Winter 2009/2010

The CTMA VIEW

The official voice of the Canadian Tooling & Machining Association

ARE YOU ON THE RIGHT PATH?

It leads to Windsor, Ontario, Canada in June 2010!

Page 12

Canada Post Mail Publications Agreement Number: 40609661

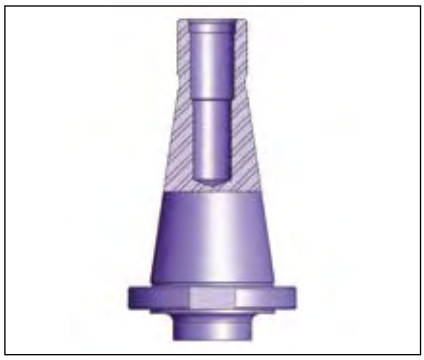
"Great Beliefs and Misbeliefs" of Tolerance and Retention Knobs

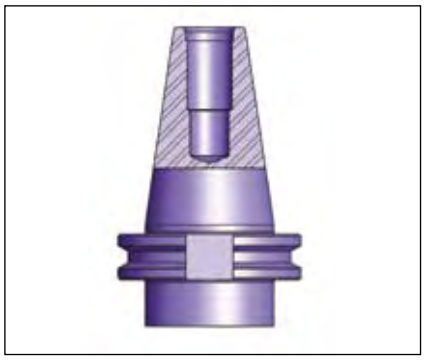
By John Stoneback, President of J&M Machine Inc.

Let's review what we know about retention knobs and toolholders. In the Spring 2009 edition, *The CTMA VIEW* published, "Do Your Toolholders Fit Your CNC Spindles? (We've Taken A Second Look)" which was followed by an article in *Modern Machine Shop's* June 2009 edition entitled, "The Knob Problem." New information was recently brought to light about V-flange tools and the relationship of the retention knob and the marks found on toolholders used in today's CNC machining centers. In this article, we'll review the information provided in previous articles and update the findings with information from companies that have begun using the new High Torque retention knobs and test fixture.

RETENTION KNOBS 101

Think back to the time before "NC" and "CNC" machines were introduced into the machine tool market. The NMTB toolholders, which were used as early as 1940, had a straight diameter at the small end of the toolholder and the machine spindles had a hole with clearance for that diameter. The draw bar, which was used to hold the toolholder in place, did not project into the tapered areas of the toolholder. When the toolholder was put into the machine spindle and the draw bar was threaded into the toolholder and tightened, there was no expansion at the taper end of the toolholder because the straight diameter was in the clearance hole in the spindle. If there was any tendency for growth of the tapered area, the spindle would restrain it.



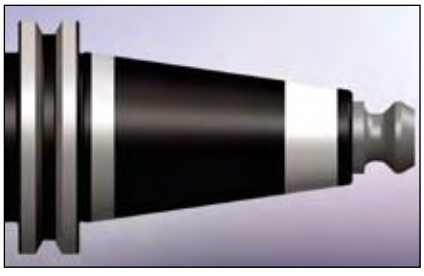


The retention knob of today came into the picture in the 1970s. Caterpillar designed a retention knob and toolholder standard so the tooling for the different machines they would purchase would have interchangeable tooling. The Cat standard was adopted by the American National Standards Institute (ANSI) in 1978 (ANSI B5.50-1-1978). Unlike the other standards in existence at that time, the Cat retention knob standard had no pilot and the thread length was shorter. The standard for the toolholder, however, had a tap depth which was .260 inch deeper than the knob length and a c-bore for a pilot with a plus .0156 diameter tolerance. This design was intended for general use, not high speed or unusually high accuracy requirement machining.

The tightening of retention knobs has not been addressed by any of the international standards. In most cases, operators don't use a socket and torque wrench when installing the retention knob. The logic used when tightening is: if the rpm of the tool is high, or the metal is hard, or the cutter is a rougher, or, when using a slab mill, make sure the retention knob is tight so the toolholder, will not pull out of the machine. Wrenches used can be two- or three-foot long; often a hammer is used to make sure the knob is tight enough.

The torque pressure used to tighten the retention knob has nothing to do with the size of the cutter or the hardness of the metal, or the rpm of the cutter. The axial pressure of the retention knob on the toolholder should be greater than the draw bar force exerted by the Belleville washer pack to ensure that the tool will pull out of the machine before the retention knob pulls away from the toolholder. Tightening the retention knob to a torque setting which exerts a force 1.2 times the draw bar pressure is adequate to achieve our goal. Exerting a greater force is not necessary and is counterproductive. J&M has designed a chart for determining retention knob torque settings for 30, 40, 50, and 60 size spindles. Note that using the same settings for standard retention knobs is not recommended.

