

TECHNOLOGY
EXCELLENCE



MACHINING

TRANSFORMATION

04 **WORLD PREMIERES**

- INH 63
- CTX 450 & CTX 550
- CTX beta 450 TC

16 **PROCESS INTEGRATION**

- MX – Machining Transformation
- DMF 300|11
- Tyrolit Group
- Ouroboros Space and Defense
- Kumera Antriebstechnik GmbH

32 **AUTOMATION**

- Automations-Matrix
- Hübner GmbH & Co. KG
- Brunvoll AS
- Alu Metall Goeke GmbH & Co. KG
- Richter Feingerätebau GmbH
- WH-AMR & MATRIS Light
- TSUZUKI MANUFACTURING CO., LTD.
- AMR 2000
- Wehl & Partner Muster + Prototypen GmbH
- Euroform Kft.
- Zhengzhou Hengda Intelligent Control Technology Co., Ltd.

72 **DX – DIGITAL TRANSFORMATION**

- DMG MORI Digital Engineering
- Digital Twin Test Cuts
- Winkelbauer GmbH
- myDMG MORI

82 **GX – GREEN TRANSFORMATION**

- GREENMODE

→ from page 04

**WORLD
PREMIERE
2023**



EXPLORE
THE WORLD
OF

MX
MACHINING
TRANSFORMATION



PROCESS INTEGRATION

→ from page 16



MACHINING DIAMOND WITH DIAMOND

Tyrolit – Schleifmittelwerke Swarovski AG & Co KG. (Austria)
 Process Integration: Mill & Turn (FD) + Grinding



GEAR CUTTING ON STANDARD MACHINES

Kumera Antriebstechnik GmbH (Austria)
 Process Integration: Turn & Mill + Gear cutting

AUTOMATION

→ from page 32



HIGH AVAILABILITY OF PARTS FOR SHIPBUILDING

Brunvoll AS (Norway)
 Automation: MATRIS workpiece handling

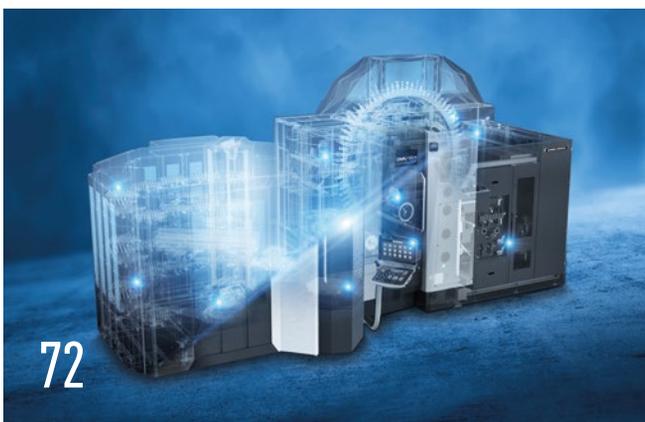


PH CELL TWIN IN A DOUBLE PACK

Wehl & Partner Muster + Prototypen GmbH (Germany)
 Automation: MATRIS workpiece handling

DX – DIGITAL TRANSFORMATION

→ from page 72

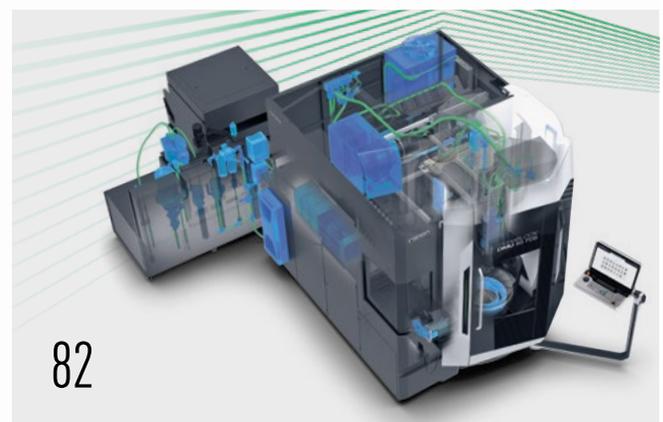


DMG MORI DIGITAL ENGINEERING

complete simulation of the entire system, including all interactions and control functions

GX – GREEN TRANSFORMATION

→ from page 82

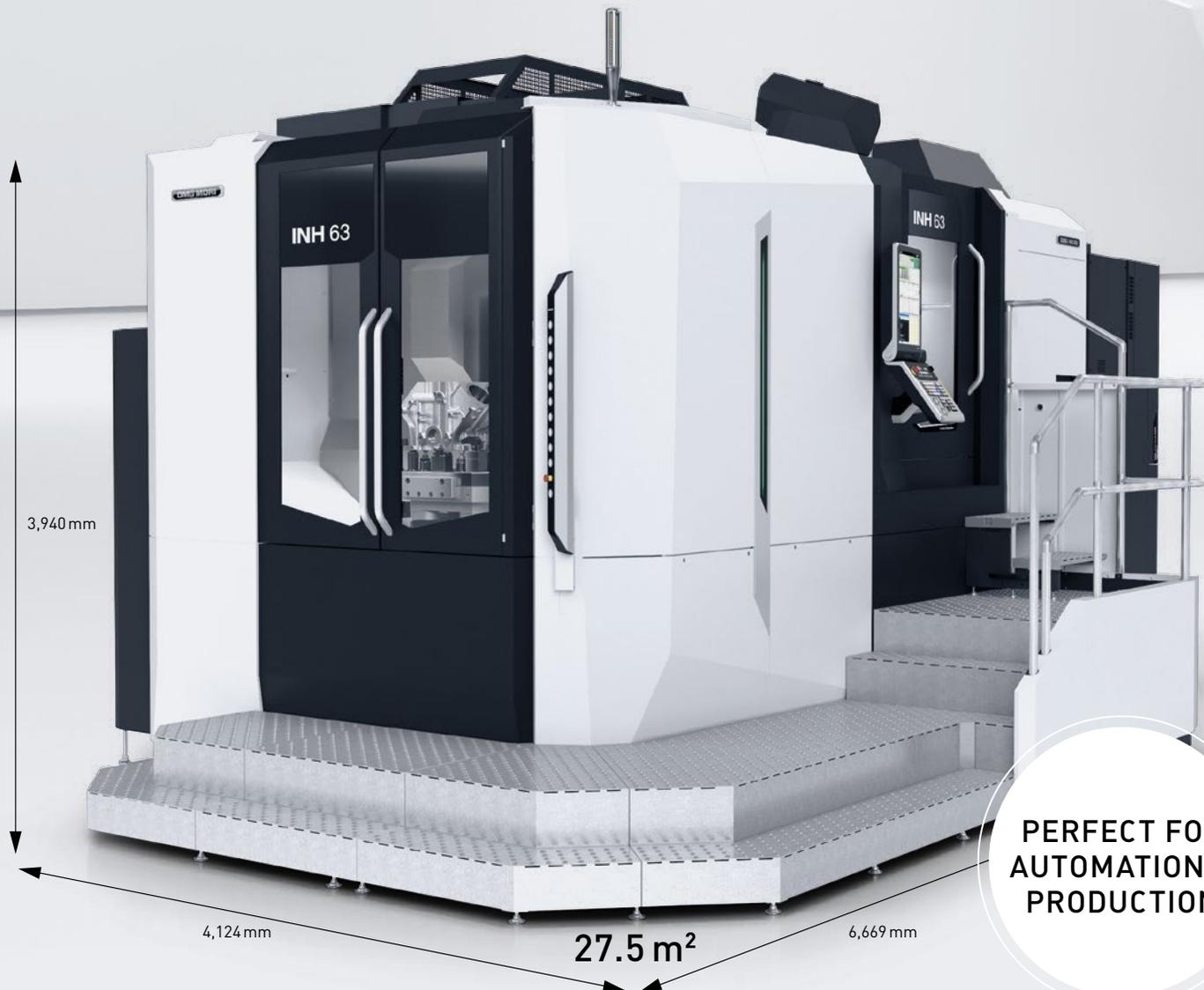


GREENMODE

PURE EFFICIENCY – More than 30% energy savings possible with GREENMODE

WORLD
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2023

INH 63 – THE NEW DEFINITION OF HIGHLY PRODUCTIVE 5-AXIS MACHINING



Engineering

CONTROL HOUSING

Material: Steel

Dimensions: 300 × 210 mm



Die & Mold

DIE CASTING MOLD

Material: Tool steel

Dimensions: 310 × 240 mm



Aerospace

VALVE BLOCK

Material: Aluminum

Dimensions: 180 × 230 mm

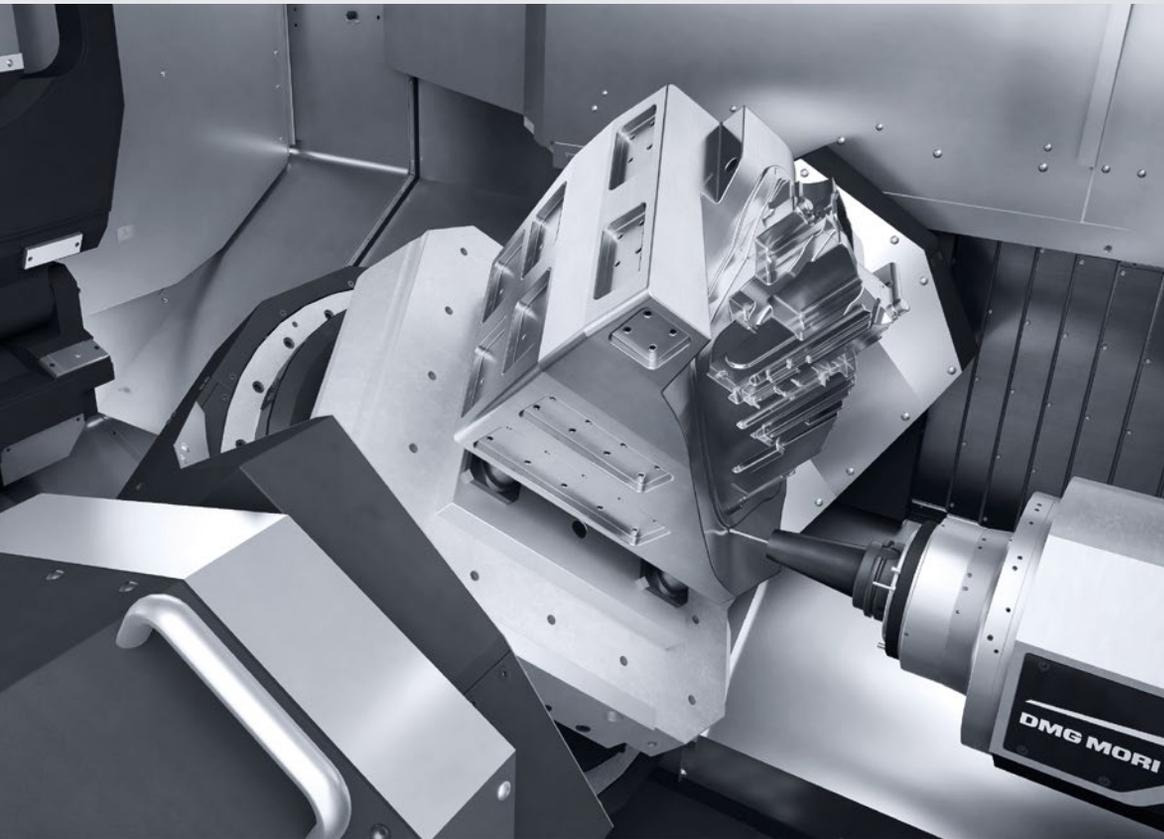


E-Mobility

BATTERY CASE

Material: Aluminum

Dimensions: 600 × 490 mm



Working area: Stainless steel cover/2x spiral conveyors

- + **Large working area**
 - X/Y/Z-axis travel: 1,050/1,100/1,050 mm, 630×630 mm pallet size
 - Workpieces 5-axis up to $\varnothing 1,070 \times 1,000$ mm/1,000 kg
($\varnothing 1,070 \times 1,300$ mm/1,500 kg for machining without A-axis functionality possible)
- + **High speed, up to 1.2g acceleration**
 - X/Y/Z: 1.0/1.2/0.7g
- + **5-axis machining**
 - Swiveling rotary table with +45°/-195° swivel range
 - DirectDrive motors: A-axis with tandem drive up to 30rpm and B-axis up to 90 rpm
- + **Heavy duty cutting**
 - powerMASTER spindle with 12,000 rpm, 808 Nm and 85 kW (10%)
 - Up to 16,000 rpm or up to 1,414 Nm (8,000 rpm) optional
- + **36 month warranty with unlimited spindle hours**
- + **Tooling**, wheel magazine for setup during production*
 - 63 tool pockets as standard, up to 363 available
 - $\varnothing 320 \times 700$ mm and 35 kg max. tool size
 - 50 kg tool weight optional
 - Optical tool breakage detection and chip breaking control
- + **CELOS**
 - CELOS with MAPPS on FANUC (SIEMENS available from 2024)

*from 2x wheels with 123 pockets



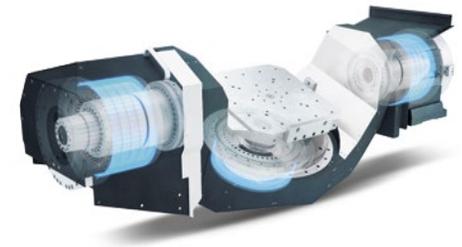
The video of the INH 63
you can find under:
www.dmgmori.co.jp/en/movie_library/movie/id=6780

Machine structure
with twin ball
screws for X, Y, Z
and slanted
column



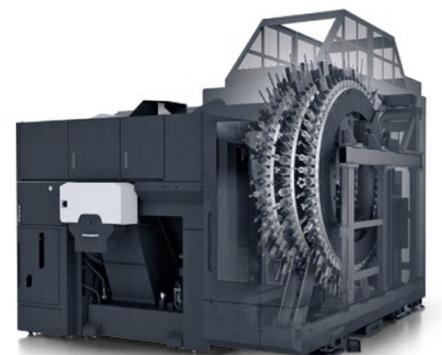
HIGHLY RIGID & DYNAMIC DESIGN

- + Twin ball screws for X, Y, Z and slanted column
- + Twin scale by MAGNESCALE for X, Y, Z
- + 3-point support



HOLISTIC COOLING CONCEPT

- + Spindle motors
- + Table – Direct Drive motors
- + Ball screws and ball screw nuts
- + Servo motors



WHEEL MAGAZINE

- + 63 tool pockets (HSK-A100/#50) with 1 wheel as standard
- + 123 tool pockets with 2 wheels up to 363 tool pockets with 6 wheels

WORLD
PREMIERE
2023

INH 63 – PERFECT FOR AUTOMATED PRODUCTION

- + **CPP – pallet handling**, entry-level flexible pallet storage solution
 - Up to 29 pallets
 - Operated via machine HMI or via the DMG MORI master computer LPS 4 (option)
 - Tool management system MCC-TMS
- + **LPP – pallet handling**, advanced pallet storage solution for up to 8 machines and 99 pallets
 - Very flexible pallet pool system for up to 8 machines, 99 pallets and 5 setup stations
 - Controlled directly via DMG MORI master computer software LPS 4
 - Integration into customer network/workflow possible
 - Monitoring and management tools for all relevant areas (planning, workpieces, fixturing, tools, etc.)
 - Tool management system MCC-TMS
- + **Workpiece handling**
 - Robot system MATRIS.
 - no programming required

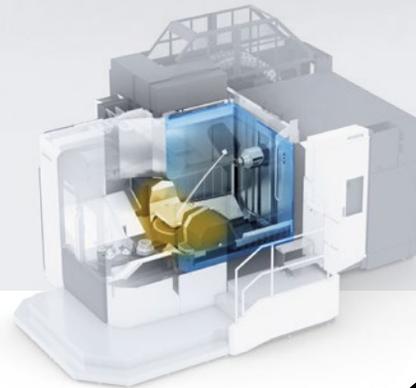


*zero-sludge***COOLANT pro** (standard)



- + For low-maintenance operation over long periods of time
- + Use of innovative large-capacity vertical coolant tank
- + Perfect separation of floating and sinking dirt particles from the coolant.

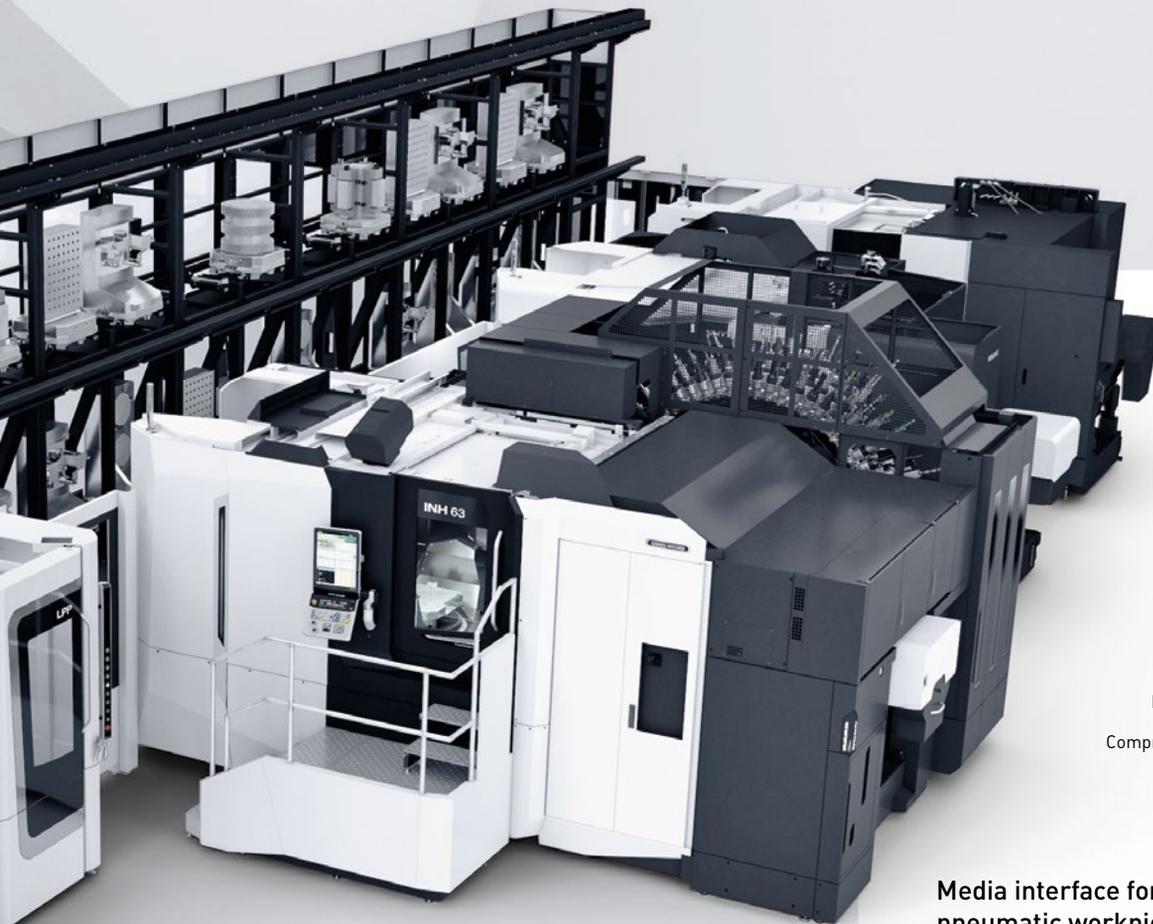
→ Contributes to the configuration of highly productive automation systems



In-Machine Coolant (standard)

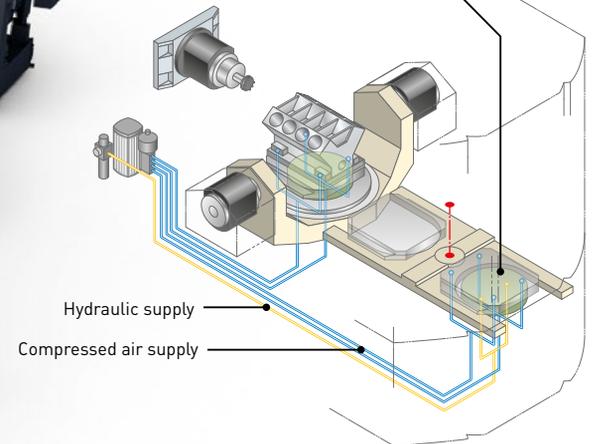


- + Hybrid cleaning method to avoid chip accumulation
- + Fixed outlets on ceiling, sides and spindle nose
- + Controlled ceiling nozzles direct the coolant specifically to the areas, where chips can accumulate
- + New: 2 frequency-controlled high-efficiency pumps with control valves for the high- and low-pressure range



1x INH 63 and 2x NHX 6300
+ LPP with 2x setup stations

>> Universal pallet design:
combination of NH 6300 DCG,
NHX 6300 and INH 63 possible



Media interface for hydraulic/ pneumatic workpiece clamping (standard) ✓

Clamping hydraulics through the pallet, maintaining the hydraulic clamping pressure during pallet change

- + 70 bar pressure
- + 8 ports for hydraulics and pneumatics
- + Technology: customized workholding fixtures by DMG MORI or our DMQP partner



AI chip removal (option)

- + AI detects the "Location" and "Amount" of chips based on the images taken
 - + High-performance coolant nozzle to remove chips
 - + Reduced manual cleaning work by the operator
- Prevents machine downtimes caused by chip accumulation



zeroFOG – BUILT-IN MIST COLLECTOR (option)

- + Air quality comparable to household air purifiers
- + Mist collection efficiency over 99.97% for 0.3µm particles
- + No additional floor space necessary
- + Unified design concept with the machine
- + Frequent filter cleaning no longer necessary

→ Contribution to SDGs:
less energy consumption and carbon emission.

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2023

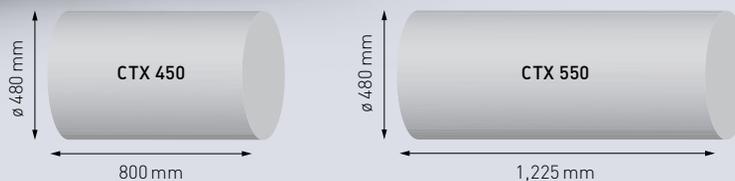
CTX 450 & CTX 550 MORE THAN A LATHE

6th GEN

CTX 450
20% INCREASED
TURNING
DIAMETER



CTX 550
45% MORE
CUTTING
PERFORMANCE



POWERFUL

- + Left spindle up to 40 kW and max. 770 Nm:
 - CTX 450: ISM 80 with 4,000 rpm and 360 Nm
 - CTX 550: ISM 102 with 3,250 rpm and 770 Nm
- + Right spindle up to 14 kW and 360 Nm
 - Opt1: ISM 65 with 5,500 rpm and 192 Nm
 - Opt2: ISM 80 with 4,000 rpm and 360 Nm
- + Air/oil lubrication turrets for 100% duty cycle in milling operations

PRECISE

- + 3 or 4 row bearings based on turnMASTER spindle concept
- + High performance spindles with precise C-axis (0.001°)
- + MAGNESCALE Direct Measuring system in X- and Y-axis as standard

FLEXIBLE

- + 6-sided complete machining thanks to left & right spindle and 130 mm Y-axis stroke
- + Direct Drive turret, up to 10,000 rpm and 49 Nm
- + Ready for Automation: Shaft unloading, Robo2Go, MATRIS, external gantry loader, etc.

12-FOLD VDI 40 TURRETS

- + 4,000 rpm/6.5 kW/21 Nm
- + OPTION High Speed Turret (V3, V4, V6)
→ 7,000 rpm/12.5 kW/27 Nm
- + OPTION Direct Drive (V6)
→ 10,000 rpm/11 kW/49 Nm



Highly reliable machines for a long-lasting investment – the new CTX 450/550 combine excellent cutting power with a convenient working area and high performance milling capacity.

Dr. Eng. Claudio Merlo
Managing Director
GRAZIANO TORTONA S. R. L.



ENERGY EFFICIENT

- + Synchron (IPM) spindle motors with up to 10 % more energy efficiency
- + Hydraulic and coolant devices with drives controlled by inverter technology
- + Energy monitor APP on board
- + Minimized compressed air consumption
- + Stand-by mode with Advanced Auto Shutdown function



DMG MORI ACADEMY

SPECIAL OFFER FOR EDUCATION

Invest in the future now and take advantage of our special prices for schools, educational institutions and training workshops. Available machine packages: CTX 350, DMU 40, NLX 2000|500, NTX 500

COMPREHENSIVE EDUCATION PACKAGE:

Extensive equipment on the machines, state-of-the art control, training courses, programming & training software, DMG MORI TrainingBox with manuals and exercises, packaging, commissioning, etc.

