Grinder Wheels

Bill Neddow

Most people don't realize they might need specialized grinder wheels when they begin their adventure with woodturning. The first thing they think of is usually a lathe. Next, turning tools and wood. Maybe sharpening enters into the process at some point, but grinder wheels? Nobody thinks of them.

Having proper wheels on your grinder makes woodturning simpler and more pleasant than struggling to sharpen tools with improper equipment. Quality wheels that are balanced and suitable for your needs will make sharpening easy. Sharp tools make turning fun.

The old pros can sharpen successfully with just about any grinder and grinder wheel. They probably don't even use a jig to hold the tool at the proper angle. Decades of practice make it easy for them to roll the tool over the grinder wheel by hand and get a perfect edge, whether it is an old gray grinder wheel or the latest ceramic ones.

The rest of us, however, appreciate all the help we can get. When we are starting, it is particularly important to simplify the process and have the most appropriate equipment.

I spent more than a decade as a production turner and used a wide variety of grinder wheels. I have tested all the popular types—and some not so popular. Some wheels work quite well, but I have a cabinet full of wheels that do not. Now I want to share those experiences with you.

Grinder size and speed

I have used 6" and 8" (15 cm and 20 cm) grinders both high and low speed. Which is best? Probably the one you have. The main difference between the 6" and 8" grinder wheels is the amount of use you get out of them. When a 6" wheel gets down to 5" (13 cm), I generally change the wheel. But I use an 8" wheel until it is about 6", which is a substantial amount of extra grinding. Yes, it costs more to begin with, but you quickly recoup the extra cost. Is it worth buying a new grinder, though? Probably not, unless you are in continual production mode.

More important than the wheel size is the speed of the grinder. There are high-speed (3450 rpm) and low-speed (1725 rpm) grinders. Low-speed grinders are increasingly popular with woodturners because of the lack of heat buildup during use. At a lower speed, there is less chance of *bluing*—heating the metal to a blue color. In the old days, this was considered a terrible thing to do, with good reason. The carbon-steel tools—all we had until the last twenty years—lose their temper if the metal turns blue from heat buildup when grinding. The tools would not hold an edge and had to be ground back significantly to get rid of the soft metal, wasting metal and grinding grit.

The newer high-speed and powdered-metal tools are much less susceptible to overheating, but it can still happen, especially if you put some pressure on the tool and take it beyond the blue stage. Many people recommend dunking a tool in cool water to keep the heat level down. I have done this and seemed to get away with it; however, it can lead to microscopic cracks in the sharp edge. It is better to use a light touch when sharpening a tool to avoid heat in the first place.

If you have a high-speed grinder, there are wheels made specifically for them. Oneway Mfg., for example, sells wheels recommended for use with high-speed grinders. These wheels tend to be harder than the low-speed ones, so don't mix them up. Personally, I prefer the lower-speed wheels because I tend to grind off less of my tool at each sharpening.

Dressing the wheel

Speed is not the only thing that causes heat. A dull wheel is a major culprit. Dress your wheel as soon as it is not cutting efficiently. When the abrasive particle contacting the steel is sharp, a metal shaving is milled from ▸

Three aluminum oxide wheels are currently available. The gray one on the left came on a new grinder and is meant for grinding soft steel. The white wheel in the center was also on the grinder and is a little too coarse for woodturners' sharpening needs, but would be suitable for major reshaping of a tool. The blue stone is distributed by Oneway Mfg. and is a type that is designed for woodturners' needs. Note: it is rated for 4,140 rpm, so is meant for a high-speed grinder. Stones are also made specifically for slow-speed grinders.

the steel and ejected. This removes a significant amount of generated heat in a spray of red sparks. A wheel with dull grit ploughs across the steel and transfers much of the heat to the steel. Hard wheels are particularly prone to getting dull.

Gray wheels

As I mentioned, those who have been turning for quite some time can do a good job of sharpening using the hard gray wheels that normally come with a grinder. For many of these turners, this was all they had, so they learned to live with the grinder wheel's limitations. Gray wheels are designed to stand up to the terrible punishment associated with metalworking shops where thick steel plate is ground, bolts shortened, and other heavy-duty jobs performed. Heavy pressure is usually put on the wheel and the metals are soft. Gray wheels are very hard, so they can do these jobs while lasting a reasonable length of time. They also tend to heat up the metal, which is not a problem in most applications.

