# Vacuum Chuck Machining and Assembly - Polyethylene 4/24

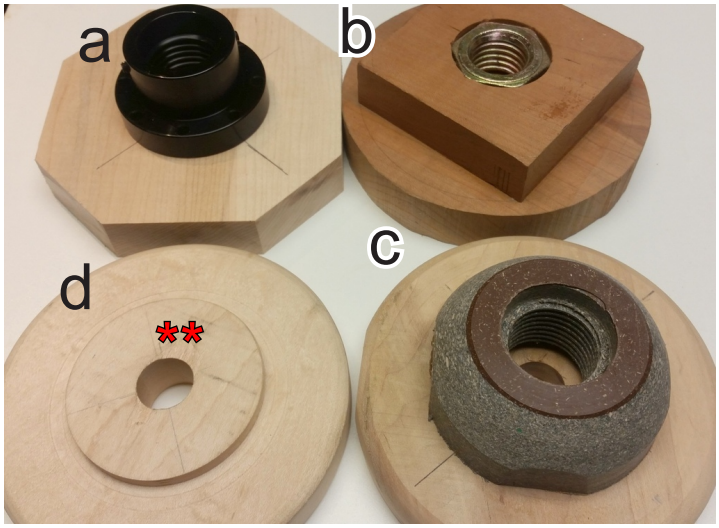
Important: Theory of operation. The vacuum is originated with the vacuum pump and travels through tubing and is connected to the hollow tube where it protrudes from the head stock. The tube terminates at the motor grade sealed bearing. The vacuum chamber is created within the PVC coupling and seals against the workpiece, aided by the closed cell gasket. There is no need to seal the headstock, this system eliminates the potential of additional vacuum leaks.

The updated use of polyethylene to capture the bearing and carry through headstock eliminates the fitting of 1/8"IP (.39") lamp rod and rattle of metal to metal in the headstock. This also saves time, eliminates alignment problems and bent rods.

Work safely. When using vacuum chuck, wear safety gear and proceed cautiously, do not stand in the trajectory of flight path of a dislodged work piece. Start slowly, use tailstock live center until you feel comfortable.

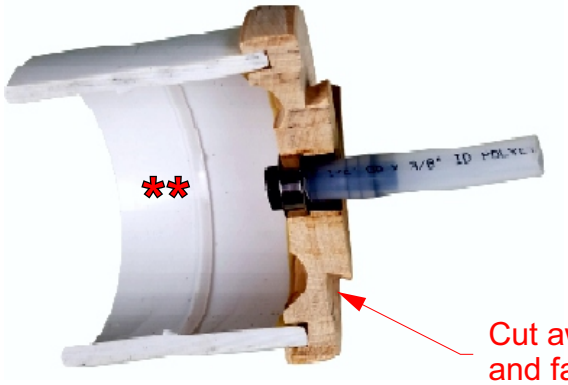

Kit Parts:

- Motor grade sealed bearing, assembled with coupling and shoulder screws
- 18" Polyethylene tubing extension through headstock
- 4"OD PVC coupling (most popular, commonly referred to as 3" Schedule 40) or various sizes of PVC your choice
- Foamies, 2mm or 5mm the gasket against your work piece
- Instructions

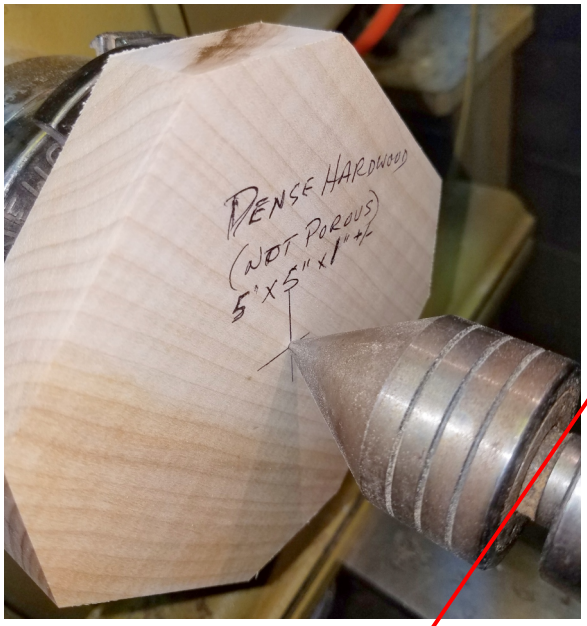



Cup to headstock, attachment methods:

- (a) Lathe face plate, If you opt for the face plate, make sure it is dedicated to this coupler. If you take it off it will never be perfectly re-centered.
- (b) Epoxy imbedded nut, note no recess for shoulder on headstock
- (c) 1"x8 or 1 1/4x8 threads. Pictured is using threads in a composite block (excellent stability)
- Also using Beall tap on 3"x3"x1 1/2" dense hardwood. Cut threads before glueing to intermediate wood. Treat threads with CA glue, retap.
- ** (d) Tenon or dovetail to fit your 4 jaw chuck my preferred method as described in instructions.
- Or can use your imagination.