Sebastian Plau
Head of Sales
DMG MORI Academy
sebastian.plau@dmgmori.com



WORLD
PREMIERE
2023

CTX beta 450 TC WELL EQUIPPED – TODAY AND IN THE FUTURE

HIGHLIGHTS

- + compactMASTER turning and milling spindle with 15,000 rpm and 120 Nm as standard (optional: 20,000 rpm)
- + Main and counter spindles with up to 5,000 rpm and maximum of 36 kW/720 Nm
- + \varnothing 76 or 102 mm bar capacity
- + Workpieces up to \varnothing 400 x 1,100 mm
- + Footprint of just 10 m²



Video of the new
CTX beta 450 TC:
youtu.be/1j5iHa2n6_8



best usability

- + CELOS for APP-based end-to-end workflows
- + 80% faster and more structured programming with 3D Shopfloor Programming & OP Workbench
- + Sinumerik ONE for more performance and new technology functions
- + Excellent ergonomics with 24" ERGOline IV

efficiency

- + Shorter set-up times thanks to process integration
- + 29% less energy consumption* thanks to braking energy recovery, LED lighting, frequency-controlled pumps and also AutoShutDown, sealing air shut-off and energy monitoring
- + Shorter process and idle times with faster NC and rapid traverse up to 50 m/min and compactMASTER with 15,000 rpm as standard

* in comparison to a reference machine of similar design



AUTOMATION – EQUIPPED AND RETROFITTABLE!

Integrated gantry automation for tools weighing up to 2 × 15 kg – or flexible, retrofittable workpiece automation with Robo2Go. Complementary magazine for 120 tools – also for subsequent expansion of your capacity to up to 200 tools.

t echnology

- + 5-axis simultaneous machining as standard for more complex components and faster machining with greater precision
- + 6-sided complete machining with identical main spindle and counter spindle for maximum flexibility in the machining strategy
- + 5-in-1 process integration: Turning, milling and grinding – with integrated structure-borne noise sensor, gear cutting and measurement
- + 36 available technology cycles for user-friendly workshop programming, for increasing productivity and safety, and to expand machine capability

a utomation

TOOL HANDLING

- + Up to 200 tool pockets (60 pockets as standard) for tools up to $\varnothing 140 \times 400$ mm
- + Loading during production

WORKPIECE HANDLING

- + Unloading unit for impact-free unloading up to 30 kg
- + Integrated gantry loader for workpieces up to 2 × 15 kg
- + Robo2Go for small to medium sized batches with intuitive operation – now with tray storage!

MX – Machining Trans- formation

The needs of society change drastically every 10 years. We have continuously developed our business model in order to fulfill these needs with new products and services. We are driving forward with **green transformation (GX), process integration, automation and digitization** of machine tools with **MX – Machining Transformation**.

Our objective is to respond to changes to the business environment with this new concept. Workpieces that used to be machined by several machines one after the other can now be manufactured by a process-integrated machine such as a 5-axis machine or a milling and turning center. The single clamping makes it possible to achieve greater accuracy. As well as process integration, automation leads to further resource optimization. For example, this includes compensating for a shortage of operators, eliminating work-in-progress that used to be idle after each process, and reducing the production footprint. Digitization helps to optimize the machining process by visualizing and providing feedback in areas in which operators cannot intervene because of the automation. The areas of process integration, automation and digital transformation have an effect on the green transformation.

Our social contribution consists of the resulting sustainability. However, other social areas include finding a solution to the shortage of skilled staff by means of automation, and developing top talent using an extensive training program within the scope of digitization.

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PROCESS INTEGRATION

→ from page 16



GX – GREEN TRANSFORMATION

→ from page 82

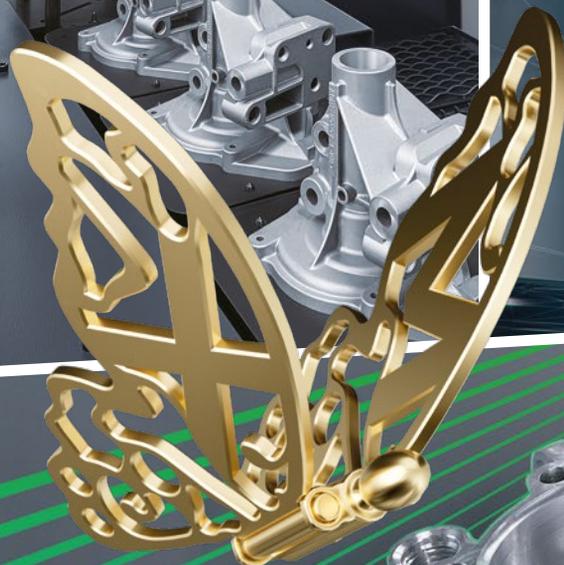
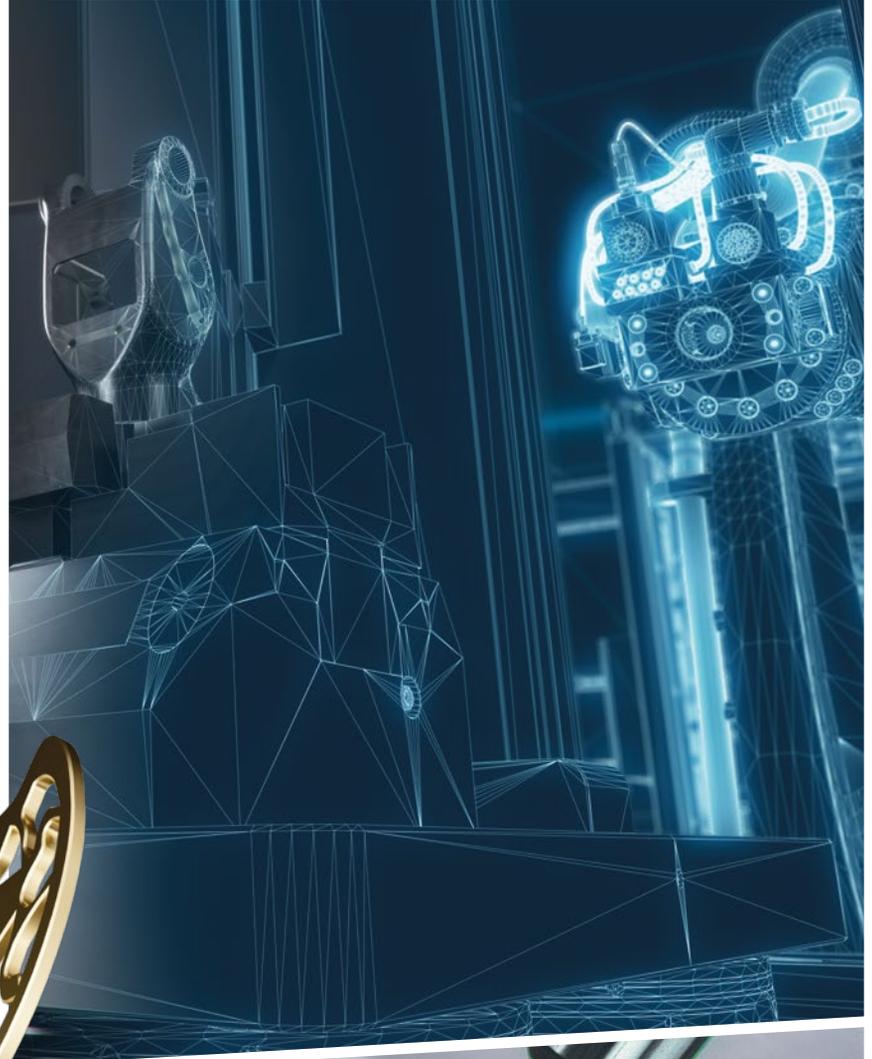
AUTOMATION

→ from page 32



DX – DIGITAL TRANSFORMATION

→ from page 72



MX – MACHINING TRANSFORMATION

WHY 5-AXIS MACHINING?

Learn how to reduce cycle times
= reduced energy cost, more money earned

WHY MX – MACHINING TRANSFORMATION?

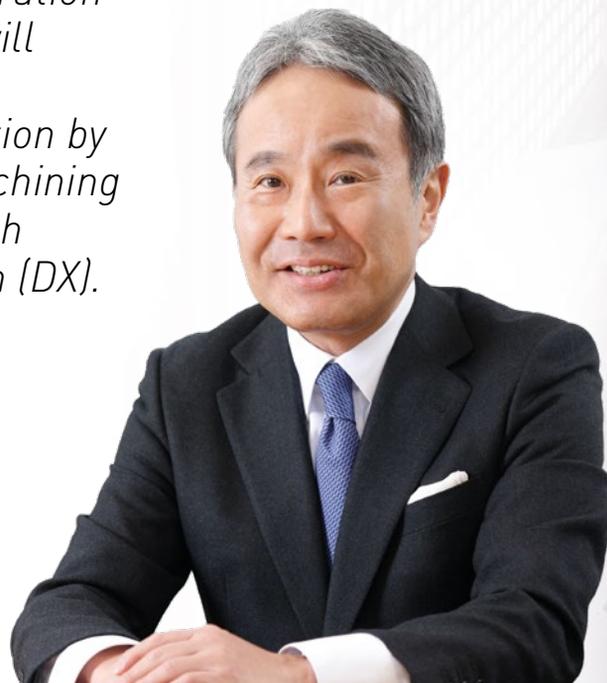
Improve your processes using process integration,
automation and digital transformation to become more
profitable & sustainable

SOLUTION FINDER

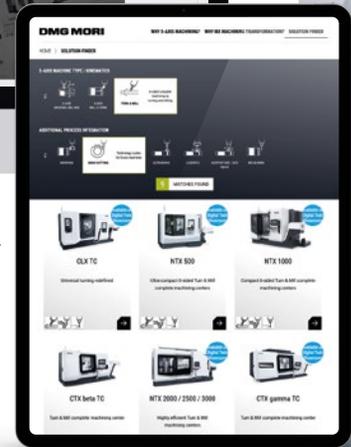
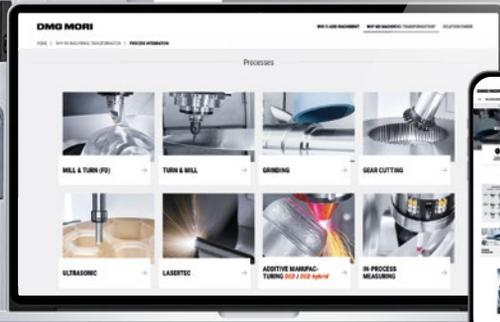
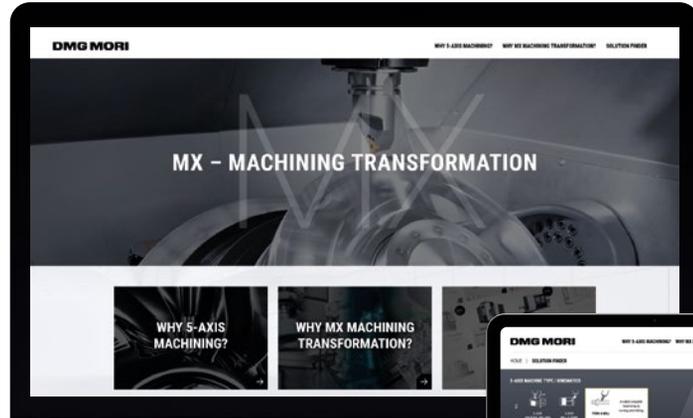
The world's biggest 5-axis portfolio
+ process integration

DMG MORI aims for ultimate Green Transformation (GX) through process integration and automation. We will contribute to global environmental protection by making the entire machining process leaner through Digital Transformation (DX).

Dr. Eng. Masahiko Mori
President
DMG MORI COMPANY LIMITED



EXPLORE THE WORLD OF MX



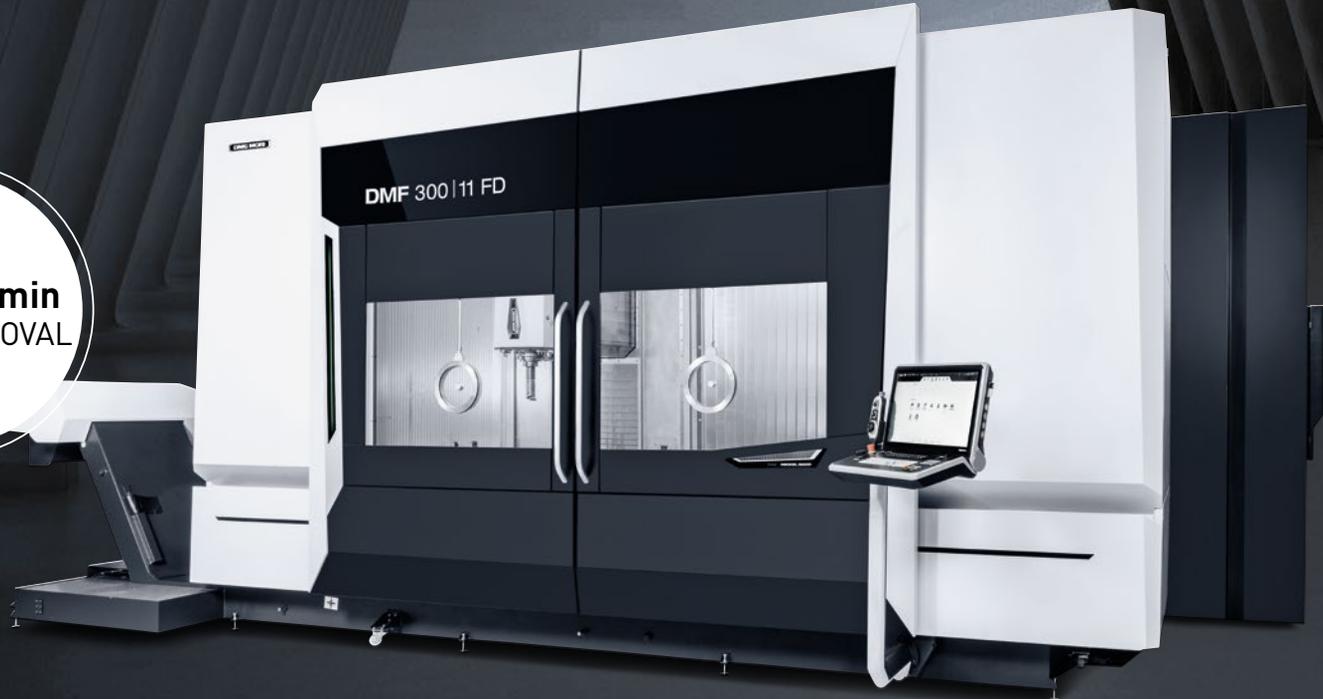
You can find our web special at:
transform.dmgmori.com



DMF 300 | 11

MAXIMUM PRECISION IN THE AREA OF TRAVELING COLUMN MACHINES

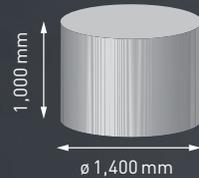
Up to **1,500 cm³/min** METAL REMOVAL RATE*



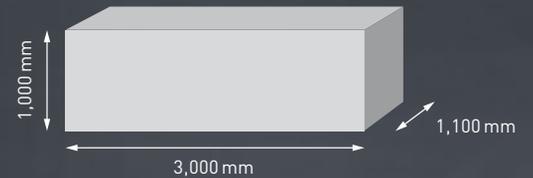
HIGHLIGHTS

- + Large work area with travels of X=3,000 mm/Y=1,100 mm/Z=1,050 mm
- + Patented and innovative tool change: fast, collision free and with process reliability behind the work table
- + Maximized rigidity thanks to 3 linear guideways in the X-axis
- + Reliable milling performance thanks to consistent overhangs
- + Excellent surface finish, high accuracy and temperature stability by means of ground and internally-cooled ball screws in all linear axes and a holistic cooling concept
- + Maximum flexibility during machining thanks to the B-axis milling head with a swivel range of $\pm 120^\circ$ and clamping force of 6,000 Nm

Workpiece dimensions, 5-axis (tool length: 100 mm)



Workpiece dimensions, 3-axis (tool length: 100 mm)



Application examples



STRUCTURAL COMPONENT
 Industry: Aerospace
 Material: AlMg4.5Mn
 Dimensions: 745 × 220 × 110 mm
 Machining time: 120 min.



TOOL MOLD
 Industry: Mold-making
 Material: 40CrMnMo8-6-4
 Dimensions: 1,000 × 600 × 310 mm
 Machining time: 2,450 min.



BATTERY BOX
 Industry: Automotive
 Material: AlSi1MgMn
 Dimensions: 900 × 1,300 × 150 mm
 Machining time: 480 min.



HOUSING
 Industry: Aerospace
 Material: AlMg4.5Mn
 Dimensions: $\phi 400 \times 215$ mm
 Machining time: 923 min.

* powerMASTER 12,000 rpm 52 kW / 430 Nm HSK A100; F = 22 m/min, $A_p = 1.2$ mm, high-feed cutter magazine

*The new DMF | 11 series:
a quantum leap for your
shop floor: Unbelievably
productive and flexible,
with a metal removal rate
of up to 1,500 cm³/min.*

Fabian Suckert
Managing Director
DECKEL MAHO Seebach



PERFORMANCE

- + SK 50 powerMASTER spindle with 12,000 rpm and up to 430 Nm
- + Maximum stability thanks to a one-piece machine bed made from nodular cast iron and 3 linear guideways in the X-axis
- + 10 µm positioning accuracy over a travel of 3,000 mm
- + Optional linear drive in the X-axis for better dynamics, accuracy and minimal wear



FLEXIBLE

- + Partition wall with pendulum machining for setting up the machine during production
- + Holistic spindle portfolio with speedMASTER spindles with up to 20,000 rpm/130 Nm and powerMASTER spindles with up to 12,000 rpm/430 Nm
- + The right solution for every application: Be it a rigid table, one or two integrated rotary tables and a milling-turning table and NC add-on table as an A-axis



PRODUCTIVE

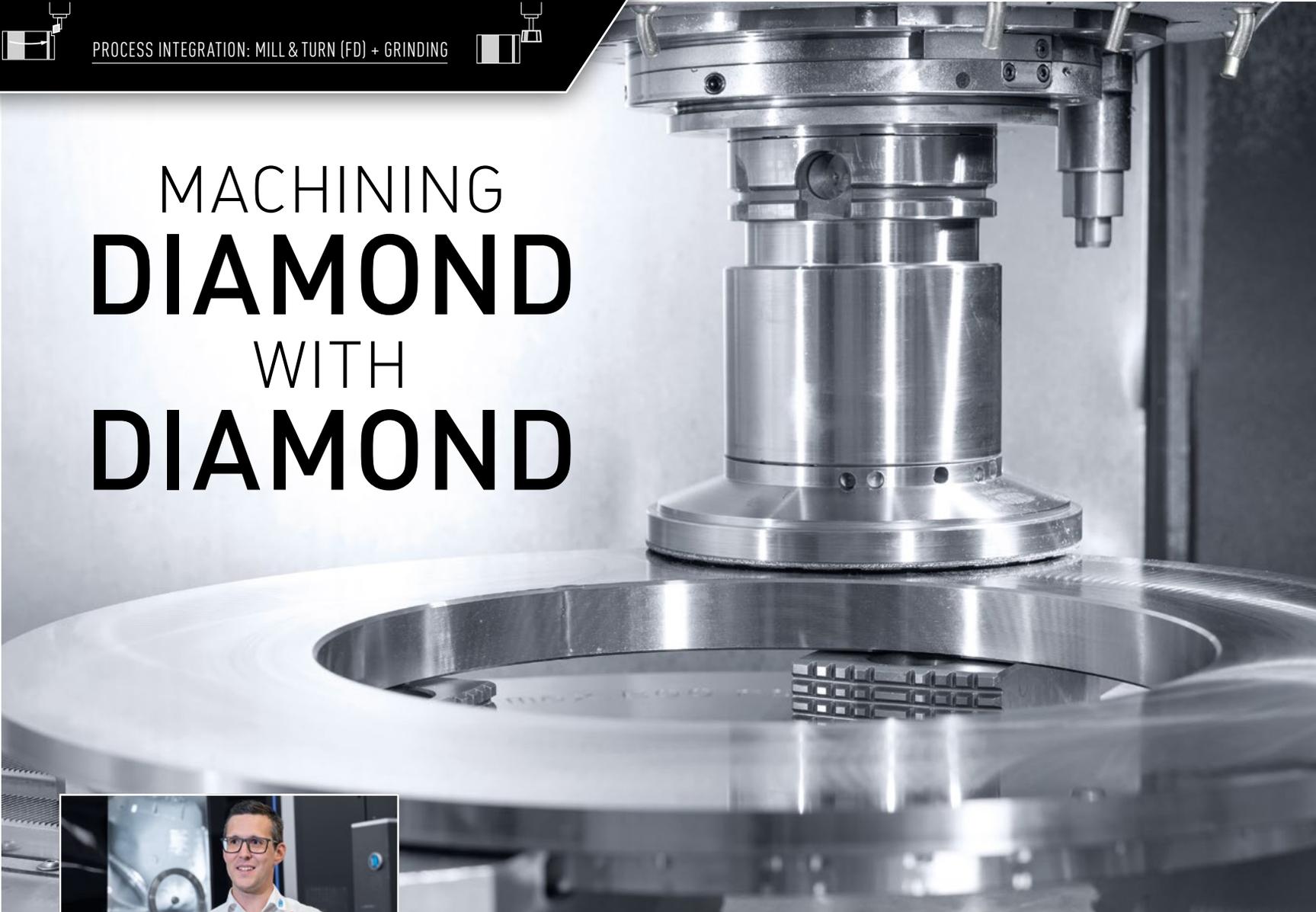
- + Technology integration: milling and turning, grinding, gear cutting, in-process measurement in a single machine
- + Tool magazines with up to 300 SK 40 pockets and up to 230 SK 50 pockets**
- + SK 40 tool length up to 400 mm (8 kg) and SK 50 tool length up to 450 mm / HSK-A100 540 mm (20 kg)
- + Milling and turning on a single machine with up to 700 rpm and a component weight of up to 1,000 kg



**Available from 2025: SK 40 with > 120 tools / SK 50 with > 50 tools using magazine behind covers



MACHINING DIAMOND WITH DIAMOND



Automated all-in-one machining for highest accuracies <math>< 10 \mu\text{m}</math>.

Thanks to the process integration of milling, turning and grinding, throughput times have been drastically reduced on the one hand and on the other we now achieve component accuracies of less than $10 \mu\text{m}$.

Florian Zitt
Process Engineering
Tyrolit Group

Tyrolit has been in business since 1919 and has its headquarters in Schwaz, Austria. Worldwide, the family-owned company employs more than 4,400 people at 31 production sites in eleven countries. As one of the leading manufacturers of bonded grinding and dressing tools for a wide range of manufacturing industries and system solutions for the construction industry, Tyrolit has 80,000 different and often customized products for individual requirements in its portfolio. At its plant in Schwaz, the company manufactures a multitude of different diamond grinding tools, which are used in many industries including the automotive industry among others. To ensure the high quality of the tools, Tyrolit has relied on state-of-the-art machine tool technology from DMG MORI in its production facilities for many years. Five lathes, turn-mill centers and machining centers are in operation in Schwaz alone.

The highlight is a DMC 80 FD duoBLOCK installed in 2020, in which grinding is also integrated. A rotary pallet storage system with seven positions automates production.

100 employees for new and further developments

A high level of innovation has long been a top priority. "Only in this way can we meet the increasing demands of our customers over the long term," explains Florian Zitt, responsible for process engineering at Tyrolit. Over 100 people in the company, who cooperate closely with research institutes and universities, are responsible for further technological development. The figures clearly speak for themselves: 30 percent of sales are generated from products that have been on the market for less than three years.

Development partners in process integration

The innovative mindset is also reflected in the company's own production. "Because it means we can manufacture most products economically," says Florian Zitt. In view of the limited space available, manufacturing solutions are called for that integrate as many machining steps as possible in one work area. "In DMG MORI, we have found a partner with which we can consistently continue to develop these possibilities." He is refer-

MILLING, TURNING, GRINDING: SHORT THROUGHPUT TIMES AND μ -PRECISION MACHINING

ring here to the integration of grinding in a DMC 80 FD duoBLOCK. Both companies cooperated in the development of this solution, which has been operating successfully since 2020.

"The combination of three machining processes in one work area saves a lot of space, because we were able to replace three machines with the machining center," says Florian Zitt, describing the conditions on the shop floor. On the other hand, throughput times have been drastically reduced because

repeated setups, operations and idle times are a thing of the past. "The fact that we no longer have to reclamp components manually also has a significant impact on accuracy," says Florian Zitt, referring to the μ -precise production of the grinding wheels, which are of course machined with diamond grinding tools from the company's own portfolio. "The extreme durability of these products makes a significant contribution to economical and also sustainable production."

Motivation thanks to responsible jobs

Florian Zitt sees another advantage in the advanced technology integration: "In the past, milling, turning and grinding were very different disciplines. Today, these disciplines are combining to create an even more responsible job." This makes a decisive contribution to motivation. "Today, I would no longer speak of machine operators, but of machine managers, because we are dealing here with absolute high-tech." Young people in particular are attracted to working with modern technologies, which benefits Tyrolit in its training. "Our goal is, of course, to retain the apprentices for the long term," says Florian Zitt.

