GUIDELINES FOR A SUCCESSFUL CRITIQUE • GETTING STARTED IN WEARABLE RINGS—PART 2

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2022 POP MERIT AWARD RECIPIENT

SEGMENTED TURNING TODAY
A REMARKABLE EVOLUTION

GETTING STARTED IN CASTING

THE SPACE BETWEEN

2022 POP EXHIBITION AND AUCTION

A TABLE SAW SLED FOR PRECISION-CUT STAVES

Dan Swaim

Stave-constructed turnings allow the turner an opportunity to exploit the grain and figure of woods, with a high degree of control over the shape and appearance of the finished work. Unlike the mystery of a solid, one-piece bowl blank, where the figure unfolds during turning, a stave-constructed piece is designed from the start with the end in mind. An additional benefit is that using flat-sawn lumber can be quite a cost savings, allowing the use of exotic woods one might not be able to afford otherwise.

One challenge, however, is that cutting staves accurately on the table saw can be problematic, even for experienced woodworkers. Since staves require compound miter cuts, sufficiently accurate setup is difficult, and the saw operation can be quite hazardous. Accurate angles are difficult to achieve, parts slip against the miter fence, and off-cuts can become trapped under the spinning blade. Even attempts to use "hold-down fingers" can expose the operator's fingers to the angled blade extending above the cut. Trying to true up poorly cut staves can be tedious and could result in poor-quality glue joints or a "wobbly" blank, where most of the wood must be wasted just to true the blank for turning safely.

For segmented woodturners, Jerry Bennett's Wedgie Sled (see example shown on page 32) solves these problems. After setup, one can expect perfect segments right off the table saw with no sanding or adjustments needed. After several failed attempts at different jigs for cutting staves, I realized that a modified version of the Wedgie Sled was the answer. With all credit to Jerry Bennett, the stave-sled idea was born, and it is now possible to cut perfect staves and glue them up straight off the table saw with no tinkering.

Stave-constructed bowls and vessels offer unlimited design opportunities, but cutting accurate staves can be challenging.

You will need to make one set-up wedge for each combination of the bowl side angle and number of staves. However, set-up wedges are quick to make and can be saved for future work. A key feature of the stave sled is that the miter angle needs to be only modestly accurate and then the blade angle is "tuned" to bring the stave into an exact fit. Both settings are then "saved" by the set-up wedge.

Build the sled

Base and fences

Building the sled, shown in *Photo 1*, is fairly simple. Note that these construction notes assume a left-tilting table saw in order for off-cuts to drop clear of the saw blade. Choose a suitable substrate; Baltic birch, medium-density fiberboard (MDF), or particle board will work. A base of about 12" × 24" (30cm × 61cm) will allow you to cut staves for bowls as deep as 10" (25cm) and up to 25" (64cm) in diameter for shallow bowls or platters.

The sled runs lengthwise on the right side of the blade. Install a runner that fits your saw's miter slot such that the base overlaps the saw blade by about ½" (13mm) (to be cut off later). Hardwood is a good choice for the runner, but I've found that a piece of leftover T-track is a great option that always fits snugly, doesn't change with humidity, and wears well. Before installing the base runner, drill the two holes for the fences to pivot on about 1½" (38mm) from the left edge and centered lengthwise about 3" (8cm) apart. Use these holes and a suitable router setup to route two arcs for both the fence and hold-down locking bolts.

Flip the base over and route recesses for the bolt heads. While carriage bolts will work fine for hold-downs, T-track bolts or, better yet, toilet bolts slide in the recess much better than carriage bolts.

Use a dimensionally stable wood for the fences, as they will be key to repeatable accuracy. Install the fence on the pivot hole, then use the routed arc as a guide to drill the second hole in the fence for quick and easy alignment and a smooth swing.

Hold-downs

The hold-downs are essential for this jig. In addition to safely holding the work, they provide the registration face to control the angle and width of the staves. Having the staves be identical in width is just as important as the miter and bevel angles. The hold-down material must be at least 1" (25mm) thick. If it flexes or lifts off of the base when applying the toggle-clamp pressure, it will cause errors in alignment. Select the hold-down thickness and toggle clamp based on the work you plan to do. On the sled shown, a spacer has been added to the hold-down to allow the toggle clamps to hold staves up to 2" (5cm) thick.

