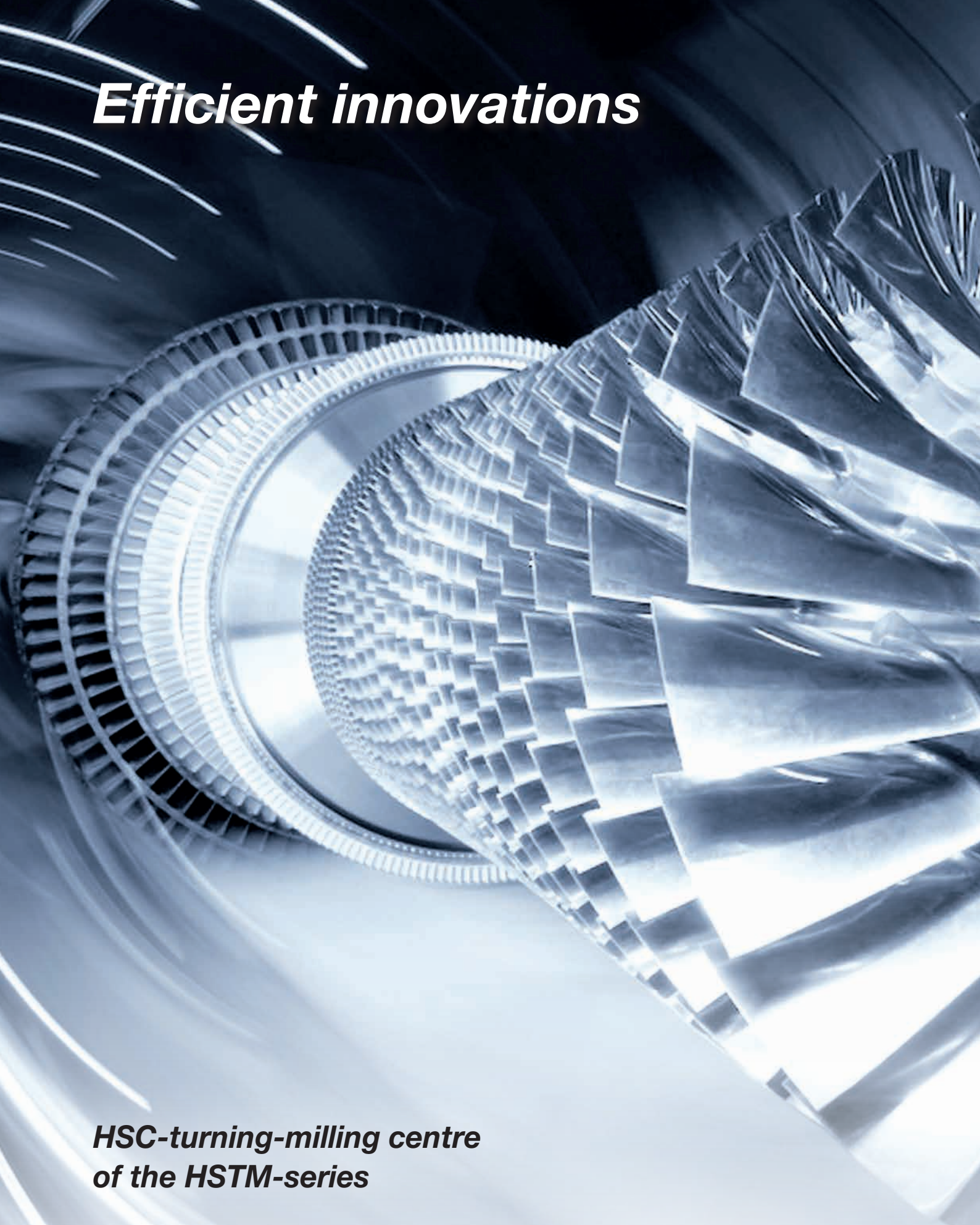
Efficient innovations



HSC-turning-milling centre of the HSTM-series

Multi-technology milling machine of the F-TB-series

HAMUEL REICHENBACHER

Members of the SCHERDELGroup

Contents

The world will be subject to change –

we will play our part in it!

Package solutions

Comprehensive in-house production

100 years of tradition

Efficient innovations

Process know-how

Lowest costs-per-piece

Materials with difficult machining characteristics

Utmost availability

Best 5-axes dynamics

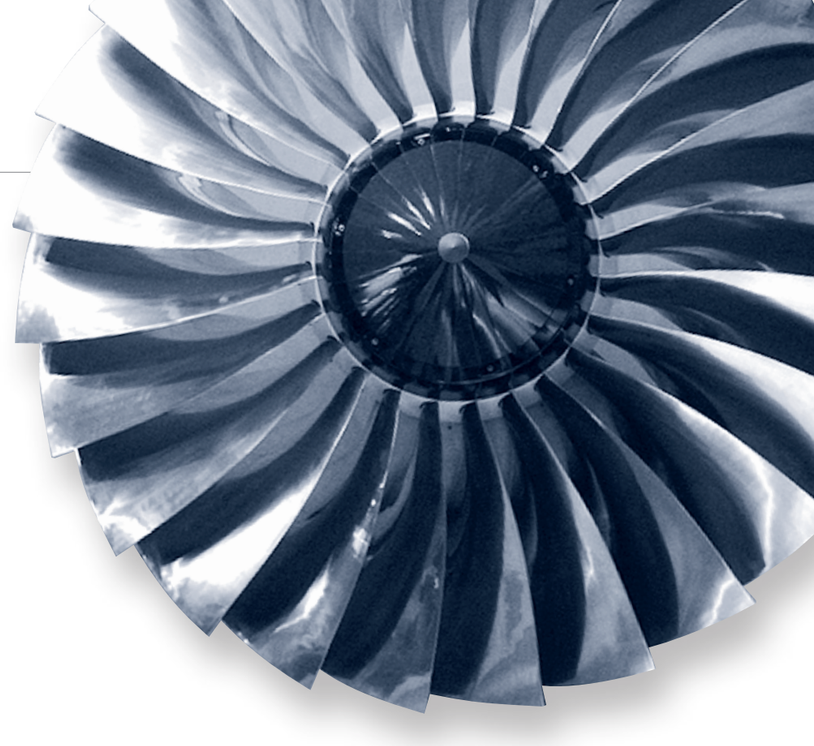
Speed and flexibility

Intricate components

HAMUEL puts the stress on efficiency

We can look back on almost 100 years of tradition in machine tool manufacture and mechanical engineering. In the field of CNC-machining alone, the company draws on 40 years of product experience. Today we can state the following: we have gained our position in the market as a leading expert for intricate components made from demanding materials, to the highest quality. Moreover, our customers benefit from low costs-per-piece, as well as from the comprehensive in-house production that permits particularly quick and flexible reactions to customer request, on our part.