Automated production in virtually unattended shifts

The integration of grinding on the DMC 80 FD duoBLOCK was one of two new developments for Tyrolit. The other is automated production. The machining center is equipped with a rotary pallet storage system for seven pallets, so autonomous production of individual parts is possible to a large extent.



Tyrolit Polaris Plus LW grinding wheel base body in lightweight design.

DMC 80 FDS duoBLOCK

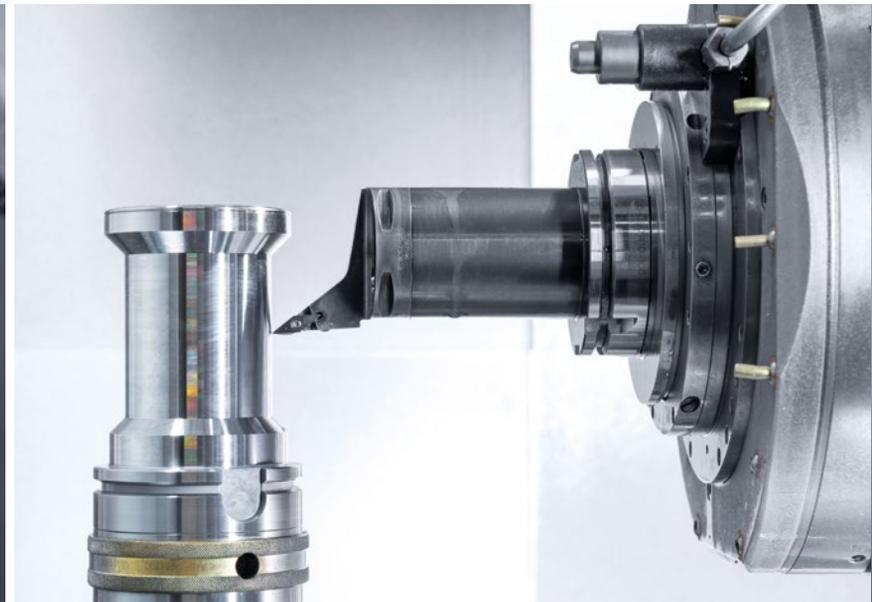
COMPLETE MACHINING: MILLING, TURNING AND GRINDING ON ONE MACHINE

HIGHLIGHTS

- + 800 rpm-Direct Drive Table for **5-axis milling and turning in a single clamping**
- + Workpieces up to $\varnothing 900 \times 1,450$ mm and 1,200 kg
- + **powerMASTER motor spindle** with 1,000 Nm and 77 kW
- + **5X torqueMASTER spindle** with 1,300 Nm and 37 kW
- + **Excellent surface quality thanks to grinding technology integration**



You can find the video on the duoBLOCK series at: youtu.be/Ql0LzkJXUAY



MILLING

TURNING

Exclusive technology cycle
360° TECHNOLOGY COMPETENCE

MILLING, TURNING AND GRINDING

- + **Milling, turning and grinding in a single clamping**
- + **Grinding cycles** for internal, external and face grinding, cylindrical grinding and **dressing cycles**
- + Stationary or rotating **dressing unit** for dressing a wide range of grinding wheels using **structure-borne sound sensors**
- + **ECS nozzle unit** for efficient flushing of the grinding gap available as an option

Available for: CTX TC (4A) // DMU / C monoBLOCK // DMU / C duoBLOCK // DMU / C Portal



A DMG MORI – Milling, Turning & Grinding video can be found at: youtu.be/WxF-grFCyR0

The use of electrically-actuated fixtures is for boosting the degree of automation even further in the future. Florian Zitt is sure that flexible automation solutions will continue to be a procurement criterion in the future: "They will enable us to increase our capacity for the production of small batches, including during unattended shifts." The batch sizes at the Schwaz site are on average three pieces.

Digitization in tool management

In addition to technology integration and automation solutions, Tyrolit will also continue to forge ahead with digitization. Digital tool management, for example, has already been implemented. "Each tool is scanned

before measurement and automatically requested when the service life of the tools on the machines decreases," Florian Zitt describes the process. Tool life is checked automatically on the machine. "This enables us to achieve reliable production processes because we replace the tools in good time."

Customer-oriented product development

With its innovative manufacturing solutions, Tyrolit is also in a position to produce innovative grinding wheels. Requests from customers are making these increasingly complex because, for example, the coolant supply must be realized in the most efficient way. "The Centuria SM-G grinding wheels have a



Electrically-actuated, intelligent chuck for highly sensitive component clamping.



Customized solution for connecting a digital tool database.

RA UP TO 0,4 µm
CIRCULARITY
UP TO 5 µm
IT4 AT ø > 300 mm

GRINDING

patented coolant supply, for example, applied directly to the diamond layer via numerous bores", Florian Zitt tells us about the design. Lightweight versions are also becoming an increasingly important topic: "The bodies of our Polaris Plus LW wheels are designed with cavities. Our range also includes carbon fiber tools." Tyrolit intends to maintain its sustained growth with such developments. "The medium-term sales target for the entire group is one billion euros," Florian Zitt advises. "That also means we will continue to invest in future-oriented manufacturing solutions such as those offered by DMG MORI."

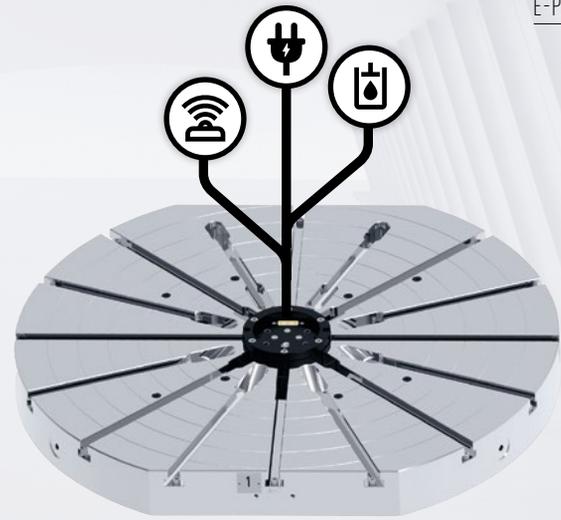
«

TYROLIT FACTS

- + Founded 1919 in Schwaz, Austria
- + 4,400 employees and 31 production locations
- + Leading manufacturer of grinding and dressing tools worldwide



Tyrolit Group
Swarovskistraße 33
6130 Schwaz, Austria
www.tyrolit.group



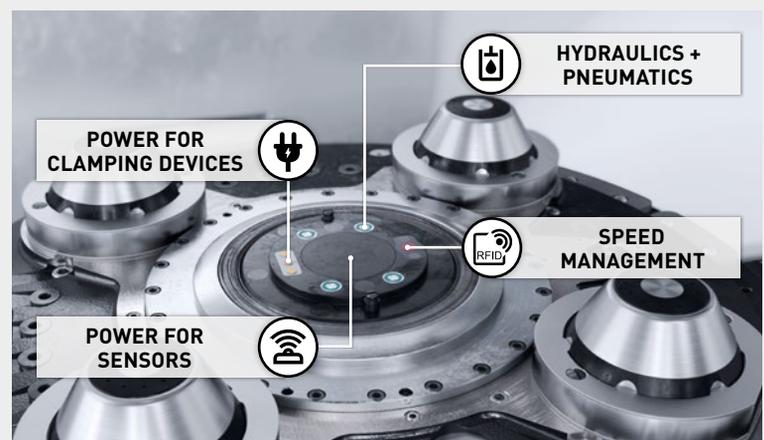
NEW: E-PALLET

HIGHLY FLEXIBLE AND INTELLIGENT INTERFACE FOR POWER, SENSORS, HYDRAULICS, AND PNEUMATICS

The new E-Pallet from DMG MORI can supply power for fully electric component fixturing by means of docking and power for sensor feedback (inductive). This permits the continuous monitoring of sensors. In addition to power, the new interface can, as usual, have up to four channels for hydraulics or pneumatics

HIGHLIGHTS

- + 48V/50A interface for fully electric fixtures
- + 24V/4A interface for continuous, secure interrogation and monitoring of the fixture by means of sensors
- + Safe wheelspeed management via RFID technology
- + Cost reduction through flexible workholding and optimized processes
- + Elimination of channel limitation due to intelligent directional control valves on the fixture
- + Electrical switching of directional control valves enables control of the individual points of clamping



A video on the E-pallet can be found at:
youtu.be/jwMW0SSbM-8



INTO SPACE

WITH 5-AXIS MACHINING AND TURN & MILL







Ouroboros Space and Defense was founded in 2016 in Lakewood, Colorado. The ten-member team has years of experience in demanding industries such as aerospace, defense, and nuclear. With this expertise, Ouroboros specializes in the high-precision machining of components for rocket engines. Customers include NASA and well-known industry giants such as SpaceX, United Launch Alliance, and Blue Origin. To meet the increasing demand for these critical components while maintaining high-quality standards, the company has added three high-end DMG MORI machines – a DMU 95 monoBLOCK, an NTX 2000 and a DMU 50 – to its machine portfolio since 2021.

14 % growth in the field of rocket propulsion systems

“We are experiencing rapid growth in the aerospace sector, especially in rocket and hypersonic propulsion applications. Annual growth in the sector is over 14 percent,” says Nathan Bourgeois, Owner of Ouroboros Space and Defense, describing current developments in his market environment. As a result, he

says, his team is in greater demand than ever to manufacture innovative technologies that provide sufficient thrust – literally – to forward-looking aerospace projects. “To do this, we first solve the major challenges in manufacturing with our team, and then build the most advanced hardware in the industry.”

DMG MORI – 5-axis machining in the ten thousandths range for space travel

Ouroboros achieves the high precision requirements with tolerances in the ten thousandths range with modern machining technologies and precision welding. The best surface qualities, complex geometries, and even single-part production are part of the daily business. Machining alone accounts for 75 percent of annual sales. “For us to produce these types of components quickly, we depend on productive and highly accurate machine tools,” says Nathan Bourgeois. He added that Ouroboros had found the perfect partner in DMG MORI. “The DMU 95 monoBLOCK was able to significantly exceed our expectations for consistent accuracy – especially compared to our previous machine tools.”

With traverse paths of 950×850×650 mm, the DMU 95 monoBLOCK offers sufficient space for a wide range of components. Only at a diameter of ø1,040 mm and a workpiece weight of 1,000 kg is the limit reached. The

DMU 95 monoBLOCK – WORKPIECES UP TO ø 1,040 mm WITH 5 µm

machining center offers 5-axis simultaneous milling with a positioning accuracy of 5 µm on a footprint of only 12 m². This is due to the rigid machine concept with high stationary masses and weight-optimized moving components as well as extensive cooling measures.

»



DMU 95 monoBLOCK

THE monoBLOCK SERIES ALWAYS FITS

- + DMU 95 monoBLOCK: Workpieces up to ø1,040×590 mm and 1,000 kg
- + speedMASTER spindle with 20,000 rpm and 130 Nm
- + 5 µm positioning accuracy and 30% higher volumetric accuracy due to VCS Complete
- + Over 96% machine availability and MASTER spindles with 36-month warranty
- + Wide range of automation solutions – also retrofittable



Click here for the video of the monoBLOCK series: youtu.be/l1jBCPF_EAM



Thanks to the 5-axis and Turn & Mill machines from DMG MORI, we have massively reduced lead times on high complexity hardware. We now regularly achieve accuracies in the ten-thousandth range that were previously impossible to manufacture.

Nathan Bourgeois (right) Owner
Constantin Diehl (left), Chief Operations Officer
Ouroboros Space and Defense

Ouroboros Space and Defense is specialized in high-precision machining of components for rocket engines. For these critical parts, they use two DMG MORI 5-axis machines, as well as one turn & mill machine NTX 2000.



1



2



3

1. Part of the Ouroboros team in front of the NTX 2000
2. The NTX 2000 enable 6-sided turn & mill complete machining of workpieces up to $\phi 670 \times 1,538$ mm
3. For smaller components up to up to $\phi 630 \times 600$ mm and 300 kg, Ouroboros uses a DMU 50 3rd Generation

**5-axis simultaneous machining:
faster and more accurate**

“Since purchasing the DMU 95 monoBLOCK, we have been able to completely machine even complex components very efficiently,” says Nathan Bourgeois, citing the added value. “The complex and feature dense hardware we regularly work with necessitates highly accurate machine tools and powerful controls to match. When running tests between our HEIDENHAIN control and our previous FANUC based systems, the difference in speed was truly incredible.” On a recently installed DMU 50, Ouroboros is expanding its capabilities in 5-axis simultaneous

machining. The more compact model offers travels of $650 \times 520 \times 475$ mm and is designed for components weighing up to 300 kg. Thus, the DMU 95 monoBLOCK can be increasingly utilized with larger components..

NTX 2000:
PROCESS
INTEGRATION
TURN & MILL

In its search for more innovative manufacturing technologies, Ouroboros in 2022 went a step further. “We also wanted to implement complete machining for demanding turbomachinery components with turning operations. DMG MORI also had a solution here with the NTX 2000,” Nathan Bourgeois recalls. “Now we can finish-machine components from all six sides without manual reclamping while the compactMASTER spindle offers us high milling performance with over 100 Nm of torque. Also beneficial is the flexibility the large work envelope gives us for workpieces up to $\phi 670 \times 1,538$ mm.” With a length of just 350 mm, the compactMASTER



To achieve high precision tool offsets, Ouroboros used a tool presetter by DMPQ (DMG MORI Qualified Products) partner HAIMER.

turn & mill spindle contributes to the size of the work envelope, as does the Y-axis travel of ± 150 mm. The additional lower turret has ± 40 mm of travel in the Y-axis. Nathan Bourgeois is more than satisfied: "The NTX 2000 is extremely versatile and also absolutely convincing in terms of machining quality."

Strong partner for significant growth

"As soon as we bought the DMU 95 monoBLOCK, we realized that DMG MORI provides us with substantial support in producing precision parts with consistent quality," says

Nathan Bourgeois, describing the collaboration with the machine tool manufacturer. This consistency is essential to achieve the planned growth targets. By 2027, Ouroboros plans to continue growing by 100 percent annually. "DMG MORI's CNC technology will continue to sustain our development in the coming years." A new manufacturing site is already being planned, he said. "We will install six to ten more DMG MORI models there."

OUROBOROS SPACE AND DEFENSE FACTS

- + Founded in 2016 in Lakewood, Colorado
- + Team of 10 experienced metalworkers specialized in high-precision machining of components for rocket engines
- + Customers include SpaceX, NASA, Blue Origin, Ursa Major



Ouroboros Space and Defense
5815 West 6th Ave unit
2C Lakewood Colorado 80214, USA
www.ouroborospace.com



TURN & MILL

6-SIDED COMPLETE MACHINING WITH TURNING AND MILLING

+ 100% TURNING:

Up to $\varnothing 1,070$ mm turning diameter for machining large workpieces up to 6,000 mm in length

+ 100% MILLING:

Up to 660 mm in the Y-axis and an ultra-compact and patented compact MASTER turning-milling spindle up to 20,000 rpm or 220 Nm (NT: turning-milling spindle up to 12,000 rpm or 302 Nm)

+ 100% TOOLS:

Up to 180 tools for maximum flexibility in machining and short setup times

+ Exclusive software & technology cycles,

e.g. 5-axis simultaneous machining for machining free-form surfaces, grooving, free-form parting, chip removal, threading, etc.

+ In-process measuring:

Multidirectional workpiece measurement as well as tool measurement and breakage control

+ Automation:

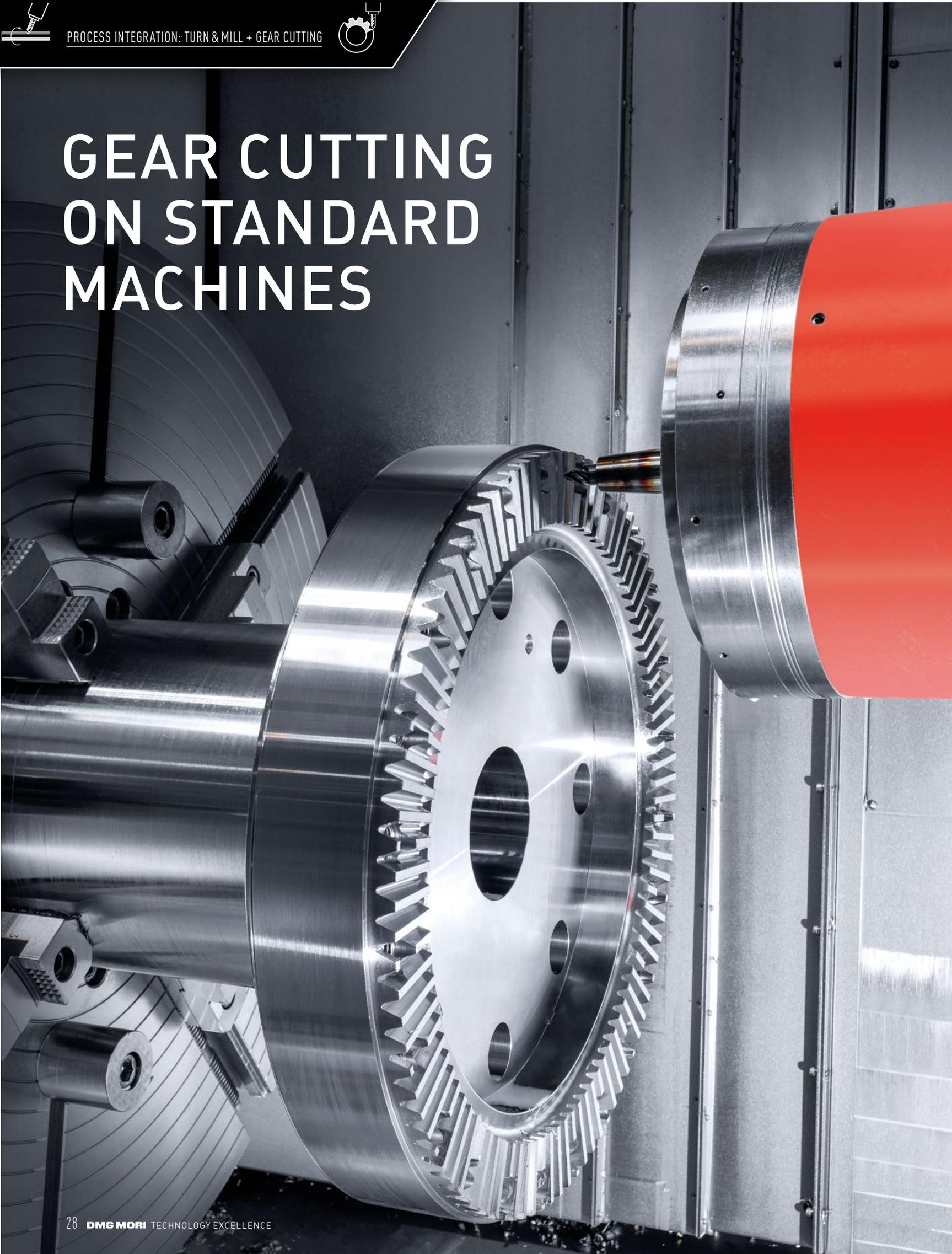
Diverse automation solutions - also retrofittable



Click here to go to the web special: transform.dmgmori.com



GEAR CUTTING ON STANDARD MACHINES





Thanks to the gearMILL software, we can produce almost any gear shape with standard tools on our turn-mill machines – to a quality comparable to special gear cutting machines.

Helmut Hohegger
Managing Director
Kumera Antriebstechnik GmbH

The history of Kumera Antriebstechnik GmbH from Graz dates back to the year 1898, when Norricum Cless Graz built chainless gears for bicycles. Since 2000 the company has been a wholly owned subsidiary of the Finnish Kumera Cooperation. Within the Kumera Power Transmission Group, the Austrian company with its approximately 50 employees produces special gear units for hydro-power plants, the paper industry and chemical installations. 50 percent of sales are also generated by the service business, such as the overhaul and repair of industrial gearboxes from our own product range as well as third-party products. Reliable machining of the gear components is ensured by five turning and turn-mill machines from DMG MORI, including an NT 5400 and the NT 6600 installed in 2021 for turned parts having diameters of up to $\varnothing 1,070$ mm and lengths up to 4,000 mm. Kumera produces sophisticated gears on both turn-mill centers with the help of the exclusive DMG MORI gearMILL technology cycle.

Reverse engineering of individual parts in just a few days

“The order situation has developed positively over the past few years,” says Helmut Hohegger, Managing Director of Kumera Antriebstechnik, about the good utilization of capacity in production. As the focus is mainly

The engineering expertise of the team is an important mainstay in this sector. “Very often we only have a single component, which we measure completely, redesign and carry out calculations and then produce it in the required quality”, is how Helmut Hohegger describes the reverse engineering process.

**NT SERIES:
TURN-MILL
MACHINING OF
WORKPIECES UP TO
 $\varnothing 1,070 \times 4,000$ mm**

on individual parts that have to be delivered as quickly as possible, flexibility plays a key role. “Especially in the service business, we try to provide spare parts within a few days.”

In production, Kumera can draw on a number of different technologies: conventional machining, wire eroding, hobbing and grinding. The company continuously optimizes its processes by regularly investing in innovative manufacturing solutions. “The two turn-mill centers from DMG MORI helped us enormously here”, says Helmut Hohegger recalling the procurements. With their large work areas, both the NT 5400 and the NT 6600 cover a wide range of components and offer maximum machining versatility. Long shafts, for example, can be set up thanks to the steady rest.

»



Produced on the NGT 6600 are large gears and other components, for example for test bench gearboxes.

Image left: The gearMILL technology cycle can be used to produce herringbone, bevel, spur and helical gears – quickly and with maximum precision.



NT 6600

TURN & MILL WORKPIECES OF LARGE DIAMETER

- + Workpieces up to $\varnothing 1,070 \times 6,076$ mm
- + 6-sided complete machining thanks to the main and optional counter spindle
- + 660 mm Y-axis for eccentric machining
- + Turn-mill spindle with up to 8,000 rpm and 302 Nm
- + Tool magazine for up to 140 tools
- + Boring bar with a length of 1,270 mm for Capto C8 tools

Turned parts having diameters of up to $\varnothing 1,070$ mm and 4,000 mm long can be produced on the NT 6600. Long shafts can also be set up easily thanks to the steady rest.

Maximum reliability – in use for over 20 years

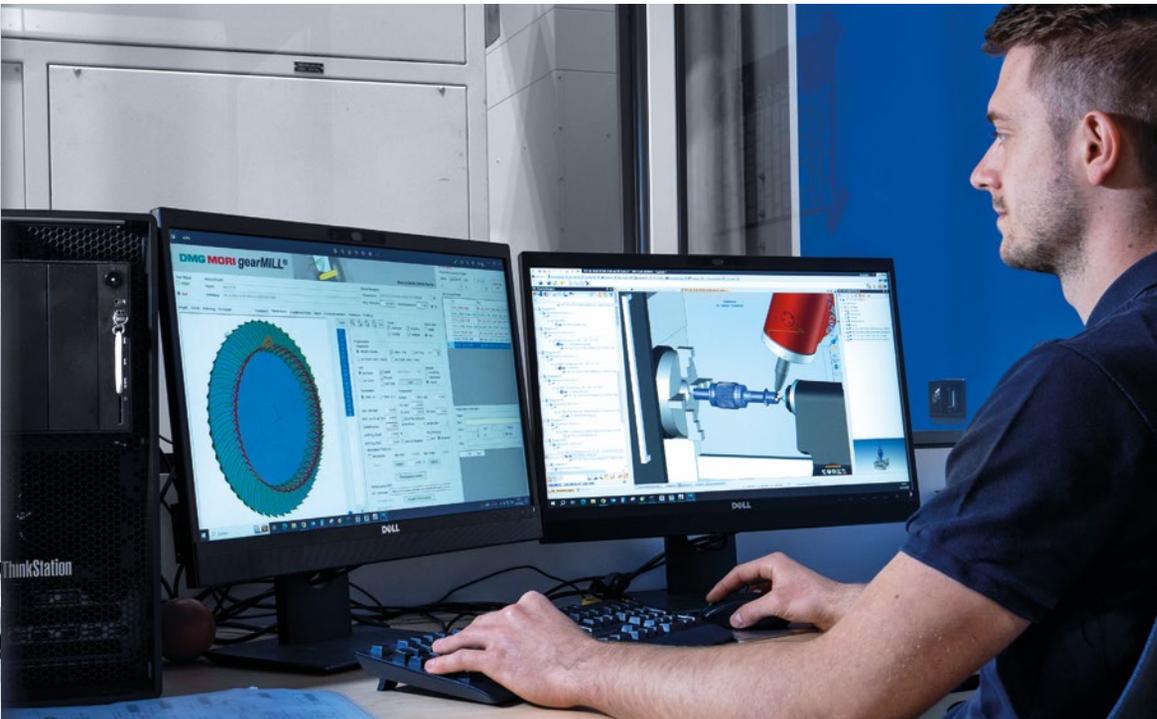
Helmut Hohegger has been familiar with the high level of reliability of the DMG MORI models for many years: "We already had lathes from Japan in use in the 1990s and still use some of them today for training purposes." The quality is impressive after such a long time. "The sturdy construction ensures optimum long-term accuracy and a high level of process reliability."

