

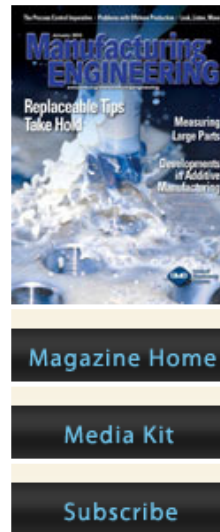
Manufacturing ENGINEERING

Manufacturing Engineering magazine delivers information you need to remain a leader, whether you are a job shop owner or other manufacturing professional and whether you work for a small, specialized shop, mid-sized supplier or large OEM.

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Replaceable Tips Take Hold

Concept offers savings for drills and mills

Jim Lorincz, Senior Editor

It's pretty much accepted that drilling is the process that is performed the most in machining, whether by machining centers, CNC lathes, or dedicated drilling machines. Cost per hole, hole quality, and hole completion are key considerations in selecting the right drill and process. Related processes such as reaming, chamfering, and counterboring/boring can be readily performed as you drill, often combined on one tool.

Exchangeable nose-piece drills were introduced in the late 1990s so that the carbide tip of the drill could be easily replaced when worn, while the drill body remained in the toolholder and/or machine spindle. Each steel drill body can accommodate a number of nose-piece diameters within a given range, saving the user to cost associated with buying a specific drill for every hole size. Drill bodies typically cover a hole size range of about 0.040" (1 mm) with many suppliers offering nose-pieces in 0.004" (0.10-mm) increments.

The concept of replaceability of carbide tips for steel drill bodies has led to the development of exchangeable-head milling cutters and modular reaming systems with the same success and benefits for users.



Replaceable-tip drills like the Qwik-Twist line address the number of drills that are typically "in-float" when using solid-carbide tools.
Photo courtesy Ingersoll Cutting Tools

Savings accrue from a number of performance and tool management sources:

- Reduced use of carbide for tool body,
- Longer tool life and predictable holemaking production,
- Reduced drill inventory,
- Eliminating float of tools to regrind and back, and back up tools required,
- Zeroing out setup time because tips are replaced in the machine and toolholder, eliminating presetting, offset, and touch-off of the replaced tool

Selecting the right drill type involves asking the right questions: about hole size, hole tolerance and surface finish, and economics of the job or the shop. For hole sizes smaller than 1/2" (12.7-mm) diam, solid-carbide drills continue to be the recommended solution in terms of tolerance and performance. For hole sizes greater than 1" (25-mm) diam, indexable insert drills, particularly for roughing applications, are recommended. Indexable insert drills are especially effective for hole sizes greater than 1" (25 mm) and even greater than 2" (51 mm) with highhorsepower machines.



Applying the replaceable-tip concept to milling cutters like the CoroMill 316 follows from the fact that solid-carbide tools typically take less than 1xD depth of cut, so all that expensive carbide flute length isn't needed.

Image courtesy of Sandvik Coromant

Replaceable-tip drills have become a popular choice in the range between, 1/2" and 1" (12.7–25.4-mm) diam size drills, where they offer a measurable competitive combination of precision hole-making capabilities and cost effectiveness. Carbide tips feature geometries optimized for the materials and applications, and are generally not intended to be reground. Each replaced tip is new, performing at the same level as every other new tip, unlike reground solid-carbide drills.

The new Top Drill M1 modular drill from Widia (Kennametal; Latrobe, PA) combines the economic benefits of modular drilling systems with the machining performance and hole quality of solid carbide tools in the standard diam range of 8 to 25.99 mm. Available in length-to-diam ratios (L:D) of 3xD and 5xD, drill bodies come in either flanged-shank (metric) or round-shank (inch) configurations.

"Launched as part of Widia's new Victory line, the TDM1 is a clampless replaceable-tip drill that features a precision-ground tip and precision-ground body," explains Chris Merlin of Kennametal. "Non-regrindable inserts eliminate the logistical and tool-life challenges associated with using reconditioned inserts."