Safety Note: Do not build/use this sled without a mechanical hold-down, such as a toggle clamp. Regardless of your imagined strength, the stave cuts are long rip cuts on relatively small pieces of wood, which cannot be held safely by hand or hand-held hold-downs. At best, the staves will slip and be unusable. More likely, the slipping piece will catch the saw blade and be kicked back into your face or body. For cutting segments, which are generally short cross-cuts, holding the work by hand is appropriate, but this is ***not*** *the case for the long rip cuts for staves.*

Chamfer or round over the edges of the fences and hold-downs to prevent trapping sawdust or debris. Assemble everything with nuts, bolts, and washers and you're ready to set up your first cuts.

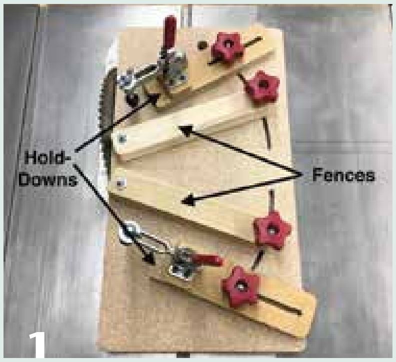
Important terms

Before cutting your first set-up wedge, let's clarify the terms that we'll be using.

The *slope* (S) is the side angle of your project as measured from the horizontal surface (tabletop) to the side. If S=70 degrees, the sides will be steep, as in a deep bowl, whereas if S=30 degrees, a shallow bowl approaching a platter will result.

The *number of staves* (N) can be anywhere from six to twenty-four or thirty-two, depending on the design and grain/figure of the wood you are using. A small number of staves (six to ten) tends to highlight the grain and ▸

Wedgie Sled modified for cutting staves



The stave sled provides hold-downs for safety as well as precision cutting.

Compound Miter Angle Formulae

Miter Angle*

$$MA = \arctan\left(\frac{1}{\cos S \times \tan\left(\frac{180}{N}\right)}\right)$$

*Miter ***gauge*** setting will be (90-MA)

Blade Angle

$BA = \arctan(\cos MA \times \tan S)$

Commonly used compound miter angles

Compound Angles for Staves

Slope	8 Staves		10 Staves		12 Staves		16 Staves	
	Miter Angle	Blade Angle	Miter Angle	Blade Angle	Miter Angle	Blade Angle	Miter Angle	Blade Angle
0	22.5	0.0	18	0.0	15.0	0.0	11.25	0.0
15	21.8	5.7	17.4	4.6	14.5	3.8	10.9	2.9
30	19.7	11.0	15.7	8.9	13.0	7.4	9.8	5.6
45	16.3	15.7	12.9	12.6	10.7	10.6	8.0	7.9
60	11.7	19.4	9.2	15.5	7.8	13.0	5.7	9.7
75	6.1	21.7	4.8	17.4	4.0	14.5	3.0	10.9
90	0.0	22.5	0.0	18	0.0	15.0	0.0	11.25

Figure 1. All settings are in degrees read directly from saw scales.

figure of the wood but causes a bit of "bounce" when truing up the bowl blank at the lathe. A small number of staves also leaves less wood for achieving curvature of the sides. A large number of staves gives a more even or consistent look to the bowl, but they can be tedious to cut and any remarkable grain or figure in the wood is lost in the final turning.

Together, S and N are used to determine the miter angle (MA) and blade angle (BA). The formulae for determining MA and BA are shown in the *Compound Miter Angle Formulae* sidebar. This information is critical for cutting the exact trapezoidal wedge needed, though *Figure 1* provides some common examples of angles for a variety of vessels. The MA is read directly off your miter gauge or a protractor. The BA is read directly off the table saw's blade angle adjustment scale. Tuning the blade, or bevel, angle is the trick to getting an exact fit for the staves, and just how to do that will be described in the following paragraphs.

Make a set-up wedge

To make your first set-up wedge, use a protractor or after-market miter gauge to set the miter angle. Using thin plywood or MDF, cut a wedge about 8" to 10" (20cm to 25cm) long and about 4" (10cm) at the wide end (*Photos 2, 3*). Cut both sides of the wedge without

Make a set-up wedge


2


3

A miter gauge is used to cut the first side of the set-up wedge, which is then flipped before cutting the second side. The miter gauge angle remains the same.


4

Use a bevel gauge to confirm that the angles on both sides of the set-up wedge are the same.

Trim and label set-up wedge


5

Trim the small end of the set-up wedge to the desired blade angle (found in *Figure 1*). Label the set-up wedge for future use.

