

▶ BY ALAN RICHTER, MANAGING EDITOR

Port Authorities

A subset of form relief tools, port contour tools perform multiple machining processes in one pass.

Developed to cut the female form for a male hydraulic or pneumatic fitting, porting tools are available in numerous configurations, including solid HSS, solid carbide, carbide-tipped, diamond-tipped and indexable insert.

All have their position in the marketplace, but, following the trend of other types of cutters, porting tools that accept indexable inserts are becoming increasingly popular, said John Husar, tool engineer for Everede Tool Co., Chicago.

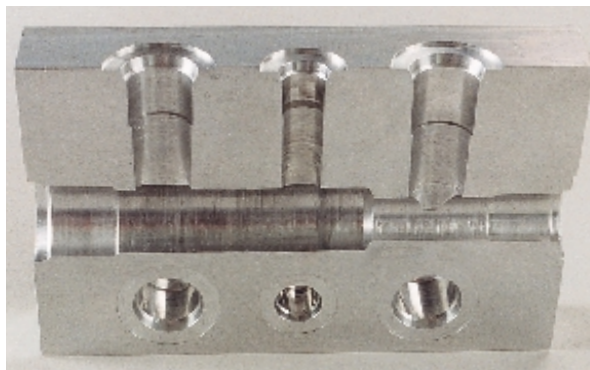
He credits the cost advantage and repeatability of indexable inserts, which typically are coated with titanium nitride. While indexable inserts reduce the cost per hole, Husar added that generally they cannot hold as tight a tolerance as a solid port tool.

"A tolerance of ± 0.0025 " is easy to hold with a solid cutting tool, but not with indexable inserts," Husar said.

Mike Massey, operations manager for Tool Fabrication Corp., Milwaukee, agreed that solid and brazed-tipped port contour cutters are applied when the tightest tolerances are required. Nonetheless, he added that the design of a two-sided insert gives an insert a repeatability of 0.001" or less.

Although end users feel they're saving money by buying four-sided index-

able inserts instead of two-sided, Massey said Tool Fabrication offers a two-sided insert that is ground rather than molded. As a result, it offers higher accuracy and repeatability, saving users 20 to 40 percent by reducing scrap. The company's inserts are TiN-



A cross section shows the internal surfaces of a port form.

coated and have a 0.005" hone.

"The two-sided insert offers high repeatability from insert to insert and from part to part," Massey said.

Massey added that for customers who are machining with indexable inserts and need to meet the most demanding specifications, Tool Fab—for an additional charge—will pre-inspect the customer's shipment of inserts by hand, discarding about 10 percent that don't conform to CAT specifications, which are tighter than the standard automotive spec.

Operating Procedure

Port contour tools are basically form reamers that were developed to eliminate having to apply guided tools to the workpiece in a three-step cycle. Typically, unless a casting has holes already formed in it, a drill roughs out a hole in a solid block of metal before a porting tool creates the minor diameter of the thread, thread chamfer and O-ring seat. The port is then tapped.

To further enhance the efficiency of the porting operation, indexable-insert port tools with a spade blade on the end have been developed to drill and port in one operation, said Gus Liepins, director of operations for The Metcut brand of Kennametal Industrial Products Group, Rockford, Ill. He said that the company

manufactures standard, double-feed port tools for producing the form and seal-surface finish required on internal, straight-thread ports in a single operation. (Metcut also offers specials.) According to Metcut, straight-thread ports usually are required for high-pressure hydraulic fittings, which must comply with automotive (SAE and the metric ISO), aerospace (NASA) and military (MS) standards.

Bruce DeWald, Metcut's business unit manager, said that traditionally, end users opted for carbide-tipped cut-

The porting tool business has grown around the use of hydraulic systems in the aerospace, automotive and machine tool industries. As hydraulic systems advanced, cutting tool manufacturers developed a single form tool to produce the port rather than having a lathe operator produce it with single-point tools.

