Segment Cutting Sleds

Version 1.0.0

The basic principle of Segmented Wood Turning is that the work is made up of many segments. The key to fast and accurate segmenting is a good segment cutting sled. This paper gives directions for two different sled designs.

Part of

The SegMaster Series

The SegMaster Series is a set of short articles provided for woodworkers interested in Segmented Wood Turning. They are short, concise, and filled with tips and techniques that readers may or may not have thought of themselves. They maximize photos and illustrations and can be skimmed quickly or read slowly and studied. They can be printed, taken to the shop, and used as tutorials. Please enjoy them and let me know how they can be improved.

Written By

The SegMaster

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Segment Cutting Sleds

I am a table saw guy. My father had a table saw and that is what I learned on. I realize that there are many woodturners out there who prefer a radial saw or a chop saw. All I can say is “Go for it.”. But I will be focusing on the table saw because it is what I know.

I will tell you how to make two sled styles. With either sled type, when I have cut the segments for a ring, there is no sanding of the edges that will be glued, and I generally do not bother to “dry fit” my segments. They almost always fit well enough on the first try.

My favorite sled type is one that I build onto an Incra V-120 Miter guide. The disadvantage, of course, is that this requires one of these guides and then run upwards of a hundred bucks. The advantages are as follows:

- It takes minimal material to for each sled.
- Between uses, the sleds are easily removed from the Miter Gauge. They are small and can be stored efficiently. It is easy to have a collection of sleds for every cutting angle. I do.
- You can build one in just a few minutes. Angle measurement is built into the Miter Gauge.

Fortunately, it is not all that difficult to build a segment cutting sled without using the V120. It uses a bit more material and takes a bit longer. It also requires precise angle measurement. Fortunately, I provide a method for precise angle measurement using a few meter sticks that you can get from Harbor Freight for $3 each. It is even easier if you have a 3D Printer.

Blade Selection

I use 7 ½ or 8” blades on my 10” table saw when I am cutting segments. I always use blades with 40 or so teeth. I prefer these because:

- They are thin and do not waste as much expensive material.
- They are inexpensive.
- The large number of teeth give me smooth cuts.
- There is much less blade spinning near my fingers; less sticking out over the work.
- Spin-down is faster than with a larger blade.

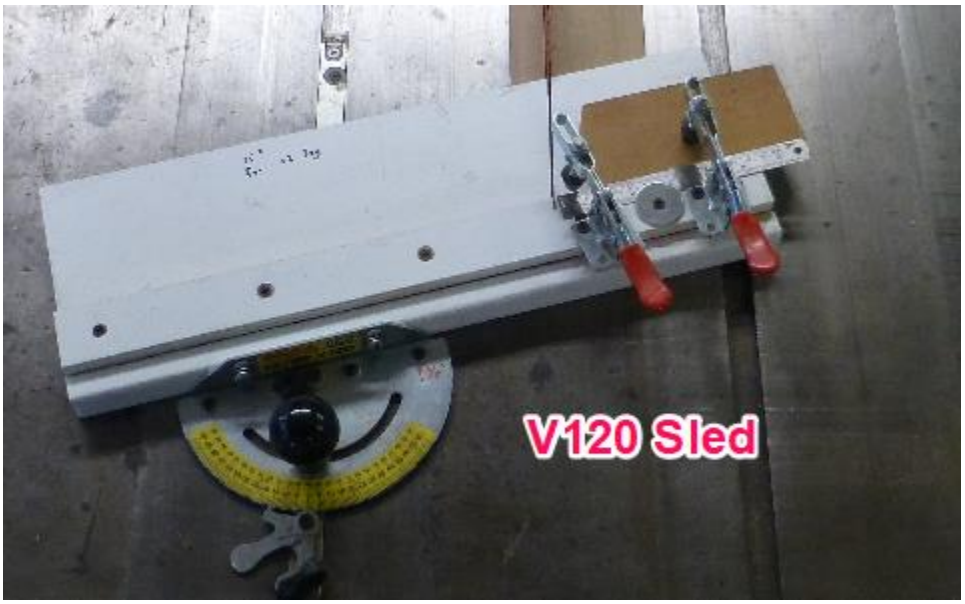
This is a matter of personal choice. Everyone else I know uses full sized blades.

