Mitutoyo

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A Mitutoyo America Corporation Publication

MAC MATTERS

The New **Surftest® SJ-210** has numerous innovative features combined with high accuracy and a competitive price making this instrument the new class leader.
(see page 2 for more information)

In this issue

From the Field

"From the Field" offers a take on Mitutoyo technologies and services from the perspective of the folks who provide them to end-users and customers. In this issue, we talk to Ken Myers, Integrated Applications Engineer, and Mike Norman, Project Coordinator, both of Mitutoyo Sales Solutions, Mason, Ohio. They'll tell us how Sales Solutions coordinates with the Mitutoyo Sales group to help provide the greatest possible value to customers.

MAC Matters: Ken and Mike, the two of you have been working together going on 8 years, providing customers with technical services and engineering support. I know that until recently your operation has been called Engineering Solutions. Now the name has been changed to Sales Solutions. This conveys the idea that you are now more closely tied to sales operations than before.

Mike Norman: That's right. The new name reflects an important organizational redirection. As Engineering Solutions, Ken and I worked under the auspices of Mitutoyo's Technical Services Division providing support directly to Mitutoyo customers. We were pretty independent of the sales organization, that is to say we didn't coordinate very tightly around sales activities. But now, operating as Sales Solutions, we are fully integrated into the sales group, offering our resources nationwide. Our charter is to add value to the sales proposition – both in terms of hardware and software, but also in terms of helping the sales group provide the best possible customer experience.

Ken Myers: You might say the new approach has to do with optimizing the allocation of Mitutoyo's "people resources." The idea is to help the sales group focus as much as possible on managing the customer relationship – secure in the knowledge that should the customer require any one-off or highly specialized solution, one that goes outside the normal application of Mitutoyo equipment – we're here to work through a solution.

MAC Matters: Could each of you please explain your role in the process?

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New Product Announcement

Surftest® SJ-210 portable roughness tester offers innovation and value

The Surftest SJ-210's large, 2.4" color LCD display includes backlighting, over-size fonts and the unique ability to re-orient screen content to be read vertically or horizontally left and right-handed. Color tolerance judgments, evaluation curves and all data can be displayed in one of 16 languages. Self-timed measurement and optional foot switch facilitate smooth, consistent operation. Up to ten measurement conditions can be registered and the ten most recent trace results are stored automatically. The SJ-210 employs a micro-SD card for storage of up to 10,000 results and support of screen capture. USB and RS-232C connectivity is supported. Security is managed via a password lock.

With high accuracy (a resolution of 0.0016µm at a measurement range of 25µm), a fast measurement speed (up to a max. of 0.75mm/s), a selection of nine exchangeable detector tips and features such as gear tooth surface detection, the Surftest SJ-210's flexibility and high throughput make it ideal for any manual surface roughness inspection task.

Inside Story

Laser scanning micrometer boosts electroless plating process capability

Tawas Plating Company & Tawas Powder Coating, Inc. (www.tawasplating.com) was established in 1954 with the mission of providing metal plating and coating services to automotive, aerospace and other demanding manufacturing sectors.

Located in Tawas City, Michigan, on Lake Huron's Saginaw Bay, Tawas Plating comprises a 45,000 square foot plating facility with an additional 26,000 square feet dedicated to powder coating. The company is ISO 9001:2000 and ISO 9002 compliant, as well as Q-1 registered.

Almost from the beginning, Tawas experienced strong demand for its electroless nickel plating offering – a process providing a unique combination of lubricity and wear-resistance as well as dimensional control, corrosion protection and superior cosmetics.

Catalyst replaces electricity

As the name suggests, electroless nickel plating does not rely on passing an electric current through a solution to form a deposit. Instead, the process depends on an auto-catalytic reaction to deposit a nickel coating on a substrate.