"Modular drills deliver predictability in performance without the issues of regrind," states Merlin. "TDM 1 avoids the choice that customers face when they must set the tool replacement somewhere below maximum usage of the reground drill to ensure regrindability," says Merlin.

"Modular tools like TDM1 offer consistent diam from replaceable insert to replaceable insert, while regrinding causes hole diam decrease because of the back-taper. Of course, regrinding causes the drill length to change. With TDM1 there is no presetting the length in the tool crib and moving tools to and from the machine, reducing programming time and machine errors," Merlin explains.

The TDM1 replaceable inserts are offered with UPM geometry in grade K20FTiAlN, featuring point designs oriented to applications in steel and cast-iron components. Aimed at the distributor market, the drill has a tip design flexible enough to accommodate 80–90% of the applications by stocking only one style.

"Applications for our Crownloc exchangeable tip drills are pretty universal," says Thomas Sandrud, Seco Tools Inc. (Troy, MI). "They include aerospace, power generation, automotive, and medical. The tool has three different geometries optimized for steel, stainless and superalloys, and cast iron. You can use the same drill body, simply by changing the crown, for different material applications."

Security of the Crownloc tip on the body is accomplished by internal clamping, with the Crown being tightened or rotated on a rod holding the tip to serrations on the drill body. Crownloc drills are available in sizes from 10 to 25.99-mm diam.

"Performance of the Crownloc replaceable-tip drill is close to that of solid carbide, and it can many times be used as a finishing tool," says Sandrud. Shops are looking for deeper holes today, and the maximum length for a standard Crownloc is 7xD, but Seco can offer up to 10xD as custom design."

"**When drills fail, it's always catastrophic,**" says Bradley Teets, vice president, Iscar Metals Inc. (Arlington, TX). "Our SumoChamdrill is the third generation of drills that began with the Chamdrill and Chamdrilljet drill families. Improved tip and pocket allow us to get 50 indexes out of the drill, and tool life that is twice that of the first generation."

"The SumoChamdrill features four different standard drill-head geometries, sharp cutting edges, and polished flutes. The drill head has ground flutes for smooth, uninterrupted chip flow, and a ground gash for better penetration," says Teets. The drill features twisted coolant nozzles with indexable drilling heads, which are available in different head configurations for various material groups. SumoChamdrills can be used on milling centers or lathes.

The SumoChamdrill shank is designed according to DIN 9766 standard with available drilling depth : diam ratios from 1.5xD, 3xD, and 5xD, to 8xD. Drill bodies feature helical coolant holes. "The accurate cylinder added to the clamping portion improves rigidity and reduces internal stresses. Rotation stopper planes on the tool are precision ground, improving the control of the drilling head position and support. To prevent the insert from being pulled out during drilling, there is an axial stopper in the pocket, which is effective even after clamping force has been lost," says Teets.

The SMD replaceable head drill from Sumitomo Electric Carbide Inc. (Mount Prospect, IL) allows users to buy one drill body to fit up to five head sizes with three different drill-tip styles matched to the different materials. The SMDT-MTL drill tip is intended for steel applications, while the SMDT-C has a chamfered edge to eliminate break out in cast-iron applications. The SMDT-MEL is designed for machining superalloys, stainless, and cast iron.

The SMD drill-body line has been expanded with the addition of the 8xD version to the 3xD and 5xD drill lineup. "The SMD nickel-plated body is said to provide longer tool life than conventional replaceable-tip drill bodies. A rigid serration coupling system ensures stability, and a carbide drill- head substrate with Sumitomo's ZX coating provides for wear resistance," says Rich Maton.

"SMD is available in metric and inch diam ranging from 0.4688 to 1.2008" [12–30.5 mm] for applications found in job shops running a variety of different materials, and in the automotive, aerospace, and oil- field component industries," says Maton.

Xtra-tec Point Drills from Walter USA Inc. (Waukesha, WI) feature replaceable tips that are optimized for drilling steel (P6001); cast iron (P6002); stainless, ductile iron, and difficult-to-cut materials (P6003); aluminum and aluminum alloys (P6004); and for deep holes up to 10x Dc for all steel and cast iron materials, stainless, and difficult-to-cut metals (B4010).

