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5-axis multi-sensor solution for large cylinder block inspection

A manufacturer's dilemma

A manufacturer of large diesel engine cylinder blocks was running two shifts per day on machining centres, followed by inspection on a very large gantry co-ordinate measuring machine (CMM). This CMM was over 20 years old and was disrupting production with an increasing number of breakdowns as well as mounting repair costs.

The challenges

The largest of the engines measured 3 m x 1.5 m x 2 m with a capacity approaching 100 litres. The gantry CMM used to inspect such large engine cylinder blocks required deep reinforced concrete foundations and a large overhead crane had to be used for loading and unloading.

The CMM inspection process assessed critical features including cylinder bores, crankshaft main bearings, camshaft bearings and a variety of location holes and faces. The results were needed as quickly as possible so that the block could be passed and moved on to assembly.

The CMM was limited to capturing touch points. Faster data capture using scanning was not possible. In addition, only dimensional inspection data could be captured as there was no ability to measure surface finish data.

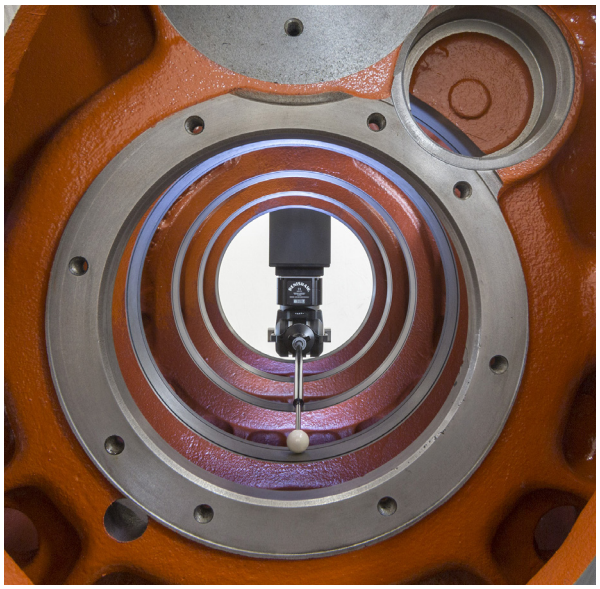
The machine was increasingly a bottleneck for the two production shifts, even before breakdowns were factored in. Because there was no off-line programming capability, any new part programs or modifications had to be written on the CMM outside normal production hours.

The weakest points in the CMM were not the machine structure or the foundations, but the ageing electronics, controller and measuring scales. These proved not only to be unreliable but, in many cases, new replacements were no longer available. During some breakdowns, the only way to restore operations was to call an engineer to 'fault find', then replace individual components on circuit boards. After several breakdowns that took weeks to fix, it was time for a rethink.

The options

Three main options were considered:

- Continue to support the old CMM; this would include buying a stock of used spare parts, plus purchasing portable measuring arms as back-up inspection devices.



REVO-2 head with RSP3-6 sensor provides extended reach for use in large cylinder block inspection.

- Buy a new large CMM (3 m x 2 m x 1 m minimum); this would require expensive new foundations. It would also mean no inspection capability whilst the lengthy construction work and installation were completed.
- Retrofit the existing CMM; this would offer an opportunity to give the CMM brand new wiring, controller, scales and rapid scanning probes.

The solution

The preferred option was to retrofit the existing CMM with a REVO® 5-axis measuring system.

One of the most compelling reasons to choose a Renishaw retrofit was that only three to four weeks of machine uptime would be lost; just a fraction of the time to install a completely new machine with a concrete base, and at a considerably reduced cost.

The retrofit included replacing the existing head with a REVO® 5-axis measurement system. The ageing controller was replaced with the latest UCC S5 controller and SPA3 amplifier combination to improve the speed of the machine. Finally, it was fitted with a new Renishaw TONiC™ position encoder system.

An immediate result of the retrofit was that the inspection time for a basic engine block was more than halved, from two hours 15 minutes to just one hour.

