Cindy Drozda

Twisted Multi-Axis Box

www.cindydrozda.com

Cindy Drozda "The Fine Art of Woodturning"
P.O. Box 19065 – Boulder, CO 80308 – voice/cell: 303-449-7170 cindy@cindydrozda.com - www.cindydrozda.com

The Twisted Triangle Box - Layout Steps

1. Your blank should have smooth, square ends. It works equally well to start with a square blank, or a rough one that you turn round first.
2. Find the center of the piece of wood on both sides. Rough down to round if desired.
3. Make a reference line that joins the top and bottom layouts. This can either be one corner of the square blank, or a line drawn using the toolrest as a guide.
4. Draw a diameter line from the reference line through center on both sides of the blank.
5. Use a good quality compass with a pencil lead type point. Sharpen the lead with a piece of sandpaper laid flat on the table.
6. Use a ruler with engraved lines for increased accuracy.
7. Pick up your layout marks accurately with an awl mark, being careful not to let the woodgrain push the awl off the layout mark.
8. Pay attention to having the 3 centers
9. Use live and drive centers with sharp points for the turning.
10. Use smaller diameter live and drive centers for the turning. 1/2" diameter is a good choice.
11. Wear sufficient PPE to feel safe!
12. Be sure the blank is held tightly between centers.
13. Use a safe spindle speed for the turning.

This type of layout can be done in a huge range of sizes.
Here's how I determined the relationships in the layout
(this formula works in this size range, and may (or may not) work the same way in much larger layouts):

Starting with the largest diameter available in my blank:

1. Multiply the major (Blue) diameter by .77 to get solid (Red) diameter
2. Subtract ½ " from the Red diameter to get the centerpoints (Green) diameter

Starting with the desired small Red diameter:

1. Multiply the Red diameter by 1.3 (or divide by .77) to get the Blue diameter
2. Subtract ½" from the Red diameter to get the Green diameter

Other things I have discovered:

1. The larger the radius of the outer arcs, the more "triangular" the box appears.
2. The smaller the radius, the more like a circle it looks
3. If the design of the box doesn't fit within the Red cylinder, the hollowing will cut through the sides. This could be either a good thing or a bad thing!
4. Other numbers of centerpoints are also possible using the exact same ideas. 6, 4, and 8 are easy to figure out.
5. The more "sides" to the geometric shape, the more it starts to look round.
6. Don't feel limited by symmetrical points! Any variation of asymmetrical polygons is possible!
7. If the centerpoints 1, 2, & 3 (or however many) are shifted in relation to each other, you will get a "twisted" triangle (or whatever). This looks cool but is harder to sand.
8. Try a tapered 3 (or 4, 6, 8, etc)-sided turning. Make the layout smaller on one end of the block.
9. This same idea works well by only shifting the centerpoints on one end of the block, also.

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The Twisted Triangle Box - Turning Steps

This design starts with a dry blank 3" x 3" x 3 1/2 ", 75mm x 75mm x 88mm
It is possible to do this project in different sizes.

1. Layout top and bottom of box, referring to the Layout Diagram and Layout Steps.
2. Mount blank between centers, round down to just over the Blue (major) diameter.
3. Part in to Red (solid) diameters on ends to create reference diameters, about 1/4" long. Darken the tenon with a marker to make it easier to see.
4. Turn multi-axis triangle using the 3 centers on the Green diameter. Cut until each side contacts Red diameter.
5. Sand the triangular outside of the box completely
6. Cut chucking tenons on both ends.
7. Chuck on bottom, part off the 1-1/4"/32mm long piece that will be made into the top of the box.
8. Hollow, sand & finish inside of box. Create lid recess, or be sure the sides of the box are straight/parallel.
9. Chuck on lid, cut tenon to fit recess in box.
10. Finish the bottom of the bottom of box.
11. Hollow, sand & finish inside of lid
12. Jam fit lid onto waste block to shape and sand the top, creating inlay if desired.
13. Sign your work!

Depending on your skill level, or personal choice, this project can be customized. Here are some suggestions:

If you are new to making boxes:

1. A successful box may be more important than doing a multi-axis one.
2. Eliminate the inlay in the lid, and plan to do that on the next box.
3. Start with a round blank, and make a box with straight sides.
4. Make a shorter box.
5. True up the drilled bottom near the opening, where the lid fits, but leave the drill surface on the rest of it.
6. Give yourself a break on the jam fits. Don't force yourself to rely upon a jam fit without the tailstock. Use a waste block to jam fit so you can re-do it if necessary

For the next challenge:

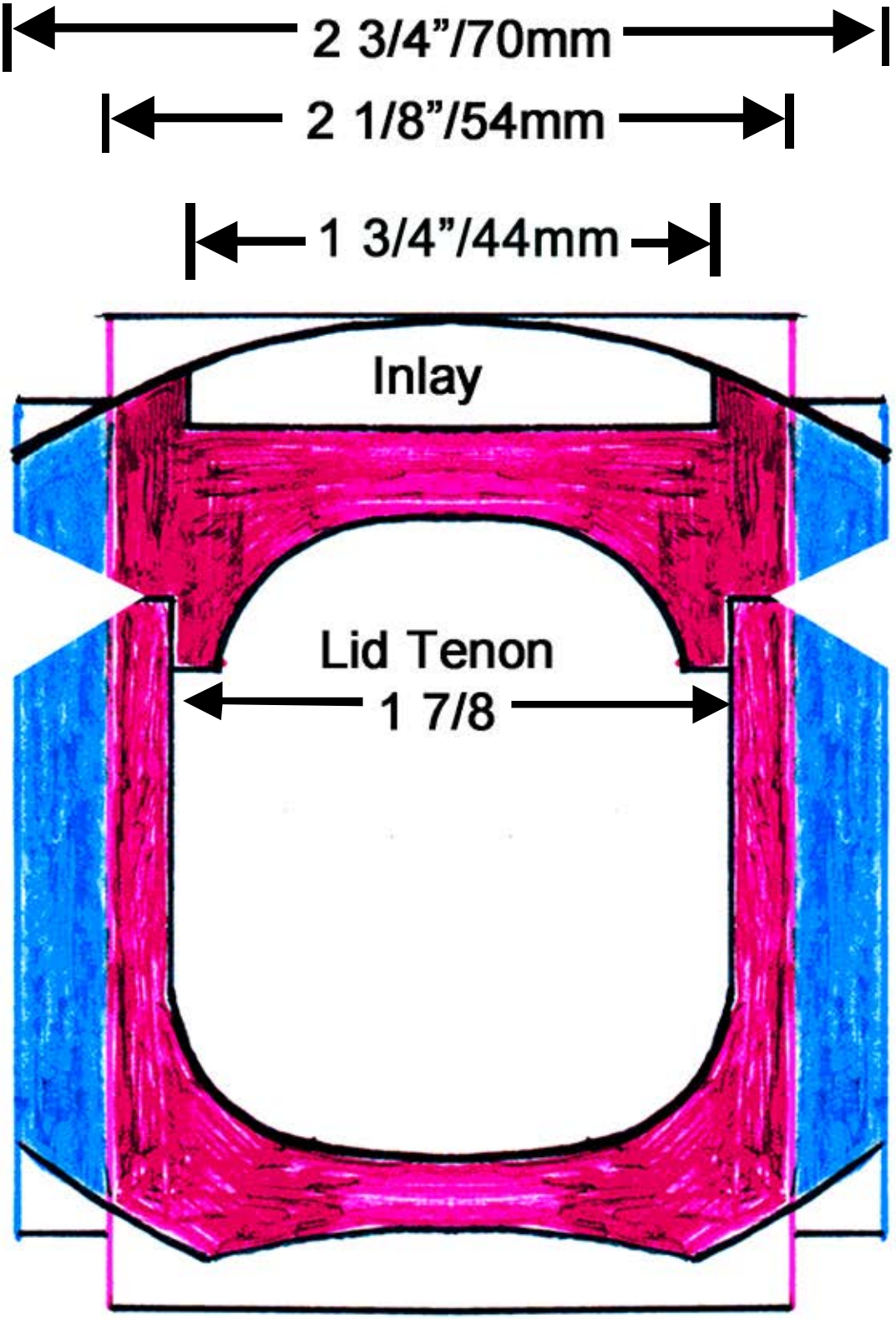
1. Do the inlay in the lid, and/or
2. Do the Multi-Axis exterior.
3. A straight Multi-Axis shape is less challenging than a twisted one.
4. Clean up the entire inside of the box bottom
5. Decorate the inside of the lid, and/or the bottom of the box.

Accept more of a challenge:

1. Do a more complicated top and/or bottom shape on the outside of the box. The undercut top and pointed top that I like to do is much more challenging.
2. Make a deeper box. More toolrest overhang is more challenging.
3. Experiment with the Multi-Axis layout. Try different sizes, tapered sides, non-equilateral triangles, etc.
4. Make a box with 2, 4, or 6 sides.
5. Experiment with box top/bottom proportions.
6. Use different amounts of layout offset for varying degrees of twist. A deeper box will look better with more layout offset.
7. Choose a more difficult wood.
8. Demand a high level of finishing without tool marks or torn grain.

Cindy Drozda's Multi-Axis Box

Plan



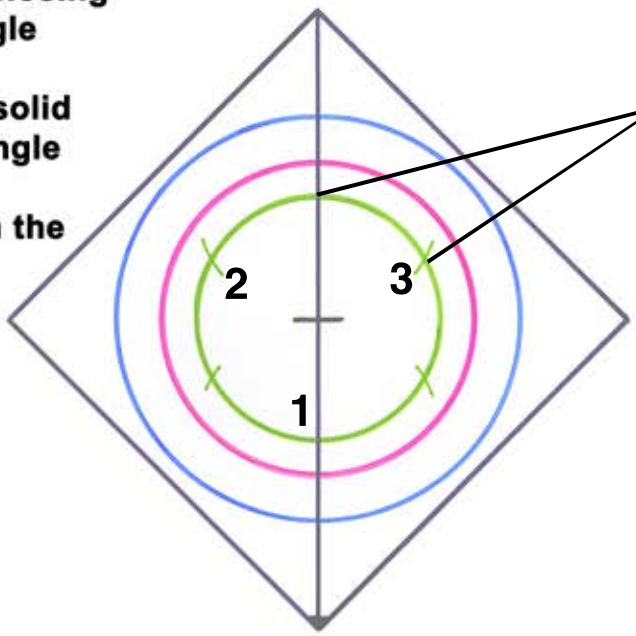
1. Your blank should have smooth, square ends.
2. It works equally well to start with a square blank, or a rough one that you turn round first.
3. Find the center of the piece of wood on both sides. Rough down to round if desired.
4. Make a reference line that joins the top and bottom layouts. This can either be one corner of the square blank, or a line drawn using the toolrest as a guide.
5. Draw a diameter line from the reference line through center on both sides of the blank.
6. Use a good quality compass with a pencil lead type point. Sharpen the lead with a piece of sandpaper laid flat on the table.
7. Use a ruler with engraved lines for increased accuracy.

