



Two Center Auxiliary Chuck

David Reed Smith

## Introduction

This article is intended as a companion article to [All Turned Hearts](#). It's supposed to be an uncomplicated to use and simple to make eccentric chuck. As it must be mounted in a 4-jawed chuck I'm calling it an auxiliary chuck. The auxiliary chuck has two centers. One center is the same as the lathe center, and the chuck can always be returned to this center within the accuracy of your 4-jawed chuck. The other center is eccentric by a fixed amount. The instructions will follow the eccentricity and blank size needed for auxiliary chucks necessary to make All Turned Hearts. If you want to adapt the Aux Chuck for other uses, see [PlanTwoCenterAuxChuck.pdf](#). Although I haven't tried this, it should be possible to design a chuck with three or four centers to be held in tower jaws, which have the depth to accommodate more tenons, in your 4-jawed chuck.

## Prepare the Blank

Cut a turning square that is 2-7/8" on each side and 2" long. It will be easier to turn if the blank is mounted in spindle orientation. Find the center of one of the largest faces by drawing diagonal corner to corner lines and make a dimple at the intersection with an awl or center punch. Measure from the center along one of the diagonals 3/16" and make a dimple as in Figure #1. Repeat marking the centers on the other largest face. Be sure to measure along the corresponding diagonal so that when the blank is mounted between centers by the offset dimples the axis of the blank will be offset but still parallel to the lathe axis.

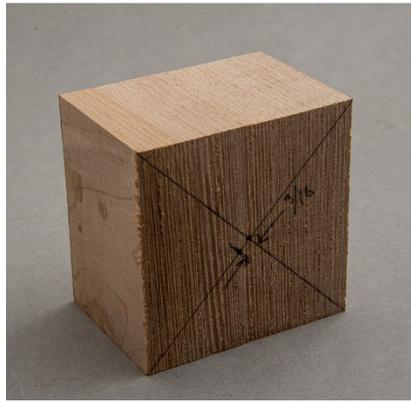


Figure #1: Mark the centers for turning the blank.

Mount the blank between centers on the lathe using the centered dimples as in Figure #2. Then turn the blank round as in Figure #3.

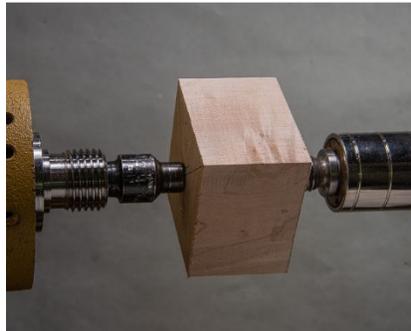


Figure #2: Mount the blank on the lathe.

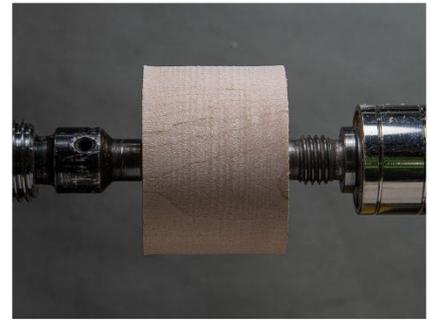


Figure #3: Turn the blank round.

## Turn Mounting Tenons

With the blank still mounted by the center dimples, mark out the depth of a tenon a little less than 1/2" (or a little less than the depth of your #2 jaws). Then turn a 2-5/8" tenon (or make the shoulder 1/8" wide) as in Figure #4. Make sure the shoulder of the tenon is square and not ragged so it can register true on the faces of the chuck jaws. Mark the mid-point of the tenon length with a penciled line.

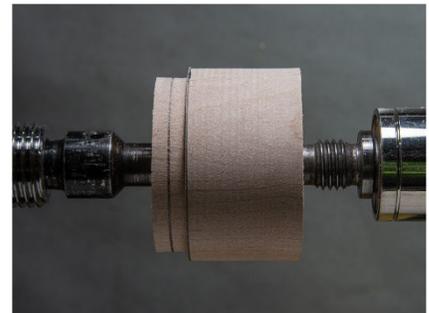


Figure #4: Turn a 2-5/8" tenon just less than 1/2" deep.

