HANSER

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By no means out of balance...

Highly productive machining of Titanium and Nickel alloys

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The mechanical machining of jet engine components is a job for professionals. In addition to the extensive quality management, the particular challenges are especially the materials that are difficult to process. Due to the damping hydrostatic guidance system Monforts`s UniCen 1000 is predestined for this task. This is well known by MTU Aero Engines who will use these machines in the future for the production of rotating components at Munich.

BY DR. DOMINIC DEUTGES

→ The life cycles of engine types can be as much as 40 years. Like in other sectors of industry, the machining processes are being optimized on an ongoing basis. In the production of turbo machines for aircrafts, the production processes for sensitive components are subject to production control. This is due to the strict quality standards which have their origins in the safety regulations for aviation. This makes it even more important in this branch of industry to implement the technological innovations in new engine types in a safe and consistent manner.

The work piece and the associated machining process must be released across the entire product development by the manufacturer of the engine. Therefore an extensive verification concerning the suitability of the components has to be carried out. The proof is to be furnished upon laboratory tests and series of experiments. Due to improper machining unintentional material damage may occur. At components which are thermal and mechanical highly stressed, this aspect must not occur. If the productions processes shall be changed later on, the verification procedure concerning the suitability of the components has to be carried out anew in most parts. The windows in which process parameters may be changed are very small.

1 Production of rotor components with UniCen 1000

Difficult materials

Depending on the place of installation inside the engine different materials will be used: nickel chromium alloys, nickel based alloys and titanium alloys. The characteristics of these materials at high temperatures and the temporal predictable wear characteristics are important for the engine manufacturer. The inferior thermal conduction of these materials which causes extreme wear of the tools is difficult for the machine and tool manufacturer.

Trend to integral components

Rotating engine components are mainly turned parts: disks, rings and shafts which are assembled to complex engine rotors. In turbines, the blades are insert-

photos: Monforts

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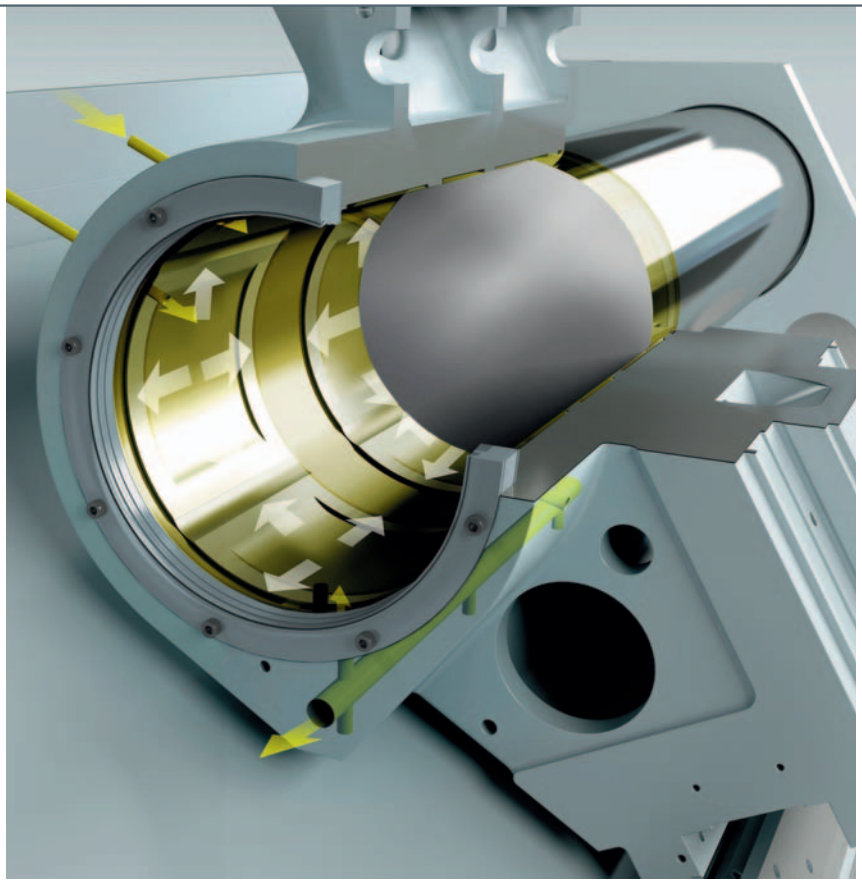

2 Hydrostatic column guide with highest damping

ed and fixed in so-called root profiles of the disks.

When using new engine types, integral components, so-called BLISK's (Blade integrated disk) are used increasingly in the compressor. This has the advantage that the weight of the components can be reduced. This results in a higher level of effectiveness of the engine.

MTU – leading global player

MTU Aero Engines in Munich is one of the leading global players in this high technology sector. Significant is for example the part of the engine development of the up-to-date GFT-engines which will do their job also in the A320 NEO in the future. This huge project can not longer be achieved by individual companies. Together with its partners Pratt & Whitney and JAEC, MTU is one of the main pillars. MTU Aero Engines' activities in the program are 18 percent. In addition to extensive responsibility for the development, MTU is responsible for the production of components of the high-pressure compressor and the entire low-pressure turbine. The one who undertakes such extensive projects in this market needs to be assured of his product quality. The basis for this purpose are reliable partners in the manufacturing sector and solid production facilities which ensure premium quality at all times. MTU Aero Engines trusts in the Monforts UniCen 1000 type turning and milling centres in the manufacturing of its rotors for engines in the realignment of the Munich Blisk production. In particular, one can rely on three characteristics of these machines:

- A high stiffness which enables a safe processing of difficult materials,
- A distinct damping which prevents the spreading of vibrations,
- The guarantee of the product quality in the long term, in short: constantly maintained accuracy.