Cindy Drozda's
Multi-Axis Twisted Box
Layout

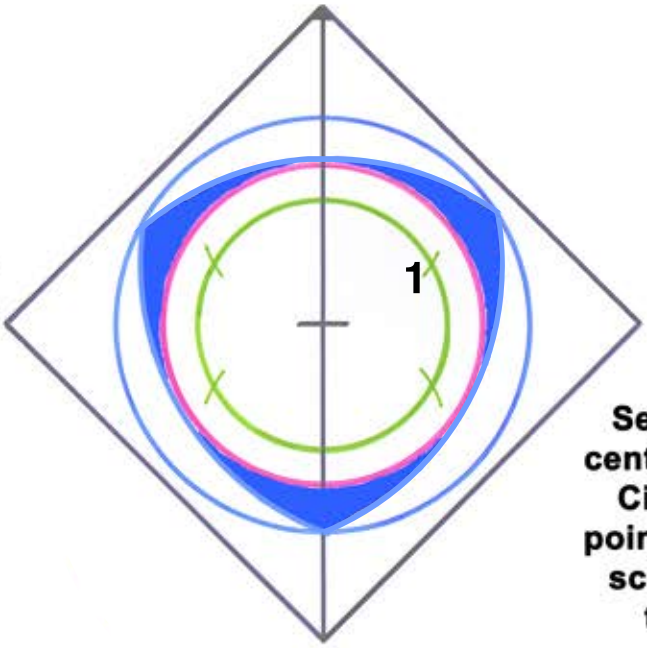
Blue - Major Diameter, enclosing all points of the triangle

Red - Indicates largest solid cylinder within the triangle

Green - Circle on which the drive center points are marked.



Compass set to Green Radius scribes arcs to divide the circumference of the circle into 6 equal arcs



2 3/4"
70mm

2 1/8"
54mm

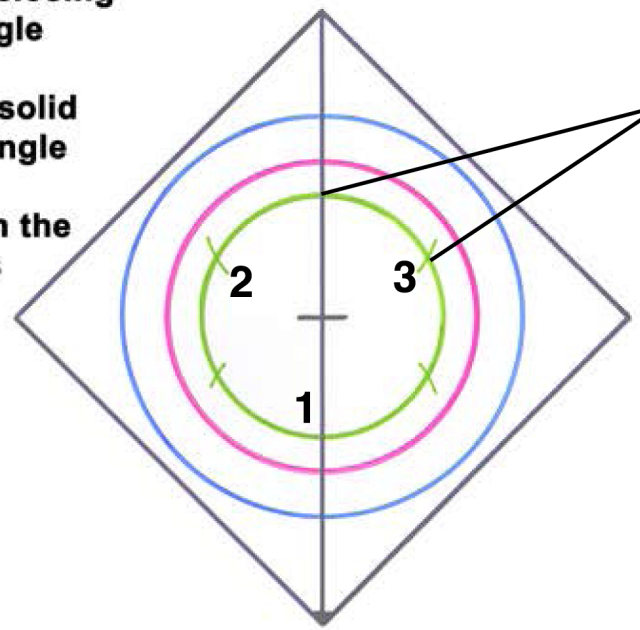
1 5/8"
41mm

Set Compass from center point on Green Circle to opposite point on Red Circle to scribe arcs of Blue triangle points

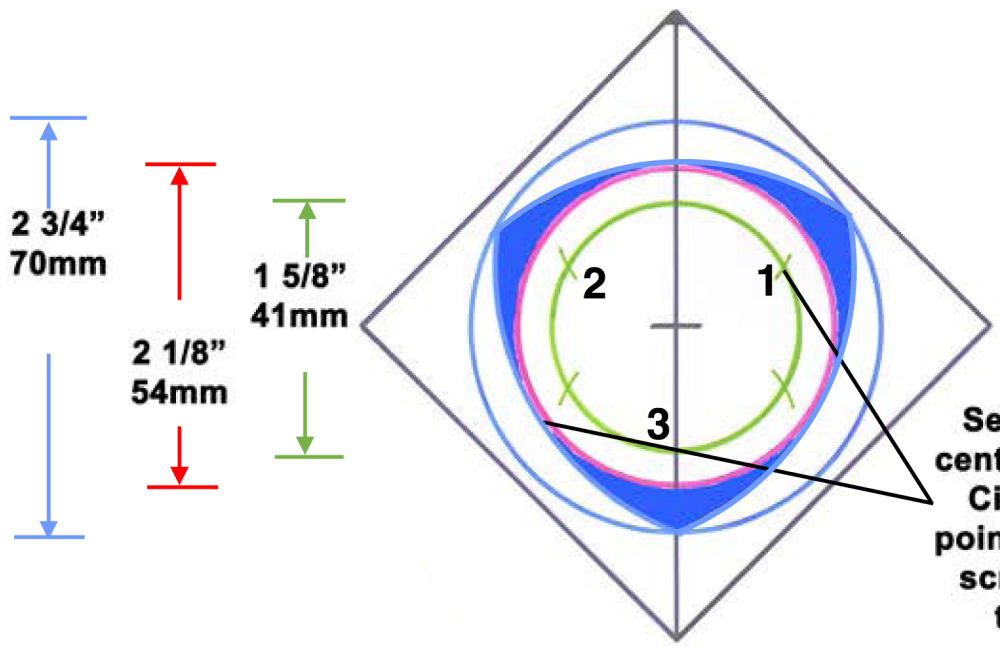
Blue - Major Diameter, enclosing all points of the triangle

Red - Indicates largest solid cylinder within the triangle

Green - Circle on which the drive center points are marked.