Two Sled Designs

I make two styles of sleds – both for the Table Saw. One requires an Incra V120 miter gauge (~$100). The other uses the square miter gauge that comes with most table saws.

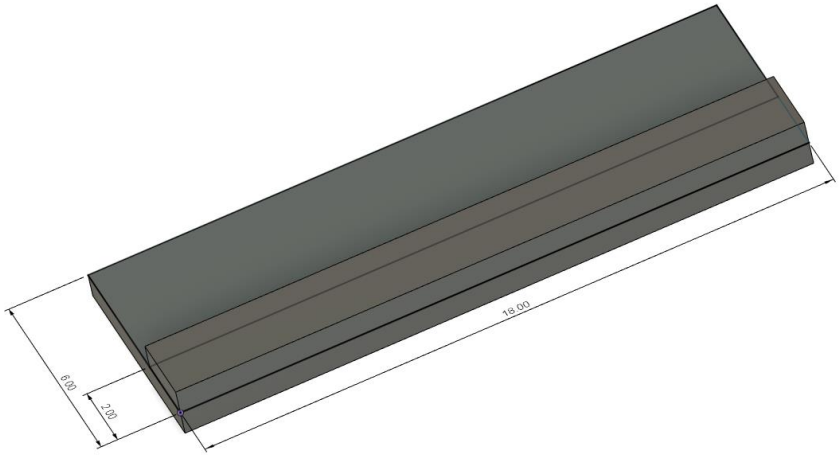
V120 Sled

You will make a sled that uses the precise angles in a V120 sled. Before you start, make sure that your V120 is exactly square to your saw blade and that it does not wobble in the track on your table saw. In other words, go through the recommended setup for the V120. You will be making a sled similar to the one shown below.



Start with a piece of high quality ¾ inch hardwood plywood 6” x 18”. Cut another ¾ inch piece that is 2” x 18”. Screw, clamp and glue the 2” board to the 6” board.

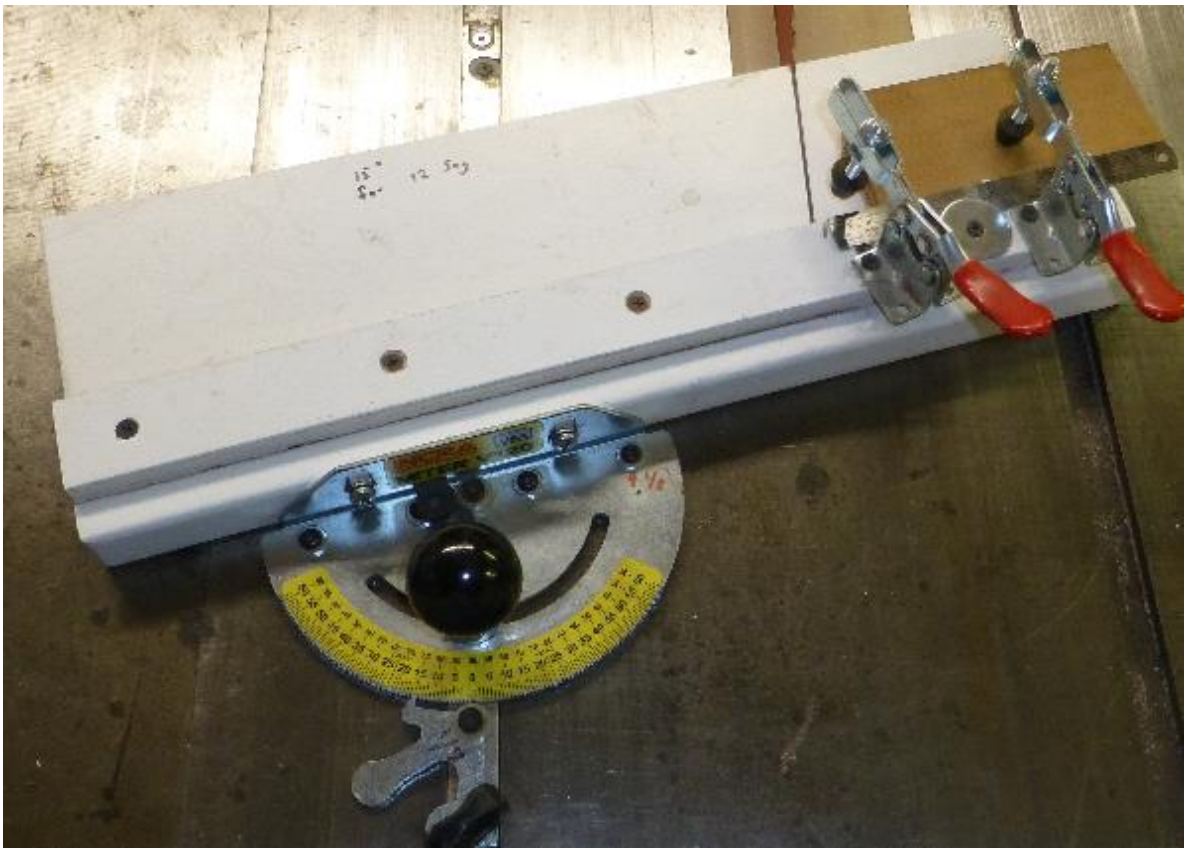
You want a direct connection from the highly accurate V120 fence, through the perfectly parallel 2” *guide board* to the piece / segment you are cutting. Let the 2” board overhang the 6” board ever so slightly so that the 2” board, rather than the 6” board is in contact with the miter fence.



