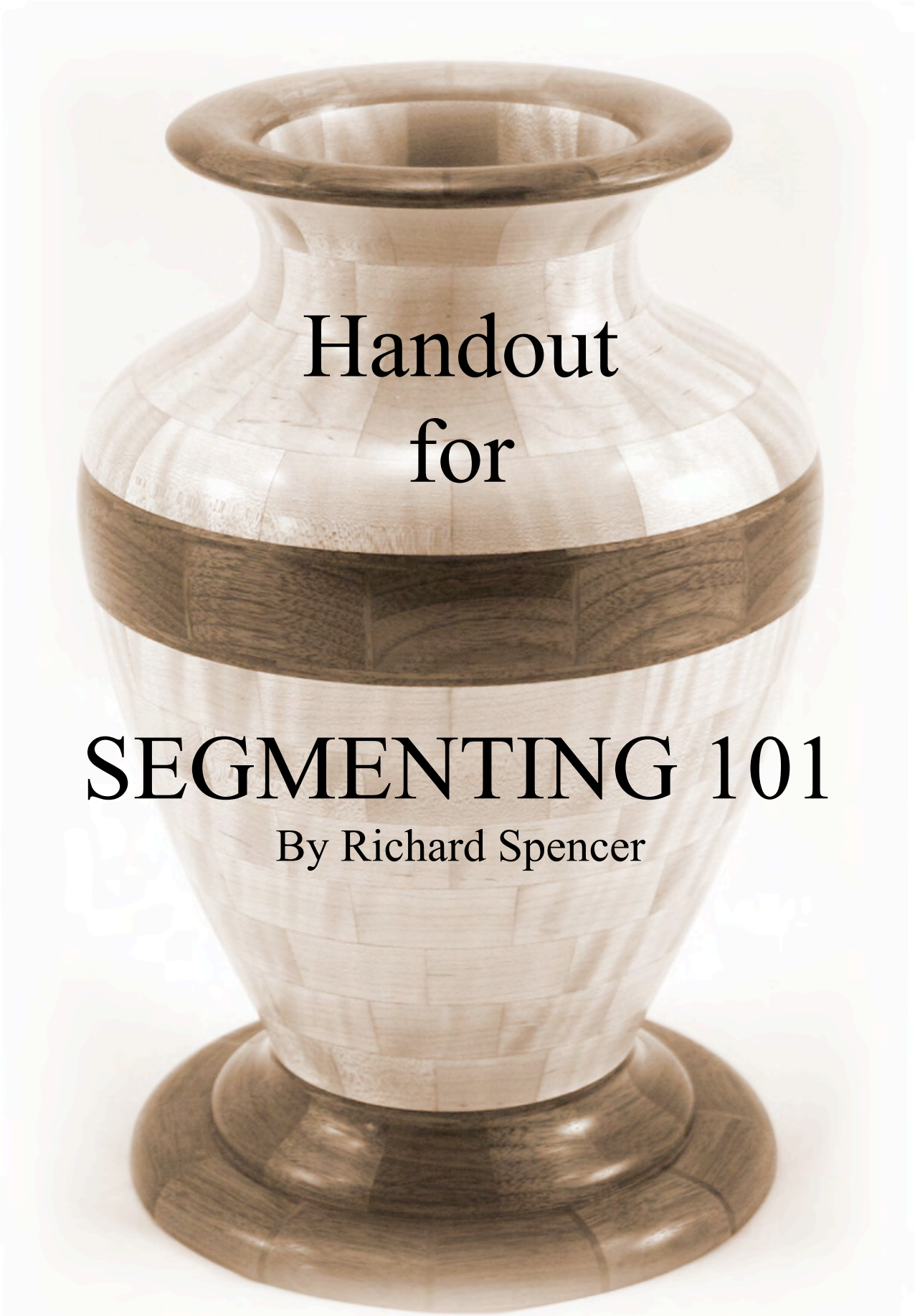


Handout for SEGMENTING 101

By Richard Spencer

Getting Started

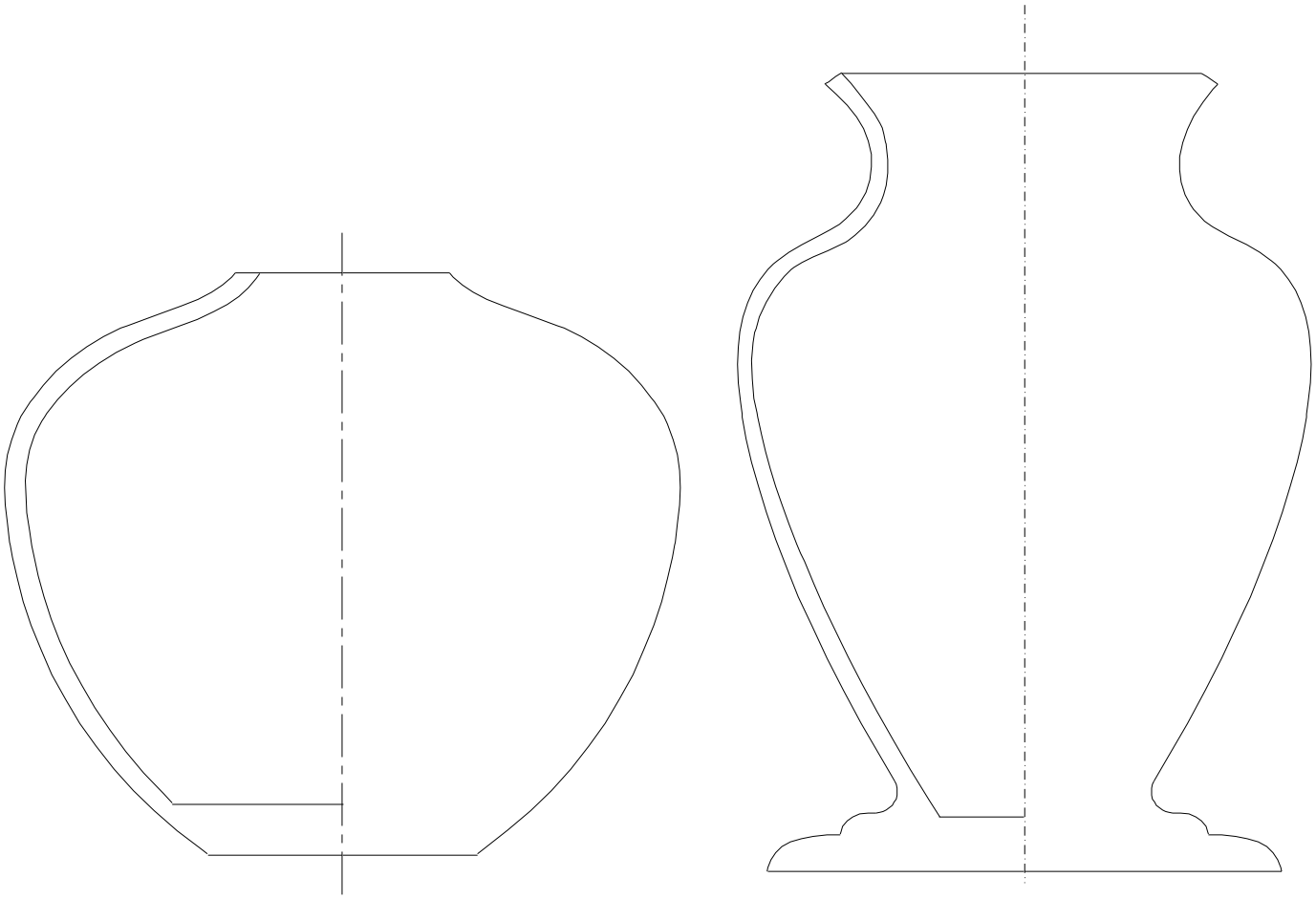
There are 8 general steps needed to complete any segmented project.

