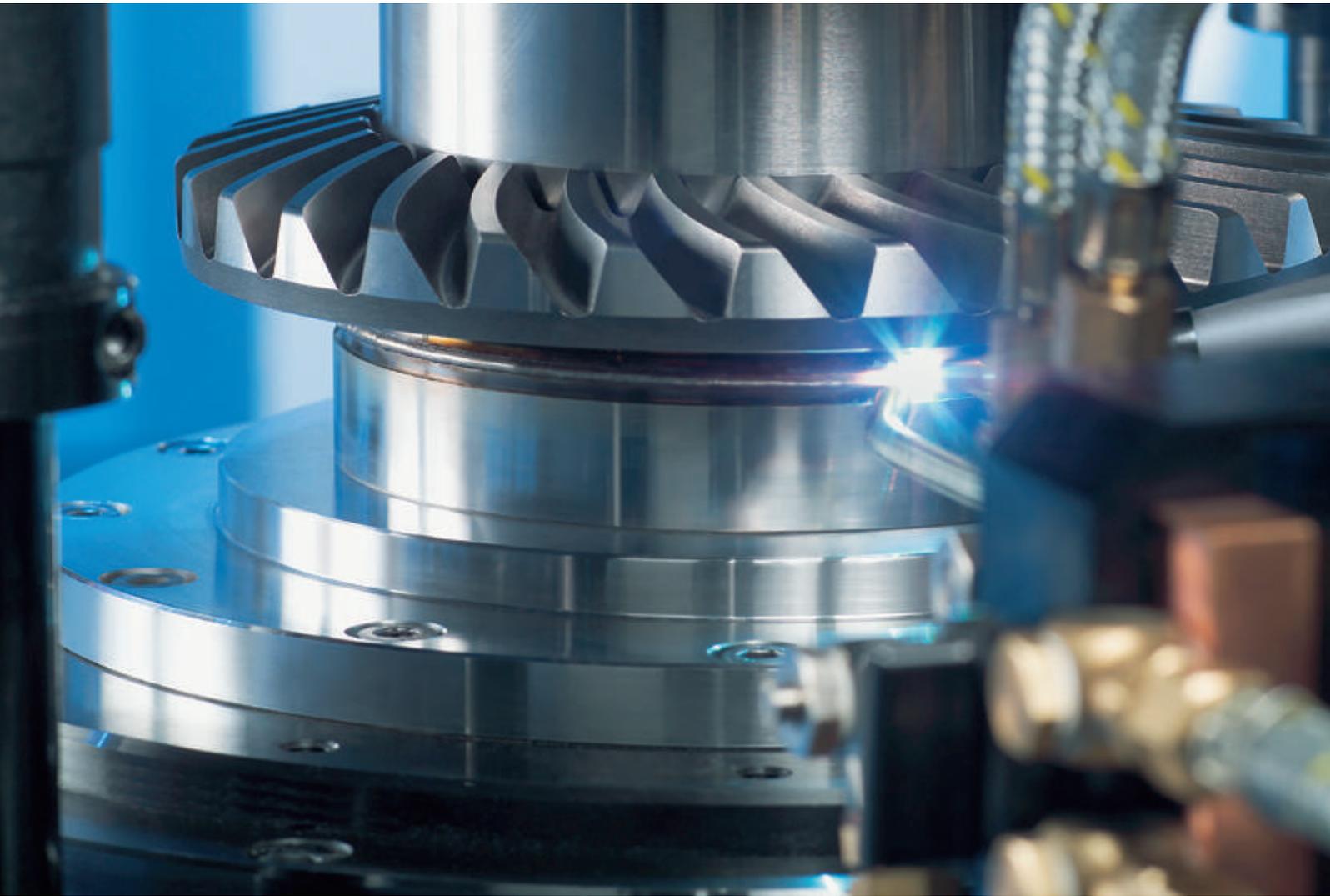


EMAG ELC LASER WELDING SYSTEMS



MANUFACTURING DEVELOPMENT

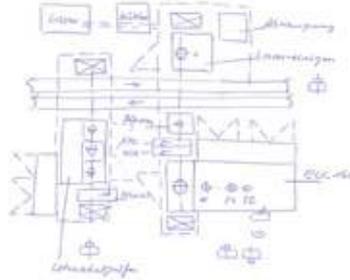
Laser welding is key in the flexible production of weight-optimized vehicle components necessary for the production of energy-efficient vehicles.

