The Fundamentals of Closed Segment Wood Turning

Presentation
by
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Segmented wood turning is much more than gluing together pieces of wood. It is about creating exciting objects that challenge you and stimulate the interest and enjoyment of others

… *Malcolm Tibbetts*

The wood turning world we have created to date is a result of thinking and experience thus far. Change and innovation requires new designs and challenges. Segmented turning offers one such pathway … *Vic Buxton*

Presentation Outline

- Why segmented turning;
- Types of construction;
- Tools & Jigs I use;
- Understanding the terminology
- Moisture Content & Grain Orientation
- Calculations involved;
- Vase design and Number of segments/rings needed;
- Creating and Securing the Vase Base
- Creating the feature Ring
- Calculating how much stock needed;
- Selecting and preparing the stock;
- Tools & Jigs for cutting the angles;

Presentation Outline Continued

- Wedge sanding, gluing and clamping;
- What to do if the pieces do not form a tight ring
- Sanding, flattening, correcting each ring;
- Gluing consecutive rings and rectifying surfaces;
- Beginning the turning process;
- Sanding and finishing en route;
- One or two piece construction approach;
- Sanding and finishing the outside;
- Options for completing & finishing the vase bottom;
- References

Why Segmented Turning?

- Segmented turning allows you to incorporate design into your wood via the placement of segments and the use of contrasting woods;
- Segmented turning allows for creating much larger vases than hollowing with normal tools can tolerate;
- Vase height and diameter is only limited by the capacity of your lathe;
- Segmented turning allows for both closed segments and open segments designs;

Types of Construction

There are three basic types of closed seg. Construction:

1) The lamination of wood layers;

2) The assembly of staves;

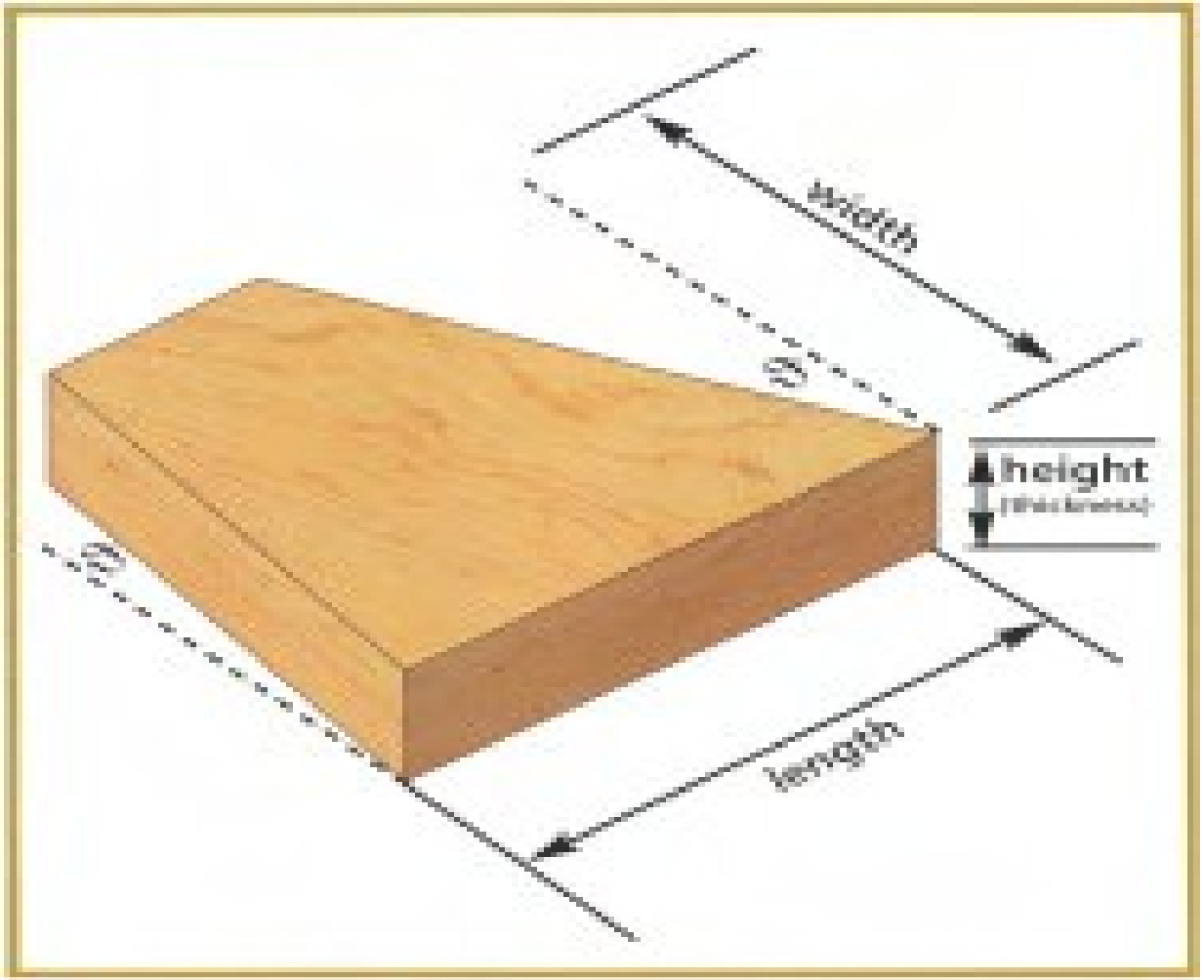
3) The creation of objects via segmented rings (samples provided)

The rest of my presentation will be about #3 but the stave construction will require the calculation of miter angles and these are described in Malcolm Tibbetts book.

Tools & Jigs I Use for Closed Segmented Turnings

- Steb center and live tail center to cut a tenon on base;
- OneWay Stronghold or other robust chuck to secure base;
- Standard bowl gouges and parting tools;
- Thickness planer for preparing stock;
- Home made sanding discs for ring problems (sample);
- Several jigs for cutting the segment angles (samples);
- Hose clamps for gluing the rings (samples);
- Flat master for flattening rings (sample);
- 2-way vice jig for rectifying surfaces (sample);
- Assorted grit sandpaper & powers sanding equipment;
- 2 steady rests for supporting very large vases;
- Jumbo jaws for finishing the vase bottom;

Understanding the Terminology



Moisture Content & Grain Orientation

- Too high moisture content can cause glue joint failure. Try to work with only kiln dried woods;
- Segment grain orientation is also very important. Most failures are from grain mis-orientation.
- Wood movement is almost always perpendicular to the grain. (Remember a board moves sideways not lengthwise);
- Proper grain orientation results in movement up and down and in and out and not from end to end. Such movement will split the ring.

