MoldMaking Expo Preview

Modern Machine Shop

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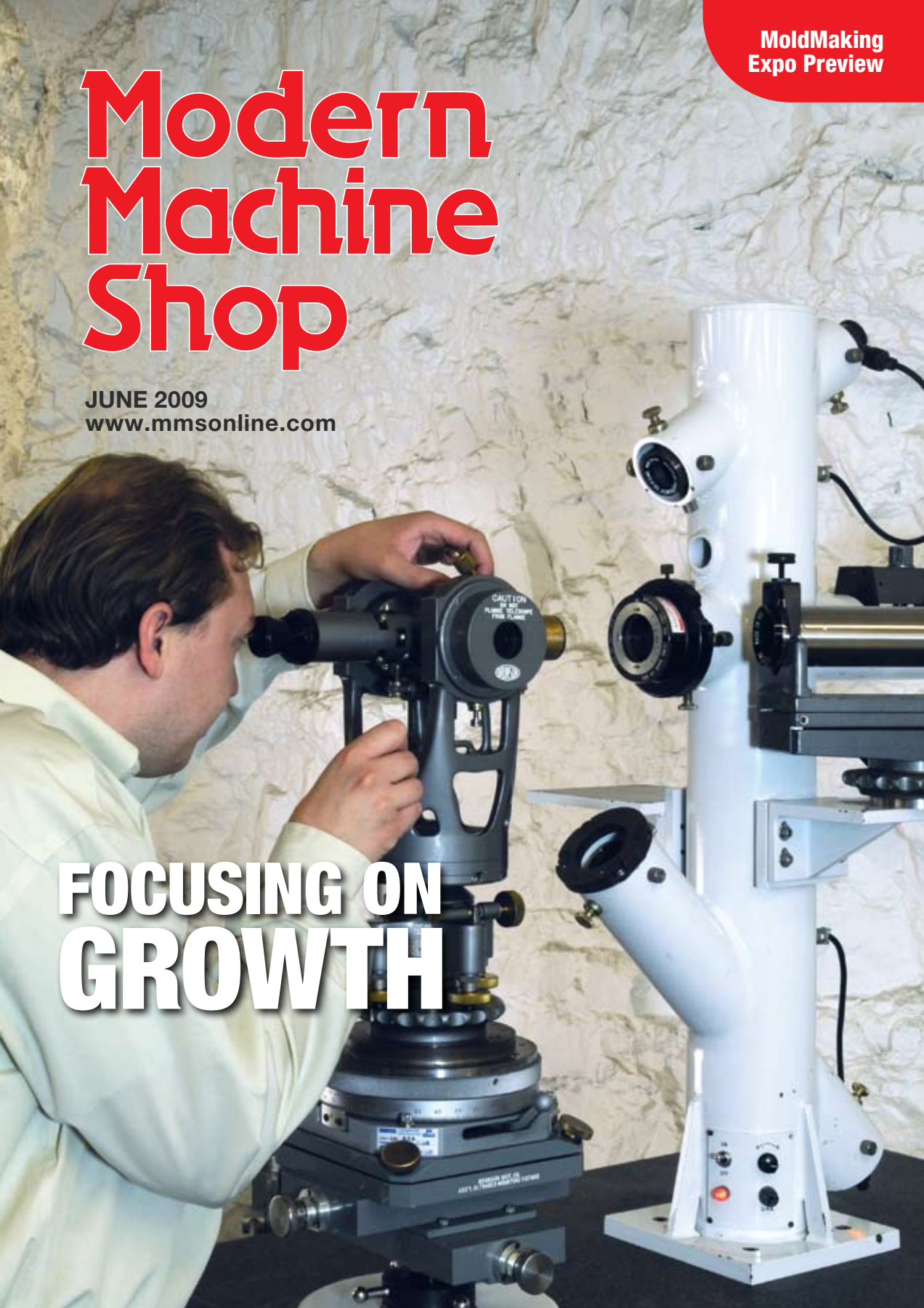

