Long Island Woodturner's Association

AUGUST 28, 2013 VOLUME 23, NUMBER 8

CLUB CALENDAR

Our next meeting will be on Saturday, September 21st at 9AM. John Kowalchuk will be our demonstrator.

CLUB MEETINGS

Long Island Wood turners Association, Inc. is a member of the American Association of Wood turners. We usually meet on the 3rd Saturday of each month at 9AM at the BOCES, Wilson Tech Campus in Dix Hills. Please check our calendar for 2013 meeting dates.

Directions- LIE to exit 51 (Deer Park Avenue). Go east one block on the service road to Westminster Ave.. Turn right and proceed to the BOCES entrance. Turn left and proceed to Bldg "D".

OUR MEETINGS

Our meetings consist of a brief business meeting followed by a "Show & Tell" of member's recent work and a demonstration by members or guest turners. All of our activities promote woodturning and opportunities for members to improve their skills. A wood and/or tool raffle is held at each meeting. A free video and text library is available for member's use. Workshops are also held at member's shops. See the Club Calendar for dates and times.

Our club website is www.liwoodturners.org . It is maintained by Marty Mandelbaum whose e-mail address is martymande@gmail

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General Business

As usual, there was no business meeting conducted during our August meeting. There were approximately 25 members present. Norm announced that he was working on the meeting schedule at BOCES and would provide a schedule for 2013-2014 in a few weeks. Steve reported that he received 20 responses to his questionnaire about demonstrations and that the results will be discussed at the Exec. Committee meeting that will follow his demonstration.

Bob Brady

A letter from Steve Fulgoni, President,

Hello all,

It is with great sadness that I have to tell of the passing of one of our most dear friends, Bob Brady.

Bob passed away last night peacefully as the result of cancer. We learned about Bob's illness just about a month ago and several of us spoke to him just within the last week.

As you know, Bob was one of the founding members of our club and for more than 25 years was a friend, mentor and the beacon of our group.

Woodturning was his passion and he was always there for us to lend a hand, give a demo and help us out. I owe my passion for woodturning to Bob's friendship.

We have lost a great man, but he left part of himself within each of us.

The will be a Memorial / Celebration of Life Service in November

Steve Fulgoni

Meeting Schedule

Here are the dates of our upcoming meetings: 9/21,10/19,1116,12/14,1/11,2/8,3/15,4/26,5/17 & 6/14

Les and Ken will be demonstrating woodturning, (and trying to solicit new members), on October 19 & 20 at the Rock Hall Museum, Lawrence, NY. Members are invited to drop by and offer support.

Tuesday meeting at John Kowalchuk home. The project will be to core a bowl. Call John for additional information.

Demonstration

Steve Fulgoni gave a demonstration of (a). How to orient a log (b). How to prepare a blank from the log and c. use of three different bowl gouge grinds to turn and hollow a bowl.
His sources were “Turning Green Wood” by Michael O’Donnell, “The Secret Life of the Forest” and “Peterson’s Field Guide”.

Steve provided a drawing of a typical hardwood tree and talked about the massive amounts of weight in the trunk and main branches. This causes the creation of reaction wood which results in changes in pith location and in tension areas above the pith and compression areas below it. The reaction wood provides the “figure” that many of us look for but also causes warping and cracking during the drying phase. For this reason, the lumber industry uses only trunk wood.

By learning how to identify different grain patterns, we can make the best use of a log and also know how the blank or finished piece will shrink and warp.

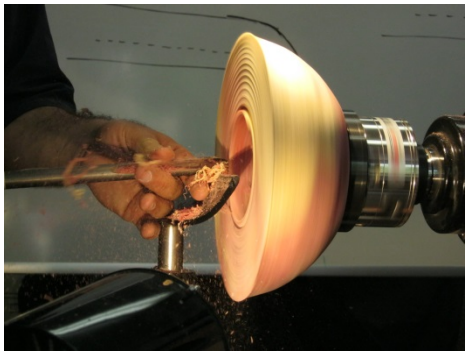
Steve talked about other “figure” that we may find such as optical interference, “cats-eye” effects, insect holes and discolorations and spalting.

Wood shrinks as water evaporates and the, cell walls collapse. The log will shrink about 4% along its radius and 8% along the circumference. Reaction wood shrinks even more. Splitting a log allows for more movement without checking and rough turning a piece with a even wall thickness will cause it to dry evenly. A piece turned very thin will reach equilibrium with the surrounding air very quickly.

To create a blank, remove the checked ends, split the log in half, (removing the pith if the log is large enough), cut a blank on the bandsaw using a round template and
seal with wax or shrinkwrap.

Steve then described the 3 types of flutes found in bowl gouges and their advantages. Using a 65 degree 5/8 gouge he first rough shapes the bottom of the bowl with a scraping cut and then used the front of the gouge, riding the bevel, to shape the outside.