Fast and simple gear production with gearMILL

The main reason for the purchase of the

NT 5400 was the possibility of milling gears efficiently. What DMG MORI had previously made possible on machining centers and CTX TC models was implemented on an NT machine for the first time. "With the gearMILL technology cycle, we can produce herringbone, bevel and helical gears at any time – quickly and with maximum precision," says Helmut Hohegger, assessing the technology integration. "Depending on the size, we achieve quality in the range DIN 5 to 7." After the successful introduction of gearMILL on the NT 5400, it was clear that Kumera would implement the same principle on the larger NT 6600 in 2021.





The user-friendly programming with gearMILL allows the flexible and economical production of sophisticated gears, flexibly and economically.

Cost-efficient production of demanding gears

What makes gearMILL so easy to use is the program creation based on drawings and gear data. In the case of the two NT machines, production takes place on standard machines with standard tools. "In combination with user-friendly programming, this allows us to produce sophisticated gears flexibly and economically," explains Helmut Hohegger.

Healthy growth and motivation of the next generation

Kumera remains competitive in a fiercely contested market by investing in advanced manufacturing solutions, such as the complete machining of gears described above. Added to this are investments in training and further education, as Helmut Hohegger goes on to tell us: "Well-trained specialists are needed to get the most out of the technology." In addition Kumera promotes a self-reliant way of working in its modern production facility. "Experience shows that this contributes to staff motivation."

Into the future with technology integration and complete machining

Technological progress in production will continue to play a major role at Kumera in the future. Also, against the background of limited production space at the urban

site, complete machining and technology integration are a great help, says Helmut Hohegger: "We focus on high-quality products and components, which we must manufacture all the more efficiently if we want to keep growing strongly."

«

KUMERA FACTS

- + Founded 1898 as Norricum Cless Graz, then later Kachelmann Getriebe GmbH
- + Since 2000 a wholly owned subsidiary of the Finnish Kumera Cooperation
- + 50 employees in industrial gear construction, e.g. for the paper, steel and cement industries as well as for test bench applications



Kumera Antriebstechnik GmbH
Raiffeisenstraße 38-40
A-8010 Graz, Austria
www.kumera.com



TECHNOLOGY CYCLE gearMILL

GEAR CUTTING ON STANDARD MACHINES WITH STANDARD TOOLS

- + Program creation based on drawings and gear data
- + Individually modifiable contact pattern
- + Post-processor for SIEMENS, HEIDENHAIN and MAPPS
- + Interface for coordinate measuring equipment (Klingelnberg, Leitz, Zeiss)
- + SPUR GEARS: Spur, helical and herringbone gears, segments
- + BEVEL GEARS: Spur, helical, spiral bevel and hypoid gears, axis angles other than 90°, Klingelnberg Zyκλο-Palloyd® and Gleason
- + WORM WHEELS: Profile ZA, ZN and ZI



Click here for the gearMILL video:
youtu.be/hqNIXwzNsj8

GLOBAL LEADER IN AUTOMATION: 14 PRODUCT LINES AND 58 PRODUCTS

SET-UP TIME



WORKPIECE HANDLING

PALLET HANDLING

TURNING

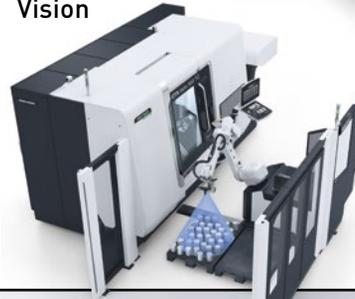


IMTR (NTX 1000)



SR (WASINO)

Robo2Go
Turning/
Vision



Robo2Go Max



MILLING

WH Cell¹



Robo2Go
Milling



MATRIS Light

AWC
(NMV/CMX V)



PH Wheel³



PH Cell 2000
PH Cell 800
PH Cell 300



RPS²



PH 150



PH 50



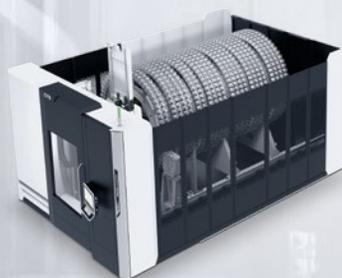
MACHINE-SPECIFIC

UNIVERSAL (1 MACHINE)

CTS – CENTRAL TOOL STORAGE



Rack magazine

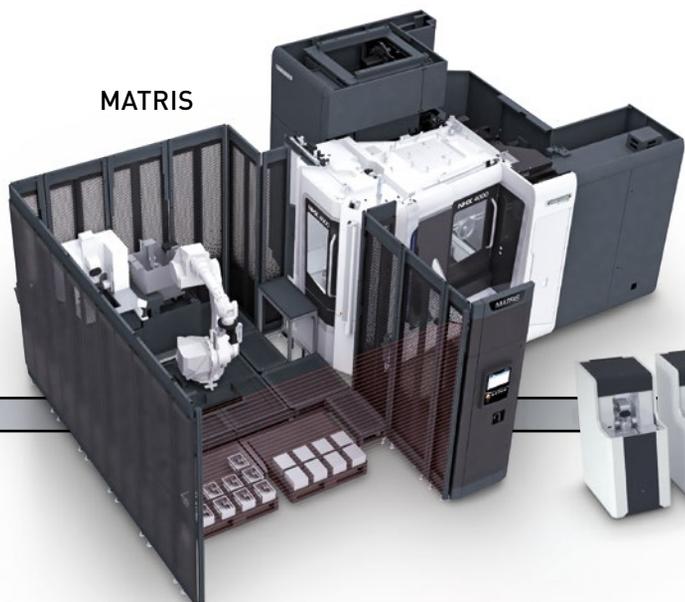


Wheel magazine

LPS – 4th Generation
Control software for DMG MORI
Automation Systems



MATRIS



GX/GX T



WH-AMR

AMR / PH-AMR

LPP



PH Cell Twin



CPP



SCALABLE (≥ 1 MACHINE)

→ COMPLEXITY

¹ DMP, CMX V, CMX U, DMU, DMU eVo, LASERTEC

² NHX, DMC H *linear*, H-monoBLOCK, monoBLOCK, duoBLOCK, Portal

³ DMC 65 monoBLOCK

PRECISION COMPONENTS

FOR LOCAL PUBLIC
TRANSPORT



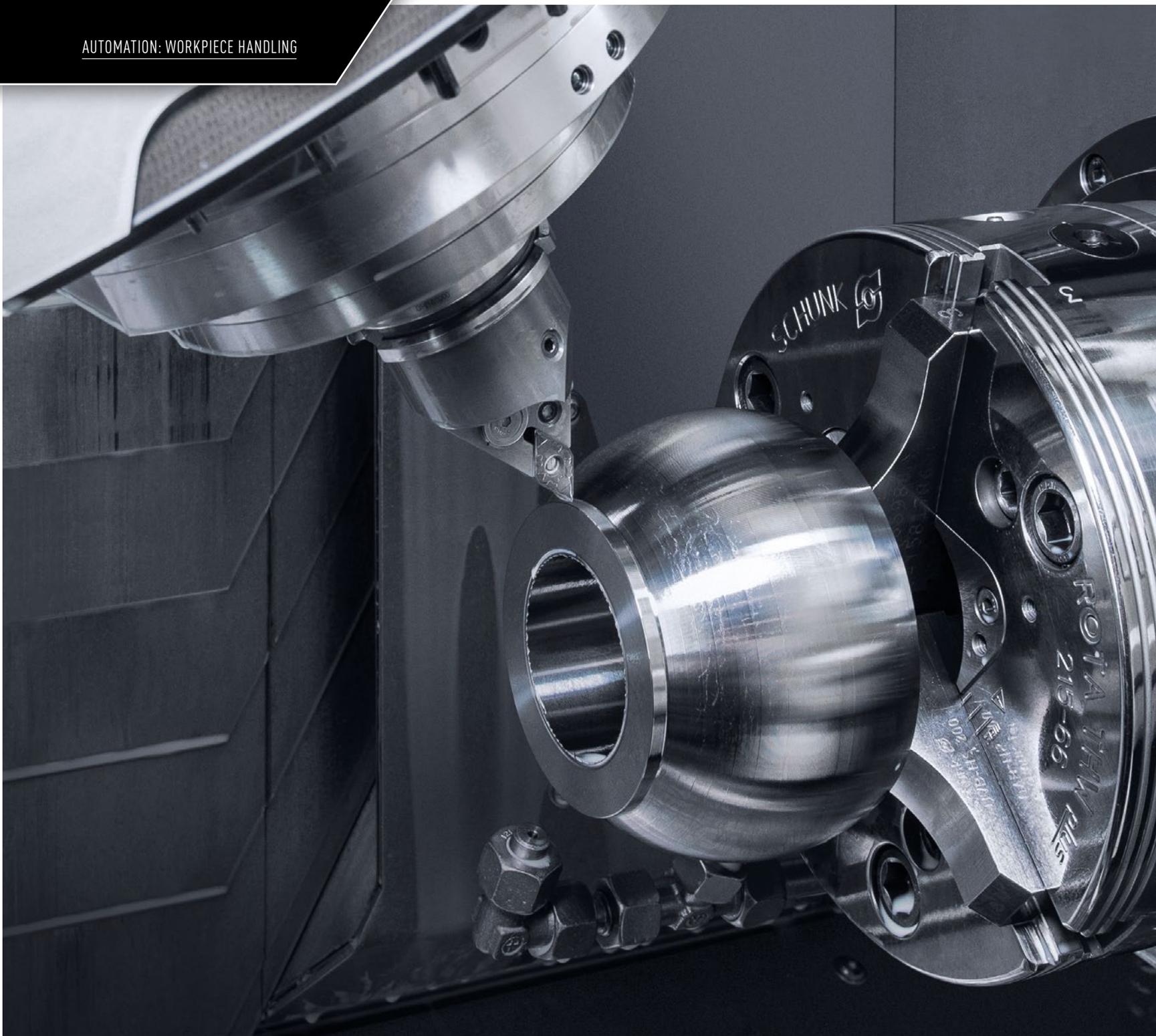


Thanks to the integration of turning and milling on one machine, we have reduced throughput times by 75 %. The automation with the Robo2Go has also increased productivity by a further 30 %.

Patrick Wessel, metal processing production manager (left)
Kevin Mönnich, CAD / CAM applications engineer (right)
Hübner GmbH & Co. KG



HÜBNER develops and produces gangway connections in such a way that bus and train manufacturers can use them as a complete component.



Kassel-based HÜBNER GmbH & Co. KG has its origins in a repair workshop for rubber products, which was established in 1946. In the 1950s, the company started to manufacture bellows for Deutsche Bahn carriages. HÜBNER also developed the first articulated buses together with Kassel company Henschel. HÜBNER now has 3,500 employees in production sites all over the world in Germany, Hungary, India, the USA and China, among others. The majority of the company's revenue nowadays comes from gangway systems connecting carriages in trains and buses. The range of services is now rounded off with the

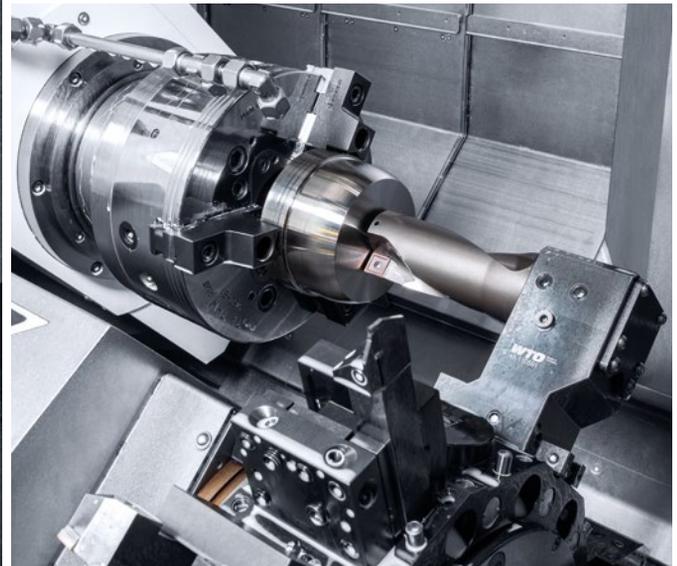
Material Solutions and Photonics divisions. The former develops demanding solutions made from elastomers, polyurethane and industrial textiles. HÜBNER Photonics specializes in the manufacture of pioneering lasers. In its production facility, HÜBNER places value on having a comprehensive manufacturing capability, especially in the machining area. The company has invested in machinery from DMG MORI repeatedly since 1988. It purchased its first automated manufacturing solution last year in the form of the CTX beta 1250 TC 4A with Robo2Go.

Complete gangway systems for buses and trains

Many people pass through gangway systems in trains, metros, trams and buses every day without paying particular attention to them. An "H" printed in one of the upper folds of the fabric often reveals that these connecting components were manufactured by HÜBNER. "We design the gangway systems in such a way that train and bus manufacturers can use them as complete components," explains Patrick Wessel, production manager in the machine shop at the HÜBNER location in Kassel. Every train is different: "This means that practically every order is a new deve-



CTX beta 1250 TC 4A:
With 6-sided turning and milling
and simultaneous machining at
two spindles, HÜBNER has been
able to reduce throughput time
by one quarter in comparison to
the original process.



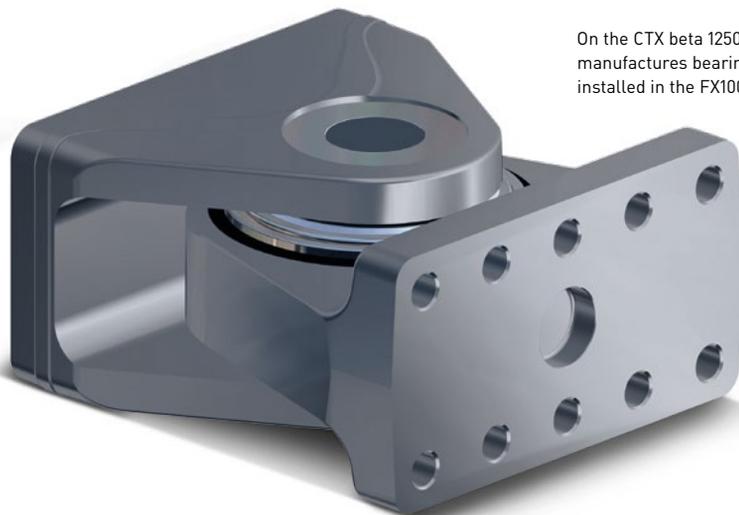
lopment, which takes place at the head-
quarters in Kassel, all the way to prototype
manufacturing.” Because of the size of the
gangway systems and the cross-section of
the respective carriage, assembly involves a
great deal of manual work.

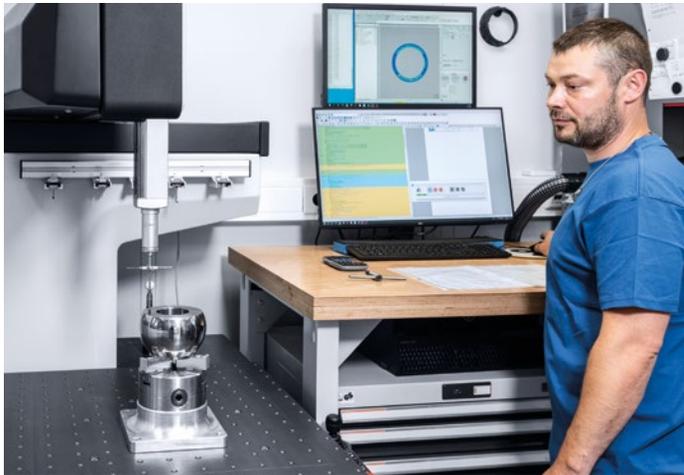
**75 percent shorter throughput times
thanks to complete 6-sided turning
and milling**

The quality requirements for safety-related
gangway systems are high. On one hand, fire
protection plays an important part and on
the other, the units must withstand extreme
mechanical loads.

»

On the CTX beta 1250 TC 4A, HÜBNER
manufactures bearings that are
installed in the FX1000pro tram joint.





The unattended production periods can be used conveniently for assembly and 100 percent inspection of the workpieces.



Simultaneous processing of two workpieces: As soon as machining at the main spindle is finished and the component has been transferred to the counter spindle using Robo2Go, a new unmachined billet is clamped.



Robo2Go

FLEXIBLE WORKPIECE HANDLING FOR SMALL TO MEDIUM BATCH SIZES

- + One APP for standardized control of all Robo2Go variants, setup of a new workpiece in less than 5 minutes.
- + Robo2Go Turning, robot load capacity 12, 25 or 35 kg
- + Rapid changeover from chuck to shaft parts
- + Robo2Go Vision, robot load capacity 35 kg
- + Reliable component detection by 3D camera, ideal for multi-job function



Click here for the Robo2Go video:
youtu.be/RdeBF1zQGpg

This particularly applies to the articulated joints that connect the gangway system to the carriage. HÜBNER has been manufacturing the bearings for such a tram articulation, the FX1000pro, on a CTX beta 1250 TC 4A with bar loader and Robo2Go since 2022. For Kevin Mönnich, CAD/CAM application engineer at HÜBNER, it was the right decision to purchase the turning and milling center: "The machine can machine all seven associated components on 6 sides in one work area, including all of the turning and milling operations." The CTX beta 1250 TC 4A has two spindles with which all 6 sides can be machined. This reduces throughput times by 75% compared with the original process on multiple machines. "This is also important in the context of increased energy costs, since we now fully utilize one machine rather than having many idle times on several machines. We achieve better quality because no further manual setups are required." A finish of Rz 0.3µm on the mirror surface of the inner bearing says it all.

The combination of the two spindles of the CTX beta 1250 TC 4A, the compactMASTER milling spindle and the second tool carrier also makes it possible for two workpieces to be machined at the same time. As soon as the first side is finished and the component has been transferred to the right-hand spindle,

a new billet is clamped. For the first time, HÜBNER is now relying on an automated solution using robots for workpiece handling. "We process large batch sizes of up to 200 workpieces for our product portfolio. The Robo2Go is the optimum automation in this

Robo2Go FOR A ONE-THIRD INCREASE IN PRODUCTIVITY

area," says Patrick Wessel. DMG MORI has designed the manufacturing solution in such a way that the robot can take the workpieces from the magazine table or from a Euro pallet next to it. Kevin Mönnich was pleasantly surprised by the outstanding productivity of the automated manufacturing solution: "We can produce a third more parts within the same time."

Room for assembly and quality control thanks to unmanned production

The unattended production periods are perfect for assembly and 100 percent inspection of the workpieces. Patrick Wessel also sees an advantage in the ergonomics: "The work becomes considerably easier because nobody needs to lift the heavy billets, which

can weigh up to 9 kg. The Robo2Go has proven to be so flexible that HÜBNER is already thinking about purchasing a second identical manufacturing solution. Efficient and automated manufacturing systems are also a way for HÜBNER to deal with the growing shortage of skilled workers. According to Patrick Wessel: "We train young people for our own needs, but at the same time we are making ourselves somewhat less dependent on personnel by optimizing processes."

Remaining an enabler of public transport with efficient processes

The topic of digitization is also a part of process optimization. "We are expecting even more efficiency from this in the future," says Patrick Wessel. He has already had good experiences with myDMG MORI. Service cases are reported online via the customer

portal. "It's faster than using the hotline and the inquiries with photos go directly to the right experts." HÜBNER can rectify many downtime issues itself with the support of DMG MORI. The minimization of downtimes and process optimizations also help to increase capacity, as do further machine tool acquisitions. Patrick Wessel looks ahead: "Investment in public transport will bring in a large number of orders and we would like to continue to be involved as an enabler of the transition to mobility by public transport."

HÜBNER FACTS

- + Established in Kassel in 1946
- + 3,500 employees at production sites in Germany, the USA and China
- + Development and manufacture of gangway systems for trains and buses



Hübner GmbH & Co. KG
 Heinrich-Hertz-Straße 2
 34123 Kassel, Germany
www.hubner-group.com



«



DMG MORI

TECHNOLOGY PARTNER



Tested, approved and used by DMG MORI

FUCHS IDM metalworking fluids and IDM greases are used in addition to our spindle oils in tough production use at DMG MORI every day. You too can rely on original quality. Put your trust in FUCHS.

www.fuchs.com/de/en

MOVING YOUR WORLD

LUBRICANTS. TECHNOLOGY. PEOPLE.





In addition to Hurtigruten, Brunnvoll is also one of the partners in the Sea Zero project, the goal being to build a completely zero-emission ship by 2030.

HIGH AVAILABILITY OF PARTS FOR SHIPBUILDING



Among other things, Brunvoll manufactures low-noise transverse thrusters that reduce noise by up to 15 dB.

As early as the beginning of the 20th century, Brunvoll Motorfabrik, which was founded at that time, produced the first diesel engines and propellers for fishing vessels. Based on an idea of the Gjendemsjø brothers, two local fishermen, the company began developing and manufacturing tunnel thrusters in 1964 – still a common principle of marine propulsion. Today's Brunvoll Group, based in Molde, Norway, stands more than ever for powerful marine propulsion systems, reliable gearboxes and innovative control electronics. Around 520 employees at five production locations ensure smooth processes from development to production and on through to service.

»



NTX 2000 / 2500 / 3000

BEST IN CLASS

- + **Turn & Mill – 6-sided complete machining** of workpieces up to $\varnothing 670 \times 1,538$ mm
- + **turnMASTER** turning spindle: 8" chuck, 5,000 rpm, max. 421 Nm
- + **compactMASTER** Turn & Mill: Spindle with 132 Nm torque and 350 mm in length
- + **Multi-tasking:** Multi-tasking – Direct drive B-axis for 5-axis simultaneous machining of complex workpieces
- + **High degree of flexibility** due to X-axis travel up to -125 mm below the spindle centerline
- + **12-pocket BMT turret** with 12,000 rpm and 80 mm Y-axis
- + CELOS with MAPPS on FANUC and CELOS with SIEMENS available



You can find the video on the NTX 3000 2nd Generation at: youtu.be/aUrrM9Z000Y

Magne Gøran Lyngstad (Vice President Process and Production Engineering) and Kjetil Hoem (Supervisor Investment Projects) in front of the MATRIS cell with an NTX 3000.

Brunvoll has been relying on highly automated processes in its production for several years – including an autonomous manufacturing solution comprising an NTX 3000 and robot automation, which DMG MORI designed for the company in 2022.

Innovative marine propulsion systems with a service life of over 25 years

From fishing boats to cruise liners – marine propulsion and control systems from Brunvoll are in use worldwide. “There are currently over 10,000 units in operation,” explains Magne Gøran Lyngstad, Vice President Process and Production Engineering, describing the wide-ranging applications of the important ship components. 75 percent of production is destined for export and the product range is constantly undergoing further development. “70,000 hours a year are

spent on the development of innovations.” The reliability of the propulsion systems is so high that their service life exceeds that of the vessels themselves. “Over 25 years is typical,” adds Kjetil Hoem, Supervisor Investment Projects. This means that in addition to development and production – which is carried out almost entirely in-house – service is also of great importance at Brunvoll.

Two unattended shifts per day thanks to intelligent automation solutions

“We guarantee high availability of spare parts because short response times are crucial,” says Kjetil Hoem, explaining the high level of service readiness. “Our wide range of products requires an enormous variety of parts, from small to large. Mostly we are talking about batch sizes of less than 15 parts.”