1 Pick a form you want to build.
2 Pick the wood you want to use.
3 Chose the number of segments.
4 Layout the rings.
5 Cut the segments for all rings.
6 Glue up all rings.
7 Glue the rings together.
8 Turn the piece.

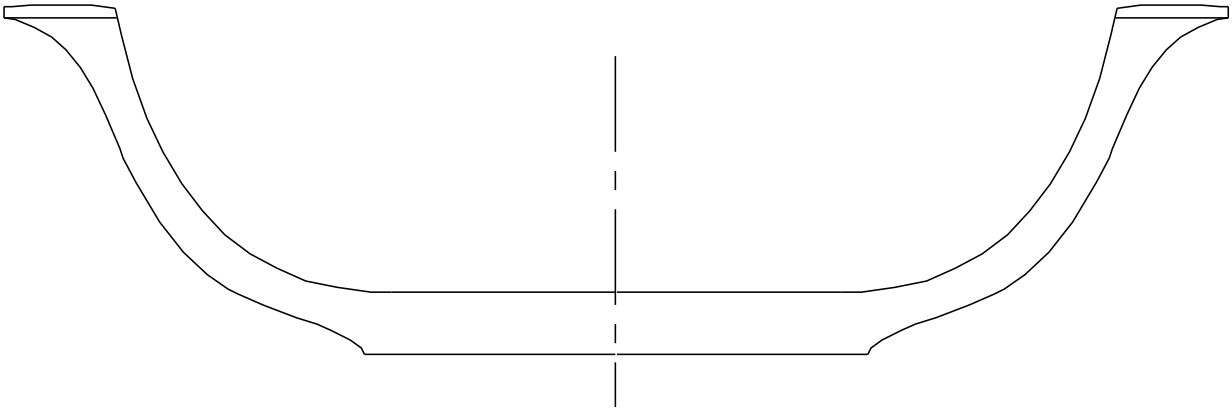
During this demo we will cover all 8, one by one.

Pick a Form

I lay out the form I want for a project on paper first. I use a CAD program but it can be done with nothing more that a sheet of graph paper. Here are some samples of forms I have built.



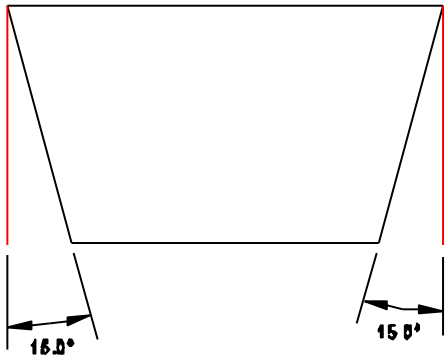
For this demo I will use a simple bowl form like this.



Pick the Number of Segments

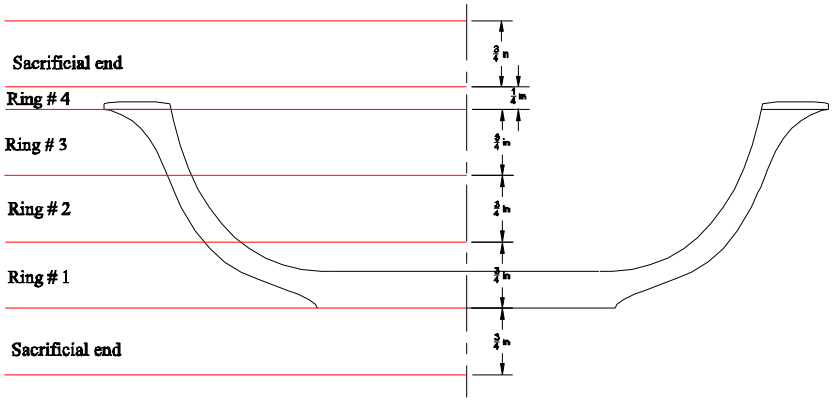
Next you need to decide how many segments you will have in each ring. You can use 6, 8, 10, 12, 16, 24, etc.

- For this demo I will use 12 segments per ring.
- I will need to cut each segment with a 15 degree angle on each side.
- If you use a different number of segments your angle will be different.

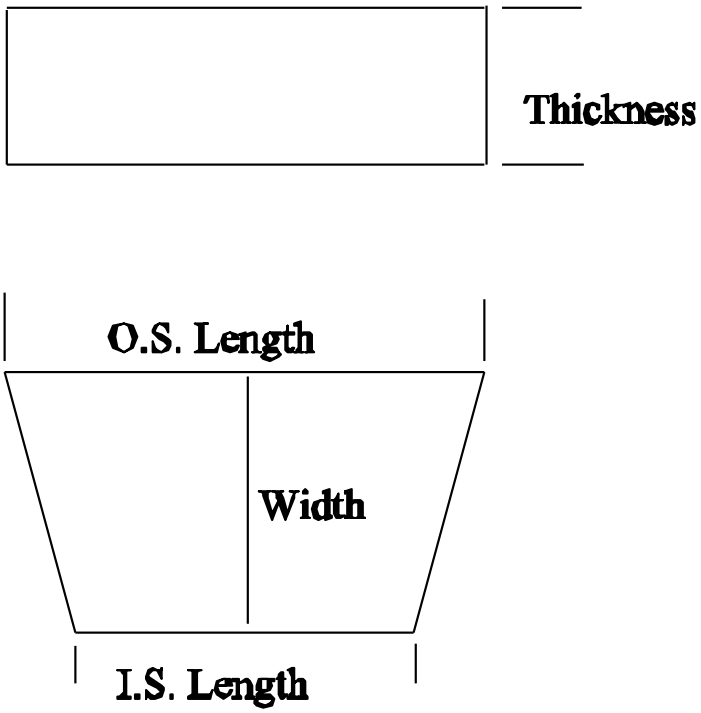


Layout the Rings

Once you have the form you want mark where the rings will land. Most rings are ¾" thick but that is not a hard, fast rule. You can design any ring to any thickness that suits you. For this demo rings 1-3 will be ¾" and the rim (ring 4) will be ¼". The sacrificial ends will be ¾" and we will talk more about them later.

