Engineering shop sees boosted productivity after installing high-torque retention knobs

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Written by JM Performance Products

Apr. 24, 2017 - The easiest and most cost-effective way to achieve the highest level of performance from existing CNC mills and tooling is to eliminate toolholder expansion.

Toolholder expansion occurs when a standard retention knob is installed into a toolholder. Pressure exerted by thread engagement, coupled with the elastic properties of the steel used to manufacture the toolholders creates a bulge at the small end of the holder. Once expansion occurs, the holder will not pull all the way into the spindle, and the toolholder can't make contact with upwards of 70 per cent of the spindle surface. Because this bulge stops the toolholder from making full contact with the taper of the spindle, a wide range of CNC milling issues surface: vibration and chatter, poor tolerances, non-repeatability, poor finishes, shortened tool life, excessive spindle wear and tear, run-out, and shallow depths of cuts. By eliminating the bulge and subsequent problems, reduced downtime, extended tool life, and increased speed and feed rates can be realized on existing machinery. This allows manufacturers to become more competitive in the world market, especially in the aerospace and automotive industries.

JM Performance Products (JMPP), describing itself as a "manufacturing innovator" of CNC mill spindle optimization products since 2009, introduced its patented high-torque retention knob several years ago. Recognizing the design flaw inherent in CNC v-flange tooling that was responsible for costly CNC milling and boring issues, JMPP designed a retention knob that can be used in existing toolholders to eliminate the bulge.

A Southern California aerospace engineering shop, Hansen Engineering Company (HEC), has embraced the high torque knobs to overcome ongoing production issues.

By converting to the high torque knobs in 14 CNC machines, requiring approximately 120 total high-torque retention knobs per machine, HEC has realized an approximate 15 per cent increase in productivity and decrease in downtime respectively since the implementation.

Established in 1962, HEC is an approved Air Transport Association (ATA) manufacturing supplier of precision NC machined multi-axis parts, assemblies and major structural assemblies. HEC specializes in complex MDI surface geometry, statistical process control, and electronic probing of part surfaces.

Two buildings on its 43,000-square-foot facility campus boast a wide array of major CNC equipment including: high-speed five-axis machining centres, heavy-duty five-axis machining centres, horizontal machining centres with dual tombstones, three-axis machining centres, and one with dual shuttle tables.

Focused on staying lean and practicing the industry 5S methodology, HEC's shop is designed for maximum productivity. The majority of HEC's high-speed enclosed CNC machines operate within a 10-

15K RPM range, running titanium, stainless steel, and aluminum at high speeds-cutting large blocks of material for a wide array of aerospace products.

Over time, everyday heavy-duty machining operations began to present increased issues. Toolholders were getting stuck in the spindle due to deformation factors evidenced by wear marks at the top and bottom of the holders, fretting appeared on contact surfaces, and increasingly long cycles developed. These persistent problems lead to increased production shut downs to allow the machines to cool off for significant periods of time. Additionally, poor finishing and chatter problems were recurring when roughing aluminum, titanium, and stainless steel for forging jobs.

High-torque results

Seeking a solution to the production issues, HEC engineering personnel initially met with JMPP's technical team at a WESTEC show in Los Angeles, where they were given a demonstration on the benefits of how the high-torque retention knobs would work with the 50 taper V-flange toolholders. JMPP's high-torque retention knob design features a knob that is longer and reaches deeper into the holder's threaded bore. As a result, all thread engagement occurs in a region of the toolholder where there is a thicker cross-section of material to resist deformation.

Intrigued by the potential, HEC initially bought 25 high-torque knobs and properly installed them, following calculated torque specs and using a retention knob socket and torque wrench. Immediately, it noticed a 5 per cent spindle load decrease using a 3.0-in. hi-feed insert mill running titanium. HEC also installed them on an aluminum forging job it was running that had consistently produced chatter problems. Among the tools tested for this job were a 1-1/4-in. diameter knuckle rougher and 2.0-in. diameter finisher.

According to HEC's Curtis Sampson, shop lead-man, "Again, the results were positive as the chatter was eliminated and it produced the best finish we have ever seen on these parts. After that, we bought 50 more pieces and immediately noticed improvements all around the table — we've been increasing their use over time ever since."

In noting the progressive conversion over time for HEC's machines since these initial tests, HEC's buyer tool crib Jose Campos stated, "Productivity has continued to increase by approximately 15 per cent. The same rate applies for downtime as there is less change out of tool cutters across the board."

Campos also provided a key example for a HEC machine running at a speed of 10,000 RPM, 350 in/min feed on aluminum parts for speed, accuracy, and repeatability. In 2015, it used 170 high-torque retention knobs for the year; in 2016, it used 300 high-torque knobs.

Campos also noted usage on HEC's latest Mazak five-axis CNC machining centre, featuring 160-in. length with dual shuttle tables, and a tool changer which is designed to run one table full of parts while the other is being loaded, eliminating downtime.

"Our Mazak machines used to make a loud noise when changing tools, and JMPP's high torque retention knobs solved that problem. The machines are much quieter now when roughing titanium and stainless steel. They also eliminated fretting of the toolholder shank," said Campos.

Key design elements of JMPP's high torque retention knobs include: longer than traditional retention knobs, with a precision pilot to increase rigidity, a relief below the flange forces threads into a deeper cross section of the toolholder. The knobs are hard turned to ensure precision fit and are balanced by design with threads cut to start and finish 180 degrees from each other. The high-torque knobs will work in existing toolholders.

Productivity potential

Ultimately, the progressive conversion over time to JMPP's high-torque retention knobs allowed HEC to overcome long-standing productivity issues for its entire fleet of high-speed CNC mills.

For HEC's demanding aerospace products production, these retention knobs have shown lower spindle loads, which is better for the machine. Additionally, when roughing titanium and stainless steel with the knobs, HEC's power meter showed a significant reduction in power consumption and overall tool life was improved. Over the long haul, HEC has been able to increase speeds and feeds that deliver better cycle times to realize substantial savings.

Sampson advised, "I would like to put a word out to the people who are not quite convinced yet, they are worth the small investment. You may not want to jump in with both feet, but just try them on a job or two

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and I am sure that you will notice improvements. In this competitive world we live in today, we can use a product like these retention knobs. They are something that we can just screw in our tools to give us an upper hand on our competitors."

Reshoring potential

HEC is an example of conversion success. Other manufacturing entities serving the automotive, aerospace, and medical device markets have been achieving similar results by implementing JMPP's high-torque retention knobs.

According to JMPP president John Stoneback, "By significantly increasing the speed of machines via eliminating the problems that were designed into v-flange tooling, conservative estimate savings of 10 to 15 per cent can be achieved. The high-torque knobs transform v-flange tooling into the most cost effective, reliable, and precision tooling system available."

Stoneback also noted the reshoring potential these substantial savings can represent in bringing machine tool die/milling jobs. "Most U.S. manufacturers are running machines 20 to 40 per cent slower than they should be. With the ability to jack up the speed of CNC machines via minimizing the expansion/deformation that happens at the small end of the taper when a standard retention knobs is installed, significant increases in tool life, production rates, and revenue can be achieved. The climate is now for U.S. manufacturers to take advantage of adopting and converting to these productivity advantages."

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