He stressed using a 45-50 degree gouge with a push cut to achieve the best finish and using a 75-80 degree gouge to complete the transition area and the bottom of

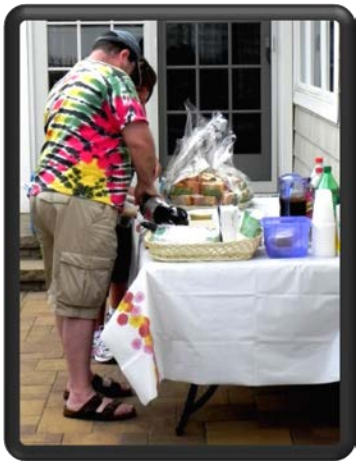


the bowl. When cutting a tenon at the bottom of a bowl, Steve carefully forms a dovetail so his jaws will pull the tenon into the chuck to seat it more firmly.

"Summer Fun, Act 2" - Party at Steve's

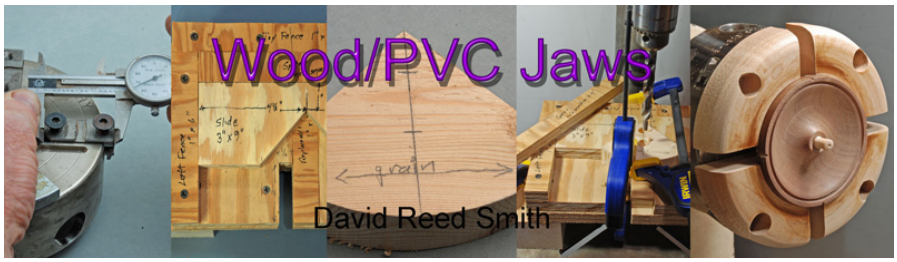
The club wishes to thank Steve and Marissa for their hospatality and being such great hosts!! We cannot forget the outstanding baked Ziti!!!

PARTY



Chapter Challenge

The Chapter Challenge for August – whatever you can turn



INTRODUCTION: 4-jawed chucks are holding devices of great versatility. You can make them even more versatile by creating your own sets of top jaws out of wood or solid PVC. Homemade jaws have two great advantages over the metal jaws that came with your chuck: You can make them any size and shape you like, and they can hold already turned and even finished portions of your work without marring it.

The key to successfully making your own top jaws is drilling the mounting holes accurately, so first this article will describe making a drilling jig that makes this almost automatic. Then tuning the jig and turning the jaw blanks to size will be shown. Last I'll show several applications for wood or PVC jaws to get you started making your own.

PRUDENCE: Making the jaws out of wood or PVC lets you turn or shape the jaws as you like, but the down side of this is because they aren't made of metal they aren't as strong. You will also lose the jaw stop that keeps you from opening the jaws too far. This is fine as long as you approach them with prudence and select your lathe speed with a healthy dose of common sense. Suit the material you make the jaws out of to the size and strength requirements of the application. Most sheet goods are unsuitable, as they are notoriously weak to tension applied perpendicular to the sheet. Mdf is probably the worst--even a minor catch would probably rip it apart above the mounting screws. Pine is suitable for small items, such as tippy tops, but I suggest avoiding construction 2x4's and their wider cousins.

Maple, or some other fine grained hard wood is excellent for medium sized application. Where high strength is required, particularly in all directions, I suggest you try solid PVC, which you can buy in a remarkable range of shapes and sizes from any Industrial Supplier, such as McMaster-Carr. Be prepared for sticker shock. We think of plastic as being cheap, but that's because plastic items usually use so little of it, whereas a 6" cylinder of solid PVC is darned heavy. But sometimes it's worth the expense and bother. I tried making a set of 5" or so sphere jaws out of wood once and they were a disaster, whereas the PVC sphere jaws I've made feel quite solid.

Always remember that the gentler hold of wood or PVC jaws means that the hold could fail and keep your lathe speed reasonable and use protective equipment if the work is going faster than you want to be hit by it. I don't wish to overstate the dangers, for instance a set of scoop jaws that completely surround the handle can eliminate the propeller effect and actually be safer, but, well, be prudent.

MAKING THE DRILLING JIG: The first step in making the drilling jig is determining the mounting hole separation for the jaws of your chuck. Trying to eyeball the centers of a tapped holes isn't good enough. One more accurate way (there are others) is to remove a jaw from your chuck and insert the mounting screws back into the chuck. Use calipers to measure the distance across the heads of the screws, and subtract the width of one head as in Fig. 1. The separation for my OneWay Stronghold chuck is 1".

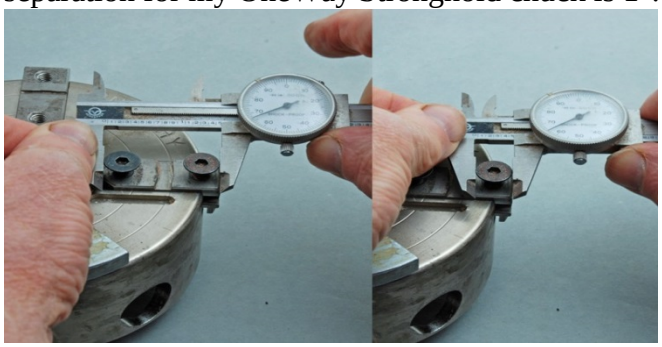


Figure #1: Measuring the separation of the jaw mounting holes.