Calculations Involved

- ***The formula for determining segment angle is*** very simple: 360 degrees / No. of Segments / 2
- For example, if you wanted a ring comprised of 12 segments the segment or wedge angle you must use is 360/ 12 /2 = 15 degrees.
- The width of the segment is determined by the stock thickness you have available.
- ***Length of Segment Calculation I use***: Diameter desired times 3.1416 (pi) = Circumference required divided by no. of segments = segment length; For example, suppose I wanted a 16" diam. Ring, then: 16 x 3.1416= 50.265" divided by 12 = 4.19' seg length. This is wedge length that I would cut on my table saw.
- ***Precise Calculation of Segment Length*** = tangent of angle X diameter (where "X" is 15 degrees = 0.26795 times the work diameter for the slice . For a 16 inch diameter ring this would be 0.26795 (tangent of 15 degrees) x 16 = 4.28 "

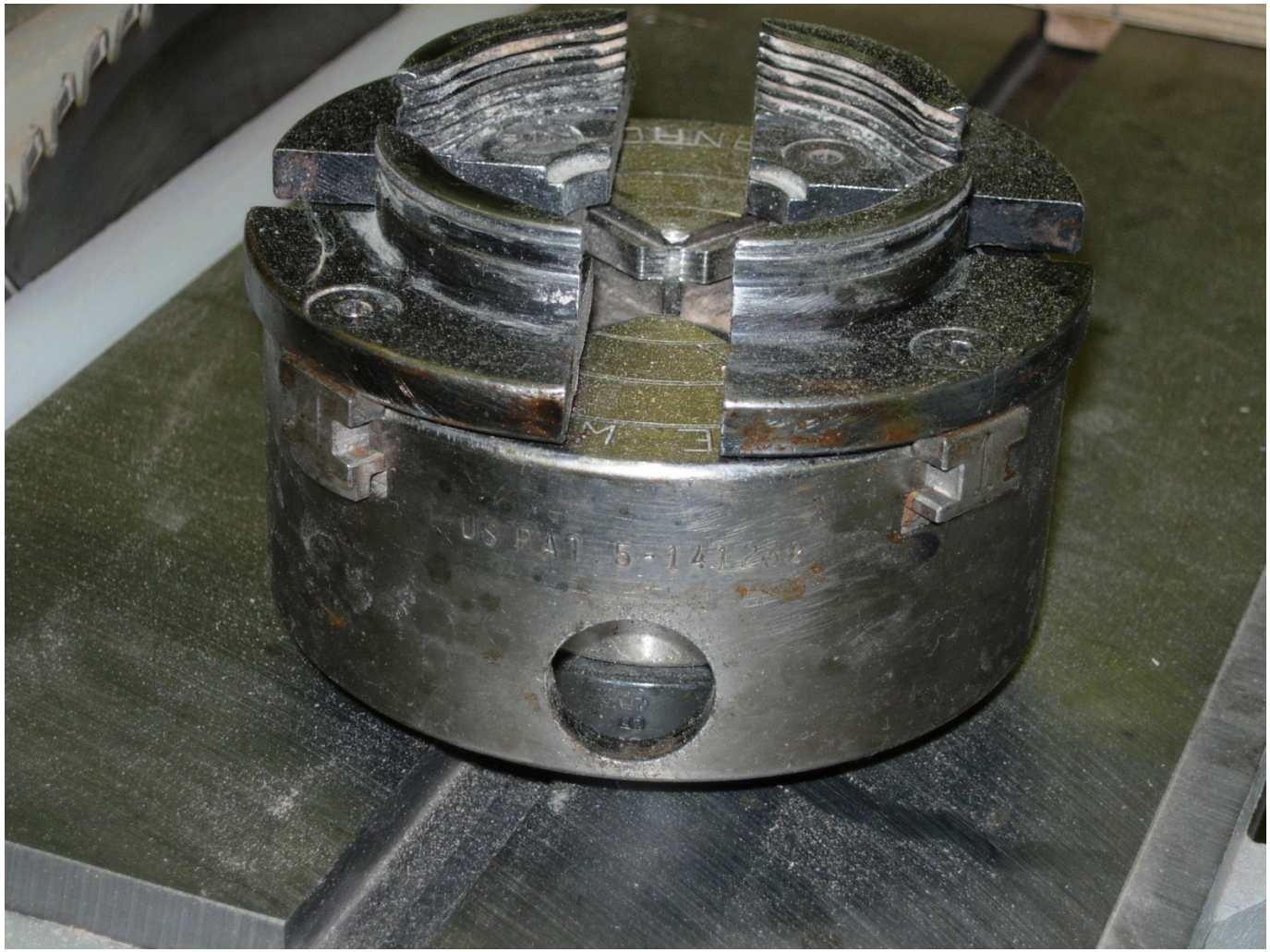
Vase Design & # of Segs/Rings Needed

- Spend time on the design! The design needs to include a consideration of the pattern you wish which will in turn determine the number of segments per ring you require to create that pattern (show example);
- Create a concept design first then move to the detailed design.
- Start off with graph paper with blocks relating to the thickness of the stock you wish to use and identifying where a larger stock may be needed to accommodate sharp curves .
- In a given ring, different woods to be used must be the same thickness.
- You will need to decide on the wall thickness
- Convert your conceptual design to a detailed design which will dictate how many rings needed and the required finished diameter of each ring.
- Plan a turning well within the capacity of your lathe (example, vase length and widest diameter).
- For large vases I uses 1.5 wide stock although the finished wall thickness will only be ½ inches. This is needed for two reasons: to accommodate segment slope angle (consistent with your design); and most importantly, my incompetence (I need lots of final adjustments room).
- For sharp slopes I sometimes use stock of 2 or 2.5 inch width

Creating & Securing the Vase Base

- I typically start with a block of walnut shaped on the band saw;
- I start by placing the block on the lathe held by a steb center at the headstock and a Oneway live center at the tailstock;
- I then create a tenon to fit my stronghold chuck;
- I then secure the base in the stonghold chuck and make it round and dead flat on the front;
- The base must be at least one inch bigger than your finished dimension to allow it to be parted off the chuck at the end;
- I usually cut in a little at the onset so I know where my final parting will occur.

