

Aerospace Industry

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01 Aerospace industry

The aerospace industry is becoming more and more demanding. Significant global growth in air traffic and, as a consequence, the resultant need to increase efficiency, thereby reducing the overall impact on the environment, drives the market.

This in turn leads to more complex geometries in harder to machine materials at an ever increasing volume. It is here that Hermle can help with our portfolio of high quality vertical mill and mill-turn machines, dedicated automation possibilities and support in CAD-CAM, tooling and machining strategies.

Market drivers



- Market growth
- Noise reduction
- Improved fuel consumption
- Weight reduction

Challenges for the industry



- Increase of efficiency
- New engine designs
- Hard-to-cut materials
- Volume production

Requirements for production



- Complex part geometries
- Increase in metal removal rate
- Higher demands on surface quality and geometrical accuracy
- 24/7 production

Hermle solutions



- Flexible machines
- Multi-tasking applications
- Rigid machine concept
- Dedicated automation solutions

Customer specific services



- Application support
- Turnkey solutions
- Key account management
- De-centralized after sales support and dedicated service agreements

02 The company

All Hermle machining centres are made in Gosheim – where the Swabian mountains are at their highest. At a site where precision mechanics and mechanical engineering have a long tradition.



Production site and company headquarters in Gosheim, Germany



Shipping and logistics centre



Technology and training centre



Assembly automation components



Assembly of models C 52 / C 62

03 The machining centres

Ergonomics, compact dimensions, workshop suitability, precision, reliability, durability. These are no empty phrases for us. Every one of our machines is distinguished by precisely these properties. Even now, after many years of production.

Worm or torque drives are used in the C axes. The A axes can be fitted with one-sided or tandem drives, depending on workpiece weight and the required dynamics. Our MT models can not only mill but also turn in 5 axes simultaneously.

As a consequence of their axis design, and the integrated nature of the Rotary Tables, Hermle machines offer a large collision circle diameter. They can process very large workpieces relative to the machine footprint. All models can even considerably exceed the 0° to 90° swivelling range.



03.1 HIGH-PERFORMANCE-LINE



C 12

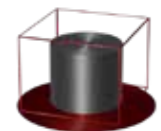


C 22

Traverse (mm):

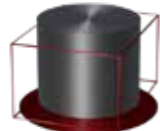
350 x 440 x 330

450 x 600 x 330



Core: Ø 320 / H 265

Collision circle: Ø 610



Core: Ø 450 / H 370

Collision circle: Ø 610

THE BEST FOR YOUR MILLING NEEDS

With its HIGH-PERFORMANCE-LINE, Hermle has been supplying high-tech sectors of the international market with highly precise and high-performance machining centres for several years now. Whether as stand-alone machine, automated system or connected manufacturing facility, our machines are second to none.



C 32

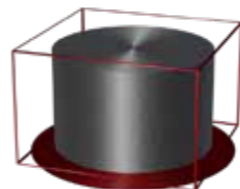


C 42 / C 42 UMT

Traverse (mm):

650 x 650 x 500

800 x 800 x 550



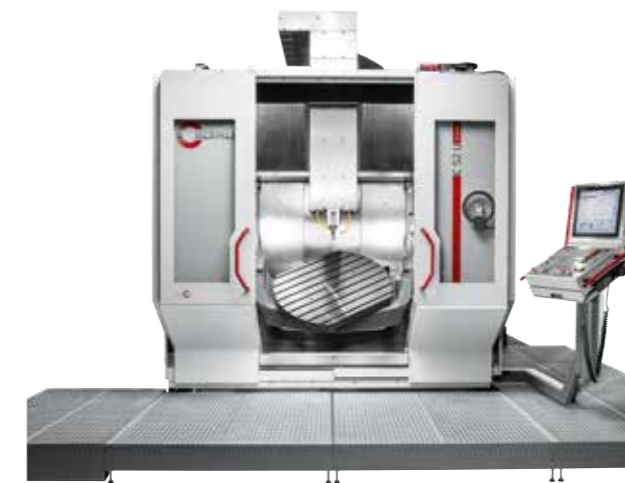
Core: Ø 650 / H 420

Collision circle: Ø 840



Core: Ø 800 / H 560

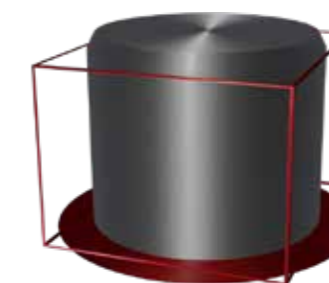
Collision circle: Ø 990



C 52 / C 52 UMT

Traverse (mm):