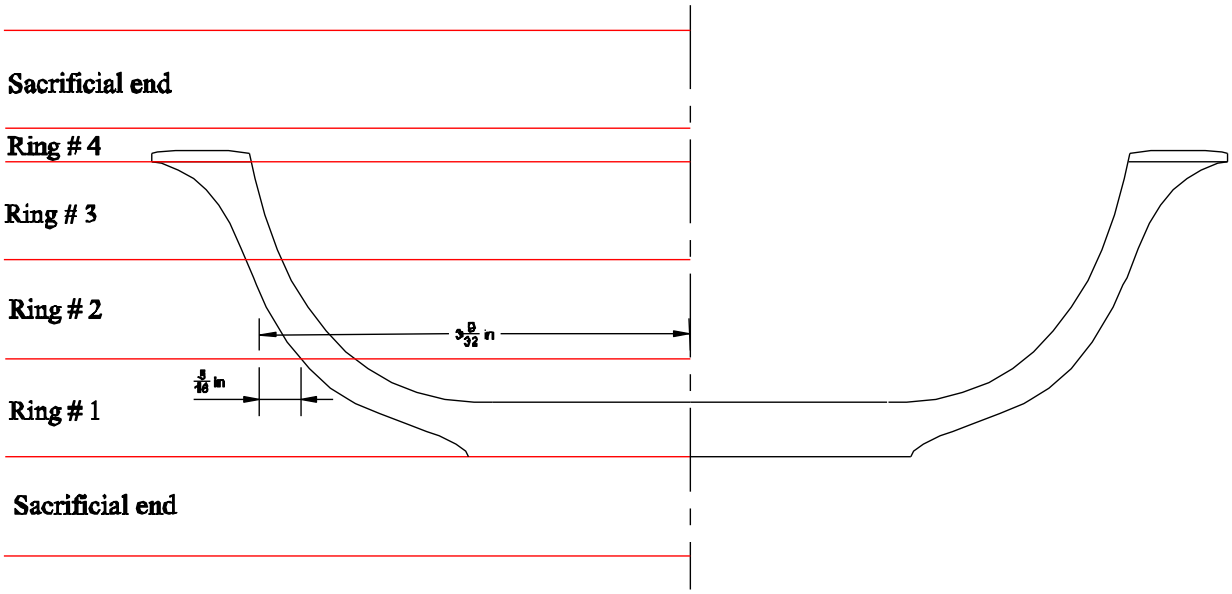


Length, width, and thickness are interchangeable in some circles, but not in segmenting. Because of the nature of segmenting the thickness must always be the vertical dimension. The outside and inside length must always be on the circumference. The width must always be on the radius. Getting any of these confused can cause the rings to be cut the wrong size.

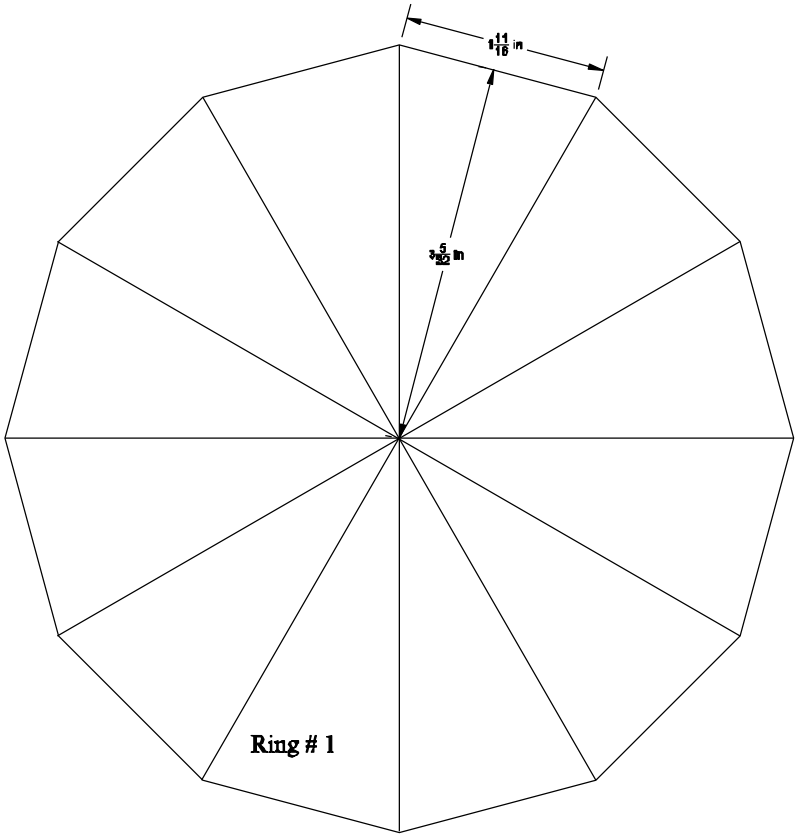


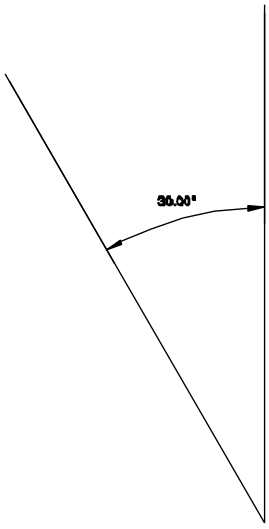
Layout Ring # 1

A polygon with 12 sides will have 12 "flat spots" so you will have to enlarge the polygon a sufficient amount so you will have enough material to turn the piece down to the correct radius. I do this by adding a fixed amount to the designed radius for each ring. The larger the radius of the ring, the larger this amount must be. To establish the outside radius for Ring 1 add 5/16" to the outside of the bowl. When you do this, you get 3 9/32".



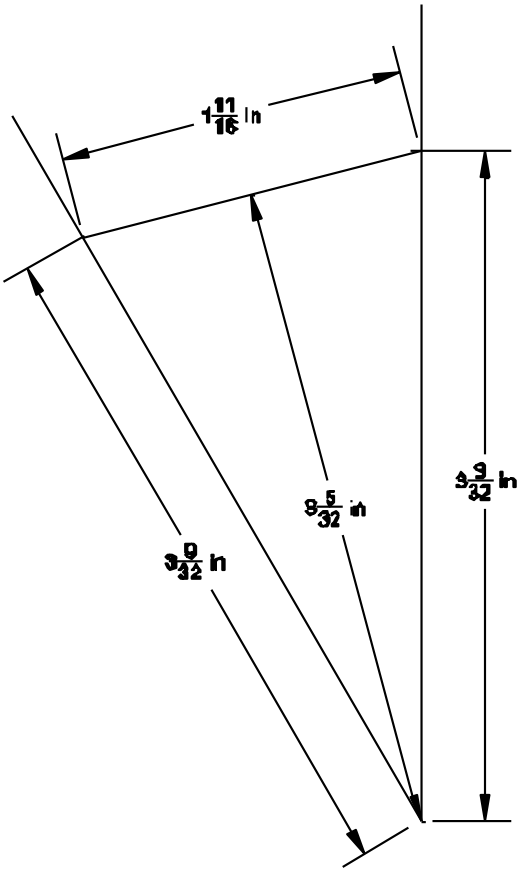
This is what Ring # 1 will look like in CAD.