Adjust the V120 for the angle you wish to cut. This will be 15 ° for 12 segment bowls.

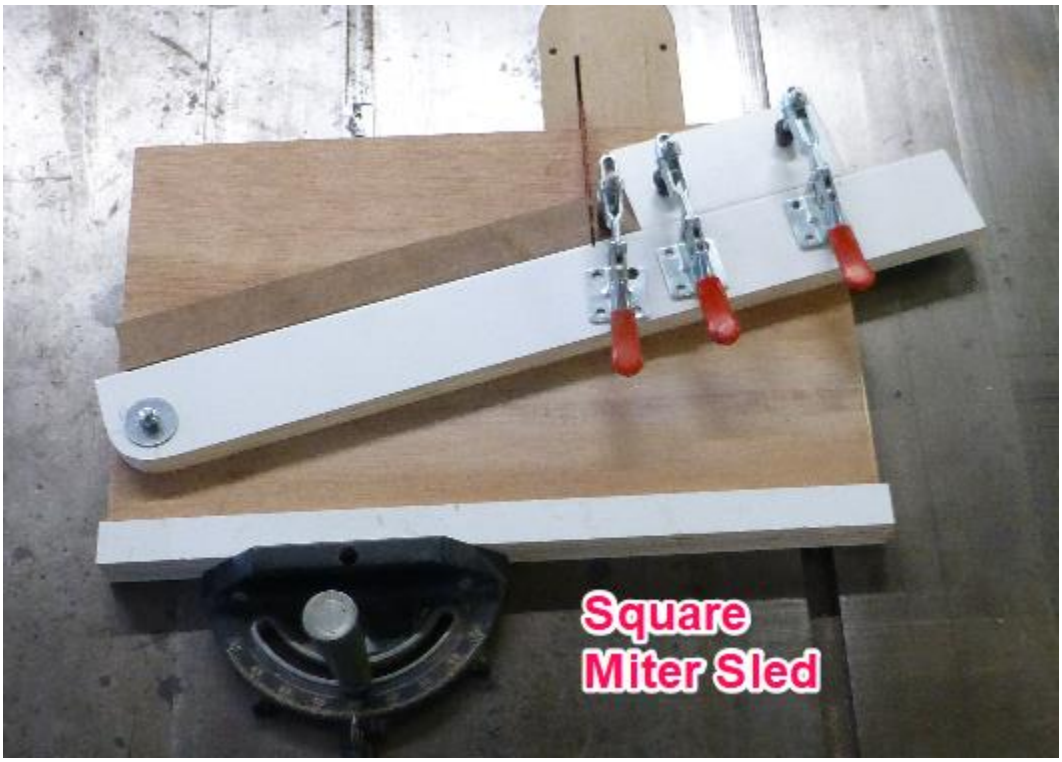
Place the sled against the V120 approximately as shown below. Secure it loosely with two appropriate Sheet Metal type screws. Slide the sled to the left, hard against the screws and tighten the screws. (This allows you to mount the sled in exactly the same position next time you re-attach it.)

Fasten two or three hold down clamps as shown. One will hold a stop block and the other will hold the segment while it is being cut. I use a single 1 3/8” sheetrock screw to hold each clamp.



