Speed and Accuracy in Segmenting

By Delbert Dowdy

1. Goals and philosophy

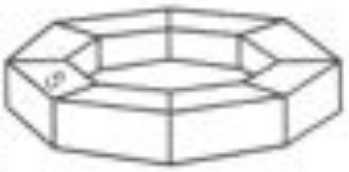
I believe that woodturners are generally impatient woodworkers. Instead of taking days or weeks to complete a project, we usually take minutes or hours to have a finished piece. Many people have told me that they have not tried segmenting because they do not have the patience for it. I am one of those that have little patience for long projects stretching out over days. On the other hand, you have an almost unlimited variety of shapes, designs, colors, and grain patterns that can all be made from dried one inch boards. To have the artistic expression available in segmenting and still satisfy my short attention span is my quest.

Sanded joints versus cut joints in segmenting has been an open discussion for some time. People who sand their joints to perfection say that you can see the difference in the joints. That may well be true and I am not here to dispute that statement. Some would say that anything less than a 99.9% fitting joint is not acceptable. I will not accept any visible gaps in any of my joints. If I can cut pieces, glue them, and achieve a 99.5% fit with no visible gaps it is not worth it to me to greatly increase my time and achieve that last 0.4%. I have no problem with those people who want that perfection and even have admiration for them but it does not fit into my personal philosophy for woodturning. The one definite disadvantage of my method is that certain types of design rings with complex patterns that are built up one segment at a time can not be cut accurately and safely and so must be sanded. I do not use these pattern rings in my turning so I am not disadvantaged.

All the items that follow are things that I have developed, borrowed, or modified to produce accurate joints in my segmenting with the least amount of time. In some cases, I will present more than one method of accomplishing a task even though I may use only one.

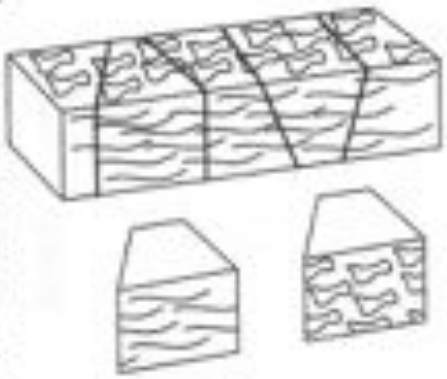
2. Rings for designing

Although I almost always sketch out the basic shape of piece I wish to make, I do not make a detailed full-size drawing of the piece with rings all laid out. Just as some people do not put things together by consulting the instructions, I do not use a pattern. For the beginner and for those that can not use my method, I would suggest you make a full size drawing and follow it. I have two sets of circle patterns that I use. One set consists of segmented rings in half inch increasing sizes. By placing the rings on top of each other I can see what sizes I need to make to get the desired shape. The other set consists of 1/8 inch plywood disks in increasing sizes. Each one is clearly marked with its diameter. They are very useful for measuring rings or determining the next ring size on your turning.



3. Grain alignment

Be sure and pay attention to the grain pattern in your piece of wood. Many woods have a very different pattern when you look at the side and the top of the plank. Depending on how you cut your strips of wood you can use either the side or top pattern. The strips are cut so that when you lay them on the cutting jig, the pattern you do not want to show is facing upward. The main limitation of this is when you need a wide segment using the grain pattern on the side and your plank is only ¾ inch thick. That limits your width to ¾ inch. Choose planks that are thicker than ¾ inch if possible.



4. Preparing wood strips

The wood planks must be cut into strips before you can cut them on the cutting jig. It is absolutely necessary that the strips of wood be straight and the sides be parallel or of uniform thickness and uniform width. Any bend in the strip or difference in thickness will show up as an angle change when cutting and this will produce a gap when gluing the segments. The best and easiest method is to use a jointer to get one straight edge and then a planer or table saw to get the other side parallel. Sometimes a board that is straight in plank form will

bend when cut into strips. Always check the straightness of the strip. The other thing that I find useful is to cut the strips into two to three foot lengths. Pieces that are longer than these are hard to control. Cutting smaller pieces will produce more unused wood as the last few inches of each piece becomes unsafe to cut on the jig. I save these off cuts and use them in other projects.

5. Making a cutting jig

Several years ago I made an adjustable angle cutting sled. It was accurate but required many steps to set it up for a different number of segments. The size was a bit larger than I needed also. To save time in setup and to improve the ease of use, I decided to make several fixed-angle sleds that do not require any setup and are smaller for ease of use. I was also determined to make a sled where I could quickly move a stop to a reading on the sled and be able to make any size ring I wanted. I will discuss the construction of the table saw cutting jig, the setting of the fence for accuracy, the marking of the table for easy sizing of rings, and the use of the cutting jig.

Cut wooden base

I chose a flat ¾ inch piece of quality plywood for my top. The dimensions are 22 x 13.5 inches. There is nothing special about these dimensions. I wanted a jig

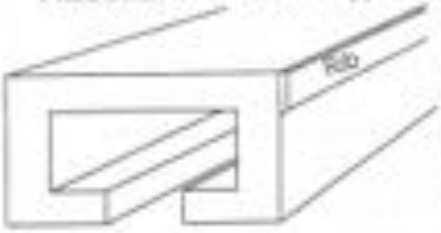
that was small and light weight but could easy cut wood 2 to 3 feet long.

Cut one piece of t-track

The secret of success of this jig is the use of one piece of a special t-track as a runner. I have tried using two runners made of various wood, plastic, and metal. Two runners either seemed to bind or be too loose. One day as I was struggling to get the runners to align, I took one runner off and placed the jig on the table with just one runner. The jig moved much smoother than ever before.