1000 x 1100 x 750



Core: Ø 1000 / H 810

Collision circle: Ø 1290



C 62 / C 62 UMT

1200 x 1300 x 900



Core: Ø 1200 / H 900

Collision circle: Ø 1400

* For reasons of standardisation, the maximum machinable object is shown here at a swivel angle of 0° and -90°. All models in the C series achieve swivel angles of considerably more than 0° or 90°.

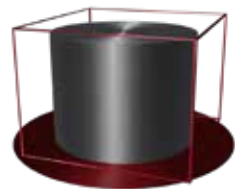
03.2 PERFORMANCE-LINE



C 250

Traverse (mm):

600 x 550 x 450



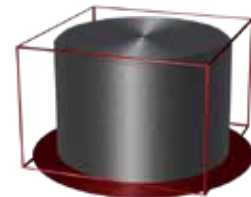
Core: Ø 450 / H 355

Collision circle: Ø 770



C 400

850 x 700 x 500



Core: Ø 650 / H 500

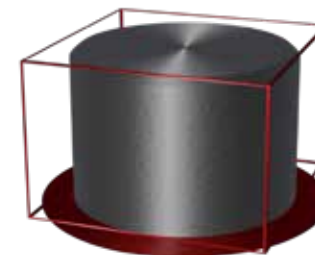
Collision circle: Ø 885



C 650

Traverse (mm):

1050 x 900 x 600



Core: Ø 900 / H 600

Collision circle: Ø 1 100

ADAPTIVE DYNAMICS WITH HIGHEST PRECISION

Hermle's PERFORMANCE-LINE machining centres have all the high-precision capabilities of the HIGH-PERFORMANCE-LINE, and the only concessions they make concern the range of equipment.

