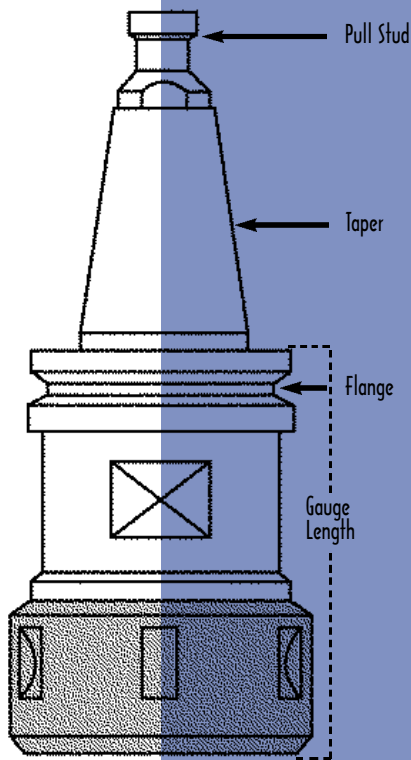


CNC Router Maintenance

TECHNICAL

BULLETIN



How to
determine
if a CNC
router tool
holder is
worn out.

GENERAL OVERVIEW

Modern CNC routers feature high-capacity tool changers that automatically swap tool holders in and out of the main spindle by a high speed swing arm, a rotary carousel, or by manual override. Periodically tool holders must be examined and possibly replaced to maintain acceptable performance. Determining if these key components need to be replaced is a difficult task. This article will help explain the criteria used to evaluate tool holders, describe when and why it is necessary to replace them and discuss the implications of not replacing them when needed.

Today's CNC routers with automatic tool changers have become the defacto standard in factories and job shops. Most operators do not have the knowledge to know why it is necessary to replace their tooling or the experience to tell when it is time to do so.

When training new operators each one should be instructed on properly evaluating tool holders so they *do not run the risk of causing expensive damage to the spindle*. First, a general understanding of tool holder components and their functions must be obtained. There are three main parts to a tool holder (also known as a collet holder or an ISO cone).

(taper)

The taper is the conical shaped area of the tool holder that enters the spindle when changing the tool. An 8 degree taper automatically centers the tool into the spindle. The taper is accurately ground to a tolerance of .0002" for both the taper tolerance and outside diameter tolerance.

(flange)

The flange is the part of the tool holder that the automatic tool changer locks on to when moving the tool from the tool changer to the spindle or back again. The flange is visually identified as the V groove found on the outer most diameter of the tool holder.

(collet pocket)

The last part of the tool holder is the collet pocket

into which the collet is inserted before being secured by various types of collet nuts.

There are some different types of holders that have other extensions instead of a collet pocket, but for this article discussion is limited to holders with collet pockets.

(sizing tool holders)

A typical size description of a tool holder is ISO 30 by ER 32. The ISO refers to the flange, the 30 refers to the size of the taper and the ER 32 indicates the style of collet used. There is one other size description that references the length of the extension of the collet holder. This is usually between 50mm and 80mm long. The length refers to how far the holder extends out in front of the spindle face (see diagram), called the gauge length dimension.

TOOL HOLDER EVALUATION

(taper)

When evaluating whether a tool holder is worn, first check the tapered part of the tool holder where it contacts the spindle. If worn this area can have a direct effect on machining accuracy. If there are any imperfections in the taper of the cone or

"...do not run the risk of causing expensive damage to the spindle."

any wear in this taper, the tool holder should not be used. Using a worn tool holder will quickly wear out your tools and ultimately ruin your spindle.

This is similar to using a bad rim on a good tire. If you use an out of round rim you will begin to ruin the tire and wheel bearings and cause vibration in the car. The same thing happens when you use a worn out toolholder. The worn taper causes an out of round condition when the tool holder is inserted into the spindle. This causes run out which leads to excessive wear on both the cutting tool and the spindle. After just several hours of use in a worn tool holder, a cutting tool can become worn

out. Any out of round condition leads to an imbalance and causes vibration. Tool vibration will cause a poor surface finish which may require expensive sanding or polishing to remedy. Vibration can increase heat build-up in the head and spindle causing spindle bearings to prematurely fail.

