THE CUTTING PROCESS

The tools vary, but not the nature of wood

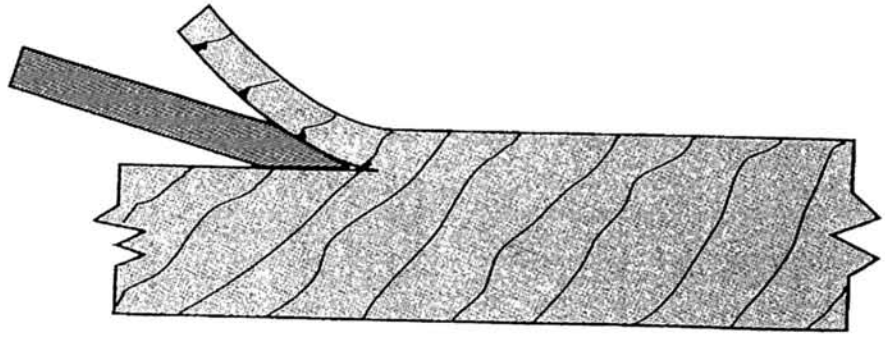
GEORGE HATFIELD

WHEN I SAW JOHN JORDAN turning on his first Australian tour, I was very impressed with the shapes he turned and the quality of the straight-off-the-tool finish he achieved on the wood.

However his turning technique appeared to be totally different from that which I use. John held his tool with a radial to the wood, whereas I hold my tool at a tangent to the wood. On closer examination I found John holds his gouge with a radial approach, with the long side bevel of the gouge (about 25° grinding angle) supported on the wood and the side cutting edge presented to the wood at an angle. I hold my tool (25° grinding angle) tangentially to the wood with the bottom bevel rubbing and the cutting edge at a skew to the wood.

So in fact we are both doing the same thing but with a different approach. Underlying each technique was an understanding of how wood wants to be cut.

In this article I will look at the various cutting actions using woodturning chisels and gouges, how to get the best possible finish off the tool and obtain the longest life of the cutting edge. As you'll see, much of what we discuss can be applied to other cutting tools as well.



As the edge cuts the wood, the bevel assists the cutting action by wedging the fibers apart. When cutting with the grain, the finished cut is left smooth and the shaving surface is chipped.

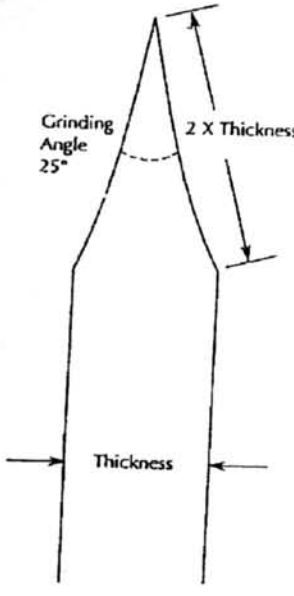
To look at the cutting process we must first examine the nature of the material we are cutting. A simple analysis of wood reveals it is made from millions of minute cells of wood tissue which are built up to form a tube like structure with vessels or tracheids growing vertically and medullary rays growing horizontally. The material these interwoven tubes form is called wood. In woodturning cuts are made across and along the grain as the wood rotates.

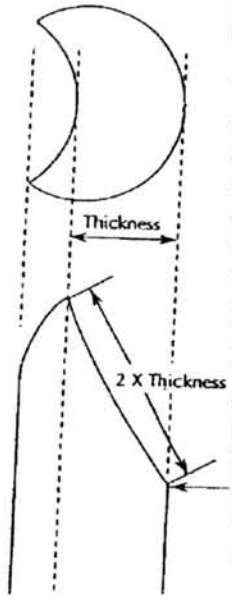
Regardless of what type of tool is used for cutting wood, be it a hand saw, hand plane, hand chisel, circular saw, jointer, planer or even sandpaper, the actual process of the cutting edge penetrating the wood and removing a shaving is all the same.

The cutting process starts when the very tip of the cutting edge severs the surface of the wood. As the edge goes deeper into the wood, the bevel (created by the grinding angle) assists in the cutting action by wedging or splitting the fibers apart, thereby reducing the work load on the cutting edge, as shown above. You will notice that when cutting with the grain, the finished cut is left smooth and the shaving surface is chipped.

It's also evident that the smaller the grinding angle, the easier the wood fibers will be wedged or split apart. However, the matter isn't so straightforward. A small angle may well split the fibers more easily, but the rigidity of the cutting edge is substantially reduced to a point where it will break.