Replaceable tips are matched to industry applications. P6003, for example, features an optimized geometry and new coating for all stainless, and long-chipping steels for general mechanical engineering, energy, and aircraft industry applications. P6004 features a sharp geometry and new type of coating for aluminum and aluminum alloys with or without silicon for general engineering, automotive, and aircraft applications. The B4010 replaceable tip drill has internal coolant supply for cooling at the cutting edge and chip evacuation in holes up to 10x Dc depth. Hardnickel plating improves chip evacuation and protects against corrosion for general engineering, energy, and automotive applications.

The GEN3SYS replaceable tip high-penetration drill from Allied Machine and Engineering Corp. (AMEC; Dover, OH) is designed to allow for maximum machine up-time and reduces costly setup time. The company says that the system can increase hole quality, surface finish, and true position when compared to competitive products. The GEN3SYS is coated with AMEC's AM200 coating. The GEN3SYS features 12–32-mm initial diam range, helical, and straightfluted options. The system features 3xD, 5xD, and 7xD L:D ratios and C1 and C2 substrate options.

The concept of replaceability of tip or head has been applied to three categories of cutting tools by Ingersoll Cutting Tools (Rockford, IL). They include the Qwik-Twist replaceable-tip drill line, the Qwik-Ream interchangeable reamer, and the Chip-Surfer line of milling tools.

The Qwik-Twist line addresses the number of drills that are typically "in-float" when using solid-carbide tools. "In production applications, we've found that users feel they can manage their manufacturing with quick change of tools on the machine," says Ingersoll Cutting Tools' Bob Jennings. "You don't have to break down the holder, the tool, and reset the tool, and the Z axis and touch off the part. It's just a matter of changing the tip. In untended production, once tool life is determined, the machine can be set and run with consistent predictable tool life. Once you dial the tool in, it's the same point, the same geometry, the same hone on the cutting edge, and the same coating," Jennings explains.

For high-speed reaming, Ingersoll's Qwik-Ream interchangeable reaming-head tools are available in an inventory of common fractional sizes, as well as specials, coated, brazed PCD, or CBN for difficult-to-machine materials. Sizes available range from 1/2 to 1 1/4" (12.7–32 mm). "Tools can be used on machining centers and lathes to take advantage of the high-performance coating and substrate," explains Ingersoll's Michael Butler. "We like to have coolant through because of the high velocities that we are reaming at, and we need to have very efficient coolant for chip evacuation and lubrication and cooling."

"We also recommend using a steerable arbor for the machining center application. That allows the user to correct for any workpiece to spindle misalignment by means of radial and axial screws on the two-piece quick-adjust toolholder and an indicator," says Butler. "Once you assume an accurate modern machine tool and good available coolant, users can expect up to 25 to 30 times faster feeds and speeds, and, because the shank is still in the machine, zero setup time," Butler says.

Ingersoll's Chip-Surfer line of milling cutters features a variety of replaceable carbide tips that adapt to straight and conical shanks with three material options; steel, heavy metal, and carbide. "A simultaneous-fit connection is what really makes the product stand out," says Michael Dieken. "Tips come in a variety of symmetrically designed styles that can be run up to 30K rpm in end mill, ball nose, chamfer and countersink, drill/mill, corner rounding, Hi-Feed, and toroidal finishing carbide tips. The adaption of the tip has a taper, that when twisted down, holds diameter tolerance within 5 tenths. When torqued with a wrench on a 90° shoulder, the tip is repeatable on height within 5 tenths."

The growth and acceptance of the concept for milling can be seen in the rapid expansion of options. When Chip-Surfer was introduced in 2000 there were 10 shanks and 20 tips. The line now includes 100 different shank styles (250 when including metric sizes) and 1500 different tips. "Typical applications include aerospace, medical, and general purpose machining. Mold and die was an early adopter because of the accuracy of the Chip-Surfer tools. Shanks with integral ER adaptation have opened opportunities on Swiss type machines, and mill-turn centers, especially for medical applications."

