# A Primer FOR DRILLING ON THE LATHE

Dennis Belcher

Drilling on the lathe is a basic operation that is frequently ignored in teaching woodturning. And while much has been written about the use of a bowl gouge or a spindle gouge, little information is available about how to drill efficiently or safely. Each of the drilling techniques I cover has advantages and disadvantages, and the "best" method depends upon the task at hand. Regardless of the drilling method, there are four requirements that all approaches share.

## Key principals

### *1. Clear the chips frequently*

When chips build up behind the drill bit, like those shown in *Photo 1*, the dam created inside the hole makes it increasingly difficult to retract the bit from the hole. The blockage will cause the drill bit to stay in the blank when the quill is retracted, separating the mating surfaces of the chuck arbor and tailstock quill. Separate the two surfaces, and the drill bit revolves with the wood at the speed of the lathe, rather than being held stationary by the tailstock. At this point, the turner must hit the off button and resist trying to grab the rotating drill chuck. Not a safe experience.

The most important habit to form when drilling on the lathe is to frequently back the bit out to clear the shavings. My rule of thumb is to clear after every four rotations of the handwheel. But I also pay attention to the stream of shavings coming out of the drill hole and adjust my clearing rate as needed. Shavings can become so packed into the bit's cutting head that they require effort to remove. Use a toothbrush to clear the chips that have adhered to the bit.

### *2. Maintain the condition of Morse tapers*

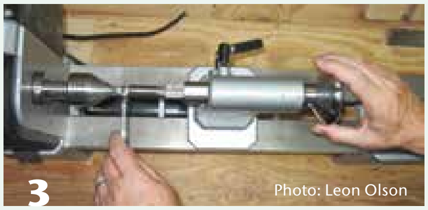
Countering the rotational forces involved in drilling relies on the friction fit between the Morse taper of the chuck arbor and the inside of tailstock quill. The holding power of the two mating surfaces is astounding, but not

## Clear chips frequently


Drill shavings eject nicely out of a sharp Forstner bit at the start of a hole. But deeper in the hole, the bit must be retracted frequently to help clear the chips.

## Quill maintenance


Clean the interior of the quill using a Morse taper cleaner.




If your quill is damaged, a reamer, used with the lathe off but aligned using the drive spindle, is turned with a wrench to redress the interior walls of the tailstock quill.

without limits. That holding power depends upon the two surfaces being in full contact with each other.

Always be sure your tailstock quill is clean and free of dust and grime that would keep the mating surfaces from making full contact (*Photo 2*). If you find that the interior of the quill has been scored or damaged, try a Morse taper reamer—matching the taper size of your quill—to redress the interior walls. This must be done by hand and not under lathe power. Done incorrectly, reaming can damage the quill. Arbors are easy to replace, quills are not. In the August 2014 issue of *American Woodturner*, Leon Olson published a helpful article, "Maintain Your Morse Tapers." Leon notes that reaming is different from cleaning and care must be taken (*Photo 3*).

Dings in the arbor are another source of problems (*Photo 4*). Storing or transporting drill chucks in a way that allows arbors to bump into other hard objects can leave dents and scratches. These dings hold the mating surfaces apart, compromising the holding power.

Leon Olson's 2014 *AW* article made me look closely at my drill chucks. I found that the arbors had been dinged. I was able to restore one arbor, but after weighing the consequences of a dangerous drilling event, I opted to recycle the most damaged arbor. I have also changed the way I store tools (*Photos 5, 6*).

## Store tools properly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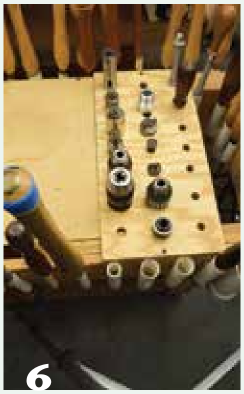
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(*4*) Closely inspect, clean, and dress the drill chuck arbor.

(*5-6*) Store accessories with arbors so that they cannot crash into each other. Open drawer storage leads to lots of scratches and dents.

