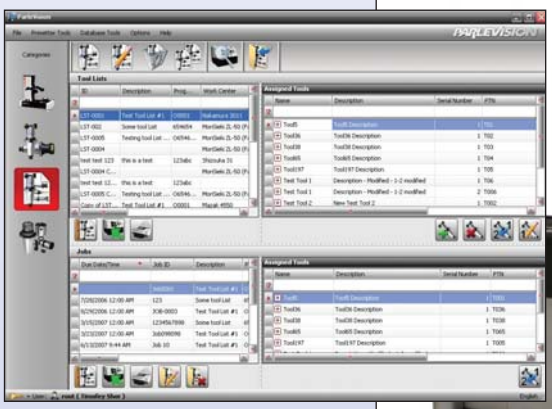
QC for Automotive Tooling



Series 2500 Parsetter with touch-screen technology by Parlec.

Advancements in tool presetting and tool monitoring systems are meeting the demands of OEMs and their parts suppliers

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Contributing Editor

When it comes to machining the engine blocks, heads, cams, pistons, injectors, and valves found in cars rolling off assembly lines worldwide, car makers are driving aggressively toward JIT tooling, faster changeovers, and the virtual elimination of bad parts. And suppliers of tool presetters, on-machine probing systems, and laser systems are providing advanced equipment offerings, custom software solutions and application engineering assistance designed to achieve these goals like never before.

"The level of support that we need to provide from an application engineering standpoint is much higher today in the automotive market," says Christopher Nuccitelli, product manager—TMM Tool Measuring and Inspection Systems for Parlec Inc. (Fairport, NY). Increasingly, he says, automotive OEMs and their Tier 1 suppliers—which represent about half of Parlec's automotive business—are providing Parlec with all the tooling specifications for a project and a directive to develop everything that is needed to support the measuring and inspection of the tooling for those lines.

"The ability to provide this support to our automotive customers (about 20% of the company's business) is one of our specialties," says Nuccitelli. Parlec recently employed those capabilities for a new engine block-line at the General Motors plant in Tonawanda, NY, where seven of the Series 2500 TMM automated presetters are in place.

Parlec engineers, says Nuccitelli, designed quick-change tooling adapters that go into the presetters, allowing GM to rapidly change out and measure all the tooling required on the line. Further, Parlec engineers designed the automation programs that measure and inspect the tools. "All the tool adapters are color-coded, and the automation system works together with touch-screen technology so the operator can go in and

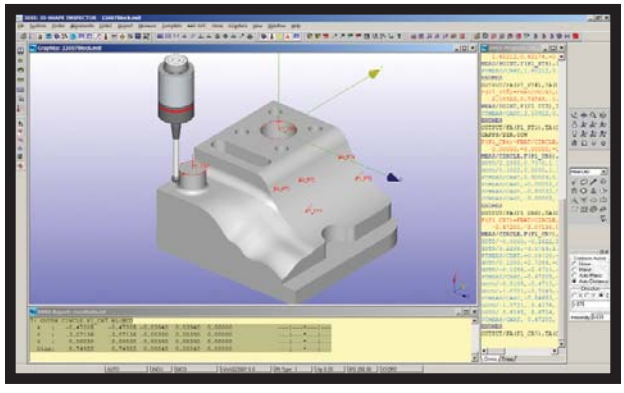
measure the tools at high volume with little error, resulting in high throughput," says Nuccitelli.

Another area in which Parlec focuses its resources is imaging technology. While other presetters use existing camera technologies provided by well-known electronics companies, Nuccitelli says Parlec has designed its own imaging system.

"This represents the biggest R&D effort in the history of our company," he explains. "We wanted to utilize the latest CMOS megapixel chip technology and the latest lens designs, and we wanted complete control over that technology." That control was achieved by working closely with imaging and optical engineering firms in Rochester, NY, home to Kodak, Xerox and Bausch and Lomb.

Parlec's ParleVision imaging system is found in both its high-end automated presetters and its newly introduced Series 1500 Parsetter benchtop tool presetters, which accomplish the same precision presetting, measuring and inspection, but without the automation.

But when repeatability of 1 or 2 µm is required, "that's when we suggest to the customer that it gets into some type of automation and power clamping," says Nuccitelli, citing as an example porting tools, which have multiple cutting edges that require a profile analysis of the porting tool. Conversely, he says, tools with more basic geometries don't necessarily require such a high level of automation.



The 3D Shape Inspector program from Marposs can be used as a direct TCP/IP or DNC interface on a CNC-integrated PC or offline by creating probing programs on an external PC. An intuitive graphical interface and various automated cycles simplify and speed programming of calibration, part measuring, and geometric body-measuring cycles.