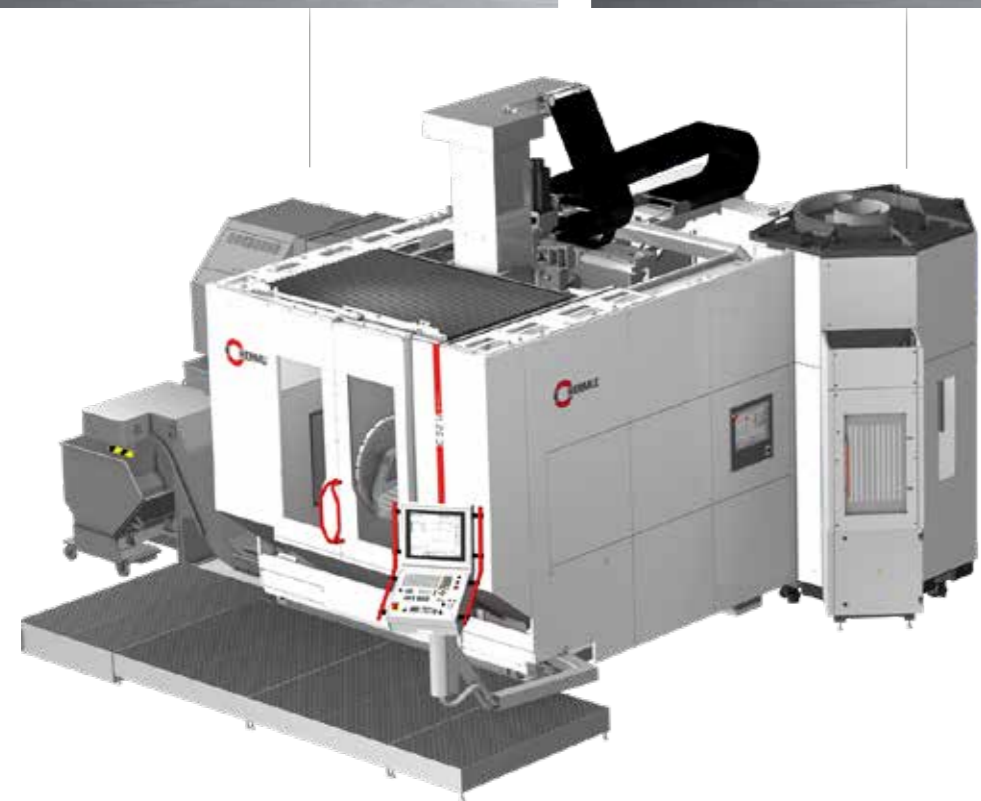


04 Automation

Machining centres and automation solutions from a single source with high system expertise during planning, installation and maintenance:

- 3, 4 and 5-axis machining centres for which we ourselves manufacture and install all components including table units, tool spindles and entire sheet metal enclosures.
- Automation solutions from pallet changing systems, pallet storage, tool magazines and flexible manufacturing systems to custom turnkey solutions.

Machining centres



Additional magazine

Pallet changer PW 100



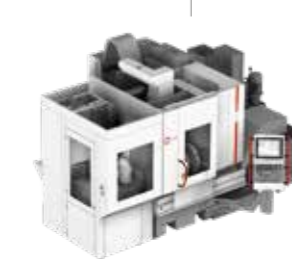
Pallet changer PW 150



Pallet changer PW 850



RS 05 robot system



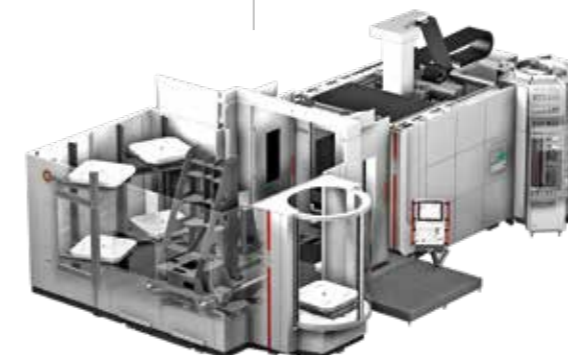
RS 1 robot system



Pallet changer PW 2000



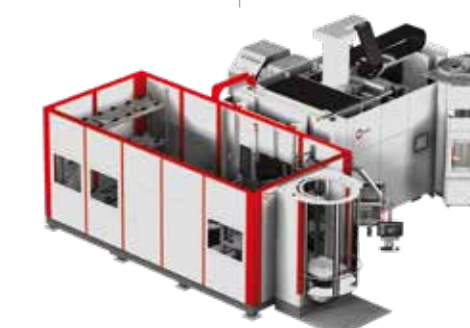
Pallet changer PW 3000



RS 2 robot system



RS 3 robot system



Handling system HS flex



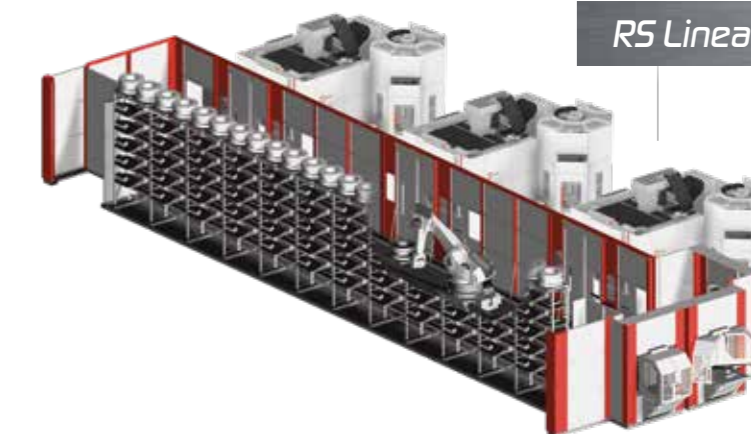
IH systems



Rotation loading system RLS 800



RS Linear robot system



Double or triple productivity. The RS 2 and RS 3 robot systems can naturally be adapted to encompass multiple machining centres with a wide variety of machining tasks. The storage systems are also completely and flexibly adjustable.

