

STEADY

as it guides

While rigid, accurate CNC machine tools and modern drill designs minimize the need for drill bushings, the well-proven concept remains a valuable tool for select applications.



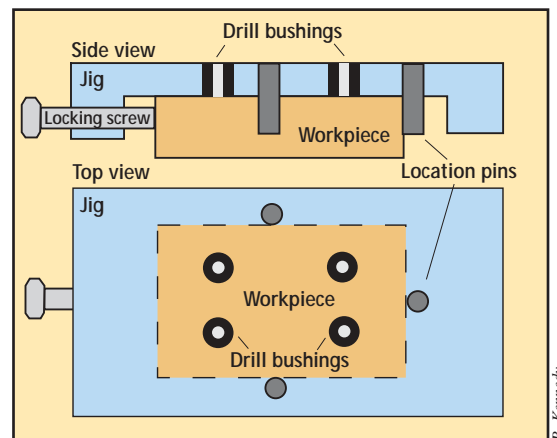
A drill bushing positions and stabilizes the drill to assure precision and repeatability.

For decades, drill bushings were required for precision holmaking operations. A shop would build a fixture to lock in the relative positions of the drill and part, then use a jig fitted with a hardened-steel bushing to guide the drill.

Such setups ensured that the drill entered the workpiece straight and produced an accurate hole. It also eliminated the need for pilot holes; prevented drill wandering and chatter when drilling holes in angled surfaces; provided stability when drill overhang was excessive; and reduced tool breakage.

Today, drill bushing use is in decline. The main reasons are the emergence of rigid, fast CNC machine tools and advanced drill designs. CNC machines can apply a spot drill and quickly follow it with the drill that penetrates to the specified depth. And sophisticated geometries allow drills to enter a workpiece without spotting.

Scott Stewart, applications engineer at International Drill Guide Inc., Anderson, S.C., pointed out that 30 years



In a classic drill bushing setup, a jig is located and locked onto the workpiece to assure repeatable positioning of the drill bushings and resultant holes.

ago, automotive plants employed transfer lines with dedicated machines arranged in multiple stations. “They would use drill bushings at every station where they used a drill,” he said. Today, most automotive work is done on CNC machines, where “there usually isn’t space in the fixture to mount a bushing,” Stewart said.

“Drill bushings were big for 50 or 60 years,” said Al Rocheford, who manages daily operations at Axly Tool & Bushing, a Briney Tooling Systems company located in Bad Axe, Mich. Axly still

manufactures bushings and supports existing installations, but the standard drill bushings that formerly made up the bulk of Axly's output now constitute only about 8 percent of its business.

Ray Yillik, founder of carbide bushing maker Yillik Precision Industries, Ontario, Calif., said: "In the smaller tool-and-die and production shops, they are still using drill bushings. The technology is good. It works. But the reality is that it is a dying commodity, because the machines are getting so good."



Yillik Precision

Drill bushings made of tungsten carbide can provide 10 to 50 times the wear life of plain steel bushings.

Filling Needs

While widespread use of commodity-type drill bushings is on the decline, demand persists for bushings that fill specific needs. Marshall Johnston, plant manager for All American Products Co., San Fernando, Calif., offered the example of a pin-locking bushing system that sees frequent application in the aerospace industry. The bushings are for use with a small ($\frac{3}{32}$ " to $\frac{1}{2}$ " in diameter) drill and an air-fed drill motor. Johnston said the system is "real handy to get in small places."

