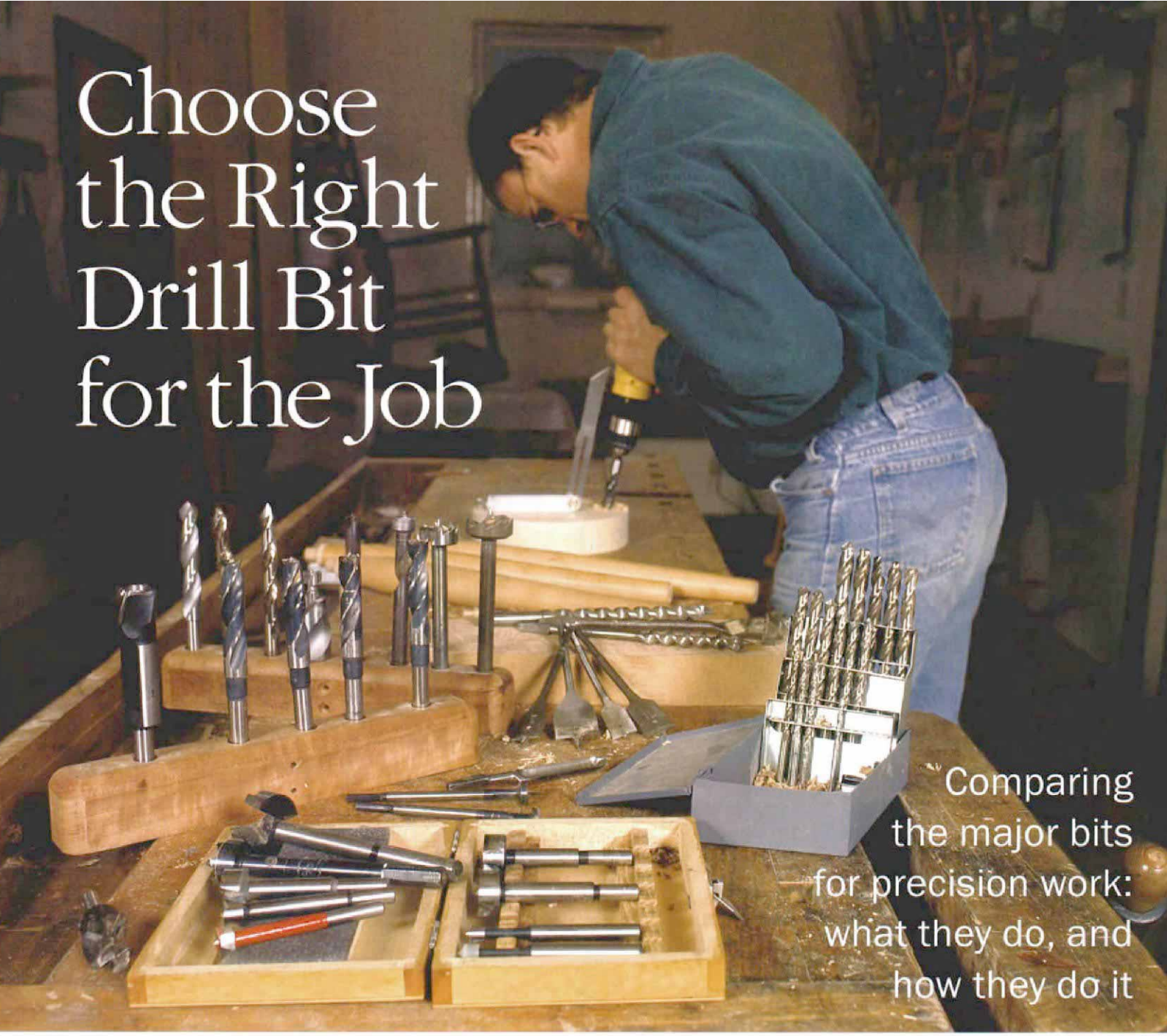

Choose the Right Drill Bit for the Job

Comparing the major bits for precision work: what they do, and how they do it

BY BRIAN BOGGS

Drilling is serious business. When I drill a hole for a rung in one of my chair legs, the leg I'm drilling is already sanded and oiled. The rung is turned to fit. Any mistake now would be very expensive, so I'm betting a lot on the performance of my drill. But why not? Drilling clean, accurate holes should be a simple task. A drill bit spinning in a chuck can be jigged to cut a hole in just about any material woodworkers use at just about any angle. But with all of the drill bits to choose from in all of the catalogs overloading our bookshelves, selecting the right bit for the task at hand can be pretty complicated.

While there is a huge variety of bits available, there are three things that all bits need to do: (1) Stay centered; (2) cut the wood loose to form a round hole; (3) eject the chips. Bits vary in how they accomplish each of these tasks. Improving performance in one area invariably diminishes it in others. No single bit covers all of the bases, but it's not likely you'll need every type available. To know which bit to