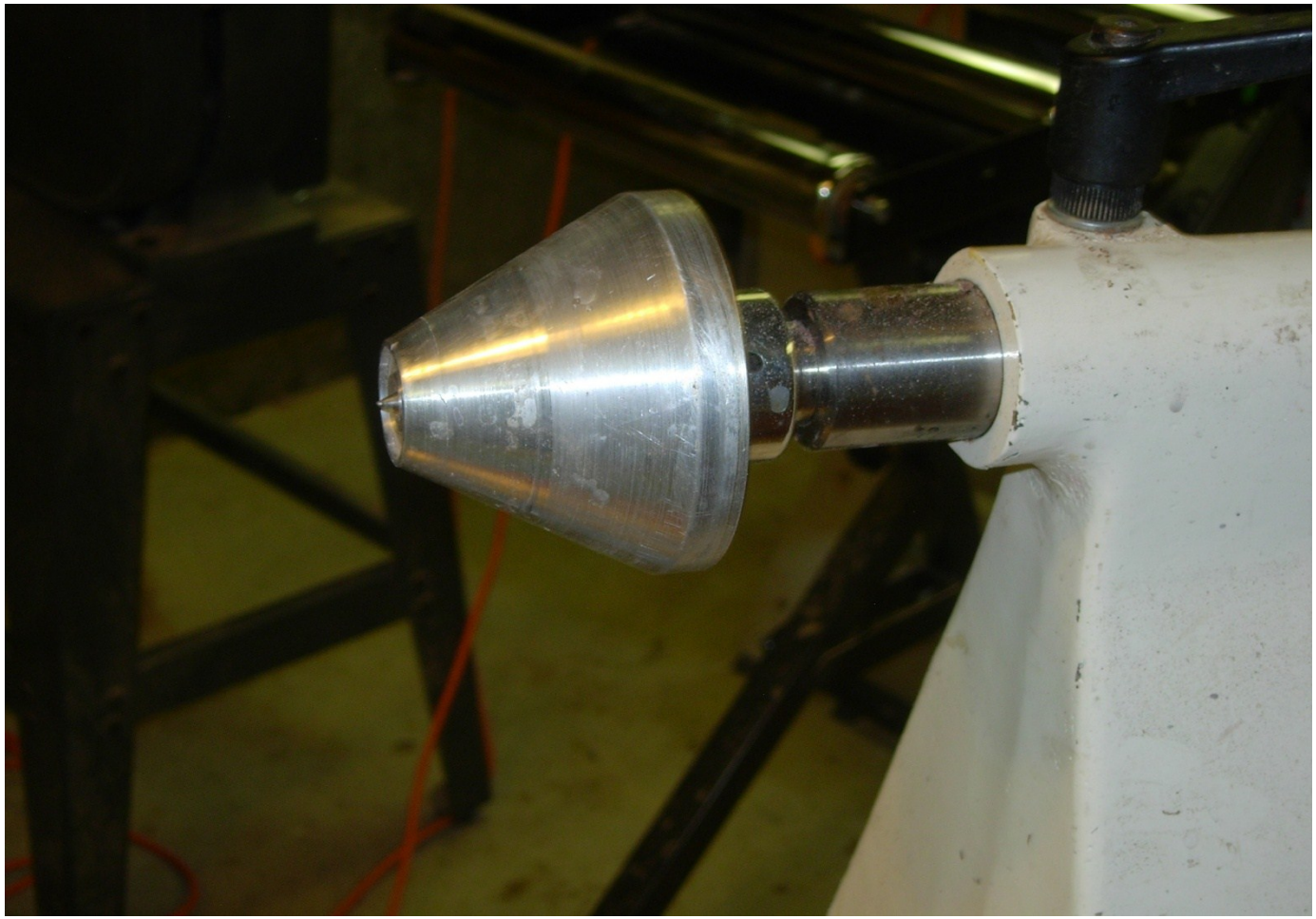
Stronghold Chuck



Base Block with tenon Cut

Steb Center

Oneway Lathe Live Center



Creating the Feature ring

- The feature ring is, or can be, the highlight of your design (point to examples);
- I often spend as much time designing and creating the feature ring as I do the rest of the vase.
- In a feature ring, all pieces (sometimes 36 or more) are cut, sanded, glued to form a repeating block.
- The 12 or more blocks are then cut to the desired angle, and the wedges are then glued together and clamped via hose clamps and then sanded as per all of the other rings.
- Once the blocks have been created and the wedges cut, the ring is assembled just like all other rings;

An example of my feature ring

Pyrographic Feature Ring

Another of My feature rings

Calculating How Much Stock is Needed

- There are basically two ways to cut a board into segments: cutting a segment and flipping the stock to cut the next segment which will result in an uneven but nonetheless, often vey interesting grain pattern; or, cutting all wedges from the same side of the board (draw on the flip chart);
- The number of feet of stock you will need will be a function of how much of your stock you are prepared to waste in order to achieve consistency in grain orientation;
- If you are frugal like me, for each type of wood to be used, the stock required is a simple calculation of seg length plus saw cut thickness times number of segs for each ring. Add up the amounts of each wood needed for each ring.

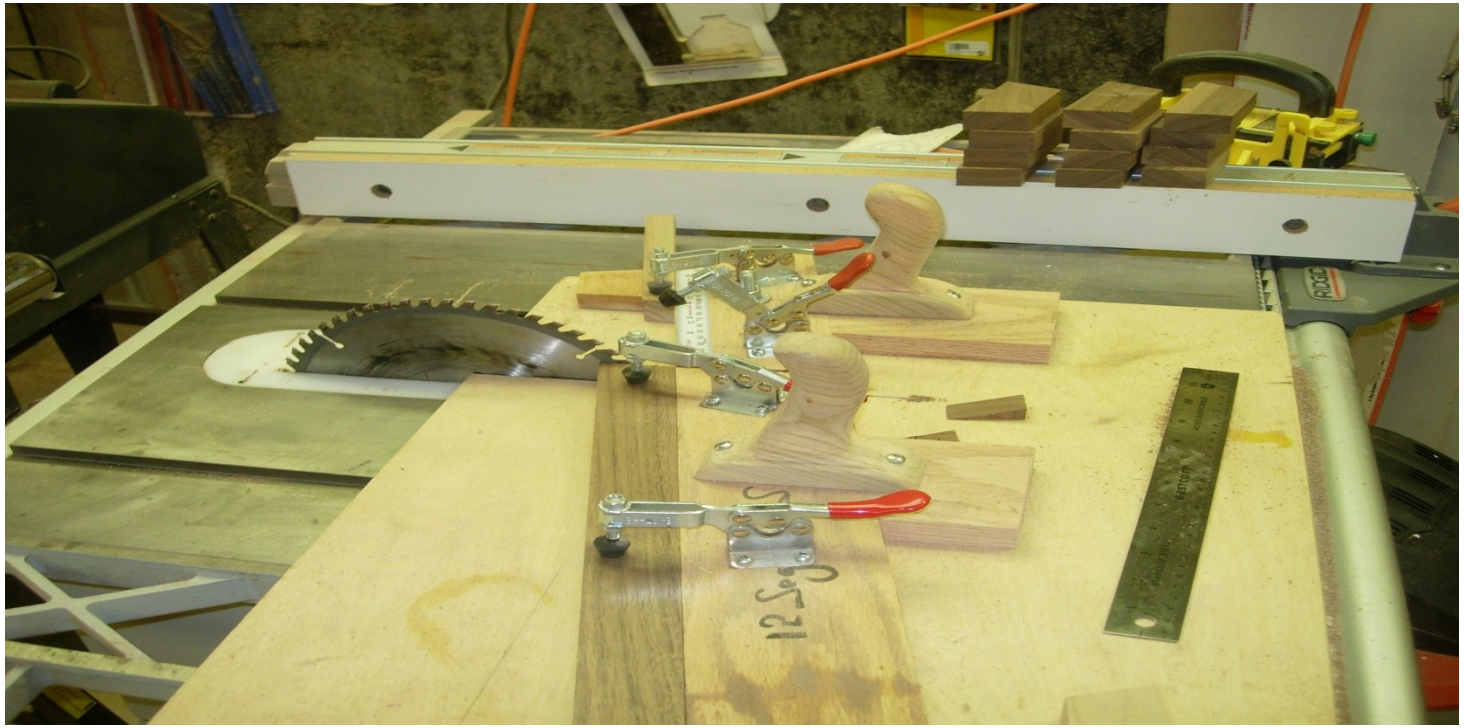
Selecting and Preparing the Stock

- In Malcolm Tibbetts book (page 22) he outlines three types of woods: woods of limited use (too soft or too oily); "OK" woods (they work but based on his experience do not inspire enthusiasm; his personal choices.
- Personal choices will obviously be limited to wood availability and cost considerations.
- In my case, my open and closed segmented turnings use locally available and reasonably cheap woods such as: maple, dark walnut, butternut and birch.
- I buy mostly flat stock about ¾ inches, cut it on the table saw to 1.5 inches in width and run the boards through a thickness planer to about 5/8 inches.
- I then cut the segments from these boards and no pre-sanding is needed.