Now cut out the parts for the jig. The Base Supports must give clearance for hold-down clamps and which can be made from any stock glued up to be thick enough. I used Irwin Quick Clamps which require about 2-1/8".The rest of the jig can be made from any 3/4" thick sheet goods. I'm using plywood for the jig in the pictures (I finally used up the melamine from the egregious "measure twice cut once" violation making the first version of this jig). Here's the cutting list:

- Base Supports, 2-5/8" x 2-1/8" x 7", 2 each
- Lower Base, 7" x 10", 1 each
- Left Upper Base, 5" x 7", 1 each
- Replaceable Insert, 1" x 7", several each
- Right Upper Base. 4" x 7", 1 each
- Left Fence, 1" x 6", 1 each
- Top Fence, 1" x 10", 1 each
- Spacer, hole separation x 9", 1 each
- Slide, 3" x 9", 1 each

Fig. 2 shows the cut out parts.

Figure #2: The parts for the drilling jig after cutting to size.

Next cut a V notch in the Slide to register the position of the jaw blanks. Measure 4-1/2" from the left edge and 1" down from the top edge and mark that spot. Then use a combination square to extend 45 degree lines from the bottom edge to the marked spot. Cut as accurately as you can with your band saw along the lines to cut out the V-notch. Fig 3 shows the completed Slide.

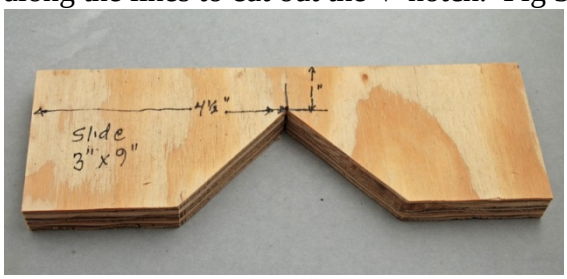


Figure #3: The Slide after cutting out the V-notch.

Now assemble the drilling jig with glue and 1-1/4" screws. It's good practice to drill at least body holes and countersink for the screw heads and a one piece set makes this go more quickly. You can drill the holes with a hand drill and guestimate their position.

Fasten the Lower Base to the Base Supports leaving enough of a ledge protruding out from the Lower Base that you can clamp the jig to your drill press table. You may wish to match the width of your drill press table. Fig. 4 shows the jig after attaching the Base Supports.

Figure #4: After attaching the Lower Base to the Base Supports.

Now add the Upper Base pieces. Begin by attaching the Left Upper Base, aligned with the left side of the Lower Base, with 4 screws. Place the Replaceable Insert next to the Left Upper Base and bring the Right Upper Base against the Replaceable Insert, aligned with the top edge of the Lower Base, and attach the Right Upper Base with 4 screws. Fig. 5 shows the Drilling Jig after attaching the Upper Base pieces.

Figure #5: After attaching the Upper Base pieces to the Lower Base.

Now attach the Top Fence aligned with the top edges of the Upper Base pieces with 4 screws. Then attach the Left Fence at the left edge of the Left Upper Base using a combination square to insure it is at a right angle to the Top Fence using 2 screws. Fig. 6 shows the Drilling Jig after attaching the fences.

Figure #6: After attaching the fences to the Drilling Jig.

The last step in making the Drilling Jig is to cut a clearance notch for clamping the jaw blanks down to the jig. Measure 1/2" over and 2" up from the bottom right corner of the Left Upper Base. Remove the Replaceable Insert and cut out the notch on your bandsaw. Fig. 7 shows the a close up of the Drilling Jig after cutting the notch. Fig. 8 shows the completed Drilling Jig.

Figure #7: After cutting out a clearance notch for clamps.

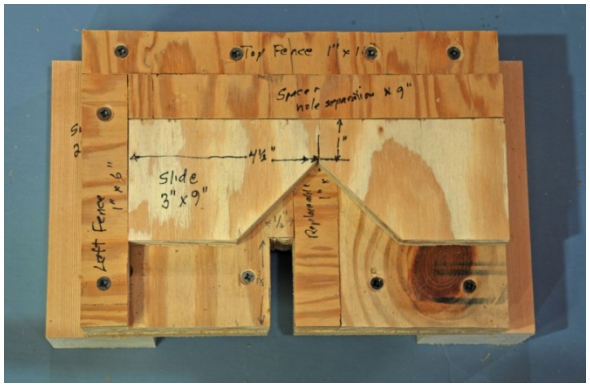


Figure #8: The completed Drilling Jig.

MAKING JAWS: The first step in making jaws is to cut the blanks. The requirements are that they have a right angled corner and be big enough for the jaws you want to make. Having the wood grain run around, or tangential to, the chuck will make turning the jaws to shape easier. I have cut triangles from a board with an appropriate width on a table saw. For the pictures in this article I've conserved wood by cutting out the blanks with a band saw. Perhaps the most accurate way would be to cut the right angle on a table saw and cut the arc on a band saw. Using PVC is a special case--I bought a cylinder of PVC, cut off the thickness I needed, and then divided it into quarters in a generous pie fashion. Do whatever works for your situation and stock on hand.

