The Basics of WORKHOLDING

Dennis Belcher

At the heart of woodturning is how to hold a workpiece on the lathe. For a beginner, this can be a complicated, confusing question. A recent woodturning catalog offered 205 different holding devices. What makes it even more confusing is that there are multiple ways to hold a workpiece for the same operation, and many projects require a sequence of different holdings methods. Yet another source of confusion comes from the evolution of holding methods; consulting older woodturning books will result in different answers than current day practices.

To find your way through this maze, it is good to understand the basic concepts of workholding on the lathe. I think of holding methods in terms of four categories—squeeze it, expand in it, push on it, and screw it—which encompass all holding methods. For any given workpiece, think about each of the four categories and whether a holding device, or method, is a safe way to hold your blank.

I find it helpful to write out the steps when I know I'll need multiple holding methods for a project. When determining the sequence, start with the holding method for the last procedure and work through ways to get there. For example, to hollow the inside of a bowl mounted in a scroll chuck, a tenon or recess is needed to hold the blank with the chuck. How can you mount the blank to create that tenon or recess? There are several possible answers, but the point is to start at the final holding method and work backwards. Thinking in terms of squeezing, expanding, pushing, or screwing will help you visualize the options.

Squeeze it

Four-jaw chucks

The scroll chuck, or four-jaw chuck, is the most commonly used device in the squeeze category. When used in compression mode, the chuck jaws squeeze down on a tenon to hold the workpiece. Chuck bodies come in different sizes, with a wide variety of jaw sizes and types (*Photo 1*). Some chuck jaws are serrated and straight-sided, and others are smooth and angled for a dovetailed tenon (*Photos 2, 3*). Generally, jaws are interchangeable on chucks made by the same manufacturer.

Different chuck jaws are designed for different uses. For example, large, 4"- (10cm-) diameter jaws excel at holding big blanks for coring because the larger diameter of the tenon provides more strength. Smaller jaws are suitable for

The ubiquitous four-jaw chuck

1

The most common holding method in the squeeze category is the scroll chuck. Pictured are chucks of different sizes with various styles of interchangeable jaw sets.

Squeeze it

2

3

A secure hold in a scroll chuck requires that the top of the jaws be in full contact with the tenon shoulder, which must be cut clean and crisp. The shape of the tenon must match angle of the jaws, straight or dovetailed, and the tenon must not make contact with the bottom of the jaws. *Note: one jaw removed for illustration purposes.*

Jaw size

Compare: Using a jaw size smaller than the intended diameter of the form's base affords more design options. The small jaws allow greater access to the wood that will become the base, or foot. *Safety Note: the tenon needs to be strong enough for safe turning; use larger jaws for a heavy green blank and smaller jaws when finish-turning.*

Jumbo jaws

Jumbo jaws hold a bowl by squeezing the rim with rubber bumpers. These jaws replace the normal jaws on a scroll chuck. Bring up the tailstock with a live center to improve the hold, and turn at low speed.

more delicate work. Jumbo jaws are made to hold a bowl by the rim so the bottom, or foot, can be completed.

The size of your chuck should also be a function of the size of your lathe. The mass of a large chuck on a small lathe means the motor will be strained at startup. You can run a small chuck on a large lathe, but a large chuck on a small lathe is a bad combination.

New turners frequently allow their chuck jaw size to determine the size of the completed form's base. But this practice generally dictates proportions that are not ideal; it can result in pieces that are squat and bottom-heavy. One way to avoid this design flaw is to use a tenon size and jaws that are smaller than the intended base. *Photos 4 and 5* show the same bowl blank on the same chuck, one with 4" jaws and one with 2" (5cm) jaws. For each case, can you visualize how you would complete the bottom?

The largest of the holding devices in the squeeze category is a chuck outfitted with jumbo jaws. These jaws are designed to hold a bowl so its bottom can be completed. As the chuck is tightened, rubber bumpers compress and hold the outside of the rim (*Photo 6*), though it is also possible for the bumpers to expand inside the rim, depending on the bowl's shape. There is a greater fly-off risk with this type of mounting; it is best to bring up the tailstock for added support and turn at a slow lathe speed.

