SHAPING AND SHARPENING

The Whys of Tools and Tool Design

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Every time I pick up a woodturning catalog, the number of "new" tools that are currently available just knocks me out. And this is a good thing. Compared to the simple scrapers and gouges that were available when I started turning, today's lot is a vast improvement. It is also vastly complicated – especially for beginning turners – trying to figure out what tool will work best for a given task. Will it work on green wood as well as dry? Or with balsa wood as well as rosewood?

Over time, most turners develop a working familiarity with their tools, or at least a certain confidence in knowing what a tool is supposed to do and how to make it work. But when it comes to understanding why a tool works (or doesn't work), many people begin to scratch their heads. It's that 'why' part that I'd like to address here.

Before I get to tool applications, let me begin with some very basic concepts of tool design that affect all tools. For instance: You get up in the morning and shave. Before lunch, you grab your ax and go cut down a tree to turn. Then, after a nice nap, you buck up the sections with a splitting mall. The razor, the ax, and the mall are all 'cutters' in some form. They each have a specific function and are very effective tools, but neither can be used to perform the function of the other … at least not efficiently.

Now, look at the edges of these tools in cross section and think of the similarities between the razor and a skew, the ax and a gouge, the mall and a scraper. They all have two surfaces or planes that join to form an edge, and each has a certain amount of mass which supports (or doesn't support) that edge: the mall having the most amount of mass, the razor the least. Obviously, the razor and the skew have a 'sharper' edge, but because they lack mass, these edges just don't stay sharp for very long … they lack durability. Specifically, the more mass a tool has to support the edge, the more durable it will be, albeit at the sake of sharpness. Gouges, then, are the compromise between the two. They sacrifice the sharpness of the skew, but they gain durability due to the greater mass supporting the edge.

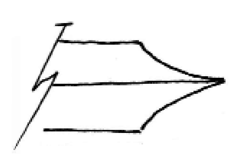
Friction and abrasion, of course, will cause any tool to lose its sharpness. The various grades of 'high speed' steel available in today's tools will extend edge-life. But some woods are so abrasive they'll quickly whack the edge off any tool — like root burls which usually contain pockets of sand, many species of Eucalyptus which contain silica, or anytime you're turning areas of bark that have been impacted with dust from the wind. Spalted woods can be a nightmare, because the black 'zone lines' are not wood anymore. As far as the tool is concerned, they act more act like charcoal, and one good slice with your tool and the edge is gone.

Let's look at some practical applications of specific tools to see how this relationship between sharpness and mass applies to cutting efficiency.

The Parting Tool:

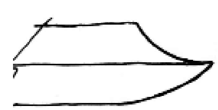
The illustration #1, below left, shows the side view of a conventional

Illustration #1



Conventional
Parting tool

Illustration #2



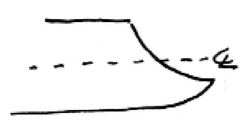
Modified with
convex edge

'diamond' shaped parting tool, where the widest part of the tip is in the center of the tool.

Contrast that with Illustration #2 next to it, which shows a modification I use for that same tool. The difference is that by grinding a convex shape under the tip, I have introduced a small amount of mass to support the edge. The tip of the modified shape isn't 'quite' as sharp as the original, but it works better because it doesn't vibrate on the wood or burnish as quickly. The result is that it stays sharp longer. Of course, you can't flip it upside down. But, in truth, once the original tool is dull on one side, it doesn't work either way.

The Illustration #3. below, shows the side view of a parting tool I made myself. It's a $^{3}/_{16}$-in.-thick by $^{5}/_{8}$-in.-wide scraper turned on its edge, and then re-sharpened using the convex/concave idea from the 'diamond' shaped tool. Notice that I've also dropped the tip below the centerline of the tool. This keeps the tool from vibrating when cutting.