Military and automotive manufacturers engineered standard fittings in the late 1940s and early '50s. One of the first designs, developed in 1956, was the MS-16142, which was a knock off of the SAE straight-thread tube fitting. Another early fitting design, the AND-10050, was replaced by MS-33649 in 1966. The MS-33514, for flareless tube connections, is another design, which came out in 1951, but is not used as extensively as the other two.

As the airframe industry began manufacturing larger commercial aircraft, the need for porting tools increased. In some cases, there were five redundant hydraulic systems within an aircraft, running almost everything—from flaps to landing gear. A good portion of the in-house or subcontracted work was centered on these hydraulic systems.

As the technology changed to “fly-by-wire,” the hydraulic systems have taken on a lesser, or back-up, role. The machine tool and auto industries have followed the same technological path. Nonetheless, a solid market still exists for porting tools in the U.S. and Europe, which will continue to be the case for the foreseeable future.

To enhance productivity, cutting tool engineers began designing port tools with added capabilities. One example is the reamer pilot. The reamer-style sizes the thread diameter at the same time that it produces the port itself. The plain, noncutting, piloted tool can either refurbish an existing port without affecting the thread or produce a new port, which requires a reaming operation prior to threading.

With the advent of CNC machining, many felt that the port tool, as well as step-form tools in general, would be on the way out. This is because that same group believed it was just as easy to program the machine to do the entire job with off-the-shelf tools, thus saving the cost of buying a special form tool. But just the opposite occurred.

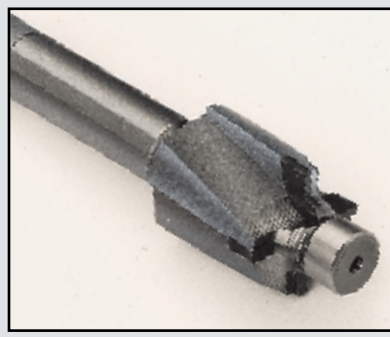
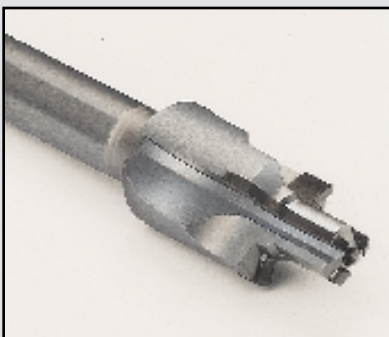
Cycle times on CNC machines became critical in order to recoup the high initial investment of the machine tool within the shortest span of time. The cost of the form tool was insignificant when compared to the savings achieved by a reduced cycle time. This is still true, even as increased competition and manufacturing efficiency has driven down the cost of machine tools.

Although it should already have happened in the U.S., more shops will produce ports with metric tools in the future, abandoning the current specifications that were established in the 1950s.

About the Author

Bill Cleveland is president of Craig Tools Inc., El Segundo, Calif.

Photos: Craig Tools



Port contour tools are basically form reamers and were developed to eliminate having to apply guided tools to the workpiece in a three-step cycle.

ters to achieve the lowest cost per hole, but that situation has changed with the availability of “double-effective,” or “double-feed,” port tools. Until recently, indexable porting tools had a one-effective-flute design, thus limiting their operating feeds and speeds, compared to multifluted carbide-tipped and solid-carbide cutters. However, he said the situation has changed with the availability of double-effective port tools. DeWald said double-feed tools can be run at the same in-feed rates as carbide-tipped and solid-carbide port tools, and replacing inserts costs less than resharping and/or retipping a tool.

DeWald said that the double-feed tool accepts one spade-blade insert for drilling the hole and two form inserts for creating the port's form and face.

“There's no need to send out an indexable tool, which reduces inventory. And most shops don't have sharpening facilities in-house,” he said.

