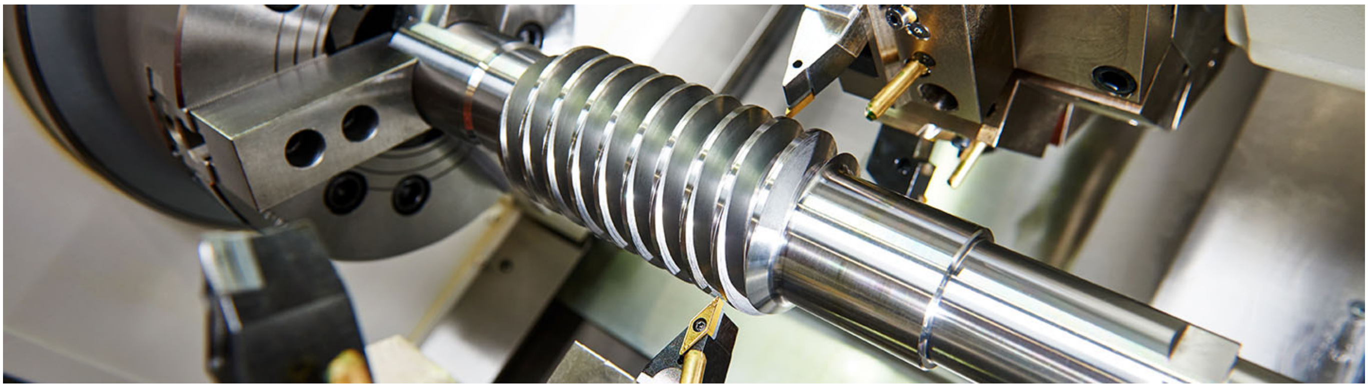

Metalworking

Fit, Form and Function: Your Buying Guide for Indexable Turning Tools

Kip Hanson | Dec 12, 2023

Keeping an assortment of brazed carbide tool bits and solid carbide rounds in the tool crib is probably a good idea. You never know when you may need to hand-grind a special tool for an oddly shaped part or hard-to-reach area.

For most turning operations, though, indexable carbide tools make machine setups ***both faster and easier while significantly reducing the downtime*** associated with tool changes. Which still leaves one problem: deciding which insert is right for the job.

Peruse a supplier's tooling catalog or website and you'll quickly find an overwhelming variety of indexable tooling. Profiling tools, groovers and threaders, boring inserts, indexable and modular drills, cutoff tools—there's no shortage of high-quality turning tools out there, all designed to make lathe turning operations more profitable and part quality more consistent.

But here again, how do you know which one (or ones) to choose?

Reading the ISO Code for Inserts

A good place to start is by learning the ISO 1832 standard, which, according to the International Organization for Standardization, "establishes a code for the designation of the usual types of indexable inserts for cutting tools in hard cutting materials or any other cutting materials, in order to simplify orders and specifications for such inserts."

Ready for a quick ISO introduction? Pick up a "typical" box of turning inserts—some CNMG432 roughers, for example, or VPGR331 profiling tools—and follow along:

1. **Shape**: The "C" in CNMG denotes the insert shape, which in this case is an 80-degree diamond (or rhombic), just as the "V" in VPGR331 signifies a 35-degree diamond. The former is a go-to geometry for heavy facing and turning operations (as is the trigon, or W shape), while the latter is limited to light finishing cuts in either direction. Other popular shapes include the D (55-degree diamond) and T (for triangle), although depending on the manufacturer, up to a dozen additional letters are in use.
2. **Relief (or clearance) angle:** In our CNMG example, the N means the insert has a 0-degree relief

angle, making it a double-sided insert. But because all cutting tools need some small amount of clearance to function, the toolholder must therefore tip the insert down slightly in the pocket to avoid rubbing. The P in VPGR, on the other hand, has an 11-degree clearance angle and sits perfectly horizontally in the toolholder. Generally speaking, the greater the angle (G is the highest at 30 degrees), the weaker the cutting edge.

3. **Tolerance class:** It's logical to think that the M in CNMG identifies it as a molded (or pressed) insert and the G in VPGR as one that's been ground to size. And while this might be true in many situations, the M actually signifies the tolerance range—looser, in this case, compared with the more stringent G—used in the insert manufacturing process.
4. ***Insert type***: This fourth placeholder covers a lot of territory. An A here indicates that the insert has a hole in the center, B means there's a hole and one countersink (allowing the mounting screw to sit flush with the top surface), G signifies a hole and chip grooves on the top and bottom surfaces (as in our double-sided CNMG), and R is a clamp-style insert with no hole and a chip groove on the top surface (like most 35-degree diamonds). Check the standard's chart. There are plenty more.
5. **Size**: Every turning and boring insert has an inscribed circle (IC) value, signifying its size in 1/8-inch increments as viewed from the top. For our -432 insert, the circle measures ½ inch (4 x 1/8 inch), just as a -331 is 3/8 inch (3 x 1/8 inch) across. Also, it's important to note that inserts with an IC of less than ¼ inch use 1/32-inch increments and rectangular inserts require two digits—one for length and one for width.
6. **Thickness**: Similarly, the thickness of inserts with an IC of ¼ inch or less is measured in 1/32-inch increments, while anything larger uses multiples of 1/16 inch—for instance, a CNMG432 and VPGR331 are both 3/16-inch thick, whereas a TCMT221 boring insert measures 1/8-inch thick.
7. **Corner rounding**: It's tempting to think of this seventh digit as the corner radius, and most of the time you would be right. That's because a CNMG432 has a 1/32-inch radius (2 x 1/64 inch), a VPGR331 has a 1/64-inch radius, and any insert with a 0 in this placeholder is considered sharp (0.005-inch radius or less). That said, some inserts have chamfers rather than radii (A, D, E, etc.), and others are flattened or truncated (N and P).

