



news

NO. 32

SCHERER · KOEPFER · RICHARDON · ELDEC · LASERTEC · REINECKER · KARSTENS · KOPP · NAXOS-UNION · WEISS · SU · ECM

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for the whole
life of the car



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production made easy

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machining of shaft ends

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A visit to Mack Rides
GmbH & Co. KG

TECHNOLOGY CONNECTED: DIGITALIZATION AND ELECTROMOBILITY

Visit us at EMO 2021 in Milan!

It's finally happening again! EMO 2021 is the first major industrial trade fair in Europe since the beginning of the pandemic and we look forward to finally having a personal conversation with you, our customers. See our latest developments in booth A32/B17. Even though there were no trade fairs last year, there have been a lot of new developments here in the EMAG Group that we want to present to you live in Milan. At the top of our list are the new digital expansion stages of the VL machines, which are now being delivered IoT-ready (more on the next page).

In addition, speaking of hardware, we now offer exciting innovations with addition of machines from EMAG SU (more on page 8). In short, there are many good reasons to visit us at EMO in Milan. This edition of EMAG News provides a small glimpse, which we hope you enjoy reading. We look forward to welcoming you in Milan.



EDNA IOT-READY EX-WORKS: VERTICAL PICK-UP TURNING MACHINES MAKE IT EASY TO GET STARTED WITH DATA- OPTIMIZED PRODUCTION

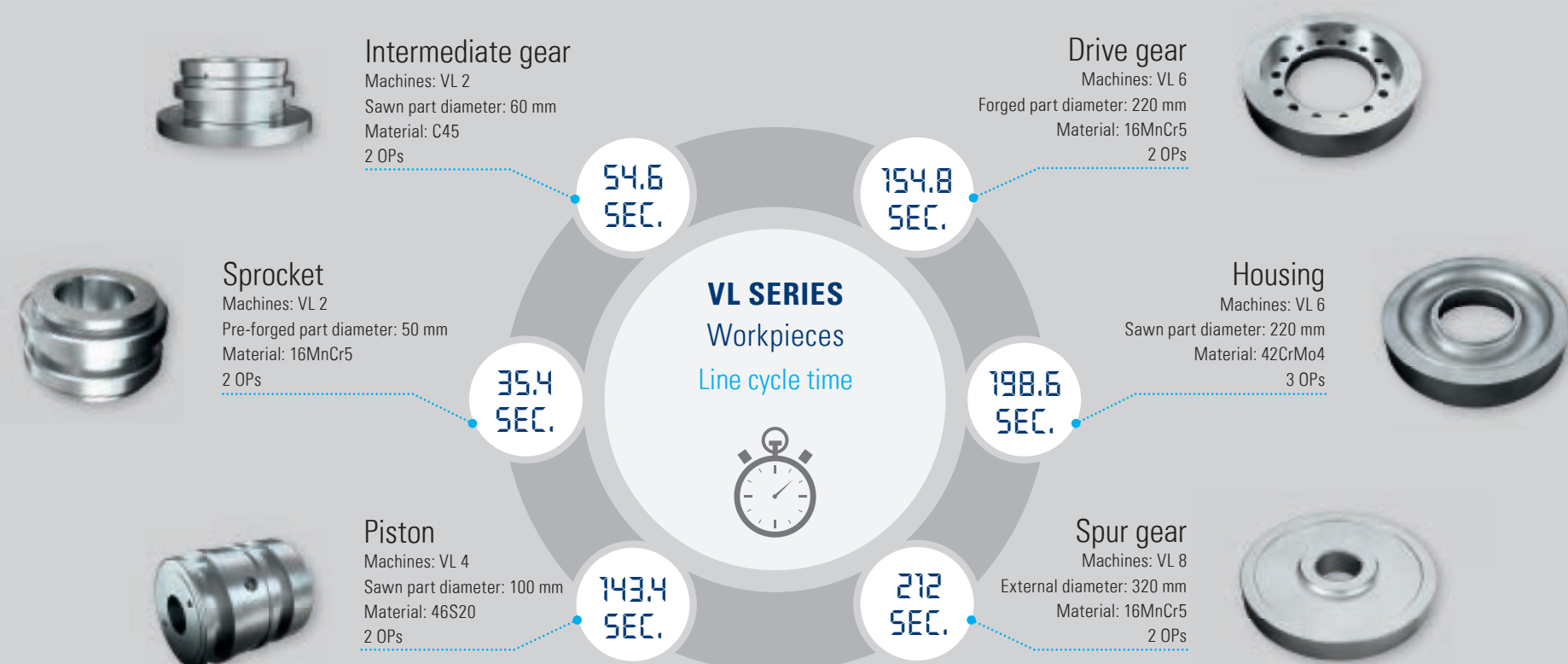
We are convinced that the future belongs to data-optimized production. Improving cycle times and reducing unit costs are important, but we go one step further and put the focus on overall equipment effectiveness (OEE) and its optimization as a basis of manufacturing data.

Using data analysis, unnecessary downtimes – due to component wear or, in the worst case, due to the failure of a machine – can be reduced or even avoided entirely. Productivity increases of over 10% are the rule here. To make entering the world of data-optimized production as easy as possible for our customers, all the machines of the VL Series now come standard in an IoT-ready state. This means that data analysis on the machines can be started virtually immediately. Find more information on data-optimized production on page 18 of this EMAG News.



LIVE
at the
EMO
MILANO
2021
The VL 2 with the new
EDNA HMI Lite control

TYPICAL WORKPIECES THAT ARE MACHINED ON MACHINES OF THE VL SERIES



TECHNICAL DATA

		VL 2	VL 4	VL 6	VL 8
Workpiece diameter, max.	mm in	100 4	200 8	300 12	400 16
Chuck diameter	mm in	160 6	260 10	400 16	500 20
Workpiece length, max.	mm in	150 6	200 8	250 10	300 12
Travel distances, X/Y (optional)/Z	mm in	650/±50/375 26/±2/15	760/±30/415 30/±1/16	900/±30/495 35/±1/19	1,110/±30/595 43/±1/23
Main spindle					
▶ Power rating, 40%/100% duty cycle	kW hp	18/14 24/19	25/18 34/24	39/28 52/38	44/35 59/47
▶ Torque, 40%/100% duty cycle	Nm ft-lb	77/59 57/44	280/202 207/149	460/340 339/251	775/600 572/443
▶ Speed, max.	rpm	6,000	4,500	3,100	2,850
Turret tool positions	Quantity	12	12	12	12
Rapid-traverse rate, X/Y (optional)/Z	m/min ipm	60/30/30 2,362/1,181/1,181	60/15/30 2,362/591/1,181	60/15/30 2,362/591/1,181	60/15/30 2,362/591/1,181
Revolutions of driven tools	rpm	6,000	6,000	6,000	6,000
Torque of driven tools, 30%/100% duty cycle	Nm ft-lb	27/15 20/11	27/15 20/11	27/15 20/11	48/30 35/22

IoT



WHAT DOES IOT-READY MEAN?

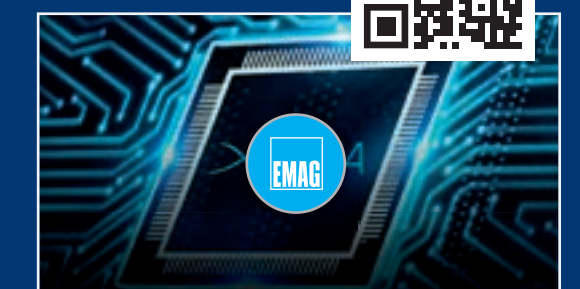
By IoT-Ready, we mean that the machines are delivered ready to integrate directly into existing IoT networks without a lot of effort. Specifically, this means that the machines are equipped with an EDNA IoT core (an IPC).