Fig. 9 shows a typical blank cut out on the bandsaw. For at least one blank plot the location of the mounting holes to use as an aid in locating the Drilling Jig on your drill press. Using a combination square draw a line that splits the right angle corner. Then using a metal jaw as a guide, lay it on top of the wood blank and mark the location of one of the holes. Measure along the line to mark the location of the other hole.

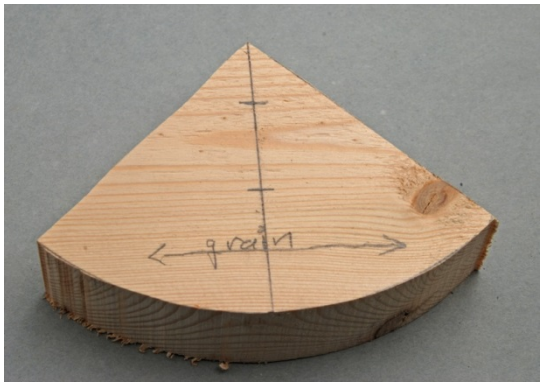


Figure #9 shows a typical jaw blank with hole locations marked.

Put the Drilling Jig on your drill press table. Put the Spacer and Slide on the Jig, and clamp a jaw blank in the Jig. Insure that the Spacer is against both Fences, that the Slide is against the Spacer and Left Fence, and that the Blank is fully nested in the V-notch of the Slide. Mount a drill in the drill press and clamp the Drilling Jig to the table so that the drill is centered on the mounting hole location closest to the right angle point of the Blank as in Fig. 10.

Figure #10: Locating the Drilling Jig on the drill press.

There are several options for drills. The initial pictures use a combined drill and countersink, which is suitable for relatively thin (less than 1") jaws using the original mounting screws for your chuck. Combined drill and countersinks are available in an assortment of sizes from any Industrial Supplier. Select one that has a small diameter section a tiny bit bigger than your mounting screws (you need a little wiggle room). I use a #7 combined drill and countersink with a minor diameter of 1/4" for the 6mm screws on my Oneway Stronghold chuck. Be sure your drill press chuck opens up far enough for the major diameter.

Set the drill press depth stop to what you think will countersink the blank correctly. Mount a piece of scrap wood with a right angle corner in the jig and clamp it down securely, as if the blank jumps up when you drill through, the depth test will be off. Test drill the scrap blank as in Fig. 11. Insert one of the screws you plan to use fully in the test blank and insure that at least 3 or 4 threads are visible below the blank. Test screwing it into your chuck and make sure that you can fully tighten the screw without the screw bottoming out in the chuck. Adjust the depth stop if necessary. Conduct this test on scrap any time you change mounting screws or set up the Drilling Jig to avoid wasting good Blanks.

Figure #11: Testing the drill press depth stop by drilling a test scrap.

Figure #12: Testing the countersink depth on the chuck.

After you've successfully set the countersink depth, remove the Spacer from the Drilling Jig. Clamp the test scrap in the Drilling Jig making sure that the Slide is against both Fences and that the test scrap is we'll nestled in the V-notch. Drill another hole as in Fig. 13. Now check the hole spacing by mounting it with both screws on your chuck as in Fig14. If the spacing of the test blank is too wide you can trim a little off the Spacer on the table saw. If the test scrap is too narrow you can cut a new Spacer or widen the Spacer by shimming it with tape or veneer or shim stock.

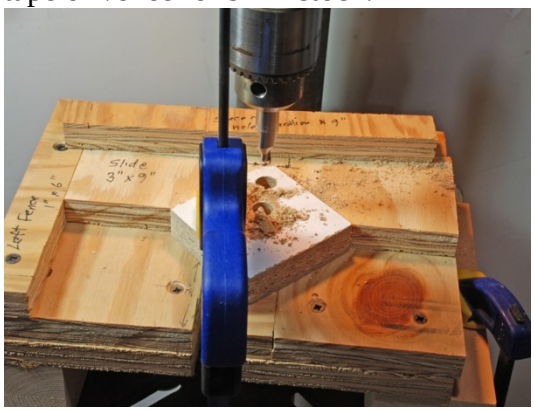


Figure #13: Testing the hole separation by drilling a second hole with the Spacer removed.

Figure #14: Testing the hole separation by mounting the test scrap on the chuck.

You're now ready to drill a set of Jaw Blanks. It probably makes sense to drill all of the holes near the corner first, then all of the outer holes. Mount the Jaw Blank in the Drilling Jig with the Spacer included between the Slide and Upper Fence. Clamp the Jaw Blank in place as in Fig. 15 and drill the inner hole. Repeat for the rest of the Jaw Blanks insuring that the Spacer, Slide and Jaw Blank are correctly positioned.

Figure #15: Drilling the inner hole in the Jaw Blank.

Now clamp the Jaw Blank in the Drilling Jig with the Spacer removed and drill the outer hole as in Fig. 16. Repeat for the rest of the Jaw Blanks

Figure #16: Drilling the outer hole in the Jaw Blank.