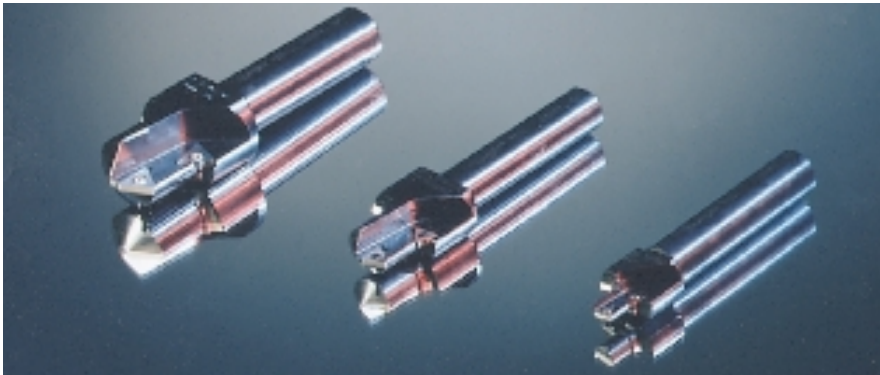
Mike Stewart Sr., CEO and president of American Tool Grinding and Mfg. Inc., Coon Rapids, Minn., pointed out that multiprocess, indexable-insert port tools improve cycle time. “Any time you eliminate tool changes, you're saving money,” he said. “Once you place the tool in the spindle, you want to do as much as you can with it.”

In contrast to Metcut, Stewart said



Metcut

A double-effective port tool accepts one spade-blade insert for drilling the hole and two form inserts for creating the port's form and face.



Dexport Tool Mfg.

A selection of standard port tools.

American Tool Grinding only produces port tools as specials, including ones that, in addition to porting, can be used for drilling, endmilling and thread milling. He also said that he's seeing more companies ordering multiprocess specials to reduce cycle time and gain a competitive edge.

Maintenance and Repair

Like other cutter bodies that accept inserts, a port tool's walls and pockets need to be kept clean and free of foreign debris, said Dick Hite, vice president of sales and manufacturing for Dexport Tool Mfg. Co., Williamsburg, Ohio. He suggested using cotton swabs or compressed air to remove any coolant slurry, grease or chips. And if a machinist drops a tool and damages its insert pocket, Hite said a file is usually all that's needed to fix the problem. When a shop starts producing out-of-tolerance ports, the culprit is often improper tool maintenance, he said.

"I don't see more than one or two tools a year that were manufactured out of tolerance," Hite said.

In addition to keeping the insert pockets and walls clean, Stewart said that properly tightening the insert screws is an important practice. But if the tool body does get damaged, he recommends having it repaired immediately, which saves money in the long run. Although sending a tool to be repaired might cost \$30 to \$40, Stewart said inserts that aren't properly held experience a shorter life, which might cost a shop \$150 in wasted inserts.

Sometimes tool damage is hard to spot; therefore, Stewart said the tool-holder's seat should be checked periodically with shim stock to make sure an insert isn't rocking in the pocket. "A

0.001"-thick shim stock shouldn't be able to slide under an insert," he said.

When having an indexable-insert port tool repaired, Stewart suggested seeking a repair facility that charges based on the amount of damage and not on the tool's initial cost. Some companies charge 50 to 60 percent the price of a new cutter, regardless of the damage, he said.

Although port-tool manufacturers are sometimes reluctant to repair or rebuild other companies' cutters, Paul Tetzlaff, manufacturing engineer with TOSCO (Tool Specialty Co.), Los Angeles, said the option exists, especially if the original manufacturer won't refurbish its tools.

"We really only like to fix our own, but we will repair others," he said.

Market Report

Porting tools are used to make parts for a wide spectrum of industries, ranging from aerospace, automotive and

agriculture to irrigation and fluid control. "There are so many different applications," Stewart said.

DeWald estimated that about \$100 million of porting tools are consumed annually in North America. He added that carbide-tipped tools represent 50 to 60 percent of the market, HSS tools are declining in use but still represent 25 percent, indexable-insert cutters are a growing segment and make up 15 percent, and diamond-tipped and solid-carbide tools represent the remaining share.