We woodturners, however, are performing a light-duty job on very hard tempered steel—simply renewing an edge on an already sharpened tool. The tool's hardness and the resulting heat are our enemy. Gray wheels tend to glaze over easily and stop cutting efficiently. When that happens, the normal reaction is to press harder, increasing the heat. If you have to use a gray wheel, clean it often and use a light touch when grinding.

White wheels

White wheels became popular about twenty years ago. They were considered a solution to all of our sharpening problems. And, to a certain extent, they were. They were soft and did not burn hard steel tools as readily. (Most were about an H grade.) The softer the wheel, the less heat buildup.

There was a downside, however. It was easy to wear a groove in a white wheel. As a result, more time was spent dressing the wheels to get rid of grooves, causing most of the wheel to be ground away by the dresser, removing ripples and grooves on the face of the wheel, white powder piling up. The wheels did not last long but did a good job of sharpening. Another problem was that with the quick wear, my grinding jig had to be constantly readjusted in order to maintain the same angles on my tools.

Blue wheels

After white wheels came blue wheels, which are still popular. They are harder, but not hard enough to cause major problems with overheating the steel. They sharpen tools quickly and easily. They are great workhorses and last longer. I continue to use them. They are a great compromise for light use on hard metals.

Wheel grit

All these wheels are made from aluminum oxide, the workhorse of the metal industry, and they are relatively inexpensive and do a good job. The blue wheels are the wheels beginners will probably like best. I keep an 80-grit wheel on one side of a grinder and 120 grit on the other side, the first for shaping tools, and the second for creating a fine edge. The edge produced by the 120 grit is sharper than that produced by the 80 grit. It looks almost like a honed edge, yet the edge will not break off the high-speed tools we use, as it used to with carbon-steel tools.

Ceramic wheels

There are new and interesting wheels on the market. The ones made from a ceramic alumina compound are better than the regular aluminum oxide wheels. The grit on these wheels is not made from your granny's ground-up teapot, even though it is called a ceramic. Each manufacturer closely guards exactly how it produces the material, but basically, the manufacturer converts a colloidal dispersion of hydrosol containing goethite into

Ceramic wheels. On the left is a Norton SG wheel and on the right, the 3X wheel. Both cut faster and cooler than aluminum oxide wheels. The SG wheel lasts a very long time. In fact, the wheel on the left has been in daily use for over two years.

a semi-solid gel, dries this gel to a glassy state, crushes it to the required grain size, and fires it at between 1200° C and 1600° C. The final product is an abrasive grit of alumina microcrystals.

A major reason why these wheels work so well is that the grits are microcrystalline. This means that each piece of grit is composed of a clump of hundreds of tiny sharp crystals. They continually break away as they are used, exposing millions of fresh sharp cutting edges. These wheels cut cool and leave a fine finish on the tool bevel. By comparison, each piece of aluminum oxide grit is one crystal, which may or may not fracture under pressure and break down to expose smaller edges as they wear. Blunt abrasives rub, which overheats tools.

Ceramic wheels are expensive, but they produce a wonderful edge. I find that when sharpening with 80 grit, the edge looks almost like it was sharpened with a 120-grit wheel. (The finest wheel I can find in ceramic is 80.) They grind almost twice as fast as aluminum oxide (so use a light touch) and produce a keen edge. The wheel self-sharpens as it grinds, it wears slowly, and requires minimal dressing. They can last five times longer than a white wheel, so they are cost-effective.

Because the ceramic is expensive to produce, it is mixed with regular aluminum oxide before being pressed into a wheel. The wheels I am referring to are 50% ceramic, such as the Norton SG wheels sold by many suppliers. Norton also manufactures a wheel that has only a 30% ceramic content, the 3X. While these cut cleanly and run cool, some people have found the wheel wears faster than they would like. Some who have had problems say their wheel has a bond hardness of I. Mine has a bond hardness of K, and has not been a problem. To me, they are good value for money, however, the SG, with its higher ceramic content is well worth the added expense.