Basic system plus 1 machine



Basic system plus 2 machines . 90°



Basic system plus 2 machines . 180°



Basic system plus 3 machines



05 Engine components

Suck-Squeeze-Bang-Blow: These are the four stages that comprise the overall function of an aero engine. The aero engine consists mainly of rotationally symmetrical parts. Hermle machining centres are ideally suited to machine these parts due to their high rigidity and precision. Since most parts require a turning operation the Hermle mill-turn technology helps to reduce the number of set-ups and thereby the need for more fixtures and gives a perfect result on one machine.



Casings

Enclose the aero engine, support the static engine framework and separate the rotational parts from the environment.



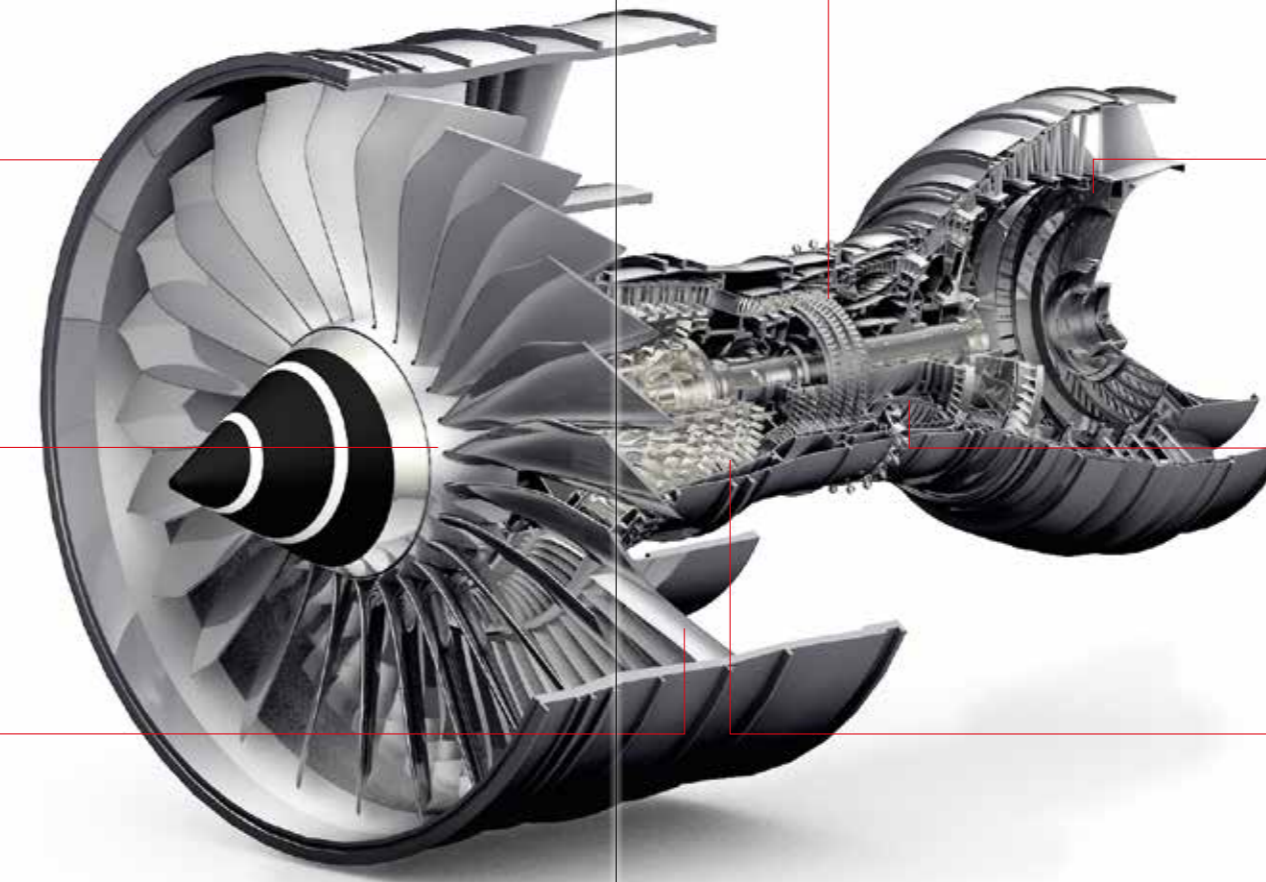
Fan disc

Holds the fan blades (suck) which create 2/3 of the thrust and is a highly critical component.