use when, I think it's important to understand the anatomy of each bit—just how it is designed and how that design affects its performance. Hopefully, this article will steer you toward the bits that best cover the range of your drilling needs.

Twist-drill bits

The most common bit, the twist drill, is also one of the simplest. It covers the widest range of cutting possibilities in wood, sheet goods, metals and plastics and is also available in the widest variety of sizes. A twist-drill bit performs adequately or well in practi-

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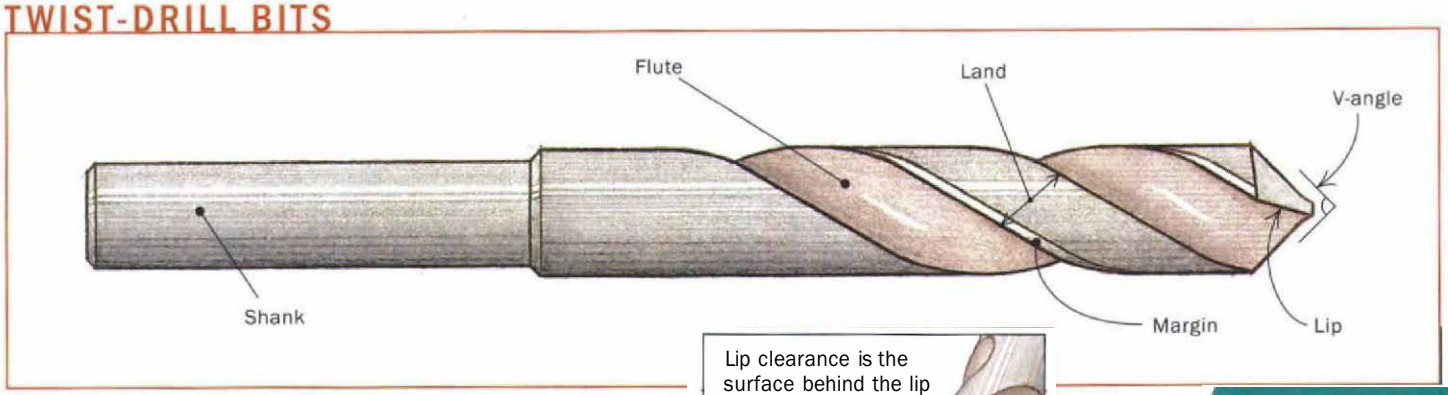
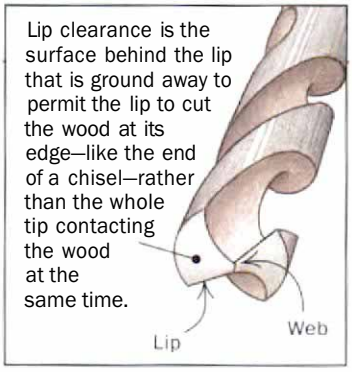
TWIST-DRILL BITS





cally all general drilling situations for woodworkers. A couple of exceptions: drilling at angles over 45° and drilling perfectly flat-bottomed holes. A twist drill is excellent for cutting holes into end grain, where the cutting action of the bit yields the cleanest, fastest and most accurate holes of any of the bits. I keep an index of inexpensive twist drills handy for general shop use, such as making plywood jigs and forms. And a few finely tuned twist drills live on a rack by my drill press, ready for more precise work.