We have learnt that nowadays a medium-sized company can only remain competitive if it is capable of developing outstanding innovations, and delivering economic solutions as a complete package when taking into consideration the special requests made by the customer. This means that innovations will not only be applied to the machine itself, but also to the entire process environment, ensuring utmost machine availability. A considerable savings potential for the machine user is, for example, generated by the advanced utilisation of carbon dioxide as the cooling agent. This also permits a more efficient customised solution in the machining of high-alloy, heat-resistant steels and of titanium material using unprecedented 5-axes dynamics. Get enthused by our capability, quality and innovative capacity!



Do you need an extraordinary solution – not just a compromise?

In aviation even the tiniest fault can be the cause of a big catastrophe. This is why we are very well aware of our great responsibility to provide excellent quality and sustained reliability with our solutions. Thus, it is insufficient to just meet the generally acceptable quality standards, we would rather aim at exceeding them time and time again. For precisely this reason, our target is to find even more efficient solutions with ever increasing advantages for all our customers.

Our system know-how, which is visible in our entire process chain, is a decisive plus point and of great assistance to you in further enhancing your competitive position, as it not only provides you with a considerable increase in your operating efficiency, but also in your safety and profitability levels. We are proud of our capability to make aviation safer by our innovative machining technologies and unique customised precision machines.

Of course this applies not only for our customers from the aviation sector, but also to our customers from other industries. The benefits from our know-how and greater demands on precision and quality have helped them all maintain an advantage over their competitors.

Machine designed for overhead crane hook handling to ensure its quick installation and start-up.

The axes for the component rotation possess an enormous torque for a processing that meets the highest quality demands as to the geometric characteristics of the components, this is particularly so at the entry and exit edges.

Integrated component loading device to achieve optimum machine productivity (as an option).

User-friendly, extremely dynamic and high-precision control systems are preferably used for the HSC-5-axes turning-milling process.

Y-Z-cross slide inclined by at 45° with respect to the machine bed:
- Optimum accessibility of the working area.
- Ideal visibility for process observation.
- Identical kinematic and dynamic conditions for the Z- and Y-axis.
- Chip chute at 45° for automatic chip removal.

The result of an optimum interaction between innovative solutions and efficiency

Machine construction with inherent rigidity. Thus, no special floor foundation is required.

The separation of the axes into components (X, A, C, U) and tool axes (Y, Z, B) permits excellent acceleration and machine dynamics.

Universal machine for the processing of blade and wheel shapes (e.g. impeller).

Unmatched damping characteristics of the machine bed, slides and housings of the rotary axes guarantee the best quality and tool life for the 5-axes HSC-turning-milling process.

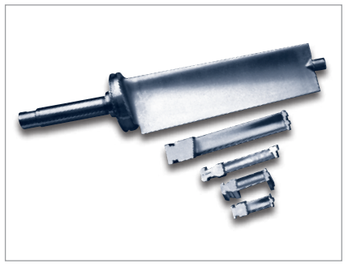
Exploit your potential – make full use of your competitive advantage!

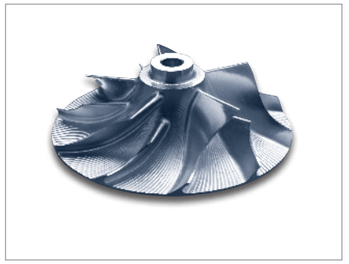
The HSC-turning-milling centre HSTM, where the components are arranged horizontally, is especially suited for the machining of turbine and compressor blades, blisks and/or radial compressors, as well as many other intricate turning-milling parts. The slant bed slides are inclined to the front at an angle of 45° to ensure optimum mass distribution, excellent loading possibilities and a brilliant view of the working area.

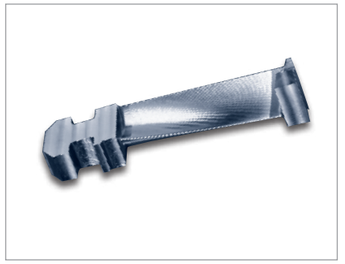
Precision and economics
Where the attainable accuracies and surface qualities are concerned, the HSTM exceeds the greatest demands made on modern blade machining. Maximum productivity is continuously ensured by its sturdiness and rigidity, as well as an integrated HSC-support.

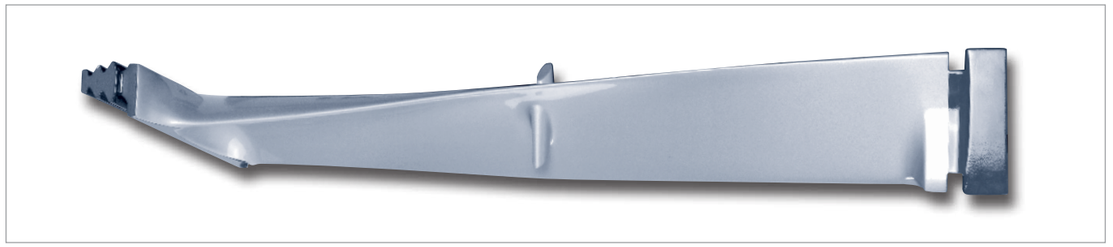
Utmost adaptability
All machines can be equipped with component changing systems for the quick loading and unloading of blanks and finished turbine blades. Attaching component magazines permits a production run of several shifts without the presence of an operator. Different types of machinery can without any problem, be interlinked to form a flexible manufacturing cell. Here, the philosophy is put into practice so that any applicable work-part can be introduced into the cell and say, a turbine blade with complete documentation, meeting the demanding criteria of the aircraft engine industry, leaves the cell finished.

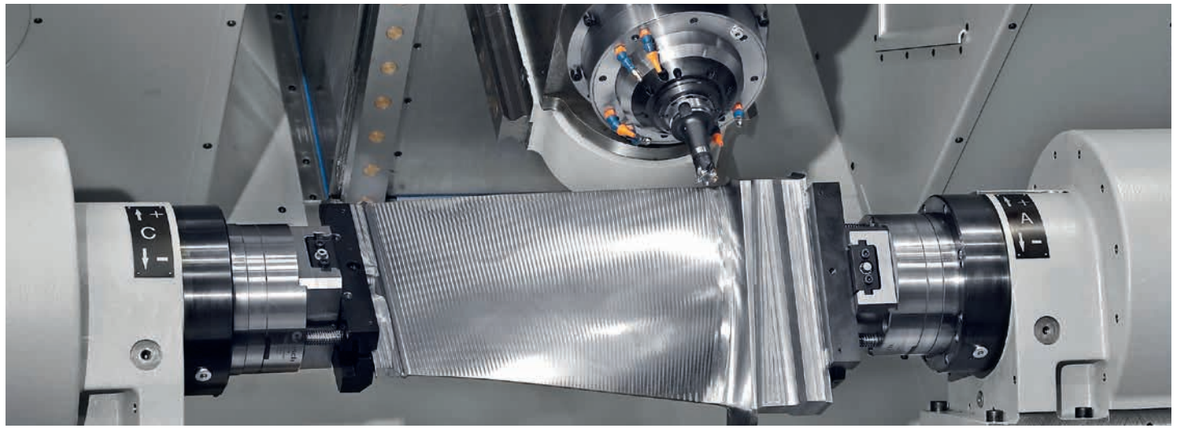
Ergonomics and productivity
The inclined position of the axes in the machining area guarantees an excellent chip removal. Standard interfaces at the rotary axes and peripheral components are the essential characteristics of this machine, being designed for utmost productivity. In arranging the operating and service elements, special importance was attached to their ergonomic layout.











