Tablesaw sled for cutting segments

Making segmented vessels and furniture pieces requires a means to cut segments of different lengths and various angles. The segment length is determined by the desired diameter of the ring of segments, and the cut angle is determined by the number of segments in the ring.

While the table saw miter gauge can be modified by addition of a fence to cut segments for segmented turnings, its accuracy and repeatability are not likely to produce consistently satisfactory results. For this reason, there are several aftermarket miter gauges available to do this sort of work. They have a common disadvantage; namely, they are pretty expensive. There is, however, an alternative; and that is to make your own jig to suit your individual needs. There are several designs for sleds to fit this need in books on the subject and on the Internet. This article presents an alternative to those designs.

This sled is intended for segmented vessels of moderate size. Dimensions of the parts may need to be scaled up if your intended use includes large segments; e.g. larger than ¾" think.

The sled suggested in this article uses basic trigonometry to determine the angles as opposed to using protractors or other angle finding methods. To get accuracy in setting up the angles, 28 inches of the base of the sled is used to represent the base of a triangle. Then a perpendicular line representing the altitude of the triangle is drawn along which marks are made to represent intercepts for each of the required angles. Thus the vertical distance from the base along the altitude is computed using the formula:

Y = 28 x Tangent(Cut angle)

The 28 is the length of the baseline, and the cut angle is determined by the number (N) of segments desired to make up a ring. The cut angle (Ca) is determined by the formula:

Ca = 180/N

Where as stated, N is the number of segments desired and Ca is the cut angle.

To make this sled, you'll need a good square, an accurate rule, and straight edge. Check your square to make sure that it is exactly 90 degrees. You'll need to make accurate measurements. Use the same rule for all measurements to ensure that any lineal error in one measurement is compensated for in others. A 48" level or something of the like will make a good straight edge.

Material you'll need:

Base:	1 – ¾" Baltic birch or MDF – 20" x 30"
Runners:	2 – hardwood 18" long x D x W
	D = depth of your miter slots minus 1/32"
	W = Width of your miter slots (tight)
	6 - #6 x 1" flat head wood screws
	Double sided tape will be helpful but not required
Fence:	1 – 18" x 1 ½" x ¾" hardwood
	1 – 18 ¾" x 2" x ¾" hardwood
	2 -- #6 or 8 x 1 ¼" flat head wood screws or drywall screws
	3 -- #6 or 8 x 1 5/8" flat head wood screws or drywall screws
	1 -- #10 flat washer
Handle:	1 – 2" x 4" x 12"
	3 -- #8 x 2" drywall screws
Stop block Assembly –	
	2 – ½" x 3" x 9" hardwood
	1 – ¼" – 20 x 2 ½" round head machine screw
	1 – ¼" Flat washer
	1 – ¼" wing nut
	2 -- #6 x 1" Flat head wood screws
Test pieces:	Several pieces 30" x 1 ½" x ¾" hardwood

Note: The depth of the runners needs to be just a little bit thinner than the slot is deep; about 1/32" thinner. The runners need to fit very tight in the miter slots. You'll sand them to fit later. Double sided tape will help to secure the runners.

Cut and mill your wood pieces ahead of time so that you don't interfere with the procedure later on. Make sure they are straight and true; all edges are at right angles to each other, and ends are trimmed square.

It's assumed that since you're attempting to make segmented vessels that you will have other tools as required and basic woodworking skills.

First align your critical saw parts (this is very important for the rest of this procedure to work).

1. Make sure your blade is parallel to the miter gauge slots and square with the table.
2. Make sure your rip fence is parallel with the miter gauge slots.

Make sure the base of the sled has at least one square corner; i.e., 90 degrees. Usually you just need to find a factory corner that is square and go from there, but if there isn't one you'll have to square the board to make this procedure work. Mark your square corner.

Apply double sided tape to the runners in three places. The double sided tape will help to keep the runners from slipping. Place the runners in the miter slots and shim them to

stand a little proud of the table top. You can use four flat washers or dimes for this if nothing else is handy. Lower your saw blade below the table top.

Set the rip fence 10 inches to the right of the blade. Set the sled base on the saw with the square corner to the lower right side, the 20” edge along the rip fence and the 30” side at the in-feed edge of the table. Use the rip fence to position the base over the runners making sure that the base is firmly pressed against the rip fence. Press down on the base to adhere it to the runners. Drill and countersink three holes in the base for 1” x #6 flat head wood screws over each runner and use the six screws to secure the runners to the base. Don’t over tighten the screws distorting the runner.