This IPC is already installed and networked with the machine control. In addition, the machines are equipped with EDNA NEURON 3DG sensors, one or more acceleration sensors on the spindle and possibly the Y-axis, which enables regular automatic monitoring of the machine's health. With this equipment, data-optimized production can begin immediately.

Further information on EDNA IoT solutions can be found at the link below.

EMAG MEDIA LIBRARY

See the webinar on the topic of IoT @ EMAG here



WPG 7: COMPACT, UNIVERSAL, EXTERNAL CIRCULAR GRINDING MACHINE FOR WORKPIECES UP TO 250 MILLIMETERS IN LENGTH

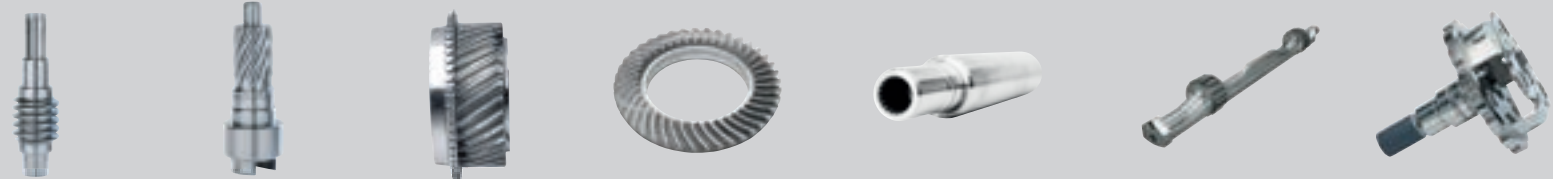
Highly productive, flexible, and with an extremely small footprint – the WPG 7 CNC external circular grinding machine delivers significantly increased performance for machining small and medium-sized workpieces.

Use this solution to perfect your grinding processes. Machine workpieces up to 250 mm in length and with a maximum diameter of 200 mm extremely efficiently with the WPG 7 from EMAG Weiss.

This is made possible by a rigid machine design, very dynamic axes, a powerful grinding wheel drive unit and an extremely small footprint. Overall, the WPG 7 only requires around four-square meters of space! Easily accessible, this robust machine can be retooled quickly for different machining jobs.



WORKPIECES



EMAG FILM

See the WPG 7 here
in the animation:



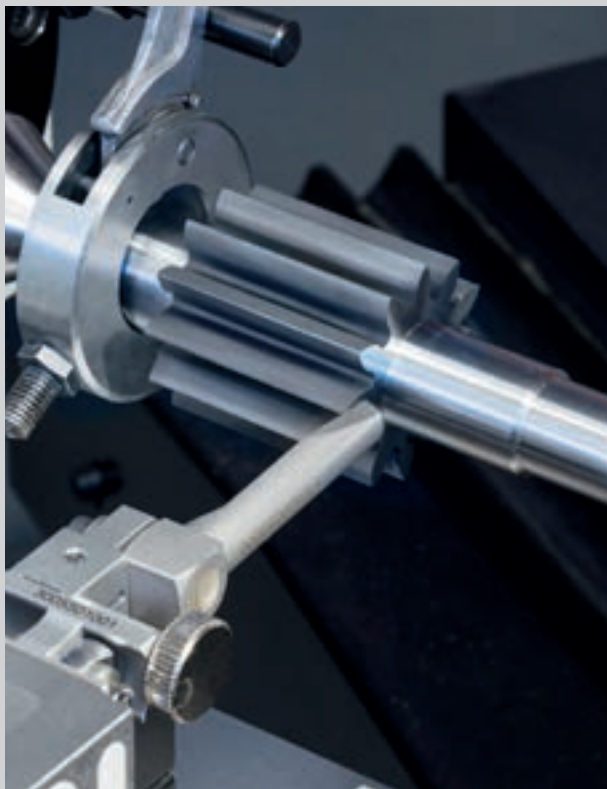
EMAG WEISS

WPG 7

TECHNICAL DATA

WPG 7

Center height	mm in	100 (125) 4 (5)
Distance between centers	mm in	280 11
Longitudinal axis (Z)		
» Longitudinal travel	mm in	380 15
» Feed rate	m/min ipm	15 591
» Table adjustment	°	8
Lateral axis (X)		
» Lateral travel	mm in	190 8
» Feed rate	m/min ipm	10 394
Grinding headstock		
» Grinding wheel diameter	mm in	400 (500) 16 (20)
» Max. grinding wheel width	mm in	80 3
» Grinding wheel bore	mm in	127 (203)
» Grinding wheel peripheral surface speed	m/s ips	50 1,968
Workpiece headstock		
» Mounting taper		W20 (W25 or MK4, MK5)
» Speed	m/s ips	0 to 2,000 0 to 78,740



EMAG SU G 250: GEAR GRINDING: HIGHEST EFFICIENCY AT MAXIMUM PRECISION

The G 250 from EMAG SU is ideal for components up to modulus 7 and with an outer diameter of 250 millimeters. Axle drive wheels, gear wheels or shafts with a maximum length of up to 550 millimeters can be finished with this solution by using either generating grinding or profile grinding. The machine has two table spindles in order to minimize idle times during the manufacturing process. In addition, great emphasis was placed on flexibility. For example, the G 250 can also be equipped with very small grinding wheels and worm grinding wheels. In the G 250 HS variant, the machine is also equipped with a high-speed grinding head (max. 20,000 rpm) on the main grinding spindle for generating grinding as well as profile grinding with very small grinding wheels. For components with an interfering contour, generating grinding is often used rather than profile grinding, leading to significantly shorter grinding times. Short chip-to-chip times, intelligent axis concepts, thermal stability (cast base) and ease-of-use – with these quality features, the machines from EMAG SU ensure boosts to performance.



TECHNICAL DATA		G 250
Workpiece diameter, max.	mm	250
	in	10
Module		0.5 – 7.0
Workpiece length, max.	mm	550
	in	21
Tooth width, max.	mm	380
	in	15
Swivel angle	°	±45
Grinding wheel diameter, max./min.	mm	250/90
	in	10/3
Grinding wheel width	mm	180
	in	7
Grinding speed, max.	m/s	80
Dressing tool diameter	mm	123
	in	5