The depth you can drill and counterbore with the combined drill and countersink is limited by the short flute and short minor diameter segment. If you want to use thicker blanks or want to use longer mounting screws for a heavier duty Jaw you can use a Subland drill. These, along with the usually metric mounting screws in a variety of lengths are available from Industrial Suppliers. I found a part number 29475A77 from McMaster-Carr worked well with for my Stronghold chuck. It's not a cheap ($43) drill bit, but worth the cost in time and accuracy if you're going to make several sets of jaws--I've

made a lot of them. The longer minor diameter section and longer flute length of the Subland drill will let you drill and countersink in one step most any size homemade jaw that's safe to use.

Follow the same procedure shown for drilling with the combined drill and countersink. You don't need to test the Spacer size again, but do test the depth of countersink on scrap and be sure that for each mounting the Spacer and Slide are against the Fences and that the Blank is well nestled in the V-notch. Fig. 17 shows drilling with the Subland drill bit.

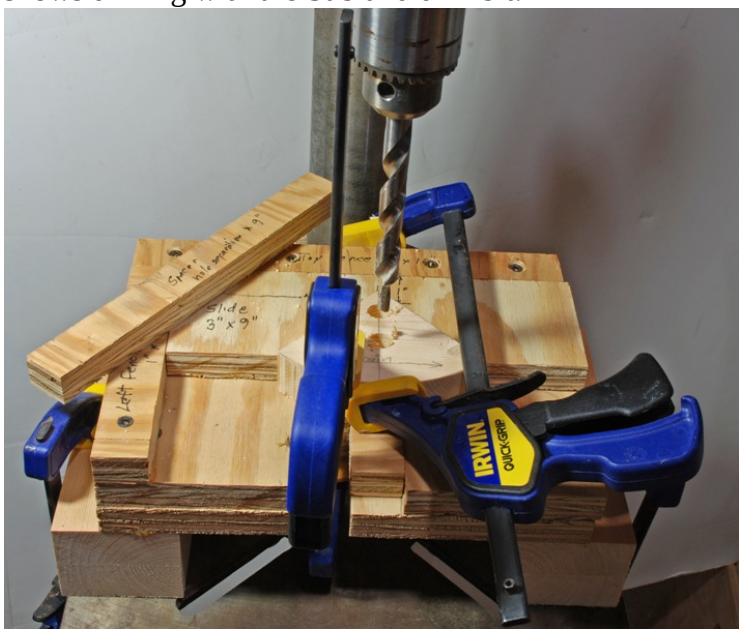


Figure #17: Drilling and countersinking in one step using a Subland drill bit.

If you don't wish to invest in a Subland drill bit for thicker blanks, nor have a combined drill and countersink for thinner ones, you will have to select separate drills. A 1/4" drill bit for the body drill and a 1/2" drill for the countersink works well for my Stronghold chuck.

If you are using a thick blank there is a significant possibility of the smaller drill drifting while drilling a deep (compared to the diameter) hole effecting the accuracy of the hole spacing. To avoid this you can drill the smaller hole from the bottom of the blank. Mount the Blank in the Drilling Jig upside down. Set the depth stop to drill about 1" and drill all the body holes for the set of jaws as in Fig. 18. Drill holes in some scrap pieces so you'll be able to test countersink depth.

Figure #18: Drilling body holes from the bottom of the Blank with the smaller drill.

Now mount the larger drill bit in your drill press to countersink the holes by drilling from the top of the jig. Use one of the drilled scrap pieces to check countersink depth, then drill the countersinks as in Fig. 19. If your jig is accurately made and you kept the Spacer and Slide registered properly the hole will line up well. If not, it's the smaller hole that matters, at least with soft woods.

Figure #19: Counterboring from the top of the Blank with the larger drill bit.

You can use the Drilling Jig to make two jaw sets with a minor modification. Two jaws are useful for mounting stock eccentrically and for encompassing long stock when mounted transversely to get rid of the propeller effect (or whirling blank of death to paraphrase Michael Mocho). Cut your Blanks to the size semi-circle you want to use. Find the middle of the straight edge and mark the hole locations. Make an extra Spacer 1" thick (the distance of the point of the V-notch from the top of the Slide). Mount the Blank in the Drilling Jig with the Spacer and the Extra Spacer (but not the Slide) in place so that the hole location is centered under the drill bit. Measure the distance from the blank to the Left Fence and cut a Side Spacer to that width. Remount the semi-circular blank using the Spacer, Extra Spacer, and Side Spacer and drill the inner holes as in Fig.20. Then remove the Spacer and drill the outer holes.

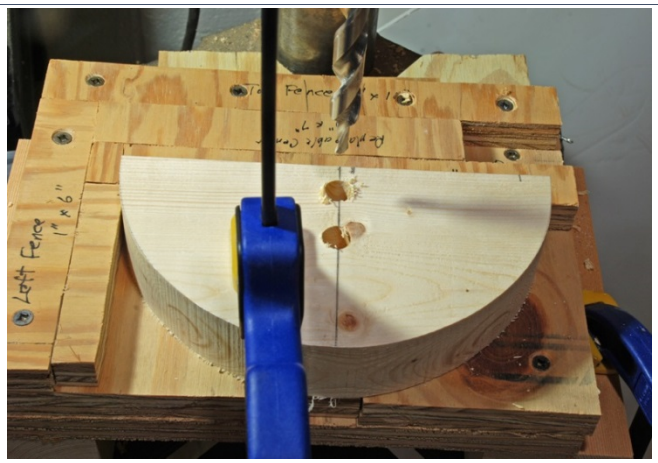


Figure #20: The Drilling Jig modified with additional Spacers for drilling two jaw sets.

