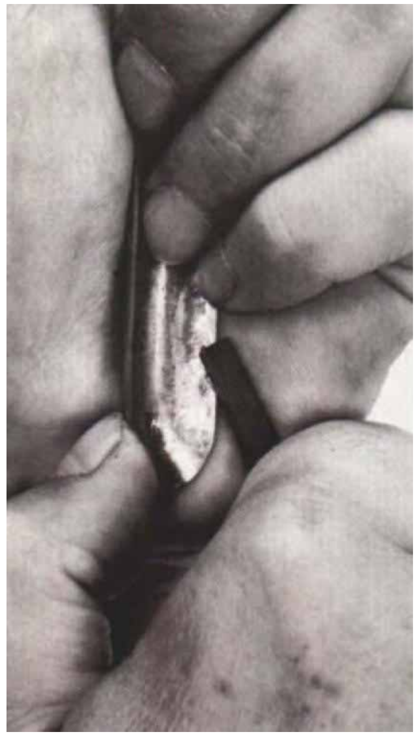
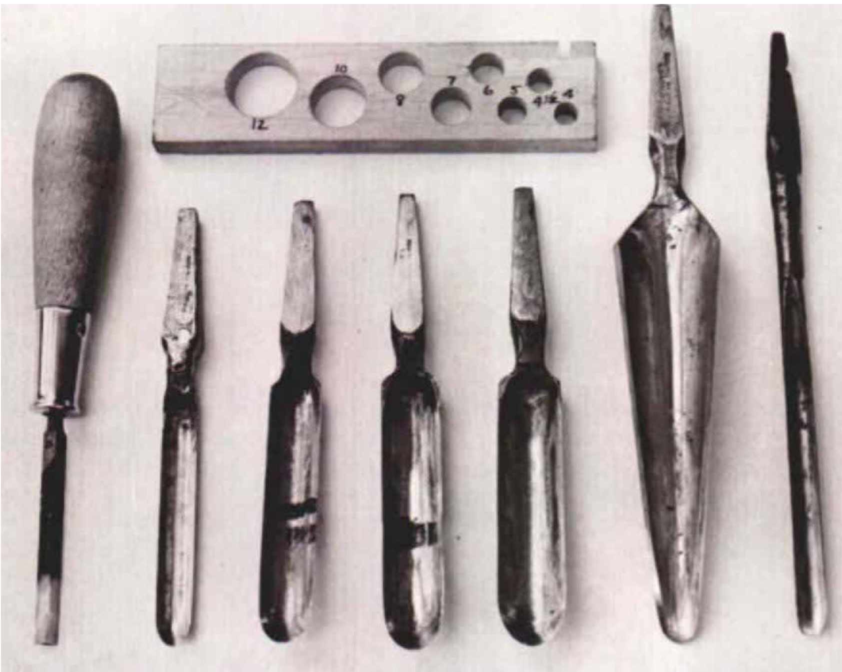
Spoon Bits

Putting 17th-century high technology to work

by David Sawyer





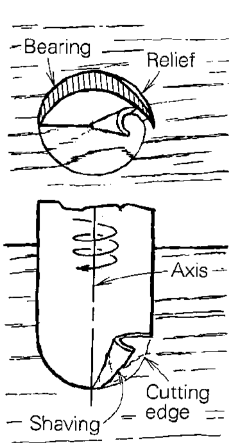
At left, a Windsor chairmaker's toolkit. The hardwood hole gauge provides references when sharpening. Lined up from left to right are the sharpening scraper, four spoon bits for mortises, a tapered reamer for leg-to-seat joints, and an old shell bit for back spindles. As shown above, bits are soft enough that you can sharpen them easily by scraping with an old file honed to a keen edge. They are tough enough to remain sharp for a few dozen holes.

For the last couple of years, Conover Tools has been selling a set of eight spoon bits and a tapered reamer in a neat canvas roll. They are copies, made in Taiwan, of a fine old set in Michael Dunbar's Windsor chairmaking toolkit. The bit sizes are six, seven, eight, nine, ten, eleven, twelve and sixteen sixteenths, with spoons about 2¾ in. long. The reamer tapers a hole at a 10° included angle, quite useful for chair leg-to-seat joints—although I'd prefer 8°, since 10° barely "sticks."

As bought, these spoons are straight-sided doweling bits, which were a mainstay for many craftsmen, such as coopers and brushmakers. Chairmakers either used the bits straight, as in Dunbar's set, or modified them into duckbill bits for boring the large-bottomed mortises found in so many old green-wood chairs. John Alexander, author of *Make a Chair from a Tree* (Taunton Press), explains the advantages of this joint on p. 72. Old-timers also used open-end spoon bits, called shell bits, which look almost like "ladyfinger" gouges. They are easier to sharpen than spoons, and cut nearly as well, even in dry hardwood chair backs. This is fortunate, since a used-up spoon bit will become a shell bit.