5a

Cut staves to length


6

7

Cut the stave sections to length, using a stop for consistency. Number and mark the orientation of the stave sections as they come off the board to allow for grain matching during glue-up. Dark pencil lines across one end indicate the top, or wide, end of the staves.

Set blade and fence angles

A single set-up wedge is used for both blade and fence angles. Set the blade angle using the small end of the set-up wedge.

(9-9a) The long sides of the wedge are used to set first the lower fence, then the upper fence. The wedge ensures easy, accurate setup every time.

changing the miter-angle setting. While it is not critical that the angle measurements are exact, it is essential that both angles are equal. Use a bevel gauge to confirm the angles (*Photo 4*). This long taper is a bit difficult to hold steady, so you may need to slightly trim both sides of the taper until both angles are identical.

Using the miter gauge again, set up the required blade angle. With a long side of the tapered wedge against the miter gauge cut off a small portion of the wedge from the small end, resulting in an edge about 2" long (*Photo 5*). You'll save this set-up wedge for future projects, so it is a good idea to label it as shown in *Photo 5a*.

Cut the first staves

The first time the set-up wedge is used, the blade angle will be adjusted to exactly match the slope and number of staves for the miter angle. The initial staves should be cut about ½" larger than the final dimension to allow for a few trimming cuts to tune the blade angle for an exact fit.

Start with a board of sufficient length to cut the desired number of staves. The lumber should be flat and, most importantly, the cross-cuts must be straight. Use a stop to ensure all staves are the same length (*Photo 6*). Number the stave pieces as they are cut to support grain-matching and orientation during glue-up. Only the rims, or tops, of the staves will be registered against the sled fences, so mark them with a heavy pencil mark and arrow as a reminder (*Photo 7*).

Using the beveled end of the set-up wedge, set the table saw blade angle (*Photo 8*). Since this is the first time the sled will have been used, advance the empty sled through the saw to trim off the overhanging edge of the base. Note that this edge will be trimmed away each time you use a smaller blade angle but will never be trimmed past the 0-degree setting on your saw. Using the set-up wedge, set the two fences, first the lower fence, then the upper fence (*Photos 9, 9a*).

After setting the toggle clamp to a firm holding pressure, register the top of the stave against the lower fence, as shown in *Photo 10*, and use the hold-down to set the desired width of cut. If your board is a little uneven in width, it doesn't matter at this point because the final width is determined by the upper fence. Make your cut by advancing the sled through the table saw using a steady, even pace. Watch between the fence and top edge of the fence to ensure the wedge segment doesn't slip or rotate as you push through the cut (*Photo 11*). If it does, use a push stick or increase clamping ▸

Cut first side of stave using lower fence

Always register the top, or wide, end of the stave against the fence—never the smaller end. Adjust the hold-down position and clamp the stave in place. Use a steady, even pressure to cut the first side.

Cut second side of stave using upper fence

(12-12a) Flip the workpiece to keep the top edge against the upper fence, adjust the hold-down position according to the desired width (allowing for some extra at this point), and finish cutting the stave. Maintain safe hand position when cutting staves.

(13) A "perfect" stave, although still a bit wider than the final dimensions.

pressure to prevent movement. This is necessary only on the lower fence.

Now flip the stave to register the top edge against the upper fence. Again, always register the top, wider edge—never the smaller end—against the fence. Use the hold-down as a side fence, as shown in *Photo 12*, and set the width to a bit oversized to allow for a few "tuning" recuts. Now pass the stave through the saw to cut your stave. Note that for this final cut, the blade pressure is pushing the stave into the fence, so slippage is not a concern like it was when registering against the lower fence. Note the user's safe hand positions when cutting staves (*Photo 12a*).

The resulting stave should be as desired, but a bit oversized in width (*Photo 13*). If all looks good, cut the remaining number of staves using the same process: use the lower fence to trim and true one edge, and use the upper fence to trim and true the stave to final width.

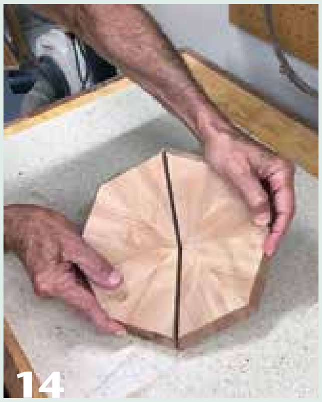
Adjust the blade angle for a perfect fit

Although your initial staves may seem "perfect," it is unlikely they will glue up without any gaps. So now you will tweak the blade angle just a bit for perfect fit and glue-up. Using masking tape or other holding methods, assemble the staves to check their fit (*Photo 14*).