A Morse taper arbor can be separated from the head and replaced at about a third of the cost of a new drill chuck. A sharp tap to the arbor through the chuck jaws will cause the arbor to release (*Photo 7*). Close examination of my chuck found a stamped "J33," the size of the end that fits in the chuck head. With that information, I was able to search for a replacement, a Morse taper arbor J33-to-MT2 with ⅜"-16 threads for a drawbar.

### *3. Use sharp drill bits*

We all understand the importance of sharp lathe tools. Sharp drill bits are no less important and are worth the modest investment in time and a few simple tools to sharpen them (*Photo 8*). An Internet search will yield a wealth of information and instructions on the topic.

The metal used in drill bits is not necessarily the same quality as the high-speed steel used in today's turning tools. Drill bits can lose temper from the heat generated in use. This is one reason to bring down the lathe speed when drilling. If you see a color change on the drill bit, the bit has been heated. If the color is dark blue, the temper is probably gone, and when temper has been lost, the steel will not hold a sharp edge.

The usual response to slow drilling—the sign of a dull bit—is to apply ▸

## Replace damaged arbors


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A drill chuck arbor separates from the head with a punch and sharp hammer tap for easy replacement.

## Keep your bits sharp


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A diamond hone, a card sharpener, and a ceramic hone are examples of the few simple tools needed to keep Forstner bits sharp and cutting cleanly.

## MAINTAIN YOUR MORSE TAPERS

**EXPLORE!**

Leon Olson's August 2014 *AW* article, "Maintain Your Morse Tapers" (vol 29, no 4, page 12) is a must read on this topic, which is vital to safe drilling on the lathe. Log on at woodturner.org to access the Explore! search tool.

more force and turn up the lathe speed. Turning up the lathe speed increases the heat of friction. The correct response is to maintain the appropriate lathe speed for the bit's diameter and sharpen the bit.

The larger the bit diameter, the slower the lathe speed should be. The bit manufacturer should provide recommended speed guidelines, and look-up tables are readily available online. Proper drilling speeds are slower than one would think. There are also significant differences in speed recommendations for drilling in hardwood versus softwood. I keep a look-up table of recommended drilling speeds posted above my lathe.

### *4. Fully seat the arbor*

With the lathe off, put the drill chuck arbor into the quill, bring the tailstock up until the bit touches the wood, lock the tailstock, and advance the quill against the wood with the handwheel. Back the bit off the wood slightly and start the lathe. This practice ensures the drill chuck arbor is fully seated and the full holding power of the Morse taper is engaged before you start to drill.

There are a number of other variables that can contribute to the drill chuck rotating in the quill. Differences between the manufacturing processes used to make an arbor or quill, the composition and quality of the steel, country of manufacture, and level of adherence to manufacturing standards can come into play.

Perhaps a dose of common sense should be the first requirement on this list. If your arbor rotates in the quill, something is wrong. If it is not your technique, then it is the tool. Arbors can be repaired to some extent; quills can be cleaned and reamed. But if the tool continues to fail, it should be replaced.

## Control bit extraction

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Maintain contact between the arbor and quill when extracting the bit from the blank by holding the back of the chuck and exerting force towards the handwheel. The bit can bind and cause the drill chuck to rotate with the blank; using a glove does not eliminate this risk.

## Drilling methods

### *The common approach*

Most of us approach drilling on the lathe with at least the intention of following the requirements outlined above. What seems to be the most commonly used method to drill on the lathe is with a drill chuck mounted in the tailstock. The tailstock is locked in place on the bed ways, and the drill bit is advanced into the spinning wood by turning the tailstock handwheel. Add to the scene one hand placed on the drill chuck in an attempt to keep the arbor in full contact with the quill (*Photo 9*).

This method has the advantage of having the tailstock locked at all times. This results in an accurately drilled hole throughout the entire depth, as long as the quill is not over-extended.

This method is slow, and cranking the handwheel is tedious. Holding the chuck with one hand while retracting the quill is dangerous because your grip may not be strong enough to prevent the arbor and quill from separating, and then you are left holding a spinning chuck and bit! Wearing a glove does not remove that risk.

