▶ BY CHRIS GUST, BRINEY TOOLING SYSTEMS

Don't Fret

How to maintain toolholders.

Nearly one-third of all toolholders in automatic toolchangers are damaged. A damaged holder can reduce part quality, tool life and spindle life.

This is partly because toolholders are easy to overlook. After all, they aren't the most expensive item on a machine tool.

However, the long-term costs of machining with a worn or otherwise damaged holder can be immense. It pays to check each toolholder carefully as part of a regular machine tool maintenance program. This article summarizes the basics of a toolholder preventive maintenance program and gives an overview about the consequences of toolholder fretting.

Know What to Look For

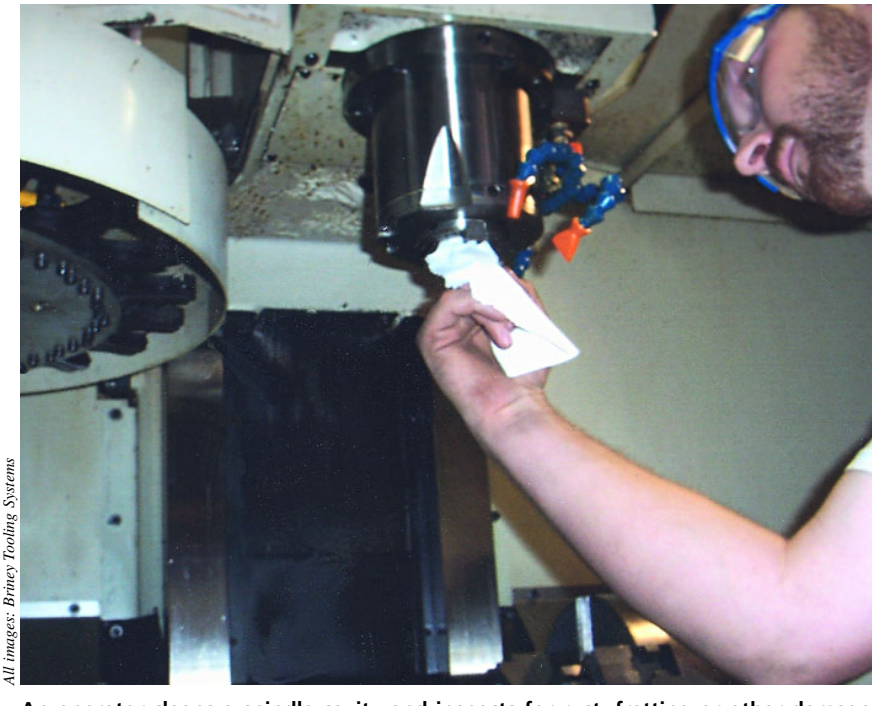
First, examine the toolholder's tapered shank and the spindle's contact surface for chips, gummy residue from coolant or lubricant, or physical damage. If the taper area of the holder or spindle shows any signs of nicks, wear or other damage, machining accuracy will be compromised.

A common source of damage is "fretting," the result of continual friction between two steel surfaces. In this case, fretting occurs when chips or other loose particles gather between the toolholder and spindle tapers. Fretting can also result when there is insufficient force to maintain uniform contact between the spindle and the toolholder's top taper, bottom taper and flange.

Fretting is indicated by tiny, copper-colored marks on the taper diameter or other changes to the toolholder's surface finish. This friction quickly causes wear, which distorts the toolholder's fit and concentricity, rendering it unreliable. Once fretting has occurred, the toolholder must be replaced, because it will damage the spindle, which is expensive to repair in terms of service cost and machine downtime.

It's also important to monitor new holders closely. If the taper shows fretting or other damage, a problem with the spindle is likely.

Regrinding standard off-the-shelf toolholders, such as endmill holders and collet chucks, is cost-prohibitive. Consider the steps involved. First, the worn shank needs to be ground undersized to clean up the pits and scars. Then, hard chrome is applied to the



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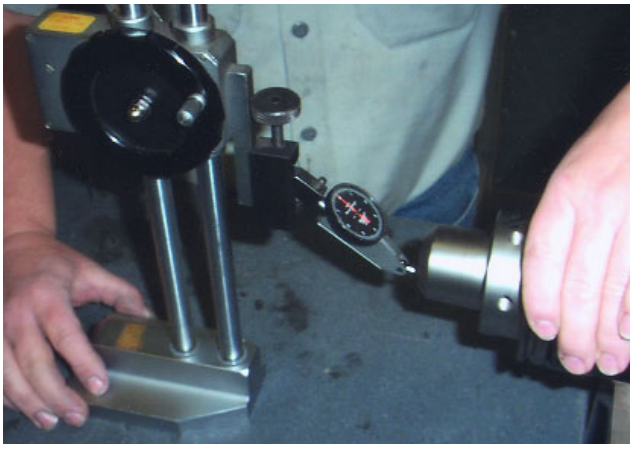
An operator cleans a spindle cavity and inspects for rust, fretting or other damage that could compromise toolholder performance.

