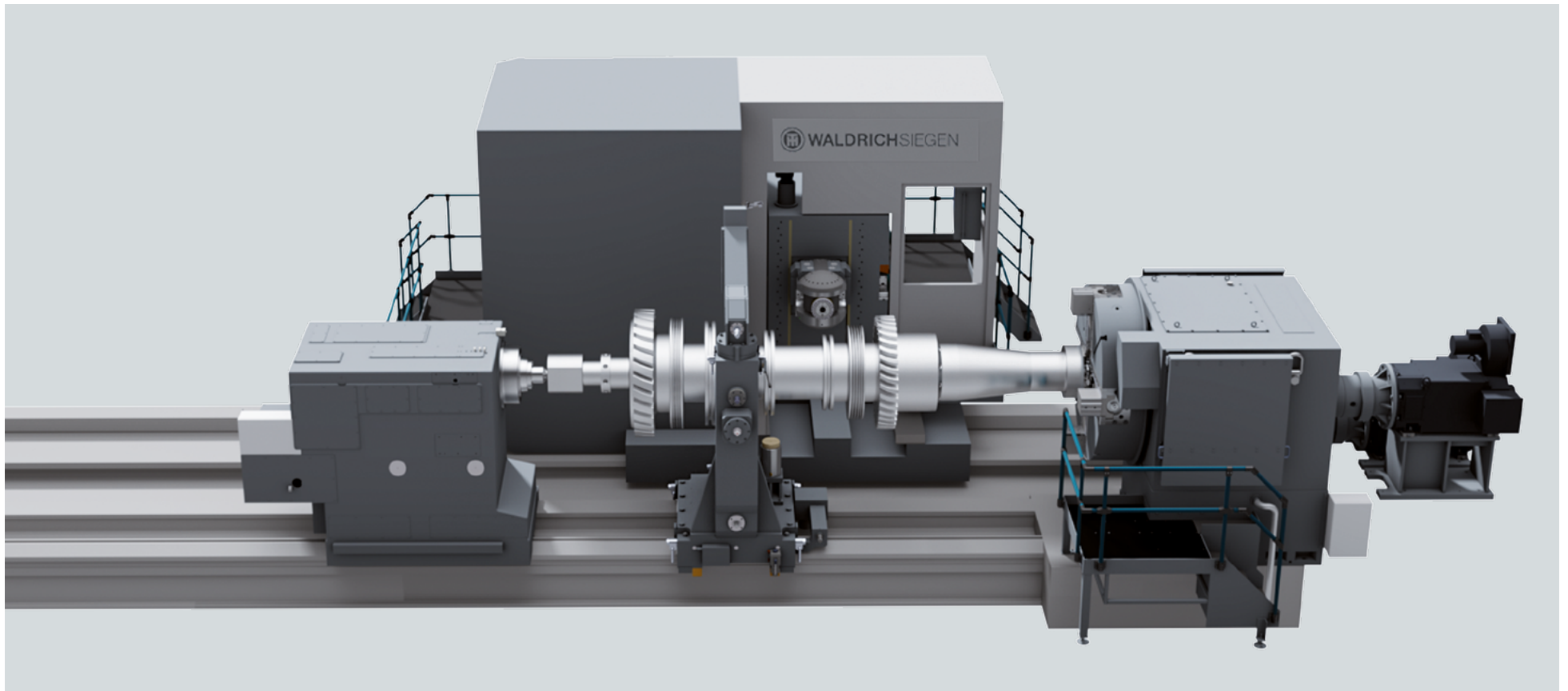


Multi-Talent ProfiTurn M: WaldrichSiegen Presents New Mill-Turning Machine



New ProfiTurn M: one machine for multiple machining operations

WaldrichSiegen has expanded its product range to include a new mill-turning machine. “The ProfiTurn M has been specifically designed for the complete machining of complex, rotationally symmetric workpieces that are run through several processing stages,” WaldrichSiegen’s President and COO Marco Tannert summarizes the machine concept.

Both turning and milling units, as well as boring and grinding units can be attached to the Master-head interface located at the milling tower. The result is highest efficiency, as all machining

stages can be performed on a single machine and multiple set-ups, which are both elaborate and costly, are reduced.

Whether turbine or generator rotors or heavy forged parts – the ProfiTurn M has been developed for the precise and efficient machining of demanding workpieces with a diameter of up to 4.2 m, a length of 25 m and weights between 20 and 250 t. The extremely rigid box-in-box construction of the milling tower guarantees highest stability, even when great cutting forces are involved. The completely encased machine operates precisely and wear-freely thanks to

the hydrostatic guides both in the carriage and the bed. An unlimited service life even at the highest performances is another advantage of the hydrostatic guides. The “stick-slip effect” is avoided, allowing for very accurate positioning. Oil pockets effectively damp vibrations and thus support the extremely precise working of the machine.

Depending on the customer’s requirements, either a high-performance boring and milling spindle or a ram is integrated in the traversing column. A tool and unit changer can be added for fully automatic operation of the machine.