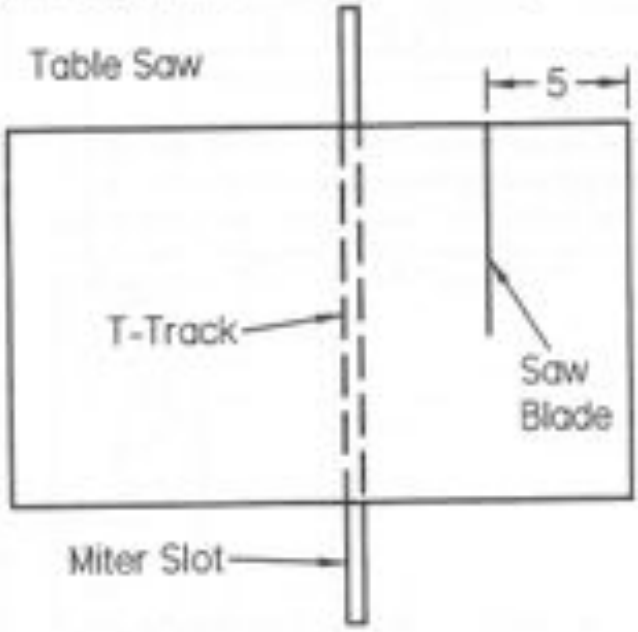
Sand side of t-track to fit in miter track

I had some t-track that happened to be a variety that has a rib running down the side. It is available from Woodworkers Supply. It is called minitrack t-slot track and is $15 for 4 feet. With the rib it will not fit into the miter slot on the table saw. Without the rib it is loose in the slot. I slowly sanded the rib down constantly fitting the t-track in the slot until it ran smoothly back and forth but did not have any sideways play.

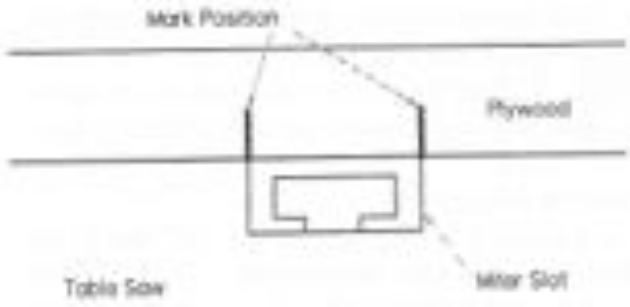


Position track on bottom and screw to bottom

Place the t-track in the miter slot with the slot facing down. Place the plywood on the tablesaw above the t-track. Align the top so the saw kerf will be 5 inches from the right side but do not cut the kerf yet. This is



just enough room to have a stop and make rings up to 12 inches in diameter. If you want larger rings, move



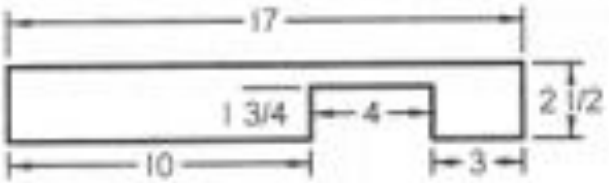
the saw kerf to the left. Mark on the ends of the top where the edges of the t-track are located. Turn the top over and align the t-track with the marks. Use ¼ inch screws to hold the track in place. The t-track does not have to be aligned perfectly with the edges of the top.

Remove screws Add glue and replace screws

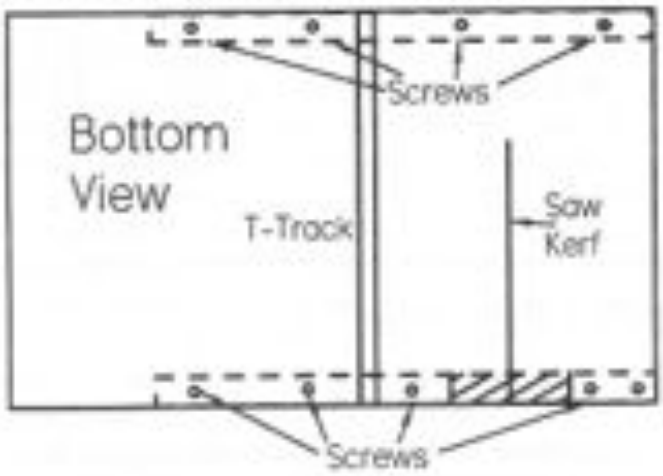
Remove the screws and apply a strong glue to the t-track. Apply the t-track to the top and hold it in place with screws every few inches. You may need to add extra screw holes in the t-track. Make sure the points of the screws do not come through the other side of the top.

Cut two fences

Now place the t-track in the miter slot. Raise the blade and cut an eight inch long saw kerf in the top. Cut two pieces of wood 17 x 2 ½ x 1. These will be the fences. Cut a slot in one 4 x 1 3/4, three inches from one



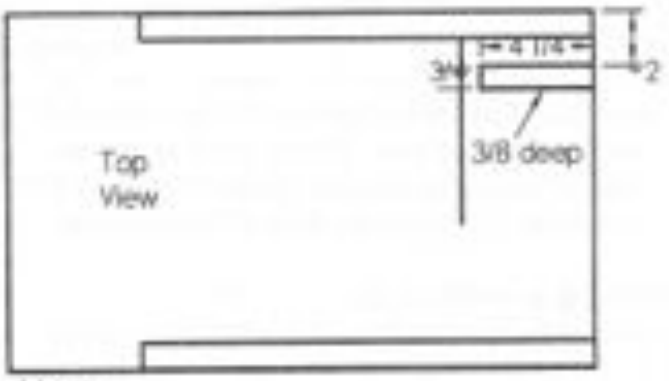
end. This should center the slot over the saw kerf for the front fence. Both fences are to be placed to the far right edge on the top. Turn the top over so the bottom



is up. Mark the location for 4 screw holes for the rear fence. Mark the location for 3 screws on the left side of the front fence and 2 screws on the right side of the front fence. Predrill these holes and counter sink them. Apply wood glue to the fences and attach them with the screws to the top.