Although the high initial cost of solid-carbide port tools limits their use, DeWald said their acceptance is increasing because the total cost can be comparable to carbide-tipped tools when resharpening expenses and tool life are taken into account. The carbide tip has a finite thickness and needs to be replaced before the tip is ground away, while a solid-carbide tool can be re-ground more times, he said. Retipping and resharpening a tool costs roughly 70 percent of new, he added.

Tetzlaff said that companies looking to apply diamond tooling should consider PCD inserts. "They can switch to coated-carbide inserts if the diamond inserts don't suffice and still use the same holder," he said.

Stewart noted that shops need to train the individuals who handle diamond inserts. At about 10 times the cost of carbide inserts, those individuals need to

| Port Size | Mild Steel | | Cast Iron | | Aluminum | |
|-------------|------------|-------|-----------|-------|----------|-------|
| | rpm | ipr | rpm | ipr | rpm | ipr |
| 5/16 - 20 | 3,000 | 0.004 | 3,000 | 0.004 | 5,000 | 0.004 |
| 1/2 - 20 | 3,000 | 0.004 | 3,000 | 0.004 | 5,000 | 0.004 |
| 5/8 - 18 | 3,000 | 0.004 | 3,000 | 0.004 | 5,000 | 0.004 |
| 3/4 - 16 | 2,200 | 0.004 | 2,000 | 0.005 | 5,000 | 0.004 |
| 7/8 - 14 | 1,800 | 0.004 | 1,600 | 0.005 | 4,500 | 0.004 |
| 1 1/16 - 12 | 1,600 | 0.005 | 1,400 | 0.006 | 3,800 | 0.005 |
| 1 3/16 - 12 | 1,400 | 0.005 | 1,200 | 0.006 | 3,400 | 0.005 |
| 1 5/16 - 12 | 1,200 | 0.005 | 1,000 | 0.006 | 3,000 | 0.005 |
| 1 7/16 - 12 | 1,000 | 0.006 | 800 | 0.007 | 2,500 | 0.006 |
| 1 9/16 - 12 | 800 | 0.006 | 600 | 0.008 | 2,000 | 0.006 |
| 2 1/2 - 12 | 600 | 0.006 | 500 | 0.008 | 1,600 | 0.006 |

Note: These speeds and feeds are starting-point recommendations. Maximum speeds and feeds will depend on the machine, workholding device and material conditions.

Recommended speeds and feeds for indexable porting tools.

know how to run the equipment properly and understand the value of the inserts, he said.

“Sometimes machinists throw away diamond inserts that are still good or won’t retrieve ones dropped into a pile of chips,” Stewart said.

Although growing, the demand for porting tools isn’t increasing rapidly, said Tetzlaff. He noted that a few more companies are producing porting tools than in the past, dividing the market-share pie into smaller slices.

DeWald agreed that sales are flat, but said the market will grow once the automotive industry gets back on track.

Conversely, John Detterbeck, president of Lester Detterbeck Enterprises Ltd., Iron River, Mich., said the North American market is declining for porting tools, because more hydraulic equipment is being manufactured over-

Companies that contributed to this article:

American Tool Grinding & Mfg. Inc.
(763) 754-2676
www.amtool-mfg.com

Craig Tools Inc.
(310) 322-0614
www.craigtools.com

Lester Detterbeck Enterprises Ltd.
(906) 265-5121
www.lesterdetterbeck.com

Dexport Tool Mfg. Co.
(513) 625-1600
www.dexport-tool.com

Everede Tool Co.
(773) 467-4200
www.everede.net

Kennametal IPG Metcut
(888) 434-4186
www.gfii.com/it/brand/metcut/metcuthome.htm

Tool Fabrication Corp.
(414) 453-5030
www.toolfab.com

TOSCO (Tool Specialty Co.)
(323) 232-3561
www.toolspecialty.com

producers of porting tools than in the past, just better marketing and advertis-

ing efforts to make their presence better-known.