Guide vanes

Gives the sucked in air, the needed flow structure and supports the static engine framework.



Single blades

Bladed discs compress the sucked in air and rotate at high speeds.



Turbine discs

In the hot area (bang-blow) out of nickel rich alloys and hold the blades which gain the energy from the burned air-kerosene mixture.



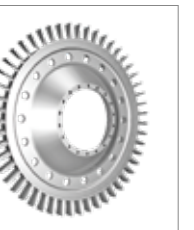
Stub shaft

Transfer the generated energy from the combustion stage back towards the front to drive the fan disc with the attached fan blades.



Blisks

Compress the sucked in air (squeeze) and transport it towards the burning chamber.



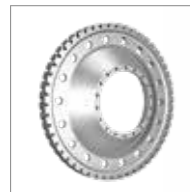
05.1 Rotatives

As the title already implies rotative parts require a huge variety of different machining operations such as milling, turning, drilling and tapping. Hermle mill-turn machining centres offer these multitasking functionalities and enable a considerable reduction of set-ups. Turning of complex and sometimes hard to access contours and the milling of dovetail or fir tree slots, in combination with hard-to-cut materials such as titanium alloys (cold section) or nickel-based super-alloys (hot section), are a major challenge for the machining process.

Fan disc



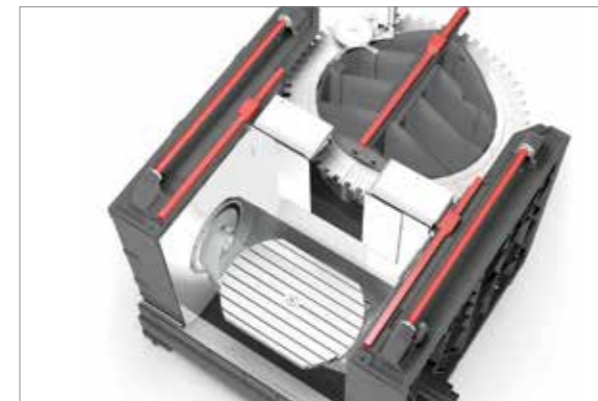
Turbine disc



Stub shaft



Rotationally symmetrical parts such as fan discs, turbine discs or stub shafts are typically machined on Hermle C 42 U / MT and C 52 U / MT machines.



RIGID MACHINE CONCEPT

A rigid machine concept in combination with a vertical tool spindle and the kinematic table set-up. The unique Hermle design includes:

- Modified gantry design & swivelling rotary table
- Extremely rigid and stable machine bed and tool spindle assembly
- Symmetrical build-up to minimize thermal impact
- Eliminates the need for a dedicated foundation



PROCESS MONITORING

The overarching driver of the aviation industry is safety. Hermle offers special process monitoring solutions to meet this requirement, already during manufacturing stages:

- Process data monitoring (i.e. tool wear, tool spindle & axis load or coolant flow)
- Process data recording
- Combination of external software and PLC-based control adaptation
- Dedicated error-reaction chains (i.e. Lift-Off functionality)



COOLANT SUPPLY

The development of innovative materials and non-process related aspects such as health & safety or environmental awareness go hand in hand with improvements of cooling lubricants. Hermle offers a huge variety of solutions:

- High pressure internal cooling lubricant supply (up to 150 bar)
- Oil based coolant units in combination with integrated fire-extinguishing systems
- Cryogenic- and minimum-quantity lubrication
- Programmable coolant nozzles

05.2 Casings

Casings, rings and seals consist of thin walled titanium alloys or nickel-based super-alloys. A large section of the machining process consists of turning, with some requirement for the milling of flange surfaces and drilling of bores. The Hermle kinematic concept is ideally suited for the turning of complex inner and outer geometries and slots. Internal machining and the production of angular bores requires a slim tool spindle design, the utilization of the swivel axis and the application of angular heads.