The modular Reamax TS tool system from KOMET of America, Inc. (Schaumburg, IL) is designed to reduce tool costs and, at the same time, increase the flexibility for meeting the varying requirements of materials and diam to be machined. The key feature of the Reamax TS Tool System is the connection between reaming head and toolholder. The high-precision connection guarantees safe transfer of torque, which occurs during reaming, and produces the concentricity required for precision machining. The connection also produces the same quality finish from hole to hole during head replacement. Applications include through holes, blind holes, small bore tolerances, up to 5xD and high-speed machining applications.

The Reamax TS tool system is a single holder with a standard connection for Dihart reaming heads available in 18 to 64.999 mm diam. Radial clamping system allows reaming tools to be changed without removing the holder from the adaptor. To compensate for wear and to meet tolerances as small as IT4, Reamax TS multiflute tools are adjustable.



The Chip-Surfer line of milling cutters now includes 100 different shank styles (300 when including metric sizes) and 1500 different tips. Photo courtesy Ingersoll Cutting Tools

"CoroMill 316, a milling tool with multiple heads that can be combined with multiple bodies, was introduced to cover the gap between the solid carbide and the indexable mills," explains David Öhlund, milling development specialist, Sandvik Coromant Co. (Fair Lawn, NJ). "We have both steel and carbide shanks. Carbide is three times stiffer than steel and is especially effective in finishing applications and longer reach applications. It helps produce a better surface finish and can eliminate steps between passes, in long-reach application with long overhangs more than 4xD."

"We found that the depth of cut typically taken with solid carbide tools is typically less than 1xD, so you don't need all that expensive carbide flute length, when all you need to do is put a solid-carbide tip on the tool," explains William Durow, milling specialist. "CoroMill was developed as a cost-effective alternative to solid carbide tools."

"One of our original goals was to develop the CoroMill 316 for areas where it was difficult to change out a tool, but the concept quickly expanded, says Durow. "For example, if you look at the medical industry and Swiss machines in particular, you can appreciate the difficulty of getting in and changing a solid-carbide tool, touching off, and starting from the beginning of the program. With the Coromill 316, you just screw on a new head. Repeatability is such that you can just push the button and keep on running."

The CoroMill 316 features an assortment of tip styles for end milling, ball nose, high-feed cutters, chamfering tools, roughing and finishing geometries, and radius ball noses in sizes from 3/8 to 1" (10–25.7 mm). Shanks are available in steel and carbide from short to long reach tools and straight or tapered styles. Typical applications include high-feed face milling, slot milling, helical interpolation, shoulder milling, profile milling, and chamfer milling. Aerospace engine casing and frame machining that require long reach with expensive solid carbide tools and medical devices are typical applications.

"The CoroMill 316 features a patented screw thread that produces the precision and stable interface," says Öhlund. "Basically two things ensure the radial and axial precision of the tool. To make sure the tool is centered in the holder, a conical interface on the replaceable tip and holder makes sure it ends up on centerline. There is a face stop. When you tighten up against the holder, it tightens up against the face for axial interface."

The concept of replaceability is being taken to a new level by BIG Kaiser Precision Tooling Inc. (Hoffman Estates, IL). It will soon be introducing a replaceable-tip milling cutter developed by parent company BIG Daishowa for its highest performing integral milling cutter, the Fullcut Mill series, which is available in 16–32 diam.

The new modular connection of the replaceable head is said to produce a tool as strong as the integral version, eliminating the drawback of catastrophic failure caused by a crash. Called the Fullcut Mill Contact Grip, it allows the tip to be replaced if damage occurs, and, more importantly, it allows for interchangeability between the FCM (shoulder and slot milling) and FCR (ramping, helical, plunge milling) insert/pocket designs. The secret of the Contact Grip is a fine-pitch threaded coupling with taper and face contact. The Fullcut Mill achieves its smooth and quiet end milling by using positive high-rake cutting edges for both radial and axial directions.

WANT MORE INFORMATION?

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