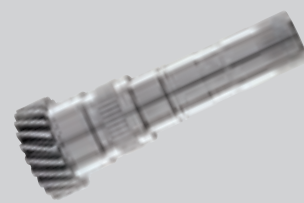
WORKPIECES



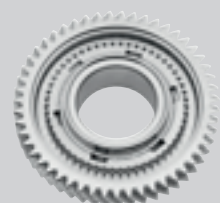
Planetary gear



Planetary gear



Sun gear shaft



Gear wheel

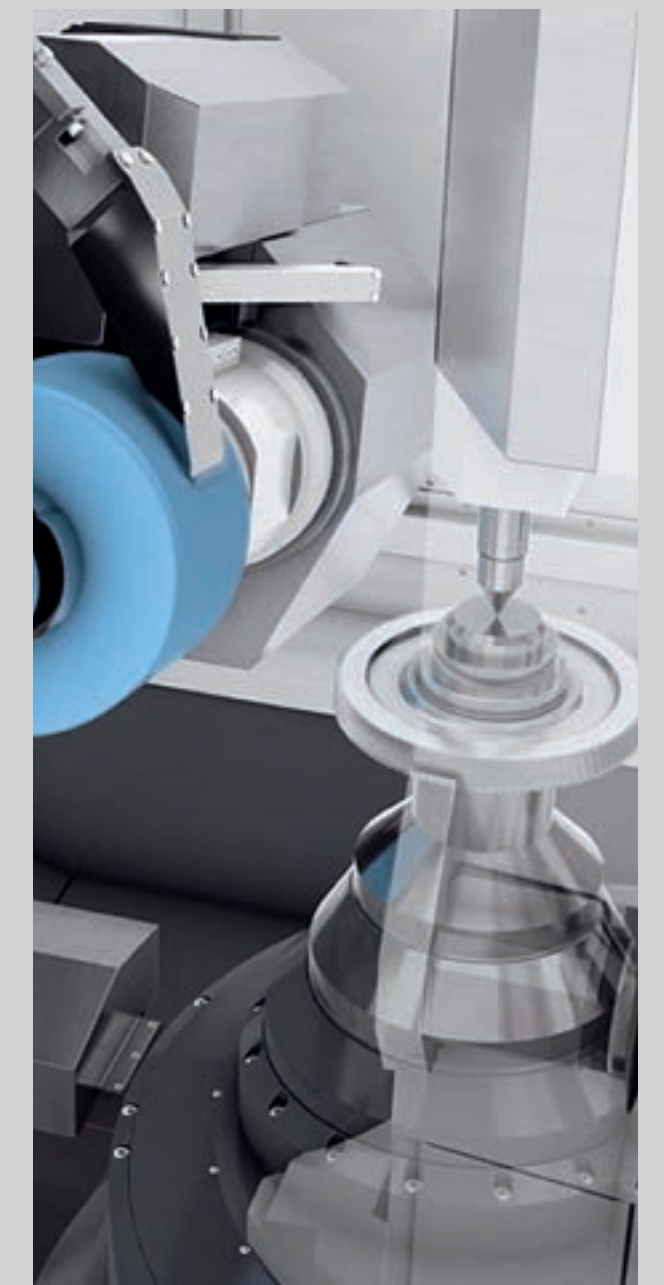
The G 250 is equipped with a double workpiece spindle, which means that unproductive idle times are nearly eliminated.

EMAG SU

G 250

BENEFITS

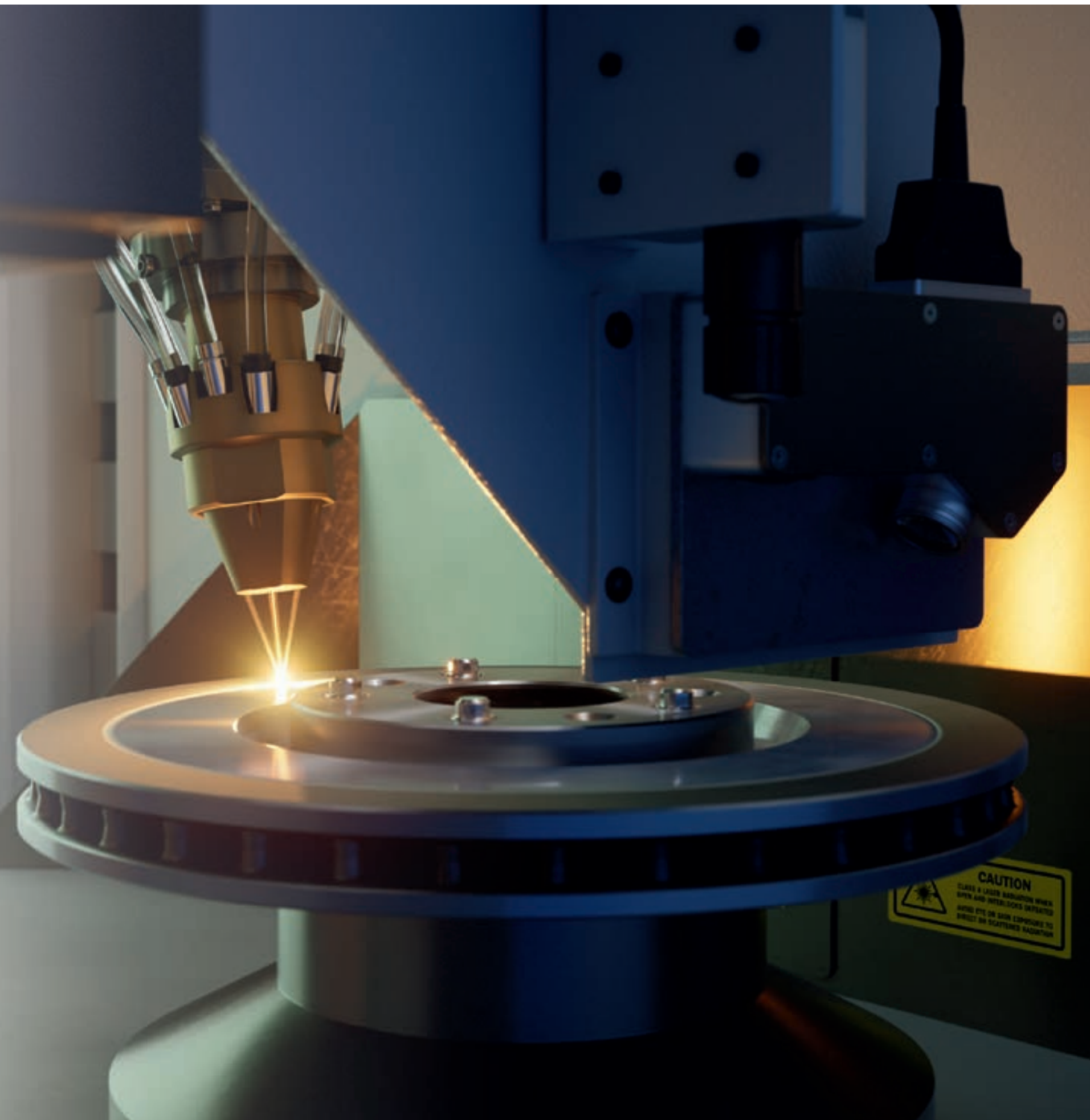
- » Direct drives for tool spindles and workpiece spindles with independent cooling circuits
- » Use of small generating grinding wheels with a usable root diameter of at least 68 mm
- » Grinding of workpieces sporting interfering contours by using small profile grinding wheels (30 mm) possible
- » Generating grinding worm wheels and profile grinding wheels on the main spindle
- » Large tool clamping capacity/standard tool and workpiece clamping systems
- » Loading and unloading of the workpiece in parallel to the machining process
- » Optional automatic loading and unloading of the workpiece
- » Topological generating grinding featuring simple operation through the visualization of the inputs in the dialog software



LASER METAL DEPOSITION FROM EMAG LASERTEC: BRAKE DISKS FOR THE WHOLE LIFE OF A CAR

Particulate reduction and corrosion protection are big changes in brake disk technology. Manufacturers rely on carbide-coated brake disks that are practically wear-free. However, coating them with tungsten carbide is a particular challenge because the process must be reliable and efficient.

