Sharpening Twist Drills

Grinding standard and brad-point bits freehand

by Ken Donnell

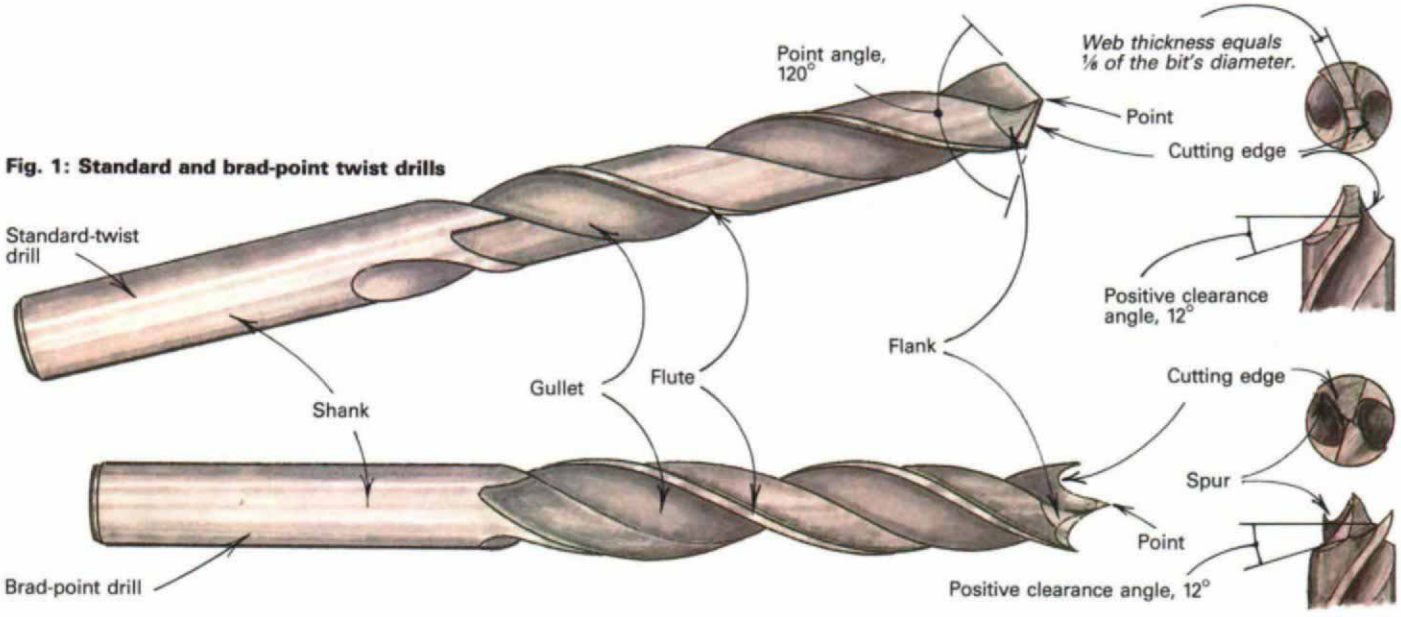


Fig. 1: Standard and brad-point twist drills

My first lesson in woodworking came from my former scoutmaster, Merle Schelase. I've often visited his workshop and always received the same lesson: how to sharpen a scraper, handsaw, chisel ancl drill bit. Each visit, he showed me these same, seemingly simple procedures and I always learned new and useful information. Most of all, I learned that even the most dedicated woodworkers can spend a lifetime perfecting their tool-sharpening skills.

While most woodworkers wouldn't think of using a poorly sharpened knife or chisel, few pay equal attention to their drill bits. But a sharp bit is as valuable as a sharp paring chisel. Shaping standard twist bits is a fast and simple procedure. It's equally easy to convert twist bits to even more efficient brad-point drills by shaping them freehand on a bench grinder.

Both standard and brad-point twist drills, such as those in figure 1 above, are intended for high-speed drilling in portable electric drills or drill presses. Each bit has a center point, two cutting edges, continuous flutes that align the bit in the hole, and gullets between the flutes through which chips are cleared from the hole when drilling.

To understand the difference between standard and brad-point twist drills, let's look at how each bores a hole in wood. On any bit, the cutting edges pare with, across and against the grain as the bit is turned. On a standard bit, the outer corner of this edge cuts the hole's circumference and commonly tears the wood fibers when going against the grain, leaving a ragged edge and an oval hole. On the brad-point bit, the spurs score the circumference of the hole, eliminating fraying, and cut the hole round. The brad-point drill cuts wood more efficiently than a standard bit because its cutting angle is smaller and because its spurs shear the wood and create a smooth exit hole. And since a standard-drill-bit point is blunt, compared to a brad-point drill, it "walks" on the surface unless you punch the hole's center. Brad-point drills, because of their long, thin point, start and center easily.

