How Manufacturers Can Optimize CNC-Machine Tooling and Increase Productivity by 10-40%

Q & A with JM Performance Products

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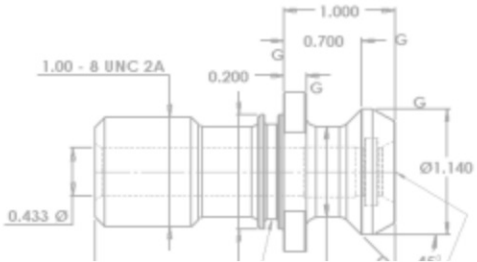
What are some issues that the CNC milling operations face, and/or how can manufacturers improve tooling performance?

As in many other industries, to be competitive in the world market, CNC manufacturing companies need to reduce their costs of production and increase their production output. More parts at less cost per part.

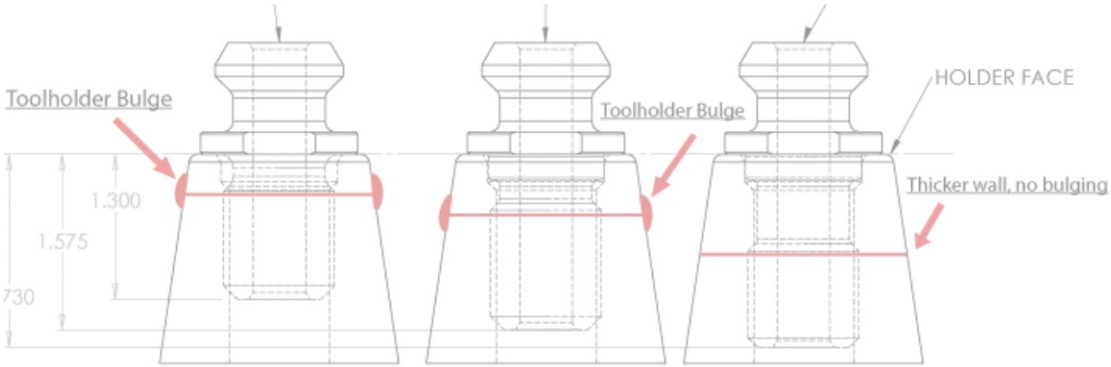
Unfortunately, with escalating raw materials prices, this becomes difficult. Therefore, manufacturers have to look to controlling tooling costs and costly downtime, while working to increase speeds and feed rates.

Better finishes yield less polishing time, which impacts outputs, and attributable man-time (wages) per part. By implementing standard routine maintenance practices, downtime for critical maintenance can not only be reduced, but planned into production scheduling. Reducing variables that impact spindle performance can extend tool life measurably.



How can manufacturers optimize cnc-machine tooling and performance to increase productivity by 10-40%?

This is multi-tiered. It requires manufacturers to establish, maintain, and enforce procedures and practices in their manufacturing environment that encompass employee education, preventative maintenance with routine inspection, and use of proper tooling in all CNC milling machines.



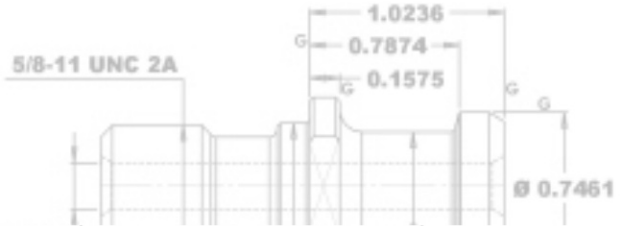
Employee Education

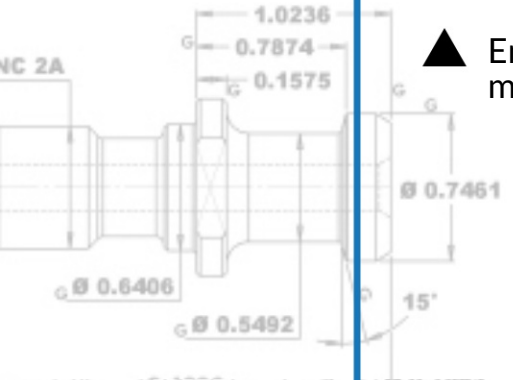
A full understanding by all employees involved in the set-up, maintenance, and operation of CNC mills is crucial to eliminate variables that can affect CNC spindle performance.

Improper installation procedures or applying excessive torque during tool installation will cause the toolholder to expand. This expansion creates a mismatch between the toolholder and the spindle creating vibration and chatter due to movement of the holder within the spindle. This movement puts unnecessary stress on the spindle, the toolholder, and the tool(s), especially those with carbide tips and edges.

Excessive torque during installation of retention knobs can weaken the knob and cause premature breakage, resulting in possible damage to the toolholder, the workpiece, or the spindle, or even harm the operator.

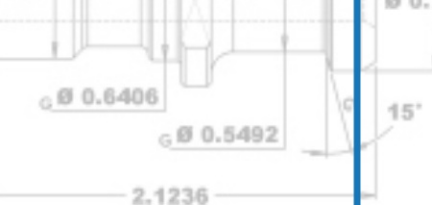
When not enough torque is applied during installation, a retention knob can back out of the toolholder or break prematurely due to metal fatigue. The knob needs to be torqued so that a proper preload is obtained to maximize retention knob performance and longevity.