Electroless nickel plating has several advantages over electroplating:

- Since it does not use electric power, it's free from flux-density and power supply varation issues – providing an even deposit regardless of workpiece geometry.
- With the proper pre-plate catalyst, electroless nickel plating can deposit on non-conductive surfaces.
- There is great flexibility in plating volume and thickness.
- The process can plate recesses and blind holes with stable thickness.
- Chemical replenishment can be monitored automatically.
- Matte, semi-bright or bright finishes can be achieved.

Many of the above characteristics are ideal for the application that represents the majority of Tawas' electroless volume: the plating of a variety of close-tolerance, round pins used to locate and secure elements of differential gears and pinion shafts found in automotive rear ends, as well as in other powertrain and similar applications.

According to Al Alexander, Plant Manager, Tawas Plating Company, an important advantage of the electroless process is the relative ease with which it can be kept within tolerance. Alexander explains, "Basically, the key chemistry parameters we need to monitor are solution concentration, temperature, and time of workpiece immersion. The bath will just sit there,

LSM-9506

happily doing nothing until the catalyst is introduced – and since the catalyst is actually the workpiece itself, in a sense the process is self-regulating. As a result, electroless nickel plating provides a more even, uniform coating than could be possible with electrolytic plating wherein variations in current, flux density and workpiece shape result in coating variability."

And a stable process is critical to Tawas since the pins they plate require very tight tolerances on coating thickness, typically .00012" ± .00002", according to Alexander. The reason for the extreme tolerance is that the pins are press-fit into the components that receive them; too thick a coating and the pins won't fit, too thin a coating and they will move about and wear prematurely.

Luckily for Tawas Plating Company and for its customers, Alexander is a real

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metrology enthusiast – if not an actual "measurement freak." That is not surprising considering Alexander's original training as a machinist and the subsequent decades of his experience in the tool & die and precision fabrication fields.

Industry's relentless drive for quality improvement

As a Plant Manager who always carries both a micrometer and vernier calipers in his pockets, Alexander is the one Tawas Plating depends on to lead its Quality Team in addressing the ever tougher quality standards that automakers are imposing on their second- and third-tier suppliers. In Alexander's view, tightened standards are a good thing for everyone. He remarks, "I've seen the automotive industry take a huge jump in quality since the introduction of QS 9000 in the mid 90's – requiring uniform standards throughout the system – from third-tier suppliers right into final assembly at the automakers. Sure, it generated controversy, but in my opinion it also generated a ton of quality. It forced more efficient operation at every level, enabling both suppliers and the automakers themselves to focus on real problems and advancing the state of design and engineering, rather than having to always put out fires. As a result, American cars are now as good as or better than offshore competition. Hopefully this will contribute to the survival of the best of the domestic nameplates and to long-term viability for manufacturing here."

Advancing plating thickness measurement

Like other plating processes, electroless nickel plating "grows" deposit thickness over time. As the process progresses, plating measurements are taken regularly to determine when to pull the workpieces from the bath so as to fix the specified thickness. (It is easy to add material, not so easy to remove it.) In Tawas's process, sampling may occur as many as 14 times before a batch is to spec, so speed of measurement is a significant productivity factor.

Three years ago, Tawas decided to critically re-evaluate its plating thickness measurement methods because of its importance to overall process capability. There was room for improvement. Tawas had been using two methods for determining coating thickness. The first used a magnetic system that functioned by gaging the amount of "pull" it took to free a magnet from the sample workpiece and translating that value to an estimated plating thickness. The greater the pull (introduced by turning a dial connected to the magnet via a spring-linkage) the nearer together the magnet and the workpiece's ferrous substrate were estimated to be, and thus the thinner the plating. This technique had a number of drawbacks; it only provided a dimension for plating thickness on one side of the pin. Also, results were heavily influenced by the operators, no two of whom controlled the device in the same way. Some used their fingers to move the dial, others a thumb, and one used the erasure end of a pencil. As a result, gage R & R (repeatability and reproducibility) was approximately 30% – significantly more than the targeted value of 10 - 20%. This measurement approach required about 2 - 3 minutes per sample.

plating thickness inspection station with LSM-9506

The second plating thickness measuring method – a destructive technique – was used to verify the magnetic process. A cross section was cut from a sample plated pin. The section was then mounted, ground, polished and finally chemically etched for examination under a measuring microscope. This was time consuming, requiring about 20 minutes per sample. According to Alexander the approach was also unreliable with respect to R & R. He explains, "Micro-sectioning samples could be subjective because each operator would see the image differently thus locating the measuring reticule in different spots." There had to be a better way, but what?