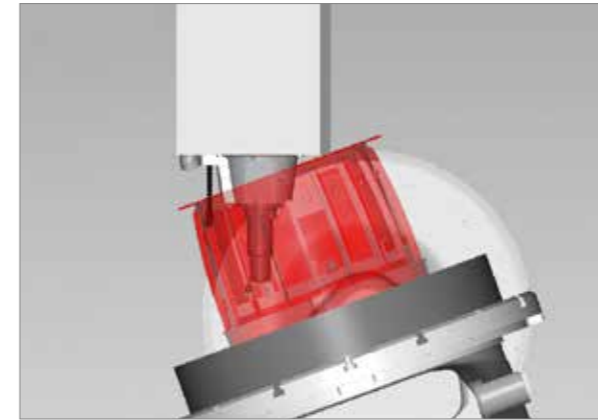
Multitasking applications of the thin walled engine casings call for flexible machining centres (C 42 U / MT, C 52 U / MT and C 62 U / MT).



MILL-TURN FUNCTIONALITY

The Hermle C 42, C 52 and C 62 machining centres are available as mill-turn (MT) machines. This combination of two applications on one machine enables:

- Angular and interpolated turning (A-axis swivel range of up to +/- 130°)
- Reduction of set-ups
- Utilization of standard tools and short tools
- Integrated balancing of table, fixture and part assembly



COMPACT SPINDLE DESIGN

Hard to access geometries in combination with hard to machine materials are the central challenge of complex engine casings. Related requirements for the spindle are:

- Compact tool spindle and Z-axis design
- Immersion of the tool spindle within the workpiece enables simple internal machining
- Increase of tool stability due to shorter overhang
- Good accessibility due to A-axis swivelling range and slim tool spindle design



DEDICATED TOOLING SOLUTIONS

Most casings require internal machining in combination with angular heads. Furthermore the need for a high tool capacity is steadily increasing. Dedicated tooling solutions cover:

- Torque support preparation for angular heads
- A-axis swivelling range expand the application of standard angular heads (90°)
- HSK-T tooling interface for milling and turning tools
- Flexible additional magazines increase the tool capacity

05.3 Blisks and impellers

The challenges of turbo machinery are always the same: Complex aerofoil shapes and a high demand on surface quality. Due to the steady target to increase compression not only Blisks of aero-engines are primarily made of nickel-based or titanium alloys. The combination of complex blade geometries and hard-to-cut materials call for a rigid machining centre equipped with dynamic table kinematics.



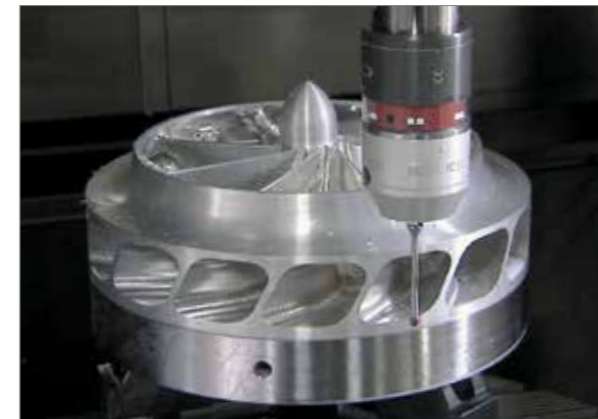
Efficient fabrication of Blisks and impellers for aircraft or land-based engines requires a dynamic 5-axis machining centre.



SWIVELLING ROTARY TABLE

Hermle tables are equipped with cutting edge drive technology for high dynamic performance during 5 axis machining, as it is the slowest axis that determines the speed when milling 5 axes simultaneously.