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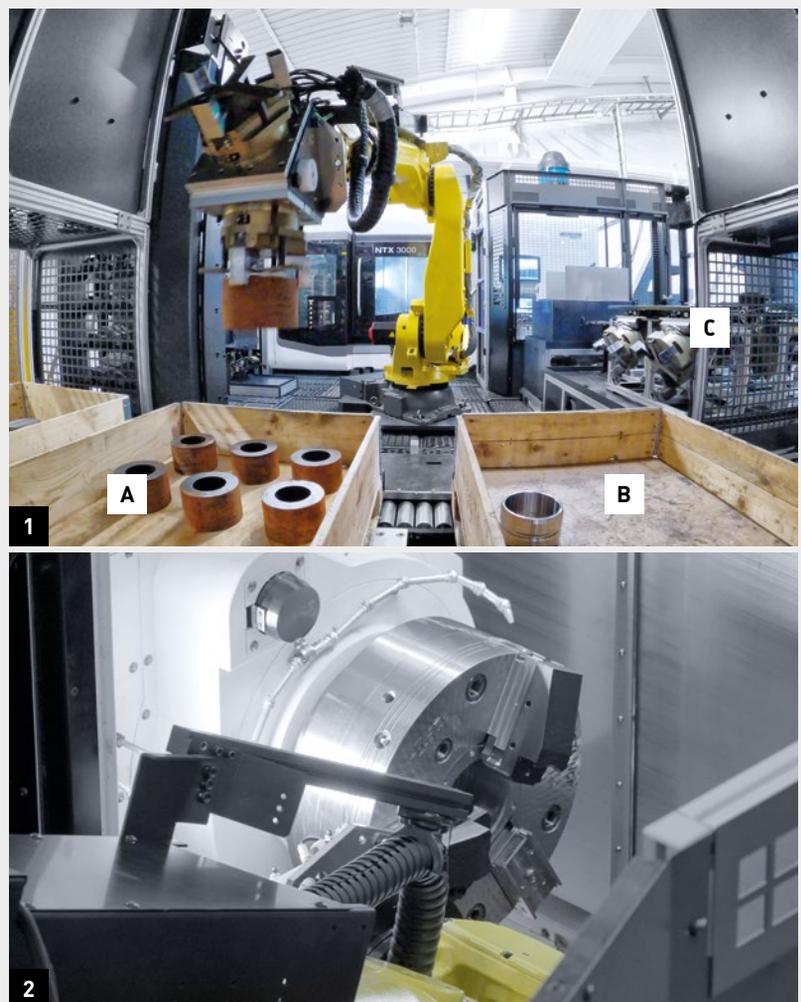


Thanks to the MATRIS workpiece handling system, the NTX 3000 now operates over two unattended shifts. And it does so with a high degree of flexibility for producing batch sizes of less than 15 parts.

MATRIS

WORKPIECE HANDLING INCLUDING VISION SYSTEM

- + MATRIS cell control via MAPPS controller: Change of grippers for the robot, change of chuck jaws, chuck jaw storage, alignment and washing or blow-off station, etc.
- + FANUC robot, incl. 3D vision workpiece recognition
- + Supply and removal of workpieces via Euro pallets, incl. RFID reader on the robot for pallet recognition
- + Interim storage for gripping different workpieces
- + Wash and blow-off station
- + 60 storage positions each accommodating 3 chuck jaws, incl. feed area for the jaws
- + 7 storage trays for robot grippers
- + Manual RFID reader for clamping jaws and robot gripper
- + Tool ID via Balluff chip
- + Preparation for future use of automated guided vehicles (AGV)



1. A/B: Supply of the billets and discharge of the finished parts via Euro pallets **C:** 7 Storage positions for robot grippers, which can be changed over automatically to suit the components or for changing chuck jaws. **2.** Automatic changeover of the jaws on the main and counter spindles. To achieve this, the cell is equipped with 60 storage positions each accommodating a set of 3 chuck jaws.

This requires a high degree of production flexibility. Magne Gøran Lyngstad names one solution: "With intelligent automation solutions, we can run two unattended shifts a day in addition to the conventional shift and significantly increase our capacity." Previously, Brunvoll had primarily used automated machining centers and mill-turn machines. "A recent investment involved the production of complex turned parts for the first time." This is exactly where DMG MORI came on the scene.

Automated 6-sided complete machining including the Vision system

The machine tool manufacturer's automation solution is based on the modular MATRIS system and includes an NTX 3000, a conveyor system for Euro pallets and a FANUC robot with automatic change of grippers. Seven can be accommodated in the cell. With the aid of a 3D vision system, the robot picks up workpieces from the Euro pallets and transfers them into the machine. An interim storage station allows the robot to grip the workpieces. Finished parts are removed, cleaned in a wash station and then replaced on the pallets. "Depending on the size of the components, we can load the workpieces on the pallets in several tiers using intermediate wooden shelves. In this case, the robot also handles the shelves," says Kjetil Hoem. The entire process is controlled by the user-friendly MAPPS controller. The whole system is also prepared for automated guided vehicles (AGVs), which Brunvoll plans to use in future for the supply and removal of the pallets.

NTX 3000: High-performance turn-mill machining with 130 Nm spindle

Brunvoll chose the NTX 3000 to machine workpieces having diameters of 45 to 400 mm. The maximum length of the parts, which weigh up to 120 kg, is 400 mm. The versatile turn-mill center even ensures 6-sided complete machining of complex components. In addition, milling operations are possible, comparable to those on a machining center, thanks to the powerful compact MASTER turn-mill spindle with over 130 Nm of torque. The tools used are equipped with a Balluff chip, so that the correct tool data can be read into the machine at any time.



The MATRIS system on the NTX 3000 enables us to manufacture a wide range of different components fully automatically and reliably. And it does so for batch sizes of less than 15 parts, incl. gripper and chuck jaw changeover.

Kjetil Hoem
Supervisor Investment Projects
Brunvoll AS

Maximum flexibility through automatic chuck jaw changeover

The extremely diverse workpieces also require extremely diverse workholding. "With this manufacturing solution, it was essential that the robot could also change the chuck jaws", said Magne Gøran Lyngstad describing one of the challenges. For this purpose, DMG MORI equipped it with a special gripper and integrated a rack system in the cell with space for 60 sets of three jaws. The robot can handle the jaws into the robotic cell via a feed area and either store them or use them immediately. The clamping system developed by DMQP (DGM MORI Qualified Products) partner Schunk is designed explicitly for such automatic changeover. The jaws, as well as the gripper hands and pallets, are identified by an RFID system to ensure absolute process reliability. The reason Brunvoll commissioned DMG MORI to design and install the automation solution was partly because everything came from a single source – with one contact person who coordinated everything. The competitive price was another key factor. A team in Japan was

responsible for the design of the manufacturing solution. "We also carried out the preliminary acceptance there in order to be able to make any subsequent improvements more

ONE FACE TO THE CUSTOMER – AUTOMATION SOLUTIONS FROM A SINGLE SOURCE

easily," recalls Kjetil Hoem. The automated NTX 3000 has been operating extremely reliably since its final installation in Molde.

Automation enables greater focus on research and better service

The increase in capacity due to unattended production at night and during the weekend is just one argument for Brunvoll to focus on automated production systems. "The fact that we are now using this approach

in turning as well compensates for the shortage of skilled staff and personnel bottlenecks", commented Magne Gøran Lyngstad, justifying the use of such solutions. "We are utilizing the potential of our well-trained employees for research and service rather than for comparatively simple machine setup." Although Brunvoll has a good training program with currently 40 young employees, the increasing use of autonomous production enables more independent and flexible planning. "Automation solutions help us remain competitive and grow sustainably."

«



The Brunvoll AS plant in Molde, Norway.

BRUNVOLL AS FACTS

- + Founded in 1912 for the manufacture of diesel engines and marine propellers in Harøya, Norway, located in Molde since 1918
- + 1964 Development and manufacture of innovative tunnel thrusters
- + 5 locations in Norway with over 500 employees for the manufacture of marine propulsion gearboxes, incl. control and automation systems



Brunvoll AS
Eikremsvingen 2c
6422 Molde, Norway
www.brunvoll.no



Click here for the Brunvoll video:
youtu.be/pQOMEX4-j0

50 PERCENT FASTER AND IMPROVED ERGONOMICS THANKS TO MODULAR AUTOMATION SOLUTION

With the installation of a MATRIS system, which autonomously loads two NZX 2500s, AMG Goeke has ushered in the production of the future. AMG Alu Metall Goeke GmbH & Co. KG, which was founded in 1980 in Wickede/Ruhr, Germany, has its origins in surface finishing. The company increased its range of capabilities in 1988 with its entry into CNC production. AMG Goeke mainly supplies customers in the commercial vehicle sector, in particular the truck building industry. With technical competence and many years of experience, the 25-strong team manufactures high-precision components and sophisticated assemblies. For machining, AMG Goeke has always relied on DMG MORI. The company operates 15 models from the world's leading manufacturer of machine tools, including several CTX and NLX lathes. The latest investment is an automated manufacturing cell consisting of two NZX 2500 twin-turret lathes and a MATRIS automation system for the machining of stub axles.

High demands on production are part of AMG's daily business. "We have been producing safety-related components for truck building for 15 years," says Ralf Goeke, who

DMG MORI: Consistently reliable turning centers

In order to be able to meet the high demand, AMG always works three shifts. "This means we can make optimum use of our machines," explains Ralf Goeke. A good example is the production of stub axles in commercial vehicle building. The component is exposed to high loads and at the same time serves as a mounting for wheel bearings and brakes. In other words: each and every part delivered must be perfect. "We have been producing stub axles continuously for 15 years – most recently using a total of eight CTX 420s." Satisfied with the reliable turning centers, AMG Goeke has remained loyal to DMG MORI to this day.

OVER 15 YEARS OF SAFETY-RELATED COMPONENTS FOR FREIGHT TRANSPORT

is an authorized signatory and responsible for quality management. His brother Andreas Goeke, also a second-generation family member who has led the company since 2003, adds: "Long-standing customer relationships with leading manufacturers and suppliers from the industry are proof of our high quality."

»



Thanks to the MATRIS system, we can now deploy our employees more effectively and the work is also much more attractive for new skilled staff.

Andreas Goeke, Managing Director
Ralf Goeke, authorized signatory (in the middle)
Tim Goeke, future Managing Director (right)
Alu Metall Goeke GmbH & Co. KG



2x NZX 2500 | 600 WITH MATRIS

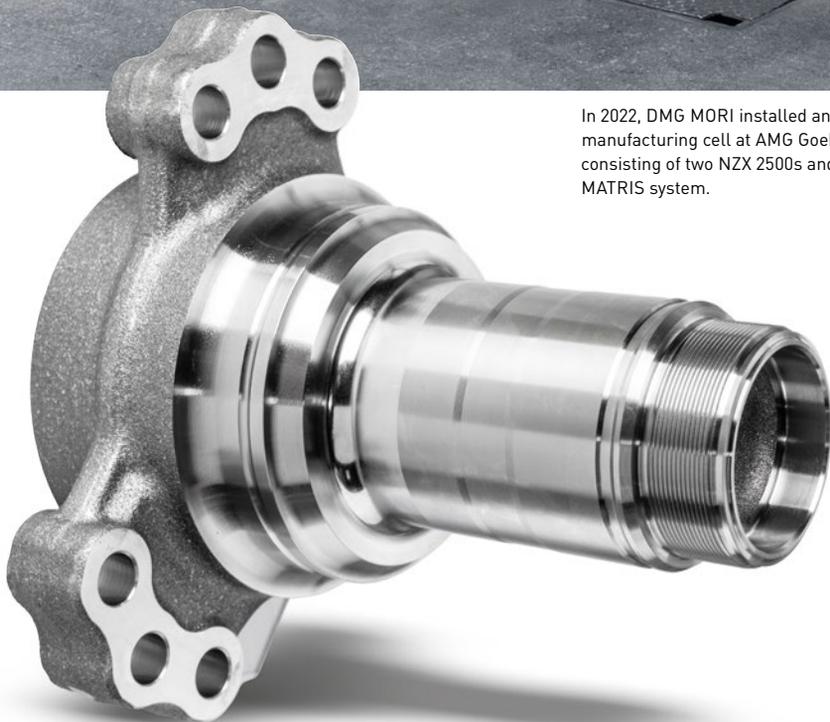
HIGHLY PRODUCTIVE SHAFT & FLANGE MACHINING

- + Workpieces up to $\varnothing 370 \times 600$ mm
- + **Two 12-station BMT turrets** with 10,000 rpm and max. 40 Nm
- + **Y-axis with +70/-50 mm** for the upper turret

MATRIS workpiece handling

- + **MATRIS cell control** via MAPPS controller
- + **Supply & removal of workpieces** via Euro pallets, incl. 3D vision system
- + **Optical workpiece measurement**, e. g. bearing seats, flank dimensions, etc.
- + **Blow-off station**

In 2022, DMG MORI installed an automated manufacturing cell at AMG Goeke consisting of two NZX 2500s and a modular MATRIS system.



Stub axles for commercial vehicles, incl. mounting for wheel bearings and brakes.



Click here for the promotional video of the NZX 2500:
youtu.be/xZRP0StZbg0



The robot with vision system loads and unloads the two NZX 2500s respectively with the left and right hand variants of the stub axles.

NZX 2500: 50 % faster throughput times

As part of an impending machine replacement in the summer of 2022, AMG Goeke rethought the manufacturing concept. Andreas Goeke recalls: "We decided in favor of two NZX 2500 turning centers. Thanks to their second turret, we were able to speed up throughput times by 50 percent." DMG MORI developed the NZX series for horizontal production turning. Box ways in all axes and a thermally stable structure guarantee reliability and consistent precision. "This makes the NZX 2500 an optimal solution for the demanding components", judges Ralf Goeke.

Another new feature that AMG Goeke introduced with the purchase of the two NZX 2500s is automated production with the modular MATRIS system. DMG MORI implemented a

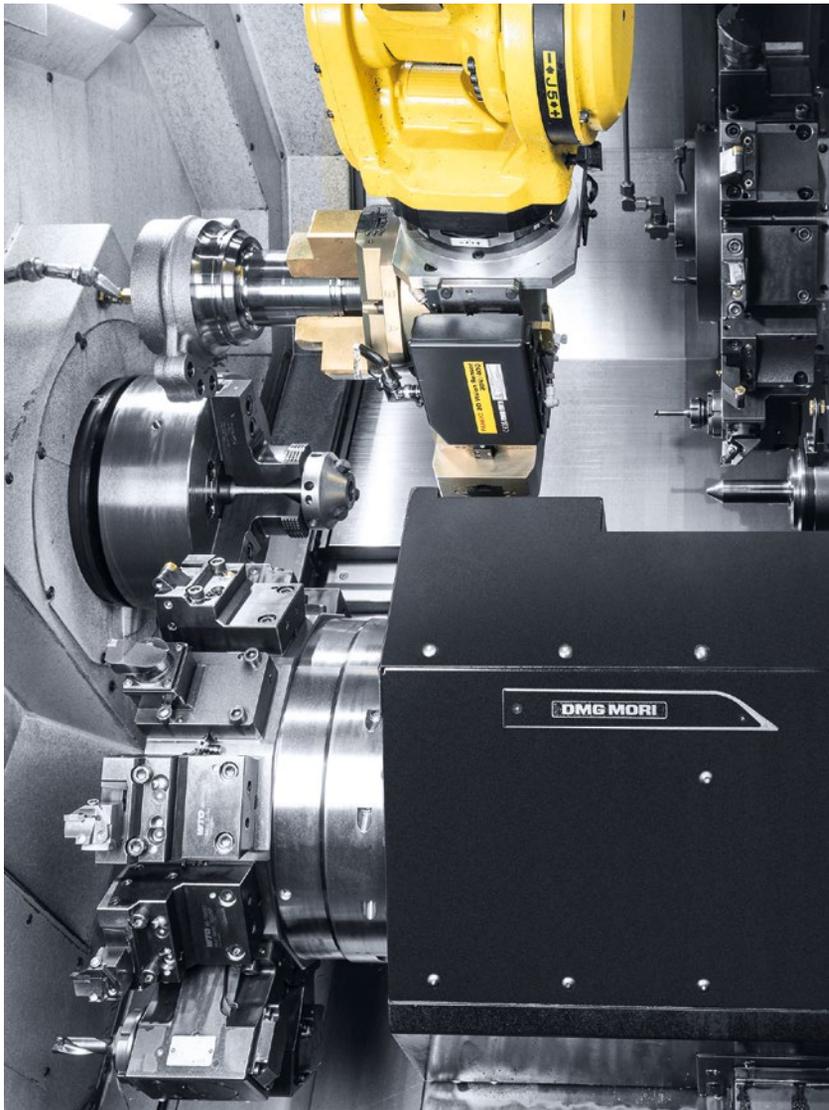
MATRIS: MODULAR AUTOMATION INCLUDING OPTICAL MEASUREMENT

manufacturing cell, in which a robot loads and unloads both turning centers with the left and right hand variants of the hand respectively. A blow-off station and a station for optical measurement of the bearing seats,

the thread core and the flank diameter are also integrated. "Of course, we have to fully document this data for our customers," adds Andreas Goeke. "In addition, all essential dimensions as well as the shape and positional tolerances are checked daily in the inspection room."

Ergonomic working environment thanks to automation

Ralf Goeke sees several advantages in autonomous production: "The fact that we can utilize the machines more efficiently and increase our productivity is only one of several beneficial aspects." Another is the more ergonomic working environment: "Manual handling of workpieces is of course far more strenuous than moving Euro pallets into the MATRIS cell." The robot with the attached vision system reliably handles the forgings and deposits



Thanks to the two turrets, the stub axles are machined 50 percent faster on the NZX 2500.



1. The modular design of the MATRIS enabled the integration of a blow-off station and a station for optical measurement of the components.
2. The optical measurement station within the automated process checks and documents the bearing seats, the thread core and the flank diameter of the stub axles.

the machined components in the same place again: "All our employees have to do is change the indexable inserts regularly and replace the Euro pallets of workpieces." The MATRIS system is controlled from a central control panel, accessible from the outside.

Solid partnerships

Andreas Goeke looks back with satisfaction on the installation and the first months using the MATRIS automation: "DMG MORI installed the system within three months and autonomous production was up and running faster than expected. So the decision in favor of automation was absolutely right, especially as our customer automated the assembly of the stub axles as well," adds Ralf Goeke. "We took this step together, so to speak, which has again strengthened our cooperation for the future."

Automated into the future

The good experience with the first automation project was groundbreaking for AMG Goeke. "Since the advantages are obvious, we will continue our cooperation with DMG MORI and in the next two years intend to install another production cell like this one," says Andreas Goeke looking ahead and also mindful of the shortage of skilled employees. "On one hand we can better deploy existing personnel, while on the other we make the work in a modern production facility more attractive for new skilled staff. This means we are ideally prepared for future business development."

ALU METALL GOEKE FACTS

- + Founded in 1980, since 1993 at the current location in Wickede an der Ruhr (Germany)
- + Manufacture of safety-related undercarriage components, e.g. for commercial vehicles
- + Certified according to DIN EN ISO 9001:2015



Alu Metall Goeke GmbH & Co. KG
Am Stadtwald 8
58739 Wickede/Ruhr, Germany
www.amg-metall.de



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AUTONOMOUS μm LEVEL PRECISION MACHINING

Thanks to the complete solution from DMG MORI, we can add two more unattended shifts to our production every day. And this with reliable processes and accuracies of to $2\mu\text{m}$.

Wolfgang Richter, Founder
Marina Gola-Richter, daughter and Managing Director
Richter Feingerätebau GmbH



A camera captures the exact position of the components on platforms. The robot grips the workpieces with precision based on the images.



1. DMG MORI integrated a blow-off station in the automation, which cleans each component before and after machining 2. Thanks to the use of several grippers, Richter Feingerätebau can also machine different workpieces automatically

Founded 60 years ago in Groß-Zimmern, Germany, Richter Feingerätebau GmbH is an experienced supplier in the fields of hydraulics, wind power and mold making. From single parts to special solutions, 21 specialists realize highly complex components with manufacturing tolerances in the μ -range. Richter Feingerätebau has relied on CNC technology from DMG MORI for machining since 1993. Good experience with the machining centers and lathes – including a DMC 80 U duoBLOCK – led to the installation of a grinding machine from DMG MORI in 2022. The special highlight: DMG MORI fully automated the TAIYO KOKI

IGV-3NT so that Richter Feingerätebau can utilize it optimally more or less around the clock.

Improved productivity with consistent quality

“As a supplier to demanding industries, we have always stood for high-quality products and absolute precision,” says Marina Gola-Richter, summing up the basic principles of Richter Feingerätebau. The second-generation family member has been managing the company founded by her father Wolfgang Richter since 2012 and knows the developments on the market very well.

“Quality requirements are on the rise and components have to be available ever faster. In addition, competition is strong. In other words: in order to remain successful, Richter Feingerätebau must continuously increase its productivity – without any compromise in quality.

DMG MORI for 30 years – now also in the grinding sector

A large part of this business philosophy is the high-performance machinery. This includes, among other things, ten machine tools from DMG MORI.

»



1 Thomas Strauß (right), authorized signatory of Richter Feingerätebau, and Horst Hoferichter, authorized signatory/technical management 2. Equipped with internal and external grinding spindles, the IGV-3NT enables the grinding of internal, external and flat surfaces in a single setup 3. In 2022, DMG MORI installed an IGV-3NT including an individually designed automation solution at Richter Feingerätebau 4. Every component is checked with a touch-probe after machining

"The cooperation began in 1993 and, due to the good experience, has lasted right up until the present day", says Marina Gola-Richter. The largest project to date with DMG MORI began in 2021. "When we needed to expand the capacity in our grinding shop, we decided in favor of TAIYO KOKI for the first time", recalls Thomas Strauß, authorized signatory at Richter Feingerätebau. The decisive factor was the vertical machine design of the IGV-3NT. "It means we make use of gravity and can grind components weighing up to 50 kg with maximum precision and using the lowest possible clamping force. Where the machine is concerned, even 100 kg is possible." Workpieces up to $\varnothing 300 \times 310$ mm can be machined

internally and externally. The company also sought an automated manufacturing solution. "DMG MORI was able to supply us with this, including an individual design and hardware from a single source," adds Horst Hoferichter, head of technical management at Richter Feingerätebau.

2 μ m process accuracy for wind power

In practice, the grinding process on the IGV-3NT involves several versions of hydraulic housing and components for wind turbines. "The manufacturing accuracy achieved is 2 μ m." In order to hold these tolerances continuously and reliably, Richter Feingerätebau built an air-conditioned room

for the machine. "Each component is measured using a touch-probe for in-process control during the machining process." Equipped with internal and external grinding spindles, the IGV-3NT enables the grinding of internal, external and flat surfaces in a single setup. The internal grinding spindle operates at Richter Feingerätebau at up to 45,000 rpm. Alternatively, spindles up to 75,000 rpm are available.

Automated grinding as an individual special solution

The special feature of the investment in the IGV-3NT is the automated process. DMG MORI in Japan designed this from scratch as a special solution. "We sent components to the team there and told them our ideas," says Thomas Strauß about the beginning of the project. He is impressed by the result: "The system comprises 15 platforms that we can load freely with unmachined parts. A camera captures the exact position of the parts so the robot can later grip them precisely and move them into the machine," is how Horst Hoferichter describes the configuration of the system. DMG MORI also integrated a blow-off device in the automation, which ensures cleaning of the workpieces before and after

Automation solution for additional shifts and personnel reduction

Richter Feingerätebau began automating grinding processes 15 years ago. "We wanted to benefit from the advantages this time as well," says Thomas Strauß, justifying the extensive investment. "We work in a single shift, but this will ideally allow us to run two more shifts autonomously." The reduction in personnel is also a key factor. "In view of the shortage of skilled workers, automated production brings an enormous benefit in day-to-day business." For future investments Richter Feingerätebau will also focus on automation solutions. "We have already ordered a DMU 60 eVo for autonomous 5-axis simultaneous machining for this very reason."

«

EVERYTHING FROM A SINGLE SOURCE: MACHINE, AUTOMATION AND PROCESS CONFIGURATION

machining. To enable the automation solution to machine different workpieces flexibly, there is also a gripper station, which the robot uses depending on the order.

As the automated IGV-3NT is a highly complex, customer-specific solution, the initial acceptance in Japan was carried out together with Thomas Strauß and Horst Hoferichter. "This made it far easier for us to coordinate final details", Thomas Strauß explains. After completion, the entire system was sent to Germany and once again subjected to an acceptance test. "Despite the size of the project, everyone involved did a perfect job," says Horst Hoferichter of the result. "And we had only one contact person who coordinated everything." The system has been operating reliably since the end of 2022.

RICHTER FEINGERÄTEBAU FACTS

- + Founded in 1963 in Groß-Zimmern near Frankfurt
- + 21 skilled staff
- + Production of precision components to within microns and complete special solutions
- + Supplier in the fields of hydraulics, wind power and mold making.



Richter Feingerätebau GmbH
Röntgenstraße 5,
64846 Groß-Zimmern, Germany
www.richter-feingeratebau.de



TAIYO KOKI IGV-3NT

VERTICAL MULTI-PROCESS GRINDING MACHINE

- + Workpieces up to ø300 x 310 mm and max. 100 kg
- + Circularity to <1µm
- + Internal and external grinding in a single clamping
- + Internal grinding spindle: 30,000 rpm, 45,000 rpm or 75,000 rpm
- + External grinding spindle: 3,700 rpm



You can view a video on TAIYO KOKI at: youtu.be/UvMedfrYvm4

DMG MORI ROBOT SYSTEMS FOR AUTOMATED PRODUCTION CELLS



Visit our website for a detailed video about WH-AMR, showing the CPC function for position correction and more: youtu.be/qyUL2rqneUg

WH-AMR – PERFORMANCE FEATURES

- 1** Multiple WH-AMR units can be used in the same area to perform **different tasks** such as workpiece and tool loading/unloading, transfer
- 2** Can exchange chuck jaws inside the machine
- 3** Robot gripper can be exchanged for consecutive machining of different workpiece shapes
- 4** Can transfer tools between turn-mill spindles and tool carts
- 5** CPC (Camera Pose Corrector) function*: Camera detects and corrects positioning errors for seamless workpiece transfer and automated operation
- 6** Can be used with shrink fit devices from HAIMER. Separate technical consultations are required to introduce this equipment



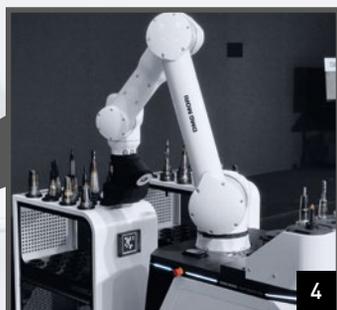
Can exchange chuck jaws inside the machine



CPC function for position correction

*5/8: Installed as a stand-alone device for demonstration purposes.