Laser focus

Alexander had long been aware of the high performance of laser scanning micrometers – both from professional journals and show demos. So when an important customer asked Tawas to guarantee plating tolerance, Alexander decided the time had come to incorporate a laser scanning micrometer into his QC routine, selecting a Mitutoyo LSM-9506 unit to do the job.

Regarding the selection process, Alexander explains, "I asked reps from three laser micrometer manufacturers to demo their machines and run an R &R in my office. Mitutoyo offered the best performing machine-software combination and their rep was the most knowledgeable and cooperative.

The LSM-9506 is robust; Tawas has it installed on the production floor approximately 10 feet from the plating tanks. Sampling begins when a rubber-gloved hand pulls a specimen from the plating tank. The sample is loaded into a V-block fixture mounted on the laser micrometer's base. A window in the fixture allows the beam to scan the workpiece providing an OD measurement. This value is compared to the OD of a raw unplated piece (also established by the LSM-9506). The plating thickness is 1/2 the difference. Since the raw pieces are made of couponed, precision, centerless ground 8620 steel, and since the LSM-9506 has a resolution of .000002" (0.05µm), this scheme provides an efficient, highly repeatable method for monitoring plating deposition and keeping it well within tolerance.

The increased measurement performance of the LSM-9506 has enabled significantly improved process capability. Alexander explains, "We are plating to a tolerance of two-tenths, so a pin is going to have between four- and six-tenths of deposition. The closer I am to the middle of that value the more capable my process. With both the magnetic gage and optical micro-sectioning, I was using up the entire tolerance band. Now, with the LSM-9506 I can easily pick from six programs, each pre-set with a high and low range, enabling me to plate several different thicknesses at the same time while never using more than half-a-tenth for the entire tolerance." Alexander continues, "Once you plug parameters into the LSM-9506 you just depend on the unit's status indicator lights – if you're within 1/2 of a tenth you get green for go, red if you're out of tolerance. If the part reads green, we'll pull the racks. If it reads red/minus, we'll just keep the process running a little longer. It may take only an additional five-to-ten minutes to gain the deposition we need. If the reading is red/plus, well, we try not to let that happen. And the whole set-up is really fast, requiring only 8 seconds to measure a sample."

According to Alexander, the Mitutoyo LSM-9506 laser scanning micrometer easily integrated into Tawas' quality programs. He reports, "With our older methods of plating measurement, we had to enter readings into a PC on the floor, introducing a chance for error, especially when the operator was rushed. On the other hand, the LSM-9506 automatically records all measurement activity and provides easy access to the data via connectivity to our enterprise-wide SPC and QC systems." **M**

Electroless nickel plating: good chemistry

Electroless nickel plating is an auto-catalytic chemical technique used to deposit a layer of nickel- phosphorus or nickel- boron alloy on a solid work piece, such as metal or plastic. The process relies on the presence of a reducing agent, for example hydrated sodium hypophosphite, $NaPO2H2.H2O$., which reacts with the metal ions to deposit metal. Alloys with different percentages of phosphorus, ranging from 2 - 5 (low phosphorus) to up to 11 -14 (high phosphorus) are possible. The metallurgical properties of the alloys depend on the percentage of phosphorus.

For more information on Laser Scan Micrometers
visit www.mitutoyo.com

From the Field...