FOCUSING ON GROWTH

Modern Machine Shop

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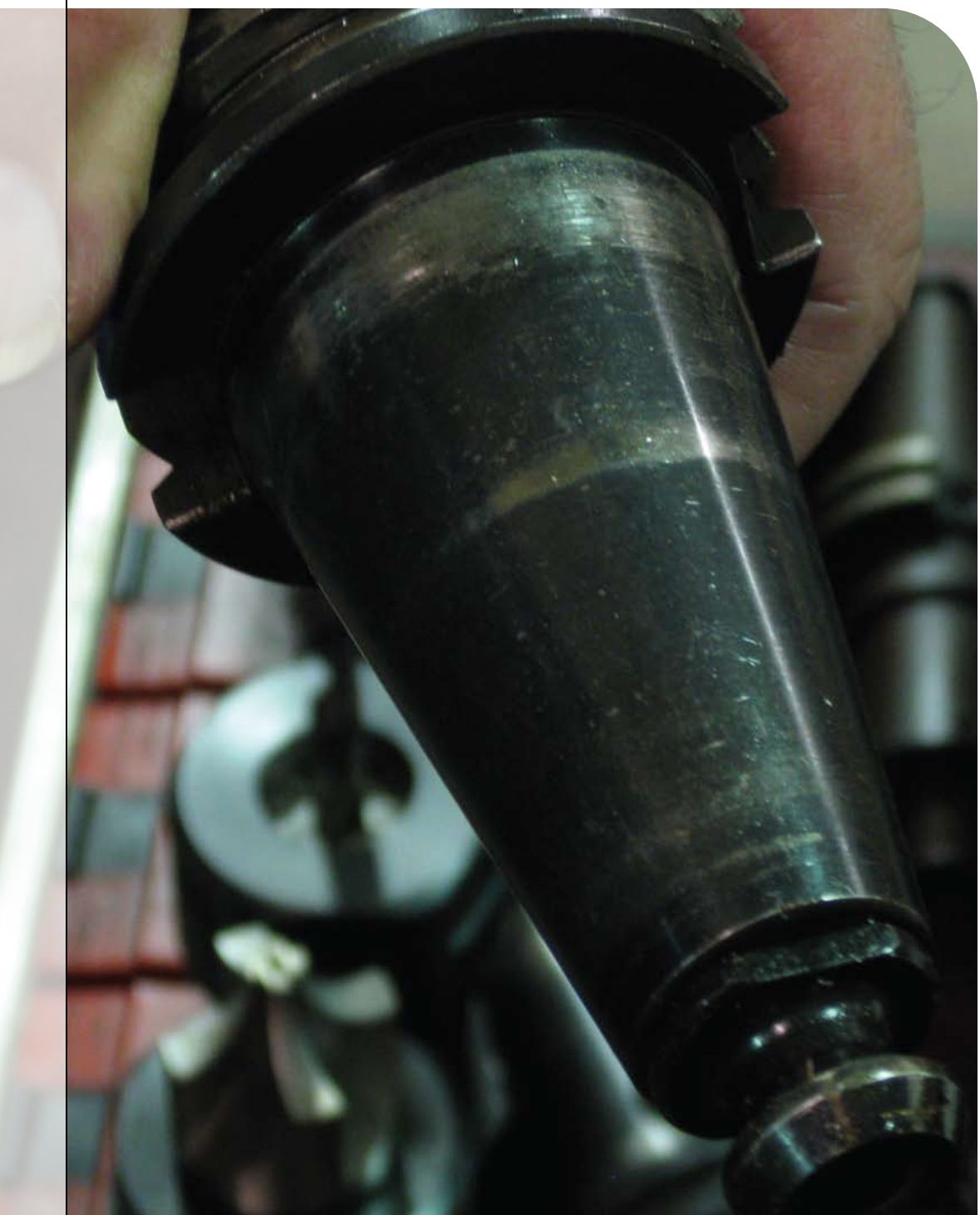
FEATURES



The KNOB Problem

The retention knob is an unmistakably critical component of the machining process. However, the tightening of the knob itself can lead to the toolholder not seating securely in the machine. You may be losing tool life to knob tightness without even knowing it.

BY PETER ZELINSKI

Shops often give considerable care to just one end of a machining center's toolholder—the end that holds the tool. On a tapered toolholder, the opposite end receives a retention knob. This knob is the near-invisible linchpin of the machining center process. It is often underappreciated.

Still, the retention knob doesn't ask for acclaim. It is a humble component performing a simple task. In a tapered holder such as the CAT or BT design, the knob screws into the holder to give the machining center's drawbar an appropriate shape to grab. If the drawbar and retention knob do not work together effectively, then the toolholder might not fit properly into the machine's spindle. Thus, this simple task is also critical, because how well the tool is secured is ultimately determined by how well the holder itself is secured.