My principal twist drill sharpening tools are a standard bench grinder, with a ¾-in.- to 1-in.-lhick by 6-in.-dia., 60-grit Carborundum wheel, and two simple test gauges. A hand-held die grinder, such as a Dremel tool, a small cylindrical stone and a woodcarver's slip stone are useful, but not essential. Always wear safety glasses when using either the hand-held or bench grinder, and grind only on the front, outer circumference and corners of the wheel, not the side. Grinding on the side can wear the wheel, eventually causing disintegration and possible injury.

Sharpening standard twist drills—There are four fundamental criteria for sharp, efficient twist drills. First, the drill shank must be straight and the point centered. Second, both cutting edges must be at the same angle, generally 60°, so they both cut simultaneously. The two 60° edges create a 120° point angle on a standard bit. Third, there must be a positive clearance angle, about 12°, behind each cutting edge so only the cutting edges, not their flanks, contact the bottom of the hole. Finally, the web, or center of the drill between the flutes, shouldn't be thicker than one-sixth the bit's diameter, which it is at the point of a new drill. Maintaining this size web will decrease the pressure you need to apply when drilling and increase the bit's ability to clear chips from the hole.

Check for straightness by rolling each bit on a hard, flat surface, such as a drill press or saw table. Hold the shank on the flat surface and as you roll the bit, check the other end. If it wobbles and doesn't continually contact the test surface, the shank is bent. Although I've occasionally straightened bent drills by hammering them on an anvil, I usually throw them away.

Before grinding, be sure the wheel's cutting face is flat, square and free of grooves. Since drill-bit geometry is easier to see on a

Drawings: Bob Goodfellow

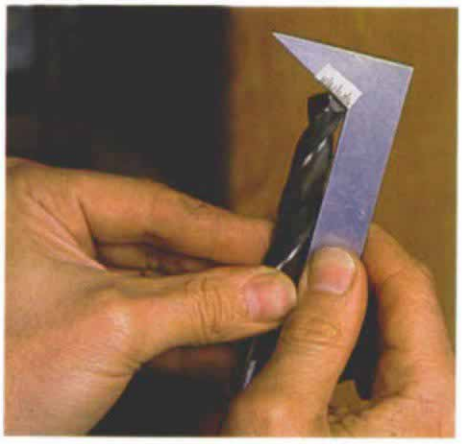
Grind standard twist drills by holding the cutting edge up so that it completely contacts the front of the wheel. Hold the shank down about 12° to relieve the back of the edge and create a positive clearance angle, which reduces the bit's friction when in use.

½-in. bit, practice holding a bit about that size against a stationary wheel on the bench grinder, As shown in the photo above, grip the middle of the bit between the thumb and first finger of the left hand and the shank with the thumb and first finger of the right hand. Hold the bit's cutting edge up, with the shank 60° to the left and down about 12°. This will maintain the point angle and clearance angle respectively. If you prefer, rest your hand on the grinder's tool rest, and with the grinder still turned off, practice bringing the bit against the wheel. As the cutting edge first touches the grinding wheel, use the left hand grip as a fulcrum to rock the cutting edge upward and the shank downward, keeping the bit in contact with the wheel. These hand motions first grind the cutting edge and then the flank, while simultaneously creating a positive clearance angle.

After a few practice runs with the grinder off, turn it on, and lightly bring the bit against the wheel, repeating the same motions you practiced with the grinder off. Grind each cutting edge with equal pressure and the same length of time, quenching the cutting edge with water to keep it cool. If the bit is only slightly dull, without nicks and gouges, one light pass on each edge and flank may be sufficient to sharpen it. If it's exceptionally dull, nicked and abused, several passes may be required.

To ensure the accuracy of your work, make a twist bit test gauge, such as those in figure 2 on the following page, for drills with a 120° point angle. Each cutting edge should be exactly parallel to the gauge blade when the flutes are held against the handle, as shown in the bottom, left photo. Check that the point is centered by turning the bit and observing the point in relation to the marks on the blade. If the point remains aligned with the same mark, it's centered. Now, check for sufficient clearance angle behind each cutting edge. With the bit's cutting edge against and aligned with the gauge blade, turn the bit; the flank should descend in relation to the marks on the handle so that space appears between the blade and the bit's flank. A flank with a 12° clearance angle will descend about 1/32 in. for each 5/32-in. flank width. If you make any correc-

If the point angle on a standard twist drill is correct, both cutting edges will be parallel to the test gauge blade. The drill point is centered if it remains aligned with the same mark when the bit is turned. The marks on the handle of this gauge are missing (left). The web's thickness is maintained at one-sixth the bit's diameter to decrease the pressure necessary when drilling and increase the bit's ability to clear chips. To thin the web, hold the gullet on the wheel's right corner and angle the shank so metal is removed from the gullet, not from the cutting edge (center). A die grinder with a cone-shape stone is ideal for thinning the web. Hold the bit in one hand and use the other hand to steady the grinder as you move the stone into the gullet (right).