Compass set to Green Radius scribes arcs to divide the circumference of the circle into 6 equal arcs



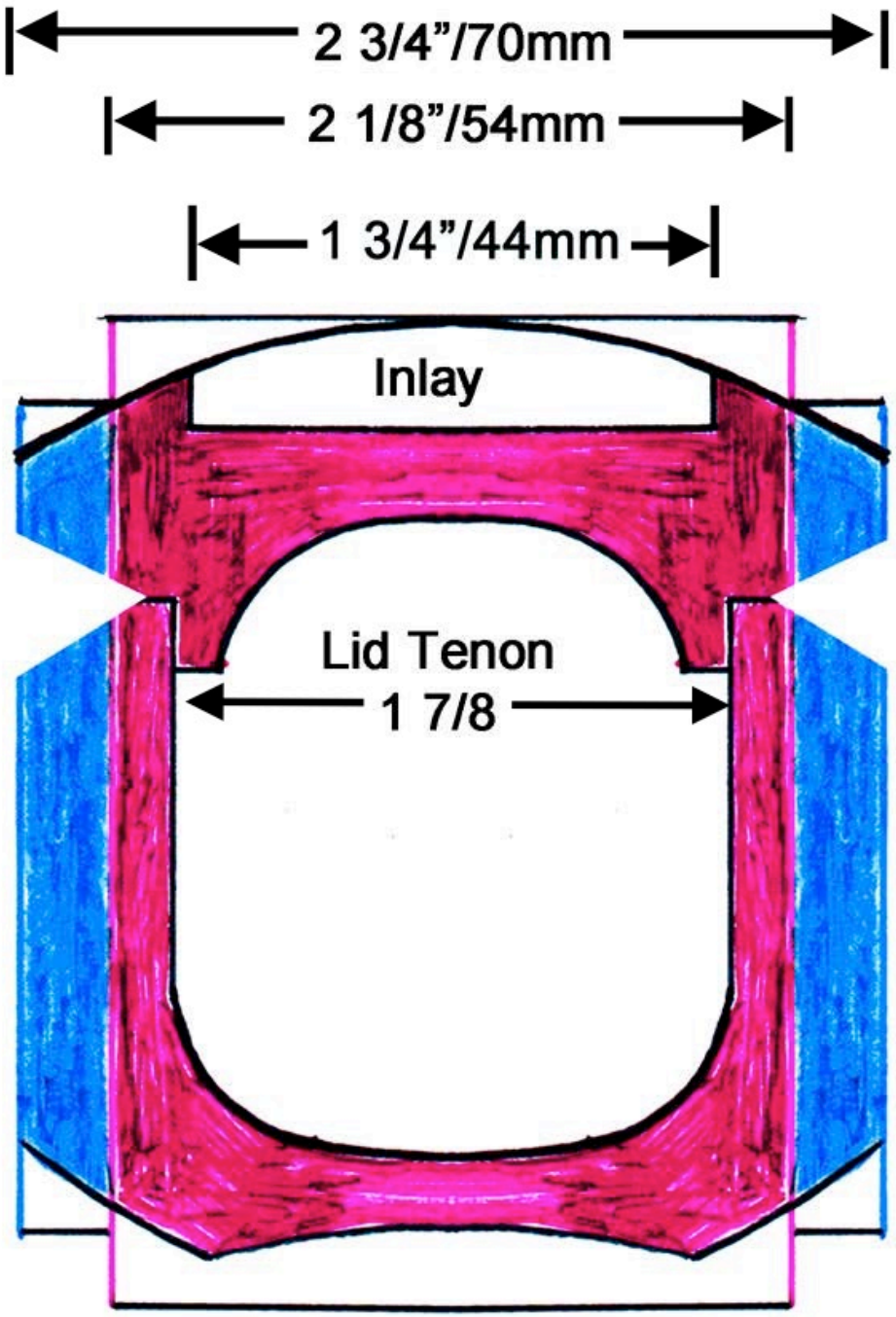
Set Compass from center point on Green Circle to opposite point on Red Circle to scribe arcs of Blue triangle points