You can do the same thing without a computer using a simple paper jig.

On a piece of paper layout 2 lines with the angle you need for the number of segments you are using. In this case we are using 12 segments per ring so the angle will be 30 degrees.



You know you need 3 9/32” radius so measure up the 2 legs of the paper jig with that dimension.
Measure between the 2 legs for the O.S. length of the segment. In this case it will be 1 11/16”.
Measure from the top to the bottom for the actual width of the segment. In this case it will be 9 5/32”.

Notice that the width of the segment is 3 5/32”. That is less than the 3 9/32” we laid it out with. The reason for the difference is the “flat sides” on the polygon, and that is one reason we add that 5/16” to the actual radius of the ring.

I use a table like this to record all the dimensions of all the rings. So we can now add all the

Demo Bowl							
Ring	O.S. Rad.	I.S. Rad.	Thickness	Width	O.S. Len.	I.S. Len.	Blank
1	3 9/32”	NA	3/4"	3 5/32”	1 11/16”	NA	13”
2							
3							
4							

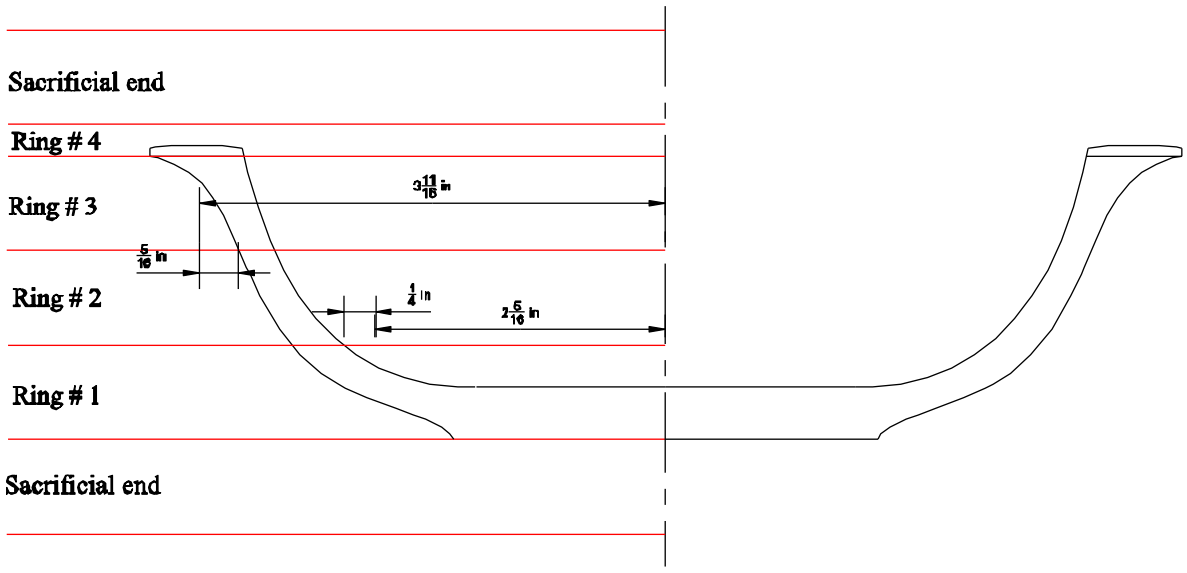
dimensions for ring # 1

Notice that the table has a column for “Blank”. This is length of the board need to cut all 12 segments from.
I figure blank length with the formula:
O.S. Length + I.S. Length + .25 x 6 = Blank Length
The outside and inside length you get from the table, the .25 is thickness of the kerf for 2 cuts on my table saw. Because all of this will make 2 segments, when you multiply it by 6 you get the actual length of the blank like this.
1 11/16” + 0” + .25 X 6 = 11 5/8”
NOTE: I always round up to the next inch and add an additional inch which make the blank for Ring # 1 = 13”

Layout Ring # 2

Ring # 2 is a little different because it will have an I.S. radius and length.
As with ring 1, add 5/16” to outside of the bowl but because ring 2 has an inside radius you will need to subtract 1/4” from the inside of the bowl. This 1/4" give you the extra material you need to turn the piece to the correct inside radius.

When you add 5/16” to the outside of the bowl you get 3 11/16” for the outside radius.
When you subtract 1/4" from the inside of the bowl you get 2 5/16”.

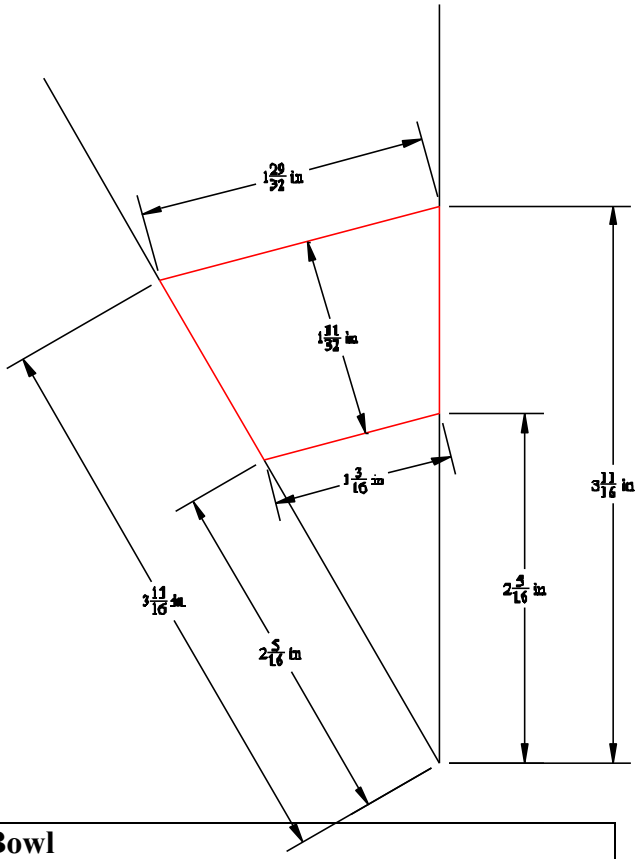


Using the paper jig with the 30 degree angle

Measure up the 2 legs of the jig with the O.S & I.S. radius of 3 11/16” and 2 5/16”.

Measure between them for the I.S. & O.S. length of the segment which will be 1 29/32” and 1 3/16”.

Measure between the lines for the actual width of the segment which will be 1 11/32”.