Remount the blank using the offset dimples as in Figure #5. Note that the axis of the blank is offset, but still parallel, to the lathe axis. The blank should not appear twisted. Turn a 2" tenon (or until the tenon is completely round) that is just less than 1/4" deep as in Figure #6. This will result in two tenons that are centered 3/16" apart that will both fit in the jaws of your 4-jawed chuck. When mounted by the smaller tenon, the Aux Chuck will be eccentric by

3/16". When mounted by the larger tenon the Aux Chuck will be co-axial with the lathe.

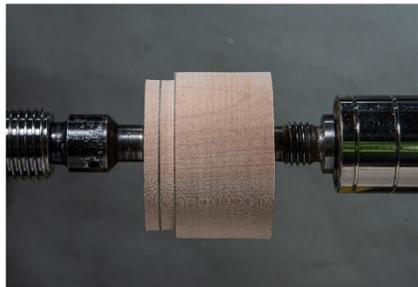


Figure #5: Mount the blank by the offset dimples.



Figure #6: Turn a 2" tenon just less than 1/4" deep.

### Turn Sphere Aux Chuck

The dimensions given in this article are for a 1-1/2" diameter spherical Turned Heart blank. If you want to make an Aux Chuck for a different sized sphere, see [Sliding Eccentric Sphere Chuck](#). It may be helpful to look at a cross-section view of the [Aux Chuck](#).

Mount the Aux Chuck Blank using the larger (centered) tenon in your 4-jawed chuck. Turn the exposed face true. Then draw a centered 1-1/2" circle on the face as in Figure #7.



Figure #7: Draw a 1-1/2" circle on the face of the blank.

Mount a 7/8" Forstner pattern drill bit in a drill chuck mounted in your tailstock. Drill a hole that is 7/8" deep as in Figure #8. The rim left by the 7/8" bit will guide turning the slope to the correct angle.

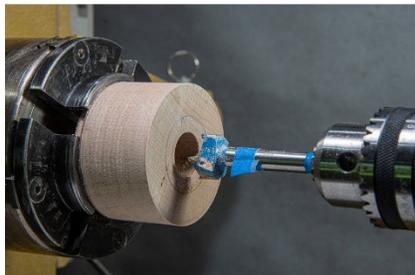


Figure #8: Drill a 7/8" hole 7/8" deep.

Now change to a 3/4" Forstner pattern bit and drill through the blank as in Figure #9. This will enable you to mount a sphere with the nubs still attached.

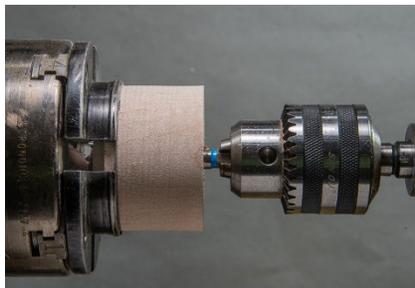


Figure #9: Drill a 3/4" hole through the blank.

Now turn a slope that connects the edge of the 1-1/2" circle with the rim of the 7/8" bit as in

Figure #10. The slope should be a straight line, and about 20° from the lathe axis. 20° is a compromise. The narrower the angle the more strongly the sphere chuck will hold. The wider the angle the wider the range of spheres that will fit.



Figure #10: Turn the sloped inside wall of the chuck.

Next turn the outside of the chuck. As connecting a vacuum line to the Aux Chuck would be involved, and vacuum doesn't hold small objects well in my experience, mostly blue tape will be used to hold the sphere in the chuck. It's easier to apply the tape if the area of the chuck where the tape will be is not tapered. Leave a full diameter flange and then reduce a tape width area to slightly larger than the 1-1/2" opening as in Figure #11.