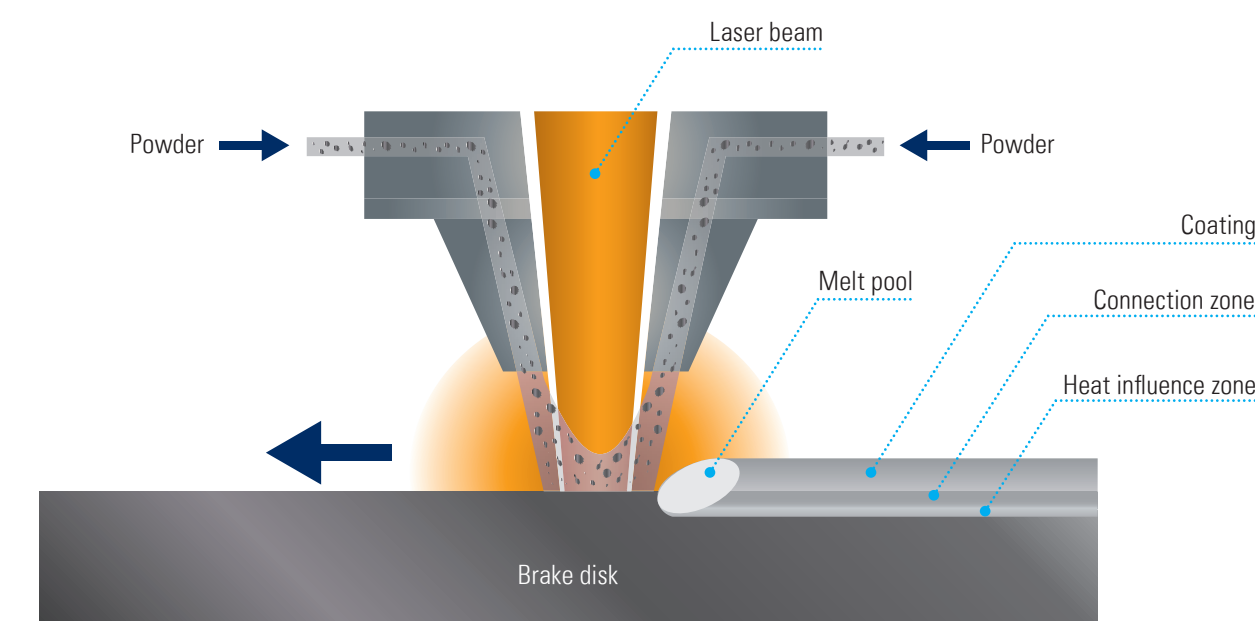
With the new ELC 450 LMD ("Laser Metal Deposition") machine, the laser welding specialists from EMAG LaserTec now offer a practical alternative – apply the multi-layered, powdered metal to the brake disk using a laser welding process. The powder melts completely in the laser beam without wasting material.



THE PROCESS IN DETAIL:

- 1 WEIGHING:**
After loading, the component is initially weighed in an uncoated state. This value serves as a reference in order to be able to determine the "coating weight" later (during the second weighing after an initial pass).
- 2 LASER CLEANING:**
Working materials and dirt are removed from the blank without leaving any residue.
- 3 PREHEAT:**
Induction technology from EMAG eldec ensures an ideal processing temperature.
- 4 LASER CLADDING:**
One layer is applied per laser process – first an adhesive layer, then the carbide coating.
- 5 MEASURING/TURNING:**
Here, the component is measured and (after two coating passes) turned over to process the second side. The coating process then starts all over again. Finally (after a total of 4 passes), the component is unloaded.

LASER COATING PROCESS



450 LMD

ELC



Dr. Mootz,
Managing Director at EMAG LaserTec

How did this coating technology come about?

Our expertise in laser technology provides an ideal basis for this application. We also have a lot of experience in the development of holistic processes. Both have been taken into account here. The machine guarantees perfect coating processes with weighing, laser cleaning and preheating as well as with sophisticated laser tool technology.

What role do upstream and downstream processes play?

The disk blank is turned prior to coating, and after the coating process, a grinding process is necessary. Both processes can be implemented with EMAG technology. Our strengths – extensive process experience combined with holistic production solutions "from a single source."

What is the status concerning the development of the ELC 450 LMC?

The development of the machine has been completed. We are currently working with a customer to carry out coating tests. But, we already see that we will be able to offer an extremely reliable and efficient solution in the future.

EMAG FILM

See the process in an animation here



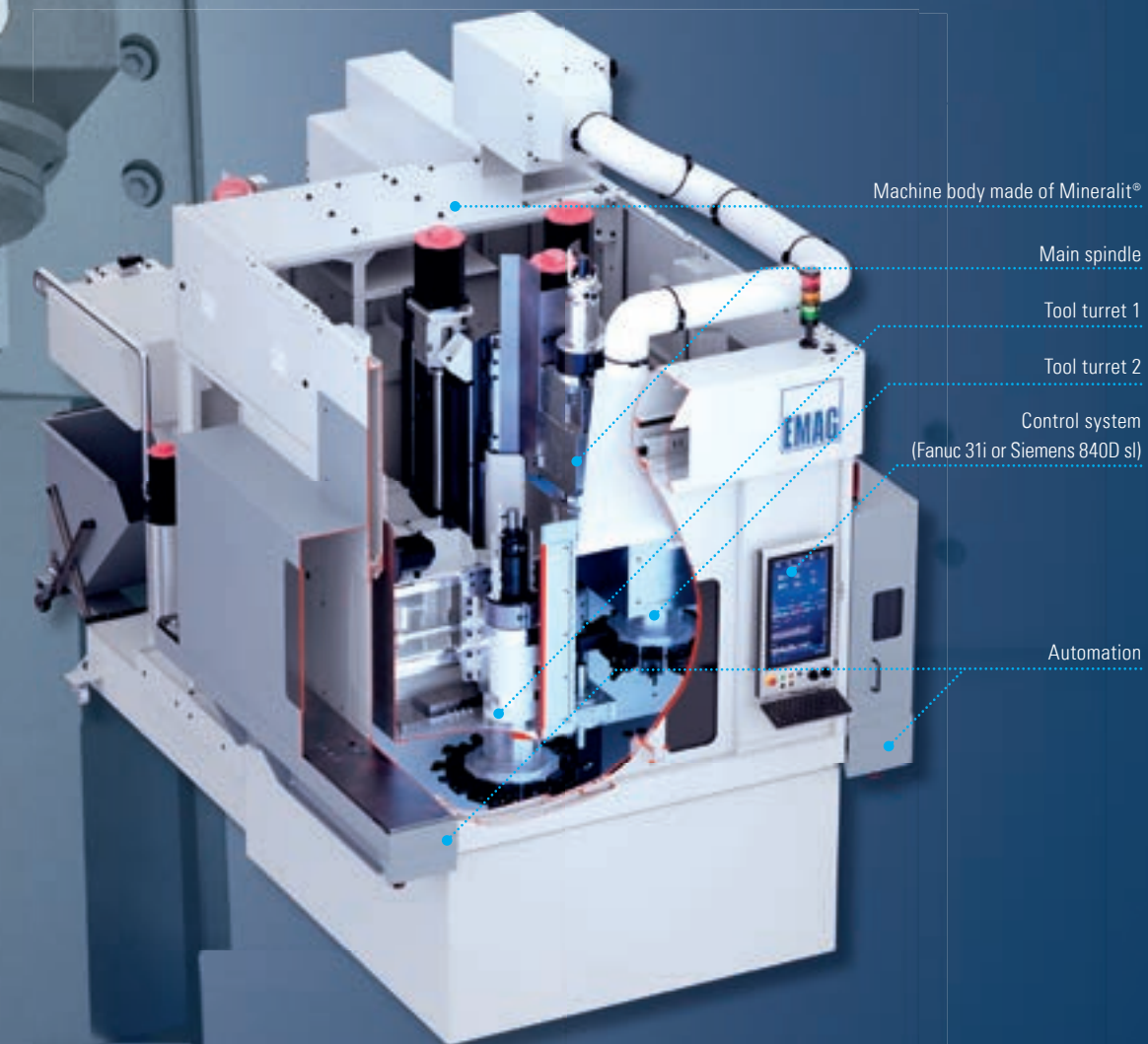
HIGHLY PRODUCTIVE SHAFT MANUFACTURING: CENTER DRIVE MACHINES FOR HIGHLY PRODUCTIVE 4-AXIS MACHINING OF SHAFT ENDS

When it comes to machining the ends of shafts, the machines of the VT Series with center drive are ideal manufacturing systems. On one hand, 4-axis machining on the VT machines guarantees highly efficient machining processes. On the other hand, the clamping of the shafts in the center drive enables optimal values in terms of positional tolerance and roundness.

Regardless of which clamping concept is used, the large machining compartment of the VT machines and the generous travel path of the two vertically mounted tool turrets enable simultaneous machining of the two shaft ends at any time. For longer workpieces, it is also possible to use an additional steady rest without any problems.

CLAMPING

- » Depending on the workpiece, clamping occurs on one or two clamping levels using collets inside the center drive. The tension is achieved mechanically by springs, opened by hydraulics.