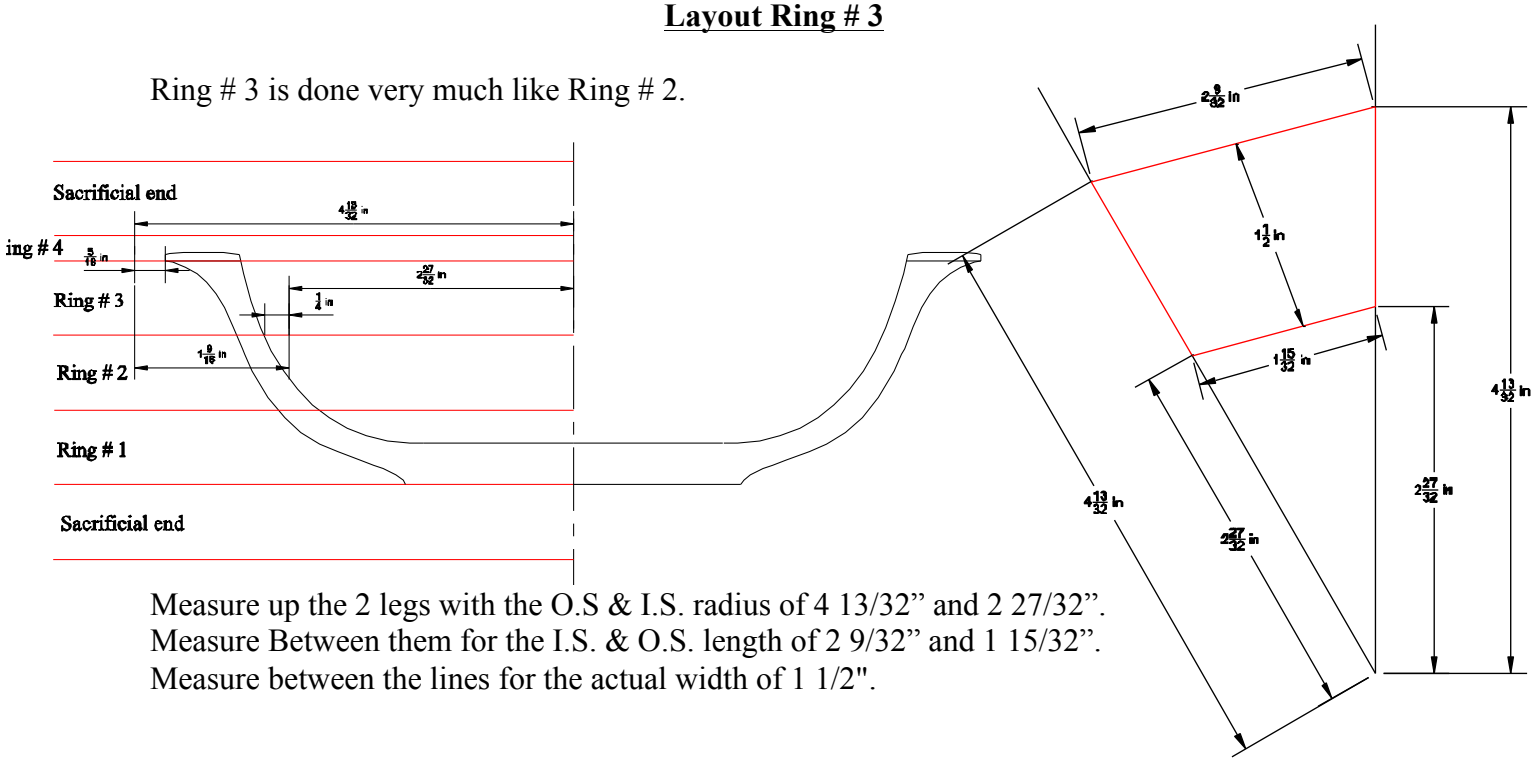


Now add the dimensions of ring # 2 to the table.

Demo Bowl							
Ring	O.S. Rad.	I.S. Rad.	Thickness	Width	O.S. Len.	I.S. Len.	Blank
1	3 9/32”	NA	3/4"	3 5/32”	1 11/16”	NA	13”
2	3 11/16”	2 5/16”	3/4"	1 11’32”	1 29/32”	1 3/16”	22”
3							
4							

Layout Ring # 3

Ring # 3 is done very much like Ring # 2.



Measure up the 2 legs with the O.S & I.S. radius of 4 13/32” and 2 27/32”.
Measure Between them for the I.S. & O.S. length of 2 9/32” and 1 15/32”.
Measure between the lines for the actual width of 1 1/2".

Add the dimensions for Ring 3 to the table.

Demo Bowl							
Ring	O.S. Rad.	I.S. Rad.	Thickness	Width	O.S. Len.	I.S. Len.	Blank
1	3 9/32”	NA	3/4"	3 5/32”	1 11/16”	NA	13”
2	3 11/16”	2 5/16”	3/4"	1 11/32”	1 29/32”	1 3/16”	22”
3	4 13/32”	2 27/32”	3/4"	1 1/2"	2 9/32”	1 15/32”	25”
4							

Layout Ring # 4

Demo Bowl							
Ring	O.S. Rad.	I.S. Rad.	Thickness	Width	O.S. Len.	I.S. Len.	Blank
1	3 9/32”	NA	3/4"	3 5/32”	1 11/16”	NA	13”
2	3 11/16”	2 5/16”	3/4"	1 11/32”	1 29/32”	1 3/16”	22”
3	4 13/32”	2 27/32”	3/4"	1 1/2"	2 9/32”	1 15/32”	25”
4	4 13/32”	2 27/32”	1/4"	1 1/2"	2 9/32”	1 15/32”	25”

Because Ring # 4 is so close to Ring # 3, I will just duplicate it with a thickness of only 1/4”.

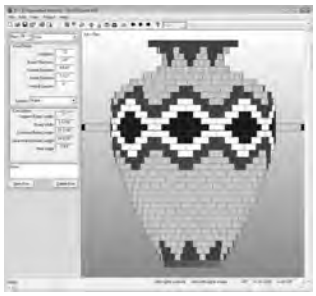
Sacrificial Ends

The sacrificial ends will be the same size and Rings 1 and 4 and they are used to hold the piece on the lathe for shaping.
Sacrificial ends can be made from any scrap material available as long as it is flat and stable. MDF is not the best choice.

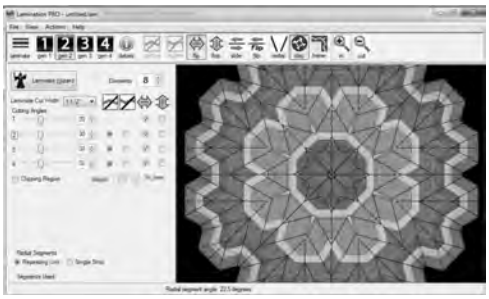
Other methods of designing segmented vessels

The method I use is only one of many.
There are manual and Computer aids available.