A twist drill's lips work both to center the bit and to cut the wood. With most other precision bits, the cutting action is divided in two: They'll have cutters that score the perimeter of the hole and lips that lift the chips within the perimeter. The sharpness of the lips is more critical with twist drills than with most bits, especially at the outer corners, where any tearout will show in the finished hole. Some tearout is inevitable with a twist drill in all but end-grain drilling; the only way to reduce or prevent it is to use a relatively slow feed rate and a very sharp lip. -

The V-angle at the tip of the bit can vary from 60° to 118° for drilling wood. Most bits in the catalogs are ground to 118°, which is standard for drilling metals. Twist drills with 90° V-angles are available (I buy them from Morris Wood Tool; 423-586-0110), but for anything more acute, I grind them myself. When working in wood, the sharper the V-angle, the better the bit centers and the cleaner entry and exit it makes. The longer point that results when the V-angle is sharper reduces the usable depth of a hole, however.

At the very tip of the twist-drill bit, the two lips meet and form a chisellike web rather than a true center point. The web is more durable than a center point, but it can cause the bit to wander just as the bit starts to cut. The web doesn't actually cut any wood; it sort of mangles the fibers as it spins, making it possible to force the bit into the wood. On larger bits a pilot hole is sometimes recommended to accommodate the large web. The smaller the web, the less force is required, the better the bit centers, and the less it walks at the entry. Manufacturers sometimes minimize, or thin, the web for this reason. I like to grind the tips to eliminate the web on my bits, sacrificing durability for performance.

A bit's clearance angle also affects its performance. The clearance angle is the amount of relief behind the cutting edge of the lip. Just as you can't do much chiseling if you

Long-point twist drill takes a sweet shaving. Ground to a 90° V-angle at the tip and sharpened properly, a twist-drill bit should cut cone-shaped shavings.

Best bit for end grain. A twist drill, which cuts like a ripsaw, bores into end grain beautifully. Brad-point and Forstner bits, which score the hole at the perimeter, act more like crosscut saws and perform better than twist drills in cross-grain but not as well in end grain.

Drawings: Vince Babak

hold the chisel flat on the workpiece, you would struggle to drill a hole if the whole tip of the bit—the cutting edge of the lip and the area behind it—contacts the wood at the same time. If there's not enough clearance, too much pressure is required to enter the wood and the bit gets hot from the friction. Too much clearance, and the bit vibrates in the cut for lack of support. When you sharpen your own bits, these angles should be maintained carefully.

Although it's true that all of the cutting takes place at the tip of the bit—those sharp-edged spiral flutes are merely passive conductors of chips—the flutes of a twist drill are still as important as any other aspect of the bit. In machinist's catalogs there are bits with a variety of flute (helix) angles to more effectively eject shavings of difficult materials. The bits I've seen in woodworking catalogs have moderate spiral flutes, and they work just fine in wood as long as they are kept clean and rust free:

Brad-point bits

A brad-point bit is basically a twist drill with a modified end. The brad-point design addresses two shortcomings of the twist-drill bit when used in wood: The bit overcomes the tendency to walk at the start of a hole, and it reduces tearout at the perimeter of the hole. These modifications make brad-point bits better than twist drills for precision cutting in virtually all cases, with the prominent exception of drilling into end grain.

