JM Performance Products, Inc.

Guide To Improving Tool Performance

Improving the connection between the toolholder and the spindle is key to improving tooling performance and to holding critical dimension in production. JM Performance Products has assembled this guide as a way to help improve mating of the toolholder to the spindle. Following these steps can lead to increase in tooling life from 10 to 30% and the ability to bore .0001" in production.

Clean the Spindle

Proper cleaning of the spindle needs to be performed on a regular schedule in addition to new tooling installation. The accumulation of grease, dirt, and other materials can cause build-up between the taper of the toolholder and spindle. Build-up prevents the toolholder taper from properly seating with the taper of the spindle, which causes variable positioning of the toolholder.

Check the Toolholder

Most machine manufacturers grind their spindles to an AT3 Taper (Cone Angle Tolerance) and toolholder manufacturer's try to maintain an AT3 Taper. AT tolerances are logarithmic; the lower the number the tighter the tolerance. Matching tool taper tolerances with machine spindle tolerances is a crucial connection. The slightest mismatch in this connection allows the toolholder to not properly seat, which allows the toolholder to move in the spindle. Mismatch in the mating of the tapers of the toolholder and spindle is magnified at higher speeds. This movement will cause run out, chatter, harmonics, and excessive tool wear. The main cause of the mismatch of tapers is toolholder tapers that have been distorted by the retention knob. To determine if toolholders are expanded, the Taper Shank Test Fixture must be used.

The Taper Shank Test Fixture is ground to mirror the taper of a CNC spindle. It measures the change of diameter by monitoring any movement of the toolholder perpendicular to the axis of the toolholder. The indicators measure movement of the toolholder in increments of 1/10,000 of an inch. The AT3 grind limit is .000059". Two graduation lines on the Taper Shank Test Fixture dial = .000058".

The Test Fixture can be used with a toolholder with or without a retention knob installed. When a holder has a retention knob installed, the fixture can be used to measure the holder. The retention knob is then removed and the holder is re-measured. This process is used to calculate any change in size of the toolholder. The process can be reversed and measure any growth of the toolholder when a retention knob is installed.

Non Destructive Hardness Test

The Taper Shank Test Fixture can also be used as a non-destructive way to test new toolholders to make sure they have been properly heat treated. Holders that are soft will not perform properly and should be removed from production. This process of testing toolholders requires the use of a Test Master. The Test Master is made of through-hardening material with threads and has the same flange diameter and flats that retention knobs have. The Test Master is installed at a predetermined torque setting into the toolholder. The Taper Test Fixture is then used to measure dimensional changes. Toolholders that read a variance of .0004" or greater should be returned and exchanged.

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Retention Knob Information

When a standard retention knob is inserted into the toolholder and tightened, the pressure of the threads expands the small end of the toolholder causing a radius to form. This expansion of the toolholder prevents it from properly seating with the spindle. When this occurs, it allows the large end of the toolholder to move in the spindle creating harmonics. Evidence of a loose toolholder is fretting marks on the toolholder.

The High Torque Retention Knob was designed to stop toolholders from expanding. They work by placing the force of the threads of the retention knob into a deeper cross-section of the toolholder. By removing contact with the thin wall cross section of the toolholder, expansion is eliminated.

Pictured to the right is a standard retention knob and and a High Torque Retention Knob. The High Torque knob is a newly designed and engineered retention knob by JM Performance Products. The High Torque Retention Knob is the only knob to stop toolholders from expanding when installed properly. The High Torque Knob will work in any toolholder that is built to industry standard specifications.

The picture to the right shows the fretting marks often found on expanded toolholders .

Proper torque settings are essential for installation. Over tightening a retention knob will expand the holder. Installed without enough torque due to the elasticity of steel, a retention knob will stretch and eventually snap. Once a retention knob has been installed, hold it and the toolholder up to a light and visually check to make sure no light can be seen under the flange of the retention knob and face of the toolholder. When changing tools, retention knobs should be examined for damage, stress fatigue, nicks, or scratched surfaces. If these conditions exist, the retention knobs should be immediately replaced. Also examine the face of the toolholder where the retention knob seats and make sure there are no burrs or nicks in either place. If the knob has o-rings, they should be examined and replaced if they show signs of wear, swelling, flat spots, or cracks. JM Performance Products recommends retention knobs be replaced every three years under normal wear. (Based on a 40 hour work week).

Checking The Drawbar Force

Drawbar force is critical for properly holding the toolholder in the spindle. When a tool is not properly clamped, it allows the toolholder to move in the spindle, which leads to problems with repeatability, bad finishes, and poor tool life. A low drawbar force can be from normal wear, broken springs in the drawbar, or an out-of-adjustment gripper mechanism. Broken springs or a loose gripper mechanism can allow tools to be pulled from the spindle during machining. Left unchecked, a tool could eventually pull out during a cut, possibly damaging the spindle, cutter, toolholder, and work piece.

The ClampForce Gage is a quick and easy way to check drawbar force. It works by simulating a tool in the spindle and measuring the clamping force in pounds of force. The first step is to make sure you are using a pressure gage that has capacity over that of the drawbar that you are checking. Select the proper taper size spindle adapter for your machine. Install the spindle adapter onto the gage head using the transfer screw along with the retention knob from your machine. Using the manual tool change method, install the ClampForce Gage into the spindle and energize the drawbar. Consult with a qualified technician if a low drawbar force is detected in your spindle.

Spindles with low drawbar force should be repaired before continuing, especially where high spindle speeds, precision boring, or heavy cutting forces are required. Frequent testing will tell you if something is quickly failing and needs immediate attention. Long term test records should be kept; they can be very helpful when diagnosing spindle drawbar problems. This will help you avoid downtime and the expense of a machine crash from a dislodged tool.

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