Outstanding technology and the relevant expertise in process development to match are essential for the use of laser welding in the production process.

1

IDEA

If you are considering implementing laser processes, our team of experienced experts is here to help you identify potential and develop a plan.



2

PROCESS DEVELOPMENT

At our laser technology centers, we develop production and testing processes, support design enhancements, create functional models/prototypes and can even start production for you.



3

CONCEPT

We design your custom manufacturing solution based on your individual requirements and necessary specifications (i.e. automation, workpiece quantities, machine layout) using time-tested concepts and techniques.





LIFE CYCLE

5



The EMAG service organization ensures the availability of your manufacturing system and ServicePlus provides any necessary support.

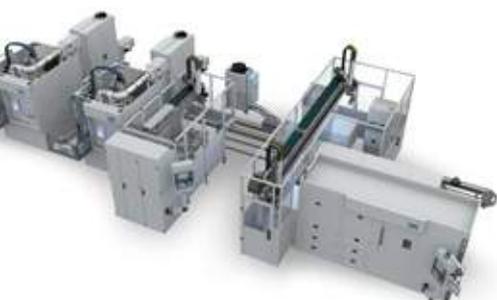


PROJECT MANAGEMENT

4



Using the latest project management and engineering techniques, as well as the extensive resources available at the EMAG Group, we'll keep your project on schedule with short lead times.



PRECISION AND PRODUCTIVITY – THE MEASURE C

Manufacturing processes for the gears in double clutch gearbox include washing, joining, preheating, laser welding, brushing, ultrasonic inspection, and destacking.

THE ADVANTAGE:

- + EMAG machine tools
- + EMAG special clamping devices
- + EMAG Automation
- + EMAG technology/process

= EMAG manufacturing system



1 PRECISION

The high precision of the basic machine, components used and clamping equipment guarantee accurate and consistent results.

2 MINIMIZE RETOOLING TIMES

The ELC laser welding systems minimize the amount of specialized components necessary, allowing for very short retooling times.

3 COMPACT DESIGN

All EMAG ELC laser welding systems are compact and comprehensive: the machine, laser source, beam guide, cooling unit, control cabinet and supply equipment are mounted on the same self-supporting base frame.

OF ALL THINGS



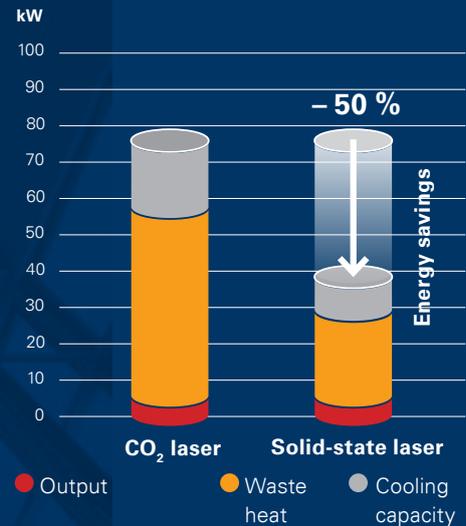
4 ENVIRONMENTALLY FRIENDLY AND ENERGY-EFFICIENT

The use of the latest solid-state lasers with their unmatched energy efficiency ensures low consumption values. The fixed process optic or welding optic means that the welding fumes can be extracted at a specific point, ensuring a precision operation.

5 PRODUCTIVITY

Short idle times, multi-station operation, improved automation solutions and high availability levels make it easy to improve productivity.

Compared to a CO₂ laser, the solid-state laser delivers the same optical output at considerably lower energy costs.



PERFECT CONNECTION

Precision mechanical engineering and the latest laser technology ensure maximum, uniform quality.



THE LATEST INSPECTION EQUIPMENT

The workpieces are checked ultrasonically after each operation to ensure complete process control.

HIGHLY PRODUCTIVE LASER WELDING SYSTEMS

Precise laser beam control enables high welding speeds and minimizes welding distortion. This allows for individual parts to be produced at a low cost and then welded.

Design features such as stationary beam control, the use of sophisticated platforms and modules, state-of-the-art laser technology, proven process equipment and finally the complete range of EMAG expertise in the development and construction of efficient, high-quality manufacturing systems form the basis of every ELC laser welding system.