There are two basic types of brad-point bits—those with scoring spurs and those without. Brad points without spurs—plain brad points—have lips that angle down and outward from the center, so they first contact the wood at the perimeter of the hole. A long point in the center engages the wood before the lips begin to cut. This style still has some tendency to tear the wood at the perimeter of the hole, but tearout can be prevented with a sharp bit and a light cut.

A fairly new variation on this plain brad point is the Vortex-D bit. It has lips that are ground at a severe downward angle and a center point that is ground on only two sides, leaving a flat, chisellike web across the center rather than the standard four-sided point of the other brad points. The bit's steeply angled lips perform like spurs to cut a clean entry, but the web at the end of the point can cause the bit to walk across the surface of the workpiece when drilling freehand. In my testing I could not find any situation where this type of bit outperformed the other brad points.

A spurred, or lipped, brad point is far superior to its spurless cousin. The spurs are extensions of the margins that score the perimeter of the hole, preventing any tearout as the chips are lifted by the cutting lips. A spurred brad point is excellent for its clean entry, clean walls and for drilling at angles. A spurred brad point will even cut a reasonably clean hole after it has dulled slightly, an important feature, especially in production situations.

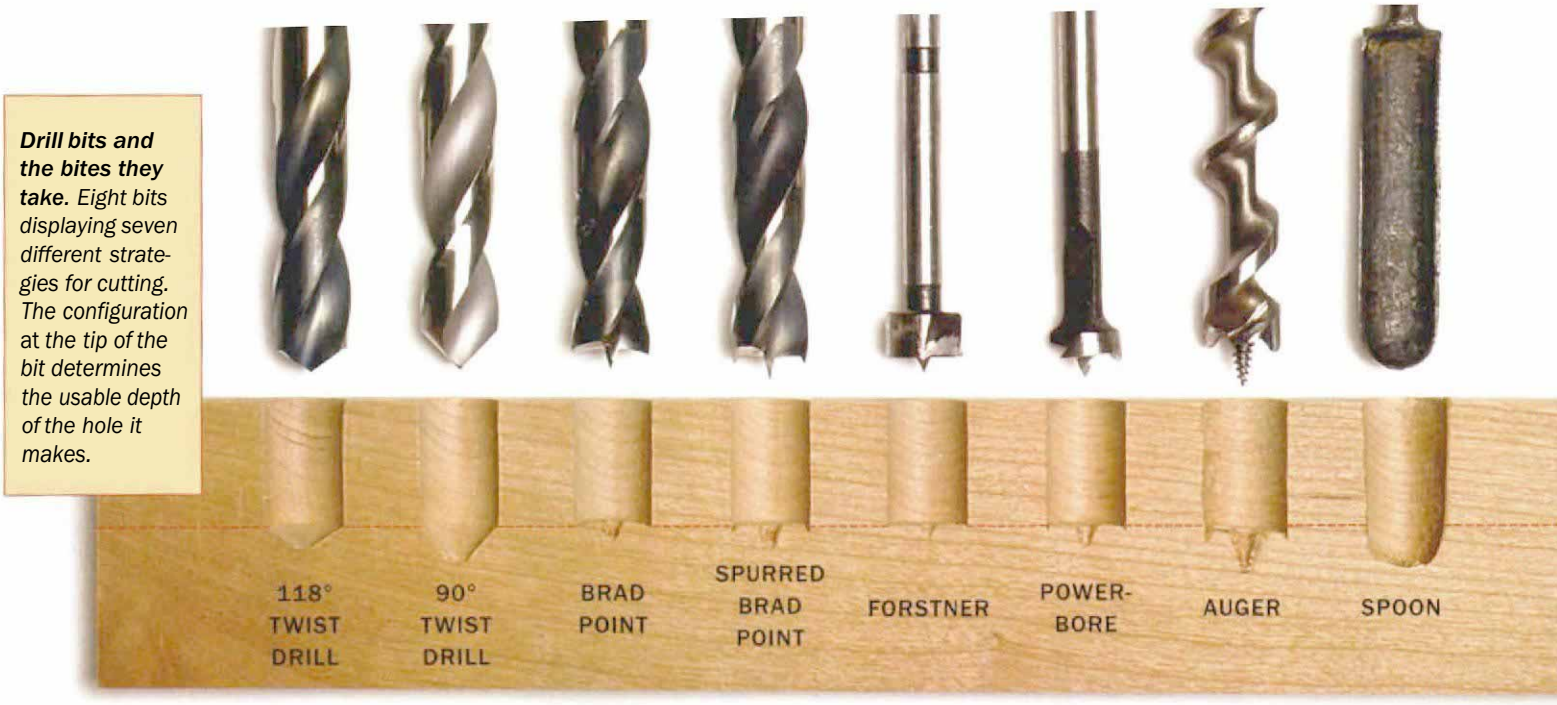
An interesting variation on the spurred brad point is a double-margin bit made in Austria (available from Woodcraft; 800-225-1153). Instead of having spurs at the ends of the lips, they are located on their own margins. This allows the lips and the spurs to be ground separately, which makes sharpening easier. Performance is virtually identical to a regular spurred brad point.