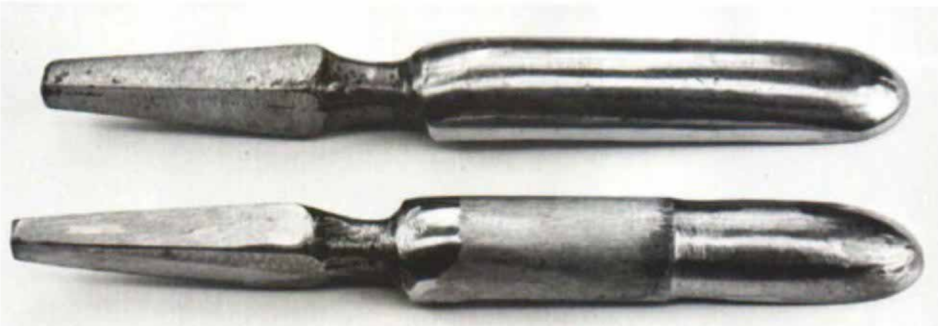
When you first unroll Conover's bits, they're beautiful. Upon closer inspection, they're kind of lumpy and bumpy, apparently finished in a hurry with a belt sander. Fear not—with a little tinkering and sharpening, they will work just fine. A lot of folks object to having to tune up new tools, but I find that this is a great way to learn all about the tools and make them truly your own.

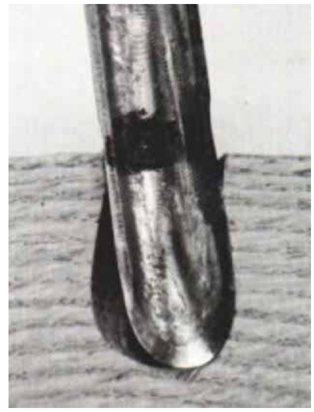
How a spoon bit cuts—The spoon bit cuts on only one side of its semicircular lip. No other part needs sharpening. The cylindrical portion guides on its outside, clears chips on its inside, and must not have a diameter greater than the cutting edge, to avoid binding or reaming a tapered hole.



Any cutting edge must have some relief on its underside. What I call the "lead" of a cutting tool would be the progress per revolution in a drill or a reamer, or the thickness of the shaving a plane takes. For a plane, lead is regulated by how far the blade projects beneath the sole; for an auger bit, it is regulated by the leadscrew. A machinists' twist drill is like a spoon bit with a straight cutting edge, and if you can visualize how it cuts and how it is sharpened, this will help you understand the spoon. Try to imagine the spiraling development of the hole and the bit following it. In a spoon bit, lead depends entirely on how much relief you grind into it—if too much, the bit gets too hungry. The relief space shown above is exaggerated for clarity. It will be gradually used up as the bit is resharpened, and then the outside must be reshaped. The bearing surface gives stability in the hole.

As we all know, you can force a dull twist bit, or one that

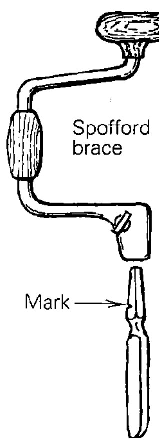




The spoon bit at top is as it comes from the manufacturer. The one below it has been modified into a duckbill for boring the chairmakers' mortise, shown at right. When shaping the bit, maintain full diameter just behind the cutting lip, but relieve the sides so that the bit can pivot in the hole to enlarge the bottom without enlarging the opening. The mark on the bit is a depth gauge.

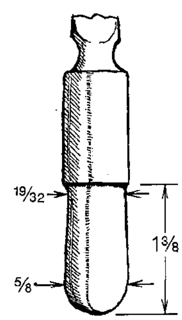
has lost its relief, to drill a hole if you press hard and compress the material. No doubt you can also do the same with a spoon bit, but it's more pleasurable to sharpen correctly and let the bit follow itself through the hole.

Tinkering—To avoid slop when boring, the axis of the bit must be right in line with the brace handle. At least one of my bits came with a misaligned tang, easily corrected with some vigorous taps on the anvil. Flattening the surfaces of the tang and some grinding at its base will improve the fit in the chuck. I use a Spofford (split-chuck) brace, and try various bit orientations to cancel errors. Then I mark the tang so that it goes in the same way every time.

