

## Nelson Engineering

### ADDS HIGH-SPEED MEASUREMENT

Nelson Engineering Inc. in Garden Grove, CA, added flexibility, brought its gear inspection in-house and improved manufacturing throughput with the purchase of one precision CMM.

**N**elson Engineering operates a Pfauter P400 5-axis CNC gear hobbing machine and a Reishauer RZ-301S gear grinding machine. Part of the company's continuing production improvement program included the installation of a Brown and Sharpe PMM-C 700 high speed precision coordinate measuring machine. The machine was purchased specifically to inspect gears, but its flexibility has allowed the company to expand its use.

In the past, Nelson Engineering had relied on contract inspection services to handle gear inspection. They had inspected prismatic parts using hand-held instruments and an older CMM.

"Installing the PMM-C was part of a larger project to bring all of our gear capabilities in-house," says Adam Nelson, Nelson Engineering's general manager. "When we purchased the PMM-C, we also purchased a Reishauer RZ-301S CNC gear grinding machine and an additional gear hobber."



Nelson added that the company had initially looked at a dedicated gear checking machine. "For the money, the CMM was a better investment for us," he says. "The PMM-C can check gears with an extremely high degree of accuracy, plus it has the size and measuring range that allows us to inspect our prismatic parts as well."

The PMM-C has a volumetric accuracy of  $E = 0.6 + L / 600$  [ $\mu\text{m}$ ], a travel speed of 400 mm/s and acceleration of 3,000 mm/s<sup>2</sup>. Its 1,200 mm X 1,000 mm X 700 mm measuring range accommodates virtually all of the parts machined by Nelson Engineering.

"We produce gears to AGMA 13 quality, but the PMM-C allows us to inspect beyond AGMA 15. We inspect our prismatic parts to  $\pm 0.0001$ ", well within the capabilities of the PMM-C," Nelson says.

#### Controlling the Machining Process

The PMM-C is installed in a dedicated, environmentally controlled inspection room near the production floor. Operators bring a machined piece to an inspector in the room, where an inspection routine is run on the part. The dimensional data is used in process control.

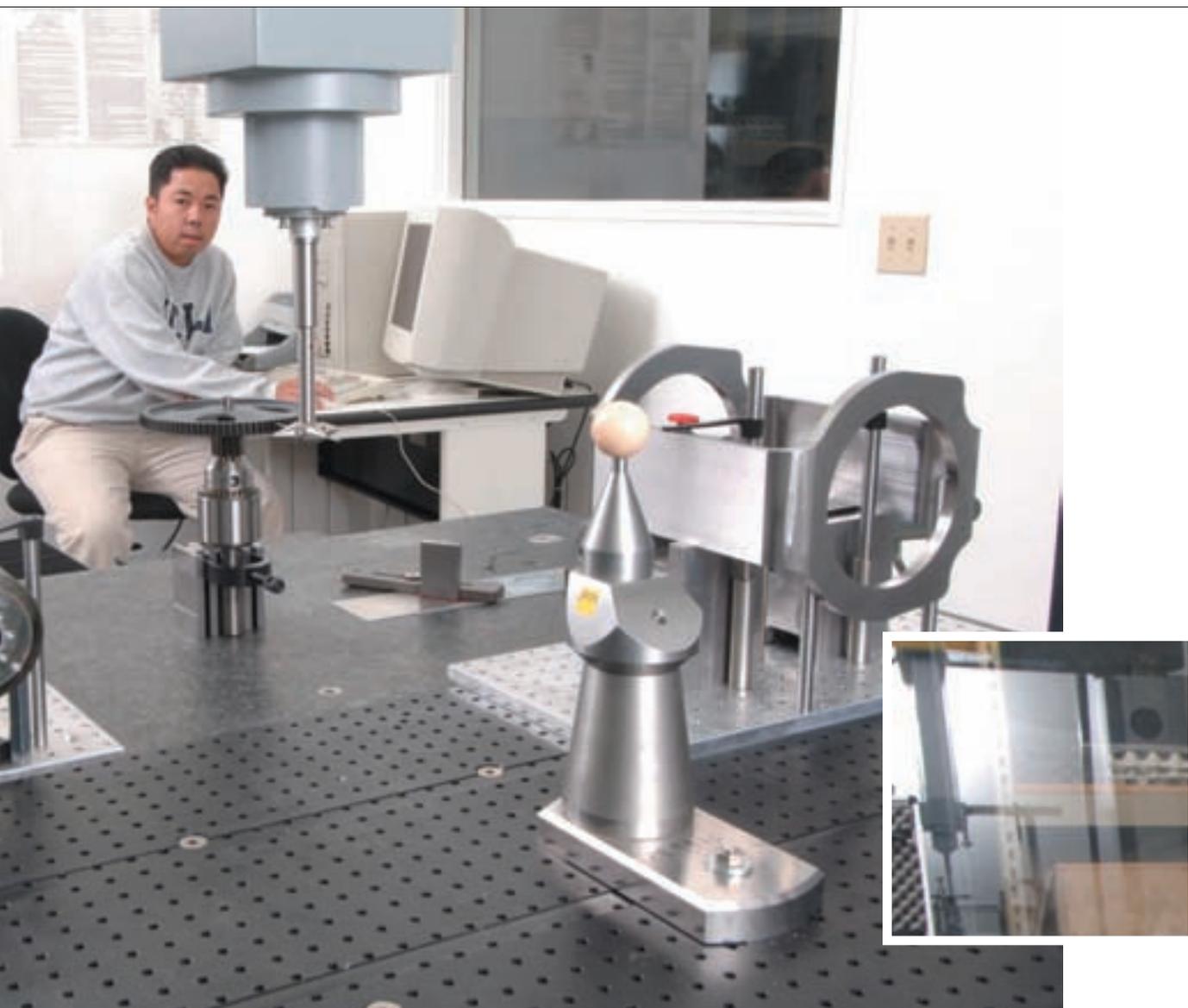
"When we're developing gear tooth profiles, we go through a constant series of iterations, fine honing the lead and involute until we get them within specification," says Harold Wagner,