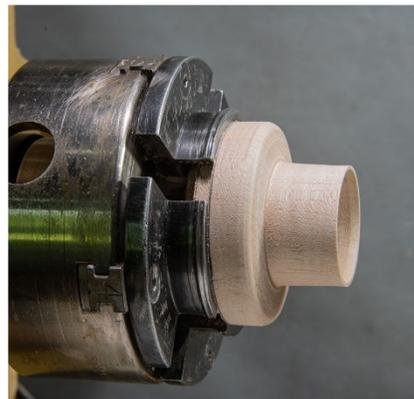


Figure #11: Turn the outside of the Aux Chuck.

It is helpful when orienting a sphere for mounting if the outside of the chuck has lines every 90°, including the minimum and maximum due to eccentricity. Extend one of the diagonal lines on the back of the chuck used to locate the center to the outside of the chuck where you can see it. Lock the lathe rotation with your indexing system. Bring up a stationary straight edge you can use to draw orientation lines close to the chuck. Turn the

chuck so that the extended diagonal line is aligned with the straight edge. Draw a line along the side of the chuck as in Figure #12. Use your indexing system to draw three additional lines so there is a line every 90°. I find it helpful to thicken the line at maximum eccentricity.

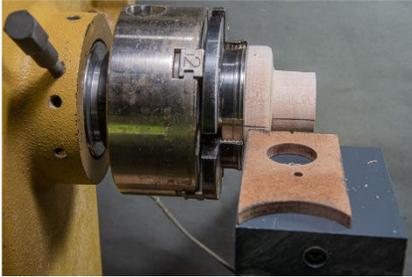


Figure #12: Mark the chuck at maximum eccentricity and every 90°.

Line the interior with 2mm craft foam. This keeps the chuck walls from marking the sphere. I've included a foam pattern in [Aux Chuck](#) that will work if you've your sphere chuck close enough to the provided dimensions. Try a paper version first. See [Sliding Eccentric Sphere Chuck](#), for how to make a pattern if the sample doesn't fit, and how to cut the foam and install it.

This completes the Sphere Aux Chuck. Figure #13 shows the chuck from two different angles.

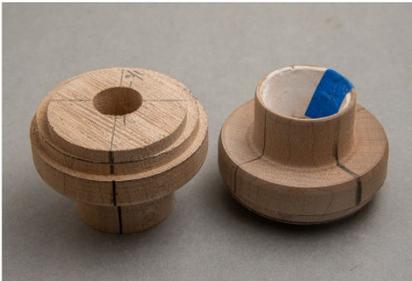


Figure #13: Completed Sphere Aux Chucks.

### Turn Cup Aux Chuck

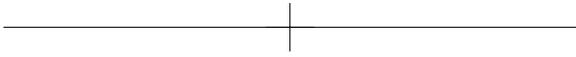
Make a Cup Aux Chuck following the same procedure for the tenons, except the eccentric center should be offset 1/4". After the tenons are done, mount the blank using the larger concentric tenon in your 4-jawed chuck and turn a shallow conical recess. Check with a 1-1/2" sphere to make sure the sphere rests on the side walls of the recess, not the rim and adjust if necessary. Taper the chuck body towards the conical recess for maximum tool access when a sphere is mounted. Then line the conical recess

with 2mm craft foam. You don't need a pattern for this, just cut a circle large enough, and cut along a radial line. Glue the foam in with spray adhesive and remove the overlap. Figure #14 shows the completed Cup Aux Chuck.

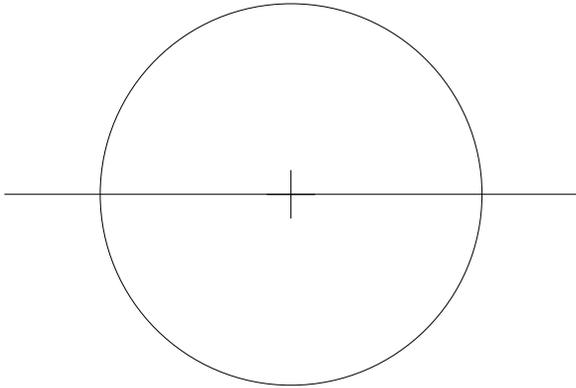


Figure # 14: The completed Cup Aux Chuck.