I use plain brad points for all of my pinning, because they are easier to sharpen than spurred brad points, especially in the smaller sizes. Were I to work with medium-density fiberboard (MDF) and melamine, I would choose these simpler bits over the spurred bits because they cut just as well in this application, and I don't have to risk dulling and burning the spurs on my good bits. I also prefer plain brad points over spurred brad points when drilling end grain. Without the spurs, a brad point cuts more like a ripsaw, leaving very clean walls, even with an aggressive feed. In general, you can think of any bit with a spur or cutting rim to be a crosscutting bit (like a crosscut saw). Choose spurless bits for end grain.

A spurred brad point is the bit of choice for the bulk of the joinery in my chairs because the bit cuts a beautiful hole, even at an angle, and I can feed a little faster than with a twist drill or a plain

Moderate angles* are no *problem for a brad-point bit. *Angles like this can be handled by a brad point because the spurs and center point are engaged before the lips begin cutting. The Austrian double-margin brad point (shown here) has separate margins for its spurs and its lips.*

Photos, this page (left) and facing page (top): Michael Pekovich



Drill bits and the bites they take. *Eight bits displaying seven different strategies for cutting. The configuration at the tip of the bit determines the usable depth of the hole it makes.*

brad point. Also, the flutes clear the chips well enough that I can plunge to the bottom of a 1½-in.-deep hole in one pass without worrying about clogging.

Forstner and multispur bits

Most bits we use are centered as they cut by contacting the workpiece with the center of the bit. A Forstner bit is unique in that it uses a peripheral rim to keep the cut running true. The rim is so effective in guiding the bit that the center point is optional. For cutting through very thin stock or anywhere a perfectly flat-bottomed hole is critical, a Forstner is the bit of choice. The bit also has the ability to cut overlapping holes, which is handy in mortising and other situations where stock removal is most easily done on the drill press. (Center-guided bits, such as twist drills and brad points, because they need to engage wood at the center of the cut to run true, have trouble with overlapping holes.) A Forstner bit is also very good for drilling at severe angles and for angled partial holes, two more operations that are very difficult for a center-guided bit. All off-angle and overlapping holes cut with a Forstner bit should be drilled on the drill press.

Most of what a Forstner bit is good at requires that the rim be extremely sharp, especially at the leading edge. The rim serves the same function as the spurs on a brad point—it scores the fibers ahead of the cut. Because the rim is continuous and stays engaged in the cut, the bit won't drift laterally. The rim also keeps the bit from taking a heavy cut. This helps prevent tearout at the beginning of a cut, even when drilling into round stock or drilling angled holes, situations where the rim can't cut the entire periphery before the lips start lifting out chips.