THE PROBLEM



The marks at the gauge line and at the threaded area of the toolholder shanks started to show up after the retention knob was used rather than the draw bar. The area between the gauge line and the threaded area have no marks. The tolerances of the toolholder tapers were suspected as the cause of the marks. In response, the tool manufacturers tightened the grinding tolerances from .000130 inch to the AT3 limit of .000079 inch, but the marks on the toolholder shanks are still present today.

The machine and toolholder manufacturers have been aware of the problem for years, but did not want to deviate from the five present standards (ISO, DIN, JIS, JMTBA, and ANSI). They also did not have a gauge to accurately, reliably and inexpensively check out the problem. There was no easy fix for the problem. Having no gauge to check the growth of the shank when the retention knob was installed made the problem very hard to detect. The companies which had equipment capable of checking a taper that was as close as the toolholder, found them to be very costly and needed an inspection room environment in order to maintain the accuracy that was required.

A new product developed by J&M Machine, "The Taper Shank Test Gauge", makes it possible to detect minute changes in diameter and detect the amount of looseness at either end of the toolholder. This gauge can detect growth in the diameter of the toolholder shank as little as .000007 of an inch and movement at the gauge line and the threaded area of .000025 inch. The test fixture has a tapered hole ground to the same tolerances as the spindle of a CNC Machining Center. The gauge has three indicators which measure movement of the toolholder out of the test gauge. The gauge has an indicator at the gauge line of the toolholder (large end) and at the small end of the toolholder at the threaded area. These indicators detect any movement perpendicular to the center line, caused by a bulge at either end of the toolholder. The gauge is stable and needs no calibration standard. The cost is $1500.00 for the 40 taper and should pay for itself in a month or two.

Manufacturers of machine tools, toolholders, touch probes, grinding attachments, boring heads, thread milling tools, end mills, and insertable mills, are realizing that to get the best performance from their products, the expansion problem must be dealt with.

Before evaluating your CNC machine's performance, make sure the drawbar pressure is at

continued on page 19

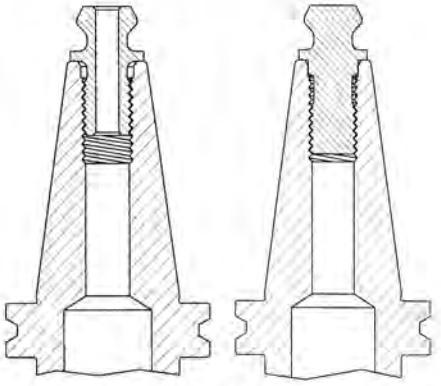
$$$ SMALL CHANGE = BIG SAVINGS $$$

The J&M High Torque Retention Knob Difference:

STANDARD KNOB HIGH-TORQUE KNOB*

- ✓ Made from **hot rolled 8620H fine grain steel**
  - ✓ Improves durability
  - ✓ Extends part life
  - ✓ Reduces distortion from heat treat
- ✓ Shot peened to relieve stress
- ✓ Deburred with radius corners for better finish
- ✓ Better finishes than required by International Standards
- ✓ Written inspection records on every mfg. lot
- ✓ Made in the USA from USA manufactured materials

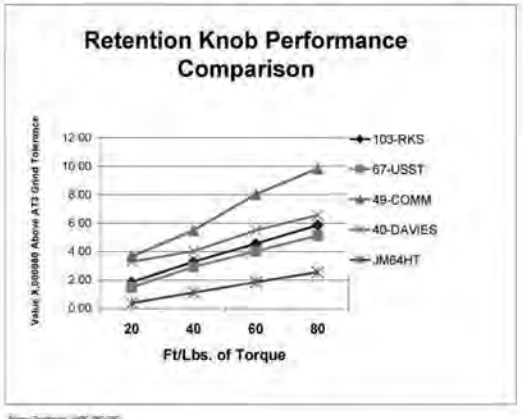
- ✓ 2X to 3X less expansion of the toolholder shank
- ✓ Laser-marked with month/year of purchase to help determine life span
- ✓ Laser-marked with part number, serial number for traceability



STANDARD KNOB HIGH-TORQUE KNOB*

** Patent-pending*

All The Qualities You Should Look For In A High Torque Retention Knob



- ✓ **REDUCES TOOLHOLDER EXPANSION**
- ✓ REDUCES COSTS
- ✓ INCREASES PROFIT
- ✓ INCREASES PRODUCTION
- ✓ INCREASES TOOL LIFE
- ✓ INCREASES FEED RATES
- ✓ INCREASES RIGIDITY
- ✓ IMPROVES TOOLHOLDER BALANCE

Distributors Welcome

- ✓ Private Labeling
- ✓ Technical Support
- ✓ Instructional Literature
- ✓ Shipped Same Day

MANUFACTURED BY

J&M MACHINE, INC.