Drilling PVC calls for some special considerations. Use some sort of lubricant such as Tap-Magic or WD40. This will make the experience much more friendly as it will make the PVC less grabby and help with chip clearance. If you use a Subland drill bit change the position of the Replaceable Insert after **each hole**. Else when the minor diameter breaks through to the already drilled Insert the major diameter tends to grab the PVC leading to deeper than intentioned holes even when clamped down.

After drilling your jaw set you're ready to mount them on your chuck. Start both screws for each jaw before tightening either. Once you have all the jaws mounted with the screws snug but not tight, close the chuck completely to allow the jaws to register on each other. This, along with numbering the jaws, will aid in remounting them accurately. Now tighten all the screws as in Fig. 21.

Figure #21: Tightening the jaws after closing them.

The jaws will hold best if they are turned to a diameter than matches the object they are to hold. As you want some reserve tightening ability, cut 4 Spacers to put in-between the jaws for for turning. Plywood or other sheet goods with a

consistent thickness works well--consider 1/4" plywood Spacers for small work and 1/2" plywood for larger work. Tighten the jaws with a Spacer in between each pair of jaws as in Fig. 22.

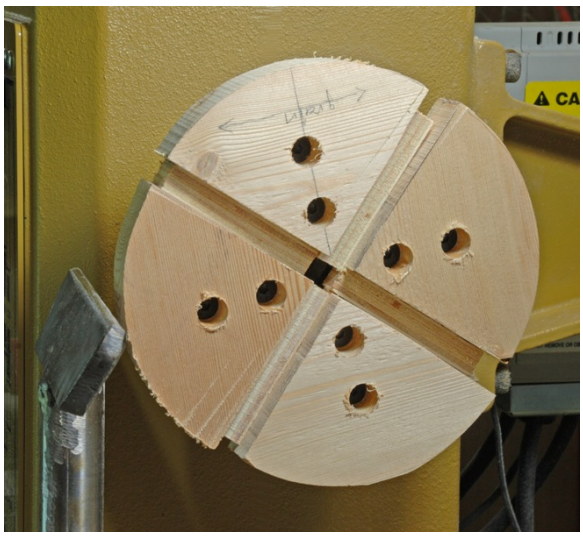


Figure #22 The jaw set with Spacers ready for shaping.

Turn the lathe on at a reasonable speed and turn the rim of the jaw set true. As there are gaps where the Spacers are, there's a potential for a catch if you cut really aggressively so take it easy. Once the rim is true, stop the lathe and number the jaws to correspond with the base jaw numbers with something obvious and indelible like a permanent marker as in Fig. 23.

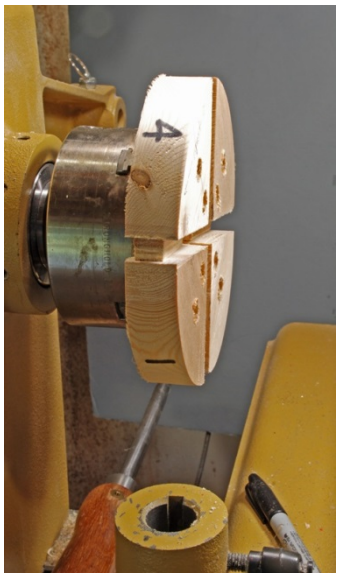


Figure #23: After truing the rim and numbering the jaws.

Now turn the jaws to shape. Pay attention to the depth as you don't want to hit the mounting screws. In general the recess to hold your work should be cylindrical--a shallow cylinder for flat shapes and a deep cylinder for spherical shapes (a little more than half the diameter). Although you could turn a dovetailed recess to match a beveled shape, in general a cylinder works best as you want to maximize contact area to spread the force required over a larger area. You can also add a liner of 2mm craft foam for an extra gentle hold. Fig. 24 shows a set of step-jaws after turning.

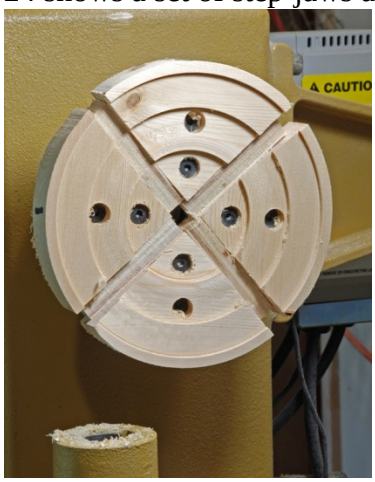


Figure #24: A set of step jaws for holding a wide diameter range.

APPLICATIONS: I've used wood jaws for turning drop spindles for many years. A drop spindle, used for spinning fiber into yarn, is basically a disc with a stick and a hook. It works best if the axes of the whorl (disc) and shaft (stick) are the same, so I glue the shaft blank into the whorl blank before turning. Two mountings are required. During the first turning the bottom of the whorl and the shaft are turned. The drop spindle is then reversed and held in the same jaws with the shaft inside the headstock spindle for turning the top of the whorl as in Fig. 25. I use a friction polish and the jaws don't mar the already finished rim of the whorl. This type of jaw set would also work nicely for hand mirrors, bull roarers, or any other shallow round shape.

