TAKING THE HEAT OFF LIVE TOOLING

Live tool with coolant-fed bearings can run at high speeds and high duty cycles without the accuracy and failure frequency problems of conventional bearings.

As live tooling becomes more popular in many CNC turning centers, the use of tooling with sealed bearing performance is becoming a challenge for shops that produce components in high volumes or with lengthy cycle times.

Today, most common live tooling designs use sealed bearings that may be contaminated or overheat under heavy, repetitive use. This can diminish machining precision, reduce the service life of tools, and result in frequent and costly maintenance that compromises productivity.

"If a shop produces items that are high cycle or high volumes, then thermal growth will usually occur in the tool head," explains Mike Thompson, lathe supervisor, Micro-Tronics, Tempe, AZ, a precision machine shop that produces metal valves and related products for the aerospace and automotive industries. "This is because the sealed bearings in the tool head tend to overheat during continuous use or under heavy loads, and that can cause serious problems."

Among the problems that Thompson experienced with live tools having sealed bearings was thermal growth causing offset deviations that adversely affected workpiece tolerances. In another instance, metal chips entered and fouled the tool head bearing after the bearing seal had failed.

To avoid such problems Thompson's company recently acquired a unique type of tool holder

each of its new Okuma LB300 lathes – a toolholder with a coolant-fed, or externally cooled, bearing assembly from Planet Products Inc. (PPC), Cincinnati, Ohio. PPC engineers have developed a patented live tool design for turret lathe applications that uses a continuous flow of filtered machine coolant to lubricate and cool the bearings, eliminating many of the existing failure modes.

Unlike conventional bearings, coolant-fed bearings do not rely on seal integrity or the lubricant packing to keep bearings operating normally under even stressful conditions. Instead, the filtered coolant used to externally cool and lubricate the live tools and workpieces now flows through the tool, keeping the bearings cool and maintaining accuracy.

Conversely, the design of conventional tooling is to prevent coolant from contacting bearings because, in the event that coolant contacts the bearing's grease packing, sludge forms that will hinder bearing functionality and eventually cause failure.

Thompson notes that, in some cases when bearing seals fail, foreign objects such as metal shavings from the workpiece can contact the bearing, causing failures. It is possible to virtually eliminate this danger with the externally cooled and lubricated coolant-fed bearing design, because the coolant will wash any metal chips or other contaminants away from the bearing assembly.

Pushing the Limits

In addition to standard coolant-fed live tools for turret lathe applications, PPC has also developed a line of speeder over-speed heads. These heads feature a gear-up ratio that allows the tool to spin faster than a turret drive. For example, if the user has a 4,000rpm turret, they may be able to get 12,000rpm to 15,000rpm with a sped-up ratio. This increased speed, along with the coolant-fed bearing feature, is advantageous for lathe operations with high-cycle, high-volume requirements, enabling them to process components considerably faster with dramatically increased tool service life.

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Those benefits have proven to be of significant value to manufacturers such as Buku Performance Products, Gambrills, Md., a small business that manufactures aftermarket high-performance components for radio-controlled vehicles.

"We compete directly against overseas manufacturers located in lower-cost environments, so production costs are always a concern for us," says Dave Maslar, Buku, CEO. "Making an investment in new tooling is a serious one that we consider carefully to ensure that we are improving the efficiencies of our existing production equipment."

When Maslar heard that PPC offered an over-speed live tooling head for his model of turret lathe, a Daewoo (now Doosan) Puma 240MB, he

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decided to see if that head could enable Buku's operation to improve production throughput of its aluminum components.

"Our cycle time was approximately six-and-a-half minutes and over four of those minutes were holding a 3/32" end mill in machining aluminum and cutting deep slots," Maslar explains. "The live tool turret on my machine is limited to 5,000rpm. That was the limiting factor for the time that it was taking to produce these components. So, the over-speed appeared to be a good way to address that issue."

By using the over-speed head, Maslar was able to reduce the cycle time by more than two minutes while maintaining tool cutting reliability and accuracy even though the cycle time placed a heavy demand on the tool.

"The bearings are running fast and they are running for a long time," he says. "But having the coolant lubricate the bearings eliminated any concerns we could have had regarding overusing the live tool for that amount of time."

Maslar adds that when bearings are externally lubricated and cooled, as with the PPC over-speed tool, the bearings tolerances can be tighter, which will improve the runout characteristic in the bearing.

There is an upper limit to the how tight you can make bearing if you are going to run the tool it is in for a long time, he says. Yet, he experienced a significant improvement in runout that he attributes to the active, external cooling and lubrication of the bearings in the tool head.

"That is a very important result because I am running a 3/32" three-flute end mill, and the feed-per-revolution is distributed among three cutting teeth," Maslar explains. "Even the slightest bit of runout can cause one tooth to substantially overcut, wear faster, and the tool will fail more quickly than it should. From a tool cost, that may be no big deal; but, from a production downtime standpoint, that may be very expensive. So far, we have not broken one end mill, and that reflects cutting times of 20 to 30 hours on a single end mill."

Maslar adds that, while Buku's operation is cutting aluminum, which is a soft material, shops that are cutting very hard materials should have an even greater appreciation for the tool runout improvements, because runout is usually a very significant issue in pushing the limits of a machining operation.

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