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**A revolution for powertrain manufacturing**

**5-axis CMM inspection – a technology breakthrough**

In the highly competitive world of automotive powertrain manufacture, companies are constantly looking to make efficiency savings and drive down production costs. One key technology breakthrough that has reduced cycle times, typically by 20% - 70%, is 5-axis CMM (co-ordinate measuring machine) scanning for the measurement of part features. CMMs that use 5-axis scanning technology achieve the greatest savings on complex parts, and when applied to cylinder heads, cylinder blocks and gear box casings, 50% time savings are common. The availability of a surface finish sensor that allows measurements to be taken within the same automated CNC inspection routines, also negates the need for manual gauging operations with hand-held equipment.

**Scanning faster – with accuracy**

All CMMs with just 3 linear X, Y and Z axes suffer from variable accuracy when scanning, getting worse at higher speeds. The acceleration and deceleration forces create significant amounts of bending in the machine structure that result in errors in the measurement data. To prevent these errors and maintain accuracy, scanning speeds are kept deliberately low (<25 mm/sec).

The REVO® 5-axis measurement system introduced technology that radically changed the speed versus accuracy conflict, with a scanning head that has two additional rotary axes, preventing these dynamic errors whilst still measuring at high speeds - up to 500mm/sec. This is achieved by keeping the machine structure stationary, and using a highly responsive measuring head to carry out measurements such as circle scans. Where measurement paths need more than two axes to be synchronised, such as when helical scanning for example, the X, Y and Z axes can be programmed to move in a vector at constant speed and the head will again carry out the high-speed scanning motion.

**The optimal measuring tools**

The REVO® system offers five different probe families, each specifically designed to maximise the advantages of 5-axis motion and infinite positioning. The probes can be changed automatically and include tactile scanning, touch-trigger, surface finish and non-contact vision probes. All are used within a common co-ordinate reference frame and provide the choice of an optimum tool to measure multiple features all on a single CMM platform.

**Automation of surface finish measurement**

The time savings achieved by 5-axis scanning for geometric inspection have been available for a few years now, but more recent developments provide additional justification for the adoption of the 5-axis CMM technologies in powertrain manufacturing including the expanded SFP2 surface finish measuring sensor range for the latest REVO®-2 head. Using REVO’s infinite positioning, all features can be reached including small bores like valve guides in cylinder heads. This added option on CMMs completely removes the need for traditional hand-held surface finish operations and surface finish measurement is carried out in around half the time. With surface finish inspection under program control, data is collected in the same coordinate reference frame as other probes and results are automatically stored for future reference. For new lines, the capital savings are around 25% when replacing a 3-axis CMM and manual gauge station with a 5-axis CMM that has a surface finish capability.

The 5-axis technology can be found on the latest generation of CMMs, but can also be retrofitted to many older machines to achieve exactly the same benefits and savings.

**Fewer probe styli**

Far fewer styli configurations are required on CMMs using REVO, reducing both inventory and cycle times. In most cases, even the most complex powertrain parts can be fully measured with just one or two styli. This is significant as CMMs waste a large proportion of their cycle times either calibrating or switching between different styli. Two design features in the REVO 5-axis systems make this possible:

Infinite rotary positioning so all angular access is under programmable control rather than dependant on changing between multiple styli configurations with fixed angles. The capability to achieve high accuracy with both short and long stylus lengths, thanks to its tip-sensing technology. As a result, the longest stylus needed to access the deepest feature is also suitable to accurately measure features right on the surface.

***How tip-sensing works***

Tip-sensing measures position directly behind the stylus tip using a laser beam directed onto a reflector at the stylus. As the stylus touches the part and bends, the reflector is displaced. The altered return path of the laser is then sensed and the exact tip position of the stylus is known because the reflector and stylus ball are close together.

**Factory 4.0**

The benefits of a digitally connected machine shop have already caused a lot of excitement in the manufacturing community because of the potential for large efficiency savings. Ideally the size and position of features are automatically monitored, and automatic adjustments made to upstream metal cutting processes based on any trends. This loop should help tolerances stay within process limits. The need for rapid data capture is therefore key, and high speed 5-axis inspection opens up the opportunity to increase sample frequency or to implement 100% in-line inspection.

For more information on the REVO-2, visit [http://www.renishaw.com/en/revo-5-axis-measurement-system--10438.](http://www.renishaw.com/en/revo-5-axis-measurement-system--10438.%20)

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**Notes to editors**

UK-based Renishaw is a world leading engineering technologies company, supplying products used for applications as diverse as jet engine and wind turbine manufacture, through to dentistry and brain surgery. It has over 4,000 employees located in the 35 countries where it has wholly owned subsidiary operations.

For the year ended June 2017 Renishaw recorded sales of £536.8 million of which 95% was due to exports. The company’s largest markets are China, the USA, Japan and Germany.

Throughout its history Renishaw has made a significant commitment to research and development, with historically between 14 and 18% of annual sales invested in R&D and engineering. The majority of this R&D and manufacturing of the company’s products is carried out in the UK.

The Company’s success has been recognised with numerous international awards, including eighteen Queen’s Awards recognising achievements in technology, export and innovation.

Further information at [www.renishaw.com](file:///E%3A%5Cwww.renishaw.com)