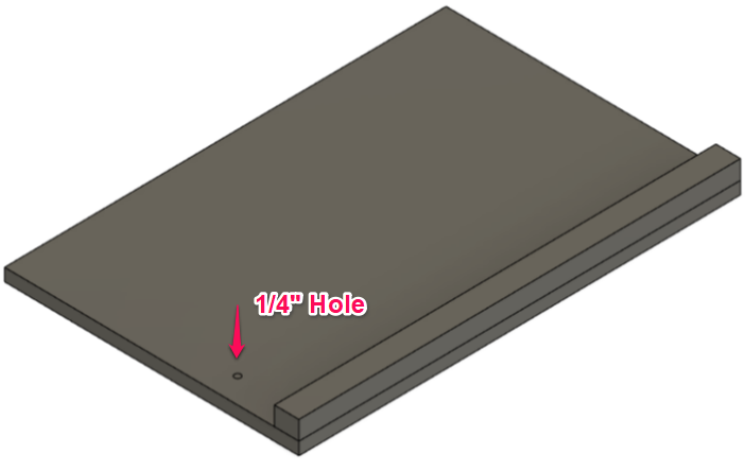
Square Miter Sled

The Square Miter Sled uses the miter fence that most likely came with your table saw. Make sure that it is set to a perfect right angle to your blade.



To make this sled, start with the following pieces cut from high quality ¾" plywood:

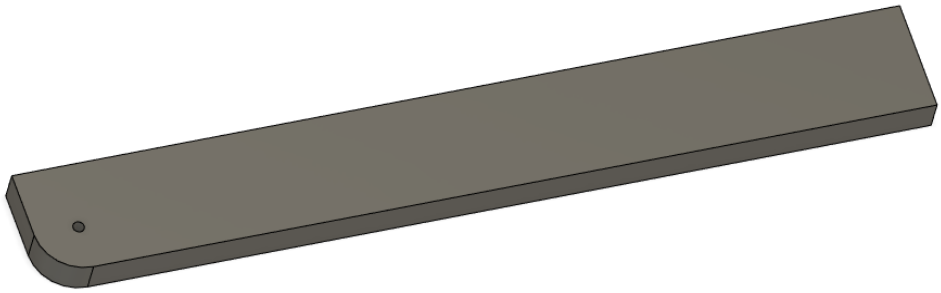
- 18" x 12" (Base)
- 18" x 1" (Reference Bar)
- 2.5" x 22 (Guide Bar)



Position the base so that one long edge is closest to you. Drill a ¼" hole through the base 1" from the left side and 3.5" up from the edge closest to you. Countersink the bottom. Secure the reference bar along that closest edge. Use screws at the ends. Glue, clamp and let set.

You want a direct connection from the highly accurate V120 fence, through the perfectly parallel 2" *reference board* to the piece / segment you are cutting. Let the 2" board overhang the 6" board ever so slightly so that the 2" board, rather than the 6" board is in contact with the miter fence.

Next, position the guide bar so that it is running left to right. Drill a ¼” hole 1” from the left and 1” from the edge closest to you. Round that corner to a 1” radius.



Secure the guide bar to the base using a ¼” bolt. Secure it with a nut – preferably a wing nut. Tighten it enough so that you can move the reference bar but it will stay where you set it.

I establish the correct angle using three metric yardsticks as follows.

Measure Accurate Angles

If you have access to a 3D printer, print an angle gauge for the angle you want. If you do not have a 3D printer, use this Meter Stick Method.

The Meter Stick Method

For this method, you need three meter sticks available from Harbor Freight: https://www.harborfreight.com/40-in-aluminum-ruler-69366.html or equivalent. They must have a Centimeters scale.

Run a 5/16” bolt through the holes in two of the meter sticks at the 100 cm mark and snug them. It is also good to round the corners at the 100 cm end. Do not round the corners at the Zero end.

Spread the angle legs to the approximate angle you want.

Use the remaining meter stick as the M*easurement leg.* Position this so that you can set the distance between the ends of the angle legs to the amount specified in the chart (26.11 cm for 15 °).