VTC 200 CD HIGHLY PRODUCTIVE SHAFT MANUFACTURING

BENEFITS

- » Short cycle times thanks to simultaneous 4-axis machining
- » High accuracy in run-out and positional tolerance
- » Short idle times due to simultaneous loading and unloading of the machines
- » Automatic loading and unloading by workpiece grippers in the tool turrets

OPERATING PRINCIPLE USING THE EXAMPLE OF A ROTOR SHAFT

The shafts are clamped and powered in the center drive. As a result, the two ends of the shaft are freely accessible for machining. Example: rotor shaft in hollow design. Both the external and internal machining of the shafts take place here simultaneously at both ends, which enables very short cycle times.

WORKPIECES



Transmission shaft



Axle shaft



Transmission shaft



Variator shaft



Transmission shaft



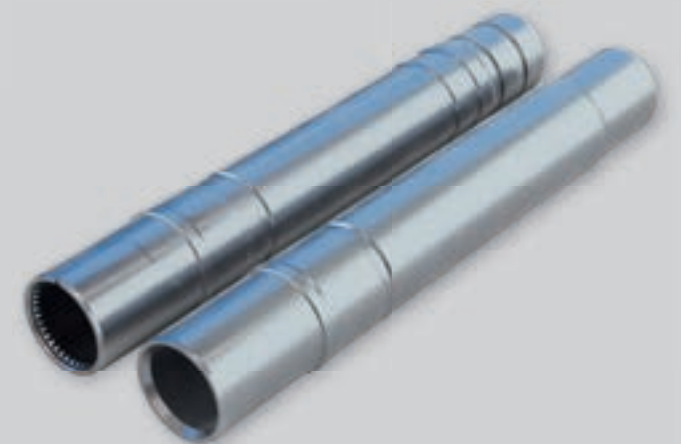
Camshaft



Transmission shaft



Transmission shaft



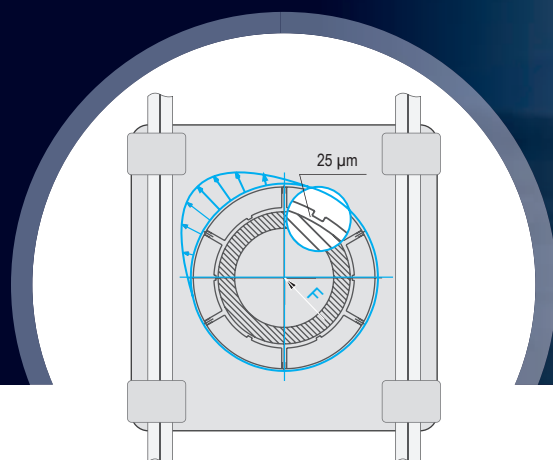
VSC 160 TWIN: HIGH-SPEED TURNING MACHINE FOR LARGE SERIES PRODUCTION

The VSC Series is a mechanical engineering classic.

For many years, EMAG has developed vertical turning machines that load themselves by moving the main spindle and performing various operations in a single clamping operation. In addition, these machines have a consistently symmetrical slide and a machine structure for thermostable production. The overall approach ensures productive and highly accurate processes for many customers. The VSC 160 TWIN is one of the fastest turning machines on the market for components up to 130 mm in diameter.

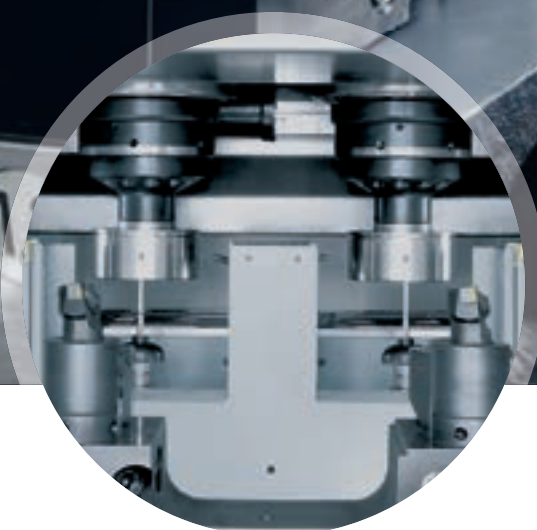
SIMULTANEOUS MACHINING

- » One machining compartment, two working spindles
- » Simultaneous processing of two workpieces with an identical workflow
- » Diameter and length corrections individually for each working spindle



WORKING SPINDLE WITH HYDROSTATIC BEARINGS

- » The thin oil film offers the best damping as a prerequisite for high surface quality and long tool service life – even with interrupted cutting



INTEGRATED QUALITY CONTROL

- » Time-saving measuring process for two workpieces at the same time. However, diameter and length corrections are made individually for each workpiece spindle (safety door between button and machining compartment open).

WORKPIECES

The VSC 160 TWIN is mainly used for large-scale production.



Peter Gröner

Team Manager at EMAG Maschinenfabrik GmbH

» Which situations best suit the VSC 160 TWIN?

The multi-spindle, vertical pick-up turning machines from EMAG are mainly used in the medium to large-scale manufacturing of precise workpieces. In other words, in situations requiring the production of large quantities of components with maximum precision at minimum cost. Machines in the TWIN design, like the VSC 160 TWIN here, process two workpieces at the same time with an identical workflow. This leads to an extremely high output. Of course, we can also implement double-sided processing of OP 10 / OP 20. Processing then takes place on a second VSC TWIN, which is linked to the first machine via a turn-over station or a TrackMotion automation system. So, who should invest in a VSC 160 TWIN? In my opinion, it's worth it for anyone who wants to manufacture high quantities with minimal cycle times in a cost-optimized manner.

TWIN VSC 160

HIGHLY DYNAMIC, PRECISE AND RELIABLE – THE VSC 160 TWIN

- » The working spindle with hydrostatic bearings in the Z-axis ensures outstanding component quality and a high tool service life for soft and hard machining operations
- » Closed, thermosymmetrical structure with machine base made of **vibration-damping Mineralit® polymer concrete**
- » Good chip flow thanks to the **vertical design**
- » **Low-wear** guiding elements
- » **Cooling system** for spindle motor, machine body, spindle, and turret
- » **Turret for 2 x 4 tools**



TECHNICAL DATA VSC 160 TWIN

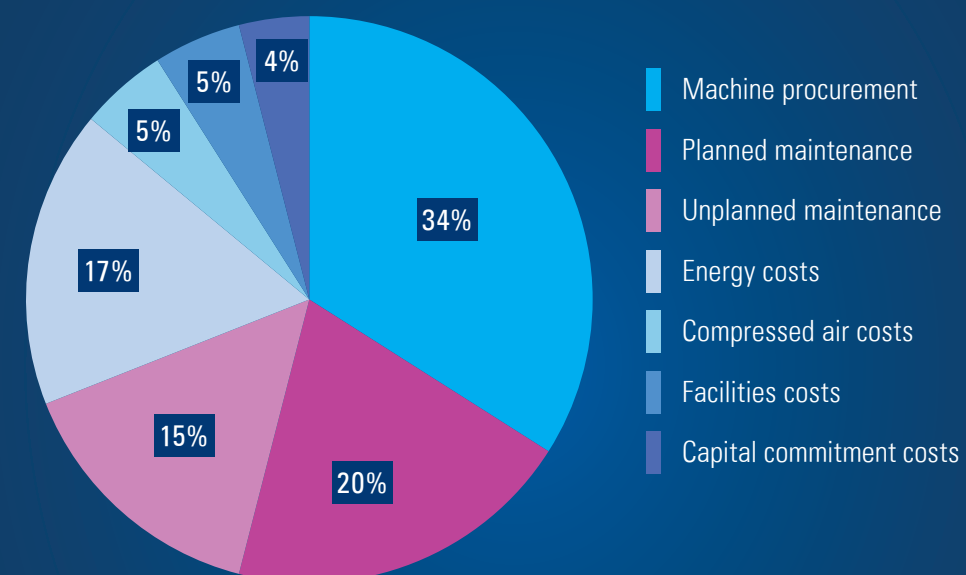
Workpiece diameter, max.	mm	130
Chuck diameter, max.	mm	130/160 5/6
Swing diameter	mm	180 7
Travel distances, X/Z	mm	850/160 33/6
Main spindle		
» Power rating, 40%/100% duty cycle	kW hp	23/17 31/23
» Torque, 40%/100% duty cycle	Nm ft-lb	71/53 52/39
» Speed, max.	1/min rpm	6,000 6,000
Rapid-traverse rate, X/Z	m/min ipm	45/30 1,772/1,181

EDNA HEALTH CHECK + NEURON 3DG AUTOMATED CONDITION MONITORING AND PREDICTIVE MAINTENANCE FOR YOUR MACHINES

Nothing is more expensive than unplanned machine downtime. Expensive staff are idle, production is disrupted and customers are dissatisfied with the inability to deliver. In short, no one wants that!