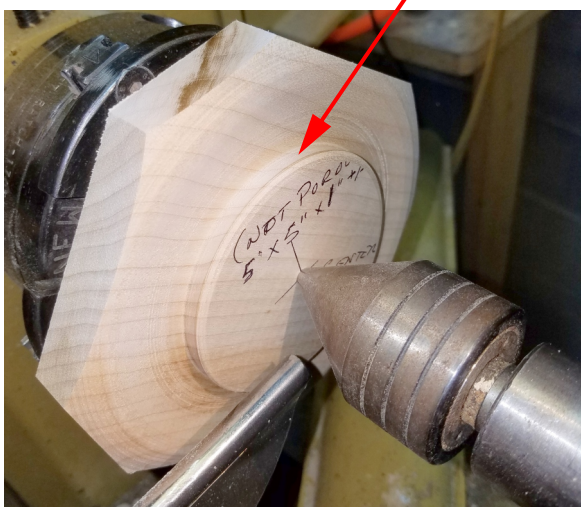


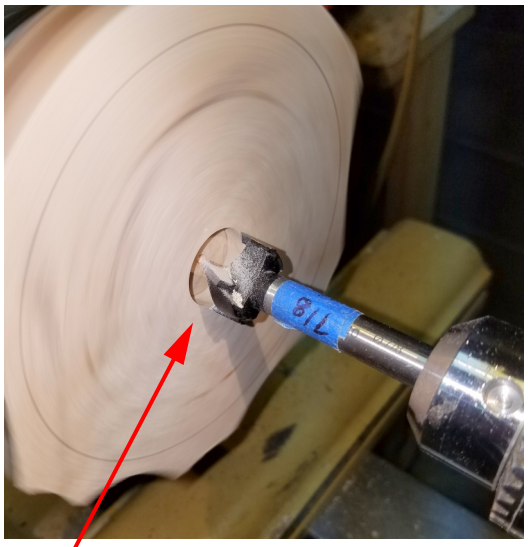

Cut away showing my original and favorite (Frugal) setup




I believe the tenon/dovetail is the most economical, "frugal" and efficient way of attaching. It is time efficient also, you remove your workpiece from the 4 jaw chuck, and then attach your vacuum coupler.

Basic hardwood 4 1/2 x 4 1/2 x 1", block if using 4"OD coupler (dense, not porous like red oak). Tenon or dovetail is turned with piece between centers or 'jam chucked' to 4 jaw chuck with jaws spread wide, with live center applied tightly. Reverse block and clamp in a 4 jaw scroll chuck. I usually mark the #1 jaw position on the wood for truer repeat clamping.





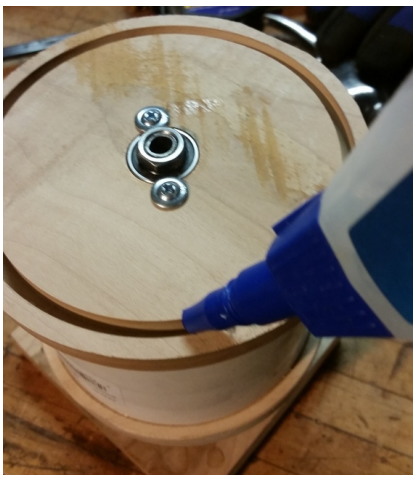
Use a 7/8" dia. Forstner bit using drill chuck in tail stock to bore the depth of the bearing thickness, 1/4". Then a 3/4" Forstner bit, through bore to allow clearance for coupling. Drill press could also be utilized, make sure bore is centered.


Test fit bearing/rod assembly for clearance. 3/8" tube should point towards headstock. Sparingly apply light coat of adhesive to ID of bore in block. Make sure no glue interferes with bearing seal, or the through bore of block. Drill pilot holes and screw shoulder screws to overlap bearing race and contain bearing in wood block.

Note: see notation on page 3 about adhesives.

Mark OD of PVC on flattened face of block with compass, dividers, or by centering coupler to spinning wood block and marking with pencil. Using 3/16" parting tool, initiate cut, stopping lathe often, test fit and adjust and turn the groove for coupler. Bore approximately 3/8" to 1/2" deep. Reduce turning pressure, keep firm on tool rest (no bounce), tool sharp and make sure final cut is level and true.

