

An eye on the spindle

The Airbus works in Varel protect machining production with the ARTIS process monitoring system

Processing times up to twenty-four hours are no rarity in machining aluminium structural components for aircraft. To prevent expensive damage to spindles and minimise machinery down times and reprocessing times the Airbus works in Varel use the ARTIS CTM tool monitoring system in its ECOSPEED high-speed processing centre.

The biggest aircraft manufactured in series production in the world is known as the Airbus A380.



1. Picture: © AIRBUS S.A.S 2005-Photo by exm/H. GOUSSÉ -.MASCLET

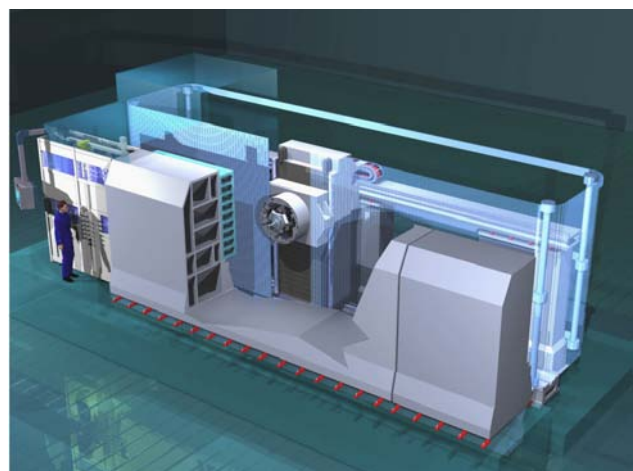
The double-storey aircraft is 72.7 m long, 24.1 m high and has a wingspan of 79.8 m and an empty weight of 291,000 kg. Manufacturing the components is distributed over various European Airbus locations with final assembly in Toulouse. The Airbus works in Varel is the main location within the Airbus Deutschland GmbH works network for machining aircraft parts and manufacturing production and assembly equipment. In the machining department complex structural components of aluminium, titanium and steel are produced for all Airbus programmes, including over four thousand components for the A380, such as fuselage ring frames.

Three million aircraft components are machined annually

The approximately 1,260 employees at the Airbus works in Varel produce three million aircraft components a year. To do so high-performance milling machines for fuselage ring frames of up to 7 metres in length are used, among much else. There are turning and milling centres processing large and extremely complex welded parts as well as fully

integrated manufacturing cells producing complex small components such as hinges and mountings. To machine large structural components like those in the fuselage or wing area of an aircraft the ECOSPEED high-speed processing centre developed by Doerries Scharmann Technologie GmbH (DST) of Moenchengladbach is used. This machines aluminium integral aircraft components with material removal of up to 8,000 cm³/minute with the aid of its parallel kinematic machining head Sprint Z3.

The design of this head is based on tripod technology. The powered milling spindle in the spindle platform can swivel within a spatial cone of ninety degrees. As the mass moved thereby is small very high dynamic forces are achieved. Workpieces are machined using a horizontal spindle and vertical pallet arrangement. Thanks to this configuration swarf is reliably removed from the working area.

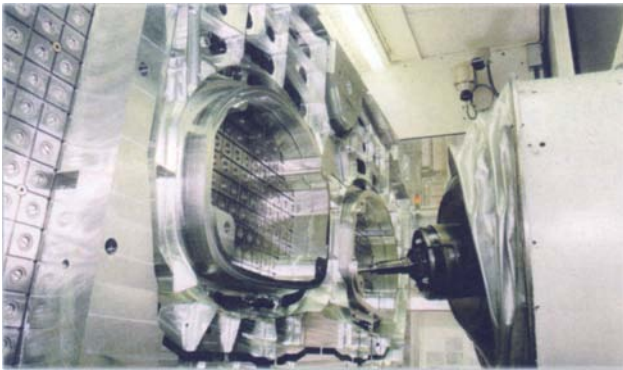


2. Picture: ECCOSPEED

Damage to spindles and workpieces is expensive

The guidance and drive arrangements in the ECOSPEED guarantee highest precision and dynamicism. It is this processing centre performance that makes economic

processing of individual components at all economical. Nevertheless, lengthy machining times of up to twenty-four hours are sometimes needed in producing complex individual components as often up to ninety percent of the material in the aluminium blocks weighing several tonnes is removed. The blocks are manually placed and retained in their holders with screws. There is a risk in the machining thereafter of the spindle milling a screw or screws with the tool. In such a case the workpiece may be



3. Picture: ECCOSPEED, Manufacturing in the processing room

destroyed or costly remachining steps be needed quite apart from the spindle/s possibly being damaged. Total spindle loss can cost 30,000 Euros. This is in addition to the costs of machinery down times and that of the aluminium block/s ruined and any remachining needed. That's why Airbus Varel decided to introduce the CTM (Computer Integrated Tool and Machine Monitoring) system made by ARTIS, as it protects not only expensive workpieces but also the machinery spindles and thus minimises overall machinery down time.

The **ARTIS CTM** is a system for monitoring machine tools, processes and machine status that is completely integrated in the machinery control system. It detects missing, broken or worn tools in machining production plant. The monitoring strategy implemented by Airbus Varel is twin-track as the torque of spindle and feed drive is monitored simultaneously with spindle oscillation values.

The CTM card as a central monitoring unit is in the form of a PC plug-in card equipped with standard interfaces and is inserted in the machinery control system control panel. It hence needs neither its own housing nor its own power supply. It's also easy to install. It offers four monitoring channels operating independently of one another that can be unified if needed. The ARTIS DTA (Digital Torque Adaption) procedure sends the current torque values from the spindle drive controllers via the profibus to the CTM

system, making installation of additional sensors superfluous. The CTM system then evaluates the data.

Dual monitoring strategy protects spindle and workpiece

Should the milling tool travel over a screw this will usually damage the edge only in specific places. If the machining process isn't immediately stopped the imbalances and uneven machining that result worsen oscillation, which stresses the machinery spindles and damages them. The same applies to a tool with excessive wear.

This is where the second monitoring strategy takes over. An ARTIS VA 2 acceleration sensor records oscillation values directly at the spindle and they are then evaluated in a VG 4 module. Both monitoring results, i.e. torque and oscillation, are linked so that an alarm is only given if both simultaneously exceed their limiting values. If so, the control systems stops feed and moves the machine to a safe position so that personnel can investigate the problem.

Before its introduction ARTIS had to adapt the monitoring system to the special circumstances prevailing in manufacturing aircraft components. Individual component manufacture prevails here with long machining times and manual placement of workpieces resulting in processing difficult to reproduce as reference values are difficult to ascertain. This circumstance not only makes production more difficult but its monitoring as well. Despite this the user demanded the least possible monitoring system adjustment effort and cost and ease of inclusion in the processing programme in view of the large variety of components. ARTIS succeeded in the course of many trials and modifications of the software, which was originally tailored to mass production, in adapting the monitoring system to these special circumstances. Airbus Varel has now had the system in operation for two and a half years and was able to detect worn tooling in good time on several occasions with it. Continued processing would have caused breakage and then spindle and workpiece damage. Incorrectly fixed workpieces were detected several times too, thus preventing expensive crashes. In view of these very positive results the Airbus works in Varel are currently considering using the ARTIS monitoring system in future projects as well.