The angle which seems to work the best for soft-to-medium-density wood



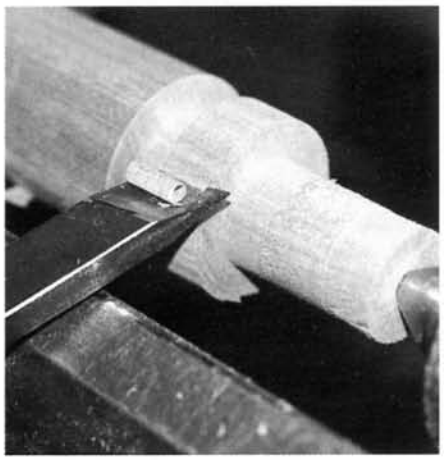


Bevels and edge thickness:

To achieve an efficient 25° grinding angle on a chisel, make the length of the bevel twice the thickness of the tool. On a gouge, make the length of the bevel twice the thickness of the distance from the bottom surface of the tool to the bottom of the concave flute.

is 25°. A rule of thumb for achieving a 25° grinding angle on a chisel is to make the length of the bevel twice the thickness of the tool. On a gouge, make the length of the bevel twice the thickness of the distance from the bottom of the flute to the bottom of the tool, as shown in the drawing on the previous page, bottom left. A stronger cutting edge is required on harder woods such as Ebony, Jarrah, or Rock Maple. For these I recommend increasing the grinding angle up to 30°.

In woodturning the cutting operation can be categorized into two actions: peeling and scraping. A peeling cut is made by placing the bevel of a chisel tangential or flat on the face of the cylinder being turned. The handle of the tool is then lifted slightly to make the cutting edge pivot off the front of the bevel into the wood. This will cause a shaving to be peeled



A Peeling Cut

(wedged) off the cylinder, as shown above. The thickness of the shaving or the amount of wood you take off is determined by how much you lift the handle or tilt the tool.

A scraping cut is made by feeding the tool into the revolving cylinder on a radial line. The cutting edge enters the wood and the shaving is forced off by the top bevel alone causing the shaving to be first compressed, then to be turned around in a tight circle

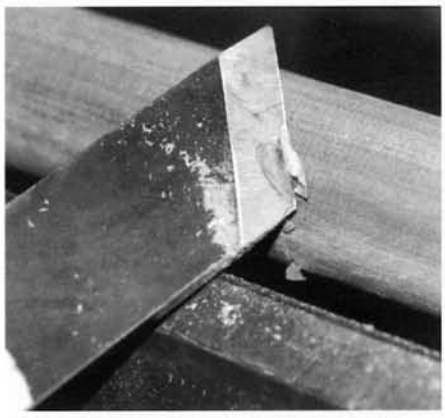
A Scraping Cut

and splintered off, as shown above.

The bottom bevel does not come in contact with the wood. In a scraping cut the cutting edge does all the work, and therefore becomes blunt considerably faster than when using a peeling action. Because of the severity of the cut, the grinding angle for a scraper is increased to about 60° to 70° and only one bevel is recommended.

If a smaller grinding angle is used the cutting edge will chatter. If two bevels are used on a scraper, the top bevel which is used to remove the shaving is at less of an angle to the rotating cylinder, therefore making it harder to roll the shaving around and take it off. It is not recommended to make heavy scraping cuts.

While the peeling action will remove wood easily, making long shavings and leaving a relatively clean finish, it can be improved considerably by presenting the cutting edge to the wood at a 45° angle to the axis of the wood. This is called a slicing or skewed cut, shown in photo below left.



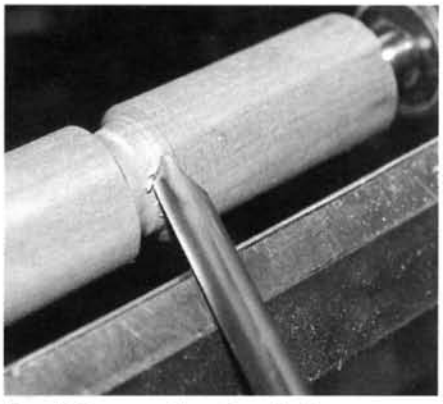
A Slicing or Skewed Cut

The slicing action works in two ways. First the skewing action makes the shaving pass across the chisel's bevel rather than come back towards the handle. In effect this action reduces the cutting angle making it better to split the wood without losing any of its strength. It also reduces the impact of the whole length of the cutting edge cutting at the one time and allows the cut to start at the bottom of the cutting edge and run along the cutting edge for the required width of cut, forming a long spiral shaving.

The wider the cut, the harder it is to control. A light cut will give off a very narrow shaving whereas, a heavy cut will make a shaving up to about $^1/_2$-in. wide. It is unusual to see shavings over that width as the wider the shavings get, the harder it is to control the cut. Use of the slicing cut on all cutting tools will give a far superior finish on the wood plus extend the life of the cutting edge and make the tool much easier to control.