Highlights – at a Glance

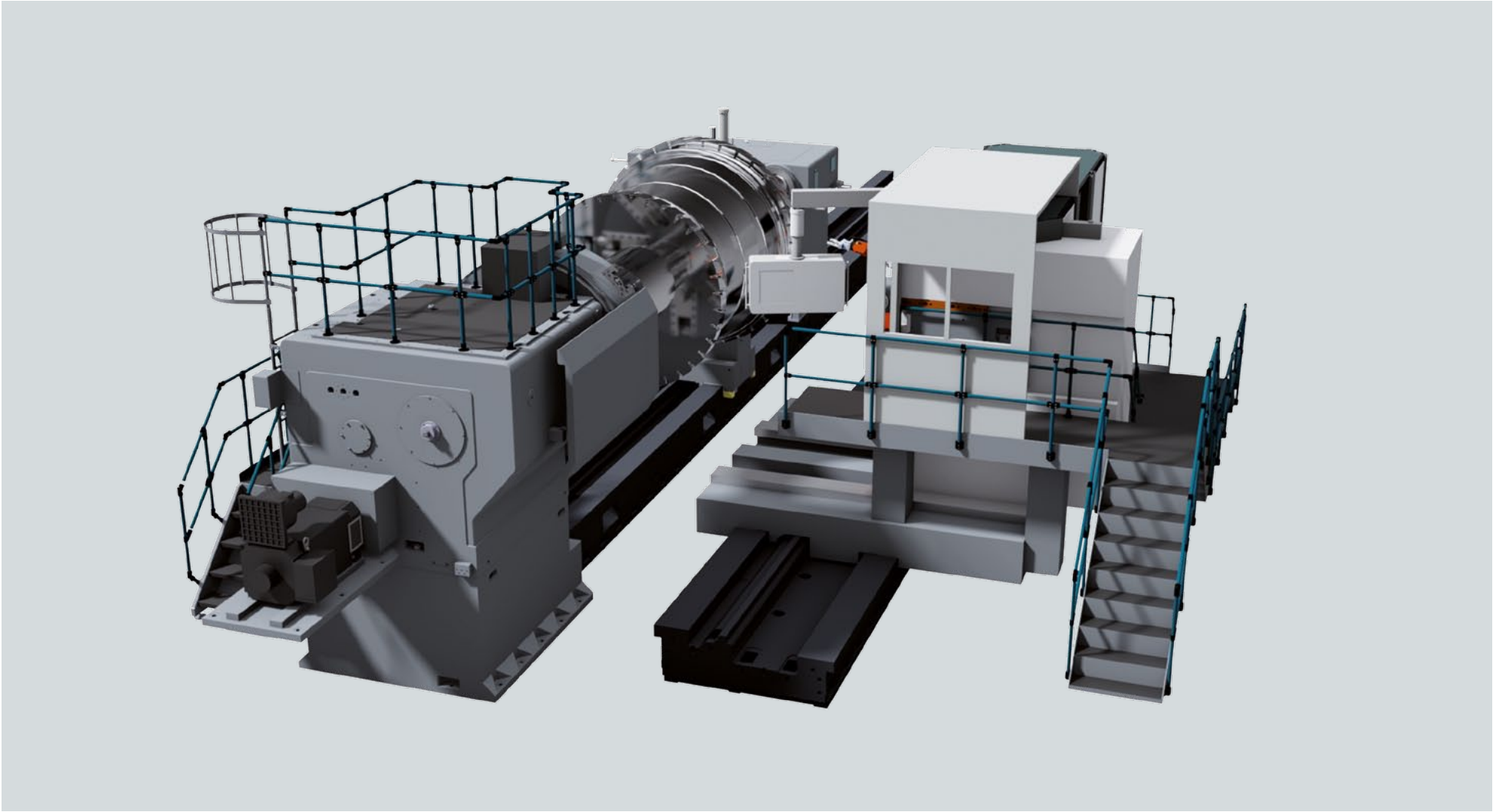
- Extremely stiff box-in-box design of the milling tower (gantry column design)
- Hydrostatic guideways for carriage and bed
- Iron-cast structural components
- Headstock with Master/Slave drive
- Powerful main milling spindle
- High level of process integration (turning, milling, grinding and boring)
- Tailstock for mounting the workpiece between centers
- Operator and maintenance-friendly machine concept
- Energy-efficient design

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Mill-turning machine ProfiTurn M with two beds

Customizable solution for complex mill-turning tasks

During the development stage of the ProfiTurn M, WaldrichSiegen’s long experience in the

areas of milling and turning operations has been an important success factor. “We were able to build on the concept of mill-turning machines, with which WaldrichSiegen had been suc-

cessful many years ago, and to optimize it,” Marco Tannert says.

“ The result of our work is a modern machine gen-

eration that sets new standards. ”

– Marco Tannert

While the tried-and-tested hori-

zontal lathe ProfiTurn H with milling head covers more simple mill-turning tasks, the ProfiTurn M is now the ideal solution for more complex mill-turning operations.