Tools & Jigs for Cutting the Angles

- There are many tools and jigs that can be used to create the angles. These include:
  - A miter / chop saw;
  - A table saw;
  - A radial arm saw.
  - A band saw
- My vases were created mostly by using the two jigs on the table saw but I have also used the radial arm saw on occasion.
- My table saw sled jig is preset for 12 segment cutting.
- The other jig purchased from Lee Valley, I use for all other rings other than 12 segments.(show jigs)

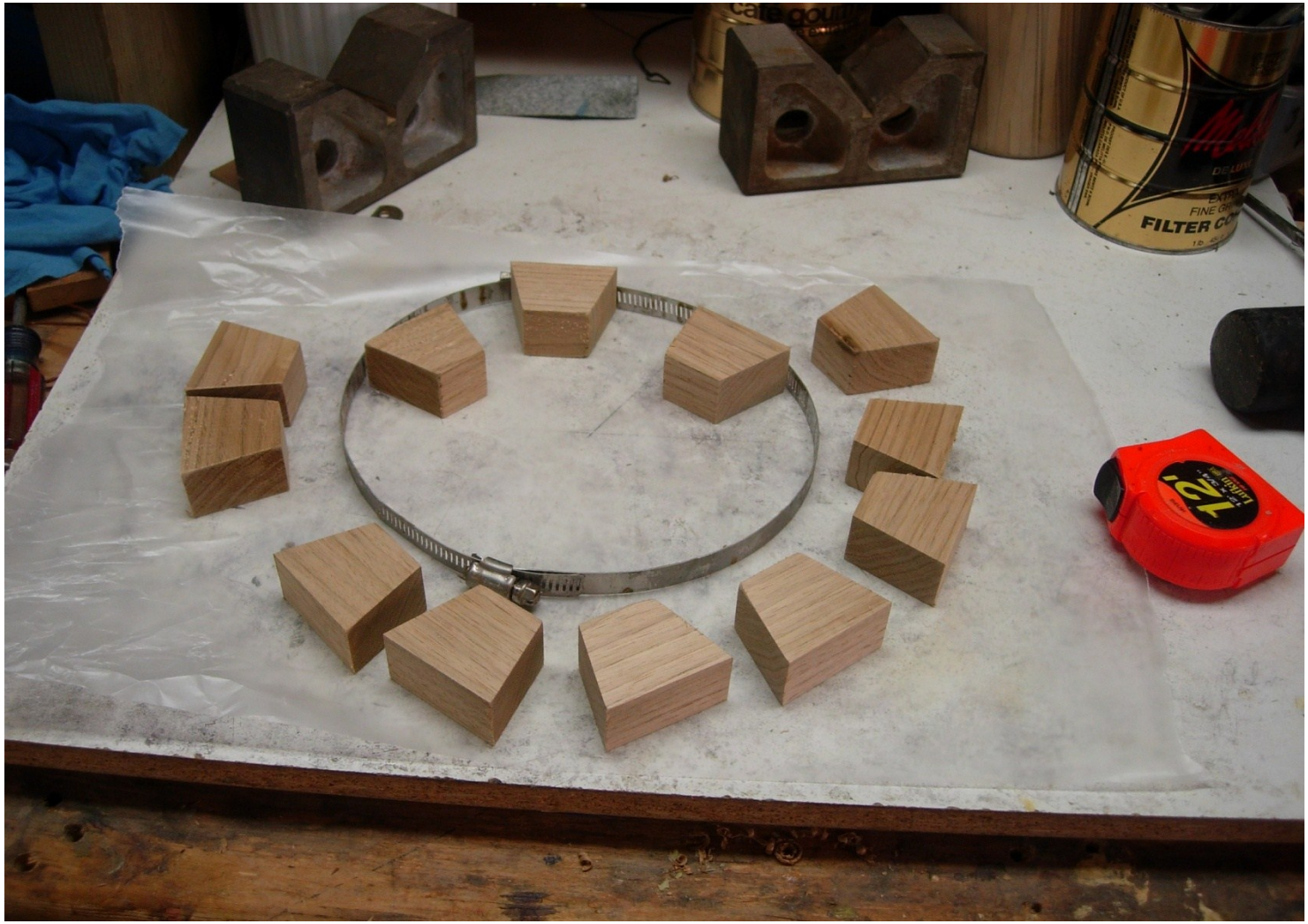
12 Segment Cutting Sled



Wedge Sanding, Gluing & Clamping

- Once you have cut your wedges using whatever tool you have you need to remove the saw burr from all edges (light sanding);
- Next you need to assemble them into a ring on top of wax paper, place a hose clamp over them and tighten to see if you can produce a tight ring. If you can, then you can proceed to gluing if not then further guidance will follow.
- Next I glue each segment edge with original Titebond white glue. Position and tighten the hose clamp. Tap with a rubber mallet to flatten the wedges and wipe the surface with a wet cloth. I then hang the rings on a rail to set overnight.
- Avoid over tightening the hose clamp as this bulges the ring in the center.
- I will often make 4-6 rings at a time.