Collet chucks

A collet is another "squeezing" type of chuck. It exerts a clamping force on the workpiece when it is tightened by means of a tapered outer collar. Collet chucks excel at holding small-diameter blanks or tenons.

Collets offer limited adjustment of capacity. That is why typically they are sold in sets, rather than individually (*Photo 7*). However, collets have two advantages for holding small-diameter blanks: they provide a strong hold on the workpiece and will not mar the wood (*Photo 8*). A variation of a collet chuck is the dedicated collet with drawbar, also shown in *Photo 8*. In this case, the drawbar runs through the headstock spindle and pulls the tapered collet tight. The taper causes the jaws to contract, holding the workpiece firmly. This holding method is used frequently when making bottle stoppers.

Drill chucks

Drill chucks are another example of holding devices in the "squeeze" ▸

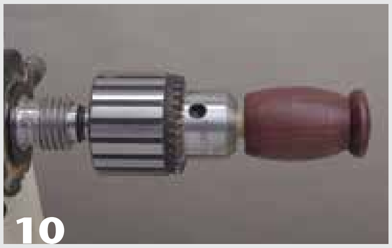
Collet chuck

A collet chuck set with jaws ranging in size from ¼" to ¾" (6mm to 19mm). A dedicated ⅜" (9.5mm) collet with drawbar is pictured in the foreground.

Collet chucks have a collar and set of jaws. Here a bottle stopper is held in a ½" collet.

Drill chuck


9


10

Drill chucks can also be used to hold small objects while turning. A drawbar running through the lathe headstock helps to secure the drill chuck in the spindle.

Expansion mode


11

Chuck jaws are expanded into a recess at the bottom of a bowl blank. This mounting method reduces waste wood, as no tenon is required. *Note: one jaw removed for illustration purposes.*

Between centers


12

The most common way to mount spindles for turning is between centers.


13

Between centers is a common holding method when beginning a bowl, as it allows the turner to make adjustments in grain alignment prior to finalizing the tenon position.

Drive and live centers


14

Drive centers are available in a range of sizes and configurations to meet various needs.


15

A sampling of the wide variety of tailstock live centers and points available.

category (*Photos 9, 10*). A drill chuck has an advantage over a dedicated collet in its wider capacity. A disadvantage of drill chucks is that they leave compression marks on the wood. Like collet chucks, drill chucks should be used only for small workpieces.

Expand in it

Scroll chucks

Scroll chucks can also be used in expansion mode, which means the jaws expand inside a recess in the workpiece (*Photo 11*). Expansion mode has the advantage of greater repeatability; a piece can be chucked, removed from the jaws, and then re-chucked and will usually still run true. This rarely happens when using a scroll chuck in compression mode.

A second advantage of expansion mode is that it uses less wood. The recess needed for chucking ultimately becomes part of the base, so no wood is wasted. When a chuck is used in compression mode, the tenon being held in the chuck typically becomes waste if it is not to be included in the base/foot design. Losing ½" (13mm) of wood from a piece of 2" stock is significant.

Push on it

Between centers

A traditional way of holding wood on the lathe is between centers (*Photos 12, 13*). The work is pinned between the headstock and tailstock, with pressure exerted from the tailstock end. The headstock and tailstock points have evolved to today's improved drive and live centers. Drive centers are inserted into the headstock and transmit rotational force to the blank. Live centers are inserted into the tailstock. Ball bearings in the live center allow it to rotate freely. The combination of the two centers allows a blank to be held securely on the lathe and yet rotate.

Drive centers vary in size and type (*Photo 14*). When turning large, green blanks, a drive with a larger cross-section provides more "bite" in the wood. This minimizes the problem of a drive center "drilling" a hole into the wood and spinning freely. A two-prong drive center allows greater adjustment of the blank and still produces a good bite into the wood. Drive centers with a small cross section excel at multiaxis work.