Setting the Measurement Leg:

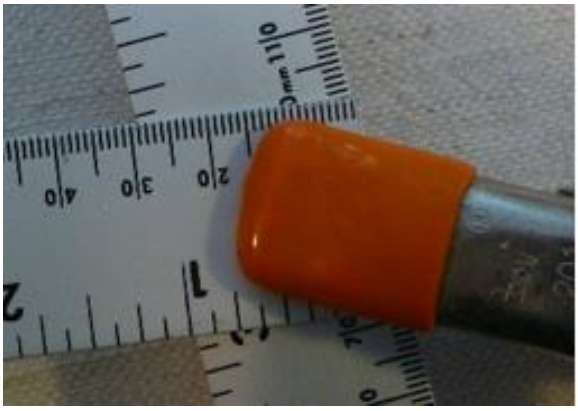
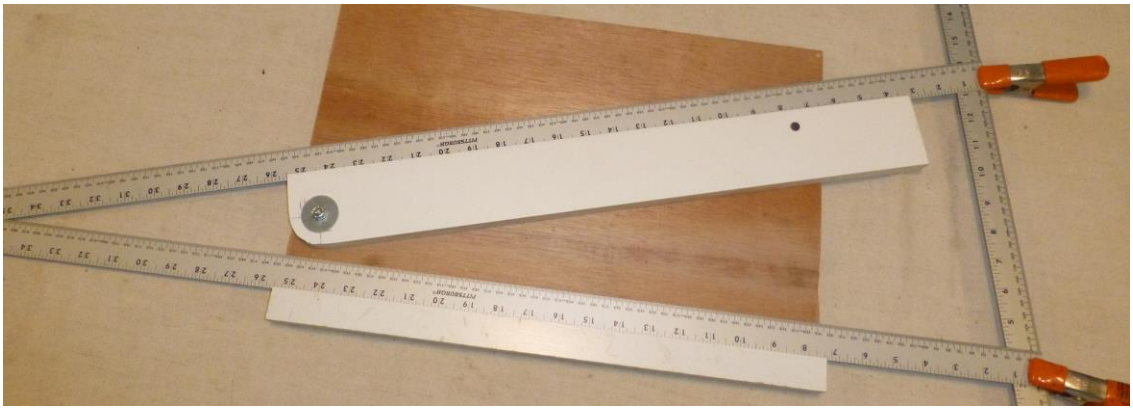


Chart for measurements:

Segments	Angle	Length
5	36	61.81
6	30	51.77
7	25.71	44.50
8	22.5	39.02
9	20	34.73
10	18	31.29
12	15	26.11
15	12	20.91
16	11.25	19.61
18	10	17.43
20	9	15.69
24	7.5	13.08
30	6	10.47
36	5	8.72

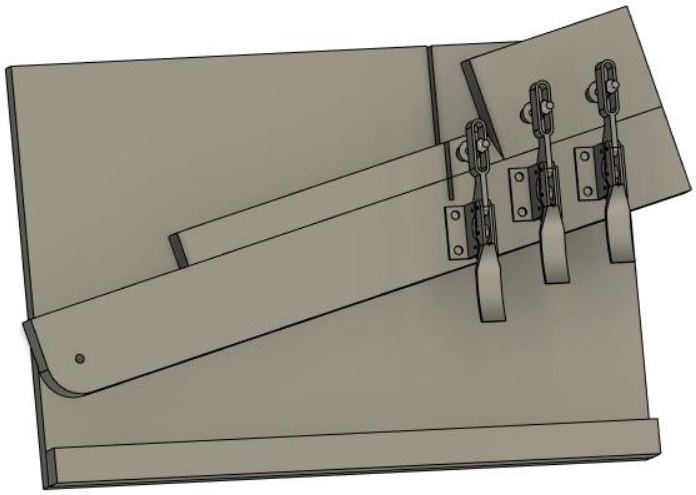
Position the measurement leg so that the cm scale is opposite the pivot point. I position one of the angle legs so that the end point is over the 10 cm mark and the other is the specified distance away. For a 12-segment ring, the other angle leg is at the 36.11 cm mark(10 + 26.11). I use the 10 cm point rather than the zero point because this gives me a bit of ruler to clamp to. I use a spring clamp to set the position perfectly. It usually takes a couple of back and forth tries before both positions are set perfectly. The acute angle will now be perfectly set to the angle you want – 15 ° for a 12-segment ring. Use the meter sticks to exactly set the angle on the sled.