ELC 160

Universal Solution for Powertrain Components

The ELC 160 is a very versatile machining platform, perfect for a wide range of production processes. This system can be used as both a single-slide machine or in its two-slide version for special applications. With the “moving workpiece - fixed beam” EMAG concept, the ELC 160 maximizes performance and operational safety. With its advancements in safety and productivity, the ELC 160 appeals to a number of different manufacturers and is used to produce powertrain components around the world.

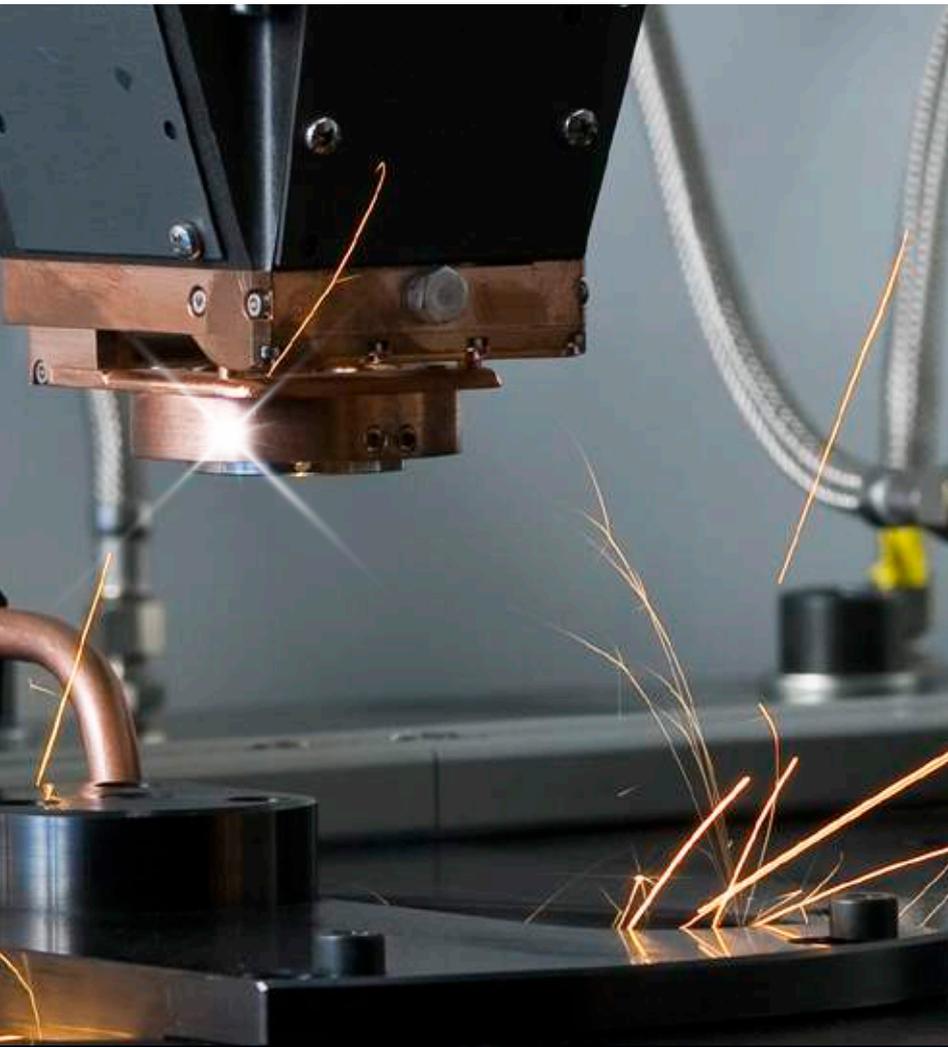


ELC 160 HP

High Performance for Welding of Output

Four processes performed simultaneously – increase machine performance. The automatically retooling ELC 160 HP can flexibly produce all ratchets in a gearbox without stopping production. All suboperations including the





- + Leading global technology company for production systems.
- + Provides customers with a unique portfolio of production systems for powertrain components.
- + EMAG ELC laser welding systems are used all over the world by OEMs, tier 1 and tier 2 companies.
- + Designed for series production and deliver outstanding precision, productivity and availability.
- + Customized automation solutions, clamping technology, manufacturing processes, quality assurance systems and support available.
- + Global sales and service network providing support to customers around the world.

ut Gears

loading/unloading of workpieces, joining, preheating for welding and laser welding can be performed using this machine. These subprocesses run concurrently to minimize cycle times.