Wedge Sanding, Gluing & Clamping

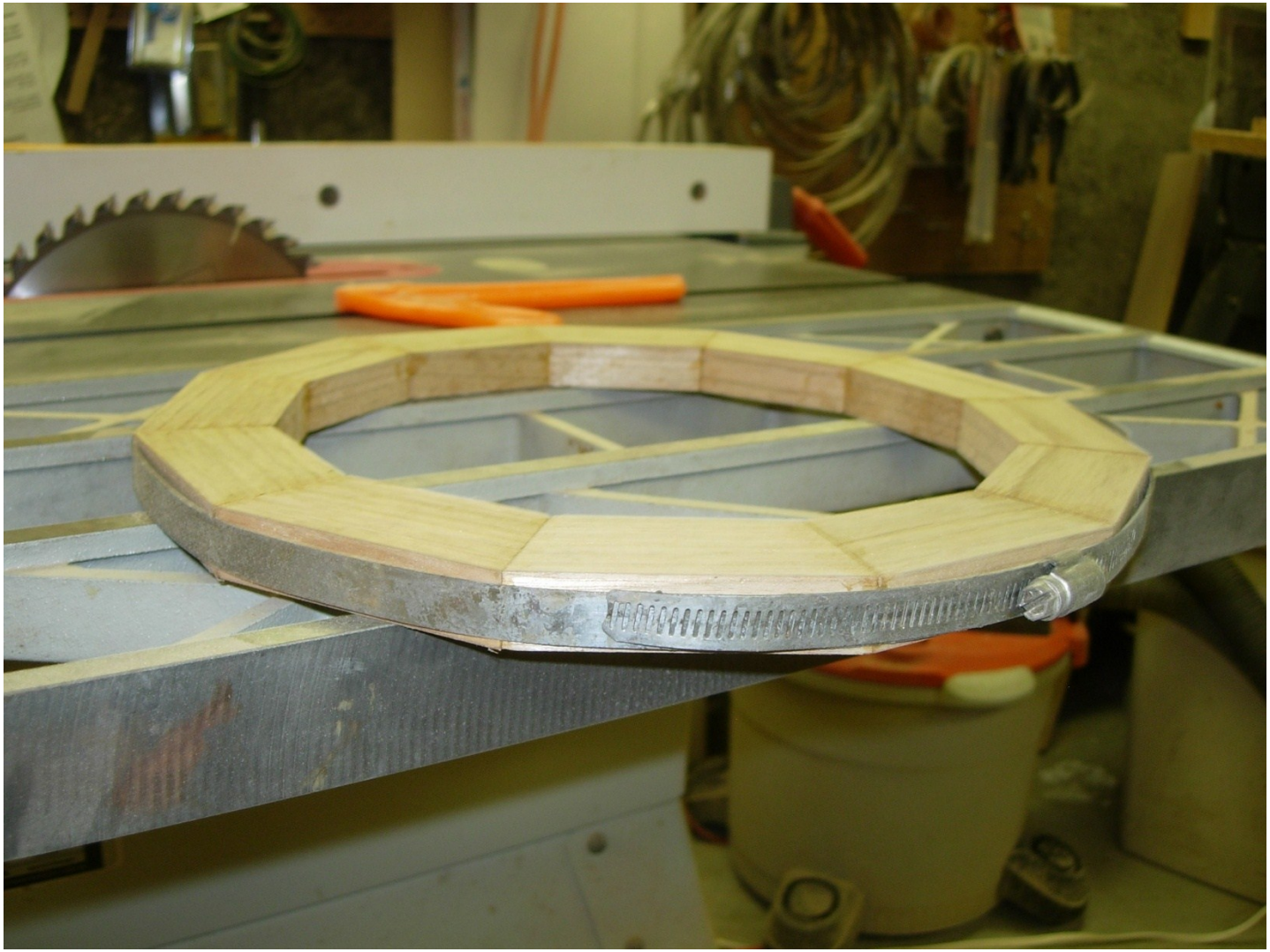


What to do if the pieces do Not form a tight Ring?

- If the wedges you have cut do not form a perfect ring (light showing between the segments) then you can rectify by first gluing / creating half rings by inserting two small pieces of dowel so the two halves are glued separately;
- Next you must sand the edges parallel on each of the two sections. I created a sanding disc and special tool rest for this purpose (see samples).
- Then glue the two sections together;
- To avoid this unnecessary step, it is best to spend time making sure the angles are precise and sanding off any burrs before gluing the wedge;

Tool Rest and Sanding Disc

Wedge Sanding, Gluing & Clamping



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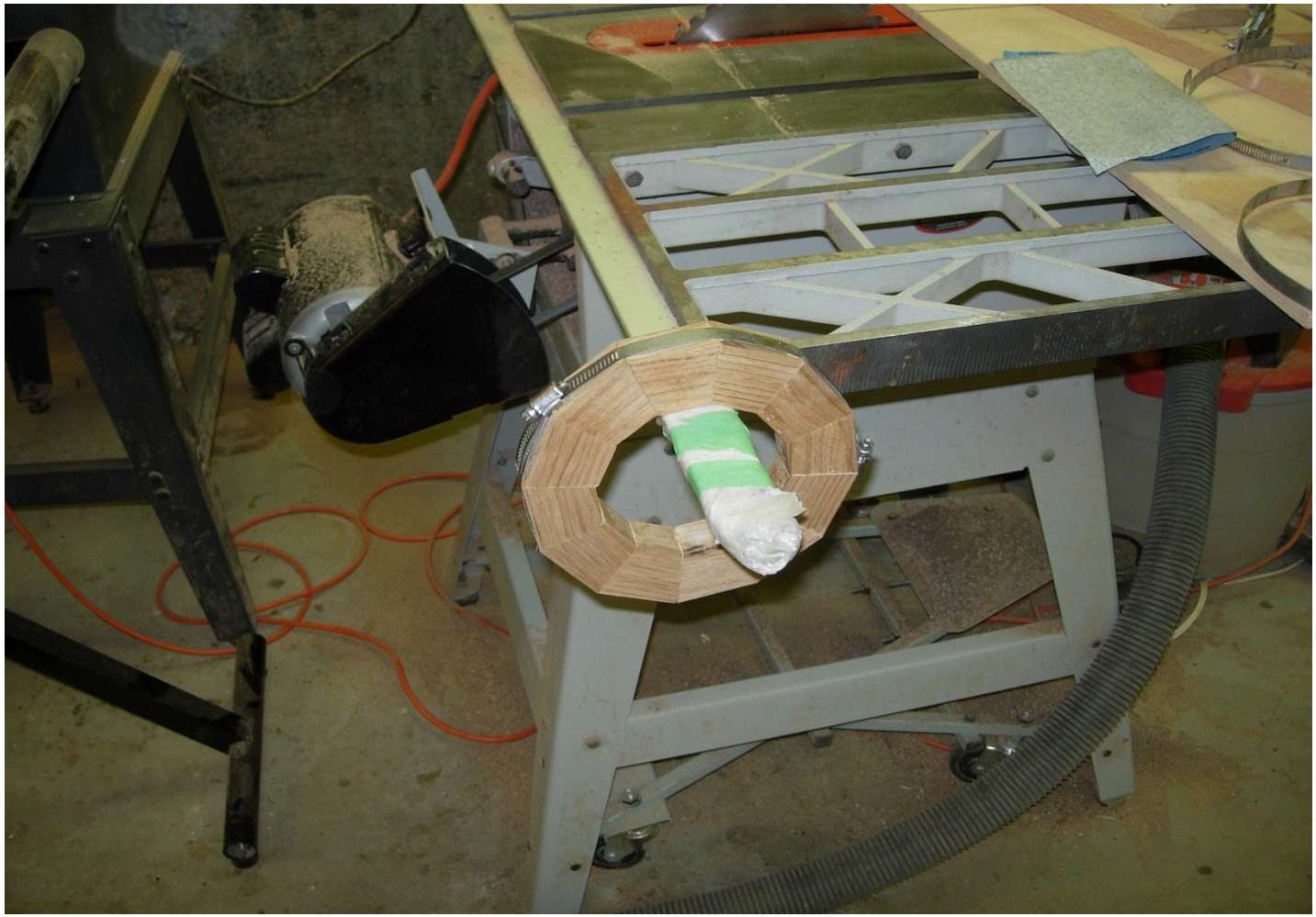