Cut slot for stop track

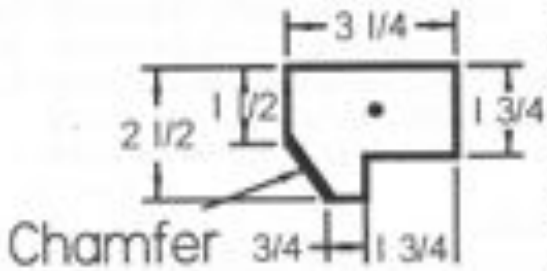
Cut a piece of t-track 4 ¼ inches long. Cut a slot parallel to the front edge and two inches from the front edge. Cut the slot so the t-track is flush with the surface



of the jig.

Glue and screw t-track

Apply strong glue and attach with 3/8 in. screws. You may need to drill extra holes in the t-track. Be sure to counter sink the screw head because a bolt head has to move along the t-track.



Cut stop Chamfer and insert bolt

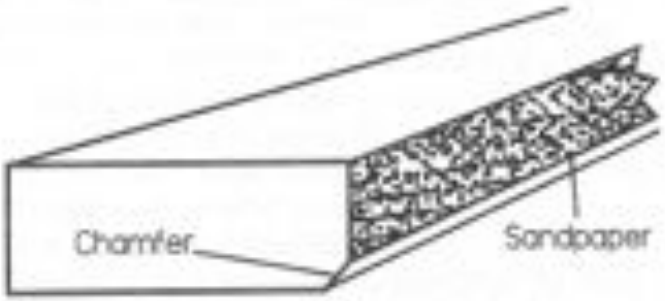
Cut a stop 3/4 inch thick from wood or mdf according to the drawing and drill a through hole for a 1/4-20 bolt. Apply a slight chamfer to both edges of the angle surface of the stop. This will reduce the chances of dust getting in the way. Insert a 1/4-20 bolt 1 ½ in long and screw on a large plastic knob for ease of movement.

Cut fence

Prepare a piece of flat 3/4 stock 2 in x 18 in to use as a fence. It must have a straight front edge.

Cut chamfer on fence

Cut a chamfer on the front edge of the fence so that wood chips or dust will not push the wood away from the fence and change the angle.



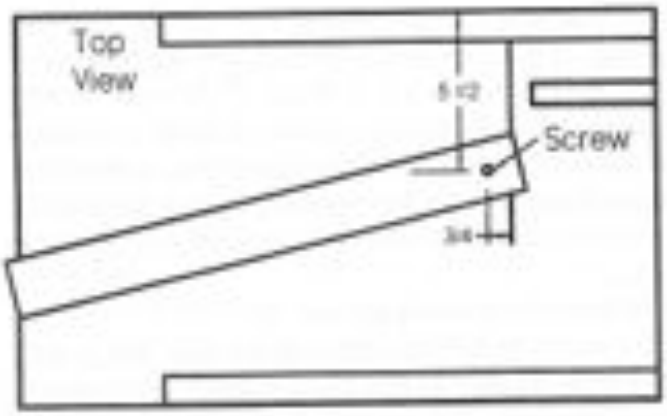
Glue sandpaper to front of fence

Take a strip of sandpaper just wide enough to cover

the front edge of the fence and glue it to the fence. You can use two pieces if you do not have long strips. I use yellow glue and a board on top of the sandpaper to apply even pressure when drying. Sandpaper with grit of 100 or 120 will work best. This sandpaper will keep the boards from slipping when cutting the segments.

Attach fence with one screw near kerf

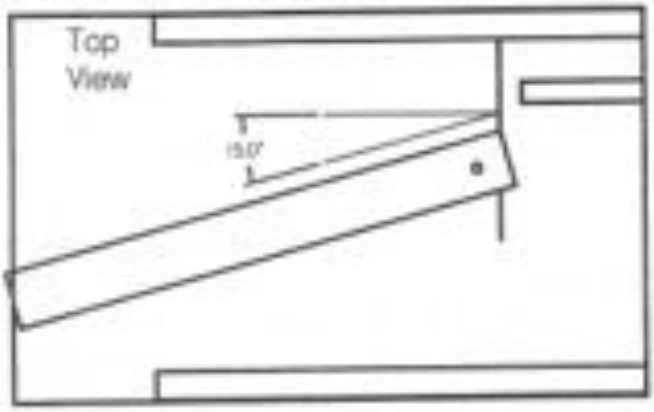
Place one screw in the fence about one inch from the end of the right side of the fence. Make sure that the right side of the fence hangs over the right side of the saw kerf. You will cut off the right side later. That will



then put the right side of the fence up against the saw kerf and give you the maximum backing for the wood you are cutting.

Measure angle approximately for fence.