Left: Convert a standard bit into a brad point by holding its cutting edge level and centered on the wheel's right corner, with its shank to the right and dropped to create a clearance angle. Deeply grind each valley equally to create a pronounced center point and spurs long enough to cut an exit hole ahead of the valley's cutting edge. Right: If you don't make a right-angle gauge, use the marks on a try square blade to check that the brad point is centered. Reference marks on its handle help you to check that the spurs are recessed equally.

tions, such as point angle, recheck the other components and regrind, if necessary, until they're all correct.

Lastly, since the web tapers over the length of the flutes, from the shank to the point, it will become thicker after you've repeatedly resharpened a bit. If a bit has been excessively reground, grind equally in each gullet until web thickness is about one-sixth the bit's diameter. While grinding the web thinner, take care not to dull the cutting edges.

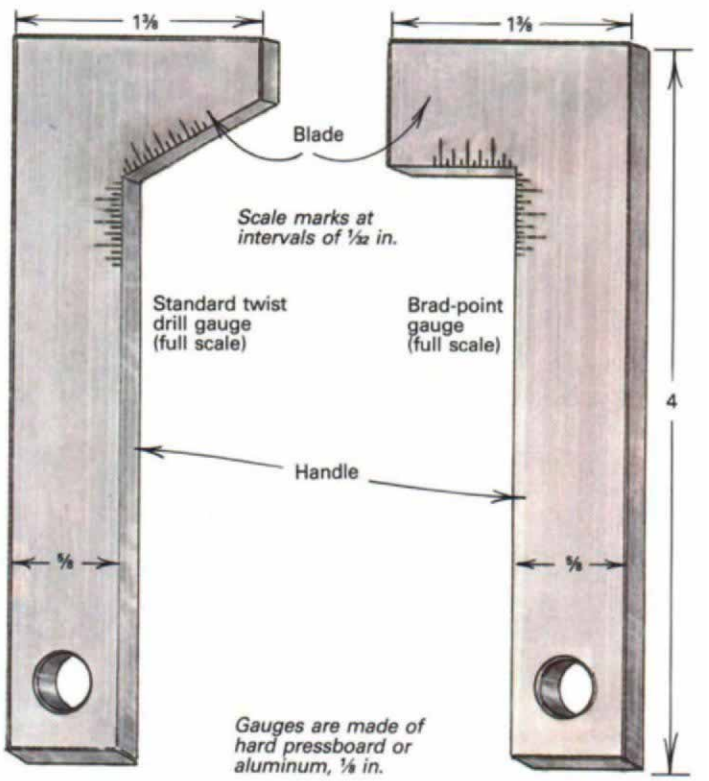
As shown in the bottom, center photo on the previous page, hold the bit with the shank downward so the gullet nestles over the right corner of the grinding wheel. Angle the shank so grinding occurs only in the gullet and not on the cutting edge. For larger-diameter bits, a die grinder with a small-diameter, cylindrical- or conical-shape cutting stone works well. While sitting, I hold the bit with one hand and the grinder with the other, as shown in the bottom, right photo on the previous page.

Converting to brad-point bits-While brad-point bits are available from most woodworking tool suppliers, you can easily convert a standard twist drill to a brad point, although the criteria for sharpness are slightly different than for standard drills. The point should be as long, thin and sharp as possible and in the exact center of the bit. The tips of the spurs should be recessed a little more than one-third the bit's diameter below the point, and located about where the outside corner of the cutting edge is in relation to the point on a standard drill. For example, when you hold the tip of a ⅜-in.-dia. brad-point bit against a try square blade, its spurs should be recessed ⅛ in. Both spurs should be recessed the same and contact the wood simultaneously when drilling perpendicular holes. Finally, as on all cutting tools, there should be a positive clearance angle so that in the valleys between the point and spurs, the actual cutting is done by the sharpened edges, rather than their flanks.

When grinding brad-point drills, most of the work is done on the corner of the grinding wheel. As shown in the left photo above, practice with a ½-in.-dia. standard twist drill, holding the cutting edge up so that it is level and centered on the right corner of the wheel. The shank should be about 60° to the right and dropped about 12° or more to create a positive clearance angle. Grind the valleys to equal depth, making them as deep as possible so the spurs will be long enough to cut an exit hole ahead of the cutting edges. Burrs on the cutting edges in the valleys are easily removed with a slip stone.

Naturally, the more rounded the corner of the wheel, the wider the valley it will grind. For smaller bits, use a crisply dressed or

Fig. 2: Test gauges



brand-new wheel. Likewise, when grinding a complete set of brad-point drills, start with the smallest bit and work toward the largest. Even with a new wheel, though, it's usually not possible to grind brad-point drills smaller than ⅛ in. in diameter.

You can check the accuracy of brad-point drills with a gauge, like the one in figure 2 above, or a try square, as shown in the right photo above. First, check that the point is centered. Note its position in reference to a mark on the blade and rotate the bit against the handle to see that the point doesn't move. Then, check that the spurs are recessed equally. With the shank against the handle and the point against the blade, note the height of one spur in relation to the marks on the handle. Rotate the bit 180° and make sure the other spur is the same height. □

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