Range of equipment

- Roller steady rests
- C-steady rests
- Hydrostatic steady rests
- Measuring of the tool and the workpiece
- A diverse range of spindle units to integrate all necessary technologies (turning, milling, grinding and boring)
- Tool changer
- Coolant system, minimum quantity lubrication
- Internal and external coolant supply
- Full room enclosure

Technical Data

Dimensions

Workpiece diameter	1 - 4.2 m
Distance between centers, max.	25 m
Workpiece weight, max.	250 t

Headstock with master/slave drive

Faceplate diameter	1.1 to 2.5 m	
Power, max.	180 kW	310 kW
Torque, max.	75 kNm	120 kNm
Speed, max.	400 min ⁻¹	210 min ⁻¹

Milling tower with permanently integrated milling spindle or extendable ram

Milling power, max.	63 kW	80 kW
Torque, max.	5,000 Nm	7,000 Nm
Speed, max.	4,000 min ⁻¹	4,000 min ⁻¹
C-axis	± 190°	± 190°

Optional turning tool slide at the milling tower

Cutting force	150 kN
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Engine block machining time cut by more than half

User report: two ProfiMill portal mills in operation at Jinan Diesel Engine Co., Ltd.



A turnkey solution: WaldrichSiegen provided two ProfiMill portal mills along with the entire application technology

What do drilling platforms, natural gas storage facilities, offshore work vessels and industrial power plants have in common? They all depend on the energy supply provided by gas and diesel engines. In these demanding fields of application, high efficiency and absolute reliability of such engines are crucial. Jinan Diesel Engine Co., Ltd. (JDEC) manufactures high-quality gas and diesel engines and generators in Jinan City in the Chinese province of Shandong. A recent addition to the company's product range posed an unprecedented machining challenge: rough milling, semi-finishing and finishing of MAN engine blocks. This prompted a successful cooperation between JDEC and the German heavy-duty machine tool expert WaldrichSiegen.

Two WaldrichSiegen ProfiMill portal milling machines proved

the perfect solution for the task at hand: they reduce the machining time by more than half. When JDEC became a licensed manufacturer of MAN 32 V and 32 L motors in 2010, it was clear that merely finding a machine supplier for the processing of motor block castings would not be enough. "What we needed was a turnkey solution," recounts Mr. Yu Haibo, Vice Managing Director of JDEC's Plant No. 01. "We were looking for a partner to provide the necessary equipment, the entire application technology, machining methods and CNC programming to turn the castings into finished engine blocks. We knew this would require vast experience in the field." WaldrichSiegen, one of the worldwide market leaders in the manufacturing of heavy-duty machine tools for milling, turning, grinding and texturing, has been an expert in designing and building customized machine tools for diesel engines for many decades. In the tender process,

two of its state-of-the-art ProfiMill portal mills with a setup width of 3,000 mm, a setup length of 8,000 mm and 6,000 mm respectively, and a clearance of 4,000 mm between the columns left the competition far behind.

Complex machining challenges expertly met

"A diesel engine block is one of the most demanding cubic workpieces. It can weigh more than 20 tons with a complicated shape and very high requirements in terms of accuracy. The cylinder bore, for example, is up to 610 mm deep. It must be perfectly positioned in relation to the bearing bore," Yu Haibo explains. The ProfiMill portal mills with a milling power of 100 kW at the tool center point combine a number of features to meet these requirements: the major components are made of high-quality cast iron and all machine axes are hydrostatically guided. A



Two ProfiMill portal milling machines with a milling power of 100 kW at the tool center point

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backlash-free hydrostatic worm drive in the X-axis ensures dynamic stiffness and high positioning accuracy. The Y-axis (saddle on cross rail) is driven by an electrically preloaded master/slave drive for outstanding accuracy in terms of positioning and feeding forces. Controlled vertical and horizontal head clearance results in excellent cutting performance and surface qualities. “When machining MAN 32 diesel engines, the increase in efficiency and accuracy is immediately noticeable,” Yu Haibo reports.

“ The quality of the workpieces has been improved. ”
– Yu Haibo

One of the main challenges in manufacturing motor blocks is the machining of surfaces and bores that are very difficult to access. “This is why we complemented the machines with special equipment,” Knud Müller, Head of Sales at Waldrich-Siegen, explains. “They feature eight special milling units each. These can be switched easily by the help of an automatic changing system.” The units are attached at the unique Waldrich-Siegen Masterhead interface. The Masterhead concept, with only the drive shaft integrated in the RAM while the bearings and milling spindles are located in the attachments, features several advantages, among them prevention of heat generation and thus geometrical problems, as well as extremely high stiffness at the Masterhead interface. In addition, the machines are

equipped with automatic tool changers with 192-pocket racks. In combination with the sophisticated measuring and control technology, the various tools and milling units fulfill even the most complicated machining duties competently and efficiently: “During critical machining tasks, as for example at the bearing hole for the crankshaft, elaborate measurements are no longer necessary. They only have to be performed sporadically now, which results in shorter machining times,” Knud Müller explains. According to Yu Haibo, the flexibility of the portal mills is a major advantage in his production facility: “The machines use many different tools and attachments for the machining of different areas, which directly improves the machining efficiency. Compared with other machines, the machining time is reduced by more than half.”