The use of the proper tools during installation and set-up will ensure that the set-up process is not a variable in tooling and/or spindle performance.

- Each employee should have access to training materials and/or training videos.
- Employees should have access to crucial information required for setup to include the Manufacturers' drawbar force specifications, retention knobs required for each mill, tightening specification, maintenance schedule(s).
- Tools and retention knobs should be installed into toolholders using a Smart Tool-Setter, torque wrench and appropriate socket to eliminate over-torquing or under-torquing during installation.
- Employees should be aware of problem indicators (burnishing, run-out, chatter & vibration, excessive tool wear) so that appropriate countermeasures can be taken to quickly eliminate the problem(s).
- Employees should be knowledgeable about machine and tooling maintenance cycles to help reduce downtime.



Maintenance

Clean the Spindle

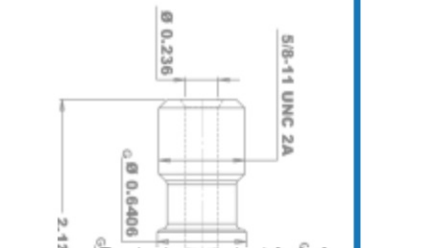
Proper cleaning of the spindle eliminates the accumulation of grease, dirt, and other materials which cause build-up between the toolholder taper and the spindle. This build-up prevents proper seating of the toolholder taper with the spindle, causing variable positioning of the toolholder.

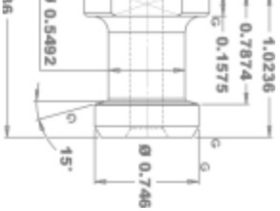
Spindle Restoration

Over time grease, dirt, and materials become adhered to the spindle, affecting tooling performance. Regular routine maintenance of the spindle will extend the time between costly major spindle maintenance and regrinds by eliminating high spots caused by debris and rust. These high spots contribute to toolholder movement, while rust can pit the spindle.

Monitor Drawbar Force

Optimal drawbar force is essential, especially where high spindle speeds, precision boring, or heavy cutting forces are required. Scheduled testing and maintenance of long-term test records will aid in spindle drawbar problem diagnosis. Preemptive spindle maintenance aids in minimizing down time and mitigates the risk and associated expense resultant from a machine crash caused by a dislodged tool. If the drawbar force is 80% or less of the machine manufacturer's recommendations, the Belleville washer stack needs to be rebuilt, and arrangements should be made with your service provider.





Toolholder Inspection

Improving the connection between the toolholder and the spindle is essential to improving tooling performance to holding critical dimensions in production. Using a Taper Test Fixture, holders should be checked for hardness, wear, and expansion. Toolholders revealing 0.0002” or greater diameter expansion upon inspection should not be used and should be exchanged with the manufacturer.

Resurface/Restore the Taper Toolholder

Just as a clean spindle is essential for proper taper contact between the spindle and v-flange toolholder, the same applies to the toolholders. A build-up of oil, dirt, hardened grease and cutting fluid, along with nicks and dents on the holder can jeopardize this taper contact. The proper use of abrasive material to periodically resurface the v-flange toolholders will extend the life of the holder and the spindle.

Inspection of In-Service Retention Knobs

Retention knobs are not intended to last indefinitely. The normal life span is approximately 6,000 to 8,000 hours of use, which translates to 3 years of single shift usage, or 1 year of 24-hour use (3 shifts). Retention knobs that have been in service for an undetermined period of time should be mag particle inspected to ensure they are not showing signs of stress, cracks or fractures that could cause critical failure and damage to the machine and/or operator. To mag particle inspect requires removal of retention knob. Removal and reinstallation cause stress and possible failure of the knob. Once the retention knob is removed, it should be scrapped and replaced with a new knob to ensure physical integrity.

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Tooling

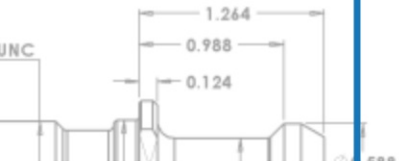
High Torque Retention Knobs

When a toolholder is not fully engaged in the spindle, each time the cutting flute makes contact with the work piece it will try to move in the opposite direction, creating harmonics and chatter, excessive spindle wear, poor tool life, inability to maintain tolerances, and poor finishes.

The threads of a standard retention knob will expand the top of the toolholder when installed. This is due to the force being applied to the first two threads at the top of the holder where the material is the thinnest. Patented High Torque Retention Knobs are designed to eliminate toolholder expansion, allowing the toolholder and the spindle to properly mate.

Dynamically balanced by design and made to fit existing toolholders, the High Torque knobs use a precision pilot which increases rigidity. Also, a relief beneath the pilot forces the threads deeper into the thicker cross-section of the toolholder. Additionally, unlike other retention knobs, the High Torque knobs carry a calculated installation torque value which is a function of the taper size and the spindle drawbar force.