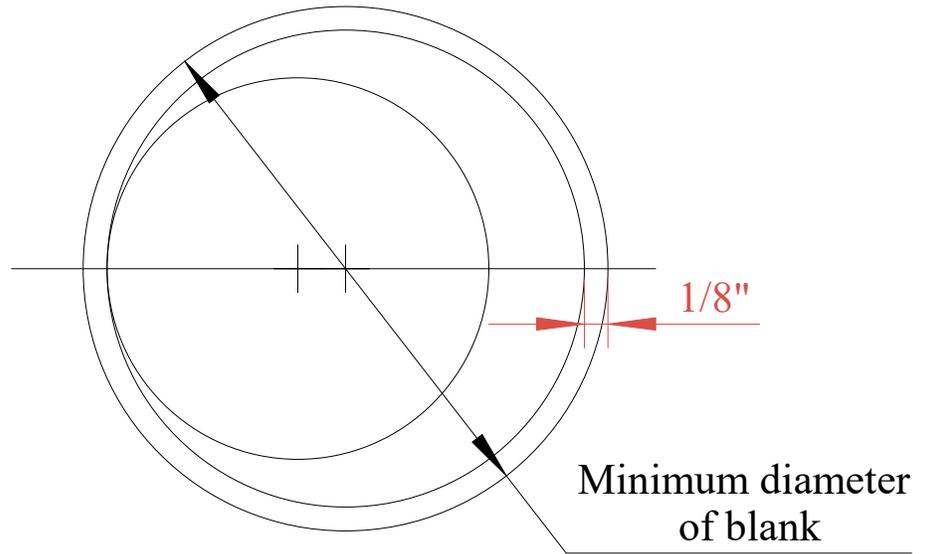
1. Draw a line and its midpoint.



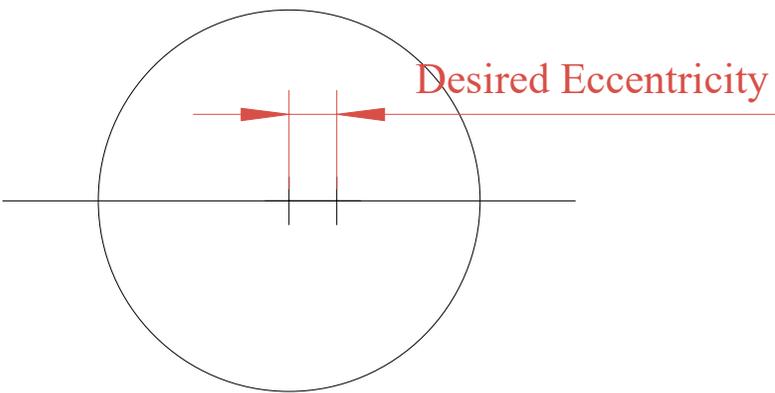
2. Draw a circle a little more than your minimum chuck diameter at the midpoint.



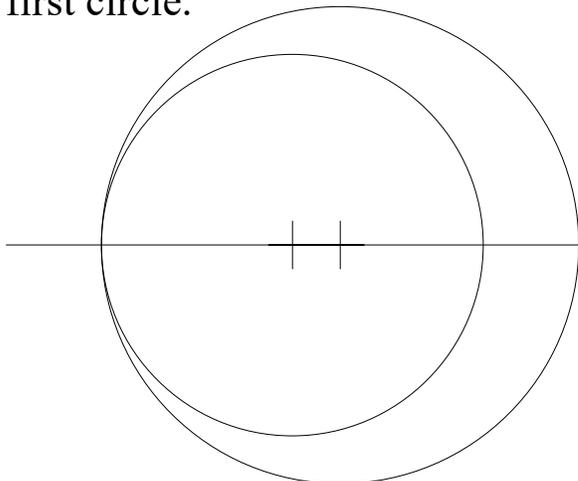
5. Draw another circle centered on the offset point with a radius 1/8" larger than the second circle.