Renishaw plc
New Mills, Wotton-under-Edge,
Gloucestershire, GL12 8JR
United Kingdom

T +44 (0)1453 524524
F +44 (0)1453 524901
E uk@renishaw.com
www.renishaw.com

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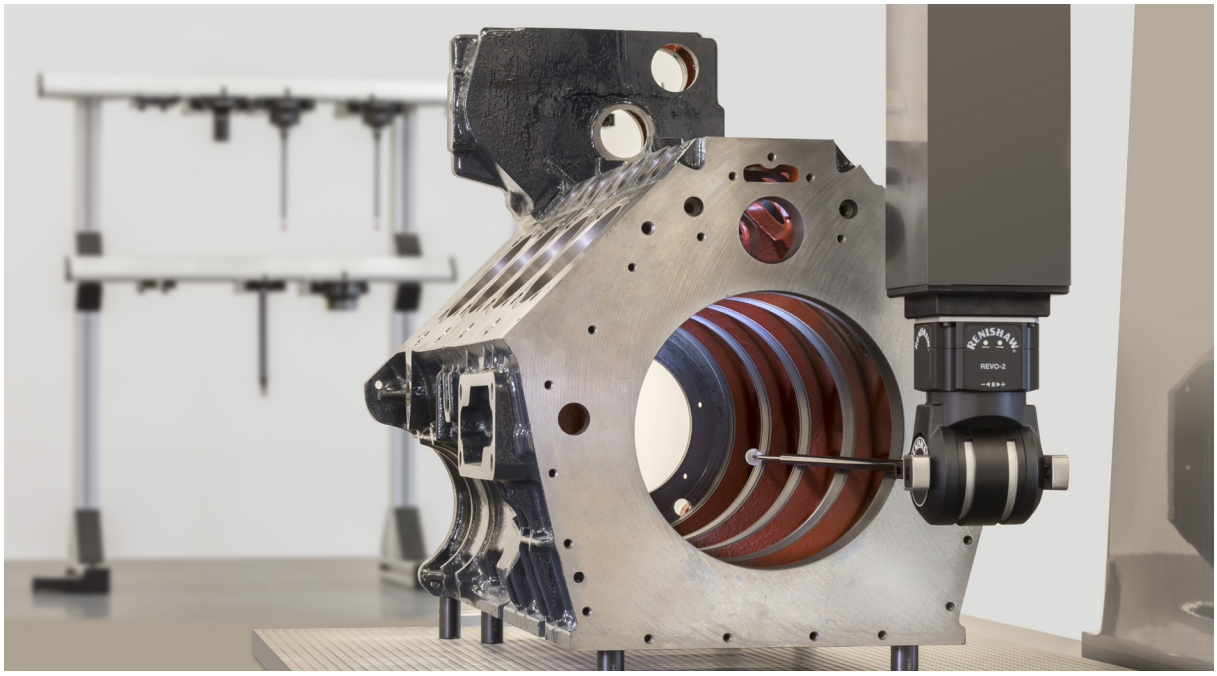

Powertrain manufacturers benefit from a 20% to 50% reduction in cycle times when integrating surface finish measurement and dimensional inspection on a single 5-axis measuring CMM.

This was before the benefits of scanning and the potential to cut more time were even investigated.

By choosing the 5-axis system with infinite positioning, it was possible to measure some features that were previously inaccessible with fixed probing. Additionally, the ability to carry multiple sensors, including surface finish, had the potential to reduce manual operations using hand held gauges.

Finally, the offline programming option with Renishaw's MODUS™ software enabled the programmers to work in parallel with inspection routines during normal shifts.

Benefits at a glance

- Shorter inspection cycle times (reductions of 20% to 50% are common)
- Earlier confirmation about upstream process changes
- Automated surface finish measurements
- Results in one digital report
- Multi-sensor capability reduces floor space requirements
- Reduced probe and styli calibration time
- More flexibility for feature access with fewer styli
- A platform for future sensors

Summary

The CMM has operated reliably since 2015, when the retrofit was completed, with only planned maintenance and annual calibration required. Further improvements have been phased in over time, one of which is the introduction of the ultra-long stylus carrying capability of the RSP3-6 probe.

The ability to automatically capture surface finish data has also proved to be invaluable and the faster, more comprehensive, data collection has provided the basis for a proactive assessment of the machining processes.

For further information about REVO systems, visit www.renishaw.com/revo

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