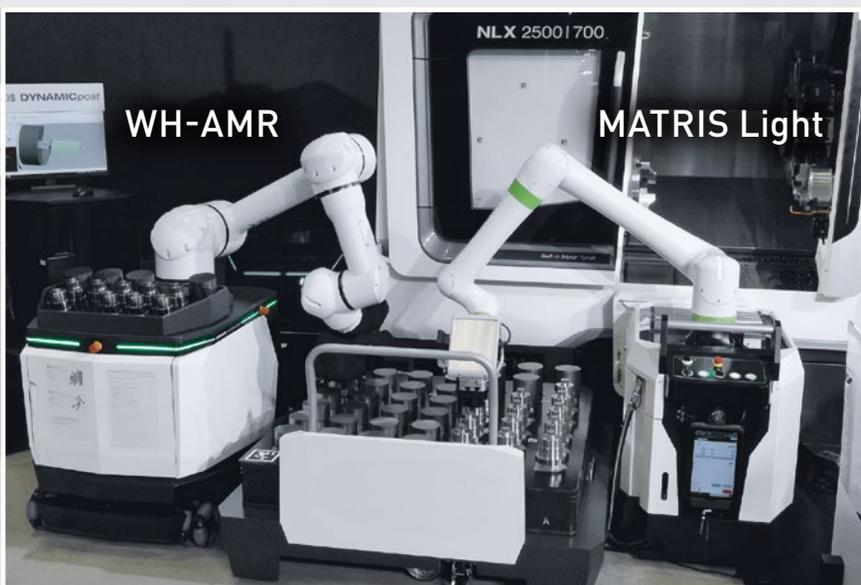
The demand for machine tools is expanding from the traditional mass production industry to high-mix, low-volume production, such as for semiconductor production equipment, medical devices and aerospace. To respond to the increasingly diverse needs of the manufacturing world, DMG MORI has developed the self-driving robot WH-AMR and the easy-to-set robot system MATRIS Light for automated production cells.



FEATURES OF MATRIS LIGHT

- 7** The robot arm of MATRIS Light can **open and close machine doors**. Makes automation possible even for existing machines in the factory without automatic doors
- 8 Fitting function***: Precisely loads workpieces into chucks, even with an inside diameter clearance of only $\varnothing 1\text{mm}$, resulting in excellent repeatability

Combined automation: Raw material/ finished workpiece transport by WH AMR and workpiece loading/unloading at the machine by MATRIS Light





We were looking for an automation system that would allow robots and operators to collaborate and work together. The automation system from DMG MORI has enabled flexible workpiece transfer between processes and made our production safer and more efficient.

Kazuhumi Miyashita
Director & General Manager of Engineering HQ
TSUZUKI MANUFACTURING CO., LTD.

FLEXIBLE ROBOTIC AUTOMATION SYSTEM FOR HIGH-VOLUME/ HIGH-MIX PRODUCTION

Founded in 1944 and headquartered in Sakaki, Nagano Prefecture, TSUZUKI MANUFACTURING is mainly engaged in parts manufacturing for the automotive and construction machinery industries. Through the application of unique production and precision machining technologies, the company has successfully combined high-volume and high-mix manufacture under one roof. Today, TSUZUKI MANUFACTURING can handle large-scale orders from the automotive industry for tens of thousands of pieces a month, while also providing hundreds of different workpiece types to the construction machinery industry. The complex production is supported by an efficient quality management system that covers the complete process chain from prototyping to mass production.

In anticipation of further expansion of the EV industry, TSUZUKI MANUFACTURING has also developed innovative technologies such as "Radial Forging", a new forging method for producing lightweight, hollow shafts.

Higher Productivity through Automation

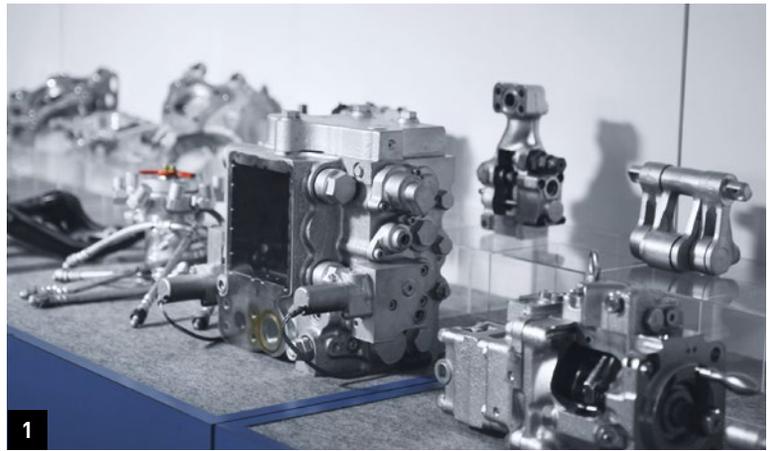
TSUZUKI MANUFACTURING has been proactively enhancing its production through automation, including the use of an autonomous system with specialized machines for manufacturing automotive parts. In 2018, the company introduced an automation line for the mass production of stator shafts with 3× NRX 2000 and 5× i 30V machines from DMG MORI – a combination of turning centers with 2 front-loaded spindles and 2 turrets and vertical machining centers with

automatic tool change at two locations on the magazine wheel. In this way, the company was able to improve on its old production line both in terms of throughput and machining accuracy.

To further increase productivity, TSUZUKI MANUFACTURING was also searching for an efficient solution to automate high-mix production for construction machinery parts. It is more difficult to automate variable-mix and variable-volume production, but the company found that the highly flexible and precise solutions from DMG MORI meet all requirements. It eventually introduced an automation system that consists of the self-driving robot WH-AMR 5 and 2x NTX 1000 2nd Generation turn-mill centers.

Variable-mix/Variable-Volume Production with the Self-driving Robot WH-AMR 5

“We were looking for an automation system that would allow robots and operators to coexist and work together. The automation system from DMG MORI has enabled flexible workpiece transfer between processes and made our production safer and more efficient”, says Mr. Kazuhumi Miyashita, the Director and General Manager of the Engineering Headquarters at TSUZUKI MANUFACTURING. In this system, the NTX 1000 integrates all required machining processes into one machine, while the WH-AMR 5 automates all operations in the process chain, including workpiece transfer, workpiece loading onto the machine, unloading of finished workpieces and transfer to the washing sta-



1. While handling large-scale orders from the automotive industry for tens of thousands of pieces a month and providing hundreds of different workpiece types to the construction machinery industry, the company successfully established an efficient quality management system that covers the complete process chain from prototyping to mass production.
 2. Automated workpiece transfer with WH-AMR enables operators to focus on more advanced tasks such as process management, leading to higher production efficiency.

AUTOMATION SYSTEM COMBINING NTX 1000 TURN-MILL CENTERS WITH THE SELF-DRIVING ROBOT WH-AMR 5

tion, reducing setup and maintenance time. As a collaborative robot system, WH-AMR 5 is cost effective since it enables long periods of unmanned operation and 24-hour production without requiring a safety fence or additional safety devices. Furthermore, WH-AMR 5 can take care of multiple machines in one area and perform various tasks that go beyond workpiece handling, including tool and fixture transfer, measurement and more.

Pursuing Technological Innovation and Quality Excellence

“DMG MORI has an extensive lineup of mill-turn, turning and machining centers and makes excellent automation proposals that include optimal peripherals and machining solutions. I believe that their robot automation systems are one step ahead of other companies”, says Mr. Miyashita about his experience with DMG MORI. Furthermore, he shares his vision for the future: “We will continue to evolve our automation systems for high-mix variable-volume production to flexibly respond to customers’ demands. We will also strive for higher quality, such as by taking measurements during workpiece transfer.” With their accumulated know-how, TSUZUKI MANUFACTURING will continue to pursue technological innovation and quality excellence to achieve further growth in a fast-changing world.

TSUZUKI MANUFACTURING FACTS

- + Established in 1944
- + 504 employees
- + Manufacturing of automotive and construction machinery parts, hydraulic equipment, and parts for the aerospace industry
- + Manufactures very lightweight, hollow shafts with the in-house developed sequential forging method “Radial Forging”



TSUZUKI MANUFACTURING CO., LTD.
 6649-1 Sakaki, Sakaki-machi,
 Hanishina-gun,
 Nagano 389-0681, Japan
www.tsuzuki-mfg.co.jp



AMR 2000

HOLISTIC AUTOMATION ON THE SHOP FLOOR

AMR's move collaboratively with humans in the same system and can avoid obstacles. The AMR 2000 platform can transport workpieces, pallets, tools and chip trolleys from external storage to the machines.

AMR HIGHLIGHTS

- + Collaborative automation solution with flexible layout design
- + Omnidirectional movement for minimal space requirements (0 m turning circle)
- + Natural Navigation based on SIEMENS SIMOVE technology
- + Security based on Sick + SIEMENS technology (Performance Level D)
- + Li-ion battery as standard
- + European safety standards (CE) for the complete automation solution
- + LPS 4 cell controller

The basis for the flexible layout lies in the modularity of the system.



Technical data	
Gross laden weight (incl. battery)	2.75 t
Maximum load	2 t
Maximum speed	6 km/h
Turning circle	0 m
Vehicle width	990 mm
Vehicle length	1,480 mm



MATERIAL HANDLING

AMR HIGHLIGHTS

- + **2,000 kg load**
- + **Material transport,** pallet size 1,200×800 mm
- + **Scope for additional tasks,** e.g. tool handling, chip disposal etc.



CHIP DISPOSAL



LPS 4

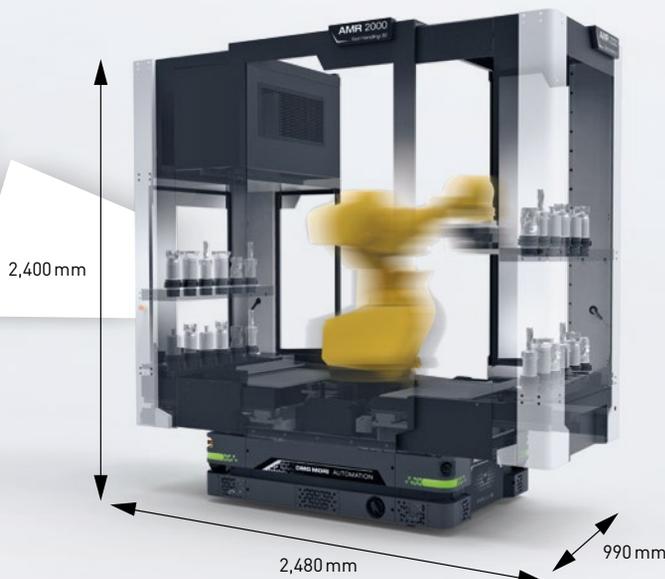
THE MASTER CONTROLLER FOR ALL AUTOMATION SOLUTIONS

- + Pallet, workpiece & tool handling
- + Tool administration and tool management
- + Fixture management
- + AMR & AGV control
- + CELOS Job Manager
- + Reporting & evaluation functions such as OEE

>> Modular software modules that can be precisely adapted to any customer requirement

TOOL HANDLING

Flexible tool management in your production using AMR. The tools are loaded directly into the tool magazine of the machine via the standard loading station. A central tool store (CTS) supplies the AMR 2000 with tools.



Tool handling technical data	
Tool holder	SK50/HSK-A 100
Max. number of tools	24
Max. tool length	650 mm
Max. tool diameter	∅ 280 x 400 mm
Max. tool weight	30 kg

PALLET HANDLING



PH-AMR 750

- + 750 kg transfer weight
incl. 500 x 500 mm pallet

AVAILABLE FOR:

- + DMU/C 65/75/85/95 monoBLOCK
- + DMU/C 65/85 H monoBLOCK

PH-AMR 5000

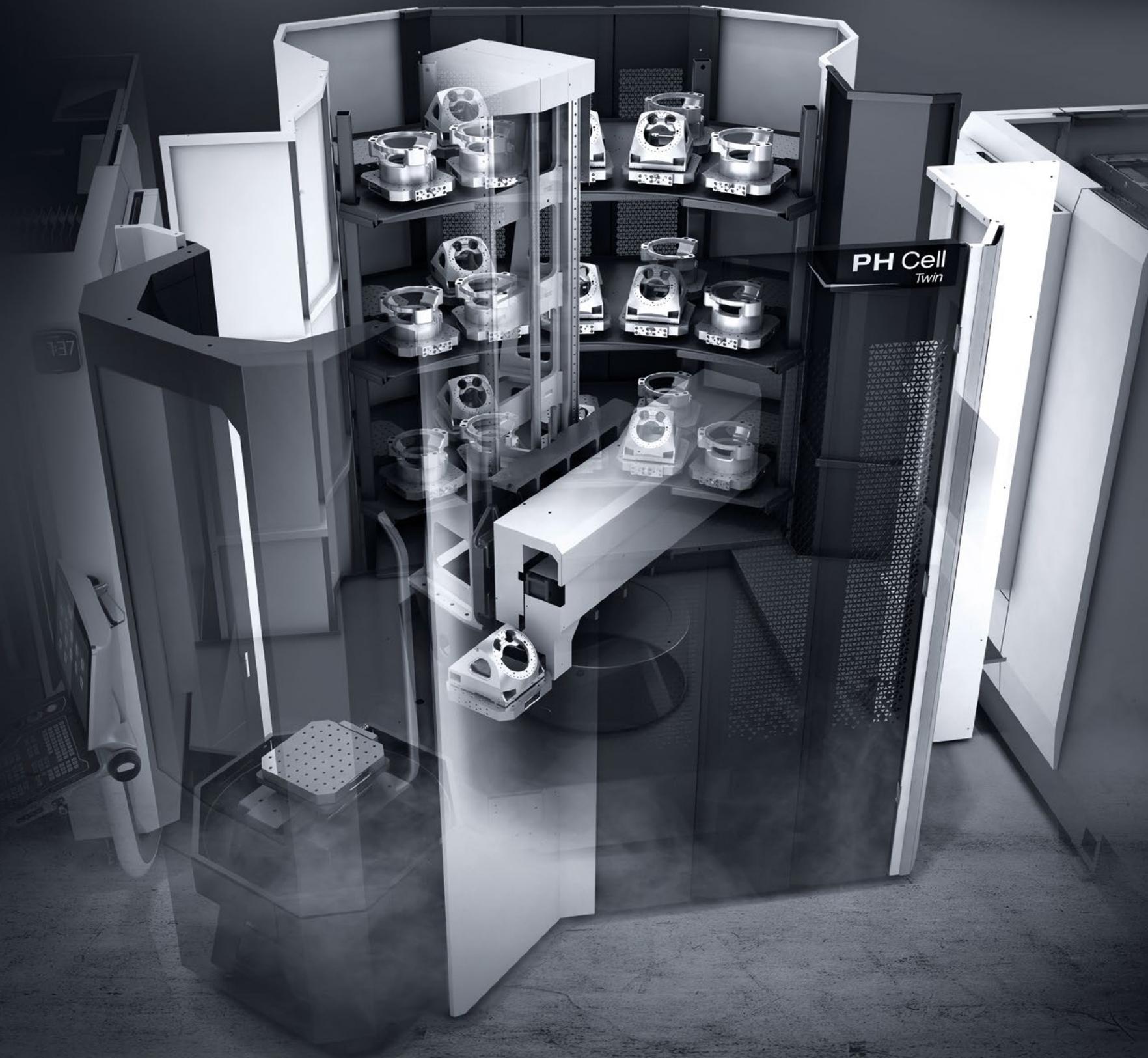
- + 5,000 kg transfer weight
incl. 1,600 x 1,250 mm pallet

AVAILABLE FOR:

- + DMU/C 160 duoBLOCK
- + DMU/C 210 duoBLOCK

PH-AMR 1500 and PH-AMR 3000 on request

PH Cell TWIN PALLETS FOR TWO MACHINES





With the two PH Cell Twins, we were able to expand the production capacity of four machines by introducing additional unmanned shifts at night and at the weekend – without extending our factory thanks to the small 12.9 m² footprint.

Alexander Wehl, Managing Partner
with his brother **Robert Wehl**, Managing Partner (right)
Wehl & Partner Muster + Prototypen GmbH

Wehl & Partner Muster + Prototypen GmbH produced the first workpieces for customers in the automotive and medical sectors as early as 1994 – at that time still in a garage and with the help of a domestic oven to harden molds. Today, the company has 80 employees at an ultra modern plant in Zimmern ob Rottweil and also operates from an additional location in Spain. There is also a subsidiary in Salach. The technological capabilities of Wehl & Partner include conventional machining, additive manufacturing and injection molding. To ensure only perfect samples and prototypes are delivered, the company relies on innovative manufacturing solutions from

DMG MORI. 24 models from the machine tool manufacturer are used in production, including numerous, partly automated, 5-axis simultaneous machining centers. These include the two latest investments: Wehl & Partner has automated two DMU 75 monoBLOCKs and two DMU 50 3rd Generation machines, each via a PH Cell Twin from DMG MORI.

From the idea to series production

“Customers from, the automotive and electrical industries and the aerospace sector, among others, come to us with a plan and we realize their idea until it is ready for series production”, summarizes Robert Wehl,

Managing Director of Wehl & Partner, speaking of his company’s service offer. He and his brother Alexander Wehl are second-generation managers of the company. He adds: “The challenge is to produce near-perfect series parts practically at the first attempt so we are able to meet the short delivery times.” Wehl & Partner usually receives 3D data first, which are checked for feasibility. Initial milling cycles are then created, followed by the development of tools for injection molding.

»



Center beam
for motor racing



Battery housing
E-mobility

The precision of the workpieces is one of the most important requirements in Wehl & Partner's daily business. "That's why high-precision machining centers have been a high priority for us for many years," says Robert Wehl, referring to the many DMG MORI machine tools in the factory. They include



1. Wehl & Partner manufactures high-precision samples and prototypes on 24 DMG MORI machines
2. 80 employees at the state-of-the-art location in Zimmern ob Rottweil take care of the development and production of these samples and prototypes, especially for customers from the automotive, electrical and aerospace industries

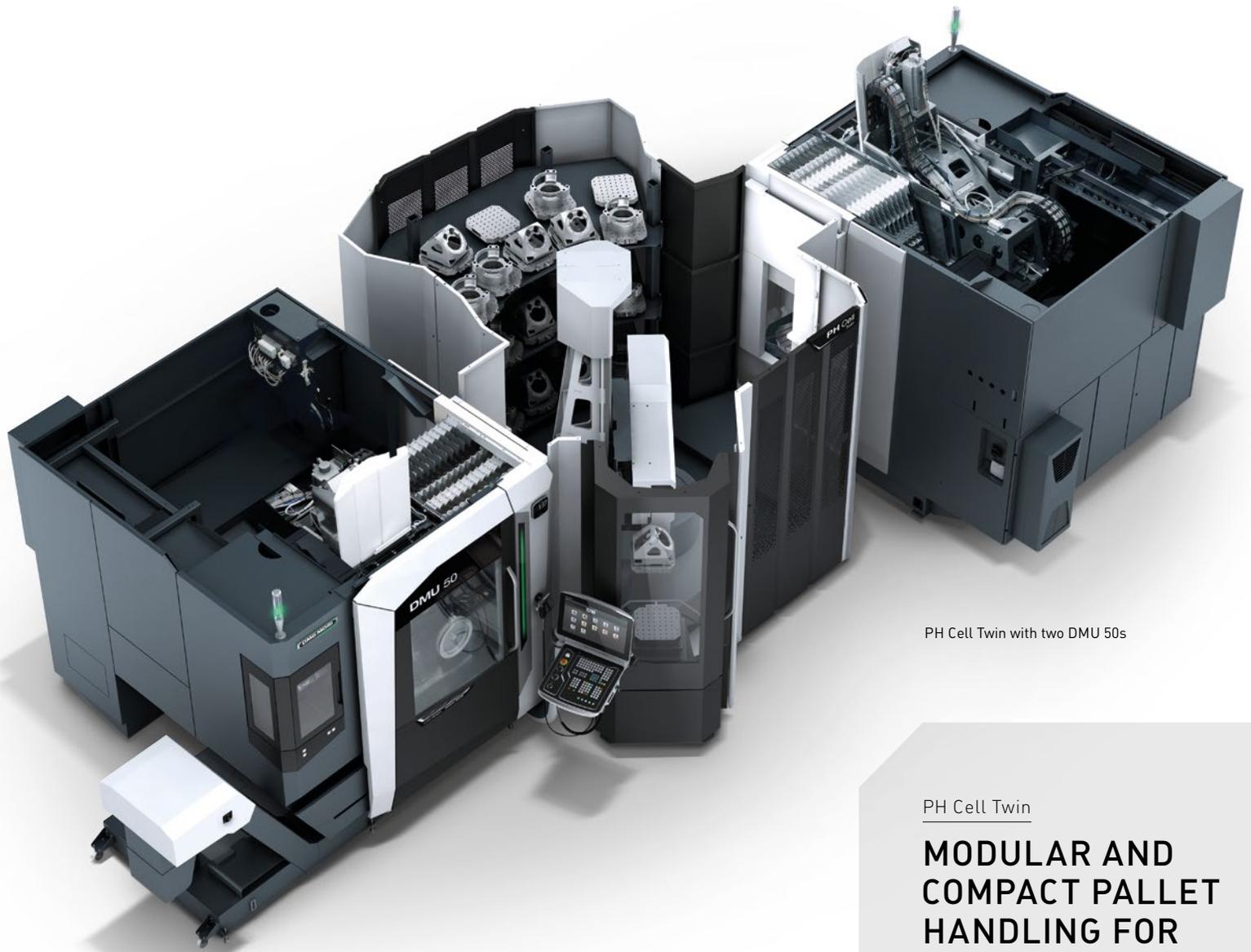
DMG MORI TECHNOLOGY THROUGHOUT THE FACTORY

several DMU eVo *linear* universal machines, CMX 1100 V and M1 vertical machining centers and turning centers such as the CTX beta 800 *linear* and CLX 350. "We have had a good experience with the reliability of DMG MORI models across all machining technologies." Alexander Wehl cites another reason for the long-standing and intensive cooperation with the machine tool manufacturer: "The product range is so large that we always find a suitable machine. For example, we use a LASERTEC 30 *SLM* in additive manufacturing. But above all, the in-house automation portfolio has been decisive for us for a long time."

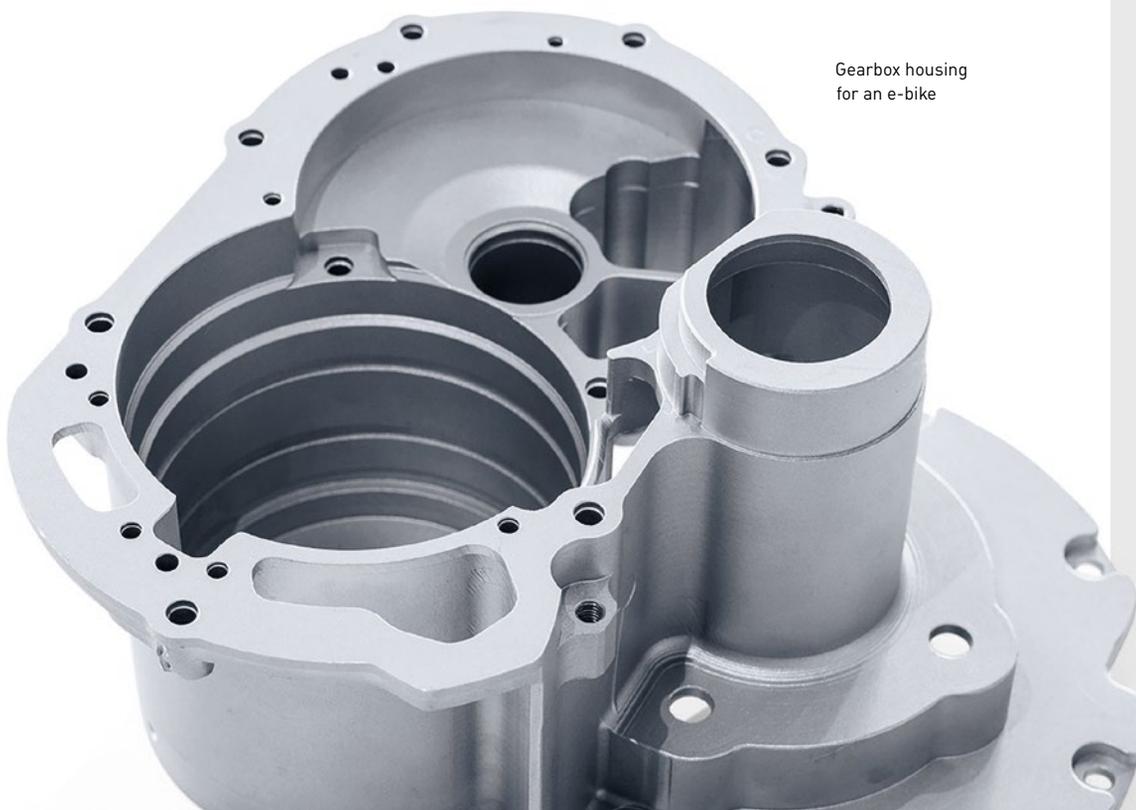
5-axis simultaneous machining for a wide range of components

The high significance placed on automation solutions is also demonstrated by the latest acquisition at Wehl & Partner.