Wood Turner Pro



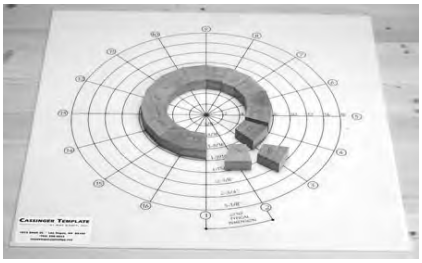
Lamination Pro



3D Design Pro

Manual aid include:

Cassinger Template



Seg-Easy Plate

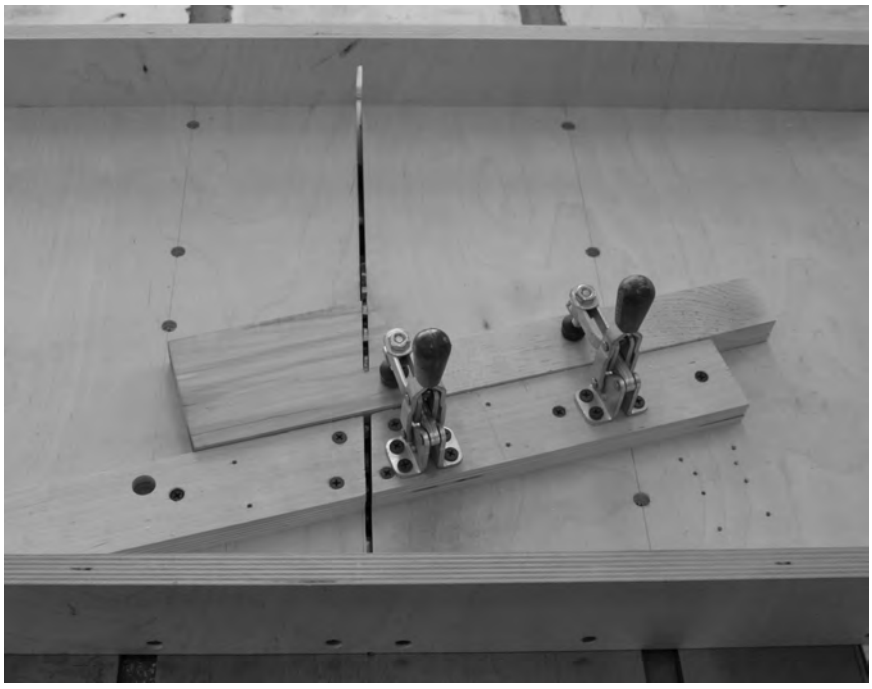
Cut the Segments

First, prepare blanks for each ring. Blanks must be completely flat with no bows or twist. If your blanks are not flat, pick a different blank. If you have any twist or bow the cut angles will not be consistent or correct and your rings will not have tight glue joints and your piece will not look good.

Once you have good blanks, cut them to width and length according to the table.

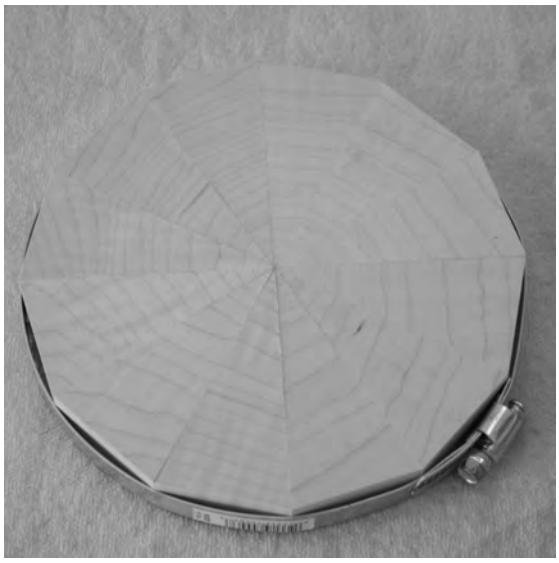
Ring # 1-- 3/4" thick, 3 5/32" wide, 13" long
Ring # 2 -- 3/4" thick, 1 11/32" wide, 22" long
Ring # 3 -- 3/4" thick, 1 1/2" wide, 25" long
Ring # 4 -- 1/4" thick, 1 1/2" wide, 25" long

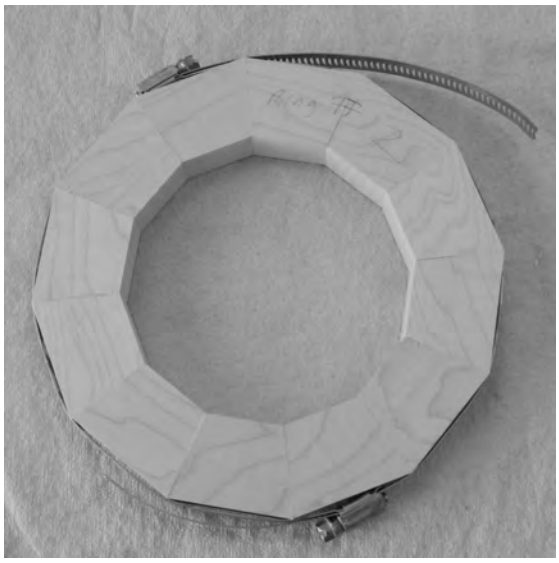
Next, cut the correct number of segments from each blank. In this case, 12.
The method and saw you use is up to you.
Make sure each angle is EXACT, close is not good enough.
I built a sled for my table saw that is EXACT.



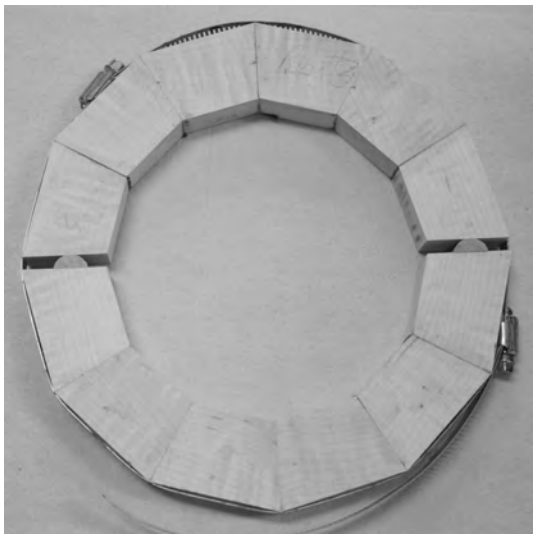
Glue up the Rings

Once you have all your segments, dry fit each ring and clamp in a hose clamp.