chief engineer. "From that point on, it's simply a matter of spot checking for the operator. We also re-qualify the part every time we re-dress the grinding wheel."

The addition of the PMM-C coordinate measuring machine has significantly improved inspection throughput at Nelson Engineering. A typical button-to-button check on a gear takes approximately 10 minutes. The result is that critical process control information can be quickly communicated to the shop floor, reducing scrap and rework.

For final inspection, the company rou-





tinely sets up 20–30 gears on the PMM-C, runs the software in a loop, and operates the CMM unmanned all night.

“We thought that we needed a dedicated gear checking machine to achieve reasonably fast inspection times,” Nelson says. “That turned out not to be true.”

#### No Rotary Table

The PMM-C at Nelson Engineering is equipped with both QUINDOS and PC-DMIS measurement and inspection software. Operators use QUINDOS, with its dedicated gear package, to inspect gears. PC-

DMIS software is used to inspect prismatic parts.

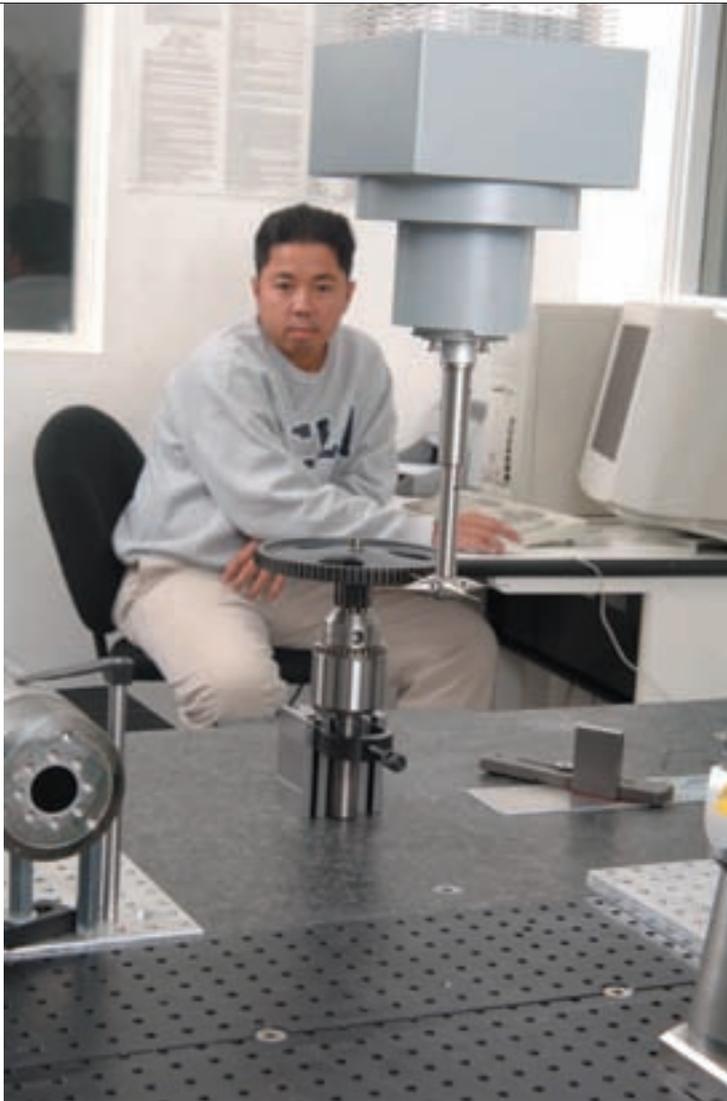
The PMM-C and the gear package of the QUINDOS software program offer the capability to inspect gears without the need for a rotary table.