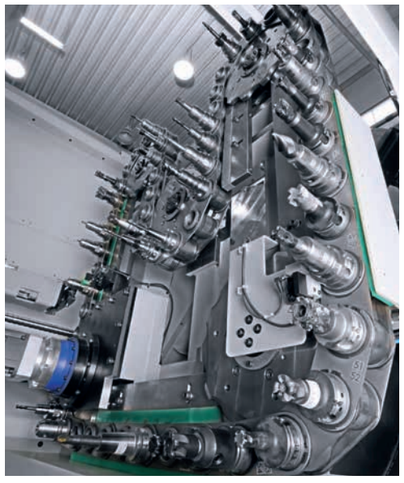
HSTM options
A- and C-axes available with anti-friction bearings, hydrostatic bearings or in mineral cast design

HSTM standards:

- Milling spindle
  Speed range 16,000 rpm
  Rated speed 3,800 rpm
  Spindle power (S1) 54 kW
  Spindle torque (S1) 136 Nm
- Positioning accuracy per VDI/DGQ 3441
  X-axis (P/Ps) 0.009/0.005 mm
  Y-axis (P/Ps) 0.009/0.005 mm
  Z-axis (P/Ps) 0.009/0.005 mm
  A-axis (P/Ps) 0.003 degrees
  B-axis (P/Ps) 0.003 degrees
  C-axis (P/Ps) 0.003 degrees
- Measuring systems:
  Absolute glass scale, absolute encoder
- CNC-control systems
  Sinumerik 840 D, FANUC 31i

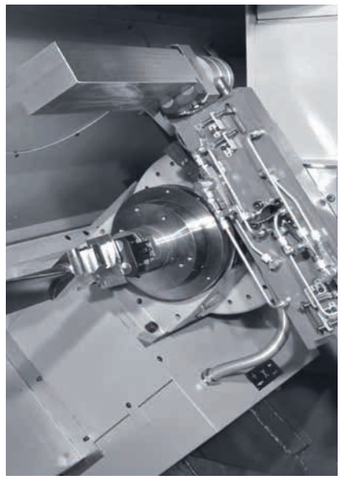
The HSTM-series guarantees:

- Excellent up-time
- Great static and dynamic rigidity
- Thermo-stability in all axes
- Modular design – the same spare parts for all machines
- Ergonomic design
- Motor spindles with high speed and strong torque
- Utmost machine dynamics for short component processing times
- Excellent accessibility for maintenance and service
- Highest demands on accuracy and surface quality
- Automatic changing of tools and components
- Excellent surface quality due to hydrostatic A- and C-axes



Tool changing chain

Tool changing disc



Component changing device

Linear handling by chain magazine

Type of machine	Main axes			Component dimensions	Machine dimensions		
	X-axis	Y-axis	Z-axis	Blade width	Length	Width	Height
HSTM 300	760 mm	400 mm	570 mm	360 mm	4,400 mm	2,800 mm	3,000 mm
HSTM 500	1,010 mm	400 mm	570 mm	360 mm	5,050 mm	2,800 mm	3,000 mm
HSTM 1000	1,490 mm	400 mm	570 mm	360 mm	6,080 mm	2,800 mm	3,100 mm
HSTM 1500	1,990 mm	400 mm	570 mm	360 mm	7,400 mm	2,800 mm	3,100 mm
HSTM 1500 XL	1,810 mm	700 mm	830 mm	700 mm	7,300 mm	3,750 mm	4,095 mm
HSTM 2000 XL	2,310 mm	700 mm	830 mm	700 mm	8,500 mm	3,750 mm	4,095 mm
HSTM 2500 XL	2,810 mm	700 mm	830 mm	700 mm	9,500 mm	3,750 mm	4,095 mm
HSTM 150 HD	600 mm	240 mm	395 mm	200 mm	3,400 mm	2,600 mm	3,200 mm
HSTM 300 HD	760 mm	400 mm	590 mm	400 mm	4,800 mm	3,000 mm	3,200 mm
HSTM 500 HD	960 mm	400 mm	590 mm	400 mm	5,200 mm	3,000 mm	3,200 mm
HSTM 700 HD	1,200 mm	400 mm	590 mm	400 mm	5,600 mm	3,000 mm	3,200 mm
HSTM 1000 HD	1,500 mm	400 mm	590 mm	400 mm	5,600 mm	3,000 mm	3,200 mm

Component spindle

Interface:	HSK-B 100	HSK-B 160	HSK-B 160
Torque:	1,050 Nm	1,530 Nm	1,845 Nm
Speed:	180 min^{-1}	180 min^{-1}	130 min^{-1}

Tool data (standard)

Tool interface:	HSK-A 63
Max. tool diameter:	80 mm
Max. tool length:	250 mm
Max. tool weight:	6 kg
Tool magazine:	24 / 36 / 60

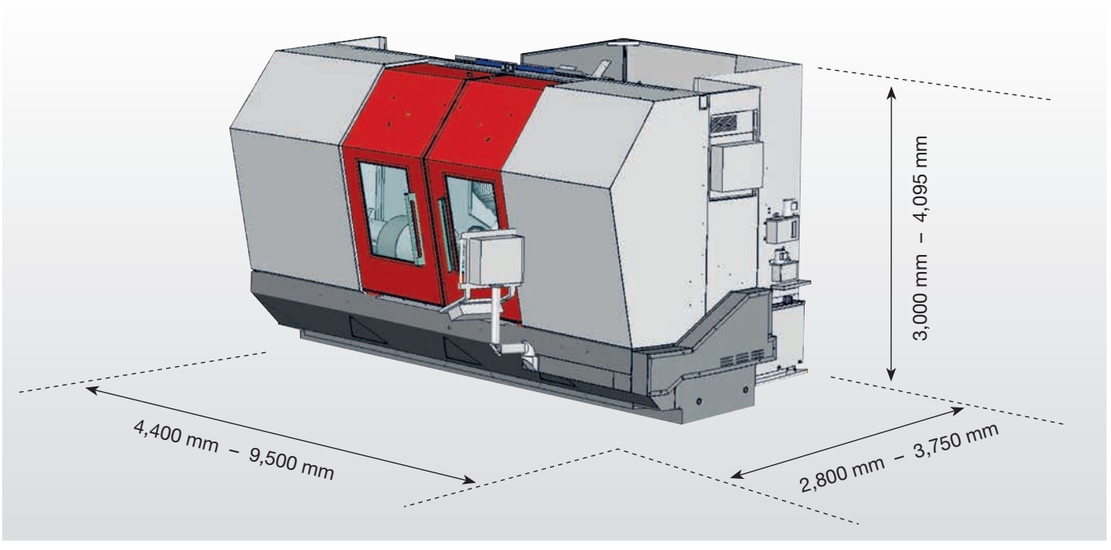
Travelling speeds		**HD**
Linear axes:	40 m/min	65 m/min
B-axis:	40 min^{-1}	100 min^{-1}
Acceleration		**HD**
Linear axes:	0,6 g	1 g
B-axis:	8 s^{-2}	15 s^{-2}