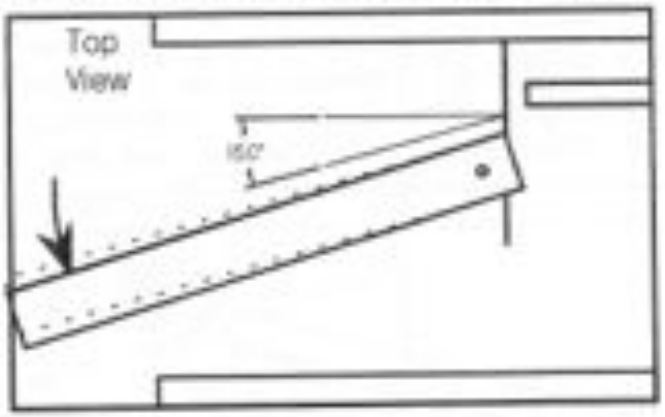
You need to know how many segments you want this jig to cut for a ring. If you were cutting 12 segments to



a ring, you would take 180 and divide it by 12 to get a 15 degree angle. This 15 degrees is measured from the perpendicular to the saw kerf. Draw a line perpendicular to the kerf about one inch in front of the fence. Draw a line about 15 degrees behind the perpendicular line. Align the fence by eye so it is parallel to the 15 degree line as close as possible.

Pull fence back on left side

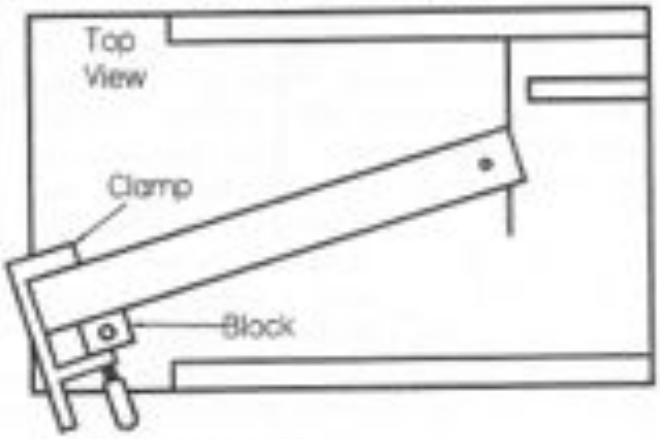
Now pull the fence back a little on the left side to in-



crease the angle a degree or so. You are going to 'sneak up on the angle'.

Screw a block behind left side onto table

Clamp the fence to the top at this point. Take a small wooden block and screw it to the top just behind and



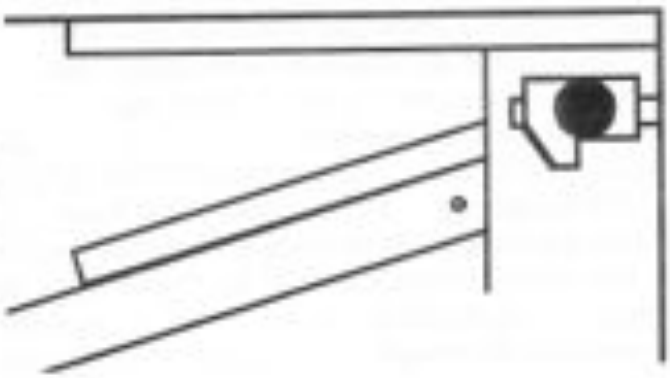
touching the fence on the left side.

Clamp fence to block

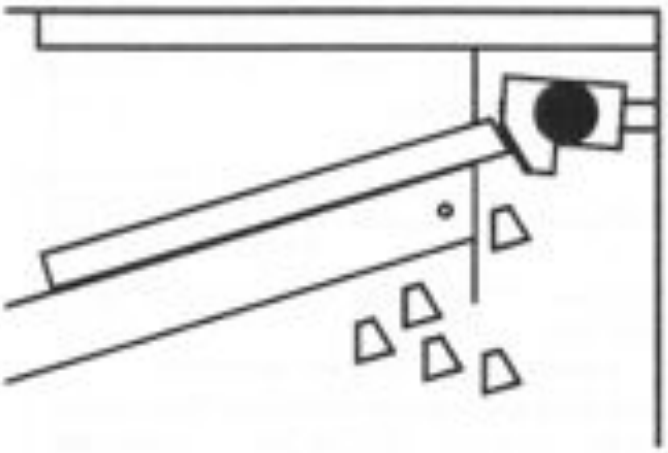
Remove that clamp from the fence and now clamp the fence to the block you screwed behind the fence.

Cut a set of segments

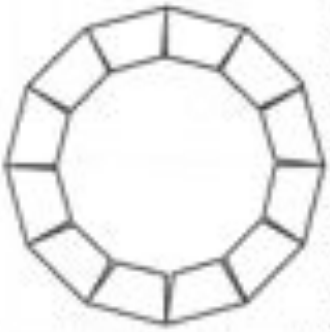
You are now ready to cut some segments. Use some



cheap wood about 1 inch in width and ¾ inch thick as you will be cutting a number of trials. Be sure that it is extremely straight and parallel. If your wood is curved, you will never be able to accurately set your fence. Run the fence through the saw blade once to cut off the right end of the fence. The wood you will cut must be short enough to fit between the blade and the clamp on the



left side. When the wood get about 6 inches long, you should consider getting a new piece as your fingers are dangerously close to the blade. Finger repair costs more than wood. Set your wood strip just a little over the right side of the kerf and run it through the saw to cut one end. Flip the wood over so the angle on the end of the wood runs from left to right. Slide the wood so about 1 inch is to the right of the kerf and bring the stop up flush with the end of the piece. Make a cut, pull the jig back, remove the piece, flip the wood, run it up to the stop and cut another segment. Cut 12 segments in all and clamp them together. You should see some gaps toward the inside of your circle.