The multispur, or sawtooth, bit is a variation on the Forstner. The multispur bit lacks the finesse and slick cut of a regular Forstner in some situations, like overlapping holes, but it cuts more aggressively. This is particularly helpful in larger holes. With larger-diameter Forstners, the rim is quite long and heat build-up gets to be a problem. The multispur design reduces friction and provides much faster entry into the wood. Most sets of Forstners come with solid rim bits up to 1 in. dia. and switch to the multispur design for the larger sizes.

For all of its advantages, the Forstner has some serious drawbacks. First, because of the design of the rim, the chip chute narrows at the opening, which makes chip ejection almost impossible in holes deeper than the height of the chute. For deeper holes the bit must be lifted nearly out of the hole every ⅛ in. or so to clear chips. Having a clogged bit going up and down is risky and affects the quality of the hole. Also, while a new Forstner tracks well, with any amount of wear the bit starts to drift slightly through the cut, especially on

All-terrain bits. *Steep angles, overlapping holes, very thin stock-none of these situations poses a problem for the Forstner bit, with its continuous rim guiding the bit. Unless the bit is backed out of deep holes every ⅛in. or so, chips become impacted above it and can cause burning.*

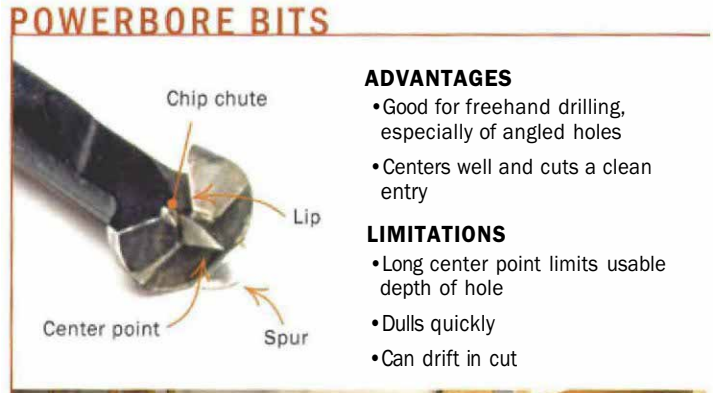
end grain. This is probably the worst problem with Forstners, and it is compounded by the fact that the bits are a bear to sharpen.

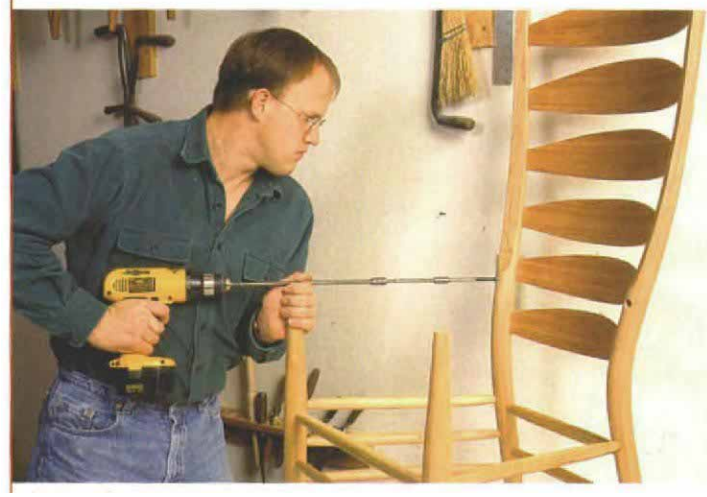
Because of the way the rim works on both Forstners and multispurs, they are well-suited for cross-grain cutting and perform pretty poorly on end grain. A Forstner cuts well in plywood, but a multispur is a better choice for manufactured sheet goods like MDF and oriented-strand board (OSB). Both bits make an ugly exit if unsupported, so use a backer board.