Design options

Standard

XL for particularly big and wide components

HD (high damping) for excellent surfaces and low tool wear



The machines of the F-TB series offer a comprehensive selection of exchangeable machining heads for various technologies.

Amazing productivity!

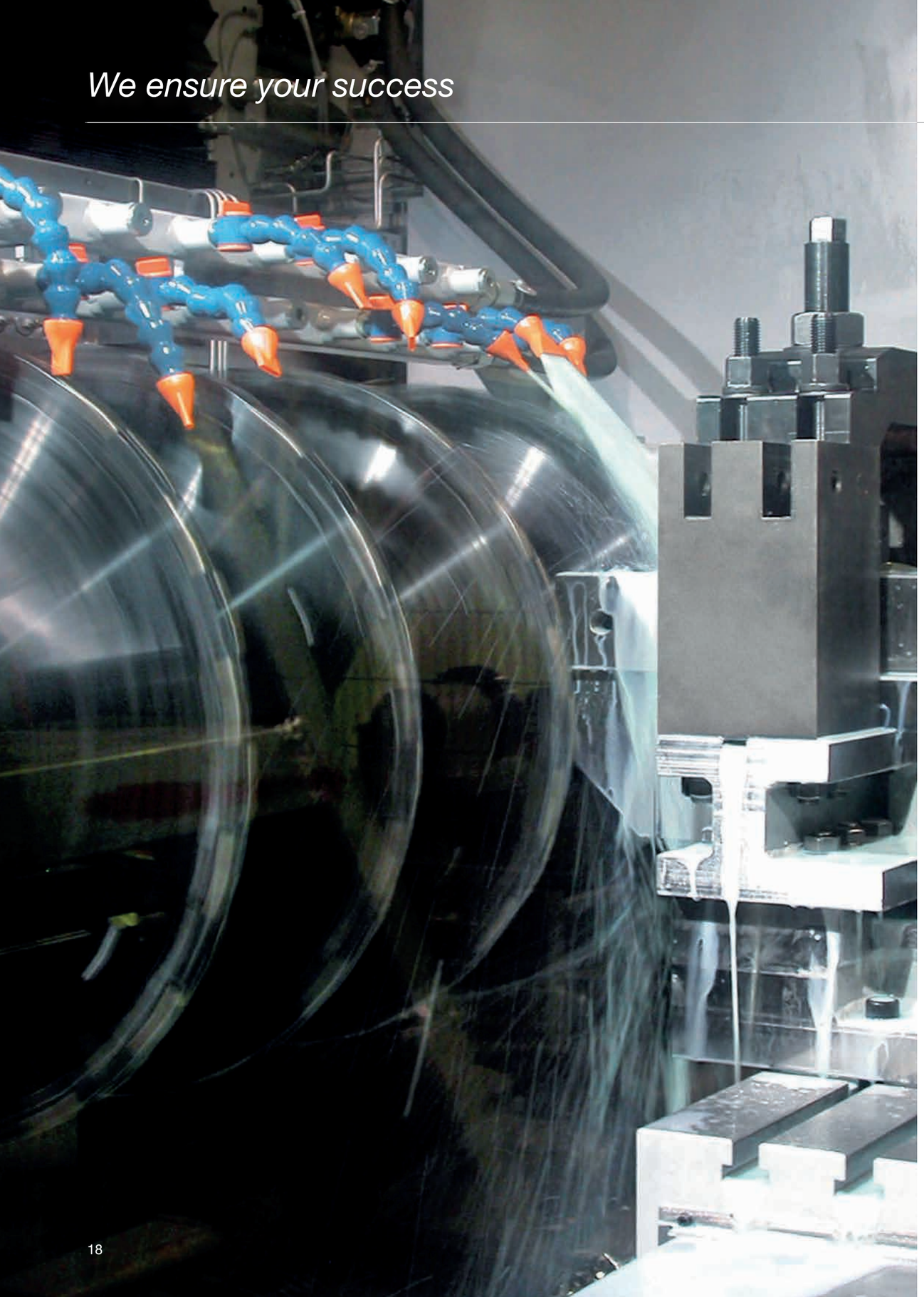
A semi-automatic changing device for the milling unit minimises down-times.

The utilisation of standard cutting inserts in the disc cutter permits a significant reduction in tool costs.

The flexible modular design of the machine allows for a multitude of application expansions.

Heavy and sturdy machine equipped with slide-ways.

Ultimate productivity owing to the utilisation of powerful drives.



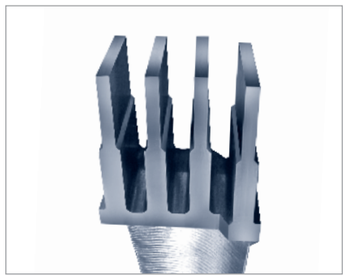
Carry unique experience!

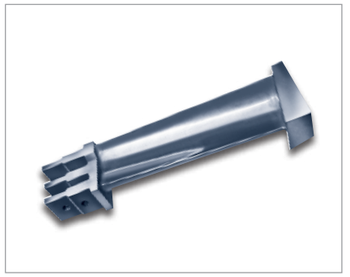
The machining centre F-TB has been especially developed for milling various geometric shapes at turbine roots and heads, as well as on other turbine components, such as blisks, impellers, wave disc segments and housings. The machine is suitable for machining intricate finger shapes at the turbine root using standard disc cutter sets and fir tree shapes using simple form cutters. In the case of the 4- to 6-axes versions the component can also be changed by an integrated pallet changing system.