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Mike: Let's start with a description of how Sales Solutions operates: A typical scenario might begin when a customer comes to us – through a rep or maybe a rep and his distributor – when an application doesn't fit a standard, out-of-the-box Mitutoyo machine configuration. For example, the customer might want to incorporate automated loading/unloading of metrology equipment. That's when all parties to the process – the rep, distributor and customer – can look to Sales Solutions for a turnkey solution.

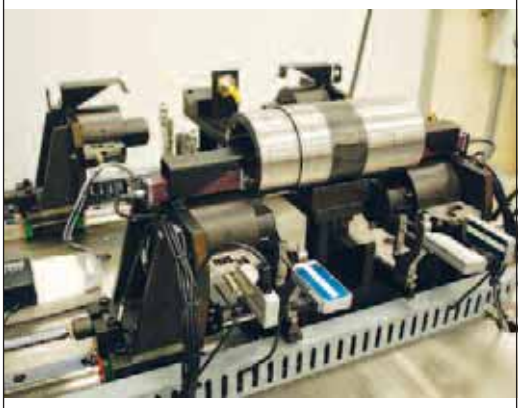
My specific role has to do with communications, logistics and project management. First I gather detailed information from the customer and the Sales group to tightly define project scope. Next I identify needed resources both internally as well as externally if necessary, for example sourcing robotics or fixturing. Then I coordinate engineering requirements with Ken while keeping all parties to the project apprised of progress.

Ken: My background is in EE with a focus on controls and automation and at Sales Solutions that's still my area. Often, the projects we develop involve crossing Mitutoyo product line categories – maybe integrating a surface finish machine and/or a vision system in to a customers automation plan, for example. A major part of the effort might be to get two very different machines to interface to a common control platform. I'd work closely with our Product Specialists and Application Engineers who are dedicated to each type of machine to make that happen. The net result is likely to be a unique solution never seen before.

Mike: And at Sales Solutions we have a new initiative to actively seek opportunities for innovation: In close coordination with sales reps, we're undertaking to actively cultivate customer relationships. We'll visit, walk the production floor with customers and dialog, asking, "Regarding your measurement routines, what do you wish you had that you don't have?" "What deficiencies do you see in your measurement processes or maybe in our equipment?" Once the conversation with the customer is going, we work with the sales group to see if new projects can be developed.

Ken: An example of this occurred when we were in a conversation with a heavy equipment manufacturer who revealed the intent to automate two, related gaging operations. Both measurements were performed sequentially on the same workpiece. The first was manual dimensional gaging, the second was surface finish gaging. Hearing this, we recommended a fully-custom solution utilizing a robotic loading system combining both measurement functions in to one gage, greatly improving accuracy and throughput. This freed up the operator to concentrate on production needs rather than constantly monitoring QC issues. By including an Industrial PC we could recognize hardware components with very little physical device configuration. Also, by utilizing our own MeasurLink® SPC software, we were able to streamline data collection for each measurement process and report it back to a central monitoring station via the customer's existing network.

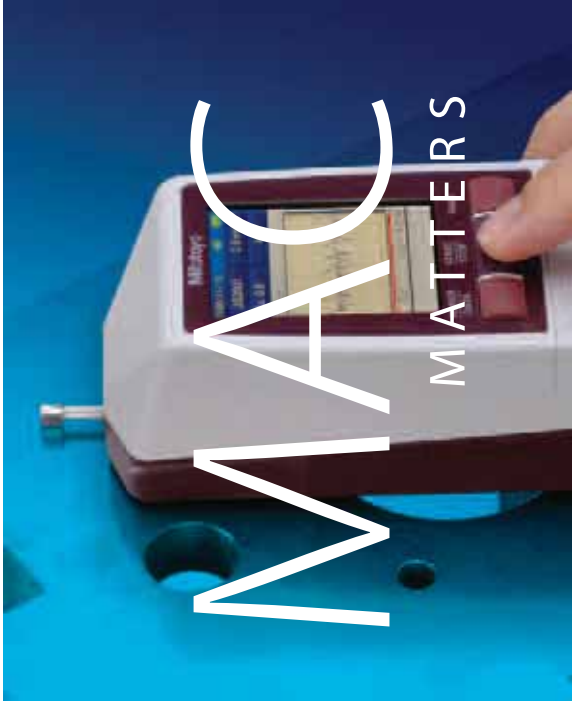
MAC Matters: OK...can you also give an example of how a "simpler" customer need might result in Sales Solutions involvement?