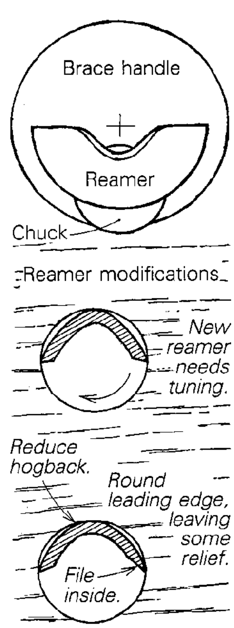


Conover's bits are hardened to Rockwell C45-50, which is soft enough to cut with a file but hard enough to drill numerous holes between sharpenings. A 10-in. mill smooth file is fine for truing up bits. You can eyeball the bit's diameter with a ruler, but vernier calipers are better. As an additional aid, make a hole gauge as shown in the photo on the facing page, or use draftsmen's circle templates, which come in 1/32-in. and 1/16-in. increments. By testing the bit in a series of round holes, you can judge its roundness and relief. A metal-cutting scraper sharpens the inside of the cutting edge by removing shavings like a one-tooth file. My scraper is an old broken-off triangular saw file, with teeth ground off two sides to yield a 60° straight cutting edge, which is then honed sharp.

First make the cylindrical portion of the spoon bit truly straight and round. Don't worry about maintaining diameter, because tenons can be made to fit. Then shape the outside of the point for relief and bearing, checking by eye with various diameters in the hole gauge. I would normally aim for clockwise rotation. My 9/16-in. bit has an imperfect left lip, which would have shortened its working life, so I sharpened it to turn counterclockwise. Now do some scraping on the inside and light stoning on the outside to remove the burr, and try some boring. After you've got the bit working well, you can convert it to a duckbill if you like. I relieved my 5/8-in. bit back about 1 3/8 in., as shown at right, to accommodate inch-long tenons.



The reamer—At first glance I thought the reamer was a disaster, since the tang is not cranked over to the centerline as on the spoon bits. But Michael Dunbar said no, just put it in the brace and ream holes, and sure enough it works fine. You just have to gently bend the tang until the reamer's axis aims dead on the brace handle. Don't even look at the chuck! The tang has a tiny waist and I noticed some twist in Dunbar's. So less brute force and more sharpening.



The reamer's cross section has a lot of hogback, which makes for too much lead and encourages a scraping rather than paring action. It's also somewhat barrel-shaped. All this is easily fixed by filing or grinding. There's plenty of metal, but you can check with calipers if you get nervous. After shaping, you can sharpen with stones and do some scraping at the point. If the point is sharp, the reamer works like a shell bit, and you need no pre-boring in softwood seats. It does a neat job of breaking through on the other side, too. You can bore and ream seats like mad, in one operation.

Making chairs—I worked up a kit for Windsor chairs and proceeded to put together two Federal period chairs using 17th-century high technology. After another dozen chairs I may see no need for Forstners, augers or brad points. I have a 5/8-in. duckbill for stretchers, 7/16-in. and 1/2-in. spoon bits and the reamer for seats, and a 5/16-in. shell and 3/8-in. spoon for spindles.

With a little practice, the bits start easily. To bore at an acute angle, it's best to start straight and change direction after the full cutting edge is in the wood. The chips are marvelous, tightly cupped spirals, like pearly-everlasting flowers. On through holes, you will be pleasantly surprised by the neatness of the break-through. Stretcher mortises can be enlarged at the bottom by canting the duckbill bit. You can do this nearly as well with a straight (doweling) bit. In either case, you will have to sharpen part of the side of the bit as well as the round point, to help the side-reaming action.

Tenons can be turned green, oversize, and dried in hot sand—a wonderful method I learned from Dunbar. This way, you can have green mortises and bone-dry tenons in the same piece. Drying takes four to eight hours (depending on size) at 200°F. Over 200°F causes too much internal checking; at 400°F you get charcoal. Check dryness by rotating the tenon between your fingers: when it won't get any more oval, it's dry. With a little experience, you can turn just oversize enough so that joints will pop together (with a large hammer) with no further fitting. The larger diameter fits *tight* against the mortise end-grain; the smaller diameter is just snug on the sides. For ⅝-in. tenons, I allow $\frac{3}{64}$ in. oversize (7½%). You can start there, and adjust for your woods and bits.

For an angled joint, you can chamfer the shoulder of the tenon and one side of the mortise. Make the mortise extra deep so that the shoulder will seat. Shrinkage may open the joint a little, but it will still look good.

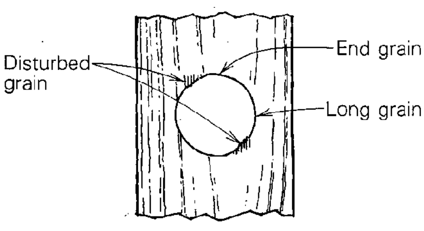
The same process of green-turning and sand-drying works with tapered leg-to-seat joints. I ream the hole in an air-dried pine seat, then fit the tenon with a cabinetmakers' rasp. With the leg properly oriented (major diameter against end grain), I rotate it back and forth a little. Then I file off the shiny spots, just like lapping the valves in a car. Repeat this until the leg feels really solid in the seat and is at the proper depth. Some angular correction is possible, and often needed. □