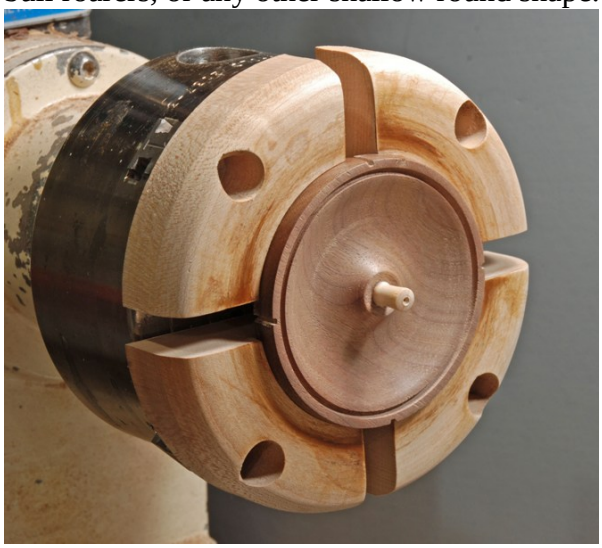


Figure #25: Holding a drop spindle for turning.

Tippy tops are fun to make and also to spin. I've tried following various directions and never discovered the secret to a sure fire tippy top so I really appreciate that tippy top jaws will let me remount the top to tweak it even after it's finished. You can easily remount the top with the shaft in to get rid of some point or prominence on the bottom that keeps it spinning upright. You can also mount it with the shaft out to trim the shaft or deepen the hollow around it if necessary.

Start with a set of fairly deep jaws and turn a cylindrical recess that is more than half the diameter of the largest top you plan to make. Taper the jaws towards the recess to get tool access as in Fig. 26. With any jaw set designed to hold spheres, a piece of cheap foam in the bottom of the chuck will gently push the sphere out letting you hold the work in with one hand and tighten with the other. As the jaws will also hold square stock, you can use the jaws to hold the top blank for initial turning of the spherical bottom, then reverse it to turn the shaft and then back off the tailstock to get easy access to form the hollow around the stem if required for your design. Since a cylinder will hold a sphere in any orientation you can also use the chuck to turn and burn weaving decorative lines as shown in Fig. 27.

Figure #26: After shaping tippy top jaws.

Figure #27: Adding decorative burned lines to the top with tippy top jaws.

You can make one piece scoops by turning a handle on a sphere between centers and then hollowing the sphere in faceplate orientation to turn the sphere into a scoop. Making dedicated scoop jaws lets you easily hold the sphere for hollowing. If you make them big enough they'll also contain the handle to get rid of the propeller effect so you can concentrate on what you're turning instead of protecting your fingers. Begin by making a set of jaws deep enough so you can turn a cylindrical recess more than half the diameter of your scoop (don't forget to allow for mounting screws) and big enough in diameter to contain the handle. After truing the rim and numbering the jaws, remove one jaw and cut a rebate for the handle on the band saw as in Fig. 28. If you wish to angle your handle relative to the open face of the scoop you can use a hand saw to ramp the rebate cut on the bandsaw as in Fig. 29.

Figure #28: Cutting a rebate for the handle in one of the jaws.

Figure #29: After cutting a ramp with a hand saw so that the handle can be angled.

You can use the jaw set as a drive between centers to finish turning the handle end as in Fig. 30. Fig. 31 shows the jaw after hollowing and the completed scoop. The yellow spots around the scoop are not very well trimmed 2mm craft foam.

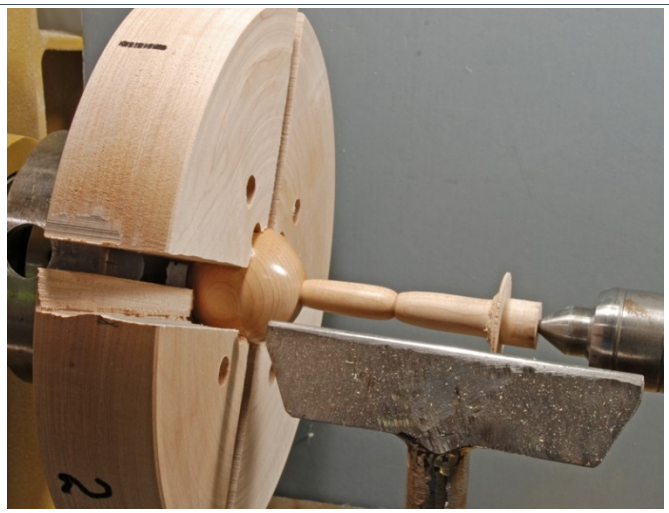


Figure #30: Mounting the scoop in the jaws for trimming the handle end.