In-line Automatic Surface Finish and Dimensional Measurement System

Mike: Sometimes customers go to their sales reps stumped by circumstances unforeseen when they originally ordered a piece of equipment. For example, they might realize that they are not exactly sure how to hold a particular workpiece to get all the measurements needed. That's when the rep can call us. We'll help by designing a custom fixture or by steering the rep to a fixture design resource.

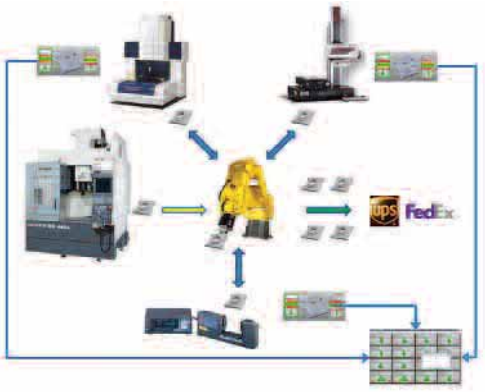
Ken: But if custom solutions – both big and small – are a major part of Sales Solutions charter, there's another part, polar opposite of "custom" that's equally important. That's when the customer-dialoging used in discovery of one-of-a-kind needs instead uncovers very common problems. Solutions to these common problems might constitute an advance to Best Practice with broad application for our entire customer base. And, if new products result, they might even find their way into our catalog.



MAC Matters: Could you briefly summarize Sales Solutions' raison d' etre?

Mike: I'd say that the purpose of Sales Solutions is to help expand the sales group's opportunities by enabling somewhat more difficult – or unusual –customer applications to be addressed quickly and effectively, thus adding value to Mitutoyo's offer.

Ken: That sounds good, Mike. I'd add that we're here to share solutions to eliminate the "reinventing the wheel" syndrome. Chances are we've probably already developed a solution something like the one needed right now! Just give us a call. **M**



Sales Solutions provides integration support for Mitutoyo's full line of measurement equipment

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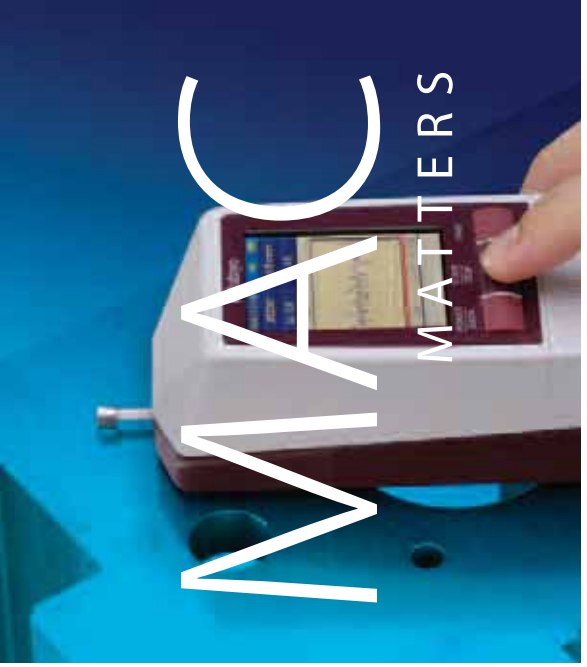

State of the Technology

Care of Hand-Held Measuring Tools

By Tony Portillo,
Applications Engineer, Mitutoyo America Corp.