ELC 250 DUO

Laser Welding System for Differentials

The ELC 250 DUO has become known to many customers as the industry standard for demanding welding processes. The two machining stations allow for the complete machining of parts requiring multiple processes, i.e. laser cleaning, joining, and welding, and the productive twin-spindle operation doubles production by time-sharing.



ELC 160 – MAXIMUM FLEXIBILITY – FROM A SINGLE

The ELC 160 is a modular system that can be configured to fit a wide range of production processes.

The three-axis NC machining module is the heart of the system, and the stationary process modules are mounted to the base.

Parts are loaded into the spindle and then moved to the individual stations where stationary components machine the workpiece.

The ELC 160 is also available as a DUO version if the part output is required. In the DUO format the stations can be operated independently so different parts can be produced at the same time.



FROM SINGLE PART TO SERIES PRODUCTION



TECHNOLOGICAL FLEXIBILITY

The ELC 160 can be equipped with all the various laser technologies. Whether it is CO₂ lasers or solid-state systems (fiber, discs) – anything is possible.

MANUALLY OR AUTOMATICALLY LOADED

The ELC 160 was designed for either manual or automatic loading (using gantry loader or industrial robots) which allows you to customize based on your production concept.

AUTOMATIC RETOOLING INCLUDED

The ELC 160 can be fitted with multiple joining stations and welding units, or counter bearings. The retooling process is NC-controlled which means that different part families can be produced without manual retooling. This leads to major cost reductions and eliminates destructive component testing.

EXPANSION STAGES/ ADDITIONAL FUNCTIONS

- + Joining/Pressing of single components
- + Induction preheating/postheating
- + Brushing the weld seam
- + Laser marking
- + Workpiece measurement

ELC 160 HP – HIGH PERFORMANCE FOR WELDING

The ELC 160 HP integrates joining, preheating for welding, if necessary, and laser beam welding in a single, compact machine structure.

The HP in the name stands for “High Performance” and to earn this title the machine includes a number of performance enhancing features. For example, the machines sub-processes run simultaneously to minimize cycle times and productivity is increased because the machine is a rotary indexing machine.

Automatic retooling for the workpiece clamping technology is performed using a method patented by EMAG, allowing the ELC 160 HP to manufacture different workpieces with batch sizes as small as one.

LASER WELDING

Clamping and fixing technology can be automatically retooled for different workpiece geometries in time with the machining cycle.



The ELC 160 HP was designed specifically for the joining and welding of wheels and clutch bodies.



**CYCLE TIME:
10 SECONDS /
RATCHET**

GEARS



LOADING

The machining process starts at the loading/unloading station where there are two pick-and-place units available. Fitted with pneumatic grippers, these pick-and-place units are responsible for transporting parts between the conveyor belt and index table.



JOINING STATION

The joining station can be fitted with up to three different joining punches. These can be selected by NC commands and retooled with no loss of time.



INDUCTION PREHEATING

A slide unit with up to two inductors can be used for induction preheating. Automatic retooling is also available.



ELC 250 DUO – THE MULTI-FUNCTIONAL LASER W

The ELC 250 DUO can machine two different workpieces or perform follow-up machining (i.e. laser cleaning/joining/welding/brushing/inspection), simultaneously, in its two independent machining stations.

This process allows for increased technological flexibility and productivity.

Designed with the EMAG pick-up principle in place, the spindle will load and position workpieces itself, as well as assisting in set-up for other required process modules.

The stationary optic principal allows for the integration of all other laser technologies. Therefore, the ELC 250 DUO can be fitted with both modern solid-state lasers (fiber, disc) and CO₂ lasers. A variety of options are available.