Outstanding long-term performance

In late 2012, the milling machines were put to the test in Waldrich-Siegen’s headquarters in Burbach, Germany: four MAN 32 V engine blocks had to be machined, meeting the performance standards defined by JDEC. The result: “The machines fulfilled our high demands in terms of accuracy in the acceptance test, especially during heavy-duty metal cutting involving great stock removal,” Yu Haibo states. Two teams of JDEC staff received extensive training in Germany for ten weeks each in order to start machine operation immediately after commissioning. After the

machines have been in operation at the Jinan City headquarters for well over a year, Yu Haibo reports that the ProfiMill portal mills continue to save considerable machining time: “The special equipment allows for five-side machining in one single setup.

“ The reduction of setup time vastly improves the machining accuracy and efficiency. ”
– Yu Haibo

Sufficient experience to provide a turnkey solution, outstanding precision and flexibility to perform the complex machining tasks at hand and efficient operation were among the deciding factors for the successful cooperation between JDEC and WaldrichSiegen. But yet another important condition had to be met to seal the deal: local after-sales service, specifically perennial technical support, maintenance service and quick access to spare parts were paramount. German Machine International Trading, WaldrichSiegen’s service and spare parts unit near Shanghai, meets these requirements to JDEC’s full content: “We are thoroughly satisfied with the WaldrichSiegen team in this regard,” Yu Haibo concludes. “We always receive feedback very quickly and WaldrichSiegen also offers helpful suggestions for the maintenance and operation of the machines.”



Switching between machining applications with an automatic tool changer

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Automatic tool changing system with 192-pocket racks



The portal mills are equipped with eight special milling units each

Precision for Power

User report: three ProfiTurn H lathes for MHPSA



ProfiTurn H with a drive power of 310 kW and a torque of 200,000 Nm

The J-Series gas turbine by Mitsubishi Hitachi Power Systems Americas, Inc. (MHPSA) can produce over 327 MW of power in single cycle and 470 MW in combined cycle – it is the most powerful gas turbine in the world. Capable of operation at inlet temperatures of 1,600 °C, it operates with record-breaking efficiency. High-performance turbines such as the J-Series gas turbine are at the heart of power generating systems that provide millions of households with electric power – a great responsibility. Each of their components has to be manufactured to the highest quality standards. Since 2012, MHPSA operates ProfiTurn H lathes made by Waldrich-Siegen to machine its gas and steam turbine rotors to extremely high standards.

MHPSA is a manufacturer of power generation systems for large utility companies, such as Southern Company, Georgia Power, and Florida Power and Light. A subsidiary of Mitsubishi Heavy Industries, Ltd. that later merged with Hitachi, Ltd., the company produces steam and gas turbines in Savannah, Georgia. With 150 years of technology

leadership in power generation solutions, MHPSA's systems guarantee reliable power supply for millions of households and companies. When MHPSA decided to acquire state-of-the-art lathes to machine its turbine rotors, it turned to the market-leading manufacturer of lathes for this application, Waldrich-Siegen. Based in Germany, Waldrich-Siegen is an expert in the design and manufacture of customized heavy-duty machine tools for complex turning operations with more than 175 years' experience in various industries. Power and precision in a single machine is the dual challenge in this application. Russell Gambelin, Maintenance and Facilities Manager and author of "Machine Tools: Specification, Purchase and Installation", summarizes MHPSA's expectations: "Quality and accuracy are the most important criteria when machining turbine rotors – workpieces that weigh up to 200 tons and rotate at 3,600 rpm during operation."

Combining great machining forces and high precision

"In 2010, we received an order from MHPSA comprising two customized lathes to machine gas and turbine rotors. Our Profi-

Turn H series seemed like the ideal solution for the task, and it was. The order for another lathe followed a year later," says Marco Tannert, President of Waldrich-Siegen. The ProfiTurn H series has been developed to

machine large and heavy rotationally symmetric workpieces. The largest of the three lathes built for MHPSA machines workpieces with a diameter of up to 205" (5,200 mm), lengths of up to 571" (14,500 mm) and weights of

up to 200 t. It has a drive power of 310 kW and a torque of 200,000 Nm. In close cooperation with MHPSA, Waldrich-Siegen tailored the lathe specifically to the task at hand. As the rotors have to be machined to

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The carriage is driven by a preloaded double pinion drive

very tight tolerances at immense metal removal rates, the machine design combines great machining force with outstanding precision.

“MHPSA requested an axial runout of less than 7 µm and a radial runout of less than 15 µm,” Marco Tannert recounts. “In order to meet these tolerances reliably, the lathe operates with an axial and radial runout tolerance of 5 µm. Combining these accuracies with a maximum cutting force of 12 tons and 10 tons at the two tools provides an unparalleled machining performance.” To achieve such high operating standards, the entire ProfiTurn H machine structure is extremely rigid. Its X-axis and Z-axis are hydrostatically guided for precise and wear-free operation and excellent thermal characteristics. “The rigid hydrostatic design and the robust structure are definitely highlights of the machine,” says Russell Gamblin. The carriage is driven along the Z-axis by a preloaded double pinion drive. The hydrostatic guideway system has been constantly refined by WaldrichSiegen over the years – today, its extremely high dynamic stiffness is unsurpassed in the market, an indispensable precondition for the complex machining tasks required by MHPSA.

