Metalworking

How High-Tech CMMs Streamline Equipment Form and Function

Kip Hanson | May 28, 2024

The coordinate measuring machine, or CMM, is a device that accurately measures nearly every dimension of machined and fabricated components that a manufacturer might need to know.

That long list of characteristics includes length, width and height, circular profiles and freeform surfaces, geometric values like parallelism, perpendicularity and true position, feature locations and much more.

The aerospace industry depends on CMMs to measure turbine blades, landing gear components and everything in between.

The fine fit of the door panels on the family car, for instance, would be impossible without CMMs, as would the engines that send them safely down the highway at the posted speed limit.

Medical parts, hardware store widgets, ***semiconductors and the machines that make them***—none would exist in their current forms without CMMs.

Simply put, they are indispensable to the manufacturing industry.

CMM Pioneers

There's general disagreement as to who invented the CMM. Some suggest it was the now-defunct Ferranti Co. of Scotland, which reportedly built a 2-axis CMM soon after World War II.

Others say it was the well-known Sheffield Corp., makers of fine gages and long since acquired by machine builder Giddings & Lewis (and then ***spun off*** into a stand-alone business unit under Hexagon ownership).

Still others claim it was the Italian company DEA, also part of Hexagon following its acquisition of Brown & Sharpe Metrology Group, which ***purchased*** the CMM maker in 1994.

Then there's Mitutoyo, which began offering 2D models in 1968 and is today one of the largest

manufacturers of metrology equipment in the world, CMMs included.

For nearly eight decades, CMMs have been a valuable commodity for machine shops, sheet metal fabricators, tool and die makers and other manufacturers, and they are growing more important with each passing year.

CMM Types: The Fab Four

Regardless of who takes bragging rights for their discovery, four distinct styles of CMMs exist today—bridge, gantry, cantilever and horizontal arm. Gene Hancz, CMM product manager at Mitutoyo America Corp., offers an overview:

- **Bridge:** If you work in a job shop making parts smaller than a suitcase, chances are excellent that you have a bridge-style CMM in the inspection room. Two types are available—fixed table (the most common) and moving table—with the latter generally being more accurate due to the separation of the X and Y axes. Both have a vertical, Z-axis head attached to the bridge, on which various contact and non-contact measuring probes can be attached.
- **Gantry:** Resembling a gantry-style machining center, these are basically larger versions of a fixed-table bridge CMM, although the largest sometimes have multiple vertical beams for added stability. On smaller machines, the table might be made of granite, although high-quality ductile cast iron is more common. Either way, gantry CMMs are designed to accommodate very large, heavy parts like those found in the aerospace and energy industries.
- **Cantilever:** Open on three sides to allow easy access, cantilever CMMs like Mitutoyo's ***MiSTAR 555*** are increasingly found on the production floor. They are compact, shop-hardened and easy to use. Some (like the MiSTAR) have multiple "accuracy statements" that allow operators to compensate for fluctuating temperatures. Hancz notes that fully 40 percent of all new CMMs sold at Mitutoyo are intended for the shop floor, although he's quick to point out that, assuming the temperatures are fairly stable and the air quality good, some shops opt for one of the company's ***CRYSTA-Apex*** line of standard bridge CMMs.
- **Horizontal arm:** Walk into an automobile manufacturer and you might see a horizontal-arm CMM used at the end of the production line. As the name suggests, these have one or more horizontal arms that extend from a fixed column or that move along a track, allowing manufacturers to perform workpiece measurements from above or the side. The ***CARBstrato*** CNC CMM, a car body measuring system from Mitutoyo, is one well-known example.

The inclusion of CNC in the product's name is significant, since automatic control is becoming an increasingly important aspect of CMMs. "We discontinued manufacturing manual CMMs about three years ago," says Hancz, a statement that holds true for many CMM builders today.

As with any machine tool, automatic CMMs are more accurate and more productive than their manual counterparts. Yes, programming is required, although the task is growing easier by the day.

Hancz notes that many customers simply import a 3D model of the workpiece, select the CMM and the sensor system to be used, and let the software take care of the heavy lifting.

"Provided there's GD&T [geometric dimensioning and tolerancing] information in the CAD file, the programming is largely automatic," he explains.

Sensor selection is similarly important. Trigger probes and probe heads like the ***Renishaw*** PH10 are quite common, although Mitutoyo and other CMM providers offer a host of non-contact laser- and camera-based scanning systems, surface roughness attachments and high-speed and 5-axis probes, all of which greatly increase a CMM's capabilities.

If equipped with a change rack, many of the sensors are automatically interchangeable as part of the inspection routine for uninterrupted operation.

The result is an all-around measuring system, one that—depending on the CMM model selected—is suitable for quality assurance in laboratory environments, the inspection room and the shop floor alike.

"When selecting a CMM, be sure to plan for your future needs, not just what you need to measure today," Hancz cautions. "It's not always easy to know what's coming, but talk to your salesperson. Determine what capacity you'll need going forward, the required accuracy level, probing heads and styli, fixturing and other accessories. Doing so now can save you a lot of aggravation and expense later."

What CMM capabilities are most important in your shop? Tell us in the comments below.

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