Live centers also are available in a wide variety of configurations (*Photo 15*). The variety of turning forms has given rise to specialized configurations of live centers. Live centers can come as a kit that offers specialized points for different types of work. Some live centers have the option of an adapter that allows a scroll chuck to be threaded onto the tailstock. The live center allows the chuck to rotate freely, which can be useful when reverse-mounting a form. Mounting the piece on the tailstock while still in the chuck ensures concentricity is maintained.

Jam chuck

16

Shopmade jam chucks. One (left) is mounted by means of a faceplate and the other with a nut epoxied in a block at the back of the disk. Both are covered with closed cell foam.

17

A bowl is reverse-mounted by pushing it against the jam chuck with tailstock pressure.

Specially turned wasteblock

18

A wasteblock held in a scroll chuck is profiled to match the opening of this vase. The tailstock pushes on the form for added security. With the right friction-fit for smaller forms, it is possible to remove the tailstock for final passes on the base.

Through-hole mounting

19

Two threaded jam chucks hold this pepper mill blank for turning. One block is threaded on the headstock and a second threaded into a live center adapter. This is one method of driving a form with a through-hole, such as this pepper mill blank.

Jam chucks

The "push on it" category also includes jam chucks. *Photos 16 and 17* show how a shopmade jam chuck can be used to reverse-mount a bowl to allow the bottom to be completed. The foam-covered disk is threaded onto the headstock, the bowl is centered on the foam disk, and the live center in the tailstock is brought up to push the bowl against the foam disk. The foam protects the rim of the bowl from damage. This method is an alternative to the use of jumbo jaws, though here the tailstock must remain in place during the entire process, leaving a nub that can be carved away after turning. Turning should be done at slow speeds with this type of mounting.

A very common type of jam chucking is the use of a wasteblock custom-turned to accept the work at hand. Very often, turners will shape a spigot so a project can be friction-fit for reverse-mounting (*Photo 18*). This works well for small vases and endgrain boxes. Another variation, without friction-fitting, is for a bowl to be placed over an appropriately shaped wasteblock and held in place with tailstock pressure, allowing access to turn the base.

Another form of jam chuck, shown in *Photo 19*, is useful for mounting projects that involve a through-hole. In this application, a block of wood has been threaded and screwed onto the headstock spindle, and a second piece of wood has been threaded and mounted on a live center adapter. Each jam block is shaped to match the hole in the middle of this small pepper mill. The tailstock is advanced to apply the needed force to both hold and turn the pepper mill blank. Using wooden jam blocks means that if my tool goes off the blank, it will contact wood, not metal.

Vacuum chucking

Another form of jam chucking is vacuum chucking. A pump is used to draw air through the lathe spindle to create a vacuum that holds the ▸

workpiece against a specialized chuck (*Photos 20-22*). The size of the vacuum chuck determines the amount of holding power. As the diameter of the chuck increases, the holding power of the vacuum also increases.

Vacuum pumps are classified according to the amount of vacuum they can create and the volume of air they can move (*Photo 23*). The amount of vacuum is denoted by how many inches of mercury the pump will lift (inHG), and flow is measured in cubic feet per minute (CFM).

Vacuum pumps used in woodturning are not able to achieve a perfect vacuum, so the flow rate of your pump is important. Wood is porous, so some air will pass through it. Regardless of the extend of the vacuum, if the flow rate of the pump is too low, air moving through the wood will keep the vacuum below the level needed to turn safely. Be sure to compare flow rate as well as inches of vacuum when considering the purchase of vacuum system. Use the tailstock for support as long as possible during turning.

A rule of thumb is that your vacuum gauge should register at least 20 inches for safe workholding. As with all rules of thumb, use common sense. Airflow through the wood can be minimized simply by rubbing wood dust over the workpiece. The flow of air will draw the dust into open wood pores, closing the airways and improving the vacuum. A second way to stop air from being pulled through the wood is to put masking tape over the porous areas of the workpiece.

Screw it

Faceplates

Faceplates are second only to between centers in the amount of security they offer. They were the holding method of choice before

Vacuum chucking

20

A variety of vacuum chucks. The varied diameters and lengths are handy for a range of forms. The top of each chuck is covered with closed cell foam and plastic wrap. The plastic keeps the foam from leaving black marks where the chuck contacts your form.

