Roundness measurement system enhances company capabilities

John Thielman, apprentice inspector, performs runout and roundness measurements on an industrial floor scrubber shaft using the Carl Zeiss/TSK Rondcom 60 inspection system

The rotating worktable enables operators to perform complex measurements.

In the industrial heartland of mid-America, a small, family-owned machine shop achieves international reach by manufacturing precision parts for the aerospace and vacuum pump industries. C&S Machine Products (Buchanan, Mich.), differentiates itself from its competitors by implementing state-of-the-art technology into its manufacturing processes.

C&S manufactures hydraulic spool and sleeve assemblies for Boeing, Parker Hannifin and the U.S. military, as well as shafts and pistons for the vacuum pump industry. The company owes its success to teamwork. Everyone, from the engineers who draft designs, to the machine operators who grind the parts, to the president who consults with all of them, collaborates on finding ways to make quality parts the best way possible.

Finding solutions

C&S Machine Products was founded in 1966 by President Joseph Saratore and Harley Cole to make prototype parts for the Bendix Corporation/ Lakeshore Division and has grown into one of the leading manufacturers in precision machining.

Dominick Saratore, vice president, is following in his father's footsteps by working to help the company take on complex machining projects. "We specialize in incorporating a wide range of high-precision CNC turning, milling, grinding and drilling, using all these pieces to manufacture complete parts for our customers," he said. "We work hard to ensure that critical machining operations are accurate."

For example, a match-fit spool and sleeve set can have clearances as small as 80 millionths (.000008) of an inch. As tolerances became tighter, the manufacturing capability of C&S began to surpass its inspection capabilities. "We were going past our

envelope," Saratore explained. "It made perfect sense to find a reliable way to measure our machining capabilities."

To accurately measure close tolerances in machined work, C&S installed the TSK Rondcom 60A measuring machine.

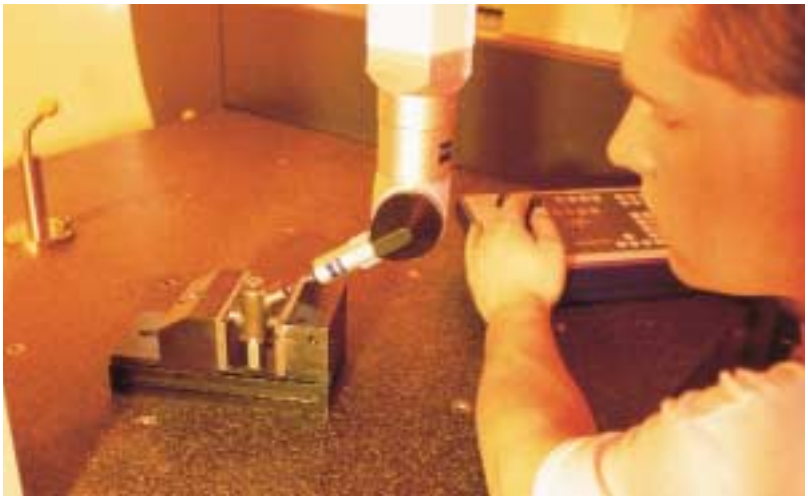
The Rondcom measures runout from a diameter to a shoulder on inlet shafts used in dry vacuum pumps, which require tolerances as tight as .00019. Because the parts use no lubrication, the machining accuracy must be superior.

"We do our best work in the tighter tolerances and now we can measure them," Saratore said. "When a customer has a product that is a problem part and difficult for others to make, those seem to be the projects where we shine with the most."

In addition to measuring straightness in both the R (radius) and Z (diagonal) axes, the Rondcom measures concentricity, coaxiality and cylindricity.

- Concentricity: measuring the inside (ID) and outside diameter (OD) of a sleeve at the same height in the Z axis—to find a common center.
- Coaxiality: measuring separate circles near the bottom and top of a datum hole. Software establishes a datum axis based on the two center points of these IDs. Operators then determine the center point of the OD, which is compared to the datum axis.
- Cylindricity: all points of a surface are equally distant from a common axis. A cylindricity tolerance defines a zone, (bounded by two concentric cylinders) in which the surface must lie. This tolerance applies to the entire surface, including both circular and longitudinal elements.

C&S also uses the Rondcom to evaluate and enhance manufacturing processes. "By checking incremental machining



The RDS probe reaches virtually every spatial angle on a complex aerospace body valve. Apprentice Inspector John Thielmann uses the RDS probe to find the intersection of the angled cylinder's center line to its bottom surface.

steps, we've been able to fine-tune our manufacturing capabilities," Saratore said. "We use it as a tool to deal with measuring millionths of an inch, which actually means something to us today. Before having the Rondcom, 10, 20 or even 30 millionths were immeasurable amounts."

Saratore is pleased with the Rondcom and said the system is doing more than he anticipated. "We purchased the machine to perform cylindricity and roundness measurements, then learned how to check a runout tolerance on a shaft shoulder."

"Previously, a customer would check a part and occasionally say it was out of tolerance," Saratore said. "We now know our parts are accurate and we can prove it." The Rondcom runout feature ensures part accuracy.

A rotating worktable on the Rondcom features automatic centering and leveling for minimal set-up time. According to Saratore, there is no comparison between the amount of time it takes to set up a part for manual inspection and the Rondcom. "On the Rondcom an operator places the part on the worktable and the software automatically centers and levels the part for inspection," he said. "There's virtually no set-up time required."

Prior to the Rondcom, operators used dial indicators and V-blocks to perform runout measurements, which can require years of experience to perform effectively. Using this manual method, if the dial on the indicator didn't move, the result was used to prove accurate machining.

Future looks good

Based on his satisfaction with the Rondcom, Saratore purchased a Zeiss Eclipse coordinate measuring machine (CMM) with an RDS (Rotating Dynamic Sensor) probe and Calypso software. He is working to incorporate the CMM more into the day-to-day inspection operations at C&S. The company had an older manual CMM that operators used to conduct part inspections. However, it couldn't repeat results satisfactorily.

"We have a lot of repetitive parts we'd like to set up with fixturing and have the Calypso software programmed to perform automatic inspections," Saratore said. "Having an unattended inspector frees up an employee's time for other tasks."

Calypso offers intuitive operation with CAD technologies. C&S operators import CAD model files to create inspection programs and use the reverse engineering capability of Calypso to obtain specifications directly from a part profile.

The Eclipse with Calypso played a big role in the C&S purchase decision since the entire shop runs on the Windows NT platform. "All of our operators know the platform," Saratore said. "They're comfortable with it."

The Eclipse RDS probe head is an added convenient feature. RDS probe technology enables the Eclipse CMM to measure virtually all characteristics of a part with one probe and one set-up. With two axes of (+/-) 180° rotation, the probe makes it possible to reach nearly every spatial angle on some of our more complex parts by allowing more than 20,000 discrete positions.

Thanks to the help from Zeiss products, Saratore believes C&S is success-bound. "We use the best tools available on the market today at C&S," he said. "We want our customers and our competitors to know we want to be the best high precision machine shop." •