As part of regular toolholder maintenance, wipe the toolholder's shank and check for surface damage that could negatively impact the holder's concentricity.



Check the toolholder's taper to be sure TIR is less than 25 percent of the spindle's TIR. Use a 0.0001" dial indicator to measure that the maximum toolholder runout is 0.0005" TIR or less.

taper and bore, or working end, of the toolholder to build it back up above the required finish dimension. After this step, the taper and then the ID, or working end, is ground to the original specifications. Not only are three separate grinding operations involved, but the expense of masking off areas where you don't want chrome applied makes the overall process cost-prohibitive.

[Editor's note: For information about the options for repairing tapered toolholders, read Part 2 of the CTE article about holder and spindle repair, online at www.ctemag.com/pdf/0012-tight-fit.pdf.]

Bad Vibes

Worn areas or nicks will cause toolholders to become "out of round," and taper accuracy will suffer—with serious consequences. Be sure that taper accuracy is AT3 or better, since lower-accuracy tapers cause vibration to occur during machining. Within less than one work shift, enough vibration-induced tool wear can occur to degrade workpiece surface finishes.

Excessive vibration can also generate excessive heat in the spindle, possibly causing the bearings to fail prematurely. Therefore, a single worn toolholder will not only damage the machine and lead to poor machining results, but incur excessive tool-replacement costs.

On a daily basis, ensure that operators keep the collet pockets and shanks free of chips and other materials that nick or otherwise damage the toolholder's tapered shank. Such damage affects the shank or collet holder's concentricity, which, in turn, will cause chatter, cutting tool damage and low-quality parts. If the holder does not seat properly in the spindle, the chatter caused by the poor fit will result in fretting and damage the spindle itself.

Even some new, low-cost toolholders may have a problem, in that their tapers may not precisely match a machine's spindle taper. This condition can only accelerate toolholder and spindle wear. Longer-reach toolholders typically wear fastest, due to higher side loading.

Toolholding System Checklist

Inspect collet holders daily. Damaged collets should be replaced immediately, since damage reduces the collet's accuracy and compromises its gripping ability. Remember, collets are typically made of a softer material than the toolholder, so they wear faster.

If collets are worn or loose, they permit the toolholder to wear excessively, resulting in tool breakage. Always check to ensure collet nuts are in good condition and torqued properly to prevent overtightening.

Pull studs, or retention knobs, are also vulnerable to wear. Pull studs, which are used to draw the tapered holder into the machine spindle, are unreliable when worn and should be checked at least once a year for wear. A worn pull stud can result in release of

Cleaning and inspection recommendations

To achieve the desired level of part quality and get the most life out of your toolholders, as well as machine tools and cutting tools, following basic housekeeping practices and tooling inspection intervals are important.

Train operators to inspect and clean the following during each shift:

- Toolholder surfaces where the holder contacts the machine spindle;
- Flanges, or the surfaces upon which the automatic toolchanger grips the holder;
- Collets, the pockets or tool-gripping surfaces within the holder; and
- Coolant connections, or through-tool coolant delivery systems.

The following are recommended intervals for tooling inspection.

- Toolholder body: annually
- Collet: annually
- Pull studs: annually
- Machine spindle: every 6 months, with a thorough monthly cleaning

—C. Gust

the toolholder during cutting, which can endanger workers.

Pull studs should be torqued lightly with a serviceable thread lock applied. This prevents overtightening and distortion of the taper at the retention knob end. This type of distortion can cause the small end of the taper to expand and contact the spindle taper before the gage line end, or large end, is properly seated. The result? Chatter, fretting and, eventually, failure.

Other toolholder mechanisms must also be inspected regularly. Normal wear and the presence of chips or corrosion can quickly degrade any toolholder system's effectiveness, reducing accuracy and part surface finish, while increasing machining cost.

The machine spindle should be cleaned thoroughly once a month to prevent any buildup of chips and oils that can cause the chips to stick to the spindle cavity. This buildup causes incorrect clamping of the toolholder, a weak connection and, ultimately, fretting.

The toolholder on the left shows wear lines, which are a result of an overtightened retention knob.

The spindle should also be inspected regularly to make sure that the Belleville springs, which retain the pull stud and toolholder, have not been damaged. Most spindle systems use a Belleville spring assembly consisting of 15 to 20 springs, and it is not unusual to find several cracked or broken springs in the assembly. Strain gages are available to test the spindle's retention force, to assist in evaluating spring damage without dismantling the spindle.

Because they are inside a spindle or toolchanger most of the time, toolholders can be inconvenient to inspect and replace. However, taking the time to maintain their condition can pay off in more consistent part quality, lower tool costs, longer spindle life and improved shop safety.

About the Author

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