STATIONARY BEAM CONTROL



Pivot-mounted spindles allow for both axial and radial welding processes



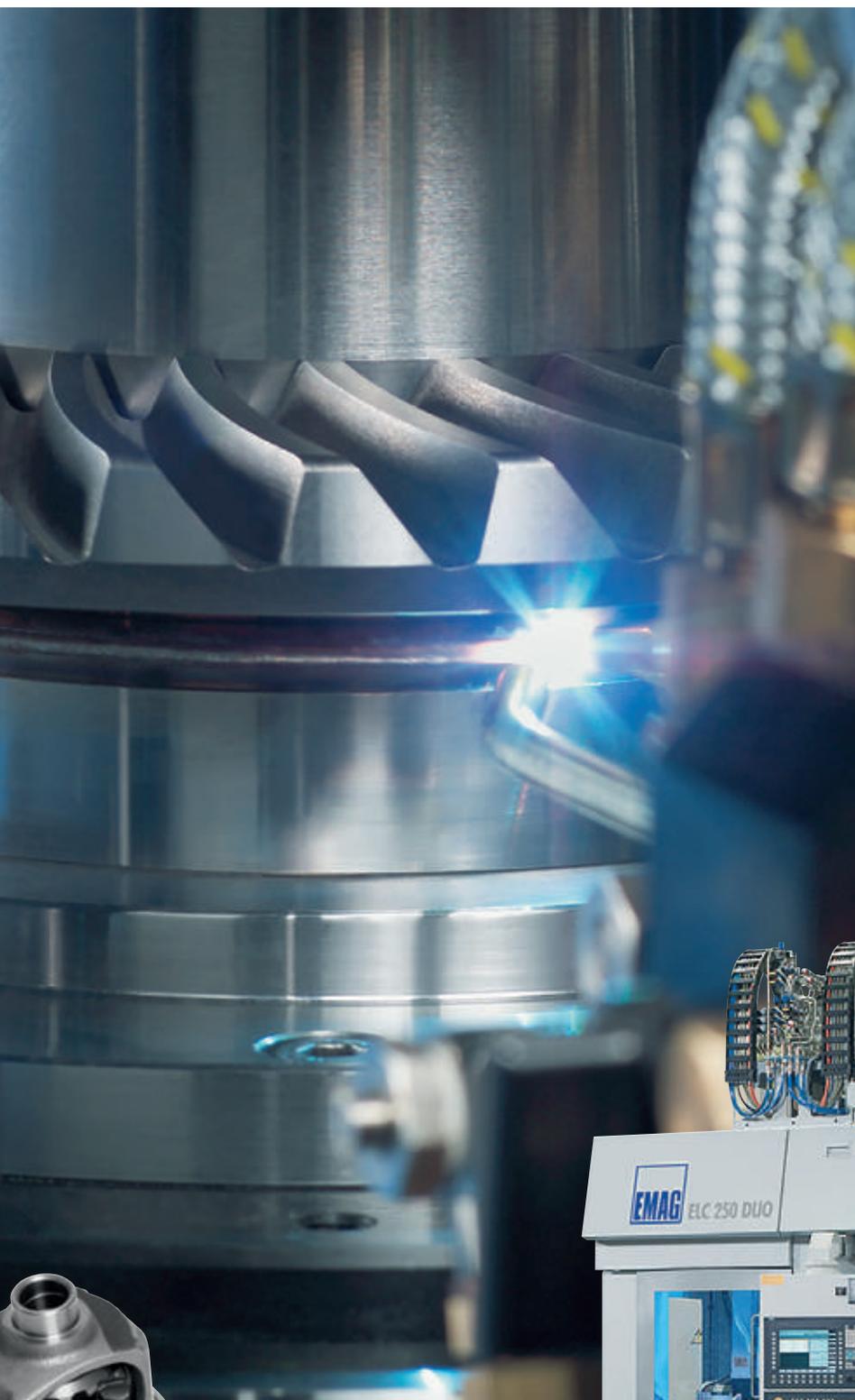
Pick-up position



Welding position



WELDING MACHINE



- + Sensors can be easily included to observe and monitor the process.
- + The compact design of the integrated energy-container and cooling system ensures the laser system takes up minimal floor space within the production line.



DUO MEANS FLEXIBILITY:

Identical operations or completely different parts can be welded independently on the two spindles.