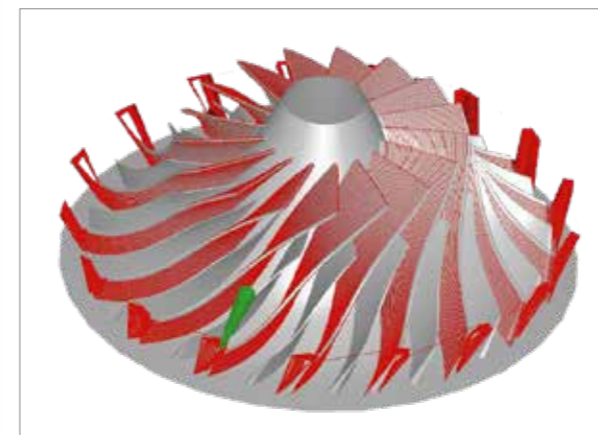
- High dynamics and torque on the A- and C-axis
- Large A-axis swivelling range for undercuts
- No accumulation of chips on the clamping surface (swivel table)
- Largest working area relative to the installation area



IN-PROCESS MEASUREMENT

In-process measurement solutions exceed the functionality of a standard touch probe. High-end measurement hardware in combination with dedicated software tools creates new opportunities:

- In-process measurement feedback and adaptive manufacturing strategies
- Generation of measurement protocols for process monitoring
- Scanning of 3D-contours
- High machine accuracy is the prerequisite for valuable measurement results



APPLICATION SUPPORT

The programming and machining of complex components such as Blisks and impellers require highly skilled operators and dedicated CAM-strategies. To achieve this, Hermle offers:

- Specialized application engineers for all commonly-used CAM software
- Kinematic design is one key-element for flank milling of aerofoil geometries
- Roughing and finishing in one set-up
- Extensive range of application training and on-site support

05.4 Single blades & guide vanes

There is a considerable variety of different processes and several manufacturing steps related to the production of single blades or guide vanes. However all have one thing in common: the call to reduce manual secondary operations is increasing. Furthermore the separate machining areas of the part generate different challenges to the process. Hermle machining solutions cover many applications such as hub-machining of nozzle guide vanes or profile machining of compressor blades as well as fabrication of forging moulds or the aerofoil of long turbine blades in combination with a pneumatic arbour holder.



The Hermle portfolio covers profile machining of compressor blades (C 12 U, C 22 U) or aerofoil and hub machining of turbine blades (C 32 U, C 42 U with pneumatic arbour holder).



06 More applications

Due to the high flexibility of Hermle machining centres the field of applications in aviation industry is not only limited to the production of aero-engine parts. The machining of structural components from every section of an aircraft is another area where Hermle machines are utilized.

Furthermore different sections of the process chain, such as prototype manufacturing or repair of engine components, complete the range of applications.

STRUCTURAL PARTS

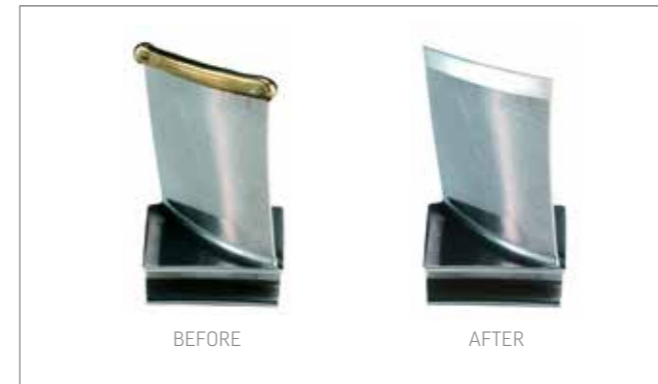
Typically high material removal rates and large material diversification call for innovative manufacturing strategies and dynamic machining centres in order to achieve economic production processes.

Conventional aluminium alloys require dynamic machines and high frequency spindles. Materials such as composites or nickel-based alloys on the other hand focus on high torque of the spindle and a stiff machine concept.

The requirement for flexibility and the need for a highly dynamic but extremely rigid machine concept make a 5-axis Hermle machining centre the suitable solution for many of these applications.