“Traditional thinking is that you have to have a rotary indexing capability to inspect gears,” Wagner says. “A rotary table is a significant added equipment cost, and we found that the PMM-C and QUINDOS software provided extremely reliable, repeatable and highly accurate inspection at a more reasonable investment.”

Both software programs provide

Nelson Engineering with the capability to generate reports. The QUINDOS gear package allows the company to replicate the same types of charts, such as redline charts, that are available with dedicated gear inspection machines. Those charts, and other reports, are added to the quality documentation shipped with the parts. “This is a plus with our customers,” Nelson adds.

Both QUINDOS and PC-DMIS software allow for offline programming. “We create our part programs directly from CAD models using the offline programming capability,” Nelson says. “This allows us to keep the PMM-C measuring parts, which is the value-



are for aerospace, aircraft and defense systems; the automotive aftermarket; and the electronic and biomedical industries.

The company offers a range of CNC milling, turning and grinding services, producing landing gear pistons, axle sockets, hydraulic actuators, small precision fittings and airframe components. Nelson Engineering is a Boeing BQMS D-682479 approved supplier and is ISO 9002 and ANSI/ASQS Q9002 compliant. The company has also been licensed by the Federal Aviation Administration to perform maintenance, repair and overhaul on commercial airline assemblies.

The company is poised for future growth. Its combined precision machining capability and certified quality control and quality assurance programs have positioned the company to take advantage of opportunities in a growing economy.

“Quality is our single biggest asset,” Nelson says. ■

#### **For more information:**

Nelson Engineering Inc.  
11600 Monarch St.  
Garden Grove, CA 92841  
Phone: (714) 893-7999  
Fax: (714) 895-5750  
E-mail: [sales@nel-eng.com](mailto:sales@nel-eng.com)  
Internet: [www.nel-eng.com](http://www.nel-eng.com)

Hexagon Metrology  
200 Frenchtown Rd.  
North Kingstown, RI 02852-1700  
Phone: (800) 766-4673  
Fax: (401) 886-2727  
Internet: [www.hexagon-metrology.us](http://www.hexagon-metrology.us)



added aspect of its operation.”

#### **Data Gathering Flexibility**

The PMM-C features the Leitz Scanning Probe (LSP) system with three ultra-precise probe modes. The discrete, single-point mode offers high precision for simple geometric dimensions. The self-centering mode automatically determines the precise center and the high/low points of symmetrical features, such as grooves, slots and gear teeth. In the scanning modes, the probe can automatically scan known and unknown convoluted surfaces at speeds of 25 mm/s with high point density for increased accuracy during form evaluations.

Nelson Engineering has started to use the scanning capabilities of the PMM-C for form grinding analysis. “By collecting a large number of data points using the scanning capabilities of the PMM-C, we have at our disposal the dimensional data that helps us more quickly and efficiently develop master gears,” Wagner says.

#### **Nelson Engineering and its Future**

Nelson Engineering, founded in 1987, specializes in precision CNC machining; gear grinding and hobbing; cylindrical, form and thread grinding; and finished assembled products. Its processes and products