There is a new type of multispur on the market, a German-made bit called Bormax. Its teeth are formed by grinding the outside of the rim in a pattern that looks like a serrated knife. This results in teeth with a profile like a typical multispur. But the grinding removes metal from the outside of the cutting rim, which is supposed to reduce friction and increase the aggressiveness of the cut, The Bormax bits I tried were aggressive to a fault. They cut quickly, but the holes were rougher than the holes from a regular Forstner. The sides of the holes had a sawn appearance, and after drilling two holes in a scrap of oak with one of the Bormax bits, the bit was too hot to touch. Still, because of the more aggressive cut, the Bormax doesn't require as much feed pressure, and for that reason I'd choose it over a regular Forstner for freehand drilling. And the cleaner machining in the chute of a Bormax does improve the chip clearance, which is an improvement over a regular Forstner. Although the Bormax concept seems sound, I'm not convinced that all of the bugs have been worked out.

Powerbore bits

For drilling accurate holes with a drill press, the three basic types of bits I have described pretty well cover the bases. But there are times when drilling freehand is the most efficient option. In chair making, installing arms on a rocker is a good example. For this job a Powerbore in a bit extension is hard to beat. The bit's long center point is well embedded in the wood before the spur begins to cut, ensuring that the bit does not wander as you start the hole, even on





Handy for freehand drilling. *The author uses a Powerbore bit for freehand drilling in cross-grain on rounded parts. The long center point of the bit holds its place positively, and the single-spur-and-lip design permits the user to start slowly, speeding up only when the bit is fully engaged in the hole.*

a rounded workpiece, The single lip and single spur allow easier entry into the wood than most bits, making it easy to start a hole with a light cut for a clean entry and pick up the pace once the lip is safely below the surface. The downside of the single-spur-and-lip arrangement is that with each revolution you pull only one helical chip out rather than two, as with most other bits. This means that you are either taking twice as long to get to the bottom of the hole or you are taking a coarser cut and leaving a rougher hole.

While good work can be done with a Powerbore, these bits are not manufactured for precision. You definitely want to check your hole diameters carefully each time you chuck up a new bit or sharpen an old one. Fortunately, the simple design of this bit makes it a breeze to sharpen and tune. In fact, I always shorten the center point a little because it is too long for my chair work. This is a risky refinement, because the long point is needed to keep the bit centered. The asymmetrical cutting action of the single spur and lip make lateral drift a good possibility with a shortened point, so if you do shorten it, watch the shaft as you drill. If it starts to drift to one side through the cut, it is time to replace the bit.

Chip clearance is another weak point with a Powerbore, It is not quite as bad as with the Forstner, but holes deeper than the diameter of the bit require backing nearly out of the hole several times to clear the chips. The bit will continue to cut whether you do this or not, but the chips can get so impacted above the cutting action that getting the bit back out of the hole becomes a major opera-

Photos, this page (left and top) and facing page (left and top): Michael Pekovich

tion. Setting up to drill horizontally will help. Save this bit for what it excels at: freehand boring through cross-grain. Unfortunately, new Powerbores will be getting harder to find because Stanley has recently discontinued the bit style.

Auger bits

The auger bit has lost popularity over the years with other bit designs improving and fewer people drilling by hand. I used auger bits exclusively when I started out in chair making, but as I began to focus more on precision, I had less use for them. Antiquated though they may be, however, there are reasons to own them.

The lead screw pulls the bit into the work, requiring virtually no feed pressure. This is helpful when drilling with a bit brace because it allows the operator to focus more on sighting the angle and less on feed pressure. And because the feed rate is determined by a screw, the depth of the hole can be calculated by counting the rotations of the brace. For deep holes the auger is a good bit because it clears its chips well and the screw point prevents the bit from wandering almost absolutely.

Most augers you'll see in woodworking catalogs have a tapered square end for bit-brace use only. But several suppliers offer the bits with round shanks for handheld electric drills. And if necessary, the tapered ends can be cut off. An auger should never be used in a drill press because the lead screw will continue to pull the bit into the workpiece until drill rotation is stopped.