Diamond wheels

Some woodturners use diamond wheels. The theory seems to be that diamond can cut anything. In theory, it does. It is great for cutting ceramics, stone, and aluminum. But diamond wheels do not cut steel efficiently. All the manufacturers agree it should not be used to sharpen the steel we woodturners use—in fact, anything with iron in it. On metals with a ferrous content, the diamond literally disappears.

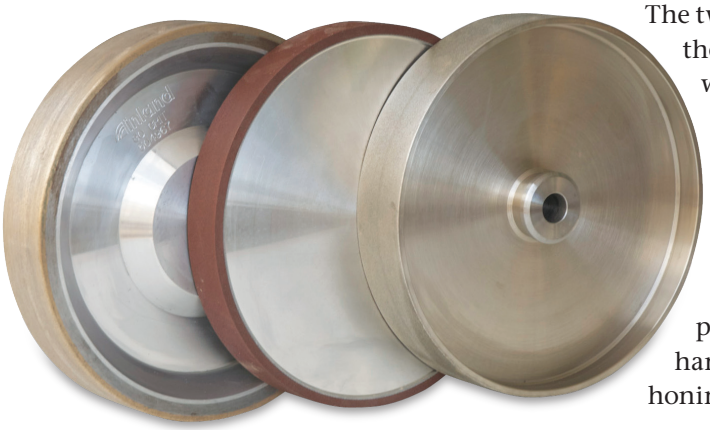
Diamond particles have a fatal attraction to the iron in the steel. The iron attracts away the carbon in the diamond one atom at a time. The two actually bond at the molecular level, which means a minute amount of the diamond gets carried away with the chip. It sounds like a slow process, and at room temperature it is—thus hand-held diamond honing stones last a long time. Start adding heat, however, and the process speeds up dramatically and catastrophically and you will find a mist of black dust around the base of your grinder, all that is left of your precious diamonds. If you put much pressure on your tool—pushing it into the diamond—you can go through the diamond layer in minutes. If you are gentle, you can get a year or so out of a diamond wheel in use daily, but it will slowly change from an 80-grit wheel to a 120-grit wheel, and eventually will only be good to use as a hone.

I have tried several brands of electroplated diamond wheels, as well as resin-impregnated ones, and an expensive wheel with ⅛" (3 mm) of diamond embedded in nickel around the rim. They all behaved the same way: The diamond quickly wore down to a finer grit and some wheels seemed to need a lot of dressing.

Cleaning them with an old aluminum oxide wheel can restore diamond wheels. That worked on all wheels I tried, but I was reluctant to use the aluminum oxide on the electroplated wheel—there is only one layer of diamond. In fact, that wheel needed less attention than the other types—just cleaning with WD40.

The wheel with the diamond/nickel mixture wore away the old aluminum oxide grinder wheel faster than my daughter's large cat inhales food. It looked great and cut well after this treatment. What happens is that the aluminum oxide wears away the bonding agent in the diamond wheels, exposing more of the diamond. If I sharpened a few ⅝" (16 mm) gouges on the wheel, however, the surface seemed to deteriorate into a finer grit and the nickel became highly polished. It always looked like it needed cleaning. I eventually took that wheel off the grinder and will give it to a stone carver. That is a $400 loss.

The resin-bonded wheel also lost its edge quickly, but would clean up well ▸



Three diamond wheels. On the left is the wheel with ⅛" (3 mm) of diamond/nickel on the rim. The polished spots caused by sharpening high-speed steel are visible. In the center is an unused resin-bonded wheel and on the right (diamond plated) is the one I found most suited to my needs. It started out as an 80-grit wheel and after a year, I am using it as a fine-honing wheel. Note that there is no identification on the two wheels on the right.

CBN wheels, my favorites. They cut cleanly, quickly, and smoothly. They have been in continual use for over a year and show no wear.

with the aluminum oxide dressing stone. The stink of hot resin in the shop was intolerable. That noxious odor was even present when I was sharpening tools. I finally gave the wheel away.

To summarize, the electroplated wheels caused the least amount of trouble. It took about a year to permanently wear them down from 80-grit to honing-wheel condition. The electroplated and resin-coated wheels cost more than $200 apiece, so I do not consider them cost effective.