### *Drawbar*

Using a drawbar solves one of the problems associated with the common approach—the chuck and quill separating. Many drill chucks have a threaded hole in the end of the arbor (*Photo 10*). To take advantage of this feature, pass a threaded rod through the tailstock and thread it into the end of the arbor. A nut tightened against a washer on the handwheel side locks the assembly in place. But before pulling the chuck arbor into the quill, check for grime on the mating

## Use a drawbar

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Many arbors will accept a drawbar made from threaded rod.


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Properly tensioned with a washer and nut, a drawbar maintains firm contact between the arbor and quill, even when extracting the bit.

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Adjusting the nut and washer to allow a small amount of travel facilitates centering the bit in the blank. After centering, tighten the nut and washer to remove the travel and lock the drawbar.

surfaces. Tightening the threaded rod can embed grit in the quill.

Drilling with a drawbar ensures the full holding power of the Morse taper. But, because the chuck is locked into the tailstock, the handwheel cannot advance the drill bit into the wood. Instead, the turner unlocks the tailstock and manually advances the bit into the wood by sliding the tailstock along the ways (*Photo 11*).

Because the tailstock is not secured to the bed ways, this method can allow the bit to wander. Any play in the tailstock can cause the initial entry point of the drill bit to be off-center, and wood grain variation can encourage the bit to wander further as it is advanced.

My approach with the drawbar has been to adjust the nut so that the quill can travel about a half-inch (*Photo 12*). I bring up the tailstock, lock it in place, and advance the drill bit to the wood with the handwheel. This ensures that the drilling begins on center. I then re-adjust the nut and washer to lock the quill, then unlock the tailstock, clear the chips, and continue drilling by manually advancing the tailstock.

### *Spring-loaded drawbar*

The spring-loaded drawbar is a variation of the drawbar technique. A stiff spring is placed on the drawbar between the back of the quill and the locking nut (*Photos 13, 14*). The spring tension ensures full contact between the arbor and quill, yet still allows turning the handwheel to advance the bit into the wood. The strength of the spring determines the strength of the mating of the arbor-quill connection. The length of the spring determines the amount of travel. Backing the drill bit out to periodically clear chips is still critical to success.

The locked tailstock and leverage of the handwheel contribute to this method's accuracy and eliminate the need to hold the drill chuck with your left hand while drilling. The disadvantage is the travel length limit imposed by the spring. Exercise caution in selecting the spring; it needs to be sufficiently stiff to hold the tapers together at all times.

### *Tailstock-mounted twist bit*

Another system of drilling on the lathe relies on a twist drill bit mounted directly into the tailstock quill (*Photo 15*). The turner's left hand helps maintain contact between the mating surfaces while retracting the bit. The tailstock can be locked and the handwheel used to advance the bit, or the tailstock can be unlocked and used to push the drill bit into the wood.

Even though the relatively shorter length of this arrangement reduces play during drilling and produces consistently straight holes, this is my least favorite technique. The left hand's proximity to the bit's sharp cutting faces can lead to ugly cuts if the bit were to bind in the hole. A glove on the left hand does not eliminate the risk of injury.

### *Adapters and extensions*

This system uses an arbor that mounts directly into the tailstock and accepts Forstner bits (*Photo 16*). Extensions can be added to increase drilling depth. The left hand manages arbor contact with the quill, and the cutting edges are comfortably far from the hand. The bit can be advanced with the handwheel or by sliding the tailstock.

This is my preferred method of drilling. I seat the arbor and bit into the tailstock and advanced the quill to fully engage the arbor, advance the tailstock until the bit meets the wood, lock the tailstock, and advance the bit into the wood with the handwheel. ▸

## Use a spring-loaded drawbar



A strong spring over the threaded rod spring-loads the drawbar, applying a counter force to keep the arbor and quill snug.

## Skip the drill chuck


Twist bits can be purchased that are milled with a Morse taper to fit directly into the quill.


Arbors for using Forstner bits directly in the tailstock quill are also available.