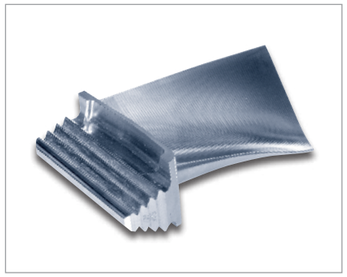
Increased rigidity and damping
While the cross slide moves in the horizontal X-Y-plane on the machine bed, at the machine column a vertical slide is guided in the Z-axis by a drive spindle. The arrangement of the linear axes results in an excellent rigidity in the machine. The linear axes have absolute glass scales.

High-torque worm drive
The turbine blade is clamped in the correct position by a device arranged on the cross slide and then correspondingly placed in the radial position for the disc cutters. A high-torque worm drive with excellent damping qualities is used to drive the cutter shaft to ensure a positive dynamic influence on the milling process. The vertical movement of the disc cutters causes the actual cutting feed.

Outstanding flexibility
A unit changing device permits the disc cutters to be exchanged for other units, such as a milling spindle or a Z-axis spindle. In combination with the roundtable available as an option this results in a highly flexible horizontal machining centre.



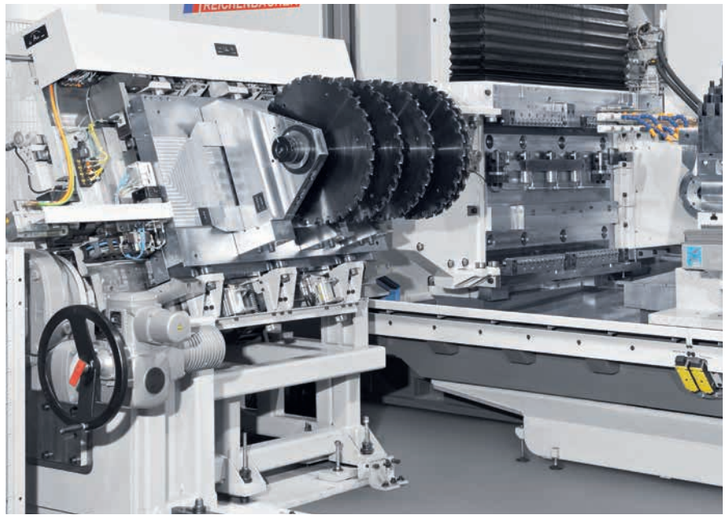




New ideas for new sales opportunities!

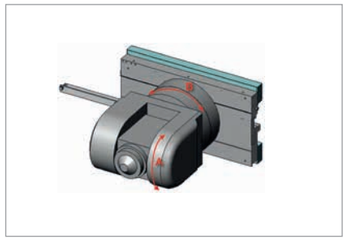
Interchangeable tool pallet
The heart of the machine is a vertical slide, similar to a pallet clamping station, which carries the tool drive. The integrated rolling and clamping elements allow for the tool pallet including the disc cutters to be laterally introduced into the vertical slide, the cutter shaft to be coupled to the drive spindle and the pallet to be hydraulically clamped in a quick and simple way.

Thus, it is possible either to set the disc cutters installed on the pallet with new tools outside the machine, or to exchange the pallet for another one with pre-mounted disc cutters (e.g. of a different diameter). On the tool pallet the cutter shaft is guided by support bearings that can be freely positioned in the axial direction. In accordance with the machining task at hand, e.g. the milling of three or five fingers, a cutter set equipped with indexing standard tips is installed on the shaft in such a way that all geometric characteristics of the finger-type root sections can be obtained by means of an NC-programme. Thus, on one hand the very expensive form milling cutters are eliminated and, on the other hand, a considerable reduction in machining time is achieved. Here, the typical overall cost reduction amounts to more than 70%.

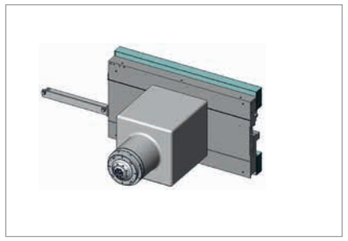


Swivelling of the tool pallet into the vertical exchange position

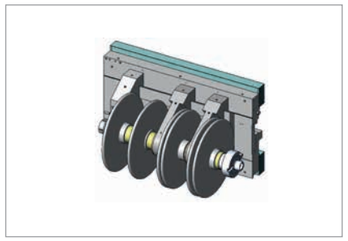
Pallet changing station
The machine is equipped with a changing station to facilitate the exchange of the pallets. It can be found laterally at the machine and performs the changing of the tool pallet in a semi-automatic operation. The tool pallet can be loaded into and removed from the changing station by means of suitable lifting gear.



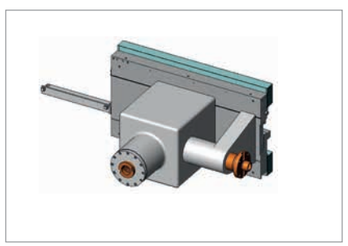
2-axes milling head



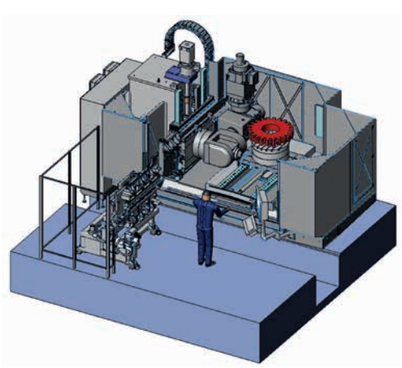
High-speed motor milling spindle



4-disc cutter unit



Horizontal milling spindle with high torque



F-TB machine in 6-axes design

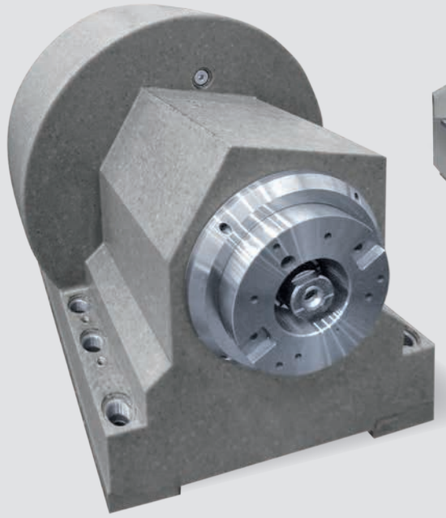
Main axes	
X-axis	1,200 mm
Y-axis	500 mm
Z-axis	1,000 mm
Travelling speeds	
X-axis	20 m/min
Y-axis	20 m/min
Z-axis	20 m/min
Machine table	
Clamping area	1,800 x 800 mm
Number of grooves	6
Groove width	18 H12 DIN 650
Milling drive	
Speed max.	600 min^{-1}
Nominal speed	136 min^{-1}
Power (S1)	55 kW
Torque (S1)	3,650 Nm
Interface cutter shaft	HSK 125 B
Tool dimensions	
Max. diameter disc cutter	600 mm
Cutter shaft	Ø 63 x 1,000 mm
CNC-control system	
	Siemens SINUMERIK 840D
Cooling lubricant and chip removal	
Chip removal	Operator side
Cooling lubricant for tool cooling with workspace flushing	Optional

Your advantages from the F-TB-series in short:

- Special design for machining characteristic root shapes for turbine blades most efficiently
- Sturdy machine design
- Utilisation of disc cutters up to Ø 600 mm
- Minimum down-times due to automated exchange of the milling units

Highly profitable innovations

The specific demands made by our customers are always at the centre of our activities. This is why we sometimes choose an unconventional approach, meaning that we follow an individual path to suit the work-part in question and thus often reach an extraordinary solution. Almost 100 years of continuous success in the market can always be attributed to more than one reason alone.