CBN wheels

Manufacturers recommend wheels made of CBN—not diamond—for sharpening tool steel. CBN is cubic boron nitride and it is almost as hard a diamond—it will actually scratch diamond. And, it does not have the fatal attraction that diamond has for iron. I have had a pair of these wheels on a grinder for over a year now and can detect no wear. Of course they will eventually wear out, all things do, but the 80-grit is still an 80-grit wheel and the 180 grit is still 180 grit. (I have found I can use the 180-grit wheel to keep my powdered metal tools, like the ones made by Doug Thompson and Dave Schweitzer, sharp as a razor.) The steel is hard enough, yet flexible enough, to maintain a scary-sharp edge, reducing dramatically the need for sanding.

CBN is used widely in industry where precise sharpening and shaping is required. Aircraft manufacturers use distinctively-profiled wheels to sharpen end mills and other precision machining tools to strict tolerances. The CBN sharpening wheels have to perform exactly the same job, with no significant measurable wear, shift after shift, day after day. That is why they last a long time in a woodturning shop.

The CBN wheels I have came prebalanced. I did not have to fuss with dressing and shaping the wheel when it was first mounted. Maintenance of CBN wheels is simple: Scrub them once in a while using a toothbrush and kerosene or WD40. This removes varnish and CA glue that gets transferred from turning tool onto the wheel. I have never had to use aggressive cleaning techniques on these wheels.

If I use a CBN wheel, I never have to adjust my sharpening jig. I can leave it set exactly the way I want, and since the wheel never gets smaller, I get the same grind every time. One light pass over the 180-grit wheel is enough to sharpen a tool to razor-blade quality most of the time. If my tool is really dull, then one pass over the 80 grit wheel, followed by a light pass over the 180 grit wheel will return the edge to perfection.

CBN grinder wheels come in almost any shape desired. The choice is endless . . . except for simple bench grinder wheels. (The shape of a standard bench grinder wheel is generally called 1A1 for diamond/CBN.) Bench grinder wheels are available, but you have to search for them. Check with your local metalworking shops.

I intend for this brief survey of grinder wheels to accomplish three objectives. First, to provide information to help you buy grinder wheels with more confidence. Second, to make your turning experience more pleasurable. And third, to help you save money—I know—I have spent far too much on grinder wheels over the years. It is my own fault, of course, but I am too curious for my own good! ■

Bill Neddow spends his retirement creating bowls for galleries and taking part in studio tours. He also does some demonstrating. Bill considers himself a semiproduction turner, following themes in his bowl designs, but trying something different with each one. He is fascinated not only by how to do something but why it works, a byproduct of thirty years as a writer, editor, and publications manager. He lives in Ottawa, Canada, with his wife and about 3,500 dry rough-turned bowls. His website is billneddow.com. You can email him at bill.neddow@sympatico.ca.

CBN bench grinder wheels (6" by ¾" [150 mm by 20 mm] only) are available in Britain from Peter Child Woodturning Supplies.

In North America, they are harder to find. Dave Schweitzer of D-way tools just started carrying CBN wheels. Another source is the one I found after searching for six months—the supplier was in my own backyard! Cuttermasters (800-417-2171 or cuttermasters.com) has both 6" and 8" (15 cm and 20 cm) wheels in a variety of grits and they ship worldwide. One major woodturning supplier is actively searching for a good source, but there has been no announcement yet.

Another source is Northwest Super Abrasives in Eugene, OR (541-683-0801). Reed Gray (robo hippy) provided this source. Reed is an active and knowledgeable contributor to woodturning forums. Reed adds, "My 80-grit (CBN) wheel is four-plus years old and until last year, I was turning maybe 800 bowls per year, along with other things. It might be halfway used up. That amount of sharpening would have worn out at least one standard grinder wheel per year."

I have tried getting the wheels from the salesmen for all the big name companies, including Norton and 3M. They all say they can deliver, but not one has called back. These companies produce CBN wheels, but it appears that bench-size grinder wheels are not part of their regular production lines.

Identifying Grinder Wheels

Most manufacturers use a system for identifying grinder wheels. There are variations—a number of manufacturers modify the identification system to meet their needs, and not all use the complete sequence of identifying codes. Some wheels carry an absolute minimum of information. It is possible, however, to figure out the code on most wheels.

There are two systems, quite similar. One is for identifying bonded wheels (made of such substances as aluminum oxide and silicone carbide). The other is for diamond and CBN (superabrasive) wheels.