»



PH Cell Twin with two DMU 50s



Gearbox housing
for an e-bike

PH Cell Twin

MODULAR AND COMPACT PALLET HANDLING FOR TWO MACHINES

- + Proven **PH Cell 300** pallet handling as a **twinsolution**, now also **for two machines**
- + A pallet handling device for **2 machines**
- + **Up to 30 pallets** in a **12.9 m²** footprint thanks to double row pallet storage on each level
- + **Workpieces up to 500 × 500 × 500 mm**
- + **Up to 300 kg transfer weight** (workpiece incl. pallet)
- + **Retrofit of a second machine** possible
- + **Separate setup station** for ergonomic loading of pallets during production



A video for the PH Cell Twin
can be found at:
youtu.be/9c0CBainceQ

NEW



PH Cell 800

MODULAR PALLET HANDLING WITH 800 kg TRANSFER WEIGHT FOR WORKPIECES UP TO $\varnothing 800 \times 800$ mm

HIGHLIGHTS

- + Up to 30 pallets in a footprint of <math>< 16.5 \text{ m}^2</math>
- + Pallets from 400×400 mm up to $\varnothing 800 \times 630$ mm
- + Machine pallets with clamping cones made from steel
- + 800 kg max. transfer weight for workpieces up to $\varnothing 800 \times 800$ mm
- + Modular design with exceptional ergonomics and accessibility
- + Retrofittable on machines prepared for automation

Compatible with machines



DMU 65/75/85/95 monoBLOCK



DMU 65/85 H monoBLOCK



DMU 80/90 duoBLOCK

	PH Cell 300	PH Cell 800
Transfer weight (kg)	300	800
Workpiece dimensions (mm)	$\varnothing 500 \times 500 \times 750$	$\varnothing 800 \times 800$
Maximum number of pallets	40	30
Minimum pallet size (mm)	320×320	400×400
Maximum pallet size (mm)	500×500	800×630

Technical data depending on the machine

“To increase our capacity, we bought four new 5-axis machining centers in 2022 and automated them in two cells,” explains Alexander Wehl. For each cell we chose two DMU 75 monoBLOCK 2nd Generation and two DMU 50 3rd Generation machines, which DMG MORI automated in each case with a PH Cell Twin. Wehl & Partner had already been operating a DMU 75 monoBLOCK from the previous series since 2018 – reason enough for Robert Wehl to install this model again: “The new generation is an ideal machine for us because the work area is perfect for our range of components. Due to its stability, it also meets our high accuracy requirements of up to 4 μm .” The DMU 50 3rd Generation is an ideal addition for the manufacture of smaller workpieces.

In the case of the two DMU 75 monoBLOCK 2nd Generation machines, the PH Cell Twin has 18 positions for 500×500 mm pallets.

FLEXIBLE & MODULAR PALLET HANDLING FOR DIFFERENT PALLET SIZES

The PH Cell Twin for the two DMU 50 3rd Generation machines has space for 30 pallets measuring 320×320 mm. “These capacities mean we can load the two automation solutions very flexibly. This is ideal for the large



The video of the Wehl & Partner customer story can be found at: youtu.be/ABGMRo8XSDU

number of different orders in sample and prototype production,” says Robert Wehl. His brother adds: “Above all, this has enabled us to expand our production capacity expediently to include unattended shifts at night and at the weekend.”

PH Cell Twin:

Up to 30 pallets in a 12.9 m² footprint

In view of the limited production space available, the compact design of the PH Cell Twin is especially useful. Alexander Wehl says in this context: “We are of course interested in manufacturing solutions that increase our productivity without us having to create additional space.” That has worked well with the two PH Cell Twins. “The just under 13 m² required for each PH Cell Twin is optimal. This allowed us to put the existing machines a little closer together and thus gain sufficient space for the two new production cells.”

Trusting cooperation with DMG MORI

Regular investment in manufacturing solutions from DMG MORI is proof of Wehl & Partner’s satisfaction with the advanced CNC technology. According to Alexander Wehl, the same applies to the good cooperation with the machine tool manufacturer: “From machine selection to the design of automation solutions to service, we always receive first-class advice and support,” says Robert Wehl. “We will continue to cultivate this trusting cooperation in the future so we can remain sustainably competitive with modern manufacturing technologies.”

WEHL & PARTNER FACTS

- + Family business founded in 1994
- + Headquarters in Zimmern ob Rottweil
- + 80 employees
- + Branch in Spain, subsidiary in Salach
- + High level of vertical integration with machining, additive manufacturing and injection molding



Wehl & Partner
 Muster + Prototypen GmbH
 Römerallee 12
 78658 Zimmern/Rottweil
 Germany
www.wehl-partner.de



<<

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AUTOMATED PRODUCTION AROUND THE CLOCK

PH Cell 2000

UP TO 21 PALLETS IN A 16.9 m² FOOTPRINT

- + Transfer weight up to 2,000 kg
- + 12 to 21 pallets in the system, pallet size 500 x 500 mm up to ø1,100 mm
- + Pallet change < 45 sec. thanks to integrated rotary pallet changer with twinFORK technology
- + Retrofittable with machine preparation
- + Short commissioning time within 3 days thanks to defined interface and modular principle



A video of the PH Cell 2000 can be found at: youtu.be/BJ8tw0-MgRw

DMU 100 P duoBLOCK with PH Cell 2000: Euroform was the first company to use the flexible pallet handling system for pallet sizes up to ø1,100 mm.

Euroform Kft. based in Budapest has been a reliable and competent partner in tool and mold making since 1993. From design to production and trialling, the approximately 70 experienced employees realize innovative solutions for a wide range of different injection molding processes. Demanding customers, mainly in the automotive industry, trust in the high quality of the products. In order to live up to this trust, Euroform uses modern and powerful machining centers from DMG MORI in tool production. The company currently uses eight models from the machine tool manufacturer, including DMU monoBLOCK machining centers, an HSC 75 linear and – the most recent investment – a DMU 100 P duoBLOCK. In addition, DMG MORI has installed the first PH Cell 2000 on the market for this machine so that

Euroform can now utilize the capacity at night and during the weekends.

End-to-end competence for injection molds
With injection moulds for 2,000 automotive components, seat pans, engine covers and tanks, Euroform has made a name for itself throughout the entire sector. “As a partner for suppliers and manufacturers, our work begins in the early development phases of new vehicles,” says Stefan Wolf, the company’s managing partner, about the close cooperation with customers. Euroform meets its high quality requirements with well-trained specialists in both design and production. “Technical competence is crucial for fully exploiting the potential of both modern CAD-CAM systems and innovative manufacturing solutions.”



PH Cell 2000: We can prepare so many pallets here in parallel with production that machine downtime is minimal – even into the night.



Euroform is currently using eight machining centers from DMG MORI.

Euroform has been using machine tool technology from DMG MORI since 1995, latterly at the current modern location that it move

DMU 100 duoBLOCK: PRECISION MACHINING OF COMPLEX GEOMETRIES

into in 2011 and expanded in 2016. Krisztina Zwick, as Managing Director responsible for day-to-day business at Euroform, points

to the perfectly tailored machine portfolio and the good service: "DMG MORI was one of the first machine tool manufacturers to open a subsidiary in Hungary, which meant that response times were always short when service was required." After regular investment in machinery, the first automated manufacturing solution was installed in 2022, a DMU 100 P duoBLOCK with a PH Cell 2000. "This step was necessary in order to utilize the machine to full capacity during unmanned shifts and thus remain competitive."

» *The combination of the DMU 100 P duoBLOCK and the PH Cell 2000 is ideal for us. It means we can now produce high-precision molded parts during unattended night & weekend shifts.*

Stefan Wolf, Managing Partner
Krisztina Zwick, Managing Director
Euroform Kft.

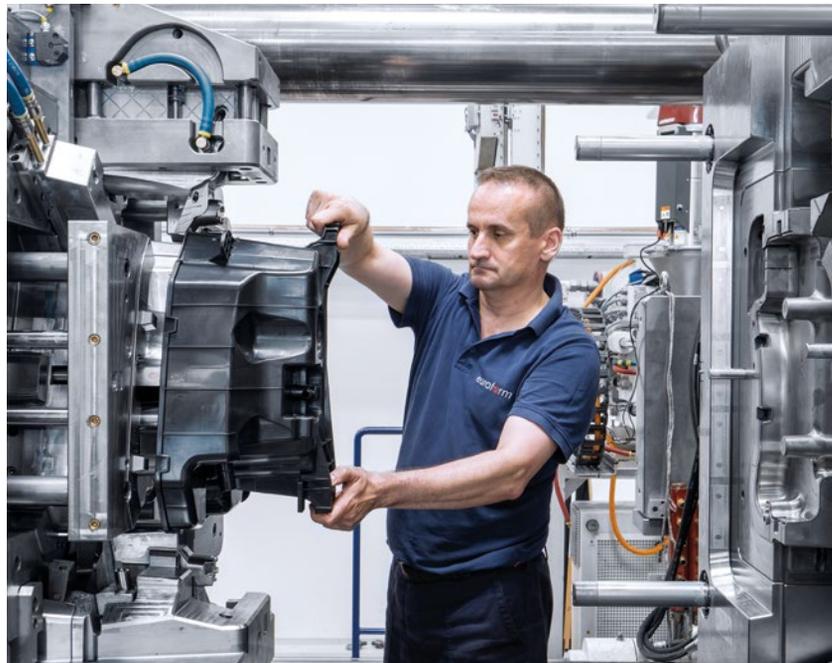


**5-axis simultaneous machining
of workpieces up to $\varnothing 1,100 \times 1,600$ mm
and 2,200 kg**

Euroform had already used a DMU 100 P duoBLOCK before. "The experience with the machining center was consistently good," judges Krisztina Zwick. "That made the decision to purchase the latest generation easier." With of $1,000 \times 1,250 \times 1,000$ mm, the 5-axis simultaneous machining center even machines large mold components efficiently. In addition, extensive cooling measures ensure the high precision of the sophisticated components.

**PH Cell 2000:
MAXIMUM CAPACITY
UTILIZATION
THANKS TO
MODULAR PALLET
HANDLING**

When Euroform ordered the DMU 100 P duoBLOCK, DMG MORI already had a suitable pallet handling system in development. The PH Cell 2000 is just as modular as the proven PH Cell 300. "Based on the smaller pallet handling system, we realized that the PH Cell 2000 was the right automation solution for us" recalls Krisztina Zwick of the purchase. So it was that Euroform became the first user of flexible pallet handling for pallet sizes up to $\varnothing 1,100$ mm. Pallets measuring $1,000 \times 800$ mm are used at Euroform. "Our PH Cell 2000 has twelve pallet positions on two levels and can accommodate workpiece heights of up to 1,350 mm." In addition, the PH Cell 2000 is available in a variant with three rack levels as well as one with four. These variants can accommodate a total of up to 17 or 21 pallets respectively. The maximum height of the workpieces can be up to 750 mm.



With injection molds for seat pans, engine covers, tanks and 2,000 automotive components, Euroform has made a name for itself throughout the entire sector.

**Flexible automation solutions
for a batch size of 1**

As Euroform almost exclusively manufactures one-off components, pallet handling such as the PH Cell 2000 is the optimal solution. "Our employees can prepare so many pallets here in parallel with production that machine downtime is minimal – even at night. In addition, a zero-point clamping system makes setup easier," says Krisztina Zwick. After these initial experiences, it goes without saying that automation solutions will also play a decisive role in future investments.

**Fast response service
with myDMG MORI**

Another topic that has long accompanied business development is digitization. Krisztina Zwick describes the consistent orientation at Euroform: "We have had a paperless working environment for many years – from design to quality control." Digital processes have also long since found their way into service.

"With myDMG MORI, we have been able to significantly accelerate processes in the event of a service request, because inquiries are transmitted directly online and end up with the right contact person."

**Mastering challenges with
targeted investments**

Automated manufacturing and digital processes are essential given the current challenges in the global marketplace. "For several years now, the Corona pandemic, the war in Ukraine and high inflation have clearly shown us that we need to constantly develop in order to remain competitive," says Stefan Wolf. Krisztina Zwick sees this as an opportunity: "With targeted investments in technologies and the training and further education of junior staff, we will continue to successfully meet these challenges."

«



DMU 100 P duoBLOCK: With travel of 1,000×1,250×1,000 mm, the 5-axis simultaneous machining center even machines large mold components efficiently. In addition, extensive cooling measures ensure the high precision of the sophisticated components.



Euroform develops and manufactures molds for many different injection molding processes. The focus is on the automotive sector, e.g. molds for engine covers, AdBlue tanks and seat pans.

EUROFORM FACTS

- + Since 1993 a reliable and competent partner in tool and mold making, focusing on components for the automotive sector
- + Around 70 employees develop and produce innovative solutions for a wide range of different injection molding processes
- + From design to production to trialling

euroform
DIE IDEALE FORM FÜR IHR PRODUKT

Euroform Kft.
Varrógépgyár u. 25.
H-1211 Budapest, Hungary
www.euroform.hu





One of the LPP Systems: LPP with 48 pallet stations, 2 setup stations and 4 NH 5000 DCG.



Thanks to DMG MORI, we have successfully automated our production and can rely 100 percent on the machines supplied by DMG MORI.

Wang Haipeng
Head of the machining shop
Zhengzhou Hengda Intelligent
Control Technology Co., Ltd.

VARIANT-RICH SMALL BATCH PRODUCTION WITH LPP

Zhengzhou Hengda Intelligent Control Technology Co., Ltd. was founded in 1999 and is a leading supplier to the mining machinery industry. As a subsidiary of Zhengzhou Coal Mining Machinery (Group) Co., Ltd. the company specializes in the development, production and sales of key components for intelligent control systems in coal mining. Zhengzhou Hengda is one of the first companies in China to apply such intelligent technologies in the mining industry. Its portfolio includes hydraulic support control systems, electrohydraulic control systems and centralized intelligent control systems for the mine face. To produce the often-large components in such a way that they meet the high safety requirements in mining, Zhengzhou Hengda uses innovative machine tool technology from DMG MORI. There will be 14 NH 5000 DCG horizontal machining centers installed by the end of 2023 including pallet handling, which will play a decisive role in production.

Automated production of batch sizes 1–10
Like most industries, mining is undergoing a major transformation. Processes are becoming more intelligent and the automation of mining machines is advancing. The trend is

NH 5000 DCG:
STABLE AND RELIABLE
HORIZONTAL
MACHINING

toward customization and made-to-measure production, so more and more orders involve small batch sizes and multiple variants. For example, Zhengzhou Hengda produced only a few dozen product models in 2012. By 2022, the number of models had increased to more than 1,390 and by 2023, the number

is expected to reach nearly 2,000. Lot sizes range from one to no more than ten parts in most cases. This clearly shows that the mining industry needs efficient and flexible production lines.

Zhengzhou Hengda has proactively grasped this trend and achieved significant growth through its forward-looking strategy. The company has always focused on the ongoing development of its products. This goes hand in hand with the optimization of manufacturing processes, i.e. the search for ever more advanced machining solutions. "In 2010, we were impressed with the NH 5000 DCG horizontal machining center from DMG MORI," recalls Wang Haipeng, head of machining at Zhengzhou Hengda. "The machine's box-in-box design ensures high rigidity and reliability." A perfect solution, Wang Haipeng thinks: "We bought two NH 5000 DCGs and significantly advanced our manufacturing."

**Automated manufacturing:
Convinced by facts**

Due to the outstanding performance of both NH 5000 DCGs, Zhengzhou Hengda repeatedly chose DMG MORI when expanding its production capacity. Soon, the topic of automation through linear pallet pools (LPP) came to the fore. At that time, Zhengzhou Hengda was not convinced about automation. The fear was that with a higher degree of automation of the machines, the need for maintenance would also increase. To ensure continuous operation of the new machine tools, Wang Haipeng – who was still a maintenance engineer at the time – was assigned to this task as an operations engineer. "DMG MORI provided factual information that completely changed our understanding of automation," Wang Haipeng recounts. "After the initial changeover, both plants were running very reliably and efficiently."

**Intelligent production layout with
linear pallet pools**

By the end of 2023, 14 NH horizontal series machines will be installed and automated with linear pallet pools (LPP). Initially, DMG MORI automated six models in 2018 using an LPP with 48 pallet positions and three setup stations. The existing two machines were integrated as well. This was followed in 2020 by another LPP with

48 pallet positions and two setup stations. Here, four automated NH 5000 DCGs were put into operation. The satisfaction with these solutions is reflected in the latest investment. "In 2022, we purchased another four NH 5000 DCGs with LPP, which will be installed at the end of 2023," says the management of Zhengzhou Hengda. The intensive cooperation with DMG MORI has sustainably strengthened trust. Wang Haipeng adds. "When it comes to orders for major projects, especially in the area of research & development, we can rely 100 percent on machines supplied by DMG MORI."

**Production of small batches
in many variants**

According to the management of Zhengzhou Hengda, the new production layout has definitely proven itself. They describe it in detail: "Hengda has connected R&D and production through the MES system, installed additional inline inspection equipment and retrofitted pallets, fixtures and other equipment for standardization." In this way, Zhengzhou Hengda achieved the optimal result in terms of both the software and hardware. As a result, flexible product changeover is now possible, while small series of many variants can also be manufactured productively. The management comments, "Today, manufacturing one part for ten products is just as efficient as machining ten parts for one product."

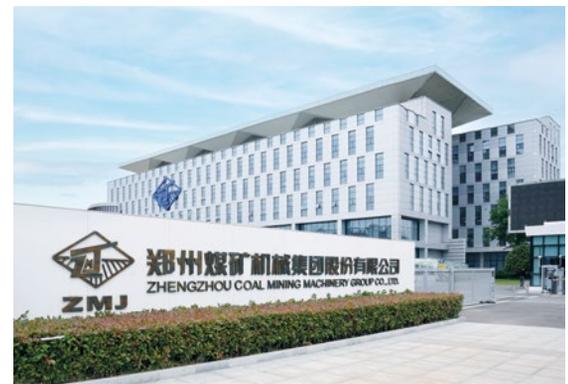
Customer-oriented cooperation

Zhengzhou Hengda is satisfied with what DMG MORI has accomplished in recent years. The management has been impressed by the customer-oriented consulting and on-time implementation of the projects. Even more important, they said, was the handling of individual requirements: "In particular, the integration of existing machines into a new LPP and the associated change in the production layout were a major challenge that DMG MORI mastered perfectly." DMG MORI worked out a detailed plan for the modernization of the production line. "During the adaptation and commissioning, which took almost 20 days, almost all machines remained in normal operation, so production capacity was not affected." Zhengzhou Hengda has had an equally good experience in the area of maintenance.

With DMG MORI into the future

Zhengzhou Hengda intends to maintain the good cooperation with DMG MORI into the future. This is because the investments in R&D activities as well as the expansion of the product range will continue in order to further advance future-oriented projects in mining. Intelligent mines and digital twins are just two examples of this progress. DMG MORI will remain an important player in this development as a reliable partner in the field of machine tool technology.

«



Zhengzhou Hengda Intelligent Control Technology Co., Ltd. is a leading supplier in the mining machinery industry.

**ZHENGZHOU HENGDA
FACTS**

- + Founded in 1999
- + Subsidiary of Zhengzhou Coal Mining Machinery (Group) Co., Ltd. + Leading supplier in the mining machinery industry
- + Specializes in the development, production and sales of key components for intelligent control systems in coal mining



Zhengzhou Hengda
Intelligent Control Technology Co., Ltd.
No. 167, 9th Street
Econ-Tech Development Zone
Zhengzhou, China
www.zmj.com



DMG MORI DIGITAL ENGINEERING

COMPLETE SIMULATION OF THE ENTIRE SYSTEM, INCLUDING ALL INTERACTIONS AND CONTROL FUNCTIONS

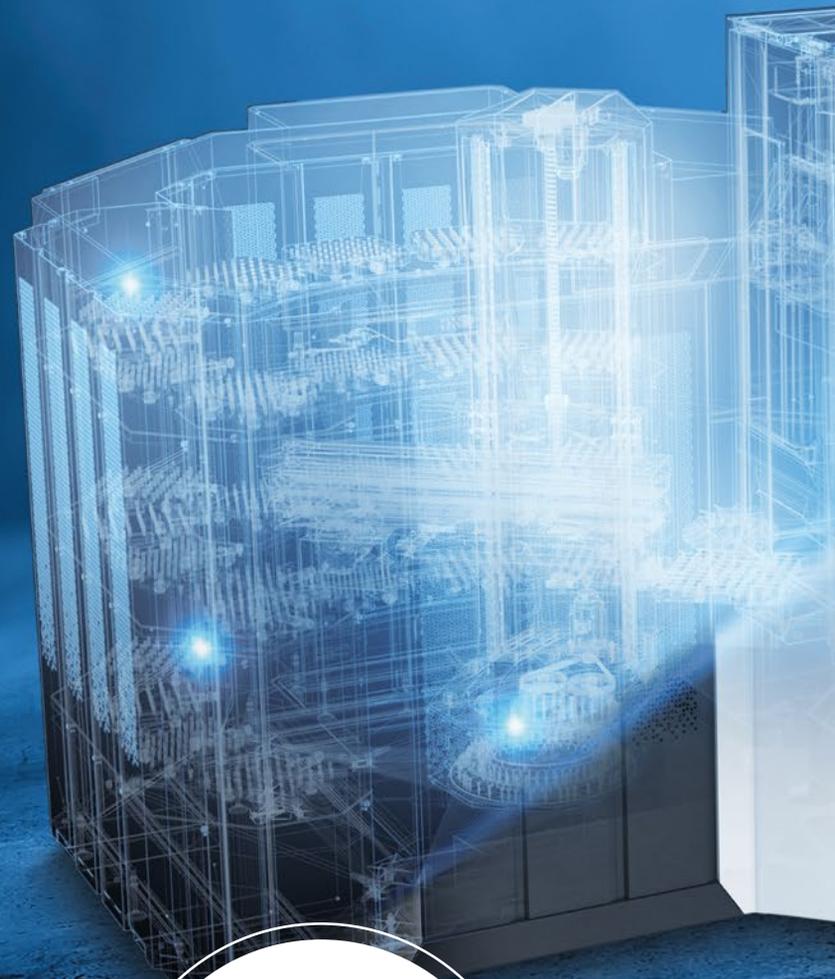
THE RESOURCE-SAVING SOLUTION FOR PRODUCTION START-UP AND TEST

The most efficient machines are the ones which produce around the clock. This is where the advantages of digital engineering lie. The machine or the entire system is completely digitally simulated in advance, including the entire program and the automation. This eliminates the extremely time-consuming and resource-intensive running-in of the actual machine. New processes can also be set up digitally while the machine is still running.

- + **40% faster production ramp-up** – Digital employee training courses and non-productive activities
- + **Production starts up to 80% sooner** – Less testing and development on the machine
- + **100% collision-free run-in** – Complete digital testing and optimization

HIGHLIGHTS

- + **Faster onto the market** by means of virtual prototypes
- + **Faster to the customer** by means of digital requirement management and virtual fine-tuning
- + **Faster to the workpiece** by means of project-related employee training
- + **Faster to the optimum** by means of data and knowledge-based service and application support throughout the entire lifecycle



**COMPLETE
SIMULATION OF THE
ENTIRE SYSTEM
INCLUDING ALL
INTERACTIONS
AND CONTROL
FUNCTIONS**



A video of the Digital Twin can be found at:
youtu.be/n00QkRUzVZY



4 × FASTER
WITH DIGITAL
ENGINEERING
FROM DMG MORI

We will optimize your production ramp-up with our digital planning solutions: Starting with simplified visualizations and layout optimizations to complete simulation of the entire production process, including all interactions.

Dr.-Ing. Daniel Niederwestberg
Digital Twin area manager
DMG MORI Digital GmbH



DIGITAL TWIN TEST CUTS

FASTER – MORE RELIABLE – MORE PRECISE

- + Less time-consuming test machining
- + No risk due to virtual testing
- + Realistic depiction of manufacturing in the digital world
- + Precise simulation, analysis and optimization of the process

Customers depend on test cuts to a considerable extent when they are selecting a suitable machine tool. When a test cut takes place, the required workpiece is machined on the actual machine in order to determine whether the customer's requirements with regard to accuracy and production time are fulfilled. However, it isn't always easy to obtain the right tools, equipment and materials to carry out test cuts within a short time.