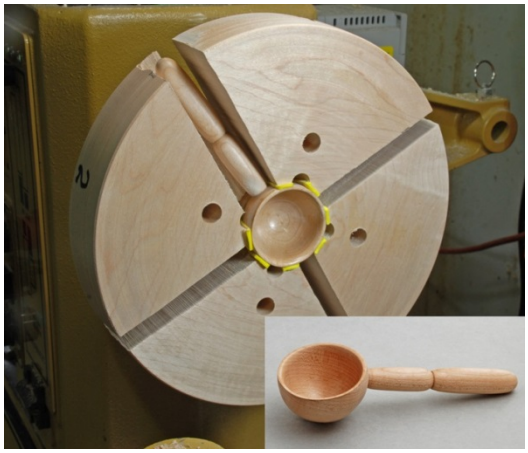


Figure #31: The set up for hollowing and completed scoop.

Two jaw chucks are versatile as they can be used for registered or infinitely adjustable eccentric mounting, as in Fig. 32 from last year's ornament article. They can also be used to safely drill sideways into spindle blanks on the lathe. At first this may seem like a strange way to drill, but I've used it to drill and taper a tapered mortise and switching chucks is a lot easier than remounting drill and reamer, and doing it in one mounting is more accurate.

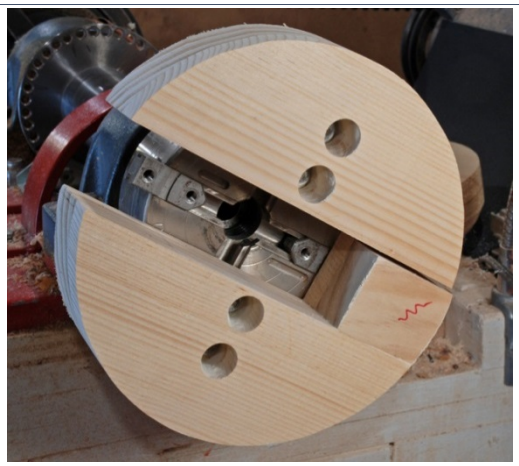


Figure #32: A registered eccentric mounting.

A chuck for holding a sphere ends up L shaped in cross-section, so one of the arms of the L ends up being weak short grain. For small spheres it's practical to make the short grain arm thick, but this doesn't work well for larger spheres. PVC, on the other hand, avoids this problem by not having grain. PVC does require more care in turning. Using a lubricant such as WD40 liberally and frequently, rough out as much of the cavity as possible by drilling with a spur or Forstner bit. Withdraw the bit any time the waste doesn't eject. PVC tends to be grabby and catch when you try to turn it deep in a recess. It's better to drill full depth and enlarge the diameter gradually with a narrow plunging cut. Fig. 33 shows a set of PVC jaws holding a sphere. This can be used to turn features on the surface of the sphere, to hollow the sphere through an access hole, or for hollowing a hemisphere as you would a bowl. If the sphere is less than the maximum allowed for by the depth of the PVC jaws place easily compressible foam in the bottom to gently push the sphere out so you can adjust the sphere to minimum depth in the jaws. To mount a hemisphere for hollowing use the foam and your tailstock ram with center removed to push the hemisphere in just below the jaw tops and then tighten.

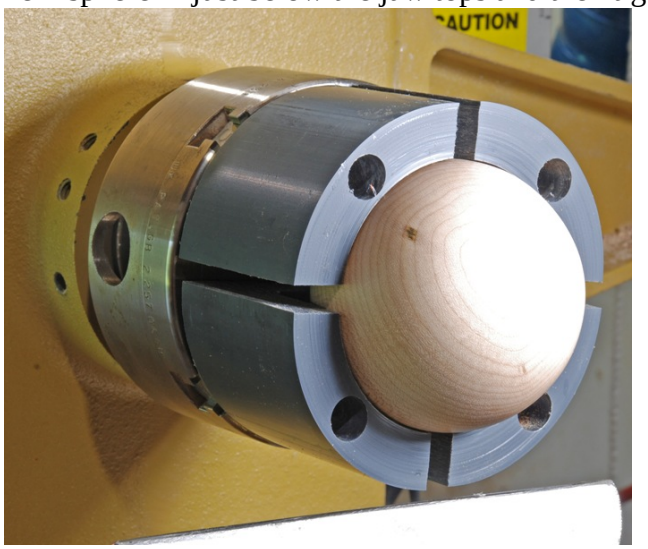


Figure #33. A set of PVC jaws for holding spheres and hemispheres.

TOOLS AND MATERIALS:

Tools:
Lathe
Bandsaw
Drill press
Combined drill and countersink or
Subland drill bit or
Individual drill bits for body and counterboring
Calipers
Combination square
Screwdriver or bit and variable speed drill
Clamps

Materials:
3/4" thick sheet goods for Drilling Jig
2-1/8”" thick wood for Support
Jaw material such as pine, maple, or PVC
2mm craft foam, optional
Longer mounting screw to fit chuck, optional

With permission from Author: David Reed Smith turns, tinkers, and certainly makes jigs in his basement in Hampstead, Maryland. By the time you read this his retirement countdown should be in double digits. This article, along with about 60 others are available on his web site at www.DavidReedSmith.com. He welcomes questions and comments via email at David@DavidReedSmith.com