Remove your spacers (washers or dimes) and try the base in your saw. It should slide easily and remain square to the table. Apply some wax to the runners and underside of the base. This will help the tight runners to slide and will impede to some extent moisture exchange that could cause the runners to distort over time.

Now, with the base on the tablesaw, begin your marking. See Figure 1. The key to accurate marking is that the 30” edge closest to you must be perpendicular with the saw blade and the right edge of the base parallel with the saw blade, miter gauge slots, and fence. This edge becomes the base line of the triangle you’re going to mark.

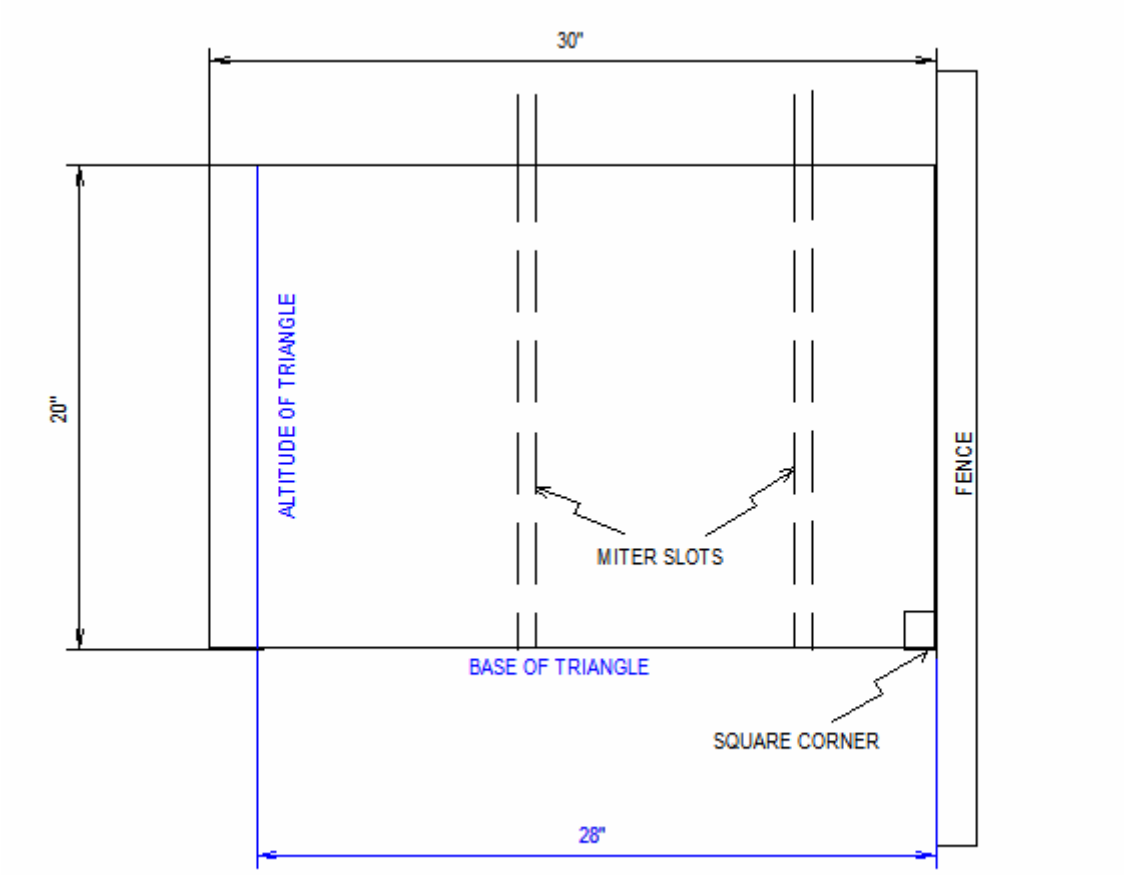

Figure 1. Sled base orientation with triangle base and altitude marked.

Next measure over 28” from the right edge of the base at the in-feed end and draw a perpendicular line. Use either a known good square or measure from the right side in two places and connect the marks. These measurements must be precise. This line should be perpendicular to the base line. Once you’re sure it is, scribe it in so that it isn’t obscured in later use. The rationale for measuring 28 inches from the far right of the base line is that the longer this line, the more precise the angles established by the vertical measurement can be.