DMG MORI has therefore realized virtual test cutting based on simulations. Digital Twin Test Cut technology makes it possible to create an exact digital copy of the machine and simulate the machining process without the need for actual tools, equipment or materials.

Depending on customer requirements, the technology can also be used to determine the optimal machining conditions. Digital Twin Test Cut technology is as reliable as cutting on a real machine, because all of the relevant factors such as cutting force, tool vibration, surface quality and more are taken into consideration.

Digital Twin Test Cuts significantly reduce the time required for test cuts. The customer can be provided with the results of the trials within 2 working days. Digital test cuts are also environmentally friendly, since no tools, materials or coolants are used and much less power is required than with actual machining.

«

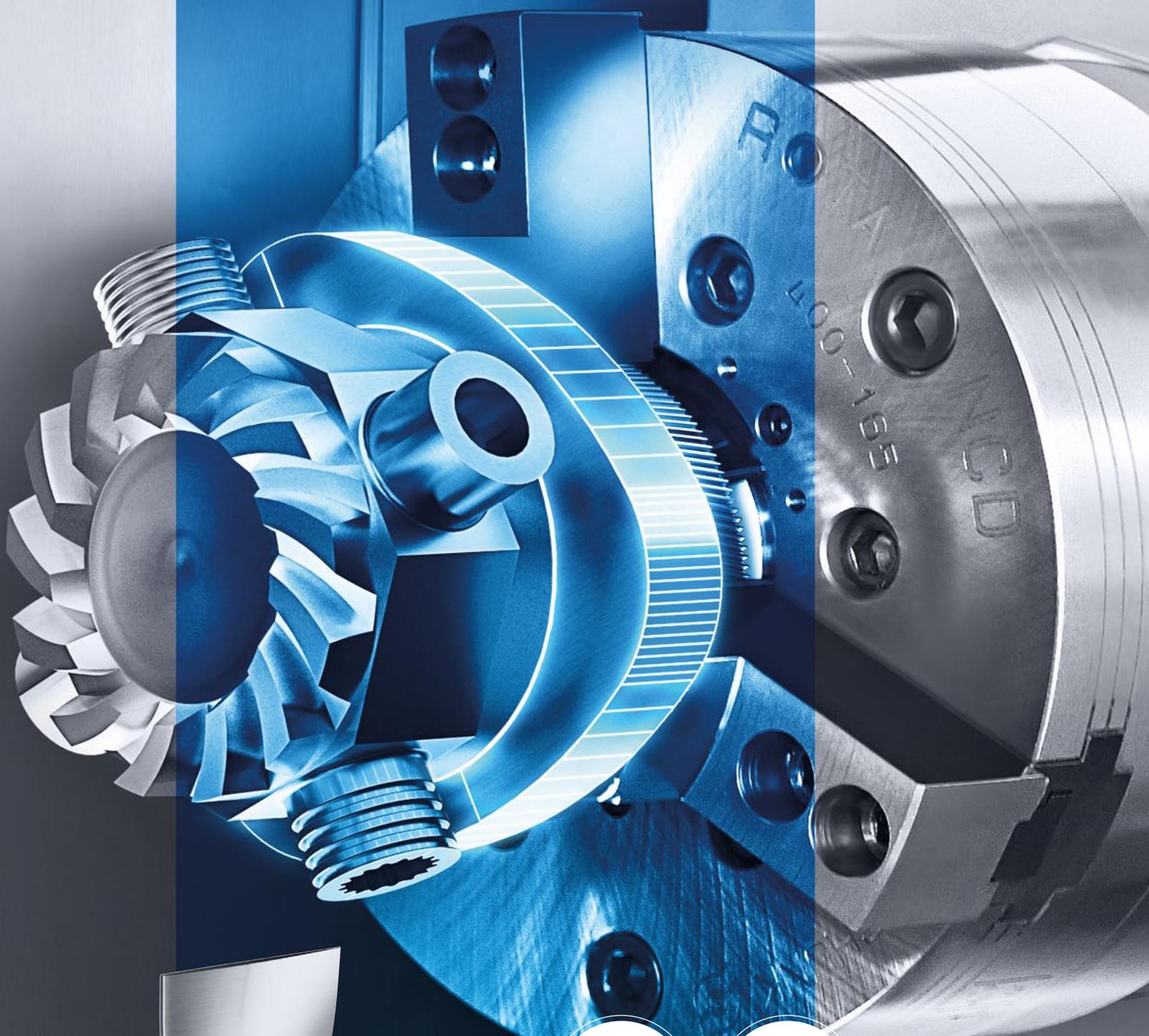
YOUR ADVANTAGES WITH DMG MORI TEST CUT

- + Simulation instead of actual machine
- + Safe test machining and fast results
- + No material or tool costs
- + Less effort when estimating cycle times

The DMG MORI Digital Twin enables open interaction of machines and processes for perfect planning, control, simulation, and analysis.

Dr. Naruhiro Irino
Operating Officer of Advanced Technology
DMG MORI Co. Ltd., Iga





UP TO
20 %
FASTER

19 % LESS
ENERGY
CONSUMPTION

Optimized
with Digital
Twin Test Cut

10:41 min
0.614 kWh

Without
Digital Twin
Test Cut

13:16 min
0.763 kWh

- 2:35 min
- 0.149 kWh

■ Manufacturing time ■ Energy consumption



The first TULIP application for ABB's new welding robot resulted in a paperless process and low training expenditure.



TULIP is used to digitize all processes from order receipt to delivery.

CUSTOMIZED APPS FOR END-TO-END DIGITIZATION

The roots of Winkelbauer GmbH from Anger in Styria date back to the 19th century – at that time it was a blacksmith's shop for horse-shoes and wagons. In 1945, the foundation was laid for today's company. Through innovation and entrepreneurial spirit, the blacksmith's shop developed into one of the leading specialists for construction equipment and components for the recycling industry in Central Europe. Today, Winkelbauer has around 160 experienced engineers who manufacture high-quality tools and equipment for construction machinery up to 150 t and highly wear-resistant components for recycling plants. The traditional company ensures high product quality with a powerful and modern machine shop, including four DMG MORI machines. In addition, Winkelbauer places a strategic focus on digitization in order to optimize processes and respond better to customer requirements and changes in the market. DMG MORI's

no-code platform TULIP makes an important contribution to this strategy. The APPS created with TULIP support paperless production, for example, reduce training costs and increase process reliability in assembly.

Innovative strength for generations

Winkelbauer has grown over several generations to become one of the largest sector specialists in Central Europe. "We successfully hold our own against the competition through continuous investment in the training and further education of our skilled staff and due to our competence in the processing of highly wear-resistant steel – in our case, this amounts to over 6,000 tons per year, more than 4,000 tons of which are wear-resistant Hardox® steels," is how Michael Winkelbauer, Managing Director of the company founded by his grandfather, explains the company's success. This tradition has resulted in great innovative

strength, which has already generated its own patents and brands. "Moreover, in our think tank we are always looking for special solutions for exceptional challenges."

MODERN MANUFACTURING SOLUTIONS AND INNOVATIVE PROCESS

At Winkelbauer, innovative thinking is reflected in its products as well as in its manufacturing. "In order to remain competitive, we have always pursued future-oriented paths that allow us to make our processes more efficient," says Michael Winkelbauer,



Optical and functional testing in assembly:
TULIP automatically generates the test reports.

Thanks to TULIP, we have already been able to make a large number of our processes completely paperless – from assembly and cycle time recording to quality assurance. With this digitization we have succeeded in drastically reducing the amount of training required for machine operation.

Michael Winkelbauer
Managing Director
Winkelbauer GmbH

referring to the technologies used. These include state-of-the-art welding robots from ABB and IGM as well as advanced CNC machines from DMG MORI. Two DMC 90 U duoBLOCKs, a DMF 360 five-axis milling machine and a CLX 550 lathe have been put into operation since 2021.

With TULIP to paperless processes

Another building block in the innovation-driven strategy for several years has been digitization. "Our goal was to make all processes paperless, from order receipt to delivery," explains Stephan Winkelbauer, who is responsible for digitization in the production process. He is the fourth generation to work in the family business. The no-code platform TULIP, which Winkelbauer also

introduced with the purchase of the DMG MORI machines, is playing an increasingly large role.

TULIP APP enables step-by-step work instructions

Winkelbauer implemented the first TULIP application on a new welding robot from ABB. "Our primary goals were a paperless process and less training expenditure," recalls Stephan Winkelbauer. Since the robot's programmer knows the requirements best, he created a TULIP APP that presents detailed work instructions for operating the welding robot – step by step. "Until now, this information was stored in space-consuming folders, involved a great deal of searching and time, and in the end was still not always up to date.

Now there is a PC in each of the two robot cells that displays everything very clearly." Each instruction of the TULIP APP must be confirmed before the robot is operated, ensuring that all steps are carried out in a process-reliable manner and documented at the same time.

Career changers trained in a few days instead of weeks

Stephan Winkelbauer is also satisfied with the reduced training expenditure: "If required, we can also entrants that are career changers to operate the welding robot comparatively quickly and schedule them into production."

»

In the past, it took weeks to train new personnel in this area, but today this can be done in just a few days. "The speed also gives us a competitive advantage." In addition, this process is scalable with TULIP: "We can transfer the program 1:1 to another welding robot, for example."

Assembly instructions including test report and cycle time recording

Another example of process optimization using TULIP is provided by the assembly of a product series. It comes in 27 variants, which leads to many different serial and article numbers as well as product data, which are recorded on a type plate. "We have created and continuously developed a TULIP APP that supports the entire assembly process," explains Stephan Winkelbauer. The component from pre-assembly is recorded and identified via the data in the safety & quality stamp. A visual and functional inspection takes place in the main assembly area, which the operator documents in TULIP. "In this way, we create an initial test report." The

APP explains the necessary steps in assembly as well. Detailed schematic drawings are stored for this purpose. "We have gradually integrated more and more functionalities into the TULIP APP, which serve to optimize the assembly process – right up to cycle time recording," says Stephan Winkelbauer.

TULIP AS AN
IMPORTANT
BUILDING BLOCK
IN THE
DIGITIZATION
STRATEGY

"We already use apps similar to the two described in warehouse management or in quality control," says Stephan Winkelbauer. He says it is important for him to

involve the staff of the respective departments at an early stage: "The team has the deepest insights and can design the apps optimally." The creation of TULIP APPs is very simple. Similar to PowerPoint, the content is inserted and placed via drag & drop. The previous uses of TULIP and the fact that it is easy to operate have convinced Winkelbauer to find many more applications and to continue to drive digitization in the company with the help of the no-code platform. Michael Winkelbauer also believes in this: "A holistic approach to digitization is crucial in order to remain competitive over the long term. In this respect, TULIP is an ideal addition to the ongoing modernization of our company."

«



In order to introduce digitization successfully, the skilled workers of the respective departments are involved at an early stage, because the teams have the deepest insights and can design the apps optimally.

WINKELBAUER FACTS

- + Founded in the 19th century as a blacksmith's shop for horseshoes and wagons
- + Focus on construction equipment since 1945
- + Over 160 employees develop and manufacture high-quality tools and equipment for construction machinery and components for recycling plants



Winkelbauer GmbH
Viertelfeistritz 64
8184 Anger, Austria
www.winkelbauer.com



Click here for the Winkelbauer video:
youtu.be/4zGPZl4fJyw



THE NEXT-GENERATION CLOUD MES – TAILORED TO YOUR NEEDS

- + Fast entry and changeover
- + NoCode/LowCode application creation
- + Drag and Drop analyses and insights into production
- + Harmonization of PDA and MDA
- + Product or process changes with minimal effort



Find out more about TULIP:
tulip.dmgmori.com

IMPROVE YOUR PRODUCTIVITY

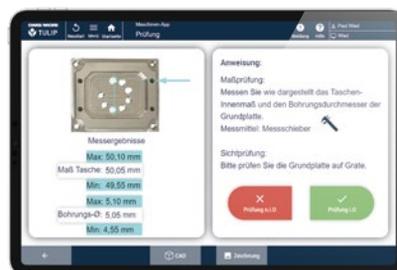
- + **MORE EFFICIENT FACTORY OPERATION:**
User-friendly programs to detect and reduce sources of error and to increase productivity and efficiency.
- + **NO CODE:**
Simple creation of fully functional industrial applications that turn users into developers.
- + **SIMPLE INTEGRATION:**
Integration of digital tools as well as existing systems (ERP/MES) via extensive interfaces.

WORK INSTRUCTIONS



Guidance of the operator through repetitive processes and tasks including QM data acquisition and PDA.

QUALITY DATA ACQUISITION



Use digital checklists and IoT devices, such as digital calipers, for consistent quality data and as a basis for continuous improvement.

MACHINE AND PRODUCTION DATA ACQUISITION



Use machine and production data to monitor the entire production area and gain insights.

myDMG MORI

FAST SUPPORT IS OUR MISSION

With myDMG MORI you can resolve your service concerns in a quick and uncomplicated way, independently of the location and the equipment. Be it via desktop, mobile phone or machine control, you're in contact with your expert service provider 24/7. To give you even more benefit from our independent direct contact, the new return function gives you the option of registering spare and exchange part returns via chat. You will receive a return label from your service expert within a very short time.

As well as the processing of your service cases, in future we will point out our LifeCycle offers – tailored exactly to the machine life cycle of your machine. As a result, you'll not miss any important information and can therefore ensure that your machine retains its value.

myDMG MORI
LOCATION –
AND DEVICE-
INDEPENDENT

YOUR TWO NEW FEATURES

NEW Q4/23

EASY RETURNS – RETURN SPARE PARTS IN AN UN- COMPLICATED WAY

- + Uncomplicated return of spare and exchange parts
- + Return label via chat function
- + Return exchange parts and find a replacement online immediately

NEW Q4/23

LIFECYCLE OFFER – SERVICE OFFERS SPECIFICALLY FOR YOUR MACHINE

- + Overview of all service offers for your machine
- + Notification when new service products are available
- + Reminder when contracts are running out, including extension offer



DMG MORI

Identify spare parts
and accept offers
with one click



Continuous direct
contact – through
to the solution

Agree service date
on the machine

*We'll resolve your service issues
in a quick and uncomplicated way.*



Not registered yet?
Free registration
in <3 min. at:
mydmgmori.com

DMG MORI CIRCULAR ECONOMY

THE SUSTAINABLE FUTURE OF YOUR MACHINE

BENEFIT FROM THE ADVANTAGES OF AN EFFECTIVE AND SUSTAINABLE CIRCULAR ECONOMY FOR YOUR MACHINE TOOLS.

At DMG MORI we are **RE**thinking the way machines can be embedded perfectly in a sustainable circular economy. Together with our suppliers and partners, we combine know-how as well as technology leadership to create the most sustainable solution for our customers. This enables us to use resources in the most efficient way and combine sustainability with economic efficiency for our customers.



REDUCE

MAXIMISE ENERGY EFFICIENCY THROUGH COMPONENTS UPGRADE

REUSE

WE OFFER USED MACHINES OF THE HIGHEST STANDARD

REFIT

SUSTAINABLE AND EFFICIENT OVERHAULING

1 HYDRAULICS

Replacement of old components with new, frequency-controlled hydraulic units. These reduce energy consumption by more than 50%.

> 50 %
ENERGY
SAVING

2 PNEUMATICS

Replacement of the installed air diffuser within the machine as well as leakage elimination, preventing air loss and thus ensuring more energy efficiency and saving resources.

UP TO
10 %
ENERGY
SAVING

INK

UP TO
50 %
ENERGY
SAVING BY
RETROFIT

With “REthinking” we do not only consider economic aspects, but also ensure sustainable and careful use of resources.



REBUILD
WE ONLY USE NEW PARTS
IF NECESSARY

REFURBISH
SENSITIVE COMPONENTS
LIKE SPINDLES
E.G. WILL ALWAYS
BE REFURBISHED

RECYCLE
REPURPOSE UP TO
90% OF THE MACHINE
COMPONENTS



3 POWERTRAIN

Replacement of worn axis components with subsequent disposal & recycling by certified specialist companies and return to the material cycle.

UP TO
10 %
ENERGY
SAVING

DMG MORI OVERHAUL

Convince yourself of our services and how we achieve optimal results for you:
youtu.be/BvU-6ZwGWrQ



SUSTAIN-
ABILITY

GREENMODE

PURE ENERGY EFFICIENCY

Increasing energy efficiency in industry is a key factor for the achievement of climate protection goals. In addition, low energy demand is becoming increasingly important for the economy in view of rising energy prices.

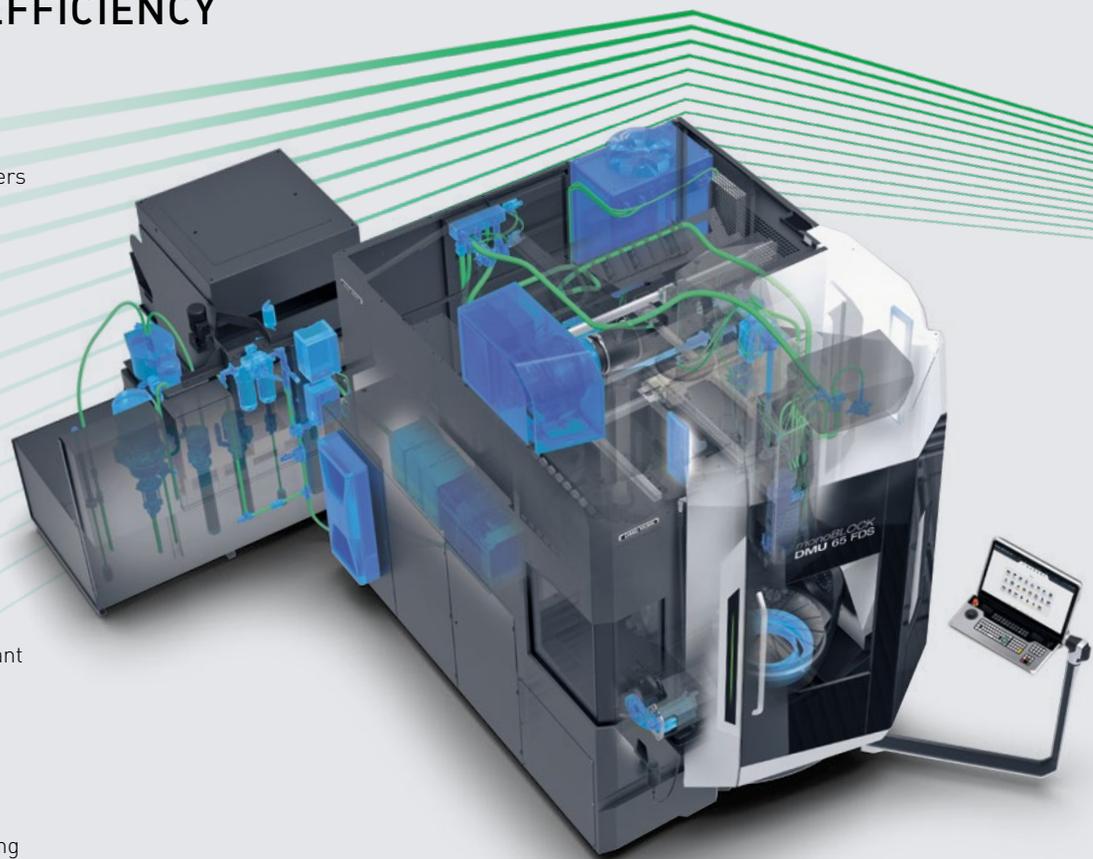
With **GREENMODE**, DMG MORI is redefining energy efficiency in manufacturing. Thanks to innovative hardware and software components, DMG MORI is able to reduce energy consumption by more than 30%. In this way, DMG MORI supports you on your way to energy-efficient production.



Dr.-Ing. Marc-André Dittrich
 Manager Corporate Development
 & Worldwide Institutions

13 MEASURES FOR MORE ENERGY EFFICIENCY

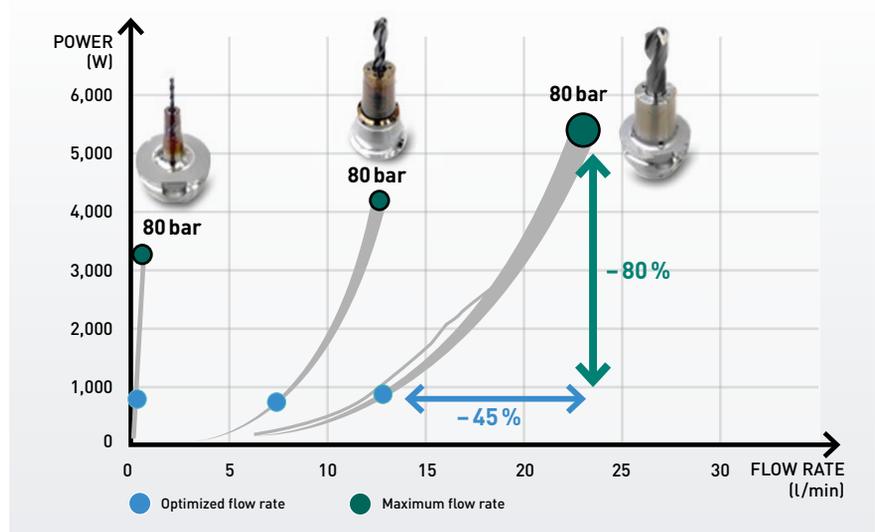
1. **Braking Energy Recovery**
2. **LED Lights**
3. **Highly Efficient Chillers**
 Best-in-class machine & cabinet chillers
4. **Advanced Auto Shutdown**
 Automatic standby & wake-up
5. **Adaptive Feed Control**
 Shorter processing times
6. **Advanced Energy Monitoring**
 Workpiece-specific energy measurements
7. **Air Leakage Monitoring**
 Fast detection of leakages
8. **Frequency-Controlled Pumps**
 Efficient coolant supply
9. **zero-sludgeCOOLANT**
 Extended coolant lifetime
10. **Adaptive Coolant Flow**
 Smart pressure & flow control of coolant
11. **zeroFOG Mist Collector**
 Compact & energy efficient unit
12. **AI Chip Removal**
 Shorter & efficient cleaning cycle
13. **Business Benefit Optimizer**
 Transparent comparison of power rating and emissions before investment



ADAPTIVE COOLING – PURE ENERGY EFFICIENCY BY DEMAND-ORIENTED PROCESS COOLING

With DMG MORI's innovative adaptive coolant supply, only as much coolant is fed into the process as is actually needed. As a result, the power consumption of the coolant pump can be reduced by up to 80%.

- + Tool-specific coolant supply
- + Integrated technology cycle to determine the optimal volume flow
- + Control of the volume flow during the process
- + Up to 80% reduced power consumption of the coolant pump



DMU 65 FDS monoBLOCK ENERGY DEMAND

-36%*

WITH GREENMODE
32,190 kWh/a

-17,890 kWh/a

WITHOUT GREENMODE
50,080 kWh/a

1. STANDBY	2. WARM UP	3. NC-READY	4. PROCESSING	5. EMERGENCY SHUTDOWN
Δ -45%	Δ -16%	Δ -11%	Δ -38%	Δ -81%
Referenz 7.7 kW GREENMODE (ECO) 4.2 kW	Referenz 9.0 kW GREENMODE 7.6 kW	Referenz 7.7 kW GREENMODE 6.9 kW	Referenz 17.3 kW GREENMODE 10.8 kW	Referenz 3.5 kW GREENMODE (ECO+) 0.7 kW

*All values shown are based on internal investigations and experiences of DMG MORI.

Actual values may differ due to different production conditions. Assumptions for yearly energy demand: 250 days/year, 2 shifts/day, 8 hours/shift, 30% standby, 20% MCreedy, 50% machining.

DOWNLOAD OUR EMO APP



The DMG MORI EVENTS APP is available in the App Store and Play Store!



Available on the
App Store

dmgmori.com/emoapp-apple



GET IT ON
Google Play

dmgmori.com/emoapp-android

TURN YOUR VISIT TO EMO HANNOVER INTO A UNIQUE EXPERIENCE

Get ready for an experience in a class of its own with the DMG MORI EVENTS APP – your smart companion to EMO 2023 in Hannover. The app provides you with tailored information, exclusive insights and comprehensive details on all products DMG MORI will be presenting at EMO 2023 in Hall 2.

DISCOVER THE BENEFITS OF THE DMG MORI EVENTS APP:

- + **Instant information:**
Access facts, highlights and brochures of our products at any time.
- + **Seamless navigation:**
Keep track of everything with our mobile booth map.
- + **Efficient planning:**
Plan your day at the show and don't miss any of our Technology City tours.
- + **Exclusive services:**
Use our checkroom in Entrance North 2 and our bars at the DMG MORI booth free of charge.
- + **Easy follow-up:**
Save your favourite products in the app and browse through all the details at your leisure after the fair.



All information about the EMO App and the free download can be found at: emoapp.dmgmori.com



SAVE THE DATE
22/01 – 02/02/2024

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