Wedge Sanding, Gluing & Clamping

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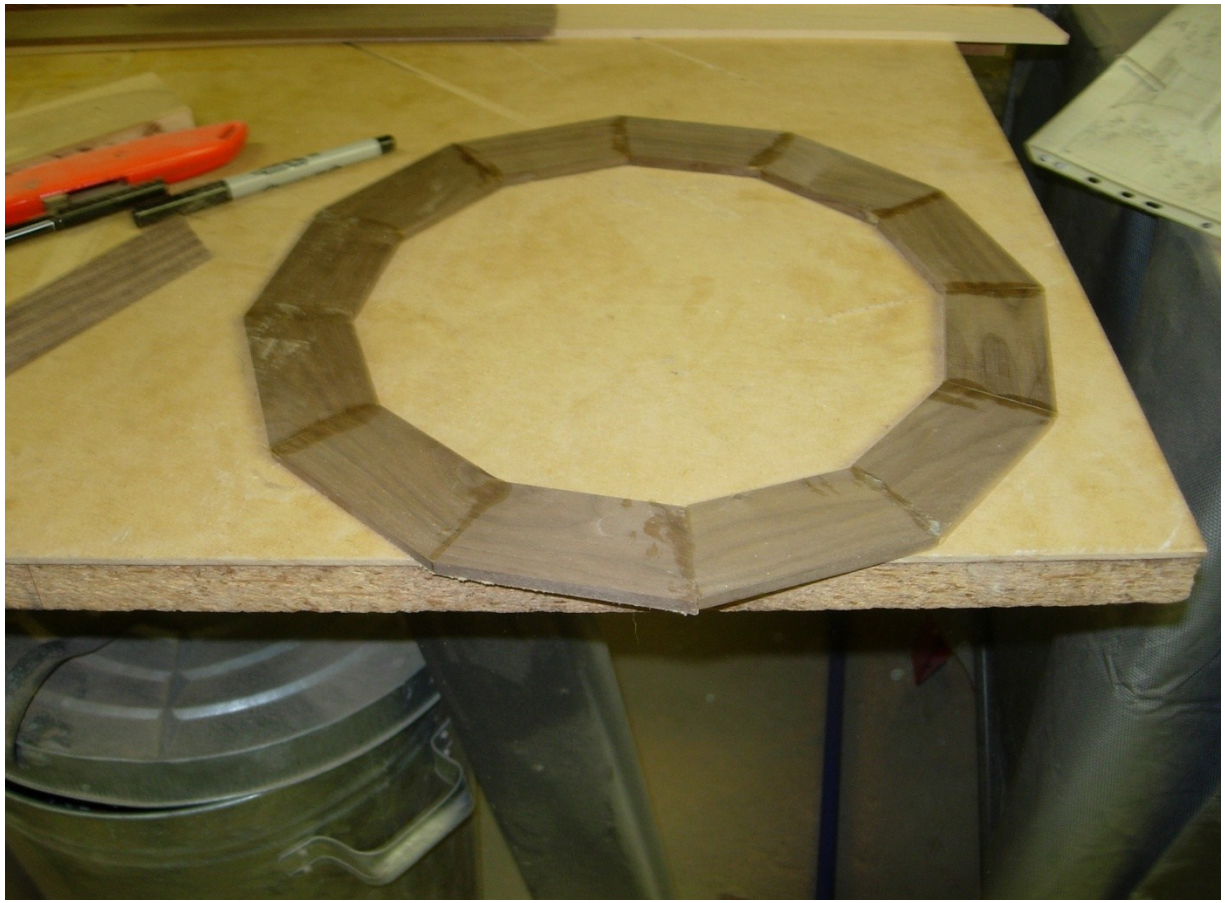
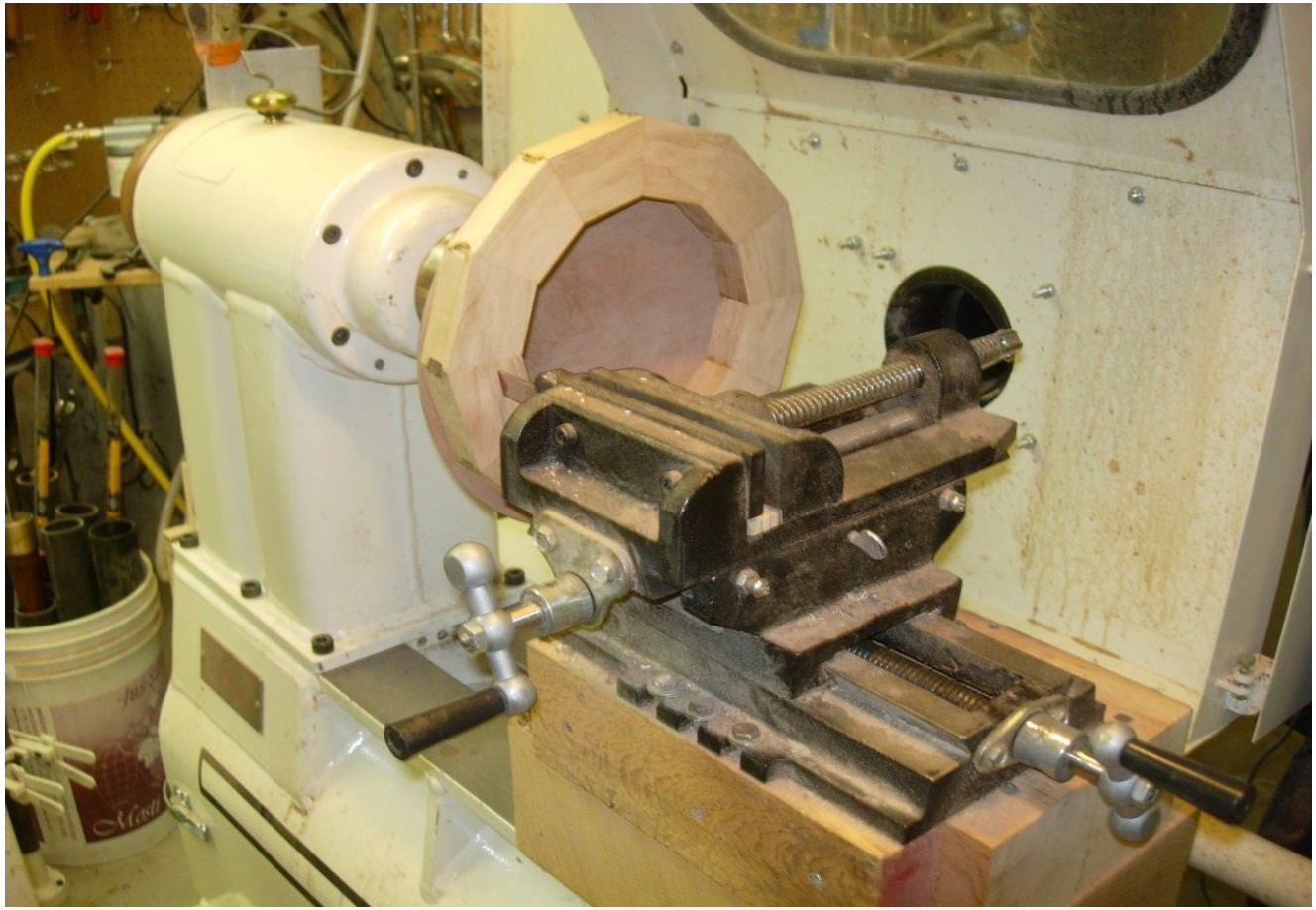