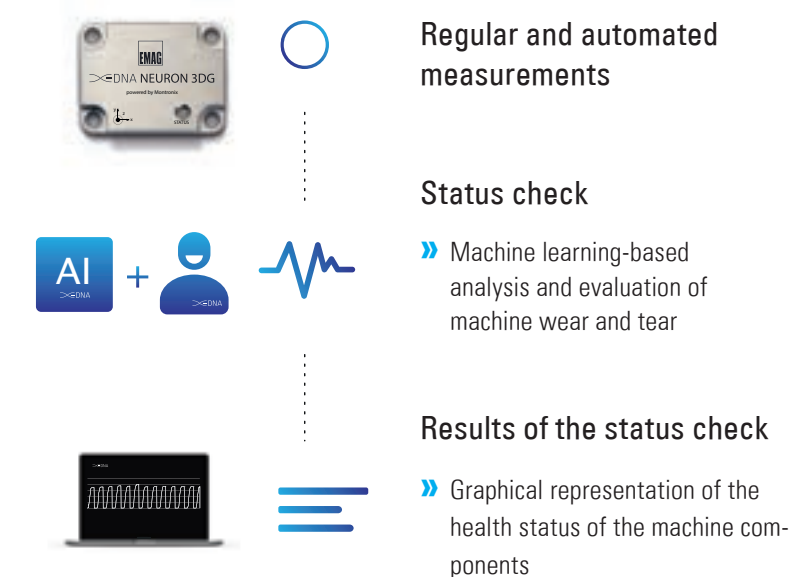
This is exactly why we developed the EDNA HealthCheck here at EMAG. Using advanced sensors and data analysis, this system enables regular status analyses of the machines in your production department. If the "health values" of one of your machines deteriorate, this is shown in the results of the analysis. In the full-blown version, you can see the results within minutes and are even proactively informed by our service team if there are critical changes. In this way, you can reschedule maintenance work or production early on.

LIFE CYCLE COSTS OF A MACHINE TOOL MAINTENANCE STRATEGY IS THE KEY TO A PROFITABLE MANUFACTURING OPERATION



The costs for planned and unplanned maintenance, using current maintenance strategies, make up over a third of the life cycle costs of a machine tool.

HEALTH CHECK PROCEDURE

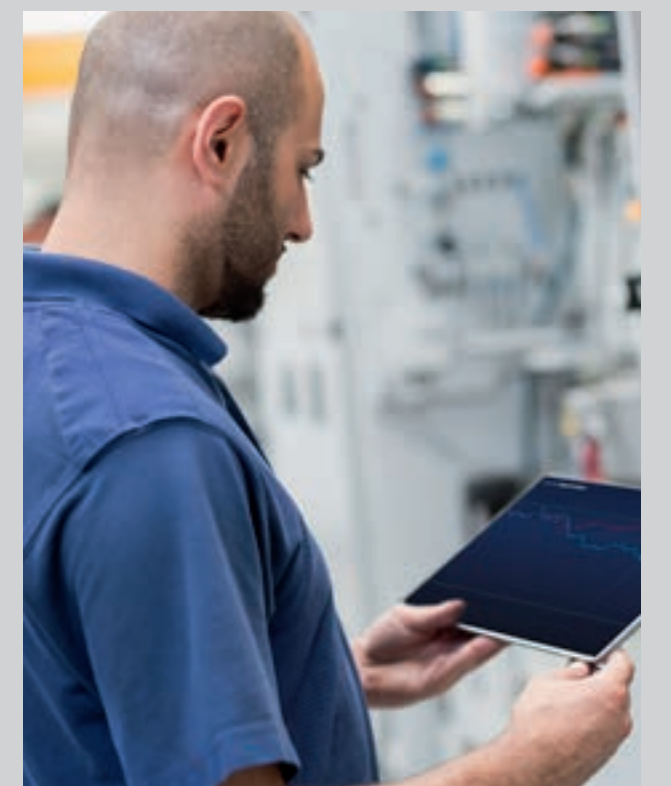


OUTPUT OF HEALTH DATA IN THE DASHBOARD

The health data of the machines are clearly displayed in the EDNA dashboard. This enables discrepancies to be recognized quickly. Here in the example, you can clearly see the drop in the health value of an axis, shown in blue. If the negative trend continues, action should be taken here without delay, as the component quality suffers – or in the worst case, it can lead to unplanned downtime.

OPERATING PRINCIPLE

The EDNA HealthCheck regularly (either automatically scheduled or triggered manually) carries out a measurement run on all axes of the working spindle. The data determined by NEURON 3DG acceleration sensors are recorded. They are then evaluated using algorithms and examined for anomalies. In the event of a severe decline in health or unusual behavior, the results are always analyzed by an experienced employee. Using the vibration data, the algorithm calculates a health value that enables conclusions to be drawn about the condition of the machine components. On the basis of the tests that are carried out regularly, trend analyses can then be completed in order to make any wear and tear in the components visible. In this way, a service appointment can be arranged in a timely manner and unplanned downtime in production can be avoided.



COOPERATION PARTNER ANACISION – SPECIALIST
FOR AI & DATA ANALYSIS IN PRODUCTION:

THE EASY WAY TO GET STARTED IN DATA- OPTIMIZED PRODUCTION

"Industry 4.0" has become a reality. Production processes can be specifically optimized based on existing data, like a view to product quality and set-up times, for example. And the way to get there is much easier than many think. EMAG partner anacision offers a compact Industry 4.0 workshop as well as a data analysis package in order to exploit the potential in a quick and targeted manner.

1

WORKSHOP: DETERMINING POTENTIAL



» **In preparation**, production experts from anacision hold an initial meeting with the customer about the current challenges in production. "We familiarize ourselves with manufacturing processes, key service commitments such as adherence to delivery dates, undesired downtimes and much more. We prepare the workshop with this foremost in our minds," explains Daniel Poodratchi from anacision.



» **The Workshop** is divided into several sections: After an introduction to the topic of "Artificial Intelligence and Data Analysis," it comes straight to the point. Along with production managers, factory employees and maintenance staff, the experts define central production challenges that can be optimized using AI data analysis. "This results in one or two recommendations for measurable action steps, which we will clearly state at the end of the workshop. We also quantify the potential for savings and performance improvements," says Poodratchi.

