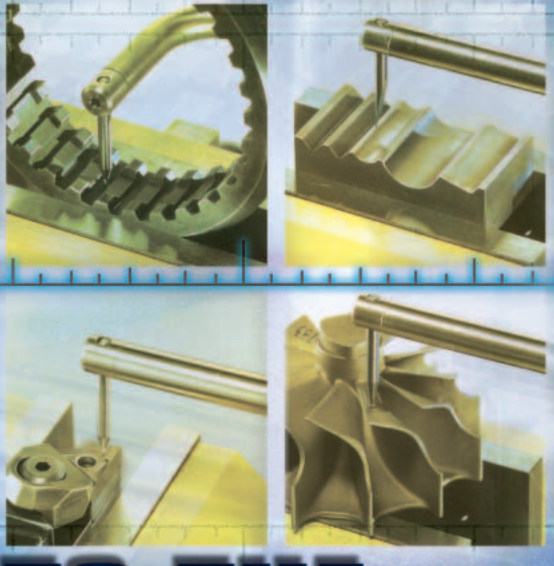
MOVING MEASURING TO THE MACHINE



by Robert Wasilesky

With the cost of testing and measurement equipment more reasonable than ever before, the time to move your measuring to the shop floor is now!

Take a peek into the machining cells at progressive large-volume gear manufacturers these days and you'll likely see more measuring devices cropping up on the shop floor right next to the machines, measuring noise, roundness, surface roughness, or contour virtually in real time. Then take a peek at those same manufacturers' productivity, yield, and customer-reject numbers, and you'll see measurable improvements. One follows the other—it's as simple as that.

You'll see such practices mostly in the manufacturing cells of first- and second-tier automotive suppliers, where ISO 9000 and QS-9000 are the driving forces. But near-machine form measurement is also expanding among manufacturers of power transmission components and electronic parts. It's increasingly prevalent in the manufacture of components that are safety- or finish-sensitive, have high added value, or require 100-percent inspection. The more hobbing, grinding, polishing, superfinishing, precision turning, boring, and reaming you see, the more near-machine measurement you'll find. The same goes for massive parts, because it's easier to bring the measurement function to the work piece.

The Next Logical Move

Today, the demands on gear usage are very high, whether they are the plastic gears of a windshield-wiper drive or ground for use in an engine's transmission. Gears must operate more efficiently, more quietly, and with less wear than ever before. Near-machine measurement isn't any revolution in quality assurance, it's just the next logical move in the inevitable migration to real-time inspection and measurement. Now gears can be measured relative to datums, accurately on one machine. The migration is occurring for the same reasons that coordinate measuring machines (CMMs) and other dimensional measuring devices have been moved to the plant floor for real-time measurement and integration into manufacturing and process control.

First, the global market is demanding higher quality and ISO 9000/QS-9000 adherence, which favors real-time measurement. More and more form-related callouts are showing up on part prints. Secondly, real-time inspection's benefit for process control has been so long-proven and so widely accepted that it's no longer seriously questioned. It's axiomatic that the closer to real time you can make a measurement, the more in control your process will be. Likewise, the better your quality reputation with customers will be. This applies as much to a total composite check with a gear tester as to a length or width measurement with a CMM. If the print specifies a parameter to a given tolerance, the closer to real time that you check that parameter the better: better for quality, process control, and the bottom line.

For instance, several engine-gear manufacturers have integrated surface roughness testing into their grinding milling operations to make sure the surface quality will not induce premature wear. They originally did it to satisfy ISO 9000/QS-9000 requirements, but they found that real-time surface measurement was also great at controlling the process and more than paid for itself in a matter of weeks.

Why Choose Real-Time Form Measurement?

The expansion of real-time form measurement is largely due to its lower price, as the gear manufacturers' case illustrates. Additionally, today's measuring devices are robust and user-friendly. And, as the number of shop floor form measurement applications increase, so does the availability of lower-priced instruments tailored exactly to specific needs.

