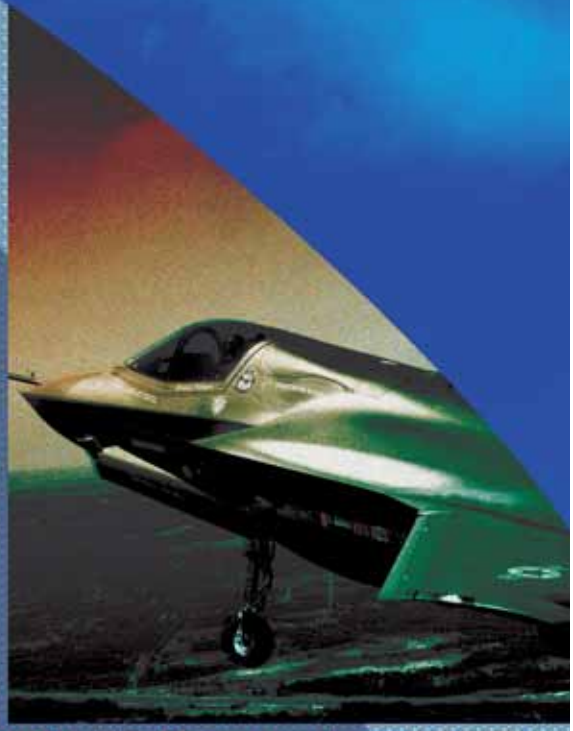
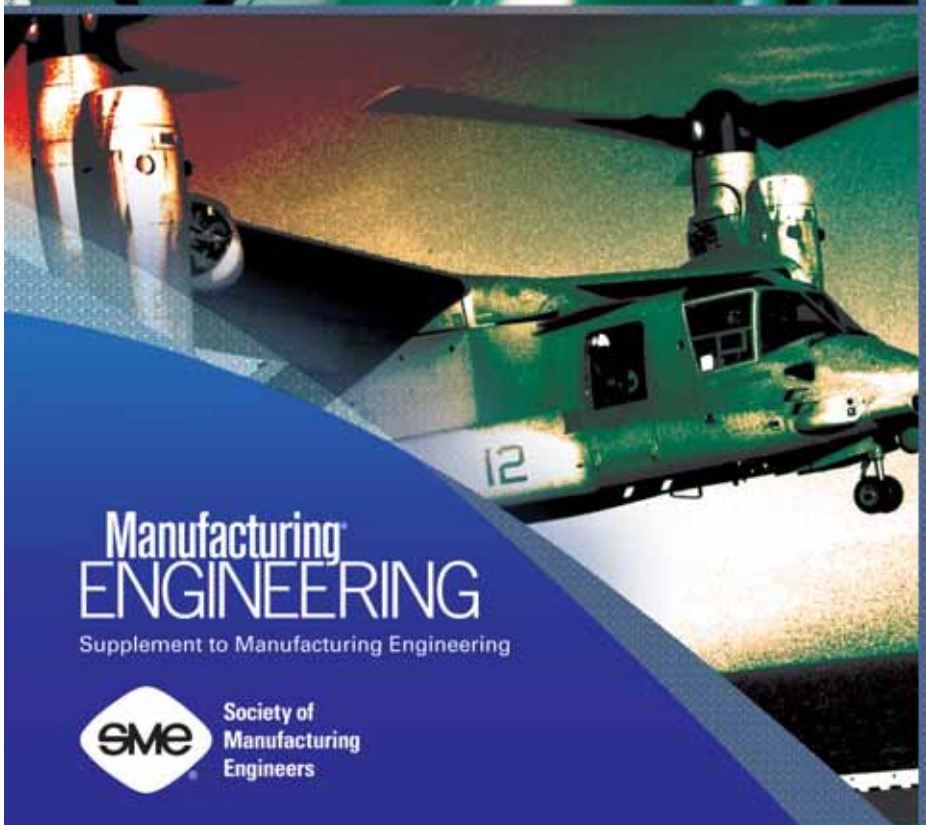
AEROSPACE & DEFENSE MANUFACTURING 2010





Manufacturing ENGINEERING
Supplement to Manufacturing Engineering

SME Society of Manufacturing Engineers

Finding Precision in Unexpected Places

Can a lowly retention knob improve high-speed machining?

For many years, John Stoneback, president of J&M Machine Inc. (Fairport Harbor, OH), ran a small job-shop making parts for local companies. Because of his reputation for making high-quality, close tolerance work, he was approached by Erickson Tool (Cleveland), and began manufacturing components for Erickson that were used in the toolholder and cutting-tool industries. One of the parts he made for Erickson on his turret lathes, and later on automatic screw machines, was a retention knob. Subsequently, Erickson Tool was purchased by Kennametal. J&M continued to make retention knobs for Kennametal, and over the years produced some 300 different styles of retention knobs. In 1996, the company moved into a new, 18,000 ft^2 (1672 m^2) facility, and continued to make retention knobs and other parts for the toolholder industry.