The nature of QC measurement is continually changing in response to developments in CMMs and other technology laden metrology instruments. Nevertheless, the precision and repeatability of hand-held dimensional measuring tools – calipers, micrometers and gages – are still relied upon heavily throughout most of manufacturing. And as tolerances of manufactured parts become ever tighter, it is even more important that the accuracy of hand-held measuring tools be maintained – requiring the tools themselves to be cared for properly. The care of hand measuring tools is an extensive subject – this article provides a general overview of the topic.

There are two main categories of maintenance for hand measuring tools. The first is in response to everyday use and handling. (This assumes that the correct tool is selected in the first place – for example, making sure the IP or Ingress Protection Rating is suitable.) The second kind of maintenance is specified by formal, periodic and documented inspection and calibration routines. Calibration is most commonly performed in-house but many quality programs specify additional calibration at accredited labs. These labs provide calibration traceable to final standards such as NIST (National Institute of Standards and Technology).

Related to calibration is use of gage blocks – extremely precise artifacts with a care regimen all their own.

Everyday care

Misuse

The leading cause of damage to hand measuring tools is misuse. Though they may look simple, these tools are precision instruments capable of delivering high accuracy: typical dial and digital calipers can measure to a resolution of .0005 in. Calipers are prone to misuse; they usually possess ID jaws that come to very sharp points – thought by some to be ideal for ripping open boxes. (Fig. 1) This kind of misuse can put burrs on the jaws – maybe too small to see – yet capable of throwing jaws out of stated accuracy.

Micrometers are commonly misused in operation. Many micrometers include a ratchet-stop feature to assist in making proper workpiece contact by "slipping" to stop closure of the micrometer faces once proper contact is made. Nevertheless, some users vigorously torque the barrel even after the ratchet starts clicking; this may cause the spindle face to degrade as it is spun or "ground" into the workpiece. As a result, parallelism between spindle and anvil faces may be adversely affected, thus taking the micrometer out of stated accuracy.

Fig. 1 Precision-ground caliper ID jaw points (not a box cutter).

The most common mishap to affect any precision measuring tool's integrity is dropping. Any tool dropped to the floor – or shocked against hard machine tool or work surfaces – should be re-calibrated before it is used again.

Preventive care/storage

Preventive care begins with an assessment of the working environment. If measurement tools are used in a harsh environment, i.e., with coolant, mist, metal chips and debris, preventive care can be as simple as wiping tools clean before storage. Wiping down with Kimwipes impregnated tissues or with a lint-free tissue and denatured alcohol will remove whatever material may be deposited on the tool. This will prevent deposits from solidifying during storage so as to not inhibit free movement at next use.

Also, calipers and micrometers should be stored with jaw faces, spindles and anvils open, gapped slightly and not touching. This will prevent distortion that can result from the following phenomena: (1) Any increase in temperature will cause tools to expand, putting pressure on the touching surfaces, and (2) even with no rise in temperature, the slight pressure of continual contact itself can cause distortion.

It is important to note that to prevent corrosion, measurement tools should be stored at or near room temperature and at relatively low humidity. Gages with electronic display windows should be kept away from direct sunlight that can cause windows to fog. Also, monitoring the charge of batteries used in electronic measuring tools will prevent battery compartment corrosion that can be caused by spent batteries. In typical applications, battery life may be about two years. Removing batteries for extended tool storage (more than a year) is recommended.

Even with proper care, normal usage can cause wear, misalignment of moving parts and changes to pre-load tensions (such as found in dial caliper gear trains). Because of these factors, periodic calibration of tools is prudent even when no wear is evident.

Calibration

Calibration establishes the relationship between the measured value indicated by a measuring tool and the corresponding value for that same measurement as set forth by accepted standards. The results of calibration permit adjustment of the measurement tool so that it performs within a desired limit of accuracy.