I have tried to simplify the systems to cover only the types of wheels woodturners generally use.

Identifying a Bonded Wheel

Number and Letter Sequence

Prefix	51
Abrasive Type	A
Abrasive Grain Size	80
Grade (Hardness)	K
Structure	5
Bond Type	V
Manufacturer's Record	05

Prefix: Manufacturers' symbols indicating the exact kind of abrasive. This is optional, and often manufacturers do not use it.

Abrasive Type: Identifies the primary grain used to make the wheel.

- A Regular Aluminum Oxide
- WA White Aluminum Oxide
- Z Aluminum Zirconium
- C Silicone Carbide
- SG Seeded Gel (Ceramic)

Abrasive Grain Size: Indicates the size of grit particles going through a screen. For example, 80 grit is what goes through one row of screen with 80 wires in one linear inch. 120 grit means there are 120 lines of screen, making the size of the grit going through a 1" (25 mm) linear line of screen smaller. The measurements range from coarse to very fine. I have found that woodturners use the medium-grit range (46, 54, 60) and fine (70, 80, 90, 100, 120, 150, 180). We most commonly use 46 grit for shaping a tool and 80 grit for sharpening. Some turners use a finer-grit wheel to keep the tool sharp, such as 120 grit.

Grade (Hardness): Hardness is rated from A to Z with A being the weakest bond and Z being the strongest. A weaker bond is preferred for grinding harder materials like tool steel. Most of the wheels we use are in the I to K range. An increase in the hardness grade by one or two letters can make a dramatic difference. A move from an H to an I, for example, could double the life of the wheel.

Structure: Basically the spacing between abrasive grains, represented by a series of numbers, with the structure becoming more open as the number increases. A 1 would be very dense. We are after a more open structure, which would probably be 5 or above.

Bond Type: The most common bond types are vitrified V and resin B. Vitrified is basically a vitreous glass much like pottery or glassware fired in a kiln, which is why there is such a fuss about not using a chipped or dropped stone made with this material—it may be cracked and can blow up. Resin is more commonly found in cut-off wheels, but can also be found in diamond and CBN wheels. There are other bond types such as Rubber R and Silicate S.

Manufacturer's Record: A private manufacturer's marking to identify a wheel. The use is optional.

Identifying a Superabrasive Wheel

The marking system for superabrasive grinder wheels is somewhat different.

Number and Letter Sequence

Abrasive Type	D
Abrasive Grain Size	80
Grade (Hardness)	N
Concentration	100
Bond Type	M
Bond Modification	77
Abrasive Depth	⅛
Manufacturer's Record	4

Abrasive Type: The letter D indicates that the abrasive is diamond. The letter B or CB is used for CBN.

Abrasive Grain Size: The number 80 represents the average grain size fitting through a linear inch of wire mesh (e.g., 120 grit would mean 120 lines of mesh).

Grade (Hardness): Like conventional wheels the letter N identifies the hardness of the wheel. Resin- and metal-bonded wheels, however, are produced with almost no porosity and the grade of the wheel is controlled by modifying the bond formulation.

Concentration: The number 100 is known as a concentration number, indicating the amount of diamond abrasive contained in the mix in the wheel. The number 100 corresponds to an abrasive content of 25 percent by volume. For CBN wheels, the number represents a concentration of 24 percent by volume. Concentration numbers of 75 or higher are are preferred. For CBN wheels, Norton drops the concentration section. Norton refers to the concentration as the grade and uses the letter W for 100 concentration, T for 75 concentration and Q for 50 concentration.

Bond Type: The letter M or N indicates the bond is metallic. Another bond is resin, represented by the letter B or R. There are also vitrified wheels V.

Bond Modification: This is the manufacturer's notation of any special bond type or modification. It is optional information.

Abrasive Depth: The working depth of the abrasive section, generally measured in inches. For example: ⅛" (3 mm). This is very important in determining the life of the wheel and its initial cost. A bond layer of ⅛" provides about half the life of a bond layer ¼" (6 mm) thick.

Manufacturer's Record: As with the bonded wheels, this is optional information on the manufacturer's private identification code for the wheel.

Safety Note

Grinder wheels can explode as they rotate at high speed. It is absolutely necessary to wear an impact-resistant faceshield when using a grinder.