuration, at any angle on a workpiece with an inclined surface.

Tooling and Automation



Tooling

Our customers experience complete autonomy while maintaining extreme accuracy, thanks to our highly accurate System 3R reference systems for holding and positioning electrodes and work pieces. All types of machines can easily be linked, which reduces set-up times and enables a seamless transfer of workpieces between different operations.

Automation

Together with System 3R, we also provide scalable and cost-effective Automation solutions for simple, single machine cells or complex, multi-process cells, tailored to your needs.

Milling



Milling

Precision tool and mold manufacturers enjoy a competitive edge with our Mikron MILL S solutions' fast and precise machining. The Mikron MILL P machines achieve above-average productivity thanks to their high performance and Automation. Customers seeking fastest return on investment benefit from the affordable efficiency of our MILL E solutions.

High-performance Airfoil Machining

Our Liechti turnkey solutions enable the highly dynamic manufacturing of precision airfoils. Thanks to the unique performance and our expertise in airfoil machining, you increase productivity by producing at the lowest cost per part.

Spindles

As part of GF Machining Solutions, Step-Tec is engaged in the very first stage of each machining center development project. Compact design combined with excellent thermal and geometric repeatability ensure the perfect integration of this core component into the machine tool.

Software



Digitalization solutions

To drive its digital transformation, GF Machining Solutions acquired symmedia GmbH, a company specialized in software for machine connectivity. Together, we offer a complete range of Industry 4.0 solutions across all industries. The future requires the ability to adapt quickly to continual digital processes. Our intelligent manufacturing offers embedded expertise, optimized production processes, and workshop Automation: solutions for smart and connected machines.

Advanced manufacturing



Laser texturing

Aesthetic and functional texturing is easy and infinitely repeatable with our digitized Laser technology. Even complex 3D geometries, including precision parts, are textured, engraved, microstructured, marked and labeled.

Laser micromachining

GF Machining Solutions offers the industry's most complete line of Laser micromachining platforms optimized for small, high-precision features to meet the increasing need for smaller, smarter parts to support today's leading-edge products.

Laser Additive Manufacturing (AM)

GF Machining Solutions and 3D Systems, a leading global provider of additive manufacturing solutions and the pioneer of 3D printing, have partnered to introduce new metal 3D printing solutions that enable manufacturers to produce complex metal parts more efficiently.

Customer Services



Worldwide for you

Ensuring the best performance throughout the lifetime of our customers' equipment is the goal of our three levels of support. Operations Support offers the complete range of original wear parts and certified consumables. Machine Support includes spare parts, technical support, and a range of preventive services to maximize machine uptime. Business Support offers customer-specific business solutions.



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At a glance

We enable our customers to run their businesses efficiently and effectively by offering innovative Milling, EDM, Laser, Additive Manufacturing, Spindle, Tooling and Automation solutions. A comprehensive package of Customer Services completes our proposition.

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