As stated, the Y distance is equal to the 28” base line times the tangent of the cut angle. For convenience, these values are provided in Table 1 to the nearest 64 of an inch. Choose from the table the cut angle you want; e.g., for 12 segments, the angle will be 15 degrees and the Y distance will be 7 ½” up the vertical line from the horizontal line. Make a mark there.

We’ll use a 12 segment ring to illustrate the set up procedure. You’ll use whichever suits your needs.

N	Ca	Y
	Degrees	Inches
8	15	11 19/32
10	9	9 3/32
12	15	7 1/2
14	12.875	6 25/64
16	11.25	5 9/16
18	10	4 15/16
20	9	4 7/16
22	8.182	4 1/32
24	7.5	3 11/16

Table 1. Angles and Y intercept for common numbers of segments.

Now draw a line from the mark on the vertical line to the lower right corner of the sled. This line should be penciled in for now. Later, you’ll scribe it as you did the others. This line will be where you’ll place the leading edge of the miter fence you’ll make in a future step.

Before going on, you need to make a decision. Do you want a sled dedicated to this specific angle or do you want to have it usable for two or three angles? Many more than that will clutter up the sled and make for confusion. If you do want to do any other angles, you’ll need to repeat the process for each angle you want; drawing a line from the

lower right corner of the sled to each intercept on the vertical line. Since you'll be cutting the sled in two parts in the following procedure, you won't easily be able to come back and add new angles later on.

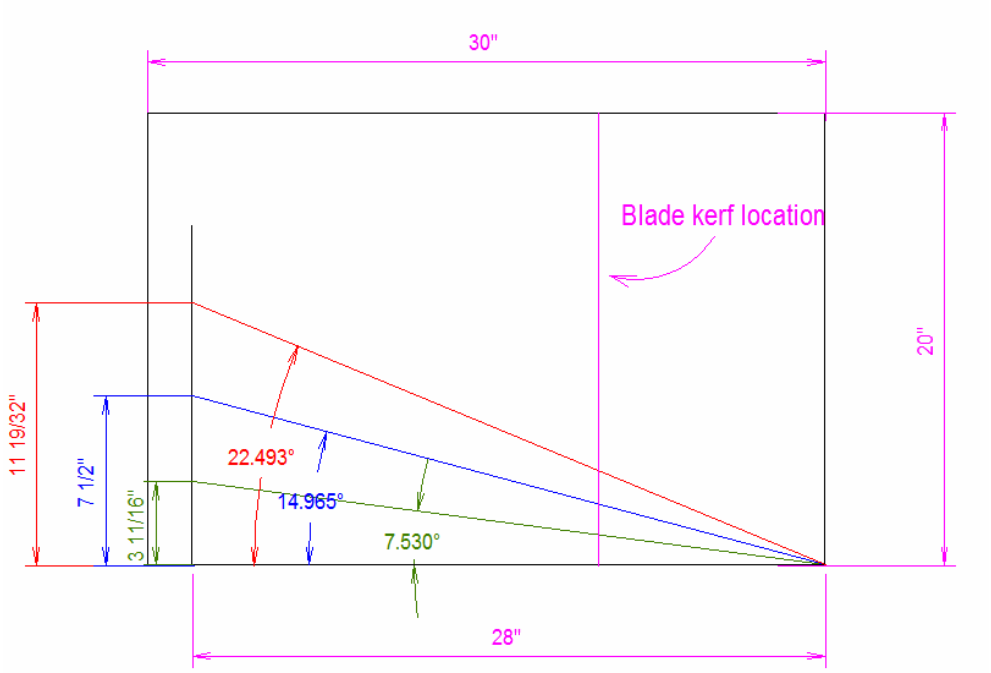

Figure 2. Base showing lines for 7.5, 15, and 22.5 degree angles. Note that the angles resulting aren't right on the desired target due to the 1/64th measurement increment.

Once you're ready to go on, back off the sled and raise the saw blade. Making sure the sled runners are engaged in the miter gauge slots, cut the sled into two pieces. If you started with a 30" sled base, the left section will be about 20" long and the right will be 10" long. The left section becomes your sled. The right remains stationary in use and provides a place for your stop blocks.

Make sure the 18" long x 1.5" wide x 3/4" thick piece of hardwood is straight along its length and has the edge square with the face. This is your miter fence. Drill and countersink a hole for a screw 1 ½" from the end to go closest to the blade. Drill a second hole through the piece about 1 ½" in from the other end. Make the second hole larger than the first so that you can start a screw in the center of the hole to leave room for adjustment; about a 5/16" hole will probably be large enough.