2

DATA ANALYSIS PACKAGE: INCREASE PRODUCTION OUTPUT

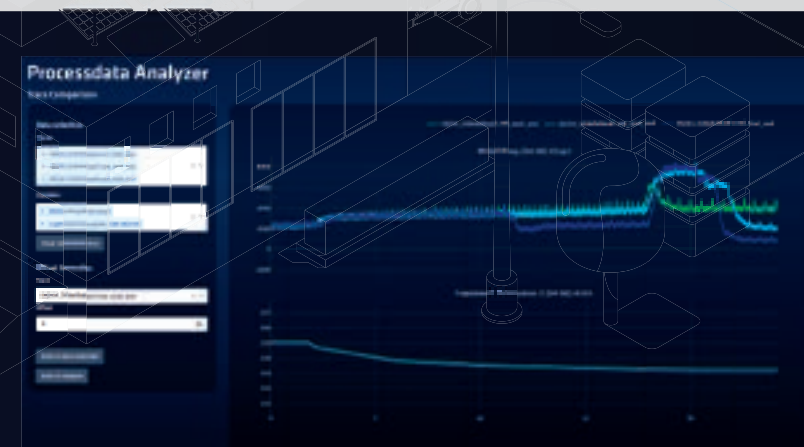
In the second step, the experts from anacision use AI technologies to analyze the existing machine and process data, for example from the EDNA IoT system from EMAG, and thus identify the triggers for downtimes, production errors or inefficient processes. The customer then receives specific recommendations for action on how to reduce downtimes or increase output in practice.

If you want to start data-optimized production now, simply contact your designated sales representative at EMAG. They will take care of everything else – it really couldn't be easier.

What can be optimized using AI analysis?

The use of AI technologies in data analysis opens up new potential in production. This includes the following goals, for example:

- » **Real-time forecasts of quality:**
Reduce time-consuming manual quality assurance processes and reduce the wasting of parts.
- » **Shift targets:**
Detect endangered shift targets and take countermeasures.
- » **Reduce brief downtimes:**
Find the causes of systematic downtimes and avoid cost drivers.
- » **Optimize set-up times:**
Increase output with the intelligent planning algorithms from anacision. These minimize set-up changes and delays.



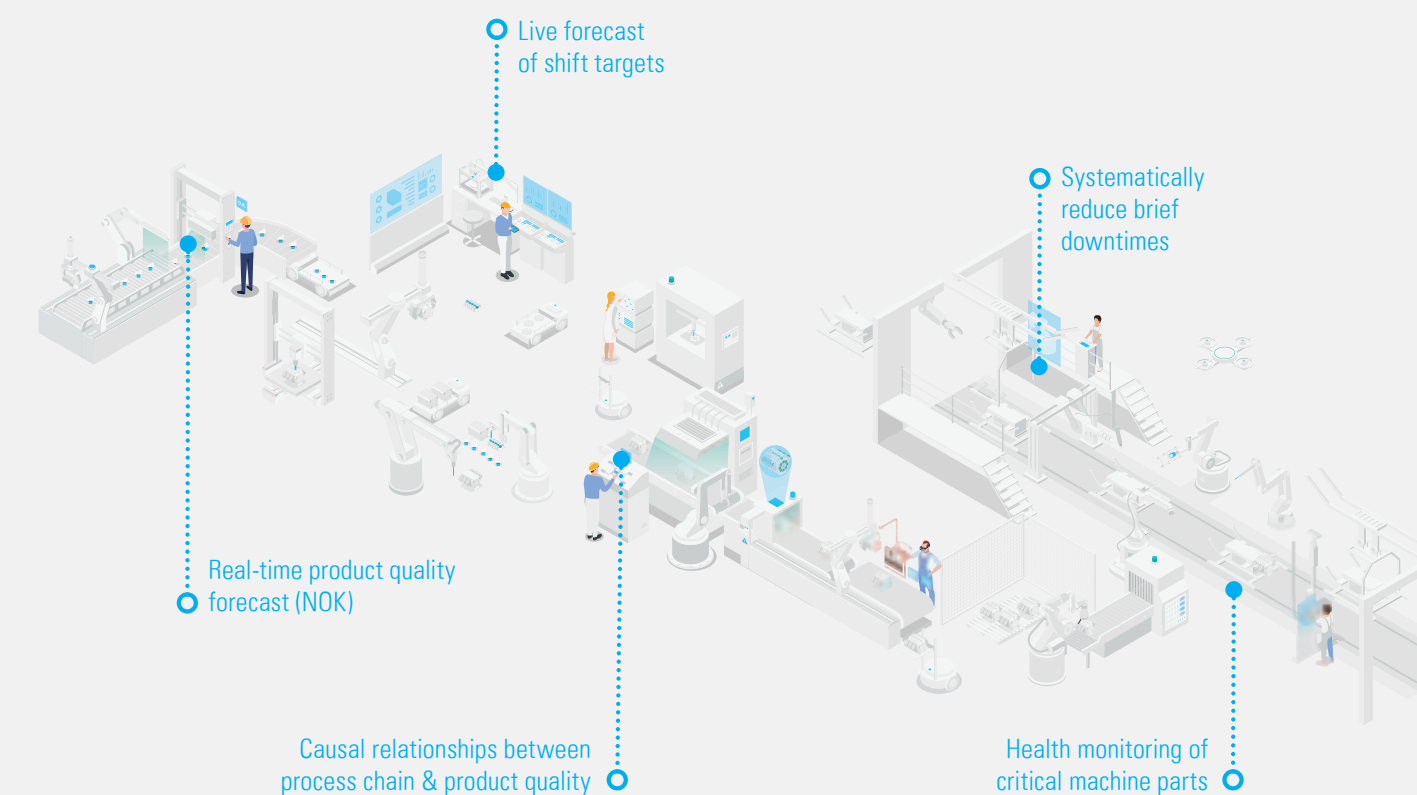
CONTACT

Please contact the EMAG Group with any inquiries or comments.



EMAG EDNA AS THE BASIS

EDNA from EMAG is a modular Industry 4.0 ecosystem made up of interconnected software and machine components. Large quantities of production data are recorded in the process and prepared for data analysis, which is basis for anacision's advantages as described here:



EMAG ELDEC GENERATOR TECHNOLOGY AT MACK RIDES: FOR THE RIGHT MOMENTUM ON A ROLLER COASTER

More than a million people ride on roller coasters, water rides or themed rides from Mack Rides every day – all over the world. Every solution is developed and produced at the location in Waldkirch near Freiburg – including rails, vehicles, decorations, animations and much more. On board for rail production: induction technology from EMAG eldec. It ensures precise heat treatment before the final straightening of the components.

The development and production of roller coasters is a task for specialists because, despite their enormous size, precision is key. Dimensional deviations outside of narrow tolerances are taboo. Mack Rides brings a wealth of experience to the table. More than 155 roller coasters made in Waldkirch are in operation worldwide. “Each model is a one-off production, since we respond intensively to customer requests. The quantities of the associated components are, therefore, rather small. At the same time, the technical demands are very high,” explains Marcel Martinetz, Head of Equipment Design. “Against this backdrop, we rely on a high level of vertical integration with which we ensure the perfection of the technical details on the one hand, and efficiently implement customer requests on the other.”

A current example from rail production makes it clear what that means in concrete terms. It is important to know that these components are up to twelve meters long, but their curved course can only deviate by a maximum of 3 millimeters in length and a maximum of 2 millimeters in track width. This precision is ensured in two steps. After being bent, the rail is inserted into a device and measured by a laser. “We then immediately identify every deviation, which we correct with the help of this special robot clamping solution. To do this, however, the rails must be heated at defined points,” explains Martinetz. In the past, specialists used an acetylene flame for heating, which led to increased workload and risk. In addition, the heat was only applied superficially. Against this backdrop, inductive heating became an alternative. Initial tests showed that a process-reliable implementation is not easy because the operator has to position, by hand, a ring inductor so that it makes contact with the pipe. A little inattention is enough to cause it to lose contact. The technology that was first tested led to overload damage. “We then approached EMAG eldec with the task of developing a significantly more robust solution,” explains Martinetz.

EMAG BLOG

Read the full interview with Marcel Martinetz, Head of Equipment Design at Mack Rides. He reports on his company's special expertise and the associated production solutions.



“The main task was to develop a robust solution.”

