

# Building a Segmented Cone

## By Les Proehl

The program I use for my Segment stuff is Woodturner PRO Ver 2.1 at [www.woodturnerpro.com](http://www.woodturnerpro.com)

**Subject:** Building a Segmented Cone

### Building a Segmented Cone

We will discuss how to build an 8 segmented ring of 6 rows from 4x4 stock. Be exact with your segmented angles. Glue lines are not liked not wanted and looks ugly. The amount of hours that are put into making segmented rings are long and turning these segmented items is fast. Your work is in the build up, not in turning.

**I use a digital caliper for all measurements.**

1. Prep stock.
2. Row 1 (bottom) cut stock at 1.562 inches ( $1 \frac{9}{16}^{\text{th}}$ ) you will need about 20 inches.
3. Row 2 – cut stock at 2.076 inches ( $2 \frac{5}{64}^{\text{th}}$ ) you will need about 24 inches.
4. Row 3 – cut stock at 2.500 inches ( $2 \frac{1}{2}$ ) you will need about 30 inches.
5. Row 4, 5 & 6 – cut stock at 1.861 inches ( $1 \frac{55}{64}^{\text{th}}$ ) you will need about 96 inches.

### Cut stock to segmented angle and length

Do math for segmented lengths and segments angles

### Segmented angle

Segmented angle equals 360 degrees divided by number of segments divided by 2

Example (360 divided by 16 = 22.5 divided by 2 = 11.25 = segmented angle)

## **Segmented length**

Diameter times Pi = circumference divided by number of segments = segmented length

Example ( $6 \times 3.1416 = 18.8496$  divided by 16 = 1.1781, I round up to 1.18 as I can not cut finer than that)

## **Tools needed to be made:**

Cutting sled for table saw

Stop block for table saw

Sanding jig for disk sander

Angle blocks for table saw and sander

Melamine circle – 8 inch & 4 inch 2 each

Using cutting sled, I made mine using  $\frac{1}{2}$  inch plywood, set adjustment arm to  $22\frac{1}{2}$  degrees. Be dead on because at 22.55 degrees you will have a lot more work to do.

I made my own angle block sets using a CNC router.

You can buy your own CNC router system for \$15,000 and up to save yourself a few dollars on angle sets or Curt will sell you a complete set for about \$200 made from aluminum or I can cut you a set on a CNC router using  $\frac{3}{4}$  MDF for about \$ 35 or so.

## **To calibrate sled using stop block:**

1. Cut one end of scrap stock at 22 ½ degrees
2. Mark stock to cut length, add about .1 inch longer than final length
3. Set up stop block for repeated cut length.
4. Cut your first segmented ring 9 segments (1 extra) you made need it or at least you have a pattern.
5. Place segments in circle and install band clamp and tighten loosely. Assure all segmented ends (outside) are even. Now tighten with modest pressure. Do not over tighten.
6. Hold segmented circle over bright light, look at segmented angle cut line; you are looking for light to sneak by the cut line. If light shows, adjust your sled and cut new stock again. Reassemble and recheck for light. This may take several attempts to get it correct, that's why we are using scrap stock and not good wood. If you use the angle blocks for set up this work will be cut down drastically.

### **Calibrate Sanding Sled**

1. Use segmented sections that were cut calibrating cutting sled.
2. You will need to sand each end of the segment using a disk sander (I use a Jet 12 inch disk sander). I have made my own jigs for the sander, Curt has a good DVD (turners library has on shelf) for this set up.

3. For sanding segments, it is recommended to use (I use) 80 grit paper.
4. Mark each cut segmented side with pencil mark from end to end; to assure that when you sand, the complete segmented cut end gets sanded. Set stop on sanding jig to the correct final length. Touch sand one edge of segment, assure full sanding of end, and then flip segment and sand to final length.
5. Place segments in circle and install band clamp and tighten loosely. Assure all segmented ends (outside edge) are even. Now tighten with modest pressure. Do not over tighten. You are not trying to hide any mis-angled sanding, you want to find it.
6. Hold circle over bright light, look at segmented angle cut line; you are looking for light to sneak by the cut line. If light shows, adjust your sanding sled and sand again, reassemble and recheck for light. This may take several attempts to get it correct, that's why we are using scrap stock and not good wood. Again using the angle block for set up will cut down your re-work.