Add spacer between block and fence

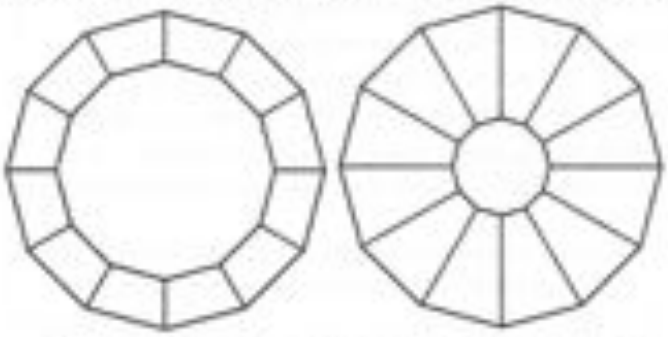
Unclamp the fence and add a spacer between the fence and block. Something between cardboard thickness and veneer thickness will do. Clamp the fence again. You should now be getting closer to the 15 degree angle.

Cut segments and add spacers

Cut 12 more segments, clamp them, and check for gaps. Keep doing this until the gap on the inside disappears. Hold the clamped ring up to a bright light and see if any light comes through. Check all the ring as gaps may appear in only one place.

Close cut wide hardwood

When the gap is gone with the cheap wood, you are ready to fine tune with some wide hard wood such as hard maple. Soft woods can be deformed by the clamps and can mask gaps that may appear. A ring made of narrow wood will not show small angle differences like

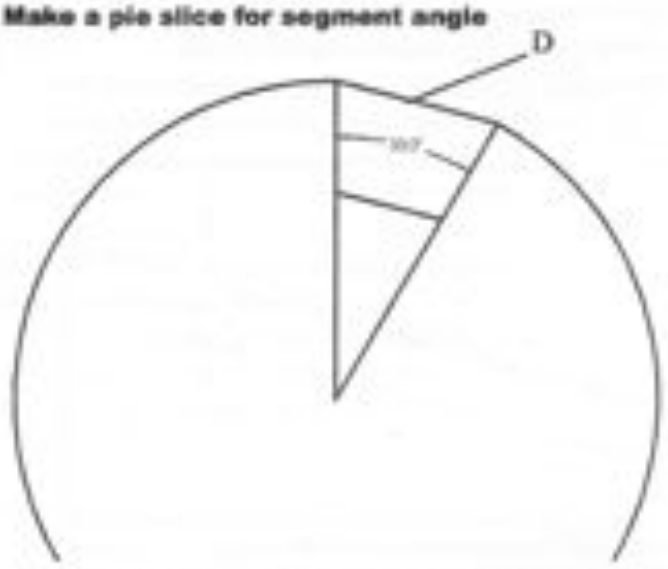


a wide piece of wood will. Use wood about 3 inches wide and cut 12 segments. Make adjustments as needed to remove any gaps. After you are satisfied there are no gaps, cut one more wide ring to make sure it will repeat.

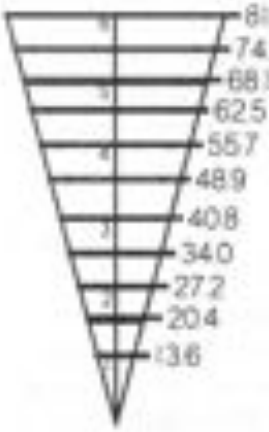
Screw fence in 3 more places

If your jig is making cuts with no gaps, put three more screws equally spaced in the fence. You can now remove the clamp, spacers, and block you screwed to the top. You should not have to make any more adjustments to cut great rings every time.

Make a pie slice for segment angle



The diameter of a ring is determined by the distance D across the outside of each segment. One can calculate these distances if you have the math ability or access to someone else's tables of the calculations. I chose to develop a method where I could actually measure the segment size. Every segment is a part of a pie slice with the tip cut off. For twelve segments each slice of the pie is 30 degrees. So I made a 30 degree wedge. The