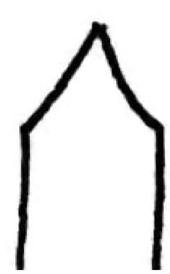
Illustration #3



Ellsworth
Shop-made tool

The Skew:

Illustration #4



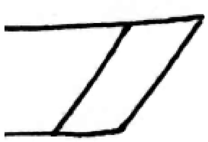
Blunt edge
Factory Grind

Illustration #5

Custom grind:
Thinner and sharper

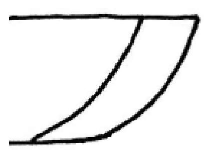
Illustrations #4 and #5 above show the cross section of two skews. The left one, #4, shows how it usually looks straight from the factory with lots of mass behind the tip, but not very sharp. The right one, #5, is the way most turners grind the tip to make it work properly. Once again, while the custom-ground thinner blade shown on the right, #5, is sharper, it lacks durability so it must be re-honed more frequently to keep a fine edge. The difference between the conventional straight-bladed skew, Illustration #6, below left, and the 'radius', or convex bladed design,

Illustration #6



Conventional Skew

Illustration #7



Radiused Skew

above right, Illustration #7, is that the 'radius' skew presents slightly less physical contact of the edge to the wood during the cut. With less of the edge touching the wood, and assuming the mass and shape of the two tools is the same, the 'radius' design creates a bit less drag on the wood and, therefore, it gives more energy to the cut.

The Scraper:

Illustration #8 shows another side-view example of what many of the lesser expensive scrapers look like. Illustration #9 shows the same tool but with a steeper bevel so it can be used to make finishing cuts on the inside of a bowl. Again, the steeper angle of the bevel in Illustration #9 provides more mass for durability, but sacrifices sharpness. To make the tool function, you must add a burr to the edge to do the cutting. [Note: It's worth experimenting with different grit wheels on the grinder to raise this burr. A 60-grit wheel will raise a huge burr that is

Illustration #8

Conventional scraper bevel

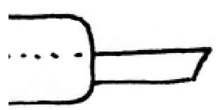
Illustration #9

Steeper bevel For finishing cuts

very aggressive on the wood. But it will also wear away quickly leaving a jagged edge that clogs up with dust from the wood and stalls the cut. Conversely, a 120-grit wheel may not raise enough of a burr to do the work. In my experience, a larger burr works well with softer woods and a finer burr works best with harder woods … but that's only a personal preference, not a rule].

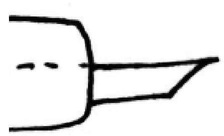
When using a small-tipped scraper with deep hollowing tools, increased control of the tip will be gained when the bevel angle is steeper, like the one shown in Illustration #10. The bevel angle shown in Illustration #11 gives a sharper edge to the tip, but is so aggressive that it may be too difficult to

Illustration #10



Steep bevel gives better control

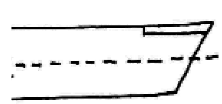
Illustration #11



Sharper tip Too aggressive

control … it's just one of those odd cases when the tip is too sharp! As well, when using a deep hollowing scraper with a straight tip, I drop the top surface of the cutter to the centerline of the shaft (Illustration #10) to prevent the tool from grabbing or vibrating on the wood. It's the same principle described above regarding the parting tool. If the

Illustration #12



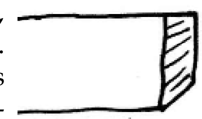
Top surface on same plane as top of shaft

top surface of the tip is above the centerline, or on the same plane as the top surface of the shaft (Illustration 12), watch out!

The Gouge:

There are many 'types' of gouges including spindle, bowl, deep-fluted, roughing, detail, hook and loop. But the principles of what I'm describing here apply to all. The steep vertical angle of the edge in the gouge shown in Illustration #13 is fine for cutting across the bottom of a deep bowl where you need to keep the bevel in contact with the wood. But it's not as 'sharp' or as 'versatile' as the gouges shown in Illustrations

Illustration #13



Side view of Steep vertical edge for cutting bottom of bowl

Illustration 14a

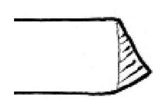
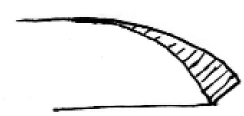


Illustration 14b

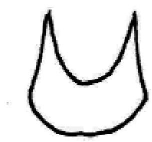


Side view where angles of edges are drawn back to create sharper edges

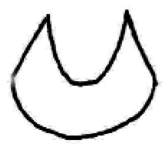
#14a & #14b, above.