The entry-level rolling flank gear checker that cost $40,000 in 1989 now runs about $20,000. Surface roughness units cost $1,500 today vs. $3,000 in 1990. For contour measurement, a basic unit suitable for near-machine measurement starts at $20,000 vs. $40,000 in 1990. These price points—typically 50 to 75 percent lower than a decade ago—are for units with resolutions well within the specifications on most part-print callouts. They may not match the resolution of top-of-the line lab instruments operating in environmentally controlled clean rooms, but they are more than equal to the task of production-part auditing to present and foreseeable accuracy levels. And because they cost much less than they used to, you can afford enough of them to spread them around to where they'll do the most good.

4B-16 Crysta Apex C 700 CMM

For instance, at less than $30,000, the Mitutoyo CRT-AC 544 CMM is the least expensive coordinate measuring machine in its class. It's easy to use, and it handles 99 percent of the shop floor prismatic measurements required on today's part prints.

The near-machine models of today's form measuring equipment don't need the clean-room atmosphere and pinpoint temperature control of older models. For instance, the new breed of affordable plant-floor form instruments performs as well at 60-degrees F to 80-degrees F as a 1990-era lab instrument in a temperature-controlled clean room. They measure at submicron levels right on the plant floor, next to a machining or turning center making chips by the bucket.

With proper fixturing, which is key, near-machine form measurement can be a one-keystroke operation for each measurement. Typically, the time needed per form measurement on the floor is about a quarter or less of that required to do it in the lab. Further, the cost disappears because the operator makes each measurement within the existing machine-cell cycle. Measurement is so quick and simple that it becomes feasible to increase the inspection frequency, even to 100-percent inspection. With proper fixturing, near-machine form measurement requires no more skill than it takes to chuck a part and push the start button to make chips.

The one exception to the "one stroke" guideline is surface measurement. Often it's wiser to run two or three measurements per piece and take the average. Even so, the operation can be very fast if planned properly.

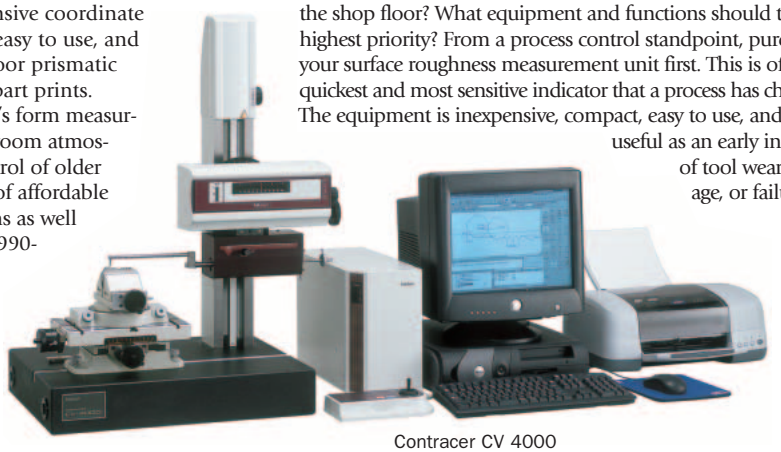
When to Make the Move

The sooner you change to shop-floor form measurement, the better off you'll be. If you make automotive OEM parts with roundness, contour, or surface roughness callouts on the print, you'll need real-time form measurement to meet ISO 9000/QS-9000 standards. And you'll need to meet those standards shortly or you'll be bumped off the qualified suppliers list.

Beyond ISO 9000/QS-9000 mandates, deciding when to move to real-time form measurement is really up to you. The key is to look at the cost/benefit in terms of the quality expectations of your market: i.e., the economic payoff to your operation in light of today's lower prices. In some cases—especially if you're running a job shop where customers' prints specify form-related standards and you're simply ignoring them for now—look also at product liability risks. Although at one time you couldn't afford to use real-time form measurement, today the question is, can you afford not to?

Progressive manufacturers of high-volume round and contoured parts are increasingly pushing the migration of form measurement to the shop floor, and they're reaping the benefits by gaining additional process control and a competitive edge.

