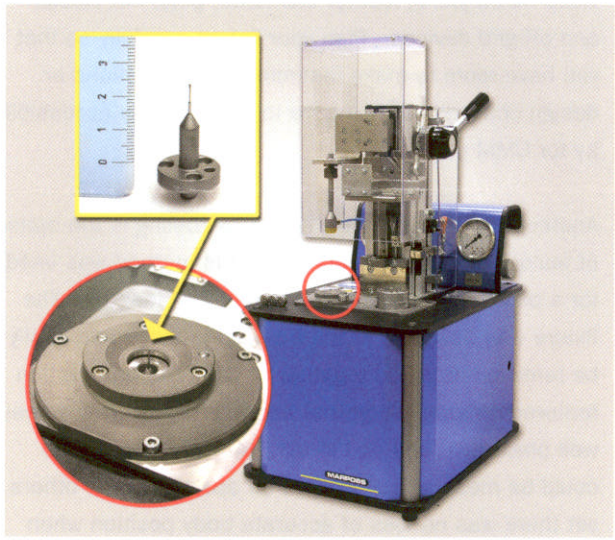
How To Measure Size And Form On The Shop Floor With Sub-Micron Accuracy

Not very long ago, sub-micron measurements of anything were the domain of specialized, dedicated instruments in controlled-environment laboratories. If you wanted to know how well your process was performing, the only way to find out was to take the parts to the lab and wait, and wait, and wait. And, while you were waiting you had the choice of either shutting down production or taking a chance on creating an entire batch of scrap parts.

That situation created a demand for near-machine, or better yet, on-machine solutions that could measure size, form or other attributes as accurately as high-end lab instruments. Much of the demand came from the automotive industry where many critical parts must meet increasingly stringent specifications in a high volume production environment.

The solution comes in the form of a combination of advanced gauging technologies with very fast computers and sophisticated software that is delivering unprecedented capabilities to the shop floor. Here's an example of how this new approach works.



The M39S system inspects and graphically displays the dimensional profile of matching surfaces on diameters less than 1mm.

ELIMINATING DOWNTIME FOR INSPECTION

A fuel injector manufacturer needed to measure size and true roundness on Plunger and Body components having a 0.6 micron roundness tolerance on the OD and ID respectfully. It was necessary for the roundness measuring equipment that the manufacturer normally used to be housed only in a laboratory environment. But halting the machining process while components were checked in the lab caused unacceptable downtime.

Marposs engineers applied an M39S gauging system employing standard LVDT technology to scan over the OD or through the ID while the part was rotated using a high precision spindle assembly. Due to such a tight tolerance, Marposs used additional transducers to monitor and then compensate for mechanical errors. The use of standard components and the robust mechanical design of the M39S system permit measuring the parts on the shop floor, right next to the production machines.

The data is then quickly analyzed by a Marposs E9066 computer that also serves as the gauging system control to deliver a graphic indication of both size and true roundness in real time—all within the machine cycle. The system is fast enough to provide 100 percent inspection of production parts, if necessary, and stable enough to achieve a GR&R of less than 20-percent on the shop floor.

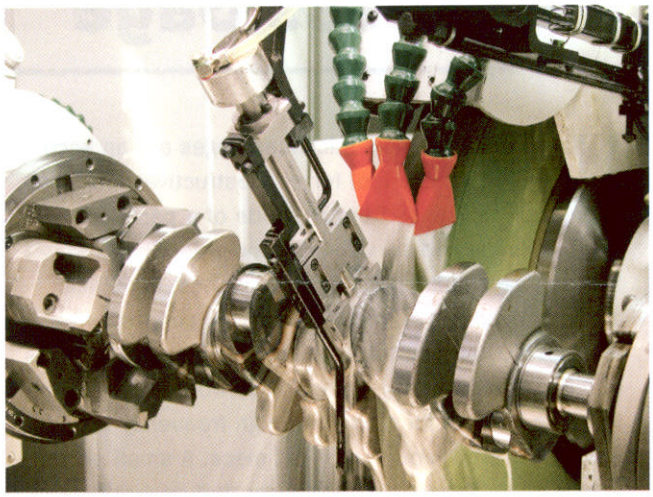
FORM MEASURING ON THE MACHINE

Another challenge involves form measurement of crankshaft pin journals on the shop floor. Crankpin roundness is a special concern for manufacturers using modern "orbital" grinders that interpolate the part geometry as the crankshaft rotates about the main bearings. As the machine warms and cools, as the tooling wears, or as coolant changes state, roundness can be adversely affected. The traditional method of checking roundness in the metrology lab involves choosing between stopping production and running the risk of producing bad parts.

Responding to the need for a more efficient system to check production quality, Marposs engineers enlisted the Fenar-L in-process size gauge that was already installed on the grinding machine. This chordal-type gauge contacts the part at three points to measure size. The gauge transducer is typically placed at the vertex of two fixed contacts set at an angle. This allows

the gauge to travel with the crankpin as the wheel "chases" the part.

The problem is that a chordal gauge set up this way cannot "see" even lobing, and multiplies tri-lobed errors by six times. By offsetting the transducer from the vertex, Marposs engineers eliminated this problem. A new device that maintains a fixed radial orientation of the gauge—replacing the normal floating arm—was also created in order to accurately obtain radial position of the form. Marposs engineers created the Shape Control software that processes measurements from the specially adapted Fenar-L gauge and, using the same filters as laboratory equipment, generates a repeatable form within 1% of the laboratory. This type of measurement integrity now enables checking production quality and compensating of the machine with a high degree of certainty—and without interrupting production. (For more information on these and other measurement solutions for the shop floor, visit www.marposs.com)



Specialized mechanical adaptations and exclusive software now permit the Fenar-L in-process size gauge to be used for measuring form and compensating the machine without removing the part to a laboratory.