To further illustrate the importance in the relationship of mass to sharpness, we only have to look at what's commonly called the "shearing" cut, or the "shear-scraping" cut. This cut can be done either with a gouge with a drawn back edge (Illustration #14b) or a scraper by placing the edge of the tool approximately 45 degrees diagonally across the surface of the wood. Regardless of which tool is used, it must have a burr on the edge, as a honed edge will simply be burnished away on the first cut. When shear cutting with a tool that has a thin, skew-

Illustration 15 **Illustration 16**



Thin-skew-like edge can cause vibration



Additional mass behind edge reduces vibration

like cross section, as in Illustration #15, shown above, the lack of mass supporting the edge will cause the tool to vibrate on the wood. To eliminate this vibration, simply use a tool with more mass behind the edge, as in Illustration #16.

Another cause of vibration comes from tools that are thin and very long, like a $^{1}/_{4}$-in. gouge that is often 8-in. long, or a long skinny parting tool, or a thin bladed scraper. It seems as if all you have to do is look at these tools and they begin to vibrate, and I wouldn't want to dangle one of them out over the tool rest just to prove my point. With the gouge and the parting tool, I simply cut these tools in half! It may seem like a waste of both steel and money, but at least they work properly. With any of these tools, always keep the tool rest as close as possible to the work piece to reduce the vibration.

Should you hone?

To hone or not to hone? Now, that is a good question! Habits and traditions being what they are, honing a tool really depends on what you want the tool to do. I hone all my skews and gouges for spindle turning, because I want a super edge to do the work … knowing that the edge will quickly burnish away and need to be re-honed. But my preference is not to hone my bowl gouges, because a burr edge works fine for rough cutting both green and dry woods. As well, I use a shearing cut instead of a conventional bevel cut for my final surface and, as mentioned above, without the burr the shearing cut just won't work.

If you find yourself over grinding your tools, you're probably learning two basic things: How to raise your level of frustration, and how to waste away a good tool! Consider that when you go to the grinder, you are NOT trying to sharpen the tool! Instead, you simply want to dress the bevel. If the bevel is properly dressed, the tool will be sharp. It's automatic.

— David Ellsworth

And I use 100-grit aluminum oxide grinding wheels, because they produce the right size of a burr to do the job and that doesn't wear away as fast as a burr produced by a 60-80 grit wheel.

Learning to sharpen

Now! As a teacher of woodturning, I would be remiss if I didn't offer a few tips on learning how to sharpen these tools. If you find yourself over grinding your tools, you're probably learning two basic things: How to raise your level of frustration, and how to waste away a good tool!

Consider that when you go to the grinder, you are NOT trying to sharpen the tool! Instead, you simply want to dress the bevel. If the bevel is properly dressed, the tool will be sharp. It's automatic.

Try this. Turn the grinder OFF! Bring the tool to the wheel in your usual manner, either with your hands or in a sharpening jig. Make a few slow passes on the non-rotating wheel so that you feel comfortable. Now close your eyes! What you will now feel is your body, and all the tension that has built up in it, mostly in your neck and your hands. Relax that death grip so that the fingers are simply cradling the tool instead of clamped to it. You will also feel your toes, your knees, and all the other body parts that are keeping you from falling over when you 'grind' the tool. Try to re-position your body by spreading your feet apart and unlocking your knees. This will allow you to move freely as you continue to practice the movement of the tool across the wheel. Open your eyes to see if the tool is still in the center of the wheel. Now close them again.

Release tension

Focus on relieving tension wherever you feel it. What you are learning is the "process" of grinding, without the tension and without wasting away the tool. Practice this for a minimum of five minutes … five! It will feel eternal, but you will be forever rewarded.

When you do turn on the grinder, the tension will likely return, so continue to focus on relaxing those areas of the body wherever the tension appears. This takes practice, but the less tension in the body, the lighter your touch will be of the tool to the wheel and the more successful you will be in dressing the bevel. Most important, be conscious not to force the tool against the wheel.

You can also practice this method of turning the machine off and closing your eyes on any cut you make on the lathe. It's a wonderful way of learning how to move with the cuts instead of forcing them.

And when you're moving properly, everything just seems to work a whole lot better.

David Ellsworth is a full-time studio woodturner who teaches turning at his home in Pennsylvania. Sketches by the author.