Marcel Martinetz, Head of
Equipment Design at Mack Rides



MAC
RIDES

QUICK AND STABLE PROCESS

The solution: including a hand ring inductor and a PICO-SC generator with an output of 15 kilowatts along with a cooling system. In use at Mack Rides for around a year, it has convinced users. It is no longer a problem if the ring inductor loses contact with the rail and Mack Rides also benefits from a very quick process. Operators start the appropriate program via the touchpad surface of the generator and guide the inductor to the component. After a rigidly defined period of time, the desired temperature is reached and the straightening phase can begin.



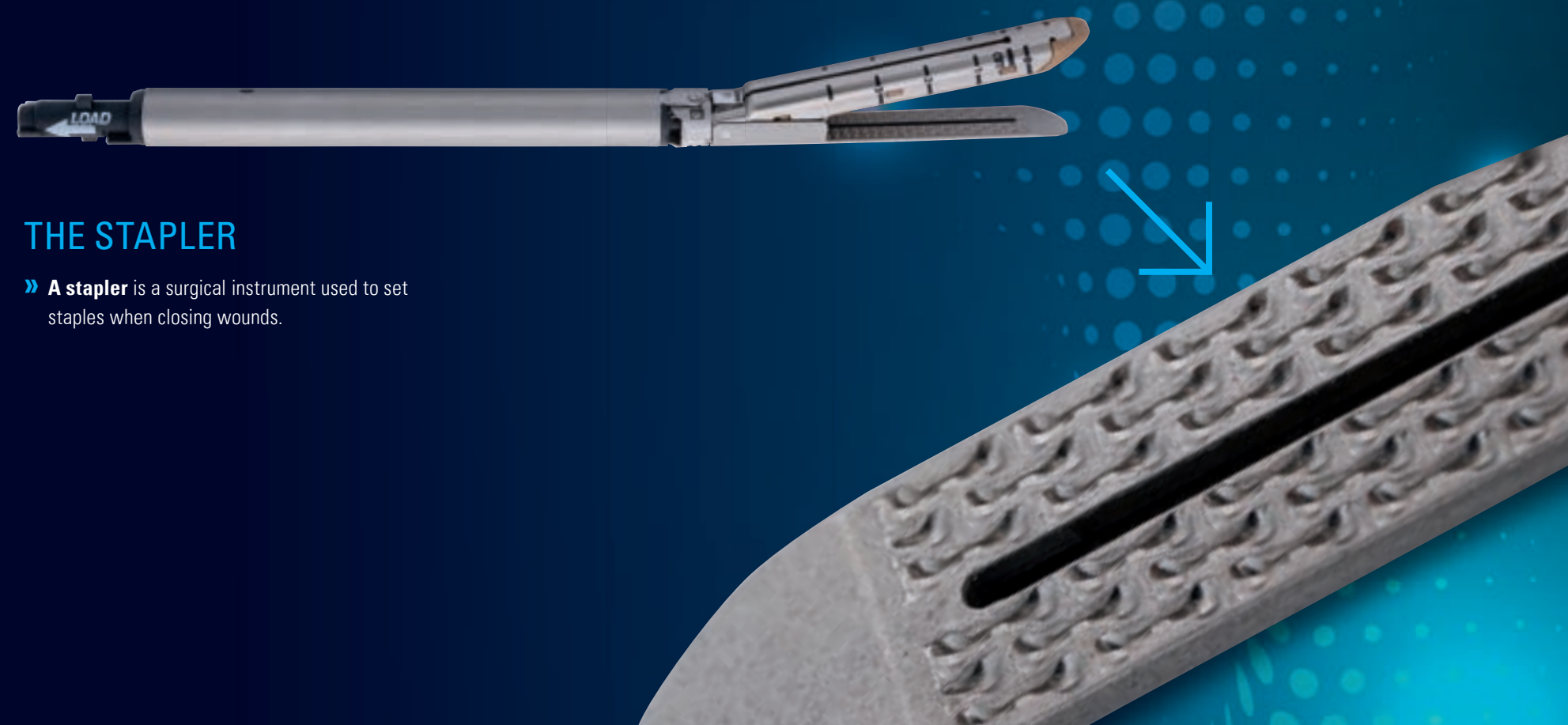
EMAG ECM CONTRIBUTION OF MICROSTRUCTURES WITH THE PECM TECHNOLOGY

With PECM (Precision Electrochemical Machining), components can be precisely machined within a short time, regardless of their hardness, with high component quality.

With the PECM technology, a reproduction accuracy of $<20\text{ }\mu\text{m}$ and a surface quality of $Ra <0.1\text{ }\mu\text{m}$ can be achieved. A fact that has been capitalized on when machining surgical staplers. Here over 40 microstructures, called "pockets," are introduced into a device where ten staplers can be clamped simultaneously. This is done at high precision and to a depth of 0.5 mm. When using conventional methods, the production of these pockets has proven to be challenging as it requires great effort. With this arrangement, cycle times of <1 minute per component can be achieved.

PECM technology can show its full strength in the production of such microstructures. PECM is a contact-free process without thermal or mechanical influences on the components, which offers great advantages, especially with delicate workpieces. The hardness of the material is also irrelevant, since it is eroded at the molecular level. Only electrical conductivity is required.

Loading is done manually or automatically. The process data can optionally be recorded via an IoT core and visualized and analyzed with different IoT modules.



THE STAPLER

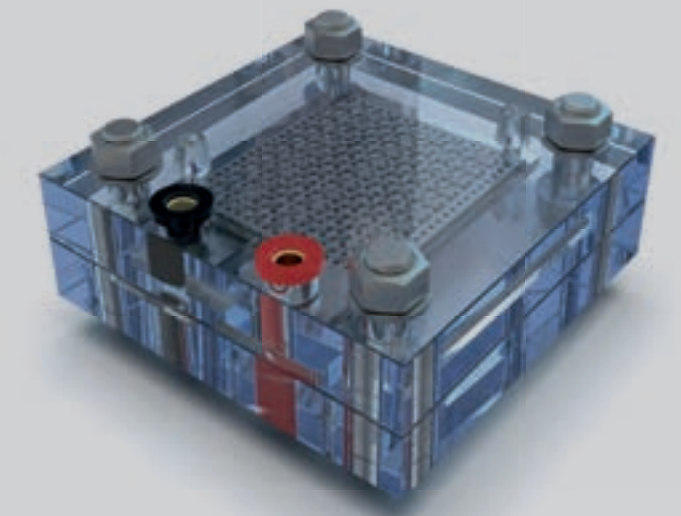
» A **stapler** is a surgical instrument used to set staples when closing wounds.

PTS 2500 for processing sophisticated 2D and 3D geometries

The EMAG PTS 2500 enables the highly precise introduction of sophisticated geometries. The ECM or PECM technology from EMAG used for this is an outstanding option, even if many developers and designers are not yet familiar with it.

TECHNICAL DATA

		PTS 2500
Machining compartment	mm inch	1,070 x 700 x 515 42 x 27.5 x 20
Clamping surface	mm inch	800 x 550 31.5 x 21.5
Generator capacity	A (DC)	2,500 – 5,000
Generator capacity	A (pulse)	6,000 – 12,000



PROCESS DEVELOPMENT FOR FUEL CELLS

Fundamentally, fuel cells have a very simple structure. A cell consists of three layers on top of each other: two gas-carrying plates and an electrolyte in between. This simplest form of fuel cell has of course very little power on its own, which is why many fuel cells in series become interconnected to whole fuel cell stacks. These packages are then installed depending on the required performance. However, it is precisely this flat design of the individual fuel cells that poses a manufacturing challenge, as very delicate structures have to be produced in very thin-walled components. Here, PECM technology offers promising machining options that are currently being researched.

EMAG LINKEDIN

If you would like to learn more about the topic, then follow us on LinkedIn, or subscribe to our newsletter on emag.com, where we will keep you informed about the possibilities of PECM technology in the coming months.





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