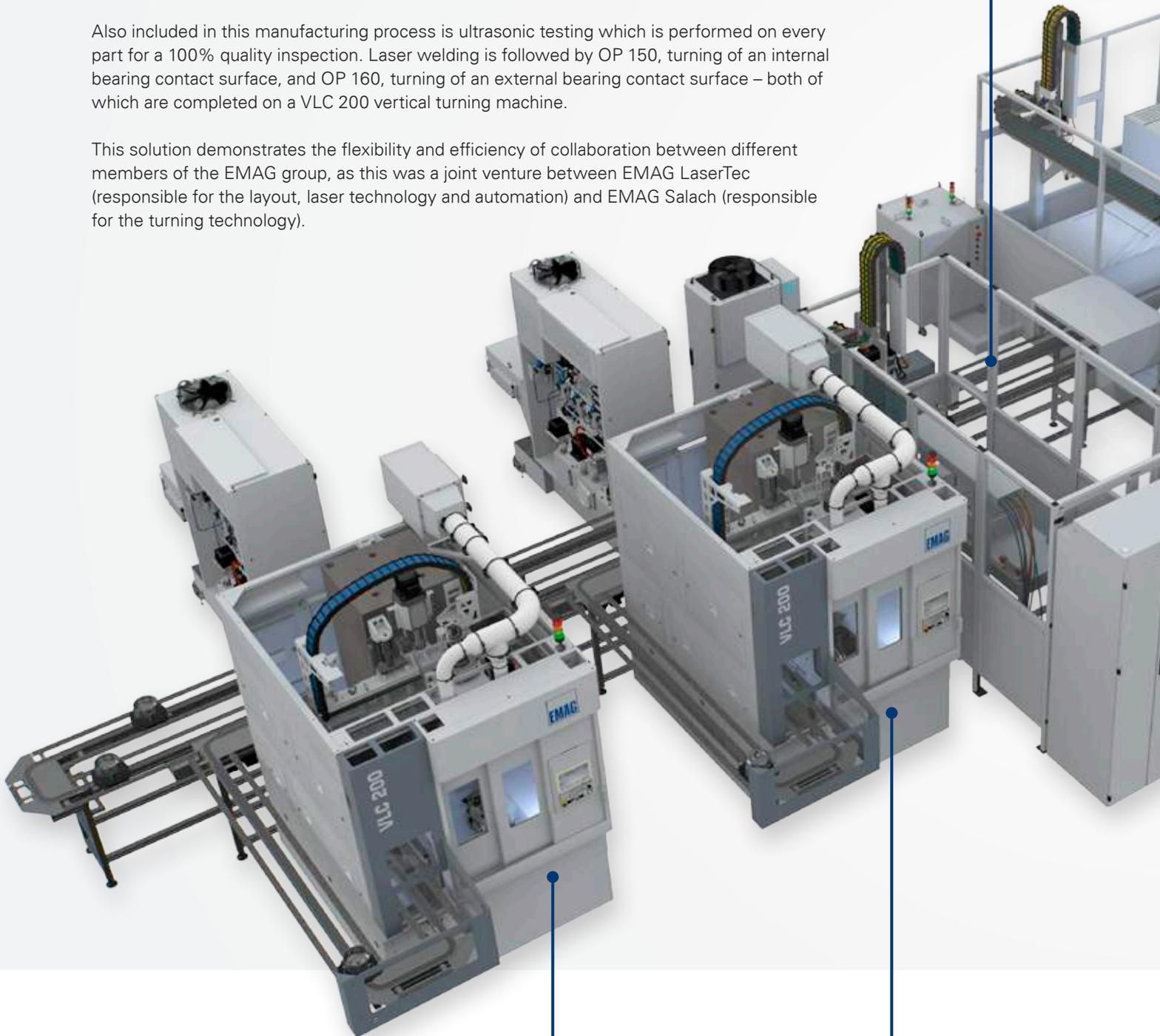
THE COMPLETE PROCESS FROM A SINGLE SOURCE

With the EMAG Groups multi-technology capabilities, we're able to create a complete, turn-key solution all in house. This example outlines a manufacturing system created for the production of sun gears and demonstrates the smart combination of a variety of EMAG companies, machines and technologies. Machining starts at OP 140 – this includes a complex combination of a laser cleaning system, which cleans welded parts surfaces with a laser beam, automation and the ELC 160 laser welding machine.

Also included in this manufacturing process is ultrasonic testing which is performed on every part for a 100% quality inspection. Laser welding is followed by OP 150, turning of an internal bearing contact surface, and OP 160, turning of an external bearing contact surface – both of which are completed on a VLC 200 vertical turning machine.

This solution demonstrates the flexibility and efficiency of collaboration between different members of the EMAG group, as this was a joint venture between EMAG LaserTec (responsible for the layout, laser technology and automation) and EMAG Salach (responsible for the turning technology).