(fretting)

If noticeable marking becomes evident on the tapered part of the tool holder, a condition called fretting may be occurring. Fretting happens when two steel parts constantly create friction between each other. Visually it is identified as small copper colored pits or copper colored marks on the largest diameter of the taper. This is evidence that the tool holder is experiencing some wear. It can be mistaken for rust, but it is not. Once there is a noticeable surface finish change along the largest diameter of the taper the tool holder should be replaced.

(cleanliness)

The second condition that should be checked on the tool holder is the cleanliness of the collet pocket. This area must be clean and free of oil, dust, and dirt. This area contacts the collet taper and if damaged by contaminants it will effect the accuracy of the cutting tool. When a tool holder is manufactured, a specific measurement is made for the runout or concentricity from the area that contacts the spindle to the area that contacts the collet. If there is any damage to this area of the collet holder, it must be replaced.

(collet nut)

Another part of the tool holder that must be maintained is the collet nut. In order for the tool holder to remain balanced it must have a balanced nut

“...become very dangerous as the spinning tool holder flies through the air.”

attached to it. The most common type of collet nut is a bearing nut. Compared to a standard nut, the bearing nut reduces the friction between the collet and nut, thus creating more holding power on the shank of the cutting tool than non-bearing nuts.

“Power Coat” anti-friction collet nuts are significantly better than even bearing nuts at reducing friction between the collet and nut, and creating more holding power on the shank of the cutting tool. This type of nut reduces the risk of the collet nut loosening and the cutting tool flying out of the collet. By reducing the radial pressure on the collet as it is being torqued down “Power Coat” nuts allow the collet to go further and straighter into the collet pocket. This improves holding

power on both the collet and the tool shank by up to 100% compared to standard nuts. Runout is reduced by 0.0001” and carbide tool life is increased up to 10%.

“Power Coat” nuts are significantly less expensive than bearing nuts and are strongly recommended when replacing or adding new collet nuts to the tool holder. A torque wrench is available to make sure the collet nut is tightened to the proper torque. It is great insurance to reduce the possibility that the collet nut would loosen while in operation and release the router bit causing a dangerous situation for the operator.

(pull studs)

Another part that must not be ignored when evaluating the tool holder is the pull stud. The pull stud is screwed into the top of the tapered part of the tool holder. The pull stud is secured by the clamping set inside of the spindle to pull the tool holder up into the spindle and a spring-loaded draw bar draws the tool holder into place. If the pull stud fails and the spindle is turning at 18,000 RPM's, the tool holder may dislodge *become very dangerous as the spinning tool holder flies through the air*. The pull stud must be checked for wear periodically. If any wear is detected, it must be replaced immediately. Do not take chances on keeping worn pull studs in the tool holder.

(collets)

Collet maintenance is very simple when compared to the tool holder. Collets must always be kept clean and free of dust and debris when changing the cutting tool. If there is any damage to the outside or inside diameter of the collet, it must be replaced. These diameters determine the collet's accuracy. If there is any wear or damage these areas, the collet is ruined. Dust covers for your collet can be purchased to eliminate dust, dirt and grime from entering the collet pocket.

A collet is manufactured of softer metal than a tool holder. As a result, the collet will wear quicker and is typically replaced before the more expensive tool holder. Collets that are severely worn cause excessive wear on both the tool holder and the cutting tool and sometimes cause small diameter carbide bits to break.

Worn collets can cost manufacturers a lot of money without anyone realizing the effects of the increase costs of router bits. Collets should be replaced at least once every six months based on an every day use.

In summary a good preventative maintenance program to replace both the collets and tool holders should be maintained by each company.

