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Knob Knowledge

What you need to know about retention knobs.

A cursory glance at a machine tool brochure tells the story: Machines are faster and more powerful than ever. In addition, machine tools are becoming "smarter," which allows them to cut complex shapes with less operator input.

But even with all the advancements in machine tool technology, proper maintenance remains critical. This holds true for everything from the major components to the lowly retention knob for flange-compatible spindles.

Retention knobs are small, disposable and relatively cheap. But few realize that they're also crucial to machining success, because they serve as the bridge between the toolholder and machine.

For the machine tool to run properly, you need to know how the knob interfaces with the machine tool, as well as how toolholder standards influence that interface. In addition, you should know how to maintain knobs, select a replacement and recognize knob wear.

Nonstandard Standards

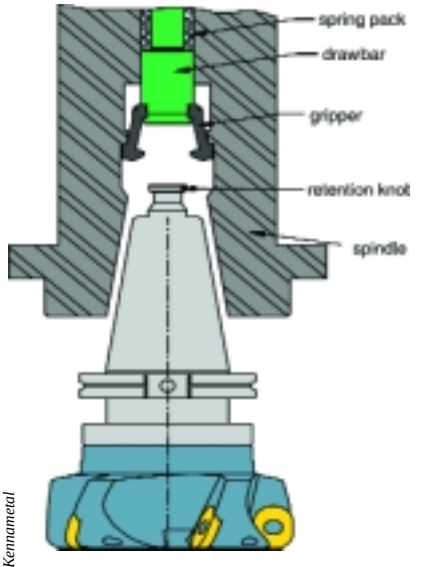
The retention knob is a threaded part that allows the machine tool's spindle to grip and accept a flange-style toolholder (usually a CAT or BT standard). A drawbar with gripper fingers grabs the knob and pulls it into the spindle. Force is maintained via a Belleville washer-type-spring pack. Therefore, a firm grip on the knob is often the only thing preventing the spindle from hurling 20 to 50 lbs. of toolholder and cutting tool across a shop floor.

As might be expected, the influence toolholder standards exert over retention knobs is profound. While the knobs are designed according to toolholder and machine tool standards, the knobs themselves are by no means standardized.

This "nonstandardization," however, does not mean that retention knobs are beyond understanding. It's just a matter of breaking the knob down to its basic components.

For example, when John W. Stoneback, president of retention-knob maker J&M Machine Inc., Fairport Harbor, Ohio, first looks at a knob, he sees two things: the head and the thread. The head is what the fingers grip and the thread screws into the toolholder.

According to Stoneback, both ends of a retention knob conform to standards, such as those established by ANSI, DIN, ISO or JMTBA (Japan Machine Tool Builders Association). Moreover, the standard of one end generally matches the other (i.e., an ANSI thread with an ANSI head). But Stoneback said sometimes there is mixing and matching of styles, leading to combinations such as an ISO thread mated with an ANSI head.



Kennametal

Kennametal identifies three major components of the adapter pullback system: the spring pack, gripper fingers and retention knob.

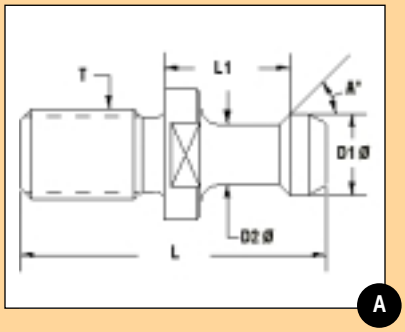
This, however, is only the tip of the iceberg when it comes to the overall variety of retention knobs available. Indeed, it is accurate to say that there are about as many specific knobs as there are models of machine tools.

Tom Christen, president of Retention Knob Supply & Mfg. Co. Inc., Bellefontaine, Ohio, attributed the large variety of knobs to machine tool engineers who strove to make

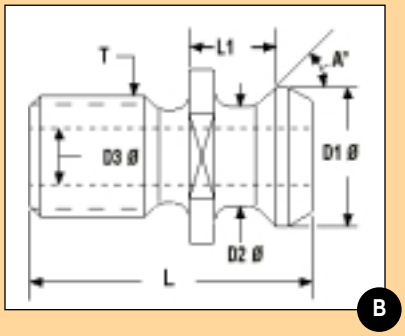
Standard-knowledge test

The following diagrams are of various retention knobs offered by J&M Machine Inc. Test your knowledge of knob standards and match the following thread/head combinations with the diagrams below. The answers are on the top of the next page. Good luck!