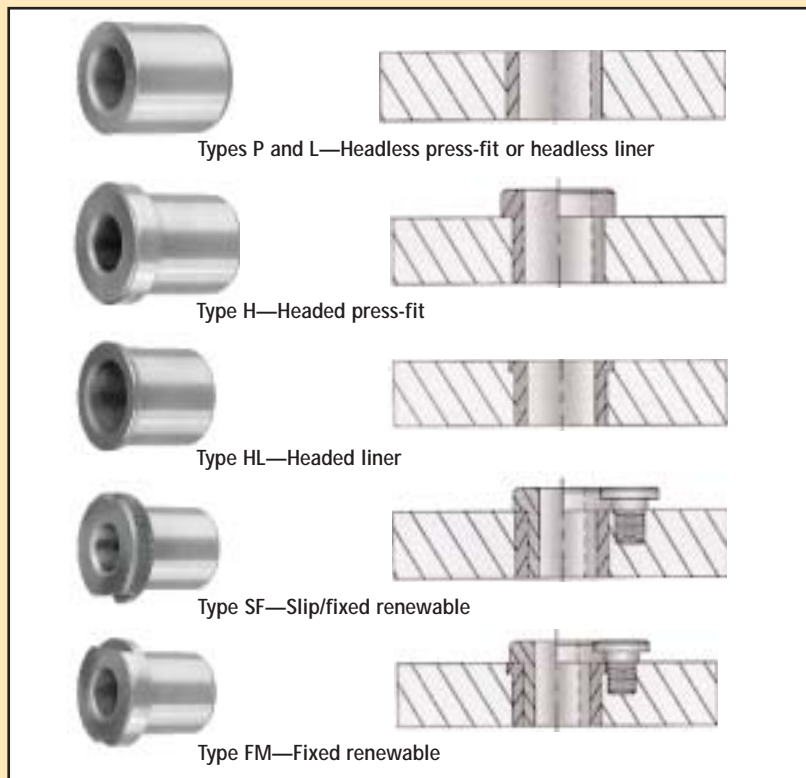
The drill motor is fairly small and compact, akin to a hand drill. The bushing system consists of a liner that is mounted in the jig plate and a bushing that is secured in the liner with a pin lock. "A little twist lock, with a 30° turn, locks it in place. It makes it a lot easier for the operator, and it speeds up the operation, too," Johnston said.

Johnston added that demand for serrated press bushings engineered for use

Bushing basics

The most widely used and least expensive drill bushing style is the press-fit (ANSI Type P). These simple, short, hollow cylinders of hardened steel are pressed into the drill jig.

A step beyond the Type P is the Type H, or head press-fit, which has a head or shoulder on the bushing's drill entry end. The head is designed to resist axial forces that can force a headless bushing out of the jig plate. The Type H's head limits how close together the bushings can be placed in the jig, and mounting holes must be counterbored if a flush fit with the jig plate is desired. For practical purposes, Type P and H bushings are permanently installed in the jig and are best for production runs where wear-related replacement isn't necessary, and where only one diameter of drill or reamer is applied.



All American

Type SF (slip/fixed renewable) and Type FM (fixed renewable) bushings fit into headless liner (L) or headed liner bushings (HL) that are pressed into mounting holes in the jig. The bushings are held in the liners by lock screws or clamps, which permit the bushing to be changed quickly. Type SF and FM bushings work well on long production runs in which bushings need to be replaced as they wear, as well as in situations where multiple tool diameters (e.g., drilling and reaming) are used.

Some bushings feature OD serrations or knurled patterns designed to grip jigs made of softer materials. Type DG (diamond groove) bushings feature a knurled pattern on the OD to enhance their grip in the jig. SG (serrata groove) bushings have straight serrations that aid pressing into a jig made of a softer material. Type SP (serrata press) bushings have serrations and also a finish-ground OD to facilitate press-in installation in soft materials.

Bushing manufacturers also add functional features to their products such as chip control geometry on the edge facing the workpiece. Other bushings are designed with ports to feed oil or coolant through the bushing body to clear chips and cool the cutting zone.

—B. Kennedy

in softer jig plate materials, such as aluminum (see sidebar, page 65), appears to be increasing as “more people are using aluminum for jig plates instead of steel because they are a lot lighter to move around. Keeps people from hurting their backs.”

Yillik said one application area for his company’s carbide bushings is proprietary product development in the au-

When you get lemons ...

... make lemonade. Successful companies recognize and adapt to challenges that can come in strange forms. For example, a manufacturer’s respected trademark may become associated with a completely different image.