For chair makers who prefer the quiet pleasure of drilling with a bit brace, this is an efficient bit to get to know. And for folks in the timber-framing trade, the long, fluted sections of the bit are essential for the deep holes needed for trunnels. But the list of problems with the auger is long. None of the new bit-brace augers I have encountered were machined accurately, and most cut an oversized hole. They all require tuning up before they cut very well, and the quality of cut of even a well-tuned bit pales in comparison with all of the previously mentioned bits.

Drilling angled holes with this bit is something of a trick, too. Because the lead screw regulates feed rate, you can't take a light cut at the entry to the hole. Because the spur can't score the entire hole before the lips engage, you can get a pretty nasty tear at the opening. Starting the hole perpendicular to the work to score the hole first and then restarting at the desired angle can prevent this, but this operation is less than ideal.

Another downside of this bit is that on the larger sizes (5/8 in. and up) the lead screw is big enough to start a split in the wood. I've had such splits go unnoticed until a chair rung is driven into its hole. A most disappointing sight in an otherwise fine chair.

Spoon bits

The spoon bit is one of the oldest styles of bits still used and has recently seen a burst of popularity among Windsor chair makers. A surprising degree of dexterity is offered with this bit and even a certain degree of precision. A spoon bit is unlike any other in several ways. Probably the most important is that it requires far more skill to use. Not only does the bit need to be powered with a bit brace, but it also requires quite a lot of practice to get it to drill a hole exactly where you want. (Wharton Valley Chair Works makes excellent spoon bits; 607-965-8420.)

The spoon bit's cutting action is similar to that of a twist drill. But it lacks the symmetrical balance that helps hold a twist drill centered, so a spoon bit pulls itself off center at the beginning of the cut. This sounds awful, but it is quite predictable, and with practice you learn where and how to begin your cut so that the hole ends where you want it to. And because the feed rate is determined by pressure, you can take a light cut for a clean entry. Once the bit is in the hole, it follows itself. But more than with any other bit, the quality of the result depends on the skill of the user.

Because of the initial skill development required to use this bit well, and the fact that it has no advantages over the twist drill, I can't recommend it as a practical requirement in your drilling arsenal. But for those of us who enjoy the challenges of mastering traditional woodworking techniques for benefits we can't take to the bank, the spoon bit is definitely a kick. □

Brian Boggs builds chairs in Berea, Ky.

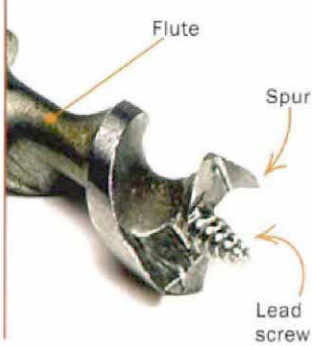
AUGER BITS

ADVANTAGES

- No power cord needed
- Good for hand-drilling moderately clean holes

LIMITATIONS

- Screw point can split wood
- Drilling angled holes is difficult
- Won't drill through thin stock



The auger's lead screw guides the cut. *With its threaded lead screw pulling the bit into the cut, the auger bit requires very little feed pressure. The user can concentrate instead on getting the angle of the hole right.*

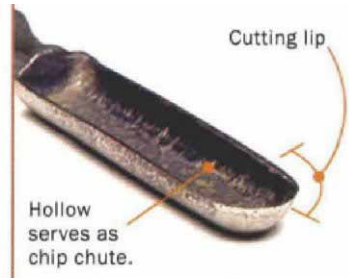
SPOON BITS

ADVANTAGES

- The link to yesteryear
- Fairly clean holes with an unusual bit

LIMITATIONS

- Centering the bit is an acquired skill
- Hole is somewhat oval



You can cut wood with a spoon? *A spoon bit makes fairly clean holes, but it takes a little time to master. The bit won't drill exactly where you start it, but you can learn the bit's eccentricities and even come to enjoy them.*