Turbomachinery production

Multitasking machining enables more efficient turbines

Mönchengladbach, September 2013 – the requirements on turbo machines are increasing. These complex systems have to become more efficient - that requires a higher temperature level resulting in extremely stable and tough materials. The Fraunhofer Innovation Cluster 'AdaM‘ is developing new machining standards for these materials. The 'UniCen 1000‘ turn-mill-center from Monforts is used as a base for this development work. It was selected because of its outstanding feature, the damping hydrostatic guide which offers ideal conditions for these challenging of machining processes.

Alternative energies are gaining importance - both in energy generation and in transportation. However, it is getting increasingly clear that well tested turbo machines will continue to be a major factor in our infrastructures for a very long time. I.e. bio gas plants also will need a similar power transformer fleet to fossil fuel power plants. And replacing feed beams and energy carriers - both in power plants and in aircraft - will take some time. This is reason enough to continue to develop turbo machines to make them more efficient - saving energy is an effective way of protecting our environment. This task is performed by the Fraunhofer Innovation Cluster 'AdaM‘ - and Monforts machine tools are part of it. The machines from Mönchengladbach are used to manufacture numerous parts for turbo machines.

The objective of the 'AdaM' project at the Fraunhofer Institutes for Laser Technology (ILT) and for Production Technology (IPT) based in Aix-la-Chapelle is to develop modern production technologies. This cluster, sponsored by the Land of North Rhine-Westphalia, brings together major OEMs such as Siemens Power Generation, MAN Diesel & Turbo, Rolls-Royce and MTU Aero Engines and many suppliers to

make the engines and turbines of tomorrow more energy efficient and more productive.

The production of turbomachines is not trivial - the materials used, such as nickel-chromium, nickel based metals and titanium alloys are poor conductors of heat and they are very tough. This results in rapid wear on cutting tools and high stability requirements to the applied machines. The Monforts UniCen 1000 turn-mill-center with its hydrostatic guide offers a particularly good characteristics for this. Many OEMs in turbomachinery industry and their suppliers use this machine. The same reason was the base of the decision to use the UniCen 1000 in the 'AdaM' project. Three characteristics of the machine were decisive: high rigidity for safe machining of difficult materials, good vibration damping and long-term accuracy for constant product quality. All this is ensured by the hydrostatic circular guide on the Z axis. The slide with the tool carrier moves on a solid column with a thin pressure oil film which prevents metal contact. This avoids the stick-slip effect and permits very short travel distances in the µm range.

Added to this are technology trends in turbo machine design: whereas previously blades and rotors were manufactured separately and then joined, in the new energy efficient and resource-friendly turbine models they form a single integrated component (BLISKs or BLINGs: blade integrated disk/ring). The blades are turned and milled from a complete disk. This reduces mass at the base of the blade, so parts are lighter and blades can be placed closer together, meaning increased efficiency. Therefore metal-cutting machines must offer the required processes of turning, milling and drilling in one machine, while satisfying the requirements for dynamics and accuracy with 5 axis machining. Inefficient transfers of parts between different machines should be avoided as far as possible: integrated machining is the better option.

Conventional turret turning centres have reached their limits in relation to today's contouring requirements. A reduction in the weight of

parts has led occasionally to very complex geometries with undercuts. This requires a flexible and adjustable tool carrier. The UniCen 1000 has a swivelling motor milling spindle that can be used both for 5 axis milling and 3 axis turning – thus the machine can produce very complex contours.

The chip transport also requires adopted solutions since the used materials tend to generate long chips. High pressure cooling lubricants are a feasible solution. The UniCen 1000 offers an internal feed up to 120 bar or an external feed with up to 350 bar. The coolant jet is pressed directly between the tool and the chip and acts at the point where heat is generated. Either the chip breaks off due to the thermal shock or it is simply broken off mechanically. This not only prevents the formation of long chips but also allows significantly higher cutting speeds.

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(Captions:)

The domain of Monforts 'UniCen 1000': machining turbine components, e.g. blade integrated air-ends (BLISK)

Integrated design: in order to reduce mass and hence weight, modern turbine rotors are no longer composed of several parts but are made as a single component. The hydrostatic 'UniCen 1000‘ from Monforts leads the way for materials that are difficult to cut.

The secret of long-term accurate heavy roughing: the hydrostatic guide of the Z axis, the outstanding feature of Monforts' machines. It ensures a high level of damping, non-wear and prevents stick-slip effects over short travel distances.

Photos: Monforts

Monforts Werkzeugmaschinen GmbH manufactures a comprehensive range of high performance CNC turning centres with various configuration options for machining with sub spindle or 4 axes and flexible turning and milling centres with 5 axis machining. A special feature of all machines is the hydrostatic guide with a 10 year warranty on wear. Almost all modern machining processes can be performed on Monforts turning centres.

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