### **Calibrating Glue Up**

1. I glue my ring into 2 halves. Do not glue up as a complete ring, as we are not that good in cutting and sanding to be a perfect fit. Remember a .01 error on each side of an 8 segment ring would be  $.01 \times 16$  would equal .16 out of round. That's a lot of glue gap.
2. I use a 5/8 inch long by 1/4 inch hard wood dowel as a spacer between segmented halves. I tape the dowel onto 2 segmented cut edges using blue tape and also on the opposing segment to assure that I will not put glue on that segmented half.

3. Assemble the circle in halves, now glue each segmented edge assuring that you have complete glue coverage on each segment. Assure that the dowels are on opposing ends to make a half circle. I use Tite Bond 3 glue as it dries darker and most of my glue up is on dark wood, helping to hide glue lines. Curt uses Tite Bond Original.
  
4. Install band clamp around segmented circle and tighten slightly. Sandwich the segmented ring between the melamine circles. Using C clamps clamp securely around melamine circle, assuring that all segmented sections are flush with each other. Now tighten band clamp TIGHT but not so tight that you break the band clamp.
  
5. Remove the C clamps and remove melamine circles from top and bottom before glue sets up. Clean up excess glue from segmented ring and melamine circle. Set aside and let dry.
  
6. After glue is dried, remove band clamp, blue tape and dowel from segmented halves. Hold the 2 halves together over bright light to see the gaps and we thought that we were perfect. HA!
  
7. Go back to the disk sander with the segmented ring halves and lightly sand to be flat on both halves, rechecking the halves with bright light, and if ok, glue and clamp.

## **Building the Cone**

When you are satisfied with your cutting, sanding, and gluing that was built from calibration stock proceed to cut, sand and glue your segmented sections. Don't forget to add to your cut length at least .1 to all cut dimensions as sanding will be required.

## **Cut segments**

Prep stock.

Row 1 (bottom) cut stock at 1.562 inches ( $1 \frac{9}{16}^{\text{th}}$ ) you will need about 20 inches.

Row 2 – cut stock at 2.076 inches ( $2 \frac{5}{64}^{\text{th}}$ ) you will need about 24 inches.

Row 3 – cut stock at 2.500 inches ( $2 \frac{1}{2}$ ) you will need about 30 inches.

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## **Sand segments**

## **Glue segments**

## **Sand rings**

When all glue up is dried, remove all clamps and sand surface on all segmented rings on both sides. I use my 25 inch drum sander for this event. I run all my segmented rings through the sander several times alternating sides at each run until any mis-alignment is sanded flat and leave a flat sanded surface for the next section of glue up.

## **Drill hole**

Using one of the large melamine circles, drill a  $\frac{3}{4}$  inch hole in the center of the large melamine circle, and mount on the tail stock. (Also drill a  $\frac{3}{4}$  inch hole in the center of the smallest circle and set aside, you will use on the small segmented rings). You will use the tail stock and melamine circle to clamp the next ring.

### **Glue up rings**

I glue up rings on my lathe using my Cole Jaw set up. Before you can glue up you must be able to center and align your segmented rings. I number each ring and mark a center line on the center of four opposing outside edges of the ring, so I can center, align and offset the segments of each ring correctly. I align the largest ring to the next largest ring. Then I turn each segmented ring set over and mark the glue area to be glued until all rings have been marked.

Mount the largest segmented ring on the Cole Jaw with no glue on it.

Now apply glue to the next ring and install on ring mounted on Cole Jaw using the center lines and glue lines. Clamp and let dry. When glue is set, glue next ring, clamp, let set and continue until all rings are completed.

### **Drill and Tap center**

When dry on small end of cone, drill center hole and tap for head stock thread. I use a  $\frac{1}{4}$  inch by 8 tap. This tap will fit on my head stock.

### **Turn Cone**

Install cone on head stock.

I turn the inside with my Lyle Jameson hollowing system.

The rest is up to you as you are all better at turning than I am. That's why I do segmented turning.