A Roughing Gouge, Skewed Cut

The photo above shows a roughing gouge with its cutting edge skewed to



Detail Gouge, Skewing Action

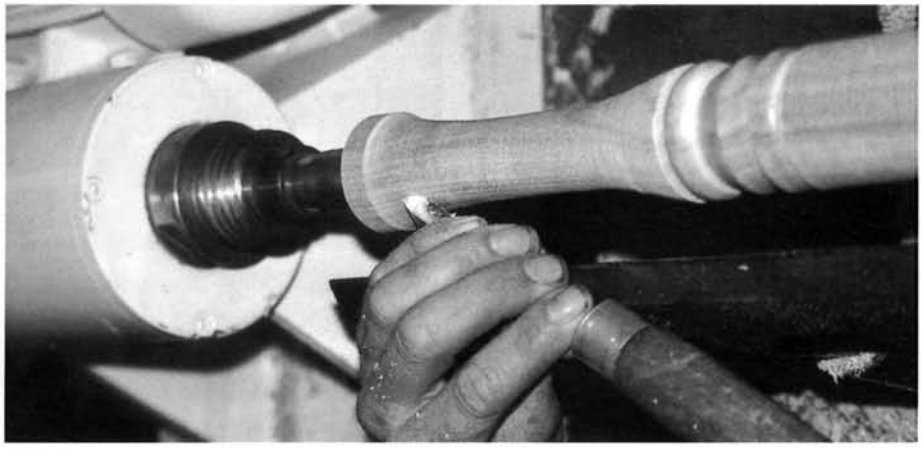
the wood when shaping a cylinder.

The photo above shows a detail gouge using the side of its cutting edge in a skewing action to shape the

Roughing Out With A Slicing Cut

curve of a hollow.

The photo above shows that even the cut made to rough a piece of square stock down to a cylinder is best accomplished using a slicing cut. However, when turning cranky grain or knotty wood the peeling action tends to split the wood off in the wrong direction or much further than required. This can sometimes be overcome by sharpening your tool and making very light cuts (narrow shavings). If the wood still splits out badly the only approach is to use a scraping cut which does not rely on the grinding angle wedging the wood apart. A scraped finish will leave a surface with small break outs or splitting but in most cases this can be sandpapered smooth. Another cutting technique which may be used on cranky grain or long concave shapes which are too curved to use a skew chisel, is to make light cuts using the side of a detail gouge in a skewed scraping action, as shown below. The side of the detail gouge is held on its back with a slight tilt towards the turning. A radial approach is used to the rotating wood like a normal scraping action, but with a slight skew. The skewed scrape will soften the cut and the curve of the face of the detail gouge will make a narrow shaving. Using this cut you will find you can cut in both directions and obtain a finish which is not as clean as a slice but better than a flat scrape. Scrapers can also be used to good effect in a skewed action but may only be fed in one direction. Be very careful if trying the skew scrape technique with a wide or flat tool. These tools tend to give wider shavings which puts more pressure on the tool.



Detail gouge is a skewed, scraping action, seen from above,

Tool Support

This brings up the final consideration of cutting techniques -- tool support. The contact of the tool on the tool rest is often disregarded by the beginner because it is out of sight when turning but in effect this is where a lot of the demons are bred. If the tool is not supported on the tool rest correctly it will tip over and cause one of those nasty dig-ins. The tool should have vertical support on the tool rest as close as possible to where the cutting edge is taking off the shaving. Another factor is that a wide cut is more stressful on the control of a tool than a thick cut, e.g. it is harder to control a tool with a shaving $^{5}/_{8}$-in. wide and $^{1}/_{16}$-in. thick than a shaving $^{1}/_{4}$-in. wide and $^{1}/_{8}$-in. thick. A good example of this is when you are working on a long springy turning. You will find using a small detail gouge will be far more controllable than using a large roughing gouge. Tool support is not as significant on narrow tools because the support is always fairly close to vertical in relation to the shaving. If the cut is made on the side opposite to that resting on the tool support when you're using wider tools (especially on scrapers because the cutting action is more severe), the leverage is too great and the tool will be pulled down onto the tool rest, and also dig into the work.

In summary: For peeling or slicing medium density wood use a grinding angle of 25°. Where possible use a slicing cut with all tools. If cutting cranky grain or cutting across the grain use a skewed scraping cut. If none of the above is possible use a scraping cut with a radial approach. Use a grinding angle of 60-to-70° with only one bevel on a scraper.

George Hatfield , a professional woodturner in Australia, will be demonstrating his spindle turning technique at the AAW symposium in Tacoma, WA.