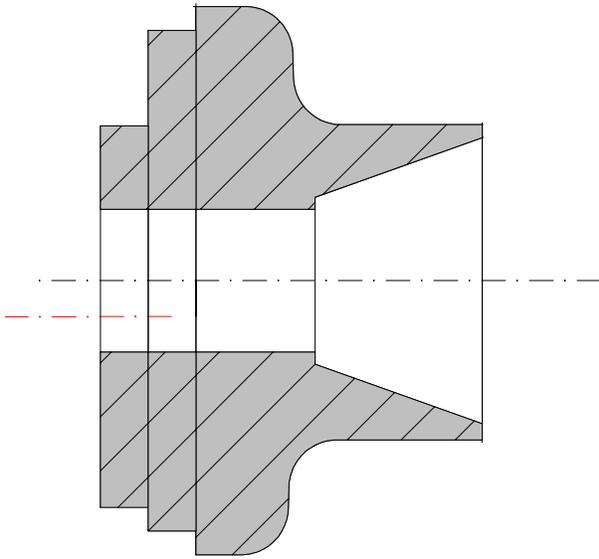
3. Measure away from the midpoint the desired eccentricity.



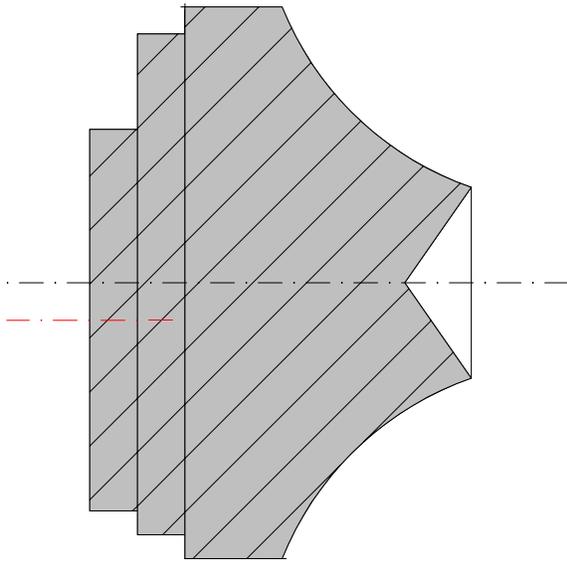
4. Draw a new circle centered on the offset point that intersects the rim of the first circle.



## Sphere Chuck

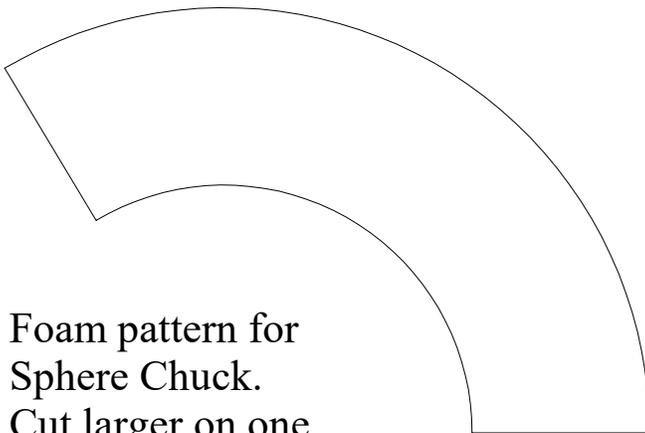


Eccentric axis



Concentric axis

## Cup Chuck



Foam pattern for  
Sphere Chuck.  
Cut larger on one  
end for overlap.