The Monforts machines provide something special nobody else does in the market for turning and milling centres. Monforts provides a hydrostatic circular guide in the Z-axis of the machine.

Hydrostatic guide way

On the UniCen 1000, Monforts carries the slide with the tool carrier on a solid column with a thin oil film. The circumferential arranged hydrostatic pockets are holding the column at all times in the centre of the slide bore due to the pressurised oil and prevent therefore any metal to metal contact. As a result, this guidance works without frictional contact and it is wear free and does not require maintenance. The oil film between bore and column ensures excellent damping characteristics to the machine. It is particularly advantageous during heavy machining that vibrations are not able to spread – the tool life will be significantly prolonged. The advantage of the low friction is also that the stick-slip-effect will not occur. This will have a positive impact especially with small movements. In this way even smallest displacement increments of 1µm may be moved free of stick-slip behaviour as well.

5-axis-milling

The trend to integral components in the production of rotating parts implies that the present separation between rotating parts, disks and rings as well as milling parts (blades) no longer exists. The processing machines must combine both techniques as economically as possible in one machine, or a cost-efficient and quality reasonable transfer of the components between the various machines must be realized.

MTU Aero Engines solves this task by using multitask machines which can make the most of their capabilities in both areas of turning and milling. The Monforts UniCen 1000 provides a swivel-mounted motorized milling spindle which enables a 5-axis-milling in combination with the X-, Y-, Z-, B- and C-axis. Typical machining tasks are combined and narrowly toleranced turning and milling operations in the area of the disk of the components.

Flexible turning

Due to continued technological progresses, the geometries at the rotors for the new up to date engines had become more and more complex. That means for turning operations that conventional turret lathes

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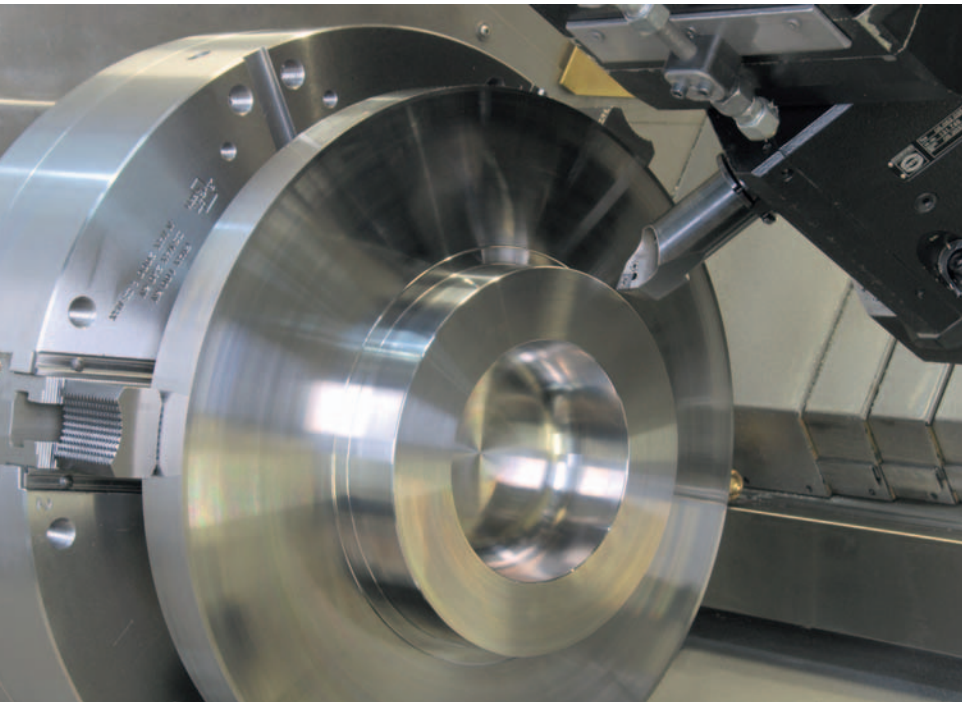

3 Turning with B-axis

for contouring operations reach their limitations. On the UniCen 1000 the B-axis can even be used interpolating for turning. So even complex geometries such as undercuts can be produced. Thereby the turning tools are firmly locked in the milling spindle by a Hirth interlocking.

High pressure coolants

A good way to optimize sensitive process parameters for increasing the productivity is the usage of high pressure coolants. Using this cooling conception, a jet of coolant will be pressed directly between tool and chip. The coolant thereby chills directly in place of the heat generation. Due to the significantly improved cooling, the chip will break either by thermal shock or it simply will be crushed mechanically. The cooling concept enables significantly increased cutting speeds and eliminates also the problem of appearing of very long chips when using these materials. When machining with the UniCen 1000, coolants can be used up to a pressure of 120 bars by means of the internal supply.

Flexible machine adjustment

The space for machines is a scarce resource in every production hall, this is also the case at MTU Aero Engines. The turning and milling centres available on the market often have a significantly greater turning length as it will be used for the production of the disk-shaped components for rotors in turbo machinery. That was also the case with Monforts with a turning length of 1,500 mm. In order to provide assistance to the customer here, Monforts flexibly shortened the machine to a turning length of 800 mm for this particular application. The result was a general shortening of the machine by 1.200 mm. This means more space inside the workshop which MTU knows now to use it considerably better. ▮ →
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