Since 1965

Set Your Course For Quality

1234 High Street • Fairport Harbor • OH 44077
440.357.1234 • Fax: 440.357.1129 • Toll Free: 800.322.7750

continued from page 17

least 80 percent of the original manufacturer's specifications. The drawbar force should be checked on a regular basis. The Belleville washers have a life span which is determined by the number of times they cycle. Testing of your draw bar force should be done every 90 days or 500 hours of use. If your facility is working three shifts a day then check once a month. It's important to note that once the Belleville washer pack begins to degrade and the pressure readings being to diminish, the failure rate accelerates. The frequency of checking should increase to anticipate the required replacement of the washer pack and replacement or maintenance of the gripper device (collets or ball).

FINDINGS

All the major brands of toolholders and retention knobs were tested at various torque settings from 20 ft/lbs through 160 ft/lbs and growth at the gauge line was detected in all tests. The results of the tests proved that when tightened, retention knobs made to any one of the 5 world standards, would expand the toolholder shank at the small end, causing the indicators at the gauge line (large end) to show movement when pressure was applied 90 degrees to the axis of the toolholder. The tests showed that the increase in diameter of the toolholder in the test varied from two to twelve times the grind tolerance. The movement of the toolholder out of the spindle was as much as .0032 inch.

The following information was compiled with the test gauge and feedback from companies who have used the new High Torque Retention Knob. Testing with the new gauge made it easy to find and solve many of the problems listed in **Figure 1** (at the top right of this page).

THINKING OUTSIDE OF THE BOX

After building the Taper Shank Test Gauge it was easy to solve the problem of the marks on the toolholder.

continued on page 20

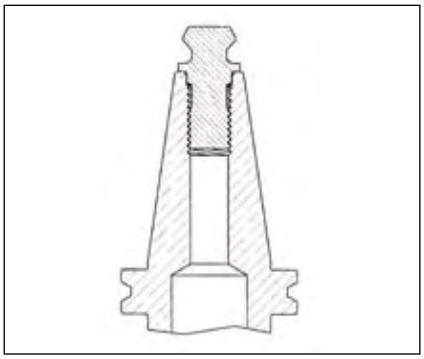
FIGURE 1

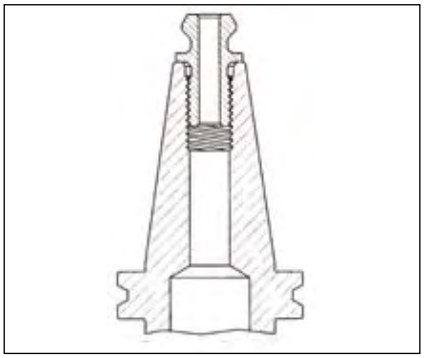
TOOLHOLDER EXPANSION AT THE THREADED AREA CAUSES THE FOLLOWING PROBLEMS	
Increased tool breakage	Reduced depth of cut
Increased machine vibration	Reduced feed rate
Increased tool wear	Reduced RPM
Increased costs	Reduced boring accuracy
Increased tool chatter	Reduced Probe accuracy
Increased spindle bearing breakdown	Reduced Bellville washer life
Increased toolholder shank wear	Reduced accuracy of tools
Increased noise	Reduced drilled hole straightness
Increased power consumption	Reduced balance of high speed tools
Spindle gauge line flare	Reduced contact area of toolholder and spindle

continued from page 19

After comparing the ANSI toolholder and retention knob standards, J&M has developed a new design retention knob. By making the retention knob as long as possible to fit the toolholder, adding a pilot, increasing the undercut length and designing the threads to be balanced, the new "High Torque Retention Knobs" solve or reduce all of the problems listed above. The instructions for tightening the knobs are included with each shipment. The High Torque knobs cost only about 25 percent more than the standard retention knobs on the market today, but with the amount that will be saved on tools, the initial cost should be recuperated within one or two months.

J&M Machine, Inc. is looking for manufacturing facilities to test the new retention knobs. If you experience any of the problems listed in this article, with your CNC mills and would like to solve them, are willing to participate in a tool study,





and maintain well-detailed cutting tool usage records, High Torque Retention Knobs will be supplied at no cost for the study. Participating companies must be willing to document the test and allow J&M to publish the test results. ■

J&M Machine, Inc. has manufactured retention knobs for 35 years. John Stoneback has been in the metal turning business since he graduated high school when he served apprenticeship with Case Manufacturing Company and Steel Improvement and Forge company (SIFCO). With his expertise in computers and their applications, and his ability to logically path the manufacturing process environment, he is currently developing software to manage and streamline the entire manufacturing business.

FOR MORE INFORMATION:
Download information about their products at www.jmmachineinc.com.
Test documentation on this subject can be downloaded at www.retentionknobtorquetest.com.
If you have further questions call (440) 357-1234 or email sales@ jmmachineinc.com.