OP 140/2
Ultrasonic inspection



OP 160
External turning

OP 150
Internal turning

OP 140/1

Laser cleaning, joining
and laser welding



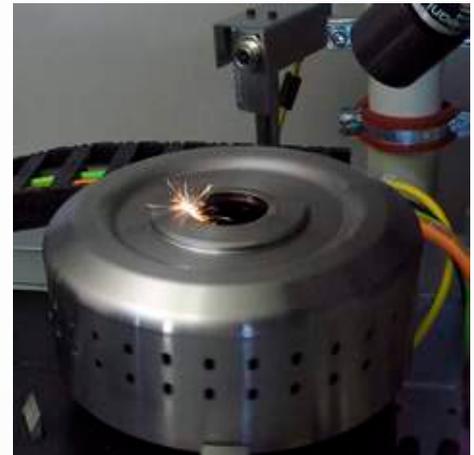
MANUFACTURING SYSTEM FOR SUN GEARS

The line features short distances, perfectly combined processes and outstanding machining resulting in high component quality.

+ **Machines:** ELC 160, 2 x VLC 200

+ **Cycle time:** 45 seconds

LASER CLEANING AS AN ALTERNATIVE TO WASHING



BENEFITS

- + Energy-efficient: lower energy consumption than conventional washing machines
- + Reliable: no additional contamination from cleaning product residues, practically zero maintenance
- + Fast: no lengthy idle times since laser cleaning can be fully integrated in the laser systems
- + Quality: all typical organic residues are removed
- + Very cost-efficient



ULTRASOUND INSPECTION EQUIPMENT

EMAG can supply you with ultrasonic inspection systems for the 100% inspection of welded workpieces, either as part of your ELC, or as a stand-alone system. Based on your preferences, these systems can be partially or fully automated. Majority of the system (testing station, testing device, water supply, component drying, automation and control technology) is developed and manufactured in-house and for the ultrasonic inspection equipment, we use only the leading manufacturers.



An ultrasonic pulse passes through the workpiece using ultrasound to measure. Variations from the known speed of sound for the particular material allows you to draw conclusions about flaws in the material such as cracks or inclusion.

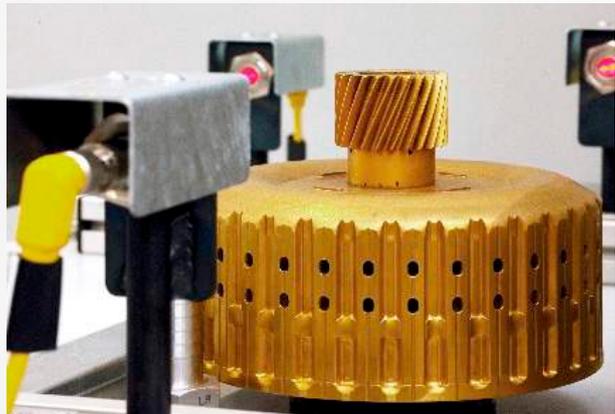
EMAG ultrasonic test software provides interfaces to all conventional OEM quality assurance systems. This guarantees perfect integration into existing software architectures.

Measurement	Value	Unit
Measurement	0.0000	mm

**100%
COMPONENT
TESTING**



For sound transmission testing using bubbler technology, the test probe is positioned a few millimeters away from the specimen. Flowing water forms a bridge between the test probe and the specimen, and is used as the transport medium for the ultrasonic waves.



Calibration is required to adjust the ultrasonic signal correctly and display the detection limit. EMAG ultrasound inspection equipment is calibrated using defined reflectors, or artificial errors, in other words artificial errors in a reference workpiece.

EMAG SPECIAL CLAMPING EQUIPMENT

Precise workpiece clamping is essential to obtain accurate results. This is true today more than ever as it is the only way to use the benefits of laser technology in a production environment. Our clamping equipment specialists have many years of expertise in the development and production of special clamping devices. All our clamping devices and equipment for ELC laser welding systems are developed and manufactured in-house. This means that we can satisfy specific welding requirements perfectly.



EMAG LaserTec develops and manufactures special clamping devices and equipment for EMAG Group machine tools. This means that EMAG can provide everything you need for maximum productivity, precision and process reliability from a single source.