Witness E.I. du Pont de Nemours & Co.’s registered Teflon trademark. The well-known product name gained unintended subconscious baggage when the media named organized crime figure John Gotti “The Teflon Don” after prosecutors couldn’t make their charges stick.

Acme Industrial Co., Carpentersville, Ill., has been serving customers for over 90 years. For the last 55 of those years, a certain animated desert bird has used “Acme” products to counter the attacks of one hapless cartoon coyote.

On its Web site, Acme steps up and acknowledges the situation. The company immediately points out the contrast between its products, quality and service and the often bizarre actions of that odd couple of the Southwest:

“Acme Industrial Co. has a proven track record of providing the highest quality products and service to manufacturers around the world since 1914. No shoddy rocket-powered roller skates, giant slingshots or coyote-crushing anvils here. We manufacture precision no-counterbore drill bushings and keylocking threaded inserts to the highest levels of workmanship.”

Acme’s strong statement clears away any subconscious connections with the cartoon company, and by contrast reinforces the company’s real-world history of quality and service. Pretty wily, wouldn’t you say?

—B. Kennedy

tomotive industry. Such products often employ difficult-to-machine or abrasive materials, and tungsten carbide bushings provide advantages over steel ones when side loads on the drill or abrasion from chips generate excessive bushing wear.

Yillik said a carbide bushing typically costs five times more than a comparable steel bushing, but provides from 10 to 50 times the wear life. In long production runs, he said, it is easy to justify the extra cost. “If they are drilling 100,000 holes, they are better off using the steel bushing, but if they are drilling a million or 2 million holes, then they should look at carbide ... they are crazy if they don’t.”

Long and Deep

Another continuing application for drill bushings, Yillik said, is gun-

Counterbore counterpoint

To support and guide the drill, the bushing ID or bearing surface at its workpiece end must be just slightly larger than the drill diameter, within a specified range. For example, for 1/4"- to 3/4"-dia. drills, a typical ID bearing surface tolerance is between 0.0005" and 0.0006" larger than the drill diameter. In other words, for a 1/2"-dia. drill, the bearing surface ID tolerance is from 0.5005" to 0.5006". But the bearing surface does not have to extend the entire length of the bushing. For example, for a 1"-long, 1/4"-dia. drill bushing, the bearing surface might be 5/8" long. The rest of the bushing can be counterbored or relieved to a larger diameter, but this a somewhat controversial matter.

Acme Industrial Co. manufactures its standard bushings without counterbores, offering counterbored bushings as specials. Other bushing makers reverse that policy, making no-counterbore bushings a special-order item. Acme President John Evans said the company believes the no-counterbore design produces a more accurate and more versatile bushing. “We also think it helps the tool to last longer,” he said. “When you go from the counterbore to the bearing surface, there’s usually a sharp corner. If the tool isn’t lined up exactly, it could hit the corner in there and chip the drill or the bushing.”

Evans said Acme believes that with counterbored bushings “often times, the chips will pack up in there and seize up the tool.” He said makers of counterbored bushings argue the other way, that the counterbore allows chips and coolant to escape the cutting zone. “Some of them actually call it a chip clearance,” he said, “but there again, depending on the material you’re drilling and the type of tool you’re using, it will pack up in there.”

—B. Kennedy

The following companies contributed to this report:

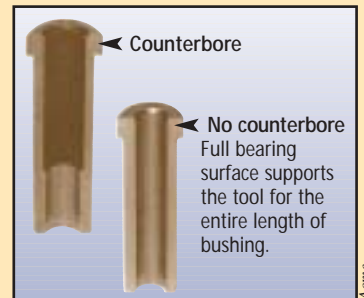
Acme Industrial Co.
(800) 323-5582
www.acmeindustrial.com