Once the hole is established, I will lock the quill, unlock the tailstock and push the bit into the wood to the target depth. As always, I clear the chips frequently.

This technique is accurate, quick, and presents no sharp edges to tear at your hand. There is, of course, a financial cost to acquire the arbor and extensions.

## Drilling by hand

Establishing a hollowing depth for a bowl or hollow form is a common drilling task on the lathe. This can be done with any of the aforementioned techniques, but this task does not require precision and most turners prefer hand drilling's speed and lack of setup.

The diameter of the bit is important in hand drilling. The rotational forces on the bit increase with its diameter. I have ¼" (6mm) and 5/16" (8mm) bits in my kit. The handles for the bits are sized to fit my grip and provide leverage against the force of rotation (*Photo 17*).

Drilling always generates heat. This is a particularly challenging problem when drilling wet wood with a handheld bit. Heat swells wood fibers, which then bind the bit. Frequently clearing both the chips from the hole and any chips packed into the bit are critical tasks. I tap the drill bit shank on the toolrest to help clear the bit. If necessary, I will use a toothbrush to remove any debris from the bit before continuing.

Begin hand drilling by establishing a center-point with the tip of a skew presented flat on the toolrest, or use the sharp corner of a parting tool. Mark the target depth with a piece of tape on the drill bit. Set the toolrest to align the center of the drill bit and the center of the vessel, with the bit held horizontally. The shaft of the bit should be parallel to the bed ways. Set the lathe to about 350 rpm, and push the drill bit into the wood. As always, frequently clear the shavings.

If the bit is pulled off-center, the shaft and handle will begin to travel in a wider circle away from the center of rotation. You can correct this problem by turning away waste until you reach the bottom of the drill hole, then re-establish the centerpoint to resume drilling.

Drilling by hand at slow speed is a reasonably safe practice. But avoid placing your hand or fingers between the bit and the toolrest, and do not attempt to control the bit by gripping the cutting edge of the tool.

## Small diameter bits

I frequently drill tiny pilot holes for eye screws in Christmas ornaments. I create a center reference with a skew, three-point tool, parting tool, or bedan. The best tool for this task is the one at hand. This reference keeps the drill bit from wandering before the hole can get started. It is a small detail that makes a great difference.

Because of the shallow depth of pilot holes, hand drilling without a chuck or even the toolrest works well. Hold the bit in a shopmade handle, locking vise grips, or the collet of a rotary carver handpiece (*Photo 18*).

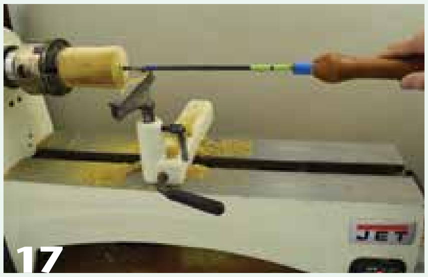
Small diameter bits are easily broken. My preferred method is to use the handpiece from my rotary carver to hold the bits. Small bits seat deeply in the handpiece, exposing a fraction of the overall length and reducing the odds of breaking the bit. I offered more tips and techniques for sizing bits and drilling pilot holes in my December 2014 *AW* article, "Christmas from the Sea."

## Conclusion

When we master the fundamentals, woodturning is a great joy. Drilling on the lathe is one of those skills that, when mastered, adds to the joy and encourages workshop safety. Without the mastery, drilling can ruin a project in the final steps.

Clean your quill, file your dings, keep your bit sharp, and clear the chips. ■

### Handle the bit




Establishing a depth hole requires less precision than other drilling tasks, so a bit mounted in a wood handle is adequate for the task.


Drilling small pilot holes does not demand the mechanical strength of a secure fixing method like a drill chuck, so shopmade bit holders or repurposed tools are suited to the task.


*Dennis Belcher retired from a 30+ year career in the investment world to his lifelong passion of working with wood. A member of the Wilmington Area Woodturners Association (North Carolina), Dennis demonstrates for clubs and participates in juried art shows. For more, contact Dennis at dennis.m.belcher@gmail.com or visit his website, seabreezewoodworks.com.*