ADAPTIVE MACHINING SOLUTIONS



HP compressor blade tip re-contouring: Welded compressor blade (left) and semi-finished blade after machining (right).

Adaptive machining solutions are widely spread especially in the maintenance, repair and overhaul industry of aircraft engines (MRO). The remanufacturing of a HP compressor blade after welding is a typical application where a high accurate machine and innovative adaptive machining software is required. Hermle cooperates with several solution providers to offer:

- Repair of blades, guide vanes or Blisks
- Machining of complex blade geometries
- Machining of the welded joint of linear friction welded (LFW) Blisks

PROTOTYPE BUSINESS



Down to the last detail – Hermle customers are not exclusively settled in the manufacturing sector of aviation parts. In the early stages of prototype construction the accuracy of Hermle machining centres is essential too.

The production of a valuable wind tunnel model for instance requires simultaneous machining of 3D-contours, high surface finish and very good contour fidelity.

07 Digital modules

Industry 4.0 and the Smart Factory.

The digital transformation is now becoming the focus of many different production operations. Hermle is there to provide support while you chart your individual course towards Industry 4.0 and the smart factory. We offer a wide range of software solutions for improving your efficiency, precision and productivity. Our digital components represent links in the chain of smarter production. We can work together in order to find out what your operation needs.

Digital components – The smart all-round package.

With Digital Production, Digital Operation and Digital Service components, we can put together a comprehensive package that will put your Hermle machining centres on a firm footing for future tasks: intelligent order management and transparent machining processes, smart machine tuning, paperless manufacturing and sophisticated technology cycles, as well as options for remote or preventive maintenance. Our digital components improve productivity, ease of operation and efficiency.



07 Digital modules



WDS – the wear diagnostic system.

Our maintenance / diagnosis system ensures regular diagnosis of the machine's condition. The current diagnosis data are then compared with data gathered since the machine was supplied. This highlights where wear has occurred and maintenance can be planned, while unscheduled downtimes can be avoided. And where a problem appears, the software contributes to targeted troubleshooting.



Remote maintenance – fast first aid.

If a problem arises with your Hermle machine, our qualified service technicians can help – quickly and easily via remote maintenance. Concrete problems can be identified quickly and without the need for time-consuming service calls. Irrespective of the control system, we can provide support for operation and programming via a secure connection. There are several options available for remote maintenance: via any PC with internet access, via an industrial PC installed in a machine switching cabinet or via a PC installed in the robot. Each of these options has its advantages – we can work together to find out which one is the best for your case.



08 Worldwide

Our motto: Direct sales and local service – nothing else will do! Hermle works for its international customers to provide direct, on-site consultation, sales, training and expert service.



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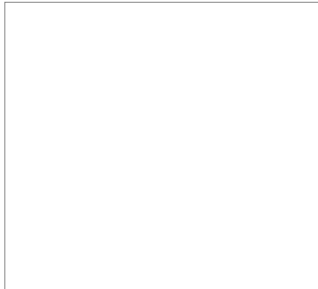
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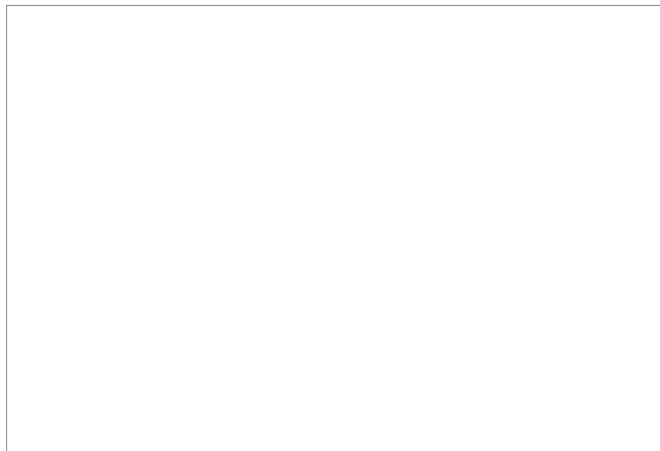
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Subject to technical modifications . 04/18/Aerospace/600/EN/ST



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