Component axis of rotation in MineralCast execution

Machine bed in MineralCast execution

HAMUEL mineral cast
Special characteristics of the HD-series

The new precision in mechanical engineering
The convincing features of the HD-series are in its form stability, as well as its heat and temperature resistance from -40° C to +100° C. Moreover, mineral cast components are resistant to corrosion, ageing, weather, water, chemicals and aggressive agents.

Reduced vibrations for high-precision machining!
A considerable improvement in the machining process can be obtained owing to the excellent damping behaviour of mineral castings. This has the following effects: better surfaces after component machining, less tool wear due to reduced vibrations, as well as a higher cutting capacity. The use of mineral castings will give you a benefit of more than a 30 per cent improvement in damping characteristics.

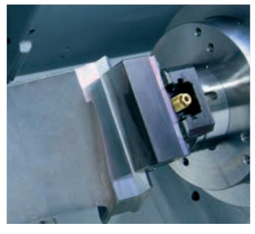
Based on the increased cutting capacity, the HD-series reaches higher machining speeds. On average, an improvement of 20 per cent was recorded for the three blade versions of our customers, while the better damping behavior and the optimized control system resulted in a reduction in tool costs of about 20 per cent. Finally, for reasons of the rigid machine construction and a high thermal and dimensional stability, a better quality will be obtained.

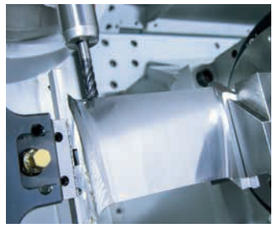
HAMUEL system process know-how

You will get from us the complete process know-how for the manufacture of turbine blades, i.e. planning and production from one source! This comprises of the technology for an optimum flexible clamping system for the component, the specific software for NC-programming, the measuring technology for in-progress and external measuring, the handling technology in the machine and in a manufacturing cell, as well as various finishing methods up to the turbine blade being ready for installation.

Blank for turbine blade

For example:
- Cutting to length
- Centering
- Testing





For example:
- Marking
- Grinding
- Cleaning

Preparation → **Clamping** → **Machining** → **Measuring** → **Finishing**

MANUFACTURING PROCESS

DOCUMENTATION

TECHNOLOGY KNOW-HOW

SYSTEM CONTROL

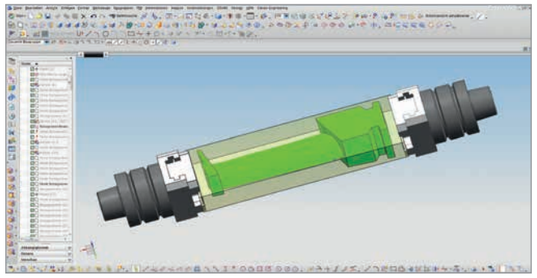
Turbine blade ready for installation

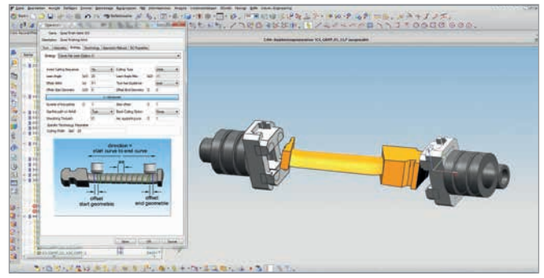
Software – a cornerstone of our success

An optimum interaction between the machine and the specifically established CAD/CAM-software is of great significance for the production of turbine blades. Our software is based on renowned CAD/CAM-systems. However, we have integrated additional important features to considerably enhance for you the manufacturing process, as well as the part programming. This means that you will definitely benefit from a reduction in programming time of up to 45 per cent, and from a similar reduction in machining time, when using this software correctly.

Your advantages in short:

- The software includes special patent protected machining strategies to obtain the maximum removal of material while ensuring the greatest precision.
- A CAD/CAM-solution with a consistently uniform user interface and data structure for the simultaneous 5-axes high-speed machining of turbine blades.
- The programme permits the efficient and faster generation of tool paths for the HSC-turning-milling machine.
- Roughing strategies with spiral roughing of blade areas, head and root transition areas and grooves.
- Finishing strategies with spiral milling and tilt and swivel angle, Z-constant machining, milling with point or flank contact, and milling of head and root area.
- Integrated post processors for the HSTM-series.
- Optimum integration into the customer CAD/CAM-structure by add-in software feature.
- Best user-tested milling technology and strategy for turbine blades.
- Automated and the shortest programming possible.





We do live by our service ideology – day by day!

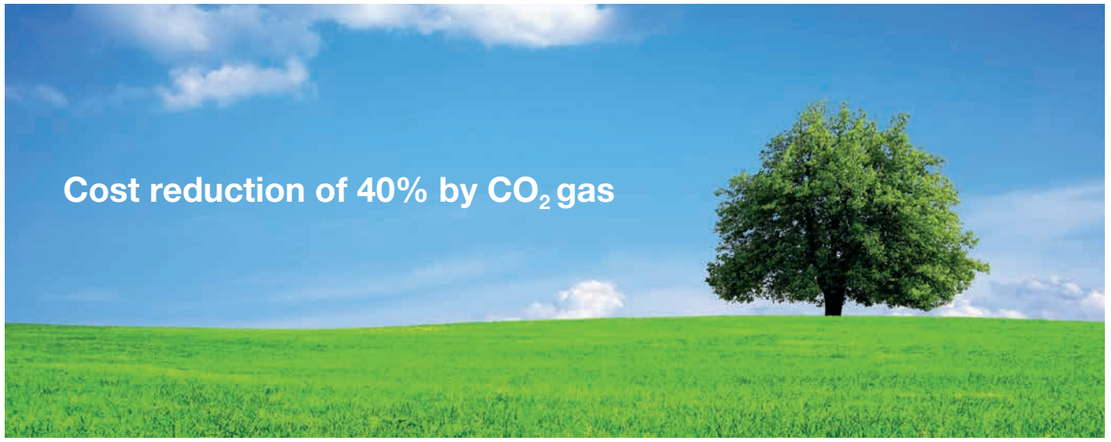
Our products are renowned all over the world for their high machine capacity and availability, their extraordinary length of life, as well as their particular ease of operation, installation and maintenance. We will place at your disposal an experienced and, above all, prompt after-sales service for your HAMUEL-machinery worldwide to enable you to make unlimited use of our strengths at any time.