How do you start moving surface and form measurement to the shop floor? What equipment and functions should take the highest priority? From a process control standpoint, purchase your surface roughness measurement unit first. This is often the quickest and most sensitive indicator that a process has changed. The equipment is inexpensive, compact, easy to use, and it's useful as an early indicator of tool wear, breakage, or failure.



Contracer CV 4000

From a part-function standpoint, however, the priorities are different. If you produce a lot of contoured parts, move contour measuring equipment out to the machine early. Unless the part meets its involute dimensional specifications, it may not work right, making surface quality irrelevant.

Keep Selection Quick and Simple

What should you look for when selecting equipment? First, remember that you're buying a dedicated single-purpose production device, not a general-purpose lab instrument. Focus on cost effectiveness to do the single part-auditing task at hand; forget about versatility. Also focus on the lowest-priced unit that can reliably achieve the resolution needed to meet present and anticipated print specifications covering form measurement, and nothing more. A resolution of 1 µin. is more than enough for shop-floor form measurement. As with many measuring instruments, the cost of form measurement devices rises exponentially with resolution.

Don't waste money on resolution or "neat" features, which you'll never need on the plant floor. Dollar for dollar, you're better off with two basic near-machine form instruments placed right in the cells than with a single "overqualified" instrument placed where it can be shared.

Avoid Overspending

When evaluating brands or models, always consider performance for the dollar for the specific job at hand. Within

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performance, be sure to weigh speed, ease of use, and robustness and connectivity along with resolution—always for the dollar.

Also look at the company behind the product. You're global; are they? Compare experience in shop floor measurement generally. Ask about price and speed of service. Shop-floor measurement equipment sees heavier duty than lab equipment, especially in 100-percent inspection situations. So speed, economy of repair, and economy of servicing become more important. Because you're buying a system to fit into your production operation, also look at the candidate's turnkey capability: instrument, software, fixturing, installation, training, and support. The job will go more smoothly, and you'll avert delays and finger pointing if something goes wrong later on.

One-Stroke Fixturing Buys You Speed

One big difference between the design

4B-15 Contour & Roughness Measurement (SV CNC)

of general-purpose lab models and dedicated shop-floor units is the importance of measurement speed. Shop-floor form measurement equipment can actually pay for itself with testing cost savings to the extent that you design the operation for speed. You don't want measurement to slow production, so it must fit in with the cell operator's existing rhythm. With a little foresight and wise investment in fixturing, this can usually be done. But think the operation through before committing to the equipment. Design "single keystroke" operation for each measurement, and select fixturing that both minimizes and tolerates setup error. To this end, plan to spend more on fixturing, as long as it speeds the operation sufficiently. The fixturing may cost more than the instrument itself, but if it gives you single-key measurement and error-

minimizing setup, it will pay for itself quickly. Reputable instrument makers will be happy to advise you on fixturing. At one gear manufacturer, a series of measurements that used to take half an hour per batch in the lab is now done in a few minutes on the shop floor. The difference is in the fixturing.

Your equipment won't necessarily need custom fixturing. Start with the standard fixtures available as accessories from instrument manufacturers and ask them for help with custom fixturing. Their experience will save you time and produce a fixtured setup that aids the process rather than slowing it down.

Sixfold Growth Seen

What's ahead for real-time form measurement? Today, only about 5 percent of the people who should be doing it are actually doing so. Some may not feel the need because they don't have an ISO 9000 or QS-9000 deadline staring them in the face, as do automotive parts suppliers. Others are adopting a "wait and see" attitude. Still others may see form-related callouts on customers' prints, but simply ignore them for now because they don't want to spend the money. This is an unnecessary risk, especially with the new affordability of shop-floor form instruments. Progressive manufacturers of high-volume round and contoured parts are increasingly pushing the migration of form measurement to the shop floor, and they're reaping the benefits by gaining additional process control and a competitive edge. The leaders will get both benefits, while the followers will just get the former.

Real-time form measurement is expected to expand at least sixfold during the next five years, and to pay for itself out of product cost savings and increased yields, as well as ISO 9000/QS-9000 compliance. If you wait for those requirements to force you into real-time form measurement, you're missing the point—and a real competitive opportunity. The price of entry has come down dramatically… the next move is up to you.

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