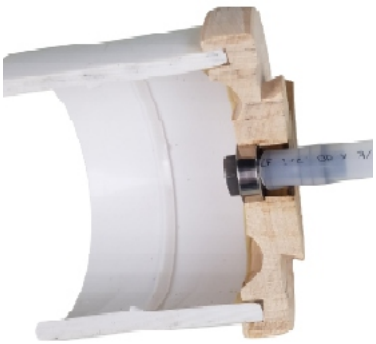
GLUE NOTE:
Suggestions; 'All Purpose Construction Adhesive' with properties, *bonding to wood, plastics, metal, read the small print*. Tends to be rather thick, tough to seat PVC in bottom of groove.
Epoxy works extremely very well. Mix a big enough quantity on glossy thick paper or flat section cut from milk jug with a crease to make trough and pour into grove. Keep in mind drying time.
~~Wood Glue (PVA)~~
~~Gorilla Glue~~



With chuck off lathe, groove facing up, partially fill bore with glue of choice, insert PVC cup and apply pressure so that cup is deeply seated. Rotate by hand while applying pressure so that glue spreads evenly. Visually check the gap between wood and cup and center. Suggest clamping using wood strips to center pressure. Picture lower left. Let cure.

Remount on lathe to true up the cup to workpiece mating surface. Acceptable runout should be 1/16" or less. If greater than 1/8" part off cup at wood and bore new groove, reglue new coupler. If you want to start over use parting tool on outside of bearing to salvage. Lathe speed 350+/- RPM, use negative angle rake scraper on PVC, suggest sharp skew chisel, burr up, laid flat on tool rest. Caution; PVC can shatter if your scraper has a up or positive angle. Ask me how I know. Firm pressure in and pressure down against tool rest. Finish with light pressure to form radius for mating surface of your work piece.

Cutaway picture shows relationship of items.



Vacuum Chuck to Workpiece:

Cut craft foam approximately 5" x 5" (4"OD cup), center and attach to chuck, using masking or electrical tape to secure corners. Make a center cutout as shown on side photo Any center hole larger than 1/4" OK.. Sticky backed foam doesn't secure well to begin with and once it does stick you can't get it off without using a scrapper. *Also see separate sheet with alternate foam suggestions.*

The 20" long 3/8" OD polyethylene tube that carries the vacuum through headstock will push into hollow 3/8" ID tube, no clamps needed. Long tube can be removed between uses or left attached. *Curvature can be straightened in very hot water* or left as is, no wear problems. Tube can be trimmed or left long. Long tube will be more versatile with usage on a wide range of small and large lathes.

With pump assy and hardware mounted, slide 3/8"ID hose from vacuum pump onto tube. The idea is 'easy on, easy off' why use a clamp when it is not needed. If fit is sloppy, a small tie wrap wound twice around hose and snugged up or a wrap of black electrical tape will make a good vacuum connection.

Bring work piece up to foam pad, with live center (hopefully there is a center mark). Alternately use a reverse adapter in tailstock holding 4 jaw chuck and workpiece. If not, approximately center and turn on pump, remove live center, slowly open ball valve and reduce vacuum to approx 5". Rotate lathe by hand and gently nudge to center work piece using tool rest corner as guide. Close valve, turn on lathe, slowly bring up to speed. Start slow, keep live center supporting until you get a feel for vacuum chucking. Finish turning, sanding, finishing your piece.

General Information:

25+/-"Hg of vacuum, (your pump should pull 27") with a 4" OD cup = 150# of holding power at sea level. Vacuum potential drops 1" per thousand feet of altitude. Same pump at Pittsburgh PA reading 27"Hg registered 21"Hg at Loveland CO. Parameters above reduced for safety, reality. Porous wood, voids, warps, irregular surfaces, seriously reduces vacuum and holding power.

Mouse pads, other closed cell foam pads, exercise pads, torn fishing foam waders etc can also be used. If you can blow through the foam don't use it.

Craft foam can be found in children's craft area of big box stores (Walmart) 50 foam sheets 5.5" x 8.5" x 2mm thick $6+/-. Hobby Lobby has 18" x 24" in 2mm or 5mm in individual sheets and choice of colors (white will not bleed onto your work piece. PU camper shell tape 1 1/4" x 3/16" one side sticky twice around diameter overhanging PVC 5/8", overlap 1/16" and tucked towards center works great and is longer lasting (found in weather striping area of building centers).

**Questions:**
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