If your segments don't fit perfectly you can "cheat" by gluing up each half separated by "half-dowels". Do this by cutting ½" dowels in half lengthwise and then cut the length to match the thickness of the segment. Assemble the ring like the picture on the left below then apply glue to the 6 segments on each "half" with the half-dowels in between and clamp with a hose clamp. When it is dry take the hose clamp off and "flatten" each half by sanding as shown in the picture on the right. This in a large piece of MDF with 80 grit sand paper glued to it. It is difficult to get the edge "square" so I use a block that I know is square to guide the half ring. Once you are happy with both halves, apply glue and clamp.



Once all your rings are glued up, flatten them top and bottom.

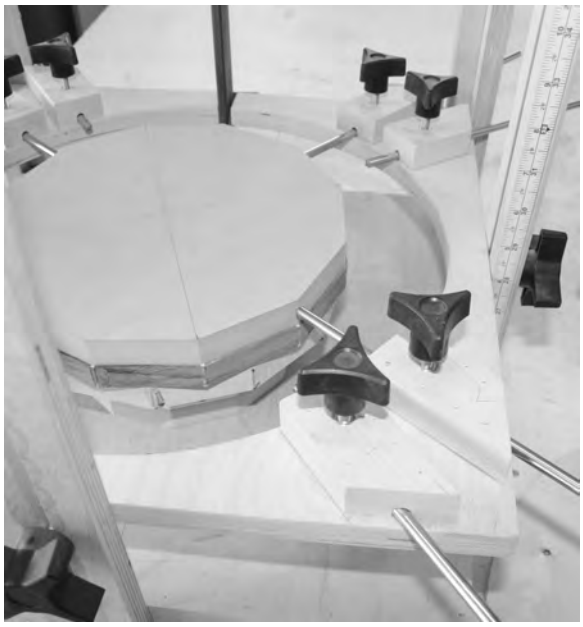
I use a power thickness sander but you can use a “Norwegian Steam Powered” one as well. This is the same piece of MDF with the 80 grit paper. Just clamp it to your bench and rotate the ring with both hands until it is flat then flip it over and do the other side. You can be sure it is flat by putting pencil lines on the face and sanding again until all the pencil lines are gone.

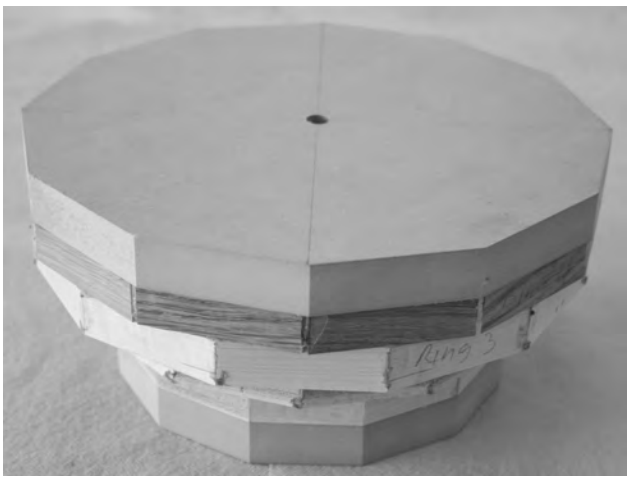
Now you are ready to glue the rings together.
There are 2 challenges to getting the rings glued together properly

- Getting them concentric.
- Getting the vertical joints lined up.

Missing either by much will hurt the look of the piece and can cause serious turning problems.

I built a jig that solves both problems at once. This jig uses 2 sets of 4 cold rolled steel rods to align each ring and keep it concentric. As I add rings, I move the rods up the jig and the bar clamp provides the clamping pressure.

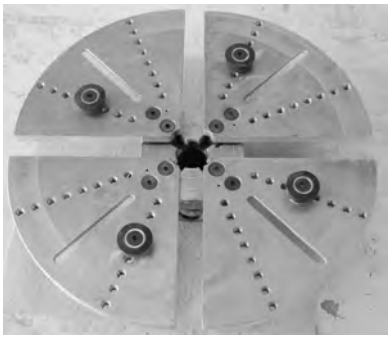




I glue a sacrificial end to the top and bottom that is the same shape as ring #’s 1 and 4. Once it is dry, it is ready to turn.

Not everyone will build a jig like this, so…
I have worked out a method that only requires a face plate, an adapter, and jumbo jaws mounted to a chuck.

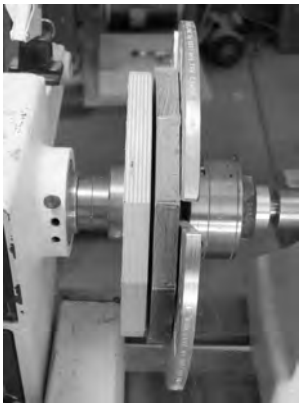




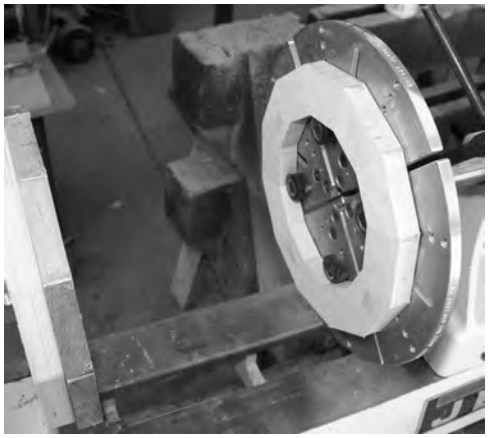
The face plate can be any size that is suitable for the piece being turned; you can even use a worm screw in a chuck for smaller pieces. The adapter has 1 ¼" X 8 tpi that matches my headstock spindle and a # 2 Morse taper which goes in the tailstock. The jumbo jaws on the chuck are mounted to the adapter.

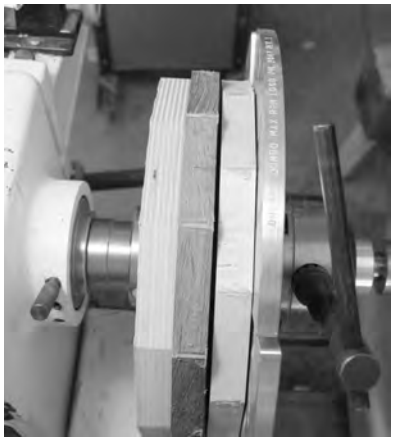
Start with the sacrificial end centered on the face plate and mounted to the headstock.
Next, attach the jumbo jaws to the adapter and mount to the tailstock.


Mount Ring 4 to the jumbo jaws. Move Ring 4 close to the headstock and adjust alignment. In this case align the edges of the segments with the sacrificial end. Next, move the tailstock back, apply double sided tape or glue, move back up, lock the tailstock and apply pressure. Wait for the glue to "tack up" before proceeding.