Final Sled Assembly

Next, put our miter gauge into the slot on your table saw and then place the sled such that there will be about 6” of area to the right of your saw blade. Secure the sled to the miter gauge using a couple of screws to hold it securely. Cut into the sled as shown below

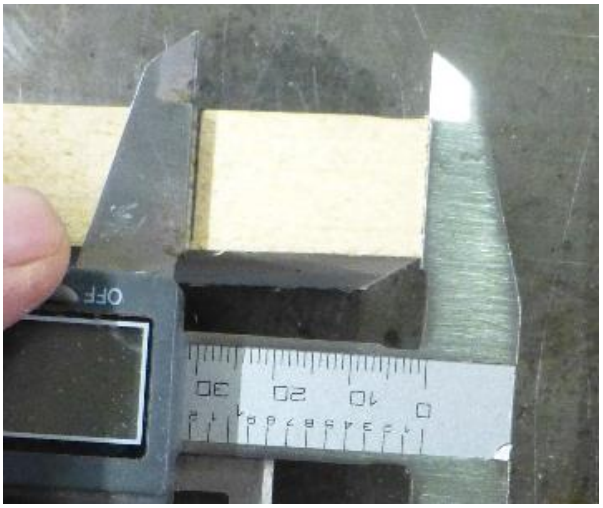
Add hold-down clamps. I use GH-201B clamps from Amazon.



Cut Your First Segment

The “stock” you use for your segments should already be cut from ¾” wood to the segment width that you need. Use your sled to trim one end to the angle on your sled.

Adjust your 6” calipers to the segment length desired. Make a mark on the stock as shown.



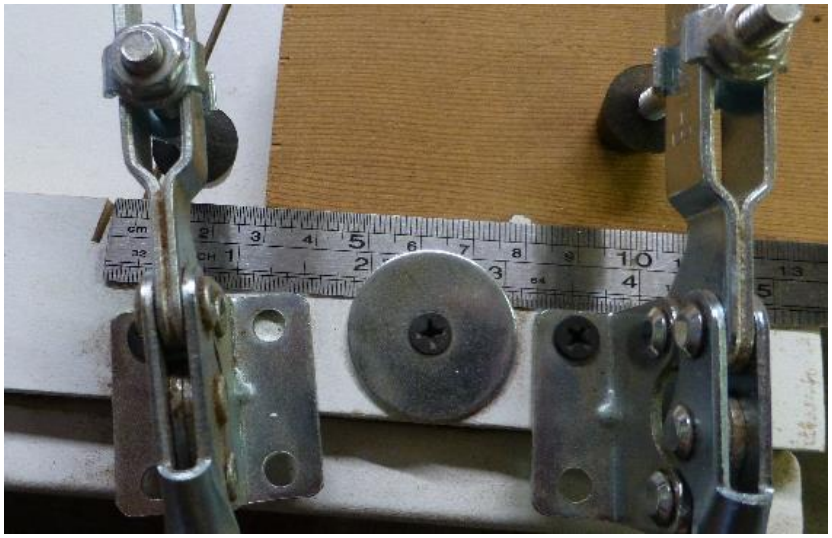
Place this stock on your sled and adjust the stop block. Clamp everything into position using the hold-down clamps:

After cutting the segment, use precision calipers to measure its length. If it is not the length you want, adjust the stop block and cut another segment. Keep doing this until you get it close enough. I am generally satisfied with +/- 0.02 inches.

Cut the other segments and proceed to glue them together.

Additional thoughts and notes.

Build a Ruler into the Sled



I ordered a set of 12 stainless steel 6” rulers from Amazon. These have a metric scale on one edge. I install one on each sled. This makes it faster to set the stop block.

I use the 6” calipers to convert from inches to centimeters. I adjust the calipers to the number of inches I want. I then convert the scale on the calipers to CM. That gives me the length in CM which I use to set my stop block.

To calibrate the ruler, I start by putting the stop block to cut a segment of about an inch or so. I cut the segment. I then measure the segment in cm. I then set the ruler to the measurement that I got on the segment. This is rather “backwards”, but it is much easier.

