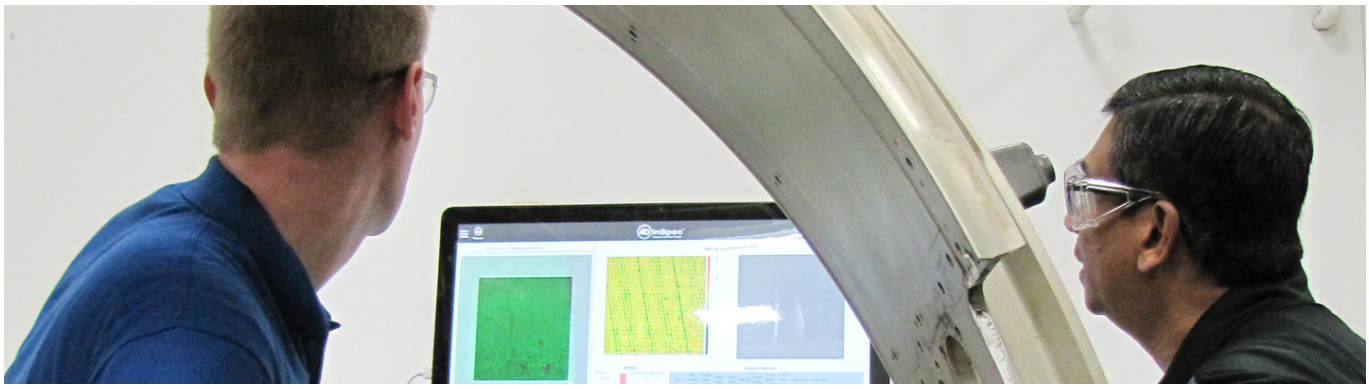

Machining

IMTS 2018: Metrology Innovation Helps Part Quality

Holly B. Martin | Aug 15, 2018

At this year's IMTS, part quality, the use of data and metrics' accuracy are getting a solo and a spotlight. We talked to Dr. Erik Novak of 4D Technology, who will be presenting at an IMTS 2018 conference session on measurement.

Metrology is important to incorporate into your quality plan. Metrology helps determine if a defect is cosmetic or functional, if the part can be repaired, or if it should be rejected–and to make a "disposition decision."

"In almost any industry, but particularly in aviation, the need for better surface metrology is being driven by a few different fronts," says Dr. Erik Novak, director of business development for 4D Technology Corp. "Customers are now demanding longer-lasting and better performing parts and products, for example, to meet increasing mileage standards."

According to Novak, if you can't measure it, essentially you can't manufacture it in today's modern society.

"Part drawings will include width, length and depth specifications for scratches, nicks and dents, and they'll also include specifications on maximum pit depth, if it's something that might have pockmarks or porosity," says Novak.

"Typically every part with a visible flaw or defect will get measured," he says.

"In industrial machine parts, we talk to a lot of shops who have parts rejected for cosmetic issues–even if it's a half-million-dollar complex machine part–because you don't know if it's just a scratch or if there's a crack underneath it," he says.

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Best Practices for Selecting Metrology Equipment

“For best practices in metrology, a manufacturer has to understand their process to be able to know when a part is good or bad,” says Erik Novak, director of business development for 4D Technology Corp.

“You need to know the depth, width, and in some cases, the volume of allowable defects–for example, how much of the area can be covered by corrosion pits,” he says.

“Assessing whether 10 percent of the area is corroded or 1 percent of the area is corroded might make the difference between throwing a part out, repairing the part or allowing the part to proceed without any intervention,” he says.

Understanding your process also includes knowing how much access you need to a product–do you need portability or do you want a microscope-based laboratory system?

Another point to consider when selecting equipment is the need for automation on a production or service line, because some metrology systems can be mounted on robotic arms.

Gauge Study

“One best practice that should happen before purchasing any measurement system is running a gauge study with the equipment they are considering purchasing,” says Novak.