Dave Sawyer, the green-wood chairmaker featured in FWW *#33, was trained as a mechanical engineer and now makes Windsor chairs. You can get spoon bits from Conover Woodcraft Specialties, Inc., 18125 Madison Rd., Parkman, Ohio 44080.*

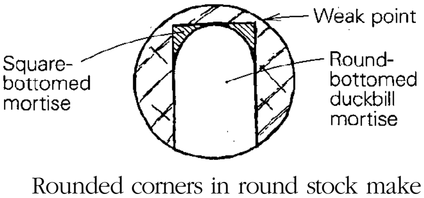
The incredible duckbill spoon bit joint

by John D. Alexander

There is no one way to drill round holes in round sticks. I have used auger bits, Forstner bits, Power Bore bits, multi-spur bits and spade bits to make chair joints, and I have a few more ideas. Modern bits, however, have drawbacks. You don't want a leadscrew or a point projecting ahead of the cutting edge, where it will poke through the other side of the chair leg before the mortise is deep enough. You don't want a flat-bottomed hole—because its bottom profile limits the size of the tenon, as explained below. Nor do you even want the hole to be truly round, because an oval hole conforms better to the tenon. Chairmakers traditionally used the duckbill spoon bit, and its peculiar quirks combine to make the ideal mortise for green-wood chairs. The duckbill even turns the spoon bit's main shortcoming, boring slop, into a virtue.

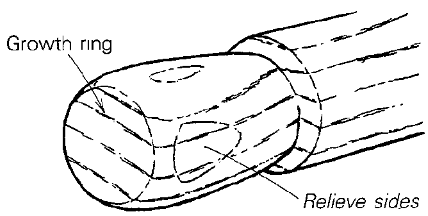


Spoon bits cut deeper in end grain than in long grain, producing an oval hole with characteristic tearout where the cutting edge makes the transition from a paring cut to a scraping cut.



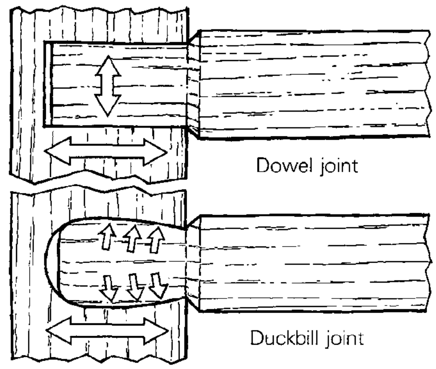
Rounded corners in round stock make for a stronger chair. If the mortise were square-bottomed, both mortise and tenon would have to be smaller.

By canting the duckbill bit during boring, you can cut the lower and upper walls of the mortise deeper, into a dovetail shape, without enlarging the opening or the sides.



Tenons are turned green, then dried. The tenon shrinks to an oval cross-section during drying, which automatically helps it conform to the oval mortise. In side view, the tenon should be shaped to conform to the mortise's dovetail profile, so that it will bear tightly against the end grain in the leg. The end of the tenon is larger than the mortise opening, but the green wood in the chair leg is compressible enough that the tenon can be pounded home. The sides of the tenon are relieved, so as not to split the chair leg as it dries and shrinks.

If a joint does not split when a tenon is pounded home, or very shortly thereafter, it is most unlikely to split later, unless the mortise is near the end of the stick. In a test piece, drive home a series of increasingly larger tenons until the leg splits, listening to the difference in sound as the peg seats. When it comes time to make the chair, drive home the size tenon just smaller than the one that split the mortise. One caution: Immediately after assembly, the dry tenon absorbs moisture from the green leg and swells, while the chair leg shrinks tighter against the sides until the leg is fully dry—if the sides of the tenon have not been relieved enough, the leg will split, starting in the areas of disturbed grain left by the spoon bit.



With cyclical changes in humidity, the mortise depth lengthens and shortens as the leg shrinks and expands. The length of the tenon, however, does not change. In the ordinary dowel joint, this creeping mortise eventually breaks the glue joint. In the duckbill joint, because of its dovetail shape, as the mortise changes, the tenon tends to remain wedged tight because it swells and shrinks in height. The duckbill joint does not rely on a glue bond, although glue doesn't hurt.

The joint, once assembled, can't be easily taken apart. If something goes wrong during assembly, the only solution is to saw off the tenon at the mouth of the mortise, bore it out and start again.

In extremely dry weather, the tenon may rattle in the mortise, but its shape prevents it from coming out. Because of all its virtues, you might think this joint would last forever, but if the joints are too dried-out, the chair will be wobbly, and the leverage effect at and within the mortise will eventually break the joints down. In a similar manner, extremes of humidity, such as in outdoor use, will sooner or later destroy the chair—there is opposing wood movement built into chair joints, and wood, once its compressible limit has been exceeded, cannot recover to normal size. □