21

22

A strong vacuum hold allows full access to the bottom of a workpiece. The open grain and wormholes in this blank necessitated the use of masking tape to minimize the airflow through the wood.

Vacuum pump system

23

A vacuum pump system includes a pump, gauge, valves, fittings, and hose.

Faceplates

24

Faceplates come in a variety of sizes. Use large plates on large pieces, small plates on small pieces. Use larger screws where appropriate.

25

Faceplates require a flat surface on the wood to make full contact with the blank. A hand plane was used to flatten this blank in the center.

today's scroll chucks and still retain the advantage of being one the most solid holding methods available.

The holding power of a faceplate is dependent on the strength and length of the screws (*Photo 24*). Common dry wall screws are prone to break and should not be used. A better choice is sheet metal screws. The critical element is the shear strength of the screw you select. Use longer, thicker screws for larger faceplates and workpieces.

When using a faceplate of any type, ensure that the entire surface of the plate is in contact with the wood (*Photo 25*). Note that when a screw is forced into wood, there will be a bulge of dislodged wood around the screw, which can push the faceplate up and cause a gap, compromising holding power. Predrilling pilot holes will help reduce this concern.

Screw chucks

Screw chucks, or woodworms, are another holding method in the "screw it" category (*Photo 26*). Common types of screw chucks can be threaded directly onto the headstock spindle, inserted in the taper of the spindle, or used in conjunction with a scroll chuck, as shown in *Photo 27*. An appropriately sized pilot hole is drilled in your turning blank, which is then threaded onto the screw chuck.

The holding power of this method comes from both the screw itself and fully mating the blank with the face of the screw chuck. The holding power can be so great that it can be difficult to remove a blank from the screw chuck when the turning is completed. Waxing the threads and/or using a spacer plate diminishes the problem. Large screw chucks excel at holding large, green blanks. As always, bringing up the tailstock to provide additional support is a recommend practice.

Screw chucks

26

A variety of screw chucks.

27

A woodworm screw is held in a scroll chuck. A properly sized hole is predrilled at the center of the blank, and the blank is screwed on until there is full contact between the top of the chuck jaws and the wood. Tailstock pressure should also be used when possible for added support.

Final thoughts

Developing a mental library of holding methods is critical to developing your skill as a woodturner. If the choices seem overwhelming, think in terms of each of the four categories of holding methods and work through the possibilities.

One final thought on holding methods: not all pieces of wood can be safely mounted and turned. The wisest decision a woodturner makes is the decision not to turn a specific blank. There is always more wood. ■

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, dennisbelcher.com.

JOURNAL ARCHIVE CONNECTION

EXPLORE!

AAW's online archives offer many articles on various commercial and shopmade workholding solutions. For further reading, log on at woodturner.org and use the Explore! search tool. Here is a sampling of *American Woodturner* articles you will find:

- "It's All in the Jaws," by Richard Raffan, December 2010 (vol 25, no 6)
- "Mastering the Four-Jaw Scroll Chuck," by Dick Gerard and Stan Wellborn, February 2010 (vol 25, no 1)
- "Meet Your Needs with Custom Soft Jaws," by Mike Peace, June 2019 (vol 34, no 3)
- "Nut Chucks for Small Turnings" (Tip), by Phil Cottell, October 2015 (vol 30, no 5)
- "Creating Vacuum Chucks from Thin Air," by Rich Sherry and Bill Small, Summer 2004 (vol 19, no 2)
- "Understanding and Improving Vacuum Chucking Systems," by John I. Giem, February 2011 (vol 26, no 1)
- "Shopmade Wooden Collets for a Scroll Chuck," by Colin Hovland, August 2017 (vol 32, no 4)
- "Wedge Mandrel," by Charlie Wortman, April 2018 (vol 33, no 2)
- "Automotive Gizmo Makes Low Cost Chuck," by Andy Cohen, Winter 2000 (vol 15, no 4)