Outstanding performance to the last detail

Turbine rotors pose a number of complex machining challenges. “Journal machining for steam and gas turbine rotors is one of the most critical tasks,” says Russell Gamblin. “The required tolerance is +50 µm/-0 µm. During operation, the rotor rotates at 3,600 rpm. The surface must match the bearing surface on the pedestal exactly.” In addition to the rigid, hydrostatic machine design, a key factor to achieving the extremely high runout accuracy and maximum performance necessary is the absolutely precise positioning of the workpiece. The ProfiTurn H lathe is equipped with a counterstay instead of a tailstock for turning the rotors in steady rests. The counterstay monitors the positioning of the rotor and prevents axial displacement. The hydrostatic steady rests add to the stiffness required for concentricity in µm range and the excellent damping characteristics of the entire machine. According to Russell Gamblin, the steady rests in particular are a major advantage with regard to the overall shop floor efficiency: “In comparison to other large lathes in operation at our facility, the ProfiTurn H lathes are set up more easily due to a better hy-

drostatic steady rest design,” he says. The rotors are positioned in the lathe with maximum precision by the help of a hydraulically adjustable quill. Clamping spindles with quick-adjustment function allow for fast and easy clamping and adjustment of the workpieces. The optimized guidance of the clamping jaws and deflection protection of the clamping spindles further increase the workpiece clamping accuracy.

These features result in smooth and reliable running of the machines in the day-to-day business in Savannah: “When I talk to the machinists on the factory floor, they tell me they would much rather operate the WaldrichSiegen lathe when compared to the other lathes,” Russell Gamblin reports. Two smaller lathes with a maximum workpiece weight of 100 tons, a maximum workpiece diameter of 87” (2,200 mm) and a maximum workpiece length of 413” (10,500 mm) and 354” (9,000 mm) respectively also took up operation in MHPSA’s facility in Savannah in 2013. They machine gas and steam turbine rotors as accurately as the larger one, as well as performing repair and revamp tasks in MHPSA’s service business.

Operating ProfiTurn H lathes has strengthened the efficiency of the entire production: “They have the least amount of downtime. Due to that and the excellent support from KPM, the WaldrichSiegen service unit in Ford City, Pennsylvania, we have significantly improved our processes and efficiency.” The superior quality of WaldrichSiegen lathes made the ProfiTurn H the first choice for MHPSA’s demanding machining tasks and since taking up operation, they have proven themselves down to the last detail. Russell Gamblin

puts it simply: “Our high expectations in terms of machining accuracy and minimal downtime have been met to our full satisfaction.

“ I would recommend WaldrichSiegen machines 100 %. ”
– Russell Gamblin

Said and done – shortly after, Mitsubishi Hitachi Power Systems in Japan purchased yet another lathe made by WaldrichSiegen.

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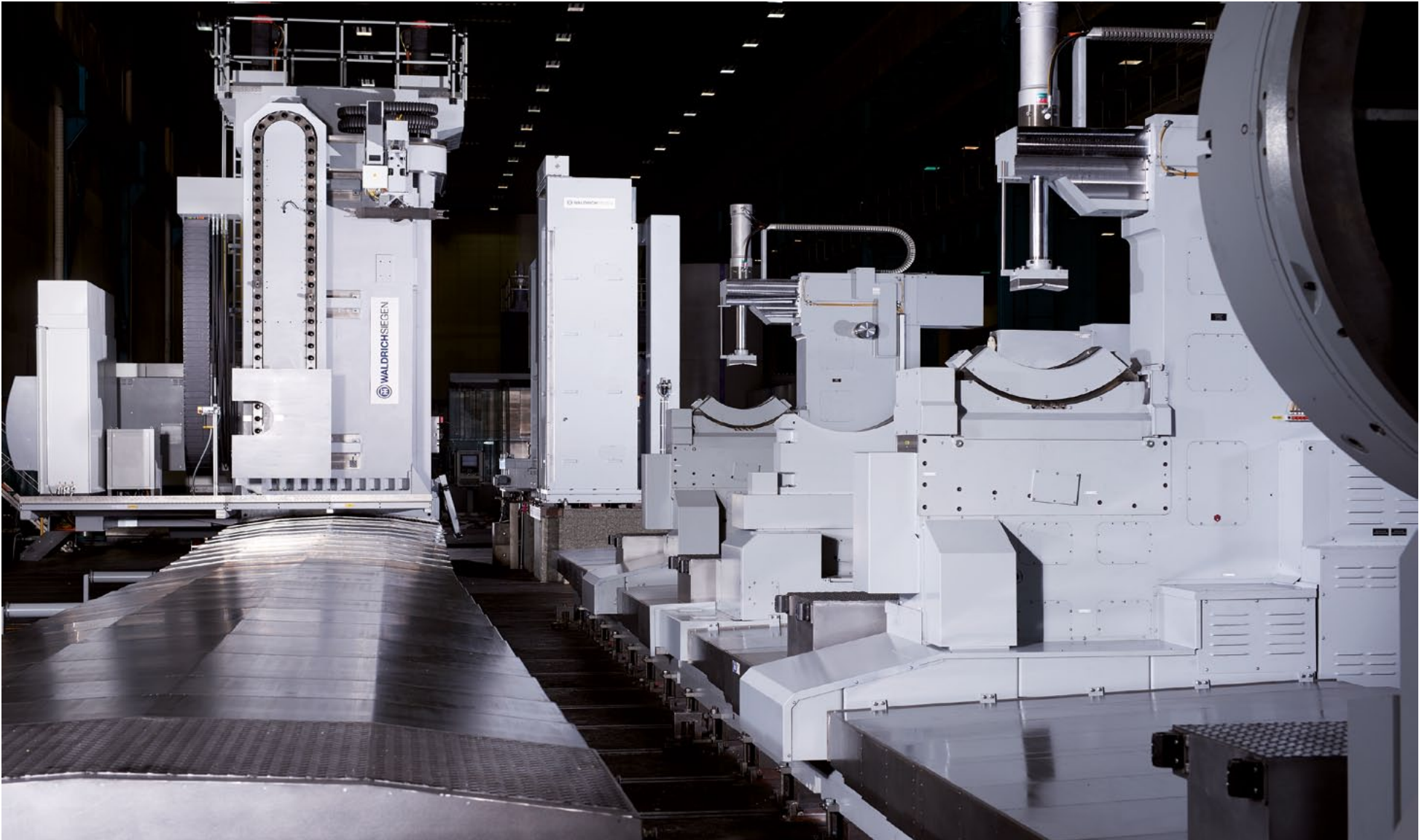
The rotors are turned in hydrostatic steady rests