Advantages to the V120 Model of Sled

I much prefer making V120 sleds for the following reasons:

- It takes minimal material to for each sled.
- You can build one in just a few minutes.
- Angle measurement is built into the Miter Gauge. No messing around with meter sticks.
- Between uses, the sleds are removed from the Miter Gauge. They are small and can be stored efficiently. It is easy to have a collection of sleds for every cutting angle adding more as you need them. I also remove the clamps from stored sleds so that I can use them on other sleds.
- By using a wider sled, you can make one that works for several different angles. Reposition the sled at a different location on the V120 miter gauge and adjust the V120 to a different angle. Just be sure to move the sled far enough on the miter gauge to avoid the cuts intersecting.

The only disadvantage is the cost of the V120 – about $100.

Fractional Angles on the V120

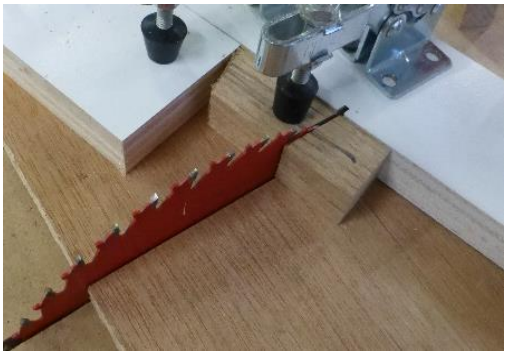
The V120 sled has notches every degree, so it is easy to set it to any integer angle up to 45°. (except for 22 and 23 since it is notched at 22 ½ ° for 8 segment bowls). But it is also pretty easy to set it for half degrees, such as 7.5 ° which is needed for 24 segment bowls. Just position the blade at the top of a notch (rather than the valley) as shown in the photo. And If you want 11 ¼° (needed for 16 segment rings), position the blade half-way down the side of the notch.

Nothing Magic About my Dimensions

By this point, you will have realized that there is nothing magical about any of the dimensions I have given you. They can be adjusted base on the material you have on hand or to your preferences. I provided specific dimensions that work for me though I often vary them based on scrap material I have on hand.

Table vs Chop Saw

I am a table saw guy. My father had a table saw and that is what I learned on. I realize that there are many woodturners out there who prefer a radial saw or a chop saw. All I can say is “Go for it.”. But I focus on the table saw because it is what I know. And keep your fingers away from that blade. Chop saws scare me. Also, using a 7 ½” blade helps.



The accompanying photo shows the cutting of the last segment from stock that is just long enough. Notice that the segment is clamped in place. No fingers are anywhere nearby. It took just a second or two to set up this cut which I did with the segment well away from the blade.

Use 8" Blades

I use 7 ½ or 8" blades on my 10" table saw when I am cutting segments. I always use blades with 40 or so teeth. I prefer these because:

- They are thin and do not waste as much expensive material.
- Blades are inexpensive.
- The large number of teeth give me smooth cuts.
- There is much less blade spinning near my fingers; less sticking out over the work.
- They spin up and spin down faster.

But, by all means, this is a matter of personal choice. Everyone else I know uses full sized blades.

Edge Alignment is Critical

Edge alignment is critical when gluing the reference boards to the base boards.

You want a direct connection from the highly accurate V120 fence, through the perfectly parallel 2" *guide or reference board* to the piece / segment you are cutting. Let the 2" board overhang the base of your sled ever so slightly so that the 2" board, rather than the 6" board is in contact with the miter fence.

Digital Protractor

When I first started segmenting, I "invested" in a Digital Protractor that was accurate to 0.3°. That is nowhere near accurate enough. Take that 0.3 ° and multiply it by the 24 cuts needed for a 12-segment ring and you are off by more than 7°. At the symposium I attended, this seemed to be an unsolved problem. This was before I figured out how to do it with yardsticks.

Just for kicks, I used my digital protractor to measure the angle that I had set on the 15° sled. I also verified this sled by cutting 12 segments from stable straight plywood and it was perfect. My digital protractor indicated an angle of 14.6°.

6" Calipers

Buy yourself a set of 6" Calipers. You can get them from Amazon or Harbor Freight for about $10. I use them all the time for many things. I have one for my desk as well as one in the shop.

Using a 3D Printer

It is only recently that I thought of using the 3D printer for angle measurement. I have the Meter Sticks and I have the table. It works well for me, even though I prefer using Incra V120 sleds. Still, I will post the Fusion 360 files and possibly some STL files for this onto http://TheSegMaster.com