If you have a gap at the outer edge of the assembled staves, increase the saw blade angle slightly (moving it in the direction of horizontal). If the gap is on the inside edge of the assembled staves, decrease the saw blade angle (moving it in the direction of vertical). Only small adjustments should be required—don't overdo it! Now recut all of your staves, trimming both sides. Reassemble with tape and test-fit again (*Photo 15*). If there is still a gap, repeat the blade-adjusting process.

When you are happy with the fit, use your miter gauge to re-trim the set-up wedge to the final blade angle (*Photo 16*). You now have a set-up wedge for repeated, accurate use.

Dry-fit and adjust



Test-fit the staves before glue-up. Held by hand pressure and masking tape on the back (not visible here), a gap at the inside edge of the staves is evident. To correct this, decrease the blade angle (i.e., move it towards vertical) and re-trim both sides of the staves. After this small adjustment, the staves fit perfectly.

Finalize set-up wedge

When your staves fit together with no gaps, re-cut the small bevel angle on the end of the set-up wedge. For future projects, you'll be able to use this wedge for quick, precise setup—no test cuts or wasted time and material trying to get an acceptable fit.

Helpful sidebars

- See *Gluing Up Staves* sidebar for tips on final assembly of the turning blank.
- See *Mounting a Staved Workpiece* for tips on mounting a staved assembly on the lathe.

Conclusion

By varying the stave thickness, width, or length, a limitless variety of bowls or vessels can be turned using one set-up wedge and the stave sled. Though it takes a few minutes to tune up the blade angle when first making the set-up wedge, it should seldom take more that three test "trimmings" to adjust the blade angle for an acceptable fit. You can then make numerous stave turnings of various height and diameter from the same set-up wedge (*Photo 17*). ■

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One wedge, many variations

17

If you vary the stave thickness, width, and/or length, numerous variations of bowls and vessels can be made using just one set-up wedge.

Gluing Up Staves

Your accurately cut staves must be glued up into a circular assembly that runs true for turning. Glue-up for stave-constructed turnings is considerably messier than for segmented rings. For one thing, you are gluing up an entire vessel, not just a single ring. Additionally, clamping a flat ring is considerably easier than a multi-sided, conical shape. A typical approach consists of several rings or "doughnuts" and multiple threaded rods to squeeze the assembly together. At least once, I've had the entire masking-taped assembly fall apart just after applying glue but before I could get the clamps on. Scrambling ensued, resulting in an off-centered glue-up and large glue lines and gaps. A much faster and more certain method is to attach small blocks to provide a surface for hose clamps to provide the clamping force.

Helpful tips

First, instead of masking tape, use gummed paper tape to hold all of the pieces in alignment (*Photo a*). This tape is much stronger than masking tape and will prevent the assembly from falling apart.

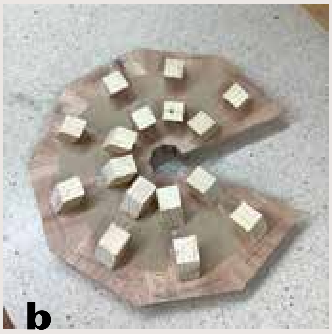
Using ¾" × ¾" (19mm × 19mm) scrap wood, cut 1"-long blocks at the same angle as your planned side slope. Using cyanoacrylate (CA) glue or hot-melt glue, attach the blocks to the stave segments, evenly spaced from the top and bottom of the staves (*Photo b*). Allow the glue to set a few minutes (or use accelerator), then fold up the assembly and apply hose clamps to bring it into alignment (*Photo c*). Dry-fit the assembly a few times to get the feel for how much force to apply to the hose clamps. If you over-tighten them, you'll probably pop off one of the glue blocks. Because the staves should fit very well, less pressure is required than you might think. Apply pressure evenly, alternating between the top and bottom hose clamps to draw the glue joints tight. When you are comfortable with the operation and have a good fit, fold out the assembly, apply an even layer of glue, fold up the assembly, and reapply the clamps.

For shallow bowls, generally 45-degree side angle or less, apply the hose clamps to the glue blocks directly. For deeper bowls, generally 45 to 75 degrees, just glue a few of the blocks on and apply the hose clamps directly to the staves just below the blocks. The glue block keeps the hose clamp from sliding up the tapered side when tightened (*Photo d*).

Although cutting and attaching the glue blocks sounds as if it would take a lot of time, it is actually faster than fiddling with multiple rings and threaded rods, especially if you need to make a new ring. After the glue has dried, pop off the glue blocks with pliers; they can be re-used many times.