“For this study, typically a shop will select 10 features of interest, such as defects or scratches, and measure those at least three times each with at least three different operators,” he says. “That way they can tell whether a feature measurement is repeatable with one operator and repeatable across operators, to really make sure your product can handle the range of what’s going to be thrown at it in their environment.”

Another best practice for choosing measurement equipment is determining which materials the equipment can work with, because surface texture and color can greatly affect the measurement process.

“A lot of manufacturing environments now are dealing with multiple materials that need to be measured,” says Novak. “For instance, an aircraft facility will deal with rubber, which is soft and black and squishy, carbon fiber composites, mirror-smooth metal, and sometimes cast iron, which is a very rough surface metal.”

Current Quality Control Techniques: Visual Comparison and Scribe Checks

"Despite the existence of quantitative metrology systems for more than a half-century now, the most common ways of qualifying parts on the shop floor still involve eyeballs and fingernails," says Novak. "People will use a comparison plate to look at a part and visually determine that a scratch is, say, 50 microns long or 1 micro inch deep."

Another common method for determining the size of a pit or groove is simply to run a fingernail across the defect for a more tactile feel, which can be highly subjective and vary from person to person. For somewhat greater accuracy, ***spherical probe scribes*** of different diameters can be scraped across a crack, to determine which size probe fits into the defect.

"When companies have done gauge studies to see how well those methods actually help them dispose of parts, they found that they're little better than guesswork and certainly not up to the tolerances placed on today's part drawings," says Novak.

"Particularly for things like aerospace, automotive and medical, an inspector will always err on the side of caution and reject or rework a part, rather than risk it going ahead with a defect," he says. "As a result, shops are rejecting literally millions of dollars' worth of good parts each year because they don't have a reliable way to quantify them."

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> Dr. Erik Novak
> Director of Business Development, 4D Technology Corp.

Metrology Labs

Some manufacturers invest in temperature- and vibration-controlled metrology labs, which contain microscope-based systems that can provide the three-dimensional data needed to make good part dispositions.

"These metrology labs have the resolution required, but they don't have ease of use," says Novak. "Because of all that sophistication, these are usually large desk-sized systems that can't be moved to the shop floor, and another challenge is that a large 8-foot part doesn't fit under a microscope," he says.

To measure a scratch or defect in such a large part requires making an impression mold of the defect, taking it to the lab, and measuring it under the microscope.

"The metrology lab might actually take a week or two in order to get a result back, and even then it's subject to how well the replication worked and other factors," says Novak. "These systems are expensive, difficult to use, and often require someone with a bachelor's degree or higher to operate, so they're not amenable to use on a production line or in a repair facility that needs to process parts quickly."

Lab-based ***metrology systems*** do have extremely high resolution, which is important for measurements on the nanometer scale, for example, in the semiconductor industry. For typical machine shop work, however, a hand-held, three-dimensional measurement tool that can be used on the shop floor provides two micrometers of resolution, which is enough to instantly determine whether the part passes or fails.

"Any delay just backs everything up," says Novak. "And of course with modern industry trends, manufacturers are under continual pressure to reduce time wherever they can in the process."

Novak is presenting "3-Dimensional Shop Floor Measurements To Improve Yield" on Thursday, Sept. 13, at the IMTS 2018 conference sessions. Registration is required.

Other *IMTS 2018 conference sessions* on metrology include:

Tuesday, Sept. 11:

"*How 'Walk-Up Metrology' Offers QC Versatility from Manual One-Feature Measurements to Semi-Automated Multi-Dimensional Testing*" by Mark G. Arenal, general manager, Starrett Kinemetric Engineering

"*Tying It All Together: The Crucial Impact of Traceability in the IIOT*" by Dave Sweet, president, MECCO

Wednesday, Sept. 12:

"*Digitalization in Machine Tool Manufacturing – You're Closer Than You May Think*" by Ramona Schindler, business development manager, Ramona Schindler

How does your shop evaluate part quality and accuracy? Share your stories.