Your advantages in short:

- 24-hour service hotline
- Tele-diagnostics for the machines, interactive technical support
- Spare parts available at very short notice owing to in-house production and optimum logistics
- Highly qualified service technicians ready for action on an international basis
- Local service contacts in all delivery countries
- Short reaction times with flexible assistance for machine maintenance and repairs
- Customer training according to individual requirements
- Retrofit (service updates on older machines using most modern technology, e.g. control systems, HDDs)
- Preventive maintenance (replacement prior to failure)
- Service contracts/annual service carried out by experts from HAMUEL
- On-site service
- Inspection of the machine and examination of its geometric accuracy

Service hotline:
+49 (0) 9561 599-300

Spare parts:
A great number of mechanical and electrical spare parts for a smooth and safe production at your plant are provided by us. Based on our comprehensive documentation, even the spare part supply for very old machines is ensured.



Convincing overall strategies

Result of a consistent development: sustainability
In our capacity as a successful German machine tool manufacturer we are at the forefront where technical progress is concerned. Above all, in the fields of energy efficiency and sustainability, we incorporate the latest developments. Numerous intelligent measures even today reduce the amount of resources needed for our products. In an exemplary way material optimisation ensures that, while the rigidity and stability of our machines is maintained, considerably less energy is required to obtain certain acceleration values, and that the cost of operation is reduced by an optimum system effectiveness of both the components and the machine.

Cost savings by optimum machine development
The most important analysis to ensure the cost-effectiveness of production is to take into consideration all the life-cycle costs. Only an estimate of life-cycle costs can be made without an exact knowledge of the future, but consistent part quality over a long working life is an essential part of our equipment.
An optimum machine design will permit significant cost savings throughout the machine life-cycle and thus render the investment much more future-proof.
It is a matter of course that we integrate several manufacturing processes into our machines. As, in our opinion, the utilisation of multi-technology not only increases the accuracy of the components produced, but also considerably improves cost-effectiveness.

Optimisation of life-cycle costs:

- Amply dimensioned machine components with a very long life-time.
- Optimum maintenance intervals.
- Very good accessibility for maintenance and service, e.g. the replacement of a motor milling spindle can take place in less than 2 hours.
- High energy efficiency resulting in reduced costs of electricity, air and other services.
- Good vibration damping owing to mineral cast components and hydrostatics, thus reduced tool wear, i.e. increased cost-effectiveness.

Cost-optimized special solution: milling with CO_2 gas

Superior technology
- Exceptional heat dissipation potential at the cutting edge, particularly when cutting dry.

Cost reduction
- Increase in cutting parameters, reduction in manufacturing times.
- Higher tool-life, lower tool costs, less downtime.
- Clean work-parts, washing avoided.

Environmentally friendly
- Avoidance of cooling emulsion waste.
- Elimination of coolant oil mist.
- Decreased chance of skin irritations.
- Increased safety of working environment.

BLUeCOMPETENCE
Alliance Member
Partner of the Engineering Industry Sustainability Initiative

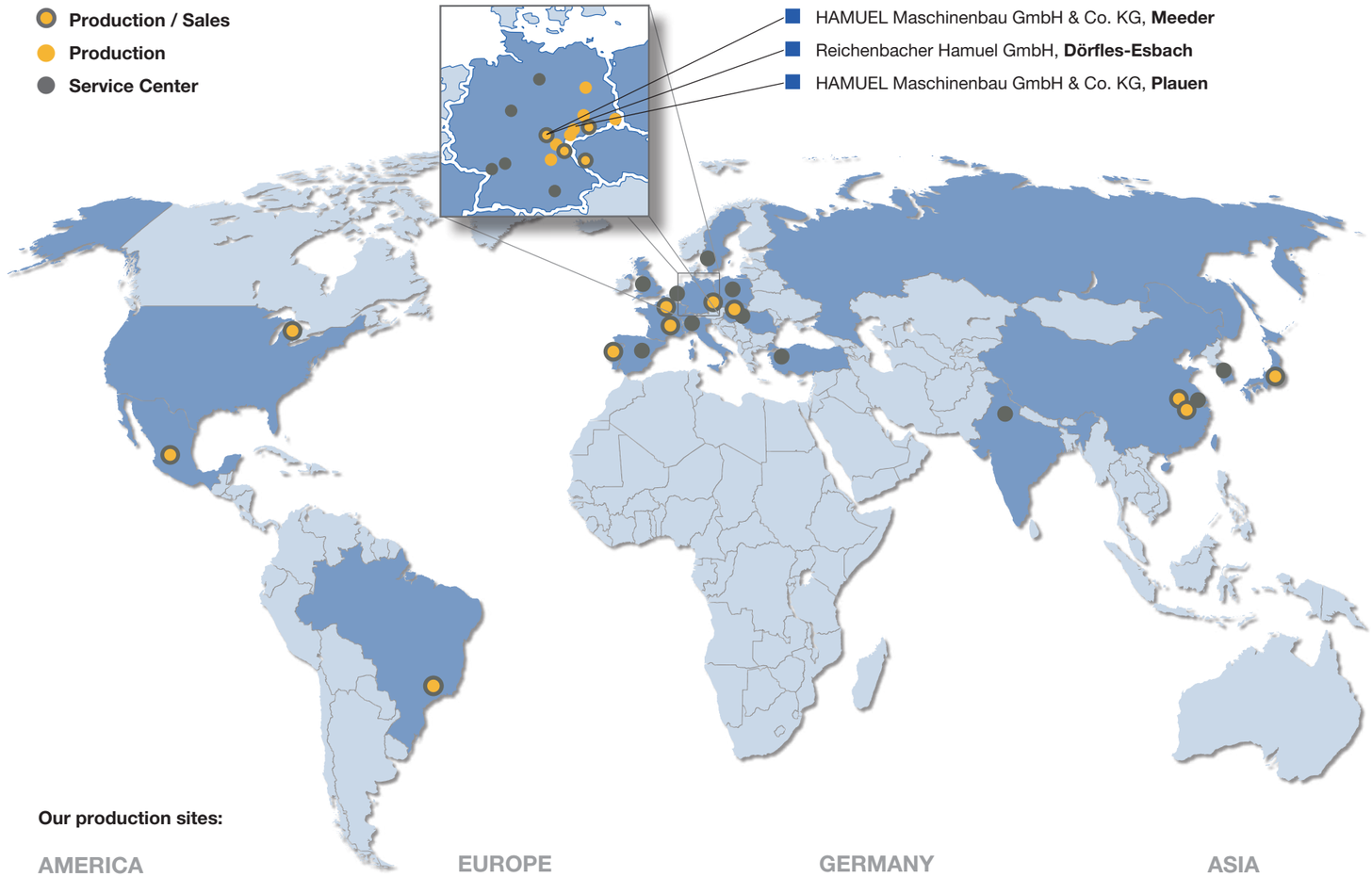
SCHERDEL

Local roots, worldwide presence

The SCHERDEL group of companies with its headquarters at Marktredwitz in the North-East of Bavaria has gone global featuring 34 locations with 45 production sites and more than 6,300 employees. The members of the SCHERDEL group offer to the market a wide range of products and services, while the individual companies are operating flexibly and autonomously in the market.