Sanding, Flattening, Correcting Each Ring

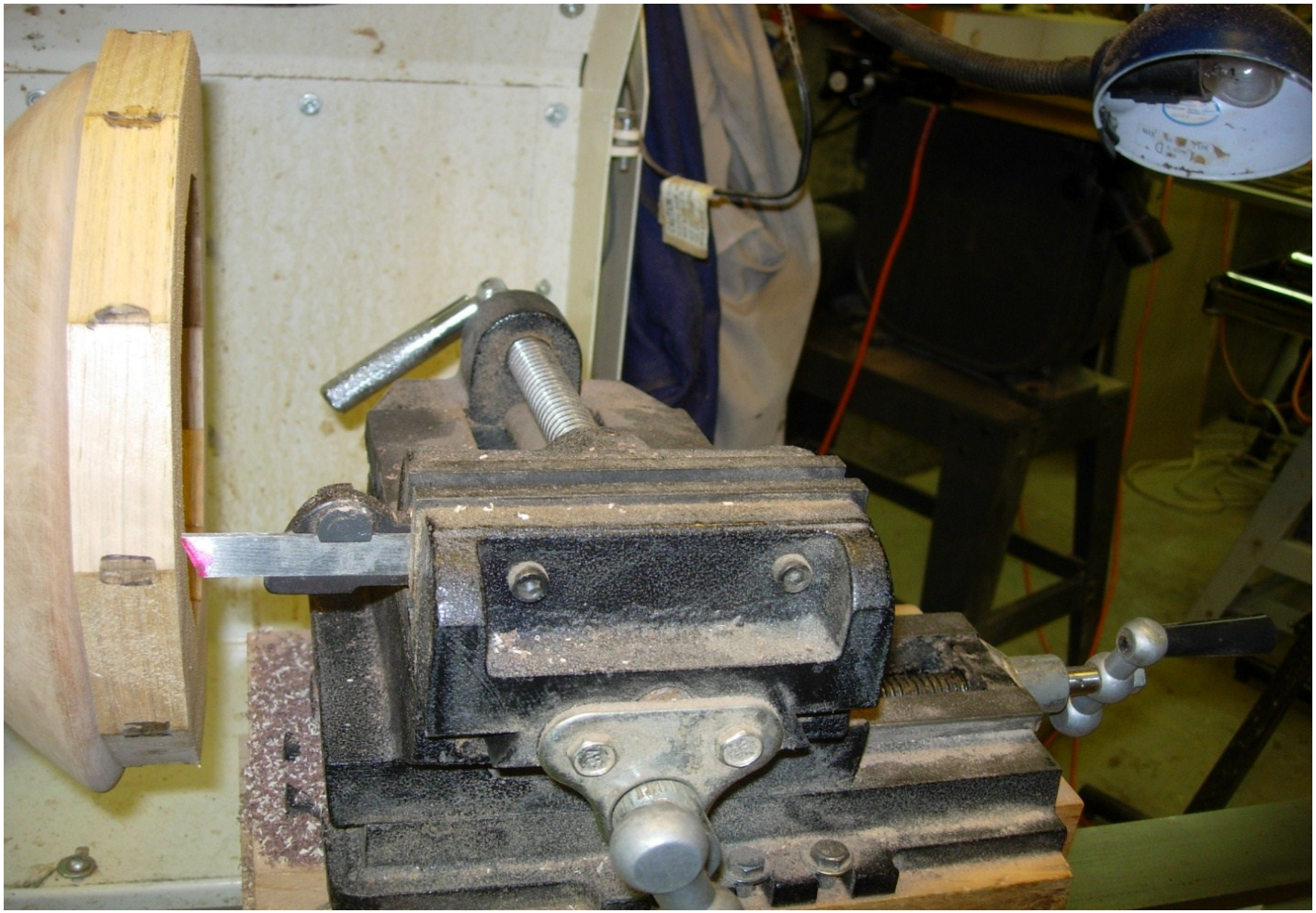
- Once the rings have cured overnight (I usually create 4-6 rings at a time) they need to be sanded / flattened on one side then glued to the previous ring and then corrected to ensure the ring stack remains parallel.
- I begin by scribbling pencil around one side of the ring.
- Next I use my "Flatmaster" sander fitted with about 100 grit sandpaper (This machine is almost dust free due centrifugal force lifting the sandpaper off the Velcro on the roller);
- I continuously rotate the ring while sanding until the pencil is gone; I then flip the ring and do the same thing on the other sides;
- Now both sides are flat but not likely exactly parallel;
- Every 2-3 rows, I use a two-way vice mounted with a shim to fit my lathe to true up the ring outer surface (make it parallel).

Flatmaster Sanding Machine

Jig for Correcting (insuring a parallel stacking of rings)



Jig for Correcting *(insuring a parallel stacking of rings)*



Gluing Consecutive Rings & Rectifying the Surfaces

- I use pretty simple techniques for aligning the segments as will be seen;
- I simply remove the ring stack (base of vase that is growing with each ring) still held in the stronghold chuck;
- I simply glue both surface and let the weight of the base and chuck be the gluing pressure;
- Not much pressure is needed but you must be careful during the first 20 minutes to ensure that the ring does not slide. If the surface used to support the stack is perfectly level in all directions sliding will not occur. If the ring slides and cures out of place you will need to cut /part it off and start that ring again;
- I sometimes glue 2 or 3 rings together before adding them to the main stack;
- Once glued you will need to use the jig I showed you to ensure the ring is parallel.