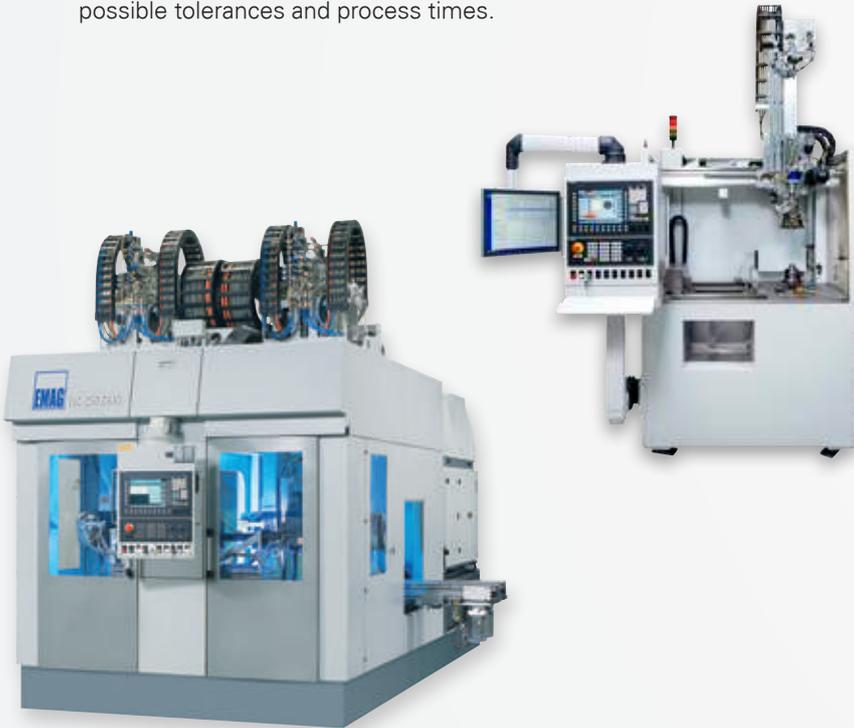
EMAG LASER SYSTEMS APPLICATION LABORATORY

Our application laboratory offers you:

- + Feasibility studies
- + Treatment tests
- + Welding process developments and component optimization
- + Prototype and mini-series production

Efficient laser welding systems, a well equipped metallographic laboratory, ultrasonic and microhardness testing stands, a measuring room and – last but not least – qualified and highly experienced staff are always at your disposal.

The use of ELC laser welding systems and standard clamping and processing equipment in the prototype phase means that you receive reliable information about the quality of welds, possible tolerances and process times.

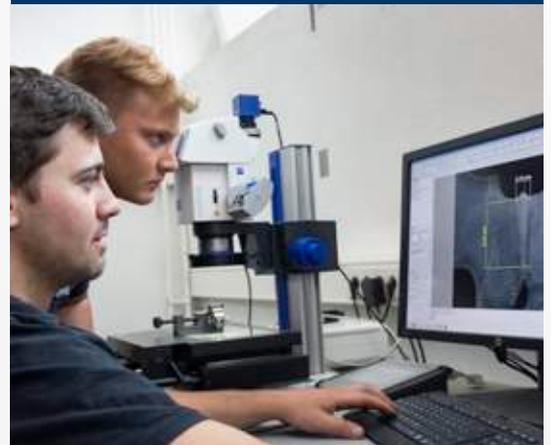


THIS PROCESS INCLUDES:

1. Component and process development
2. Prototyping
3. Small batch series production

LABORATORY EQUIPMENT

- + Laser welding (CO₂, disc and fiber laser)
- + Laser hardening
- + Ultrasound crack inspection
- + Cross-section inspection through polished sections
- + Video microscope
- + Micro hardness tester
- + Surface test
- + Thermal camera
- + Measurement room



GLOBAL EMAG SERVICE

EMAG ServicePlus offers you a variety of individually modifiable services, customized to suit your specific requirements – from training to preventative maintenance, and retrofits to service parts.

In order to provide the best options for our customers, we use state-of-the-art technology and continuously optimize our ServicePlus organization. For instance, we meticulously analyze all of our service calls, record important information provided and highlight their solution, then we make these notes available to clients worldwide and continuously improve the relevant software components. We're committed to finding solutions for even the most complicated problems. We guarantee that we will find the right solution for you, thanks to our trained service technicians and our commitment to offering the highest standard of service.

We plan, develop, operate, monitor, test, install, inspect, service and repair. We reduce idle times, boost productivity, prevent wear and ensure that your investment has a long service life. We detect and correct technical deviations at an early stage and notify you promptly when replacement parts are due.



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Subject to technical changes.

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