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Care of Hand-Held Measuring Tools

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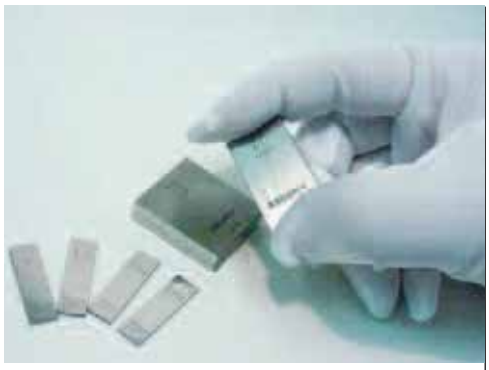

Fig. 2 Example gage blocks and use of white gloves

In-house calibration may be performed on newly-purchased tools, or as a result of re-adjustment needed for tools that may have been dropped or otherwise shocked, or in fulfillment of a calibration schedule that may be specified by a company's own standards and/or as stipulated by external standards (ISO).

Gage blocks

In-house calibration usually employs gage blocks – precisely manufactured of steel or ceramic– with dimensional tolerances that fall within known standards. A tool being calibrated is used to measure a gage block then the obtained value is compared to the known value of the block.

Gage blocks come in a wide variety of sizes and in sets ranging from half-a- dozen to more than a hundred. Different size blocks are stacked together to create the exact dimension required. When stacked, the blocks' visibly flat surfaces are rubbed or "wrung" together to eliminate any foreign matter, even air, that may lie between them. As a result of their extreme flatness, wrung gage blocks can get so close together that the molecules from one surface interact with molecules from the other, essentially welding the blocks together. Rarely, gage blocks left wrung together for extended periods are impossible to separate.

Care issues for gage blocks include wear, burring, and corrosion. Wear is caused by foreign matter contamination; some is airborne but most is deposited from the operator's hands in combination with oil from the fingers. Wearing white gloves counters this problem. (Fig. 2) Burring and scratches are caused when an edge from one block being wrung slips over and cuts into the other block. Care should be taken to avoid burring; damaged blocks should be removed and replaced as soon as possible. Corrosion can easily result from oil deposited from fingers; again, use of white gloves provides the solution. Additionally, corrosion can be prevented by assuring that gage blocks are always stored in their cases –at room temperature and humidity – and never stored wrung together.

In conclusion, the correct care and maintenance of hand-held measuring tools is well worth the effort. Properly cared for tools are more accurate, easier to use and offer extended service life – all factors that impact quality, productivity and the bottom line. M

For more information on Care of Hand-Held Measuring Tools
Contact your local M³ Solution Center Metrology Specialist

Next Up Course Schedule

Dimensional Metrology
(2 day)
June 8-9, Chicago
June 22-23, Los Angeles
July 20-21, Cincinnati
Aug. 17-18, Jackson
Sept. 21-22, Detroit
Oct. 5-6, Boston
Oct. 19-20, Chicago
Nov. 9-10, Charlotte

Integrated GD&T
(4 Day Course)
June 15-18, Chicago
June 29-July 2, Los Angeles
July 13-16, Cincinnati
Aug. 24-27, Jackson
Sept. 28-Oct. 1, Detroit
Oct. 19-22, Boston
Nov. 2-5, Chicago
Nov. 16-19, Charlotte

Hands-On Gage Calibration
(3 day)
Aug. 31-Sept. 2, Elk Grove
Oct. 26-28, Elk Grove

Gage Calibration Systems and Methods
June 10-11, Chicago
June 24-25, Los Angeles
July 22-23, Cincinnati
Aug. 19-20, Jackson
Sept. 23-24, Detroit
Oct. 7-8, Boston
Oct. 21-22, Chicago
Nov. 11-12, Charlotte

Estimating Measurement Uncertainty
(2 day)
July 27-28, Los Angeles
Oct. 26-27, Boston
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July 13-15, Booth 6246

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July 25-29, Booth 106

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