Gluing the Rings

Gluing the Rings

Gluing the Rings

Gluing the Rings

Shaping the Outside

Sanding & Finishing the Inside en Route

- Experience has taught me to turn the inside of the vase as I go along;
- I usually target for about a ½ to 5/8 inch wall thickness;
- After each 2-3 rows, I turn the inside to create a smooth inner surface;
- I then turn the outside wall to a little larger than the final desired diameter;
- The reason for this is to allow for shape adjustments as needed at the final stages of turning;
- Unless you plan to hand sand and have long arms, it will be best to sand (and seal with Tung oil) the inside as you go along as well.
- I do not sand or finish the outside wall until the entire vase has been constructed

Sanding & Finishing the Inside en Route

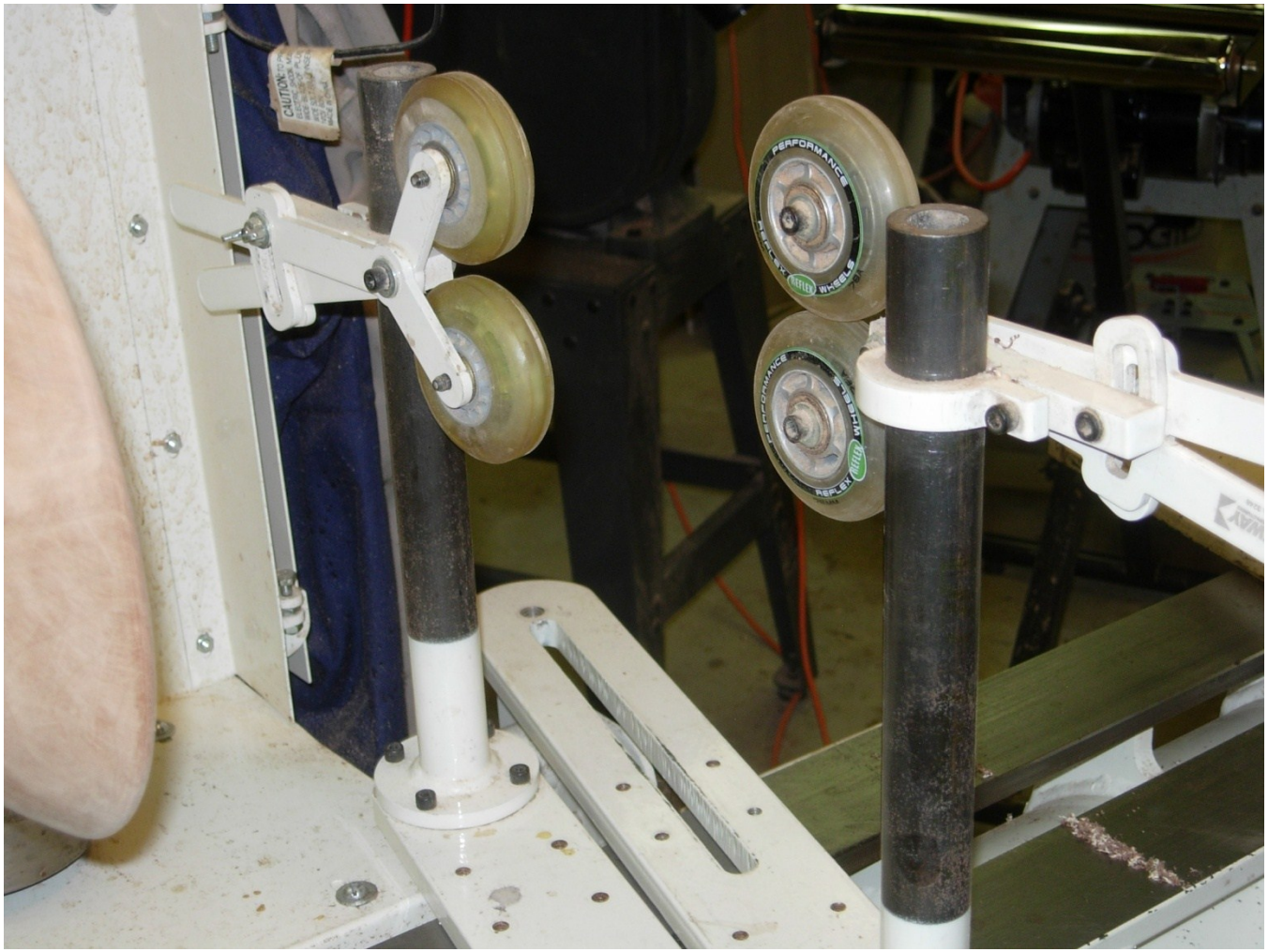
- I sometimes ignore turning the tight inside curves at the neck because of the dangerous torque this will create on a very large vase (I have had very large vases break the tenon as a result of this torque);
- I sand the inside every 2-3 rows to about 400 grit then apply 2-3 coats of Tung oil;
- It is also much easier to sand the inside every 3-4 rows then to use an extended reach for sanding;
- I stop the Tung oil application 1-2 rows from the top (the most recently added rings) to allow for overlap of sanding;
- Finer grits for inside sanding are not necessary other than the upper neck where folks tend to stick their hands in to feel the surface;
- Sometimes when there are very sharp curves I neglect the sanding (where the under-edge can not be seen) and just proceed to sealing with Tung oil.

Sanding and Finishing the Rings

Jumbo Jaws

Jumbo Jaws

Oneway Steady Supports



Sanding and Finishing the Outside

- The final turning consists of turning to the final dimensions;
- This is not the time to redesign the shape of you vase as your final shape can only be altered slightly or you will run out of gluing edge.
- Next, I power sand up to about 1000 grit;
- Next I apply about 3-4 coats of Tung oil or sometimes Wipe On Polyurethane;
- After the finish has cured, I part off the base (I take it down to about 1 inch then finish parting with a Japanese saw).

Options for Completing - Finishing The Vase Bottom

- There several ways of finishing the vase bottom but my preference is to hold the vase cap using jumbo jaws;
- I then use the live center positioned to the center point of the base;
- I then use the parting tool to indent the base about ½ inch from the edge and ½ inch deep;
- I then turn the bottom and remove the final small knob with a chisel and then finish via hand sanding and oiling.
- The final step is buffing using the Beal System.

Finishing Using the Beal System

One or Two Piece Construction Approach

- With very large vases it will be necessary to either provide external support or create the vase in two sections (top and bottom halves) then glue these two together. I have used both techniques;
- With vases of up to 28 inches in height I had in past found that by using two Oneway Steady supports I can do it all with just the base secured in the stronghold chuck;
- After a large tenon break, now if over 24 inches then I now create the vase in two sections. I will start building from the base then stop at the feature ring;
- I will create the vase cap using a block in a chuck then part it off and switch to holding it with jumbo jaws and begin adding rings from the top down;
- I will conclude by joining the two sections together and jam chucking the live center end for the final outside wall sanding and finishing.

References

1) Book: "Segmented Wood Turning, a step-by-step guide "…Malcolm Tibbetts;
2) Sled design and other helpful info: http://www.woodturningonline.com/Turning/segmented_turning/index.html#jigs
3) Flatmaster was sold historically at the Ottawa Wood Show each year by Stockroom Supply. You may contact them at : www.stockroomsupply.com/shop;
4) Plans for cutting wedges = www.turnedwood.com/framesled.html;
5) Graph Paper: http://www.incompetech.com/graphpaper/plain/
6) http://www.woodturner.org/resources/Tibbetts%20Handout.pdf
7) http://www.donleman.com/press/basic_segmenting.pdf
8) http://woodtreks.com/determining-the-dimensions-of-segmented-pieces/41/

A SAMPLE DRAWING

from: http://www.woodturner.org/resources/Tibbetts%20Handout.pdf