A few years ago, CKS Briney Co.'s Jim Smith called Stoneback. He wanted to know if Stoneback had received any complaints from customers about the shanks of V-flange tools expanding. Stoneback's initial response was "no," but several months later he read an article about marks on toolholders at both the gage line and the small end. Recalling the uniform wear marks on the NMTB toolholder compared to the V-flange holder, Stoneback sketched out a test fixture and had drawings made.

The first test fixture was soft. When a toolholder shank was inserted into the fixture, there was no movement at either end—the fixture fit like a

Retention knob test fixture.

glove. The shop supervisor tested a few ANSI 40-taper retention knobs and, to his surprise, the indicators on the fixture that measured movement out of the test fixture indicated a move of 0.001" (0.03 mm), when torque was at 40 lb-ft (54 N•m). This movement calculates out to be 3.55 times the total AT3 gage limit over size at the small end of the toolholder at the threaded area. Consequently, when the toolholder was in the machine spindle, the spindle was 0.000280" (0.007 mm) larger than the toolholder at the gage line. Because the total AT3 gage limit was 0.000078" (0.002 mm), the tool was free to move like a bell clanger when it was in a cut. Also, when loaded into the spindle, the toolholder could locate anywhere within the 0.000280" larger diameter of the spindle.

J&M personnel designed a test protocol, a hardened fixture was designed and built, and tests were conducted. Six retention knobs of different brands were purchased, along with six of the most popular brands of toolholders. The retention knobs were tightened to 20, 40, 60, 80, 100, 120, 140, and 160 lb-ft (27, 54, 81, 108, 136, 163, 190, and 217 N•m).for the first tests. The test was redesigned when the first results revealed that the expansion of the small end of the toolholder was as much as 20 times the grind limit over size at 160 lb-ft.

During the second round of testing, the tightness range went from 20 to 80 lb-ft. All retention knobs in the second tests showed expansion of the toolholder when tightened to 20 lb-ft. The same retention knob and toolholder were tested numerous times, and the new test fixture's repeatability was excellent.

The testing revealed that upon removal of the retention knobs, all the toolholders went back to their original size. Some retention knobs caused toolholder expansion with as little as 13 lb-ft (17.6 N•m) of torque. Results were not uniform when testing six toolholders of the same brand using the same retention knob. Occasionally, several same-brand toolholders expanded far beyond the average of the group. Stoneback and his associates suspect that incorrect heat treating caused these results.

Newly designed retention knobs with many variations, including softer threads, harder threads, reduced major diameter, tapered pitch diameter, and knobs designed with thread pitch increased by a few thousandths per foot were tested.

After reviewing the ANSI retention knob standard for toolholders, it became apparent that the thread depth of the toolholder was much longer than the threads on the standard retention knobs. J&M tried the longer threaded design, and noted a little less expansion of the toolholder. The undercut from the pilot to threads was extended, so that the threads were at the minimum thread length for maximum strength. Next, the threads were lengthened so that the start and the end of the threads were 180° apart for balance.

The new high-torque knob was designed for high-speed machining. It has a pilot for stability, longer threads within 1/32" (0.79 mm) of minimum toolholder tap depth, and an undercut to reduce toolholder expansion. Threads start and end 180° apart for balance. Pilot tolerances for high-speed machining are the same as ISO, DIN, and JMTBA tolerances, and the high-speed pilot is designed to fit the 0.0007" (0.02-mm) tolerance counterbore. High-torque knob tests revealed two to ten times less expansion than standard ANSI retention knobs. The high-torque knob's pilots will fit in the counterbores of standard toolholders made to the ANSI ASME 1972 and higher standard, and will increase tool life.

J&M has been making their High Torque Retention Knobs in 30, 40, 50, and 60 spindle sizes, with very close tolerances on the pilots. Precision toolholders made to the new J&M Hi–Torque counterbore dimensions will meet the demands of new high material removal rate machines that are capable of close tolerances, high speed, heavy-duty roughing, and precision boring.

"We had suspected that the new high-torque retention knobs would **increase tool life and reduce chatter."**

Historically, J&M sold retention knobs through approximately 300 distributors in the US and Canada. Once the design of the new retention knobs was complete, the company contacted its distributors by mail, e-mail, and fax to introduce these products. Because of the reduction of sales caused by the economic situation in February 2009, however, distributors were experiencing a reduction in orders, and very few were trying to sell new products. They regarded the new high-torque retention knobs as a product that could further reduce their sales.

Stoneback decided to take the product to SME's WESTEC exhibition in Los Angeles, and see what end-users thought of it. He also spoke to machine, toolholder, and cutting-tool manufacturers, CNC spindle repair companies, and tool distributors. All of his contacts agreed that the new retention knob was a good idea.

After evaluating the reactions of different companies and end-users, Stoneback decided to attend machine tool shows so that he could drum up some sales.

As Stoneback puts it: "We had suspected that the new high-torque retention knobs would increase tool life and reduce chatter. We were very surprised when our customers started reporting many improvements that we never thought of. Our customers continually tell us how these knobs are saving them money on tools, improving finishes, reducing stress and energy consumption on their mills, and increasing productivity."✈

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