



Machining

4 Under-the-Radar Tips for 5-Axis CNC Productivity

Kip Hanson | Jun 25, 2019

There are some excellent reasons to use 5-axis CNC machines, but to really reap the productivity benefits you'll need the right tooling and techniques—some of which are under the radar. We talk to three industry experts for timesaving and productivity guidance.

Whether your shop uses all five axes simultaneously or limits its machining to 3+2, 5-axis CNC machining centers are the best thing to happen to productivity since carbide. There are a host of benefits to using **5-axis machining** including: reduced part handling, fewer fixtures, shorter lead times, higher part quality, the elimination of work-in-process, and making complex and otherwise impossible parts, such as knee implants and impeller blades.

Before diving all the way in, it is important to understand how part-making on a 5-axis CNC will be significantly different than the work on a 3-axis VMC or other system.

You may need entirely different tooling and workholding—and new strategies for setup and changeover. We talk to three industry experts for timesaving and productivity advice that is unique to 5-axis CNC systems.

5-Axis Machining Tip #1: Make Multiple Parts in Less Time with the Right Baseplate, Change Setups Quickly

One of the first negatives you might hear about 5-axis machining centers is the notion that they're limited to one part per cycle. Not so, says Brad Evans, team lead for stationary workholding at **Schunk**.

"Many people overlook the ability to machine multiple parts on a 5-axis machine," he says. "But if you equip your machine with a 45-degree pyramidal baseplate, you eliminate most of the interference problems and can machine anywhere from three to six parts per cycle, depending on the pyramid."

Schunk's KSC-series 5-axis vises are designed to mount on one of these SEP-style pyramids, but Evans acknowledges that anyone's vise will fit. Special vises are another thing that some shops overlook.

Whatever the workholding and however many parts can be squeezed into the machine, though, Evans strongly recommends using a VERO-S or comparable zero-point locating system to reduce setup time and take full advantage of a 5-axis machining center's flexibility.

"Due to their higher cost, it's particularly important to keep the door closed as much as possible on a 5-axis machining center," Evans explains. "So if you have a quick-change system and a three- or four-sided pyramid with a vise on each side, you can not only run the machine much longer between door openings but also switch to a different setup within minutes. You're not dialing anything in or touching off—just drop the next job in and go."

Find out why a trunnion system cannot compete with a 5-axis CNC and much more in "8 Important Facts About 5-Axis Machining Centers and High-Performance Machining."

5-Axis Machining Tip #2: Use Toolpath Simulation

Multiple parts per cycle can raise the already high crash potential of 5-axis machining where long tool lengths and tight quarters increase the risk of interference.

Bad days due to machine collisions can be easily avoided—all it takes is a little additional effort up front, and a software package dedicated to making the most out of every machine tool, says Gene Granata, product manager for toolpath simulation software Vericut at **CGTech**.

"A lot of shops rely on their CAM system's simulation capabilities to detect interference," he says. "The problem here is that a program might check out just fine during toolpath development, but once it's been post-processed, errors can be introduced."

True toolpath simulation also verifies the entire machine tool, including travel limits, behavior of specific CNC control functions like dynamic offsets and cutter compensation, the ever-changing workpiece, the fixtures and toolholders, and even the clamps that hold the vise to the table. This level of realism and accuracy is difficult to achieve in any programming system.

Toolpath simulation provides much more than crash avoidance, however—it also increases machining efficiency. Because 5-axis machining operations are generally more complex than those performed on less-capable machine tools, many programmers—particularly those new to 5-axis work—retract tools much further than is needed to clear the workpiece.

They may also use a slow approach and slow positioning feed rates because they are not confident about how the machine will move or how close the tool really is to potentially colliding with something.

"They waste all kinds of time and motion doing that and go through extensive prove-out processes on the shop floor, whereas a good simulator shows you exactly what's going on inside the machine and how it's behaving," says Granata. "This lets programmers stay closer to the part during positioning moves, which increases overall efficiency, while at the same time assuring the programmer that there won't be any problems once the job hits the floor. The goal should always be first part, good part."



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5-Axis Machining Tip #3: Calibrate Your CNC Machine for Proper Alignment

Another way to stay out of trouble is by keeping the machine's spindle and axes properly aligned. Most 5-axis machining centers come equipped with tool center point (TCP) or similar control options to avoid the surface mismatches and geometric inaccuracies that might otherwise occur as the machine axes rotate from plane to plane. But if the machine itself is out of tune, all the TCP in the world won't be effective.

Routine machine calibration is important on any CNC machine tool, notes Tom Ellis, marketing manager of **Renishaw's** laser and calibration product division, but especially so on 5-axis machining centers.

"Given the relatively high center of rotation, eliminating all misalignment is fundamental to your ability to make a part correctly," he says. "That's why we developed the AxiSet."

The AxiSet Check-Up system looks like nothing more than a metal lollipop attached to a magnetic base. Looks can be deceiving. By placing the calibration sphere on the table of a 5-axis machining center or the chuck on a multitasking lathe and then probing it in various axial and radial positions, mechanical form errors can quickly be displayed and corrected.

The system software is also able to determine the exact center of rotation and convey this information to the machine tool control. The result is perfect alignment of all machine axis and pivot points.

"The AxiSet, together with the XM-60 multi-axis calibrator and QC20-W ballbar, is what we use on our own machine tools," says Ellis. "A lot of people don't realize it, but Renishaw is a major manufacturer, producing a million or so parts each month for our various products. Routine calibration provides data about how a machine is performing, and gives people advance warning of potential issues, whether there's been a crash or not, or whether anyone's reported one or not."

5-Axis Machining Tip #4: The Value of Automated Workholding

Brad Evans of **Schunk** has another piece of advice: Ditch the vise handle.

"In an automation situation, or even for greater ergonomics, shops have a choice between hydraulic and pneumatic workholding," he says. "Hydraulics have the edge in terms of gripping force, but not by a whole lot, and if there's ever a leak in the system, you're looking at possible contamination of the cutting fluids and floor dry all around the machine."

It's for these reasons that pneumatic clamping has grown in popularity and capabilities over recent years. It's simple to install and maintain, and if there's a leak, it vents to the atmosphere.

No big deal. Evans says it's quite easy to plumb one of the VERO-S quick-change chucks or pyramid fixtures for compressed air and tie it into a PLC inside the machine's electrical cabinet if automatic clamp and unclamp is desired.

Otherwise, a manifold and hand-actuated valve or valves are both quick and affordable. Either way, automated workholding is one more of the boxes that should be checked on a 5-axis machining center.

Do you use pneumatic or hydraulic clamping in your 5-axis system today? Talk to your peers in the metalworking forum. [registration required]