The ProfiTurn H operates with an axial and radial runout tolerance of 5 µm

Machining generator and turbine rotors with a single machine

New Machine Concept by WaldrichSiegen and UnionChemnitz



New machining concept based on a horizontal boring mill (left) and a sophisticated set-up system (right)

From generator shafts to flange bores and fir tree grooves – generator rotors and turbine rotors each pose a number of critical and very different machining challenges. This is why the machining of these complex workpieces usually requires two separate, specialized machine tools. WaldrichSiegen and UnionChemnitz have now developed a universal rotor slotter that allows for the efficient machining of both workpieces on a single machine.

The innovative machine concept is the result of a collaborative effort of the world-leading expert in heavy-duty machine tools for this application, WaldrichSiegen, and its sister company UnionChemnitz, a specialist in manufacturing horizontal boring and milling machines with more than 160 years' experience. The rotor slotter is specifically tailored to the requirements of a large American power plant manufacturer. It is based on

UnionChemnitz's most powerful horizontal boring and milling machine PCR 260 with a spindle diameter of 260 mm, a power of 128 kW and a torque of 19,000 Nm, combined with a sophisticated, CNC-controlled set-up system designed by WaldrichSiegen and UnionChemnitz.

The rotor slotter machines rotors with a length of up to 15,500 mm, a diameter of up to 2,400 mm and a maximum weight of 150 t. It is equipped with a FANUC 30i control. Depending on the workpiece, it adapts to the various machining tasks required with a range of boring and milling units. These can weigh up to four tons. Outstanding stability is therefore one of the machine's most vital qualities. The machine bed is made of extremely robust cast iron, reliably absorbing vibrations. A fully hydrostatic guidance system guarantees highest precision and protection from wear even when performing heavy-duty machining. Both the heavily ribbed column and the

ram are designed for extra stiffness, as well. Double hydrostatic guideways enclose the ram completely, resulting in excellent damping of vibrations and reliable long-term stability. Thanks to the machine's overall stability, it achieves remarkable performances. When slotting generator shafts, a disk cutter with a diameter of 1,250 mm is mounted. It can mill grooves with a depth of 125 mm in a single cut, applying 111 kW spindle power at a torque of 33,000 Nm, and removal rate of about a ton per hour.

A major challenge in machining rotors is aligning the workpieces in the machine tool, a time-consuming process which often takes up as much as eight hours' valuable machining time. The set-up system automatically adjusts the rotor once it has been placed into a highly precise clamping device, reducing the set-up time to approximately an hour. Based on data gathered by state-of-the-art measuring de-



Pick-up station: each machining challenge is expertly met

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vices, numerically controlled, hydrostatic steady rests position the rotor in micrometer range – while bearing a weight of up to 80 tons each. Absolute set-up precision is crucial for various demanding machining tasks performed with the rotor slotter – for example when boring flange bores, which form the connection between turbine and generator, to tolerances of 10 µm.

The rotor slotter meets each specific machining challenge with customized spindle units, milling heads and tools and the appropriate NC programming solutions: curved fir tree grooves

in turbine rotors, for example, an extremely complex machining task, are pre-machined with a large bell cutter and finished with a finger cutter. An automatic tool changer allows for quick and efficient switching between machining applications.