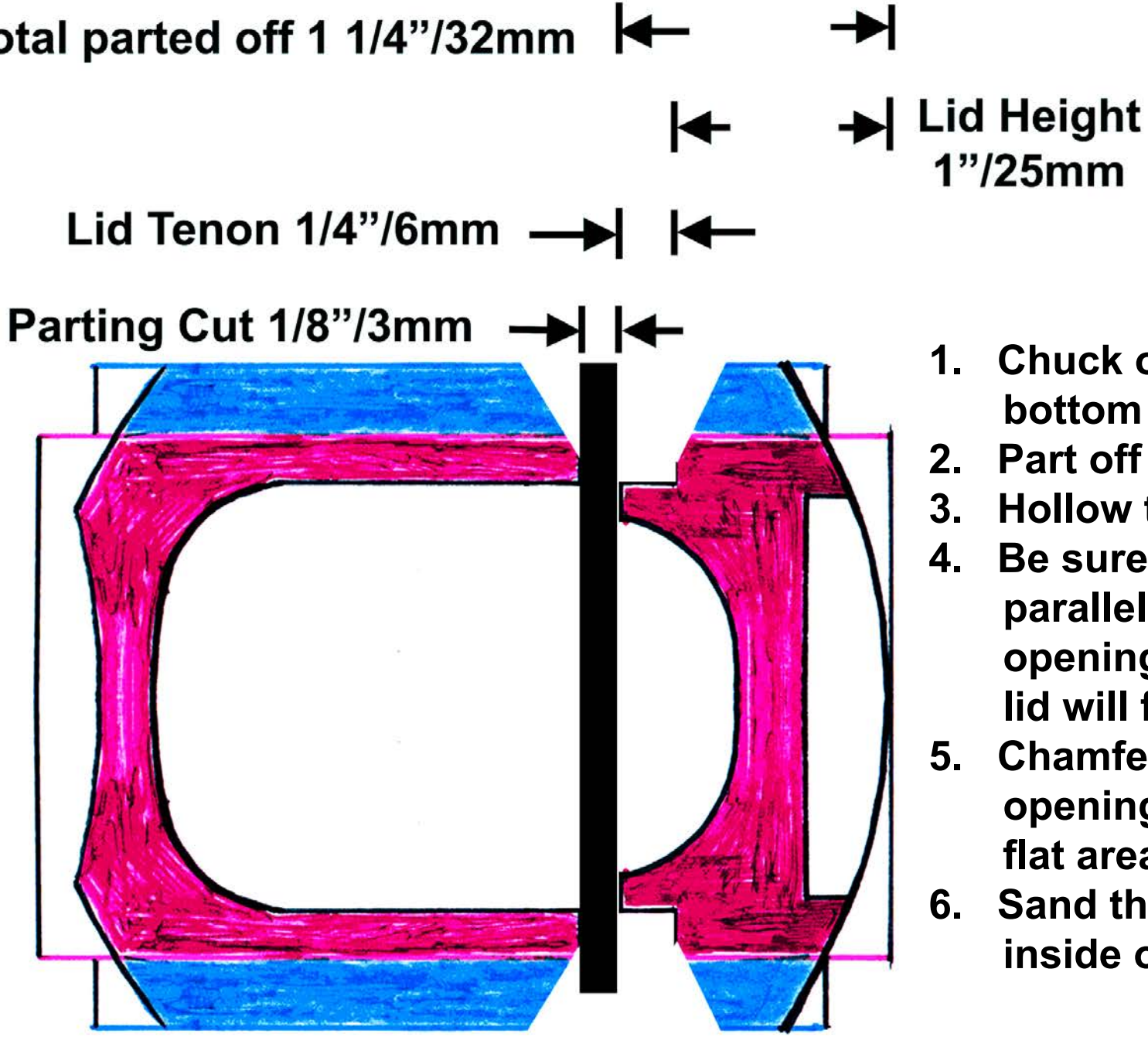
1. Pick up your layout marks accurately with an awl mark, being careful not to let the wood grain push the awl away from the layout mark.
2. Pay attention to having the 3 centers numbered clockwise on one end of the blank, counter-clockwise on the other.
3. Rotate the 3 centers the desired amount on one side of the blank in relation to the other side to get a twist.

1. The more the top and bottom layouts are rotated in relation to each other, the steeper the twist angle will be.
2. The further apart the top and bottom of the box are, the shallower the twist angle will be.
3. A taller box will look better with more twist.
4. A shorter box will look better with less twist.