John Stoneback, president of J&M Machine in Fairport Harbor, Ohio, says he believes insecure holding of toolholders is far more typical of machining center processes than most shops realize. The problem lies in the potential effect of the knob itself on the holder. J&M makes these knobs, and it recently began studying what happens to the toolholder when they are tightened. The company developed a test fixture for this very purpose—measuring minute changes in a tapered toolholder's shape.

The study found that across various makes and sizes of tapered toolholders, overtightening the retention knob by even a mild degree was enough to produce a bulge in the narrow end of the holder.

In fact, Mr. Stoneback says that in some cases just tightening the knob, not overtightening, was enough. The company has measured the effect in cases where just 10 to 15 foot-pounds of torque was applied.

As a result, the toolholder loses the shape that matches the cone of the spindle. This means the toolholder doesn't fit the spindle precisely, leaving it free to move like a clapper in a bell.

This bell can't be heard, but the effect of the movement can be seen. Mr. Stoneback has seen it himself. He says the mis-fitting of the toolholder explains a common wear pattern on toolholder tapers—one he has routinely seen on holders throughout his shop. The photo on the facing page shows one of these holders. As it illustrates, toolholder tapers often show wear at the narrow end plus wear near the mouth. If the taper has black oxide coating, the region between these wear areas remains black. That's because this part of the toolholder remains untouched, Mr. Stoneback says. On the distorted toolholder, this

Left In this common toolholder wear pattern, the taper is worn at both the narrow end and nearer to the flange. The unworn area in between makes much less contact with the spindle.

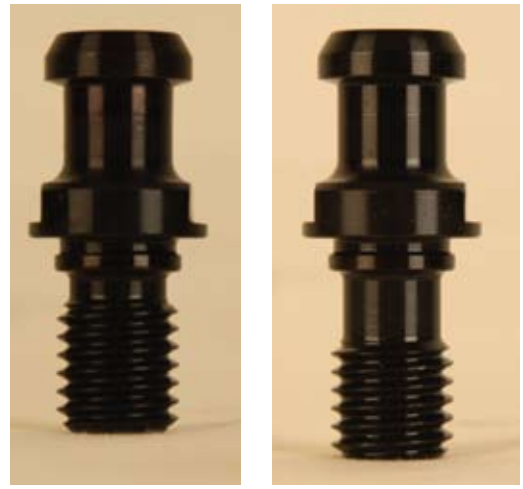
part of the taper never quite makes direct contact with the inside of the spindle.

POTENTIAL IMPACT

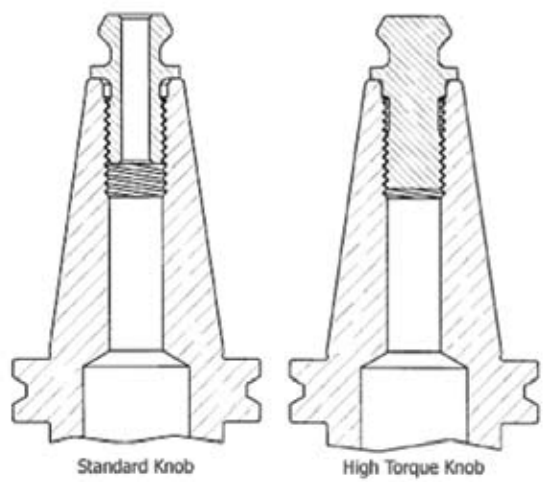
What this might mean for the stability at the tool tip and the life of the cutting tool are not hard to imagine. Carbide cutting edges are brittle when experiencing impacts other than those in the cutting direction. Where play exists between the toolholder and spindle taper, the resulting hammering of the tool is likely to speed the cutting edge toward failure.

This impact has been discovered in a big way in one particularly extreme application. J&M Machine developed an alternative retention knob design that produces less deformation of the holder when torqued to the same tightness as a standard knob. The knob has now been tested in a few shops, one of which performs aggressive slab milling of titanium. This shop had been accustomed to changing inserts two to three times per day. Once it switched to the new retention knobs, a single set of inserts lasted for a week without having to be changed.