Nuccitelli also sees a great movement toward systems that can be easily integrated, and systems where the CAM system, machine tool controls, and presetters are all sharing the same set of data. "We're partnering with the machine-tool builders and the makers of CAM software, so we can ensure that our customers can implement an integrated system and easily interface with all their stored data."

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Nuccitelli also would like to see makers of presetters partnering with suppliers of on-machine probing systems. "That," he says, "would give customers the best of both worlds: the breakage detection and in-cycle compensation of on machine monitoring, and the inspection and off-line measuring capabilities of presetters.

At Blum Laser Measuring Technology (LMT) Inc. (Erlanger, NY), software drives the application of laser systems that are used for tool measurement and broken-tool detection within the world of car manufacturing.

"Due to the high-production requirements in automotive manufacturing, the machine tools are extremely polluted because of the coolant and chips flying around, all of which can disturb the laser beam," says Paul Meinhardt, general manager. "So we developed software that effectively deals with the coolant and chips, allowing the systems to differentiate between the coolant, chips, and tools."

These advancements are found in Blum's LaserConrol NT (New Technology) systems, which allow the user to position the receiver in the laser beam so that within 1.5 sec, says Meinhardt, "it will be determined whether there is excessive runout, or if the tool is within the specified tolerances."

Meinhardt adds that within the past five years, laser systems have achieved an approximate 50% market share in automotive applications, and that the company continues to advance its line of touch probes for locating and measurement, and bore gages used in machining centers and flexible manufacturing cells.

"Software is turning into an important measuring and monitoring tool," says Sharad Mundra, Mida Probing product manager at Marposs Corp. (Auburn Hills, MI). Mundra remembers when equipment makers would sell customers their probing and laser systems, and leave it to the customer to determine how to apply the systems.

Now, Mundra says, automotive customers and their Tier 1 and Tier 2 suppliers want and need more as they run leaner with fewer engineers. "We're continually investing in R&D to stay on top of the trends impacting our cus-

tomers," says Gary Sicheneder, who manages new business development at Marposs. The company's recent introduction of the 3D Shape Inspector (3DSI) serves as a good example. Combined with Mida probing systems, the 3D shape inspection software provides on-machine checking of part shape and dimensions, which allows immediate reworking of out-of-tolerance measurements.

Wireless technology is another area where Marposs is focusing resources. A year ago the company's Testar division introduced the M1 Wave wireless bore gauge. It includes a standard EBG plug gauge that is directly connected to a special handle housing a Bluetooth transmitter and batteries. Real-time measurement values are displayed on the receiving electronic unit. Measurement data can be transmitted and stored as desired.

Marposs believes that there will be a continued shift toward wireless, as it affords operators the freedom to work and perform inspections without the movement limitations associated with wired systems.

"We have an installation where we're monitoring 175 CNC machines with three presetters," says Alexander Zoller, vice president of Zoller Inc. (Ann Arbor, MI), maker of the Zoller tool presetting, measurement and inspection product line. "Everything is connected to our tool management system and presetter. Based on a warning limit and tool requirement list, replacement tools will be delivered just in time to the CNC machines.

"Because the customer can track the status of the tooling, he only needs to keep the minimum supply on hand. Additionally, incoming inspection control for new tools can be performed, and only tools with confirmed accuracy and tolerance will be accepted," says Zoller. "When the equipment is combined with a tool ID system, we're able to monitor and track tool life to ensure greater manufacturing efficiencies."

"As the machine tool market has evolved to further CNC technology, we have advanced and adapted our systems to work on CNC machines," says Steve Cvetan of Techna-Tool Inc. (Hartland, WI). "In the past, rotary and inline transfer systems were the bulk of the machines we worked with. Today, those have been reduced to 30% of our business, with the remainder being CNC."

Techna-Tool's BK Mikro 8 systems can learn up to 128 different tool lengths using Profibus software. Once the positions are learned, the machine can verify that the tool is not broken or misloaded.

While Cvetan says on-machine monitoring is critical for automotive customers, there are still many instances where the OEM may fail to recognize the need for on-machine monitoring, choosing instead to rely on the vendor to always provide what the OEM needs. In other situations, he says, the OEM may believe that it will be successful with the various products that it has engineered and included on its system.

Cvetan expects to see more in the way of digital systems and wireless communications. "Today, with the advancement of integrated CNC transfer machines, we can handle up to 20 machine tools with a single monitoring system."

Zoller's Venturion 600 tool presetter and measuring machine with pilot 3.0 image processing software.

"Automotive is becoming more like other manufacturing environments as it moves to more flexible machine tools with capabilities for fast changeovers and continuous improvement," says Barry Rogers of Renishaw Inc. (Hoffman Estates, IL).