Each of these companies can resort to the longstanding experience and the know-how of the other members of the group. This results in precious synergies that will not only save the customer's time and money, but also present him with entirely new perspectives.

Only in the fields of mechanical and plant engineering, as well as tool manufacture, the SCHERDEL group employs more than 700 people. Our customers appreciate the strong synergies inherent in our group of companies, as in accordance with the "full-service-principle", they provide them with comprehensive solutions to their problems.



Our production sites:

AMERICA
Brazil, Sorocaba
Mexico, Silao
USA, Muskegon

EUROPE
France, L'Arbresle
France, Beauvais
Portugal, S. J. da Madeira
Russia, Kaluga
Slovakia, Myjava
Czech Republic, Bor

GERMANY
Berlin
Chemnitz
Coburg
Erlangen
Marktredwitz
and its region
Marienberg
Plauen
Röslau
Seifhennersdorf
Treuen

ASIA
China, Anqing
China, Huzhou
Japan, Aichi

HAMUEL REICHENBACHER

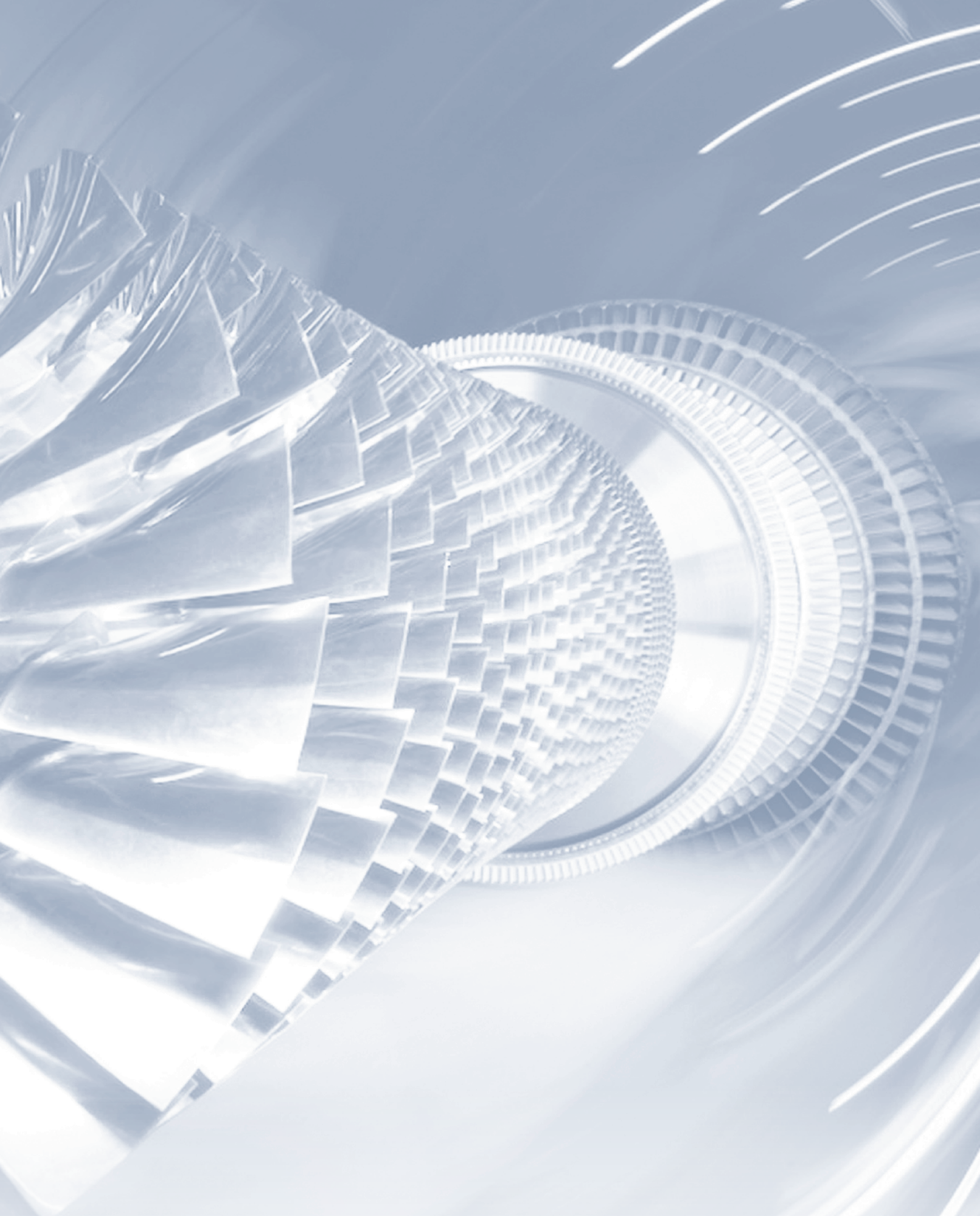
The REICHENBACHER-HAMUEL group of companies

The HAMUEL Maschinenbau GmbH & Co. KG is part of the Reichenbacher-Hamuel group of companies. The other companies are the Reichenbacher Hamuel GmbH, as well as the HAMUEL Maschinenbau Plauen GmbH & Co. KG. These three companies operate under the name of Reichenbacher-Hamuel.

Almost 100 years of experience in mechanical engineering, as well as around 40 years of know-how in CNC-machining are self-explicatory: nearly 5,000 CNC-machines produced by this group are in use in the most diverse industries all over the world. Many in-house developments and patents document the great inventive capacity of this group of companies.

Our products:

- **HSC-TURN-MILLING CENTRES**
- Machining centres
- Multi-technology milling machines
- Component manufacturing
- Software
- Machine installation
- Retrofit



HAMUEL REICHENBACHER
Members of the SCHERDELgroup

HAMUEL Maschinenbau GmbH & Co. KG
Industriestraße 6 · 96484 Meeder (Germany)
Phone: +49 95 66-92 24 0 · Fax: +49 95 66-92 24 80
info@hamuel.de · www.hamuel.de

IM 05/2023