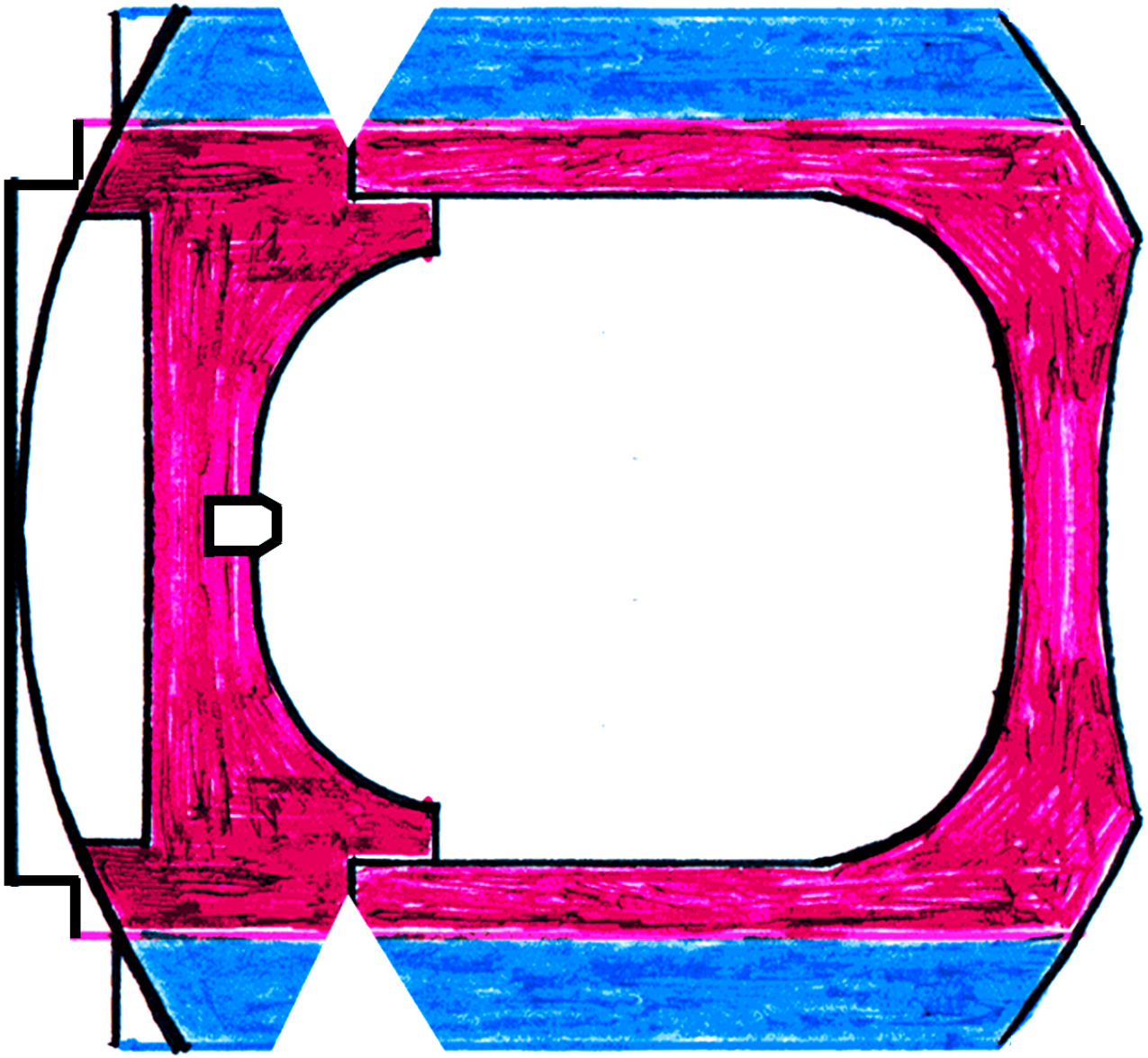
1. Use live and drive centers with sharp points for the turning.
2. Use smaller diameter live and drive centers. 1/2” diameter is a good choice.
3. Wear sufficient PPE to feel safe!
4. Be sure the blank is held tightly between centers.
5. Use a safe spindle speed for the turning.
6. The faster you are able to safely turn the spindle speed, the easier it will be to get a clean, straight cut.
7. Turn the Multi-Axis Triangle shape using the 3 sets of centers on the Green diameter.
8. Cut until each side contacts the Red diameter tenon. It helps to blacken the tenon so it is easier to see.
9. Sand the Multi-Axis outside of the box completely
10. Cut chucking tenons on both ends, creating a shoulder to bear up against the face of the chuck jaws.

Design your box within the Red Diameter to keep from exposing the lid tenon on the sides of the box.