Place this fence on the base with the leading edge along the line you just drew and its right end at or near the saw kerf; then fasten the right end of the fence using a 1 1/4" screw. Center a screw in the hole on the left end of the fence with a flat washer and tighten. Make sure to align the leading edge of the fence to the pencil line as you snug up the screws.

Now for the right side of the sled: The right side of the sled is free to move forward and back, but you'll mostly leave it at the in feed end of the table where the stop blocks will be handy to set the work piece and will be out of the way when the cut is made; thus, not trapping the segment.
You can make a stop block system with two blocks. One is stationary and the other moves in and out perpendicular to the saw kerf. The stationary block is attached with screws from the underside of the base and serves as a reference to keep the movable block square with the saw kerf. Figure 3 shows its location. Aligning it with the edge of the base assures that it is square with the sled.

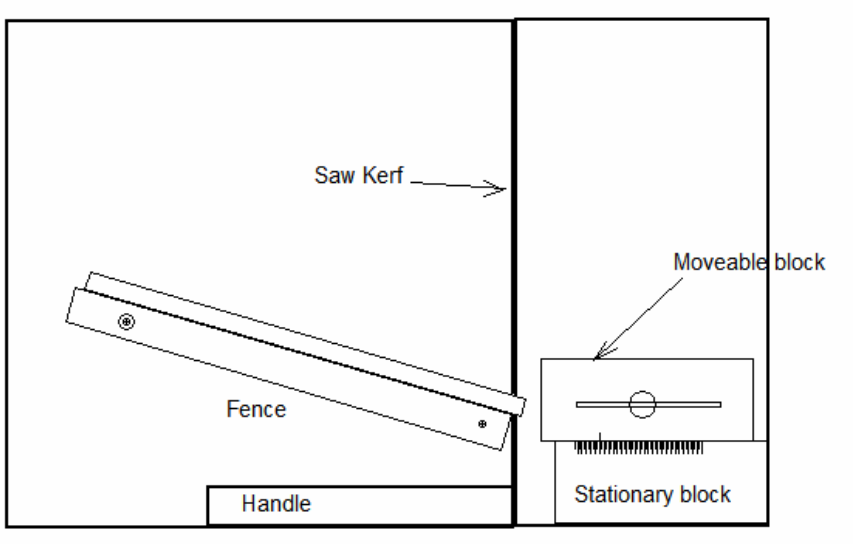

Figure 3 Stop block configuration.

The stop block assembly in this design is made up of two pieces, 1/2" x 3" by 9". The movable block needs to have a ¼" x 6" slot centered along its length in both directions. See Figure 4.

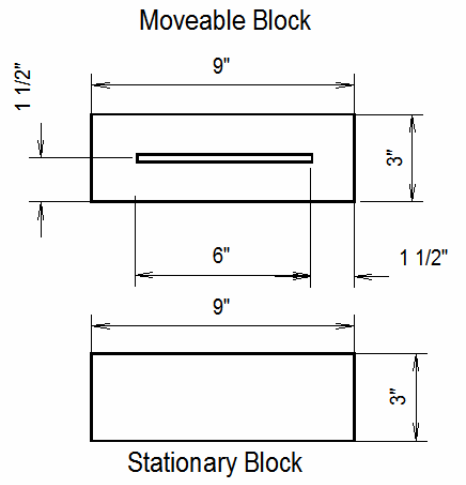

Figure 4. Stop block members

The movable stop block requires a fixing mechanism. Locate a hole in the base by placing the movable block against the stationary block and determining the hole's placement. With the block members in Figure 4, a hole in the base about 6 ½" from the saw kerf will permit cutting 5" segments. For the movable block to maintain contact with the stationary block, the hole needs to be placed so that it is centered front to back in the slot. This is best done by using the movable block as a pattern.

Once you have the hole location marked, drill and tap it for a ¼" machine screw thread. It is sometimes helpful to use CA glue to harden the threads in wood after you've threaded it. If you do this, wait until the glue is hardened (don't use accelerator) and run the tap through it again to loosen the threads. Use a wingnut with a washer to tighten the moveable block once set.

It is important to remember when setting up a stop block that its business end (i.e., the end which will 'stop' the work piece) needs to be parallel to the saw kerf. This will permit setting the work piece against any part of the stop block face and get the same segment length. This is a labor saving device since trying to stop the pointed end of a segment against a non-parallel edge will require unnecessary concentration and dexterity.