WaldrichSiegen and Union-Chernitz are specialists in integrating custom solutions. Process integration is the key to success: flexible machining concepts allow for a broad range of applications with a single machine. Solutions specifically tailored to customers' requirements by UnionChernitz

include a boring mill with a high-speed rotary table for turning operations and a boring mill equipped with a grinding unit; WaldrichSiegen recently built a mill turning machine with an integrated grinding unit. By combining their expertise in developing innovative machine concepts, WaldrichSiegen and Union-Chernitz have raised the bar once more in the flexible machining of workpieces for the energy industry: the rotor slotter is unique in its universality, allowing for complete machining of both generator and turbine rotors.

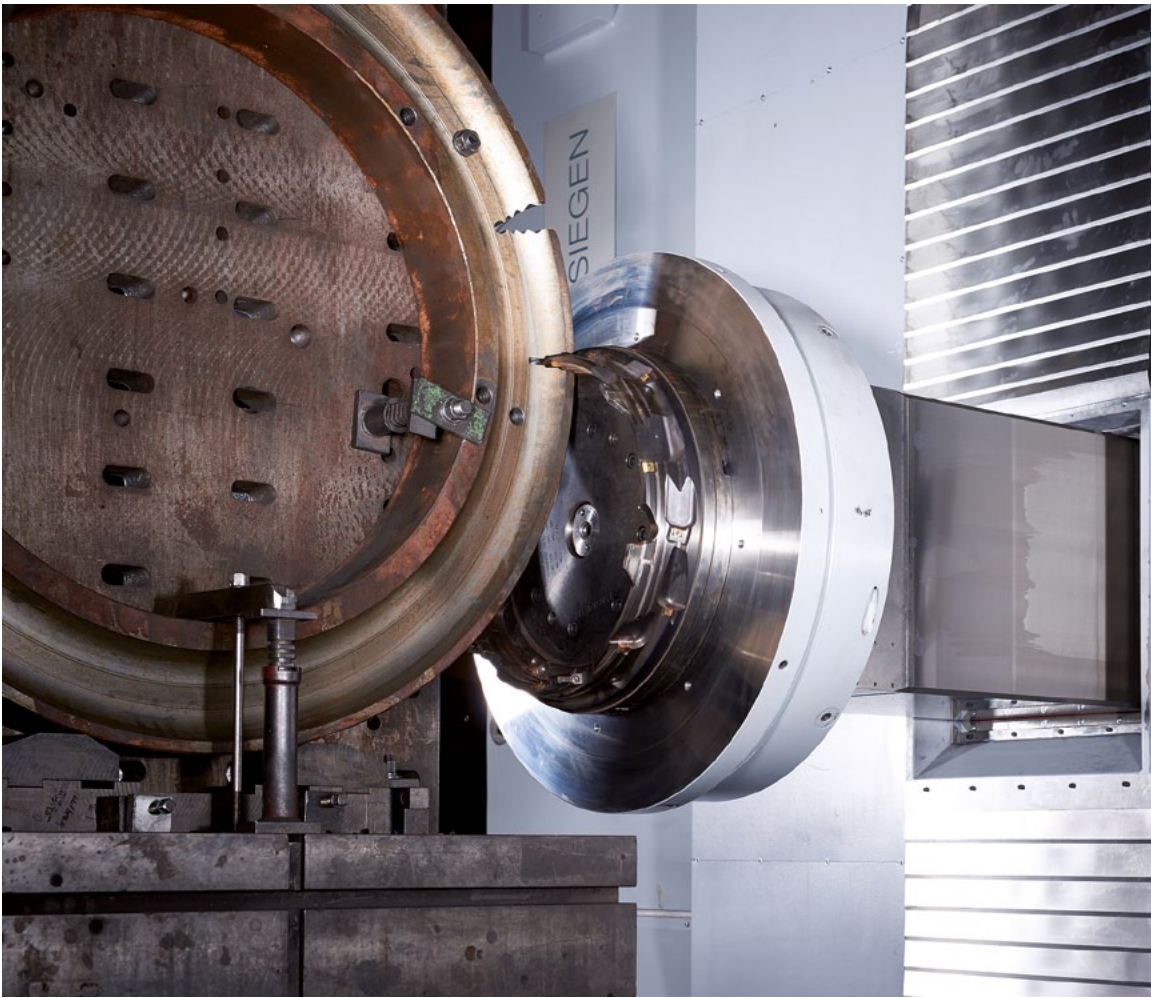
Technical Data

Dimensions

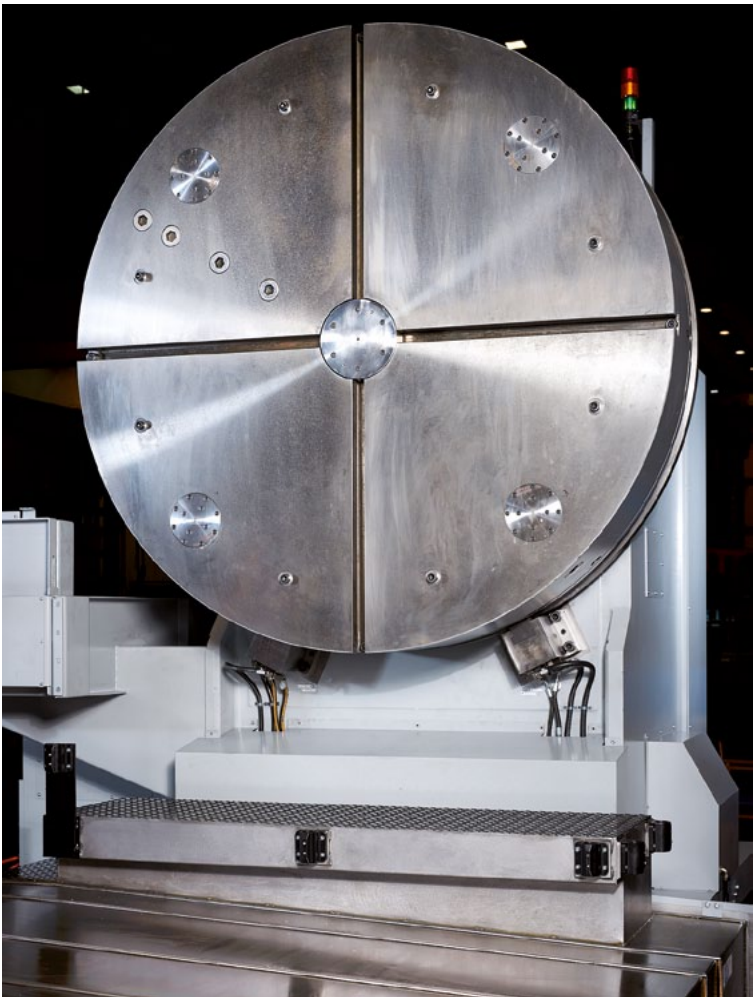
Workpiece diameter	2,400 mm
Workpiece length, max.	15,500 mm
Workpiece weight, max.	150 t

Performance

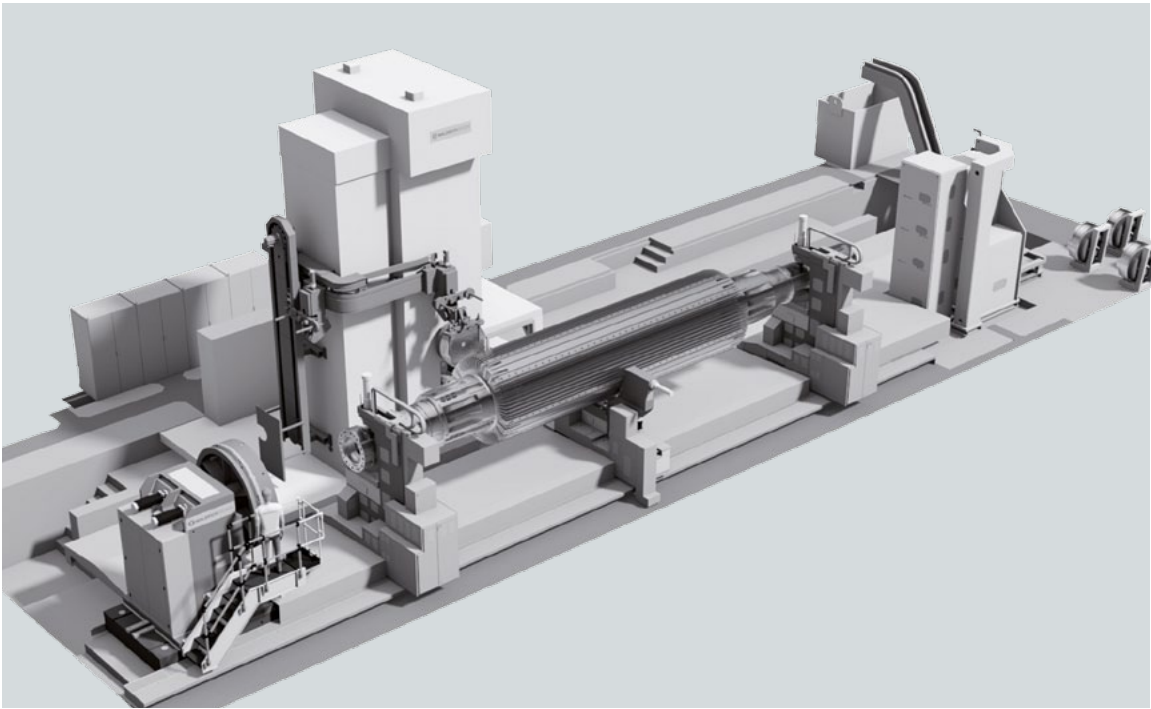
Power, max.	128 kW
Torque, max.	19,000 Nm
Speed range	1 - 1,600 rpm



Machining of fir tree grooves with a bell cutter



Indexer for precise and secure positioning of workpieces



New rotor slotter concept: a joint effort of WaldrichSiegen and UnionChernitz

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