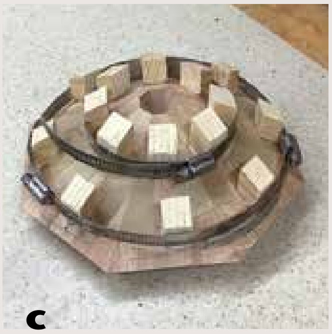
a

Paper shipping tape has superior holding power over masking tape and allows for better handling.



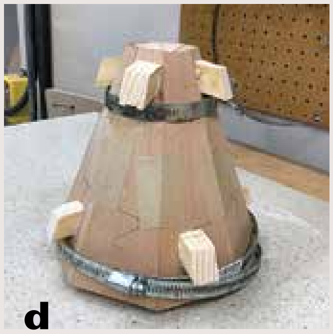
b

Small glue blocks attached directly on the staves with CA or hot-melt glue aid in keeping hose clamps in place.



c

Hose clamps draw the glue joints tight. Dry-fit the assembly first to get a feel for sufficient pressure.



d

For deeper bowls, the glue blocks just keep the hose clamps from sliding up the tapered sides.

Mounting a Staved Workpiece

For your glued-up stave construction to run true on the lathe, allowing the maximum amount of wood to be available for final shaping, the workpiece should be as round as possible, mounted parallel to the lathe axis, and co-aligned with the lathe center. Perfect staves and a good glue-up provide the roundness needed. To mount the workpiece to run true, I use a shopmade drawbar and four-jaw chuck to cut an internal recess for mounting on a four-jaw chuck (*Photo a*).

Flatten top and bottom

First, check that your workpiece top and bottom are flat and parallel to each other. Examine the edges of the large diameter and knock off any glue blobs or obvious high spots. Set the workpiece on a flat surface and ensure it doesn't rock. If it does, rub it on a piece of sandpaper until it is stable. Place a ruler across the small end and check that it is level. If it isn't, flattening the small end on a drill press with a sanding disk is a quick way to true that area (*Photo b*).

Drawbar centers workpiece

With the large and small diameter rims flat and parallel, the workpiece will be parallel to the lathe axis, but not necessarily centered on the axis. A drawbar mounted through the lathe's headstock is the solution. With the four-jaw chuck open fairly wide, press the small end of the workpiece against the flat bottom of the jaws, install the drawbar with a centering disk or cone of appropriate size and draw the workpiece snugly, but not tightly, against the jaws (*Photos c, d*). Tighten down on the jaws to center the workpiece on the chuck, but not so tight as to lift the workpiece off the flats. Then tighten the drawbar to firmly hold the workpiece.

At slow speed, rotate the workpiece to confirm it runs true. If it wobbles, loosen the jaws slightly and tap the workpiece in the direction needed to true it up. Check that the drawbar remains tight. At this point, all of the holding power is between the drawbar and the flats of the chuck jaws; the jaws' gripping surfaces are just providing alignment to center the workpiece.

Using a slow speed, 600 rpm or less, cut a very small recess with a parting tool or bedan just slightly larger than the minimum opening of your chuck jaws (*Photo e*).

You're all set for a perfect turning. Pull the workpiece off the chuck/drawbar, flip it over, and mount it on the four-jaw chuck in expansion mode. With the work mounted in this fashion, you can completely turn and sand the outside, attach a foot with a mounting recess or tenon, and then flip the piece to finish the inside turning and finishing (*Photo f*).

a

A simple shopmade drawbar comprises all-thread rod and a centering cone.

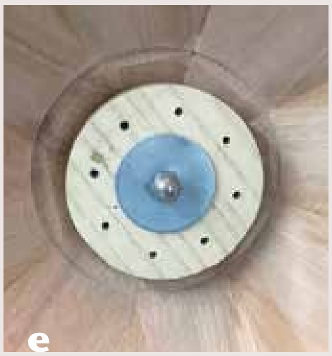
b

The base can be flattened using a drill press with a sanding disk.

c

d

The small end of the workpiece sits on the flats of the four-jaw chuck, while the drawbar centers and holds the workpiece firmly.



e

f

(e) Because the jaws will hold the workpiece in expansion mode, only a small recess is needed.

(f) Reverse-mounting the piece with the jaws in expansion mode allows excellent access for complete outside turning, sanding, and installing a foot. Turn a recess or tenon on the foot for remounting the piece to turn the inside.