1. ISO/ISO (Style A) _____
2. DIN/DIN (Style B) _____
3. ANSI/ANSI _____
4. DIN/DIN (Style A) _____
5. ANSI/JMTBA _____
6. ISO/ISO (Style B) _____
7. JMTBA/JMTBA _____
8. JMTBA/ANSI _____



A



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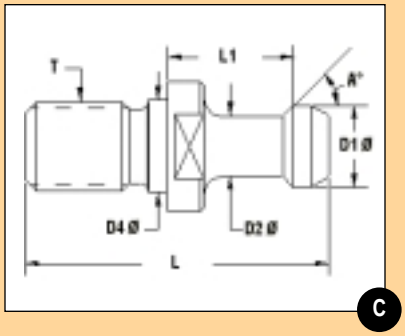
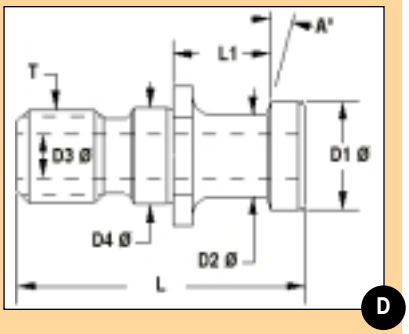
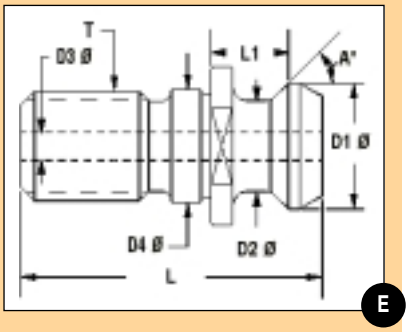


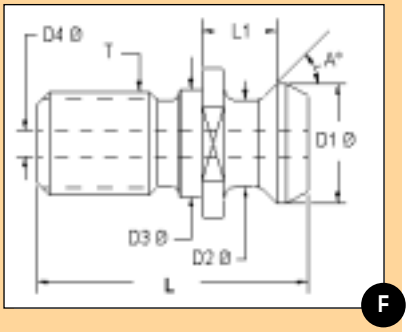
C



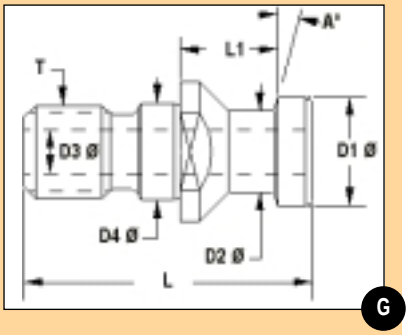
D



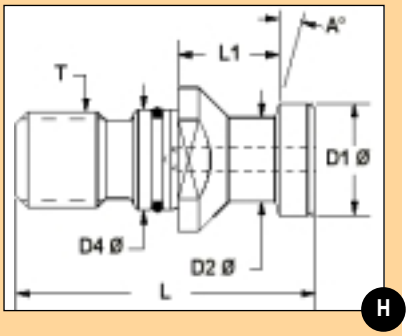
E



F



G



H

their machines unique. He said that designers not only followed the established standards, but they varied from the standards to make the knobs unique to their particular machine. From there, the variations in knob design proliferated.

"Pretty soon, you had a situation where engineers and the machine tool builders really weren't sure what retention knob went with their machines," Christen said.

While some knobs can fit into more than one machine, at least in terms of adapted tapers fitting into the larger-size spindles, knobmakers agree that whatever knob is used, it must fit precisely into the spindle. The consequences of an error are severe, to say the least. In addition to the high cost of downtime, there is also the possibility of a broken machine, personal injury—even death.