The movable block can be set by measuring the segment length along the fence to the edge of the block. To do this, align the rule along the fence with the end at the corner of the movable block.

With the use of a computer and spreadsheet, the setback distance (i.e., the distance from the saw kerf to the stop block) for each segment length can be computed directly using the formula:

D = SL x Cosine(Ca)

Where: SL is the segment length desired
Ca is the cut angle (which is the angle of the fence with reference to the blade.

Either block can have a scale with the other having an index mark so that the segment length can be set quickly. This method is easier to set up and is recommended if you have access to a computer. It's a lot easier to measure from the saw kerf to the stop block than it is to measure along the fence angle.

Now it's time to calibrate your miter fence. Set the stop block about 1 ½" from the kerf. Using the first test piece; cut the 12 segments for your first ring. Assemble the segments into a ring and tighten a hose clamp to bring them together. Hold the ring up to the light. Inspect for gaps in the ring. If you're lucky you won't see any, but more likely there will be gaps (hopefully small ones) either on the inside or outside of the ring.

If there is a gap on the inside of the ring, you'll need to decrease the angle of your fence. If it's on the outside, increase the angle. This is done by lightly tapping on the edge of the fence at the left end (near the large hole with the washer and screw). Use a light

hammer and block of wood. To decrease the angle, tap the end of the leading edge. To increase the angle, tap the trailing edge. Tap very lightly. It won't take much to close the gap. You won't tap directly on the leading edge since that will be your reference edge for cutting segments.

Now cut another 12 segments and repeat the inspection process. Repeat this procedure until the segments close with no gaps. Then carefully drill and countersink two more holes in the fence and fasten it to the base with screws. Now cut one final test piece to make sure that fastening the fence down didn't cause it to move.

If you've decided to make the sled accommodate more than one angle, you'll be putting on and taking off the fence. It's a good practice to recalibrate the fence each time it's moved. This is done by following the above procedure. If you've scribed the mark for a given angle accurately, the calibration process should go quickly.

Now using the second piece of fence wood, drill and countersink three equally spaced holes about 3/8" from one edge on the face. See Figure 5. Using three 1 5/8" drywall screws, attach this piece to the leading edge of your fence at 90 degrees so that the fence is now two pieces forming an "L". Leave about ¾" overlapping the saw kerf. Raise the blade ¾" above the table and cut through the new part of the fence. This will make an overhang to contain the segments once cut and until you're able to pull them away from the blade. It will also serve somewhat as a blade guard.

Once you're sure of the fence location, use your scribe to scratch a mark along the leading edge of the fence to facilitate returning the fence to that position if it ever needs to be removed.

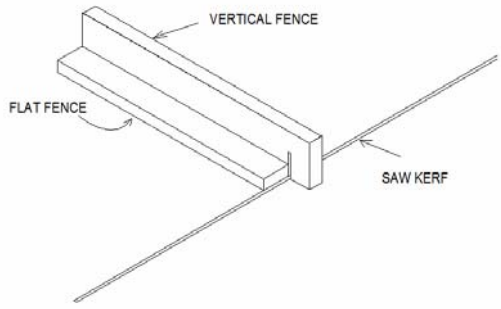

Figure 5. Vertical fence installed.

Add a handle to the sled. A 12" piece of 2x4 with the edges chamfered should be attached to the sled with screws from underneath. See Figure 6 for placement.

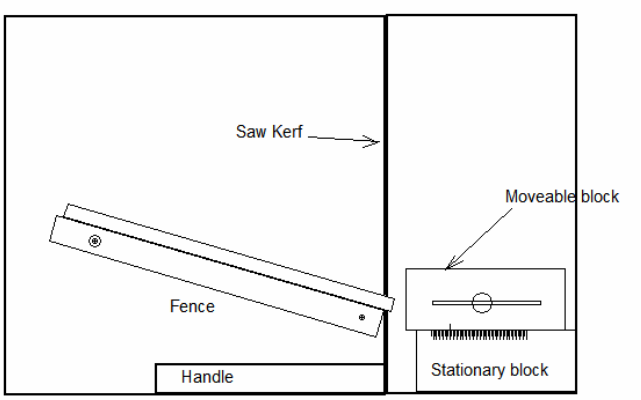

Figure 6. Location of handle

With the exception of the base material, this sled can be made with scrap wood from around the shop or from readily available hardwood. The overall cost should be less than $25. Once set up, this sled can be as accurate as the more expensive miter gauges and more reliable and accurate than your standard one.

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