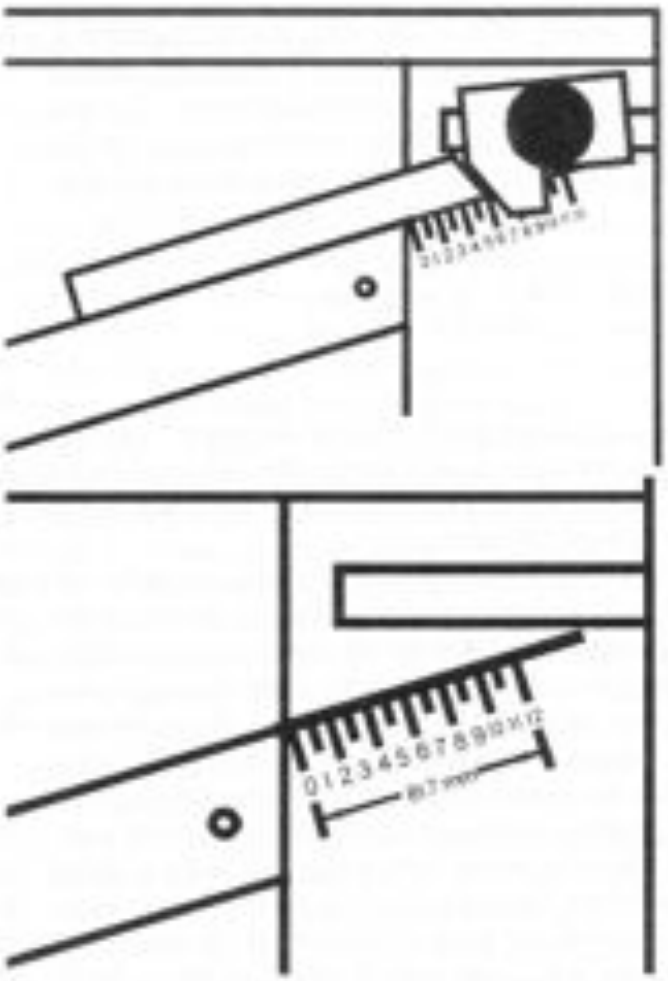


radius of the ring would be measured along the center line of the wedge. I drew a center line and measured every 1/2 inch along the centerline. A perpendicular line was drawn to the center line at each 1/2 inch mark. The perpendicular lines are the distances D across the segments for each radius. This distance is what you need to know to cut segments of the correct size for each diameter. I measured the perpendicular lines for each 1/2 in distance. This would be the equivalent of 1 inch intervals in diameter. Here is where I switched over to the metric system and measured in mm to the nearest tenth of a millimeter. It is more accurate than using inches. In the picture a 5 inch radius circle would need a segment whose outside distance D is 68.1 mm. We will still relate it back to diameter of rings in inches. We can now make a table. Distances versus diameter of ring.

Radius (in)	Diameter (in)	Size of Segment D (mm)
1	2	13.6
1.5	3	20.4
2	4	27.2
2.5	5	34
3	6	40.8
3.5	7	48.9
4	8	55.7
4.5	9	62.5
5	10	68.1
5.5	11	74.9
6	12	81.7

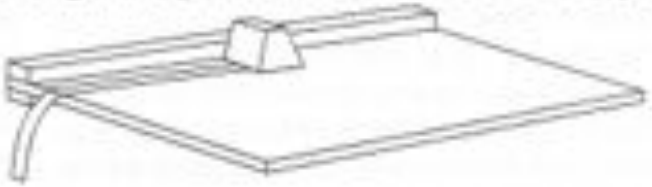
Mark for radius and diameters

On the cutting jig I drew a line along the front of the fence to the right of the kerf. I took the measurement for the perpendicular lines (size of segment shown in table to left) and marked them along this line on the jig. I then labeled the diameter that they correspond to. That way I can extend the board to be cut until it aligns with the proper diameter I want, I then slide the stop up to the board and tighten the knob. The picture below shows the jig set to cut 12 segments that will make a ring that is 6 inches in diameter. Since the marks are evenly spaced, you can divide the spaces to get 1/2 inch or 1/4 inch variations in diameter.



6. Using tape

Once the segments are cut, they are ready to be joined with glue and clamped. After trying many methods of joining the segments, the quickest and easiest is using tape. I use a tan colored quality grade of masking tape. The cheaper version of the tape tears easily and can be a pain. I see no need to pay three times as much for the easy release colored painting tape as I will be turning the tape off on the lathe and I want more adhesion than the colored tape gives. It will seem at first as the tape just takes extra time but when you see how it saves times in the steps afterwards, it is worth it. To make the tape work well you need a straight edge to place the segments against. I use a piece of wood on my gluing board as the straight edge. I tear off enough tape to go around the ring plus a few inches. The tape is laid



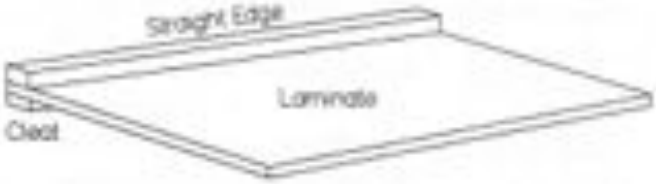
next to the fence with the adhesive upward with a few inches hanging off the right side. The first segment is laid on the left edge of the tape, covering the end of the tape and fitting next to the straight board. The next segment is placed to the right of the first one. I use the straight board and the previous segment to quickly slide

the next piece into place. Place all the pieces in line. If the tape begins to twist or change direction, realign the tape or tear the uncovered piece off and reposition it under the last segment.

How does all this save time? Lets looks at the options without using tape. You could glue the pieces two by two and then glue them together to form half rings. Clamp the two halves with a dowel between the halves and then sand the surfaces flat. After gluing the two halves together you have a ring. Sanding the halves is ticklish and time consuming. If you are going to glue a ring together at once, you will want to check for gaps. You place the pieces into a ring and place a clamp around them. As you tighten the pieces want to move up and down and toward the center of the circle. You adjust the pieces and tighten. After you check the fit you are ready to start all over this time putting glue on the surfaces, tightening, and adjusting. Using tape you place the pieces on the strip. It takes a few seconds to align the pieces. Placing the pieces against the straight edge insures one side of the ring is flat. Roll the pieces into a circle and use the left over tape to complete the circle. You can pick up the ring and it will stay together. Place the clamp on the tape and tighten. You will notice the pieces have minimal movement up and down and toward the center of the circle. If you are satisfied there are no gaps, unroll the tape and place the segments facing upward again. Applying glue is now very easy. Roll the segments into a ring again and apply the clamp.