That was a very abbreviated tour through the ISO 1832 standard, now on its sixth edition and spanning 24 pages. You'll find it a helpful starting point on your road to insert selection.

Beyond the ISO Code: Proprietary Cutting Tool Inserts

Unfortunately, you'll also find it chock-full of exceptions. In their ongoing effort to address the machining world's ever-evolving landscape, cutting tool manufacturers continue to develop novel, often proprietary solutions that don't fit neatly into any standardized set of guidelines.

Kennametal's FIX8 line is among these solutions.

"There's a lot to consider during insert selection," says Robert Keilmann, marketing portfolio manager at the company. "ISO turning tools are suitable for a great many applications, but given the huge variety of parts and materials in this landscape, not to mention the evolution of CNC machine tools, we've found it necessary to develop turning tools that provide effective chip formation and extended tool life on lower-horsepower machinery. Our FIX8 line does exactly that."

And reduced power consumption is only one of the benefits, says Kennametal Global Product Manager Scott DeVinney.

"The flip side of the FIX8 is that you can take much heavier cuts than with a WNMG- or CNMG-style rougher, and do so even on lighter-duty machines," he says. "And since you have eight cutting edges to work with, the cost per part is generally lower as well."

Working with Difficult Materials

“Proper insert selection depends on many factors,” says John Winter, a turning product specialist at Sandvik Coromant. “Workpiece material and geometry are high on the list, but choosing an insert with adequate edge line security for the operation—a tool that can handle interrupted cuts, for instance—is equally important.”

Winter and the other experts are happy to help customers decode the ISO standard and find the optimal insert for a given application, but as Winter points out, even the perfect grade, shape and coating will often bring only small gains.

Hitting a home run might require thinking outside the ISO box, he says. “If you’re striving for consistent 15 percent to 25 percent increases in productivity, you should look at changing your whole process. Using trochoidal toolpaths during roughing operations is one such approach.”

Trochoidal turning (also known by the trade names Dynamic Turning and VoluTurn) can be done with ISO-standard round inserts, but it’s more effective when the insert has a rail interface for graduated indexing, as with the company’s CoroTurn 107 RCMT.

“We’re also seeing great success with our PrimeTurning offering, which uses a similar chip-thinning strategy, as well as the eight-sided CoroTurn 800,” Winter says. “Yes, these solutions require some changes to your turning strategy but are well worth the time investment for shops that are working with difficult materials or looking for ways to leapfrog their competition.”

Using QR Codes to Fine-Tune Performance

Sandvik Coromant is not alone. Abhay Chaubal, product manager for the Americas at Seco Tools, is quick to point out that the company’s MF2 chipbreaker and RCMT insert solve the all-too-common chip control problem encountered when using round inserts.

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> John Winter
> Sandvik Coromant

The combination is especially useful when turning heat-resistant superalloys and similarly difficult materials.

Like Winter, he encourages shops to explore alternative toolpaths, with ISO inserts or otherwise. He also notes that recent innovations in toolholding can bring significant results.

“Our 3D-printed Jetstream coolant clamps deliver cutting fluid to the correct location for different turning applications like heavy roughing, roughing and finishing,” he says. “They can also be used with our Steadyline brand of modular boring bars, which have an internal dampening mechanism to eliminate chatter, improve surface finish and increase productivity.”

While choosing the right turning insert and toolholding system is critical, so is proper process development, says Seco Tools Indexable Product Specialist Jay McCord. Too often, shops don’t follow the manufacturer’s feed and speed recommendations and fail to use a scientific approach to troubleshooting, including documenting one change at a time.

“That’s one of the reasons why we’ve begun marking our inserts with QR codes, which allow the user to scan the code with a smartphone and pull up the product page showing the correct cutting parameters for the material you're currently turning," McCord says. "They also provide traceability back to the manufacturing process in case of a problem and make it easier to dispense individual inserts from a vending machine. As with many of our customers, Seco Tools is very focused on continuous improvement, and this is just one more example of that."

Small Price for Big Benefits

Iscar USA, a member of the IMC Group, is another cutting tool manufacturer pursuing continuous improvement opportunities for its customers, which is why the company isn't afraid of setting aside the ISO 1832 standard when it makes sense.

"One of the drawbacks of ISO standard tools is that they typically rely on a top clamp, eccentric screw or some combination of the two to hold the insert in place," says Robert Navarrete, national product specialist for parting, grooving and turning. "Yet these can allow a microscopic amount of insert lift, leading to vibration and reduced tool life. A dovetail-style geometry and on-edge clamping system eliminate this by taking pressure off the screw and redirecting it into the pocket."

Navarrete is talking about Iscar's HELITURN line of tangentially clamped turning tools. As he explains, these offer greater stability in the pocket, not only improving tool life and surface quality but also significantly increasing the tool's metal removal capabilities. "It also provides much better predictability, an attribute that's particularly relevant to shops that wish to run lights-out," he says.

There's just one caveat, though, and it applies to each of the proprietary solutions described here and elsewhere: Machine shops must invest in new toolholders, followed by reprogramming and process optimization.

But considering that a new toolholder and box of inserts sell for a few hundred bucks or so, it's a small price to pay for the potential benefits.

"If we see that a shop can enjoy a 20 percent improvement in either tool life or productivity, we're happy to present that to them in a written pre-sales test report and then prove it to them on the production floor," Navarrete says. "Return on investment is generally quite fast when adopting a new tooling technology like this, with some customers saving tens or even hundreds of thousands of dollars. It's pretty much a no-brainer."

What jobs can your machine shop handle more easily with indexable cutting tools? Tell us in the comments below.

