

# Faster cylinder head inspection with REVO® 5-axis multi-sensor CMM system

## The need for speed

Many features need to be controlled during the manufacturing process for petrol and diesel cylinder heads, used in both conventional and hybrid vehicles. Some features, such as valve seats and guides, have complex tolerances designed to ensure that engines perform efficiently, meet emissions regulations and reach their design life without breakdown. Speeding up the feature control will enable the manufacturer to improve all round business efficiency.

High-volume engine manufacturers have utilised 5-axis inspection technology to transform their manufacturing processes, saving costs and improving production efficiency simultaneously.



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.

## Traditional methods

Traditionally, surface finish measurements have been performed by an operator at a separate gauging station, with the use of an industrial manipulator. The manipulator indexes the head into different orientations to access the surfaces to be inspected. A typical set up would involve 10 - 15 different gauges, all operated manually, to carry out the full measurement cycle.

A co-ordinate measuring machine (CMM) would be used prior to this for dimensional inspection, verifying that each feature's dimension and form is within the upper and lower tolerance limits. The tolerance is calculated in reference to a sample component, typically taken from the production line every 200-300 parts, or just after a cutter change in the machine tool. A pass or fail result for each feature is automatically generated and reported to an SPC (Statistical Process Control) system.

This two-step process is time consuming and requires high levels of resource, has high labour costs and is susceptible to human error.

## Improved methods

### 5-axis CMM measurement

Without the advantages of 5-axis control, all CMMs suffer from variable accuracy when scanning, getting worse at higher speeds. The acceleration and deceleration forces create noticeable amounts of bending in the machine structure and introduce errors in the measurement data.

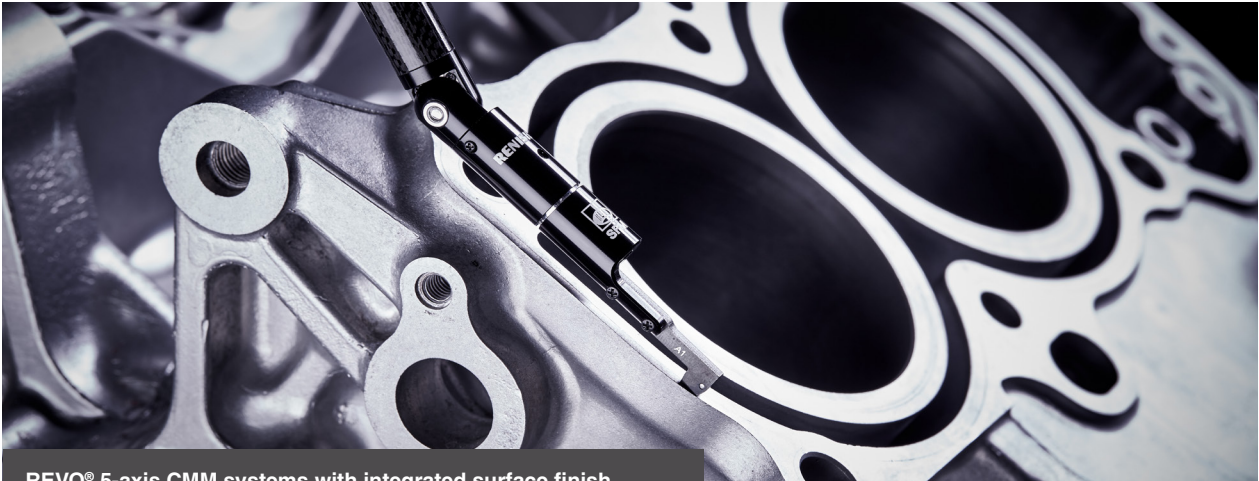
To prevent those errors and maintain accuracy, scanning speeds are kept deliberately low (less than 25 mm / sec). By adding a REVO-2 scanning head with its two additional rotary axes, it is possible to remove those dynamic errors whilst still measuring at high speeds – up to 500 mm / sec. This is achieved by keeping the machine structure stationary and using the highly responsive REVO-2 head to carry out measurements such as circle scans. Where measurement paths need to synchronise more than two axes, such as when helical/spiral scanning, the X, Y and Z axes of the CMM can be programmed to move in a vector (a straight line, at constant speed), again allowing the REVO-2 head to carry out the high-speed scanning motion.

## The cost of quality

The overall cost of cylinder head inspection is directly related to three main elements:

- The capital cost of the CMM and surface finish gauging equipment
- The labour requirement of the operations
- The time needed to carry out the measurements

5-axis CMM inspection, with integrated surface finish measurements, delivers a significant improvement in all three areas. However, its benefits aren't limited to just these three elements though.



REVO® 5-axis CMM systems with integrated surface finish measurement deliver a significant improvement in inspection time and labour requirements for cylinder head quality control.

## Integration

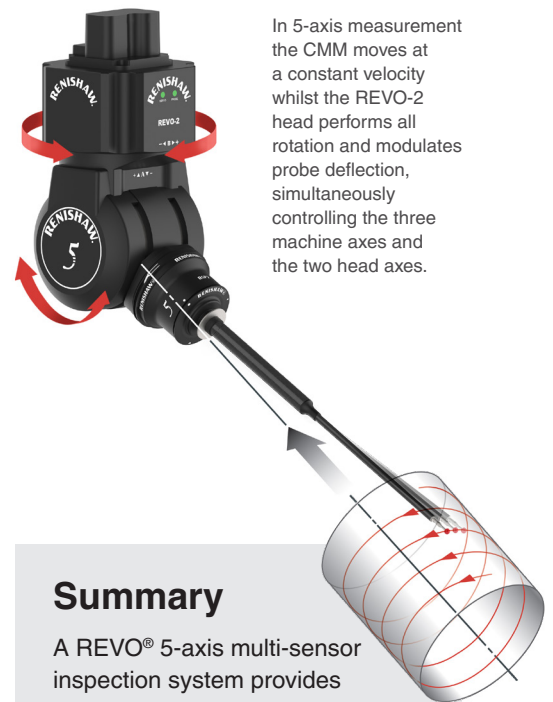
Integrating surface finish measurement and dimensional inspection on a single CMM, when using 5-axis inspection technology, enables data capture at much higher speeds. A 15% - 50% reduction in cycle time is common, even when inspecting cylinder blocks and gearbox casings.

## REVO® system 5-axis measurement benefits at a glance:

- Frees up floor space
- Fewer operations
- Quicker inspection results
- All data in a single digital report
- More flexibility
- Fewer styli
- Tip sensing

## Tip sensing

The ability to use long-reach styli whilst also maintaining high accuracy is only possible by using 'tip sensing' technology. A laser is fired down a hollow carbon fibre stylus tube and reflected from a small mirror positioned directly behind the stylus tip. Because accuracy is similar at both short and long lengths, one stylus can be used for all measurements in most cases – saving calibration time and stylus inventory.




In 5-axis measurement the CMM moves at a constant velocity whilst the REVO-2 head performs all rotation and modulates probe deflection, simultaneously controlling the three machine axes and the two head axes.

## Summary

A REVO® 5-axis multi-sensor inspection system provides increased speed and flexibility to inspect complex features such as valve seats and guides with accuracy and precision. The efficiency savings allow manufacturers to reduce capital outlay and annual labour costs.

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