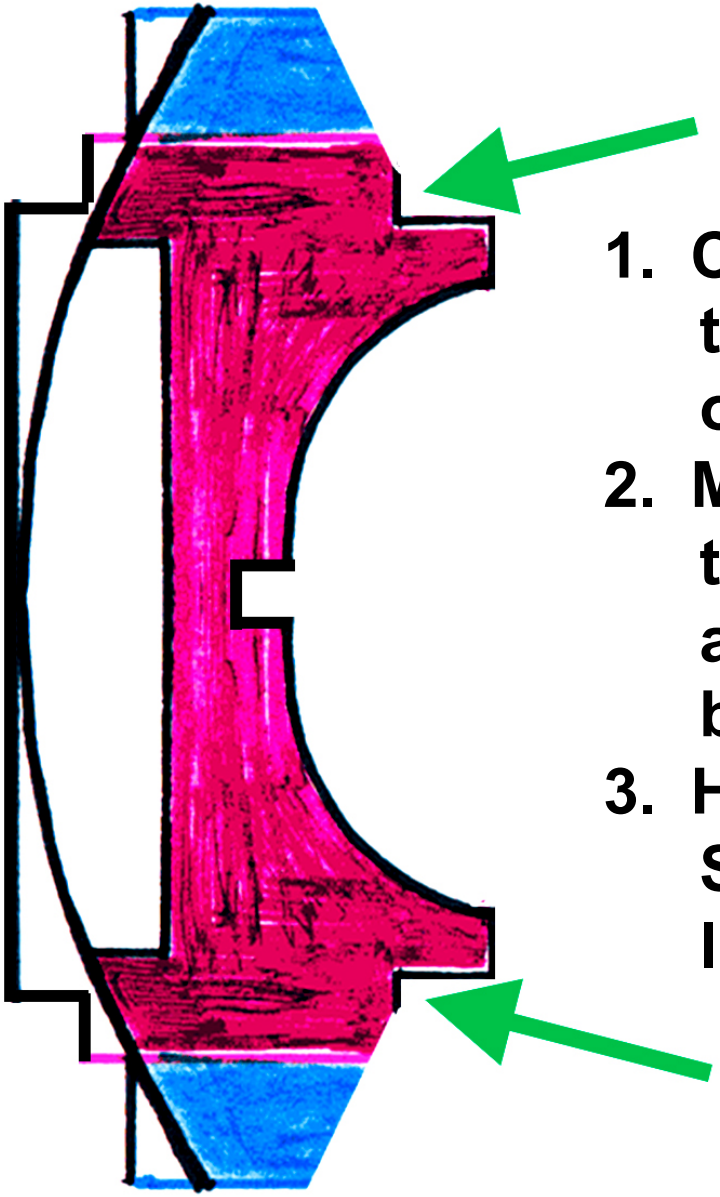




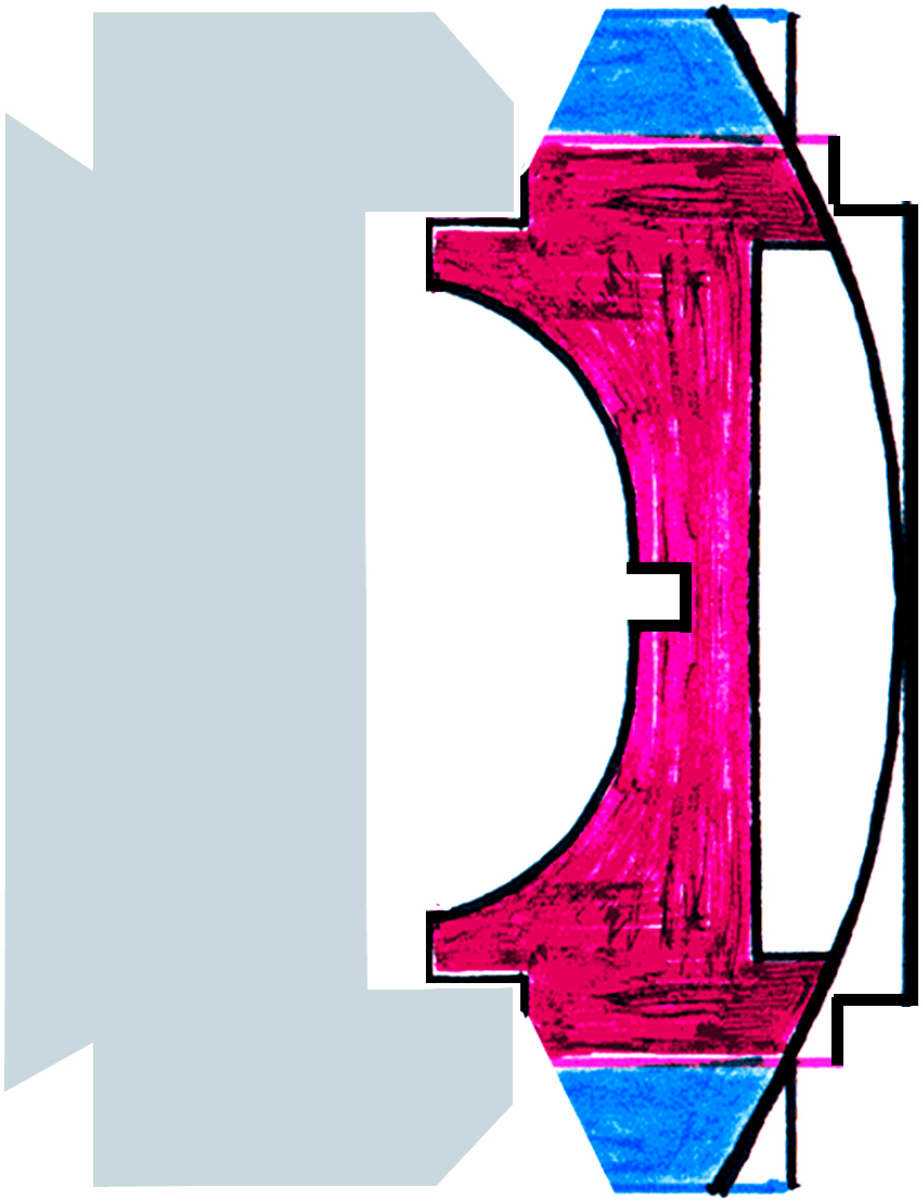
1. Chuck on the bottom of the box.
2. Part off the Lid.
3. Hollow the box.
4. Be sure to create a parallel wall at the opening where the lid will fit.
5. Chamfer the opening, leaving a flat area at the rim.
6. Sand the rim and inside of the box.



1. Chuck on the lid
2. Cut a tenon to jam-fit the box bottom.
3. Shape and sand the bottom.

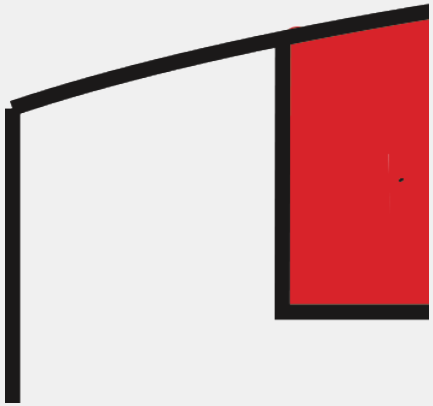


1. Create a chamfer on the lid to match the one on the bottom.
2. Match the flat next to the tenon with the one at the rim on the bottom.
3. Hollow, Detail, and Sand the inside of the lid.

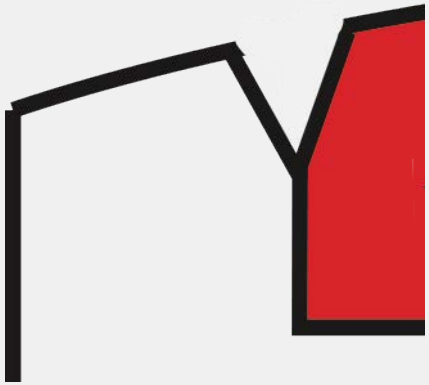


1. Size the inlay using a friction drive, either the chuck jaws or a flattened waste block.
2. Jam fit the lid into a recess in the waste block. Chamfer the waste block so you can get your fingers in to remove the lid.
3. Drill a hole through the waste block for insurance.
4. Shape the top of the box.
5. Cut a recess for the inlay and glue it in, clamp with the tailstock
6. Shape the inlay, add a bead or half-bead if desired, and sand.