To underscore the gravity of choosing the right knob, each page in the knob section of a catalog published by Kennametal Inc., Latrobe, Pa., includes a clear warning about the danger to life and property if an incorrect knob is fitted to a toolholder.

Selection Criteria

Given the dizzying array of knobs available, how do you go about selecting one?

A good place to start is the owner's manual that came with your machine tool. Christen said that most machine builders provide a drawing of the required knob in the manual. He added that knob dimensions might also be taken directly from the knob that comes with the machine.

For most knobs, there are seven to 10 dimensions that suppliers need to fulfill a customer's orders. However, Christen said there are three broad areas that really need to be paid attention to when selecting a retention knob: the head angle, the head's gage length and the thread type. Fortunately, all three areas are relatively easy to determine, because you can simply measure them with standard tools, such as rulers and calipers.

The picture gets more complicated when a shop needs to match a tooling

Answer Key:
1-D, 2-H, 3-B, 4-G, 5-A, 6-E, 7-C, 8-F

standard that's different from its machine. An example would be if the tooling were in English units and the machine tool specs were metric.

Christen cited a shop that purchased a metric machine tool and English-taper adapters. Retention Knob Supply had to create a knob with metric measurements for the knob and English threads for the toolholder.

A fourth criterion that Christen mentioned is the heat treating of the knob. When diagnosing a problem that may have been caused by a faulty knob, improper heat-treatment is one of the areas considered.

"It's one of the first things we check if a customer has a problem," said Christen. "Our metallurgist will make sure that the heat-treat process was done correctly."

Maintenance Matters

Although retention knobs are consumable parts, a cost-efficient shop takes steps to make them last as long as possible. Stoneback stressed that knobs need to be stored properly when not in use. It's important that they don't touch each other. Ensuring this helps prevent them from incurring the nicks and scratches that can limit the fingers' ability to grab the knob tightly.

Proper maintenance is especially critical for knobs that have O-rings fitted on or in them. Stoneback recommends changing O-rings on a regular basis. In addition, he recommends pulling the knobs off and cleaning them thoroughly, making sure no particles or grit are present.

Properly tightening a knob also extends its life. Stoneback said it's important to tighten them with a torque wrench. "If you try tightening them with a crescent wrench, you might as well forget about it. You're going to start to roll over your corners."

The torque wrench also ensures torque uniformity. "A knob's funny," continued Stoneback. "You don't want to overtighten it because that can cause a fracture, and you don't want to undertighten it because you'll end up [throwing] the tool" from the spindle.

Above all, Stoneback strongly urged shops not to cut corners, such as using binding compounds to force a knob into a hole for which it was not designed. He said he has seen too many shops try this with unhappy results. "If the knobs don't stay in properly by themselves, then there's something wrong."

Recently, Stoneback set out to determine how many knobs in a customer's shop were cracked. But, the task was impossible to perform because the shop had glued its knobs into toolholders. On that basis alone, Stoneback dismissed the shop's safety program as "nonexistent."

Speaking of safety programs, Stoneback also stressed the need for shops to maintain records. Such records, he said, should include who inspected the knob, what type of inspection was conducted and when it was performed.

And, he recommends that knobs used for roughing operations be inspected with a magnetic-particle inspection machine. This procedure, which usually requires knobs to be sent out, identifies any stress fractures that may have developed beneath the surface.

Wear Evaluation

Stoneback briefly described what to look for when inspecting a knob for wear. When gripper fingers grab a knob, small marks are produced on the knob's surface. He said that the marks on each side of the retention knob should be compared with the marks of the gripper fingers that grab the knob. The marks should be uniformly spaced.

Therefore, if a machine has three gripper fingers, the operator should see three evenly spaced and uniform marks burnished into the angle under the head of the knob. A broken finger will dig into the knob, leaving a telltale, nonuniform mark. By examining the knob's surface and angle underneath its head, Stoneback said, "you can tell the basic condition of your feed fingers."

Getting a grip on knob knowledge is not hard. It takes a basic understanding of your machine tool and toolholder, as well as documenting the essential knob dimensions and performing routine, periodic inspections for wear.

The following companies contributed to this article:

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