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Faster shop-floor inspection with REVO® 5-axis multi-sensor CMM system

Automotive manufacturers benefit from up to a 50% reduction in cycle times when integrating surface finish measurement and dimensional inspection on a single 5-axis measuring CMM.

Real world application

When expanding their production line to facilitate a third engine design, with dedicated lines for cylinder heads, blocks and cranks, this global automotive manufacturer needed a new approach to its dimensional measurement functions. Currently, part inspection for the first and oldest engine lines was managed by a centrally located 3-axis CMM lab facility. This lab required thermal control and was away from the machining lines, so when the different parts arrived, they joined the ever-present inspection queue. The second, more modern, lines all utilised at-line 3-axis CMMs followed by at-line manual inspection stations to capture surface finish data.

Challenges

The optimum inspection solution needed to be both cost effective but also take advantage of new technology. An at-line option was favoured to reduce part mileage within the plant and eliminate bottlenecks at the central inspection facilities.

The manufacturer in question approached Renishaw with a specification that also included the following requests:

- If dimensional inspection and surface finish measurements could be combined in one operation, this would be a distinct advantage.
- The inspection results needed to be accurate in an at-line, shop floor environment (temperature range of 10°C to 30°C).
- The solution needed to be cost effective by employing new technologies, where appropriate.
- The solution had to pass a series of strict Gauge Repeatability & Reproducibility (GR&R) tests.

Solution

To meet the specific requirements of this manufacturer, the chosen solution was a REVO® 5-axis multi-sensor system. The infinitely indexable measuring head in the REVO system gives a wide choice of interchangeable contact and non-contact sensors and the flexibility to orientate to a wider range of features.

The REVO-2 head, with an operating temperature range of +10 °C to +40 °C, could be installed at-line with no additional thermal controls needed.

For this application, three sensors were selected; one REVO scanning probe (RSP2) for dimensional data capture, another REVO scanning probe (RSP3) for cranked styli and the surface finish probe (SFP2) for surface finish inspection. This enabled the combination of dimensional and surface roughness measurements to be completed automatically in the same measuring program. This multi-sensor capability gave a large cost saving in both capital and labour, especially as it meant the cost of the manual surface finish equipment station was avoided altogether, also freeing up space on the shop floor.

Cycle times were reduced so much that even with additional surface finish measurements included, they were still faster than the current 3-axis CMM measurement (without surface finish). This reduced cycle time provided the customer with more shift flexibility to accept future designs and products, whilst the versatility of the REVO 5-axis system meant very little additional equipment was needed for this. This proved to be useful earlier than expected when an additional part was added, even before the equipment had been installed.

In addition, Renishaw provided a bespoke loading/unloading station with additional storage for pallets immediately before and after inspection. Multi-purpose modular metrology fixtures were designed and manufactured in-house by Renishaw. They were carefully designed to eliminate the need to re-fixture during the inspection process and offered a single solution to hold a range of cranks after all machining operations.

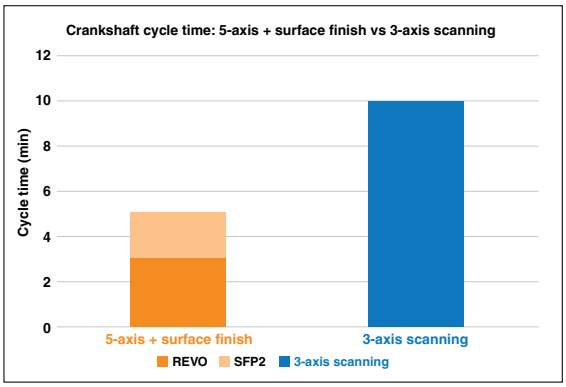
A further reason for cycle time reduction was the 5-axis system's requirement for fewer styli to reach all features, meaning fewer tool changes were required, and those that remained were conducted automatically. A subsequent benefit of this was that storage space and costs were considerably fewer, as less styli were required. Furthermore, fewer styli also meant that less investment was needed in the hardware itself.

Reliability and support

The plant was running a two-shift pattern, six days per week, so reliability and support were major factors to be considered. The chosen solution would act as primary inspection for both the new line, and one of the existing two lines. In addition, it would also offer an emergency back-up option to the remaining line.

Results

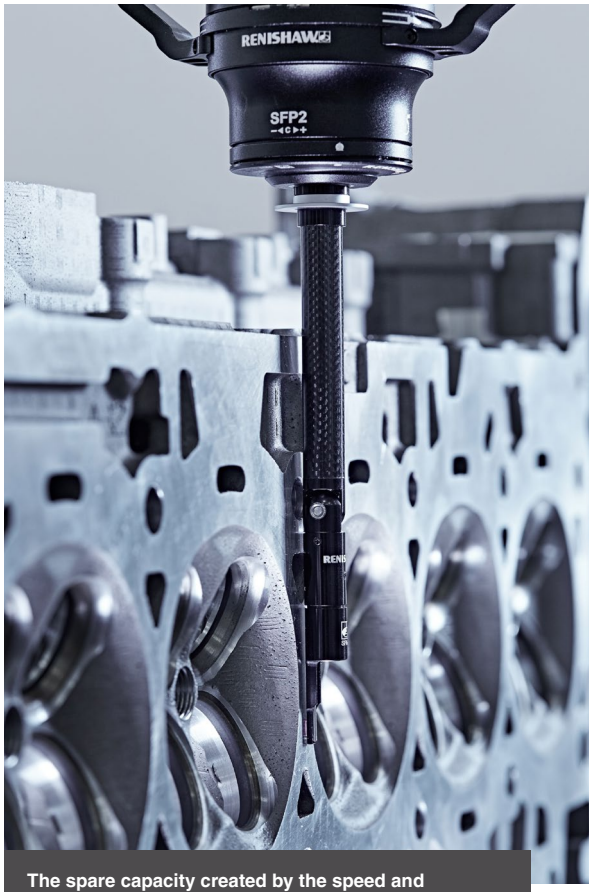
Implementing this solution exceeded the overall goals of the project to eliminate the measurement bottleneck, provide an at-line capability and be cost effective. In addition to these aims, the measurement cycle time savings for the dimensional inspection were around 45%. The spare capacity this created allowed additional surface finish features to be added, plus additional parts to be inspected.



The REVO 5-axis systems combined dimensional measurement and surface finish capability meant the manual surface finish operation was removed completely and the footprint of the factory was reduced. In addition, the multipurpose fixture and the 5-axis system led to a significant improvement in feature access, as well as:

- No manual gauge set-up time
- No calibration or repair costs for manual surface finish instruments
- Labour savings for manual surface finish inspection
- Reduced styli inventory

The result for the customer was a more automated process of inspection, with fewer manual processes. Previously, operators were required to load the parts on the CMM, run the dimensional measurement (with the fixture changes) before transferring the part to the measurement station and conducting the surface finish measurement. Now, operators are only required to load the part onto the fixturing, leaving all the inspection and reporting to the automated technology.



The spare capacity created by the speed and accuracy of the REVO 5-axis multi-sensor system allowed the measurement of additional surface finish features, plus additional parts to be inspected.

Summary

Renishaw provided a high-performance solution which has resulted in a huge reduction in inspection cycle times and hence cost savings such as valve seats and guides with accuracy and precision. The REVO® 5-axis multi-sensor inspection system provided the speed and flexibility to inspect not only the dimensional measurements, but also the surface finish in one complete solution. The efficiency savings allowed this manufacturer to reduce capital outlay and annual labour costs.

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