



Focus on Applications

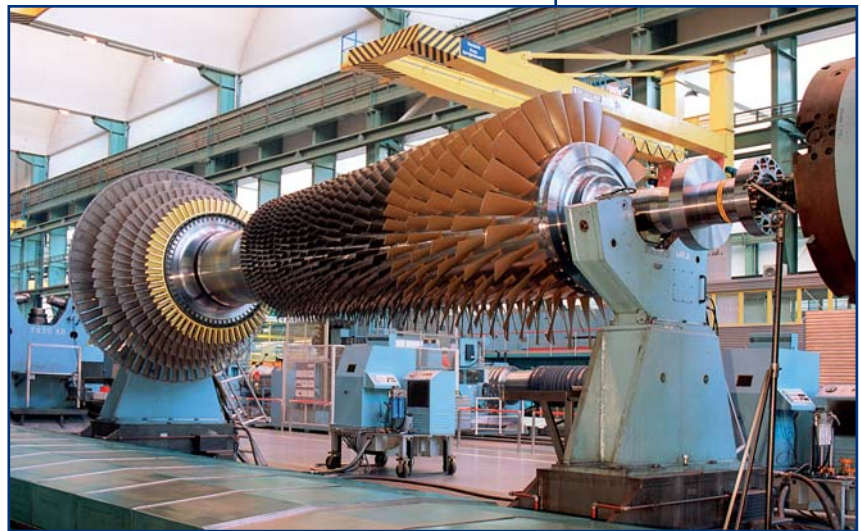
Alstom: Energy made to measure

Turbine blade machining represents one of the key value-added production operations in Alstom's Power Turbo-Systems plant in Birr, Switzerland and a Hexagon Metrology coordinate measuring machine (CMM) is an integral part of a flexible machining system (FMS) cell, which finish grinds and inspects turbine blades and vanes.

In this FMS cell, a Mägerle Grinding Centre (MGC 130) and a DEA CMM (Scirocco Activ 14-09-07) operate under a master program to automatically finish grind and inspect no less than five blade types and three vane types. Working three shifts per day, this cell produces the blades and vanes needed for rotors for various power systems. With 4,000 employees in two sites (Baden and Birr), Alstom is one of the largest industrial companies in Switzerland and the Birr plant is one of the leading suppliers for Alstom's rotary turbine systems. These high-speed rotating systems need turbine blades machined to close tolerances and Alstom has pioneered in many processes to make blades and vanes. One of Alstom's key requirements for its turbine blade FMS cell was to have an in-built process control procedure to guarantee that blades and vanes are finish ground to within specification with no downtime during the inspection process. After the development of the cell, Alstom has chosen Hexagon Metrology as technological partner for metrology aspects.

One of the key factors for choosing this measurement system is the ability of the PC-DMIS software to easily interface with the other cell components, besides being entirely developed in MS-Windows environment.