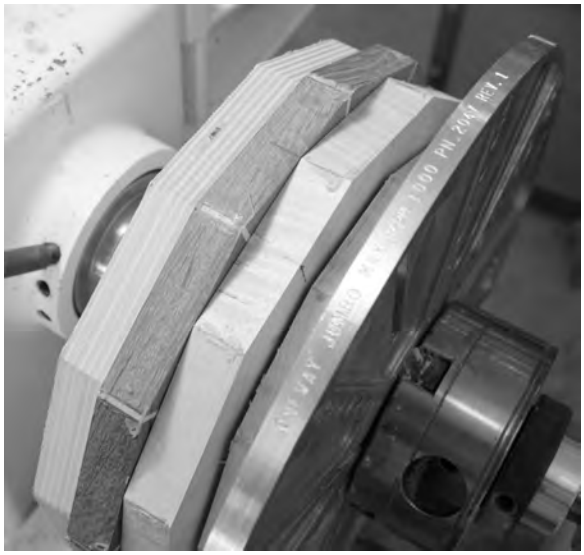



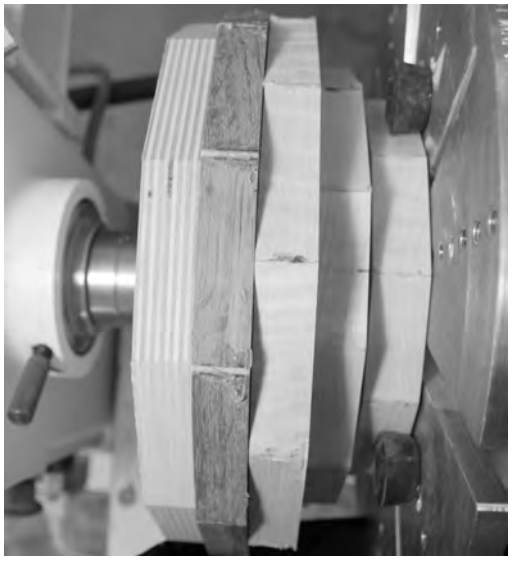
Mount Ring 3 to the jumbo jaws. Move Ring 3 close to the headstock and adjust alignment. In this case you want the edge of the segments on Ring 3 to be in the center of the segments on Ring 4. To do this, mark the center of one of the segments on Ring 4 and align an edge of a segment on Ring 3 with it.
Next, move the tailstock back, apply glue, move back up, lock the tailstock and apply pressure. Let the glue tack up.



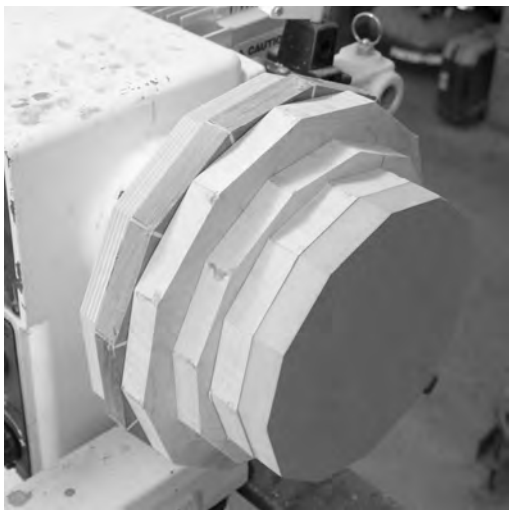


Rings 2 and 1 are done in the same way and finally the sacrificial end is added to Ring 1.



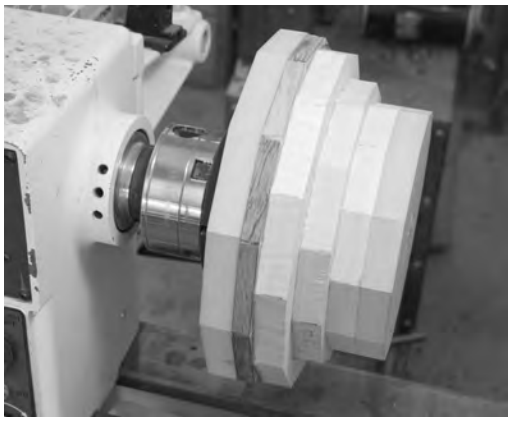


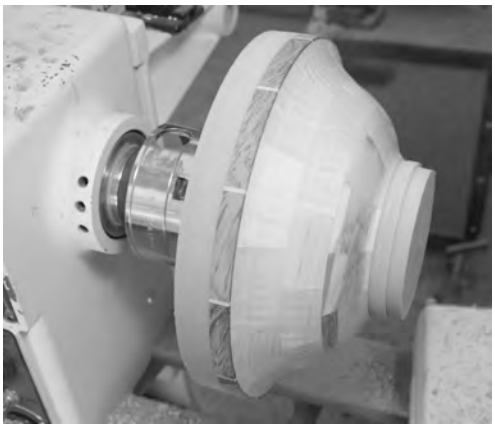
You are now ready to turn the bowl.



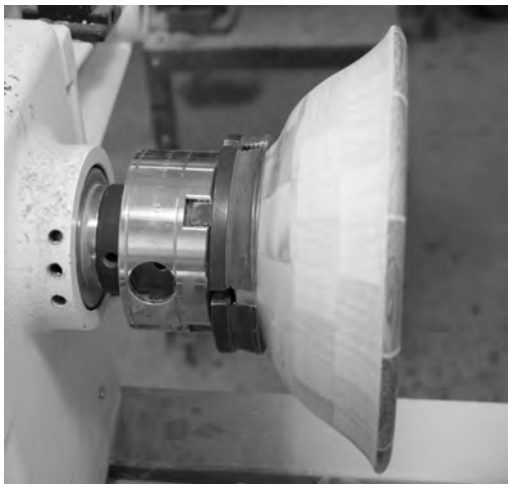
Turning the Bowl

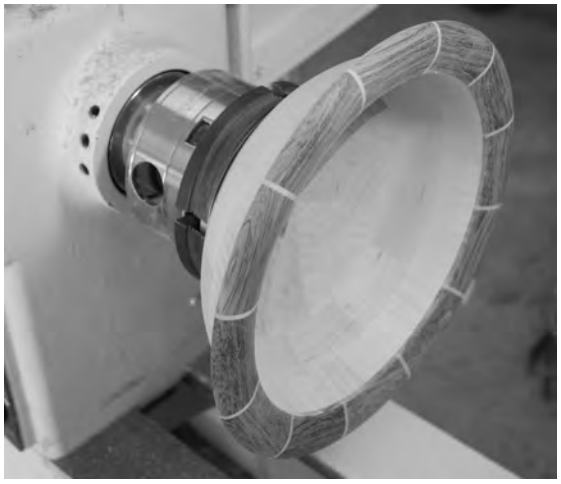
With the blank mounted you can now turn a tenon on the bottom sacrificial end and turn most of the outside of the bowl.





Now flip the bowl and chuck the bottom tenon. Part off the top sacrificial end and turn the inside of the bowl.





Flip the bowl once more and chuck the rim in jumbo jaws. I usually put blue masking tape to protect the rim. Part off the bottom sacrificial end and finish the bottom of the bowl. I like to put o-rings on the bottom of most of my work and here is where I cut the grove.