All American Products Co.
(818) 361-0059
www.allamericanproducts.com

Axly Tool & Bushing Inc.
(800) 248-0622
www.brineytooling.com

International Drill Guide Inc.
(864) 225-2214
www.gundrill.com

Yillik Precision Industries
(800) 854-9847
www.yillik.com

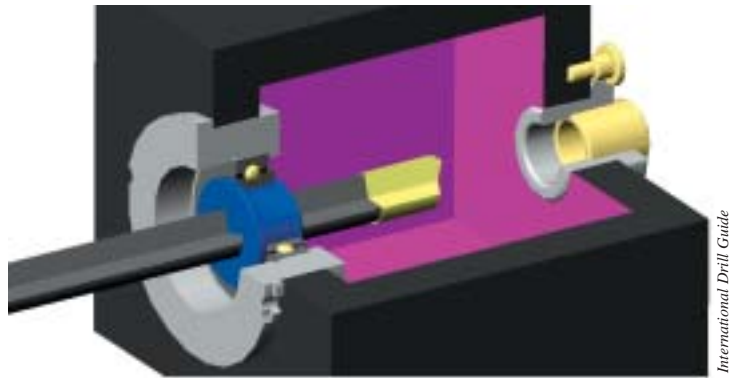


Opinion varies as to whether a counterbored drill bushing (left) provides an escape path for chips and coolant or promotes chip packing and increased tool wear.

Acme

drilling. The reason is that a gundrill is not a self-piloting tool. The off-center configuration of the gundrill's flute dictates the use of a starter hole or guidance provided by a bushing. Usually on CNC mills and lathes there is no practical way to set up a jig plate and bushing. In that case, a deep hole can be located with a spot drill run to a depth of 1/2 or 3/4 of the drill diameter, then be completed with a gundrill. The high-pressure coolant capability available on many CNC machines clears the chips from deep holes.

However, for high-volume production of deep holes, "there are still a lot



Because a gundrill is not self-positioning, a drill bushing (right) is used on the workpiece side of the gundrill's chip box to direct the tool into the workpiece. At left, a polymer guide bushing damps vibration, stabilizes the drill and seals chips and coolants in the chip box.

Bushing business

With 200,000 bushing sizes in stock, All American Products Co. probably has "the largest inventory in the world," said plant manager Marshall Johnston. "When we make stock for our inventory, we make about 2 to 3 years' supply at a time."

Why? "When a guy needs a bushing, he wants it now. It's the last thing he remembers when he is assembling his fixture. He doesn't want to wait 3 or 4 weeks for it to come by boat, or spend money to fly it across the Big Pond," Johnston said.

In this age of finance-department-dictated skeletal inventories and just-in-time supply, the policy is a throwback. "Yes, it's old-fashioned," Johnston said. "But it's easier to sell if you have a full cart." Minimal inventory, he said, "is not good for the trade. It really isn't good for the customer." As a result, Johnston said, All American faces minimal overseas competition.

—B. Kennedy

of people purchasing dedicated gundrilling machines," said International Drill Guide's Stewart. "The fastest, most efficient way to gundrill is to pilot the tool through a bushing rather than a prequalified hole."

The drill bushing on a dedicated gundrilling machine is located at the front of a chip box into which chips and coolant flow as they are forced along the drill flutes and out of the hole.

International Drill Guide provides polymer drill guides that ride in a bearing at the back of the chip box and seal in the chips and coolant. The center hole of the guide mirrors the distinctive cross-section of a gundrill. The polymer construction enables the guide to stretch over the gundrill tip and conform to the drill shaft, creating a tight seal.

Stewart said polymer guides have other benefits. Because "metal parts ring like a bell, and polymer parts don't

ring at all," the guides dampen the energy that can make a long, thin drill vibrate and chatter. Consequently, shops also use polymer guides in a machine's steady rest to stabilize long gundrills. Stewart said his company's primary customers are automotive companies

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and their Tier 1 suppliers who use dedicated gundrilling machines to drill cylinder heads, engine blocks, camshafts, crankshafts and other powertrain components.

No matter the application, the need for drill bushings is definitely on the wane. The technology, said Yillik, "is not something that 10 or 15 years from now there is going to be much call for." However, applications will persist where certain drill bushing styles and materials provide precision and productivity in specific holemaking operations. △