7. Using a glue board

Gluing segments can be a messy job. Spreading waxed paper or getting glue on everything are options. Getting glue on workbenches is not really an option. Waxed paper works but it moves around unless you tape it down and you may need to put new paper down several times during a long glue session. Since I was using a scraper to remove dried glue from surfaces where it spilled, I decided to find a surface that I could just scrape the dried glue off and not worry about it. I took a piece of ¾ inch plywood and covered it with cabinet laminate. It needs to be large enough to hold my segments and all



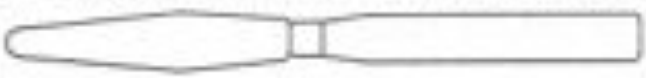
the tools I will use. My board is 16 x 36 in. To the top I attached a straight board one to two inches wide and ¾ inch thick that I use with tape to form the ring. On the under side of the board I attached another straight board or cleat that I use to keep the glue board in place. By pushing the cleat up to the table top, the board can only move back or sideways. Scrapers cost between $8 and $25 at your local hardware store.

8. Gluing

Most segmenters use one of the PVA glues (yellow glue) such as Titebond 1, 2, or 3. A recent article in "Fine Woodworking" magazine tested glues and found glues like Titebond 3 to be the strongest followed closely by Titebond 1. Titebond 1 has a shorter drying time so I use Titebond 1. I have tried any number of glue bottles. Most glue containers are fairly stiff plastic that requires some effort to get the glue out and have a tendency to clog. Having tried a number of kitchen container bottles and purchased expensive glue bottles, my favorite

is a small $1 four oz. squeeze travel bottle with spout and a simple red cap that I get at the Container Store. The bottle is very easy to squeeze, puts out just the right amount of glue, rarely ever clogs the spout if I forget to put on the cap, and does not seem to dry out. It is the perfect lazy person's glue bottle.

Once I have checked the ring for gaps, I stretch the segments back in a line still attached to the tape. I apply a dab of glue (scientific measurement) on each segment at the top of the side and let it run down the side. You learn how much glue to add so you get some glue squeeze out but not a lot. The extra squeeze out is wasted glue and is messy. I use a thin metal artist's palette knife to spread the glue. They are available for around $3. It is small and flexible which makes it easy to get in between the



segments. Do not try to spread the glue by just tightening the ring as certain places on the segments may not get glue and as you turn away the ring, the part that is left may be the part with less glue. You are now ready to apply the clamp.

9. Clamps

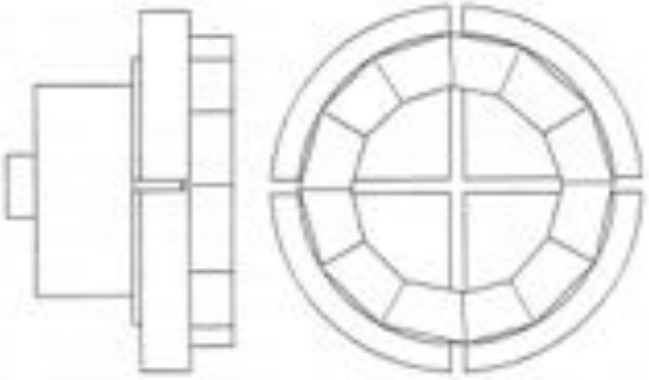
If your segments fit, you do not need a tremendous pressure in your clamps. It is possible to apply too much pressure and glue starve a joint. There is a line of hose clamps that are inexpensive and quickly adjustable. I get mine online at www.mscdirect.com Click browse in the left hand corner and in the next page on the right in the box labeled big book page search enter 4218. On the next page on the right you will find the Quick Release Worm Drive Clamps. Choose one with a minimum diameter of about 2 inches up to the maximum diameter you will be using. They are about $ 2 each. To use the clamp, you lift the screw, pull it tight around the ring, put the screw back in place and tighten. If you over tighten these clamps they will break. They are fairly cheap and break only occasionally. You learn how much pressure the clamps need just as you learn with experience how much to tighten a nut on a bolt. Use a nut driver on the bolt head instead of a flathead screwdriver. Try to center the clamp on the segment ring to get ever clamping pressure on the ring.

10. Screw gun

One of the members of our club has an old Makita screw gun that he uses to tighten the clamps. It has ratcheting and so stops at just the right pressure. Most modern powerful screw drivers are heavy and so powerful they break the clamps. With the advent of the palm size screw drivers, I found one that works very well. It does not tighten the clamp too much and stops a little short of the final pressure. A couple of twists of the driver by hand is enough to reach a stopping point. It is the Kobalt 3.6 Volt Li-Ion Battery Cell Screwdriver Model: RV328 which sells for $26.97 at Lowes. Get a small nut driver head to fit in the screwdriver from Walmart for about $2.

11. Flattening rings

Once the glue is dry, and the clamp removed, the ring must be flattened on one side in order to glue it to the turning. There are several ways of flattening the rings. The four methods that I have tried are a drum thickness sander like the Performax, a belt sander, a disk sander, and wooden jaws on a chuck. If your thickness sander is set up so that you do not have any snipe at the beginning or end of the ring, this method is quick and easy. If there is the tiniest bit of snipe then there will be a gap in the ring. Having been unable to remove all the snipe, I do not use this method. A sanding disk attached to the lathe or a motor works well but is very hard on your hands because of the ways you have to hold the rings. I began to develop problems with my hands using this method. I have a six inch belt sander that is the quickest way to get the rings flat. If you constantly move the rings across the belt and rotate the rings after a second or two of sanding, you can easily and quickly flatten 12 inch rings or larger. The rings must be held firmly when placing on the belt which is running so it is not jerked from your hand. If your hand slips off the ring and onto the belt, you can loose quite a bit of skin in a very short time. The finer the grit the faster it wears out and the longer it takes to flatten the ring. I use a 60 grit belt which would seem to be too coarse. Never have I detected any gap of any form between the rings