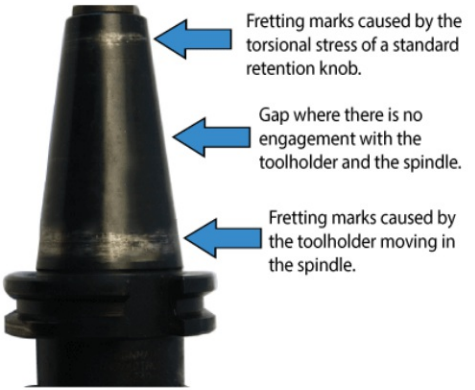
Manufactured from 8620H, 9310H and H13 steel, the knobs are shot peened to reduce stress, hard ground, and laser marked for traceability.



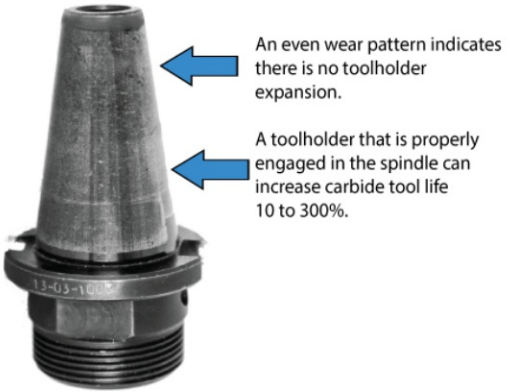
The High Torque Retention Knobs are proven to:

- Improve finishes
- Increase tool life
- Increase rigidity
- Improve tolerances
- Increase productivity by allowing increases in feeds and speeds
- Improve toolholder life
- Increase spindle life
- Decrease harmonics, vibration, and chatter

Toolholder with uneven wear pattern



Toolholder with even wear pattern



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Retention Knob Sockets/Torque Wrenches/Adapters

Proper installation of a retention knob into the toolholder is critical to maintain proper toolholder to spindle engagement. Improper retention knob installation can lead to stress on the knobs, causing breakage or damage to the toolholder and spindle.

Retention knob sockets are manufactured for DIN, ANSI, and JMTBA style knobs for 30, 40, 45, 50, and 60 taper sizes.

Torque wrenches are available in 10-80 ft/lbs and 20-150 ft/lbs.

½" and 3/8" drive torque wrenches are available in 10-100 ft./lbs. and 20-150 ft./lbs.

Implementation of the system yields measurable results:

- Increased tool life
- Improved spindle life
- Reduced machine downtime
- Faster set-up times
- Increased feed rates
- Increased RPS (Speed) rates
- Reduction of machine operator time per mill
- Reduced run-out
- Better finishes

Why don't the majority of manufacturers use a Spindle Optimization System?

The majority do not identify the correlation between sound maintenance practices and mill performance. The mills represent a significant investment and often the attitude is that it should perform consistently without too much attention. When issues surface, such as tolerancing issues, skilled machinists will make adjustments to the process without looking at possible causes.

Normally, they do not recognize the need to adopt a Spindle Optimization System until they have experienced a catastrophic failure, higher than normal rejections, or are unable to produce parts economically.

What are some common misconceptions that manufacturers hold?

One of the biggest misconceptions in the industry is that the retention knob is just a “bolt”. In reality, the retention knob is as important a tool as any of the end mills, cutters, drills, or toolholders. In fact, without the retention knob, the rest of the tooling cannot be used in v-flange manufacturing. The knob is the one part that creates the secure fit of the tooling in the spindle.

Manufacturers will spend significant money to bring in a high-end, fast, multi-axis machine and equip their tool crib with the best tooling, but then buy the least expensive knobs they can find, thinking that the knob is unimportant, while in fact the quality and design of the retention knob can completely negate the benefits of purchasing high-end tooling and machines.

What outcomes have manufacturers seen after implementing a Spindle Optimization System?

- Manufacturers have experienced tool life increases by 15% and more.
- They have seen their load meters drop, indicating the machine is using less power.
- Finishes are improved because of run-out elimination.
- Set-up times are reduced which means tool changes are faster so production breaks for retooling are reduced.
- Spindle regrinding and rebuilding is very expensive, but proper maintenance delays the need to regrind the spindle or maintain the Belleville washer stacks.
- Elimination of vibration and chatter which impacts both the machine and the tools.
- Maintaining tight tolerances without backing off the speed.

JM PERFORMANCE PRODUCTS, INC

Originally founded in 1966 under the name J&M Machine, Inc., we recently changed names as our focus changed. With only a handful of machines and a family's desire to be more than the stereotypical job shop, JM Performance Products has firmly established itself as a model shop leader for manufacturing development, and quality control of precision turned parts.

In order to stay technologically ahead in this field, JMPP continues to enhance and refine its technology, quality, and production methods through research, education, and advanced equipment. With the combination of our skilled, team oriented craftspeople, JMPP's state-of-the-art equipment, and futuristic innovativeness, our common goals of customer satisfaction and being the "next generation" manufacturing company, can be accomplished.

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