Advancements such as Renishaw's strain gage technology, he says, are helping customers improve accuracy. Strain gage technology allows the probe to trigger at much lower and highly consistent contact forces, using longer styli with little measurement degradation for part accessibility. The OMP400, for example, provides accuracy and repeatability of ¼ µm, "which exceeds the inherent accuracy and repeatability of the machine tool itself," says Rogers.

While US automakers are reluctant to talk about applications that give them competitive advantages, Rogers cites a success at a Nissan engine plant in Sunderland, UK. Nissan engineer Simon Edwards says that at the plant "a new camshaft process replaced two dedicated camshaft lines to form one flexible line. It occupies half the floor space of the two originals while maintaining the same output."

Critical to the success of the Nissan line is the application of turret-mounted probes made by Renishaw that are used for part set-up and post-machining inspection. The system's

implementation didn't happen without resistance from some of the plant's machine operators and other engineers, recalls Edwards, "they did not want machine time spent on what they saw as measuring operations. The common feedback was that 'machines are there to cut metal, not measure.'"

Today, however, after two million parts produced, Edwards says: "To my knowledge, as a result of this process there has never xbeen a scrap component on these machines."

Rogers says his firm has for a long while provided both optical and radio transmission probes for wireless installation. "Now we are the first to offer radio probes with frequency-hopping capability to avoid interference from other radio frequencies or wireless systems on the plant floor," he says, referencing the company's newly introduced RMP60 machine tool probe.

"The need for tool presetting and measuring systems in the automotive market is amplified due to the number of operations and the rhythms that are typical of the automotive market," says Richard E. McCarthy, Sr., BIG Kaiser Precision Tooling Inc. (Elk Grove Village, IL). He says that as automotive companies approach new projects—manufacturing plants for new engines, transmissions, gear boxes, etc.—they're looking to equipment suppliers for turnkey solutions to manufacturing challenges.

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McCarthy cites several examples of recent equipment advances from his company that are intended to assist automobile makers and their tier suppliers. "One is our all-in-one tool presetting, measuring and shrink fit system and the second is a tool presetting and measuring system for measuring turn-broaching tools."

Shrink fit technology was already available on the market, but it had never been implemented by automotive in a full-scale way, according to McCarthy. "The main reasons were the time it took to shrink a tool correctly, the safety issues, and the very large number of tools a system had to set on each shift." The company provide what it claims to be the "first-ever" combination shrink-fit system and tool presetter all-in-one package, a solution now in its third generation.

As for the second system, it permits automatic measuring of large turn— broaching tools. "These tools are used in the manufacturing of crankshafts; before our system, this operation took more than two shifts, without any means of knowing if the tool had been set correctly," says McCarthy, "or even if all of the inserts had been put on the cutter. Today our turn broaching application inspects the largest of these tools completely and automatically. It guides the operator in the replacement of worn and out-of-tolerance inserts, and gives an inspection report on the hole operation; a definite advantage in improving.

"Most of our attention in automotive," continues McCarthy, "is geared towards the improvement of our vision system in order to better detect tool ware and to allow our customers to constantly improve their end product quality while reducing their cost of manufacturing."

Other key areas, he observes, "are the role of tool management and the full integration of our systems with the existing environment to present as much data as possible to make educated decisions, which are based on hard facts and not theory."

What it all comes down to is this, says Preben Hansen, vice president of Lyndex-Nikken (Mundelein, IL): "The automotive market is focused on decreasing the price per part while maintaining high quality and high-volume production of parts. Without a presetter, the time spent setting up tools means more hours of lost machine availability and therefore lower profits."

Lyndex-Nikken presetters by Elbo Controlli, says Hansen, now include an exclusive Twinvision camera system with both inspection and measurement functions. The system uses a CMOS (complementary metal oxide semiconductor) image sensor, rather than a conventional CCD (charge coupled device) camera.

One of Lyndex-Nikken's newest Twinvision-equipped presetters by Elbo Controlli is the E-450. The movement accuracy of both *X* and *Z* axes is achieved through the use of stable granite supporting surfaces. The spindle body on the E-450's machine base limits run-out error to less than 2 µm. A radial rotation spindle brake eliminates the error of rotational axis misalignment.

The optical scales of the E-450 detect interference produced by part movement through the use of a glass ruler attached to the fixed part of the machine. Each optical scale has a resolution of 1µm. The E-450 incorporates a double system of prismatic rails for *X*-axis movement with three double recirculating ball-bearing sliding blocks, and a monorail with one sliding block for the *Z*-axis. Axis movements for the E-450 include manual rapid and manual micrometric adjustments. The maximum measuring diameter of the E-450 is 400 mm (radius 200 mm) and the maximum measuring height is 500 mm.

Hansen says the company also will announce a new line of presetters at EMO that will feature next generation software at EMO Hanover, Sept. 17–22. ■