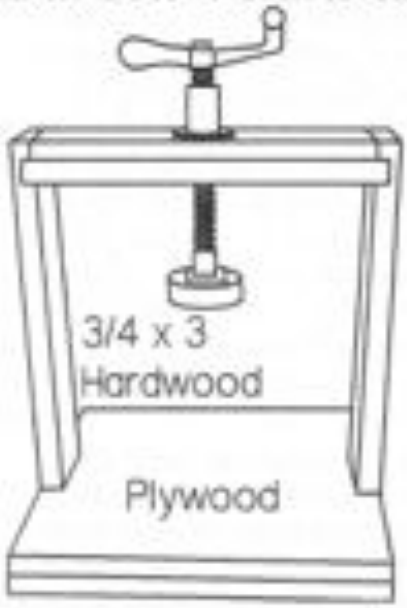


using the 60 grit belt. The 60 grit belt can flatten a ring in 15 seconds easily. The other method I have used is wooden jaws attached to flat jaws on my Oneway Talon chuck. The flat jaws are available for Oneway chucks for about $40. I cut four pieces of a fir 2x4 into squares which I attach to the plates to make one large square. The square is then turned round on the lathe. Grooves are cut into the wood of different diameters to hold the wood. Once the ring is in the jaws, I use a scraper and

flattening board to quickly create one flat surface. With one side flat you are now ready to glue on the ring and put it in a press.

12. Using a ring press

I attach rings to my object one at a time and turn them flat to accept the next ring. Without an accurate thickness sander, it is too easy to glue two rings together that are not uniform thickness. Rings of varying thickness are easy to spot on a turned object. I have tried four methods of holding rings during gluing. Using individual clamps such as C clamps has not worked unless the piece is large diameter and shallow. If your drill press table moves up and down, you can use the drill press to hold rings. I have made a wooden piece to fit over the chuck to distribute the pressure. For very long pieces, this is my favored method. You can always use your lathe as a press if you do not need it while your piece is drying. I usually am making several pieces at the same time and so I need the lathe to flatten rings and do preliminary turning. Most of my rings are attached using three wooden presses I made according to plans that were in Wood magazine. You can find the basic plans on www.woodmagazine.com. Under project plans it is called *A press for gluing stacked bowl blanks*. The press is made from wood and a veneer press screw. I found the cheapest veneer screws at Woodworker' Supply www.woodworker.com. They have a 9 inch screw for $25 and $14. I use the $14 screw and find that they work as well as the more expensive version. Two of my presses can hold pieces up to 12 inches high and 12 inches in diameter and the third holds pieces up to 9 inches high and 12 inches in diameter. You could easily modify these sizes. Since the screw will not extend all the way to the bottom, I use wooden blocks under the object to bring it up to the screw. After I have applied glue to the last ring on the object, it is spread with the palette knife. I usually put the next ring on the table and put the turned object on top. Since the next ring is usually larger than the last one on the object, you can use your eyes and hands to center the ring. Use the segment joints to center then on the bottom segment. Your hands can often feel if the space on all side of the ring is uniform. If you have applied a lot of glue and begin to tighten, the ring may try to move. Either let the glue set for a minute or two or very gradually tighten the press, wait a minute, and tighten a little more until the ring does not move.



13. Flattening board

After taking the object out of the press, place it on the lathe and turn the ring flat. This should cause each ring in turn to be uniform in thickness. That is the result that I get. I use a scraper to get the ring close to flat. The final sanding is done with a sanding board. I have made a board 2 inches wide by 3 feet long. The width and length can easily vary. The board must be flat. I choose a piece of flat ¾ inch plywood. I then glue sandpaper to both sides. Originally I glued 80 grit paper to both sides. My board now has 50 grit on one side and 80 grit

on the other side. The type of sandpaper is important. I use sanding belts that I cut to size. The belts are cut a little larger than the wood. Using yellow glue I attach the sandpaper to each side and clamp straight boards to both sides until dry. The sandpaper is then trimmed using a utility knife. Using the 50 grit side first cuts the wood down fast so that just a quick touch up with 80 grit smoothes the surface. I first rest the board on the lathe bed with one hand placed there and bring the board into the rotating ring with my hand placed at about the center of the ring. You quickly get a feel when the board is equally pressing against both sides of the ring. Watching the space between the board and the ring gives you an idea how close you are to flattening the ring. Us-

ing the 80 grit you should see no gap between the ring and the board. Always test the flatness using a straight edge. I keep a metal 12 inch straight edge handy. Settle for nothing less than perfectly flat all the way across the ring. You are now ready of the next flattening ring to be glued on. Wood that becomes caked on the board especially from oily woods can be removed with a stiff wire brush and a pick. A long board can be moved up and down to expose new material. A 3 foot board should last most people many months. Then tear off the paper and begin again.

14. Turning and Sanding

To mention just a few things about turning and sanding the turned pieces. The pieces can be turned with bowl gouges and spindle gouges because there is rarely any end grain in the segments. Scrapers can produce very nice surfaces on many woods because of the grain direction. As the rings are added, I find it easier to turn and sand the inside surfaces as I add each ring as opposed to going back and reaching down inside the piece. If I am hand sanding my pieces, I like to use a backer for my sandpaper. Old thick mouse pads work great. I cut them about 3 inches long and widths to match the width of the sandpaper. My sandpaper is cut in strips that I just roll around the pad as it is used up. Turn the lathe speed down to around 500 rpm and sand away without any problems with heat buildup in your paper. Since you are using kiln dried wood, the heat generated in the wood should not create any problems.

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