Illustrations on this page show the design difference of these "high-torque" or lower-deformation knobs. As the drawing shows, the knob has no threads to engage at the narrower part of the toolholder taper. The knob is also longer, reaching a little deeper into the holder's threaded bore. As a result, all thread engagement occurs in a region of the toolholder where the diameter is large and where there is correspondingly more material to resist deformation. Where torque of 40 foot-pounds with a standard knob might deform a holder by three to five times the grind limit of 0.000080 inch, says Mr. Stoneback, the same torque with the high-torque knob deforms the holder by one times this limit.



Here is a standard retention knob **(LEFT)** beside the alternative design **(RIGHT)**. The latter knob deforms the holder less because the threads take hold deeper into the taper, where the surrounding thickness is greater.



As this diagram shows, the high-torque design has no threads within the narrowest region of the holder.

LEARN MORE

Video: Retention Knob Tightening And Toolholder Deflection

Footage on *MMS Online* illustrates the retention knob testing, showing how the toolholder taper is measured with and without the retention knob to capture the knob's effect. Find the video in our Toolholder Zone at www.mmsonline.com/toolholders.

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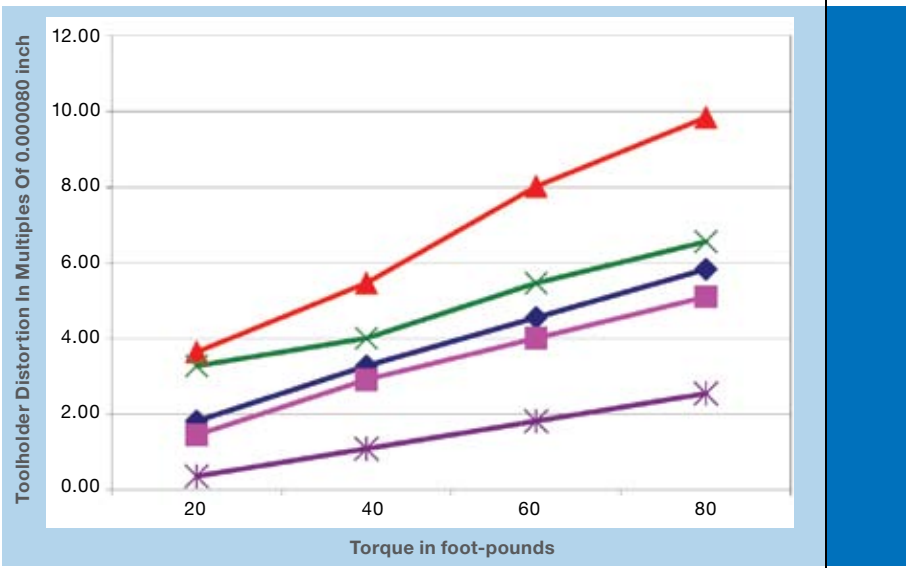

Here is the measured toolholder deformation for various retention knobs tested at different torque values in the same holder. The curve on the bottom is the high-torque knob design.

The use of the test fixture that the company developed can let a shop measure its own toolholders with and without tightened knobs to diagnose its own toolholder deformation. Video on *MMS Online* shows this measurement being done. (See red box on facing page.) J&M Machine's measurements revealed that holder deformation varies widely among different brands of both holders and knobs. The graph on this page illustrates the variation. This graph shows different knobs in the same holders, but similar variation was found when the same standard knob was used in different holders.

Here is a toolholder inserted in the test fixture for measuring toolholder deflection.

On this graph, the most extreme deformation seen is about 0.0008 inch. When the toolholder is in use, this discrepancy increases by a factor of 3.4 as the diameter of the taper increases toward the mouth of the spindle—to about 0.0027 inch. That's a lot. Fortunately though, in a way, it's also not that much.

THE GOOD NEWS

Mr. Stoneback points out that it's likely that a shop's toolholders are all still usable. His shop's were.

The extent of deformation measured was all in the elastic range, meaning the holder recovers its shape each time the retention knob is removed.

The extent of impacts within the spindle resulting from a loose fit also typically will not have been enough to damage the holder. Any noticeable wear is likely to be visible only because the taper has a black oxide finish. The underlying form of the holder is still good.

All of this means that the shop that can get its retention knob tightening under control can probably begin using its current holders within a process that holds this tooling much more securely. As the shop begins to fully make use of its tapered holders, says Mr. Stoneback, the previously untouched part of the taper won't go to waste after all. ■

For more information from J&M Machine, enter the company name at **www.mmsonline.com/suppliers** or call 800-322-7750.