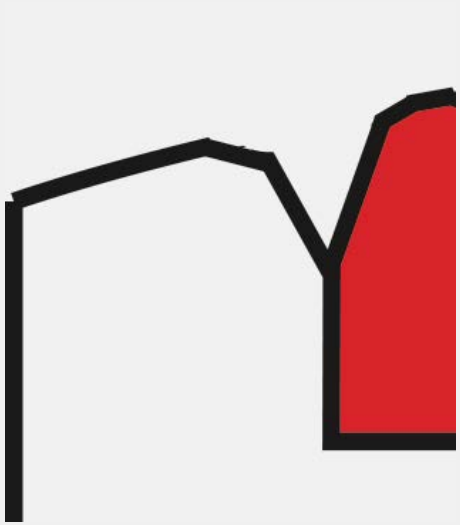
1 – The flush inlay



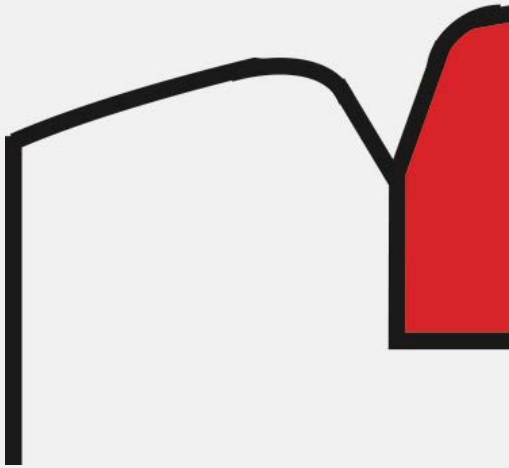
2 - Cut a Vee Groove parallel to the joint line



3 – Chamfer the top corners of the Vee Grooves



4 - Sand to a smooth round bead or half bead with double sided abrasive



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Tool List for the Triangle Box woodturning project

Gather up your tools:

1. 3/4"/19mm Spindle Roughing Gouge (Optional: different sizes of SRG, or use a bowl gouge)
2. 1/16"/1.5mm Parting Tool (Optional to use 1/8" if that's what you have)
3. 3/8"/10mm Beading and Parting Tool (optional: other type or width of straight across negative rake scraper)
4. 3/8"/10mm 40/40 Bowl Gouge (Optional)
5. 1/2"/13mm Straight Side, Flat Bottom Box Negative Rake Scraper (optional: other scraper to true up the opening of the box bottom, and/or to finish the inside bottom of the box. A 3/8"/10mm - 1/2"/13mm round nose scraper works well for this)
6. 1/8"/3mm Parting Tool (I prefer a non-diamond, non-fluted style, but use what you have)
7. General Brand Vernier Caliper (for scribing) (Optional: any caliper that can be locked will work. Be sure to round/soften the sharp corners of the outside jaws)
8. 1-3/4"/45mm Forstner Drill that can be held in the tailstock taper. (I use the Carter Products Strong Bore. A Jacobs Chuck works well, too)
9. 1/2"/13mm Square Recess Scraper (Optional: other straight edged scraper to true up the opening of the box bottom and to cut a jam fit recess)
10. 3/8"/10mm Finial Gouge (Optional: Your favorite grind of spindle gouge, in width from 1/4"/6mm – 1/2"/13mm
11. 1/4"/6mm Pyramid Tool (Optional)
12. Figure 8 Caliper (for wall thickness) (Optional: your choice of wall thickness caliper)
13. Depth Gauge
14. Compass for layout
15. Ruler for layout
16. Awl
17. 1/2"/13mm Steb Centers for headstock and tailstock (Optional: Other live/drive centers with similar size footprint. They need a point that will locate accurately on your awl marks, and a cup-type rim that will grip the wood. A "Safety Driver" works well in the headstock. A OneWay or Powermatic Live Center works well)
18. Glue, if you are doing the inlay. (I use Franklin Titebond, aliphatic resin carpenter's wood glue)
19. A lathe with electronic variable speed. Being able to adjust the speed from zero rpm up is an important safety consideration.
20. Your choice of PPE. I like to wear a full face shield when turning the piece between centers to do the multi-axis turning. Remember that the only thing keeping that out of balance piece of wood on the lathe is the pressure between the live and drive centers!

Please note: It is not necessary to have all of these tools to make this project! I have listed what I use, with some suggested options, but it is possible to make this box without owning all of these tools.

Most of these tools (and more) are available on my website, cindydrozda.com. The rest of them can be found at other woodturning tool suppliers.

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Prepare your blank:

I start this project with a 3" diameter, or 3" square, piece of wood about 3-1/2" long. That's 75mm diameter or square, and 90mm long. The length can vary a lot. For this layout, it needs to yield over 2-3/4"/70mm in diameter once it is rounded.

Timber choice can be almost anything that will hold together to make a box. I have used straight grain wood, like Ash, Cherry, Maple, Madrone, Walnut, Burls, and exotics. Spalted wood can tear out badly and not maintain crisp corners. Very hard wood (such as exotics) will take more time, but the result will be beautiful.

Very soft wood will compress a lot when turned multi-axis between centers. I recommend not choosing excessively soft wood, or spalted wood.

You will also need a piece for the inlay, if you choose to do it. Any good looking contrasting material works well. The piece needs to be about 2-1/4"/55mm square or round, and about 5/16"/8mm thick or more. I like to use a showy piece of burl or figured wood that is a complimentary and contrasting color to the main box. Flatten at least one face of the piece on a belt or disk sander for best results. A bandsaw cut does work out ok if it's smooth and straight.