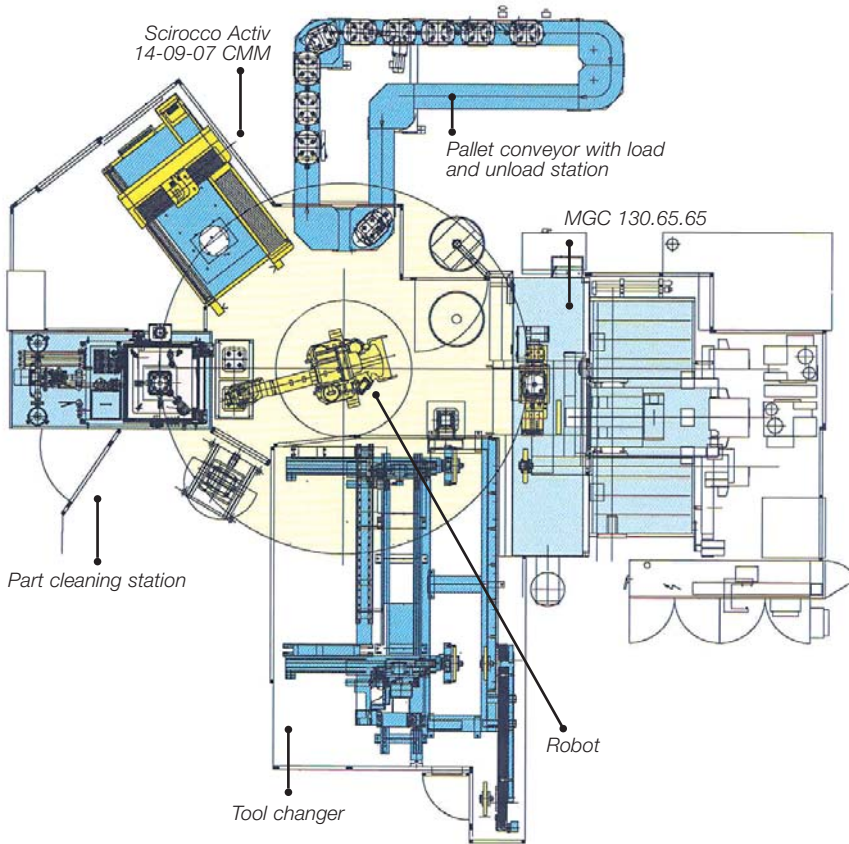
"Our biggest challenge was to integrate the CMM so that the manufacturing process is completely automated," says Sven Köhler, Alstom's Manufacturing Engineering Group Leader, "After



analysing measured values, the CMM software decides whether the part is to be accepted or not." Hexagon Metrology has worked closely with Swiss machine builder Mägerle to develop the Scirocco-MGC Integrated System, which ensures that the MGC 130 grinding centre and Scirocco Activ measuring machine work in close coordination to grind and inspect blades and vanes. The cell consists of seven components (Figure 1):

- Pallet conveyor with a load and unload station;
- MGC 130.65.65 grinding centre;
- Tool changer for the grinding centre;
- Scirocco Activ CMM;
- Material handling robots (one for the CMM, one for the deburring station);
- Deburring station;
- Part cleaning station.





part. The robot takes this finished part and places it on the Scirocco CMM for the post grinding inspection. Only those surfaces ground in a setting are measured against their reference values. These results are final in case measured features meet drawing specifications; they are temporary in case material still needs to be removed. Each measured feature has a so-called feedback parameter and this data is transferred from the CMM to the MGC controller. This enables the program tool preset values to be accordingly changed so that the selected part features can be machined to remove any excess stock. This way each turbine blade or vane can be machined with certainty to within the required tolerance limits.

The grinding cell operates in an attenuated correction cycle, which implies that the feedback data from the CMM to the MGC allows correction to the following part to be produced. "This operating strategy has resulted in a 40% time saving in grinding operations," says Hermann Emminger of Alstom's Manufacturing Engineering department.

Mr. Emminger also refers to the long grinding cycle times, which may take 20 to 35 minutes per blade. In addition, each blade has to be ground in up to three settings, each setting requiring its own fixture. Presently the FMS cell operates 24 hours per day in a workshop environment where the entire system has proven its robustness. This is truly a rugged system for all seasons.

"The Alstom FMS cell is a good example of how Hexagon Metrology and Mägerle have partnered to provide customers with complete manufacturing solutions", says Andrew Barclay, Hexagon Metrology Switzerland General Manager, "So far, we have developed 3 such integrated systems and expect a growing demand in the future". ■



Presently, three operators run two grinding cells and one of their tasks is to load parts on/unload parts from the pallet conveyor leading to the FMS cell. A robot then picks up the part from the pallet conveyor and places it on the Scirocco CMM for a pre-grinding measurement operation. The purpose of this operation is to establish the three-dimensional position of the component within the pallet reference system. The CMM determines the X, Y and Z coordinates of the component's origin as well as its angular position. This information is then transmitted to the MGC controller so that the correct position for machining is achieved. After completion of this pre-grinding measuring operation, the robot moves the part and places it on an empty holding device on the MGC's rotary loading station. Once the part is loaded, the loading station rotates 180° to present the loaded part for grinding. At the same time, a second holding device appears before the robot and this one holds a finished ground





Hexagon Metrology

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