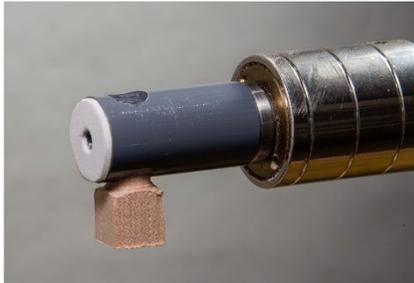


Sphere Alignment Center

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Introduction



Main: Sphere Alignment Center

The most accurate way I've found to align a sphere in my sphere chuck for making decorative or functional cuts is to mark the axis, either with pencil on the sphere or fine point Sharpie on masking tape, and then aligning the mark with a tailstock center. The Sphere Alignment Center lets me align the axis and hold it there while turning on the vacuum pump or taping the sphere in the chuck, all without needing extra hands or denting the sphere.

The Sphere Alignment Center can be made of anything that can be drilled and tapped. It's threaded on the back with 3/4-10 threads to screw onto a OneWay tailstock center. A cross-axis half inch hole is drilled near the front. It's padded on the front end with 2mm craft foam. A small axial hole is drilled through the foam into the cross-axis hole. Then a dowel is turned to fit snugly in the cross-axis hole. The dowel is beveled to 45° and a mirror glued to the beveled surface.

In use, the dowel is inserted in one end of the cross-axis hole so that one can look through the axial hole by looking through the other end of the cross-axis hole. Make an easily visible X mark on the sphere or on tape applied to the sphere. Keep the X centered in the view of the axial hole until the sphere alignment center clamps the sphere in the sphere chuck. You can then turn on a vacuum system, tape the sphere into the chuck with blue tape, or both. You can then back off the center, or just remove the beveled dowel and leave it engaged for extra holding power.

Making the Body

The photos will follow using 1" solid PVC rod for the body of the sphere alignment center. PVC is relatively easy to turn, drill, and tap, and is dimensionally stable. You could use a hardwood such as maple, but keep in mind that wood must be tapped into face grain. Clear acrylic will allow more light in to the mark, but is harder to turn, drill, and tap, and is disposed to spall or crack if you over-do any of these operations.

Chuck a 1" (maybe 1-1/2" if you use wood) cylinder that is 2" long of the material you choose in a 4-jawed chuck with #1 jaws. Turn the end flat and square with a small chamfer on the rim as shown in Figure #1. I've found that a slightly rounded negative rake scraper is a relatively user-friendly tool for turning PVC.

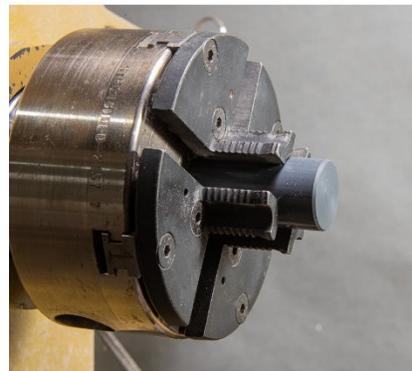


Figure #1: Turn the end face of the rod square.

Use a combined drill and countersink to start a centered hole as in Figure #2. Then use a 21/32" drill bit, as in Figure #3, to drill the tap hole. Measuring from the shoulder of the drill bit, drill 1-1/8" deep for regular taps, or 7/8" deep, if you have a bottoming tap. Lubrication and a slow lathe speed helps yield a clean hole.

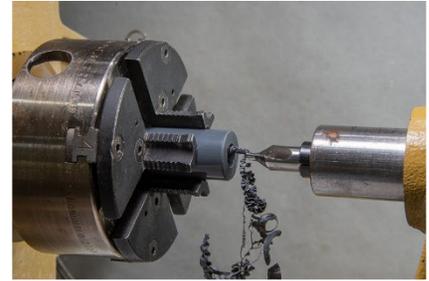


Figure #2: Start a centered hole.

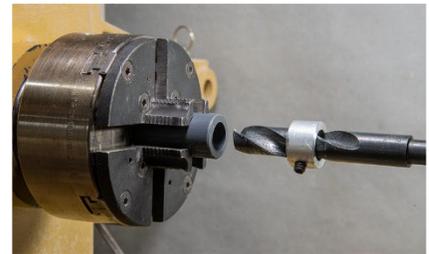


Figure #3: Drill the tap hole.

To tap the threads, first lock the lathe spindle. Insert a [mini-tap guide](#) in a tailstock mounted drill chuck. The mini-tap guide has a spring loaded plunger that keeps the tap aligned axially as the tap advances. If you don't have a tap guide but do have a third hand you can use a tailstock center and advance the tailstock as you turn the tap. Put the nose of a 3/4-10NC tap in the drilled hole. Bring the mini-tap guide the dimple in the back of the tap. Use a wrench or tap wrench to turn the tap to advance it as in Figure #4. You may have to stop occasionally to advance the tailstock when you near exceeding the travel of the mini-tap guide plunger.

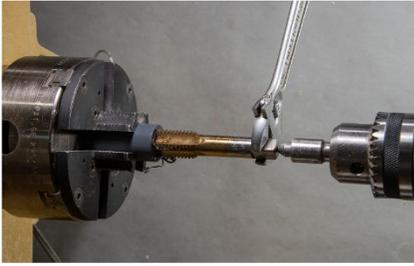


Figure #4: Tap the threads using a mini-tap guide.

Figure #5 shows the body after tapping. There are some burrs remaining that might interfere with the body screwing flat onto the flange on the Oneway tailstock center. It's also harder to start threading something that does not have a chamfer at the threaded opening. So turn away the burrs and turn a small chamfer at the rim of the threaded hole as in Figure #6

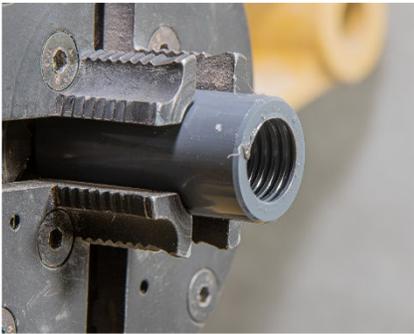


Figure #5: The body after tapping the threads.

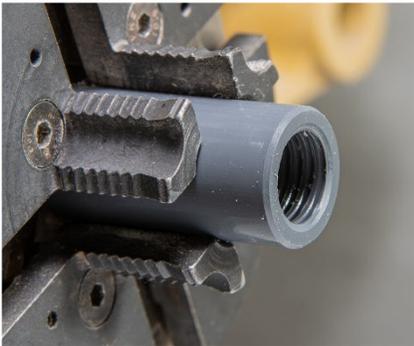


Figure #6: The body after deburring and chamfering.

Mount a short section of 3/4 x10 threaded rod in a collet (or other) chuck as in Figure #7. Screw

the body onto the threaded rod. Then turn the end of the body flat and chamfer the rim as in Figure #8.



Figure #7: Mount 3/4x10 threaded rod in a chuck.



Figure #8: Turn the face of the body flat and chamfer the rim.

Remove the body from the chuck. Clamp the body to your drill press table so that it is centered and aligned with a mark 3/8" from the body face. Then use a combined drill and countersink to start a hole as in Figure #9. Then drill a through hole with a 1/2" drill bit as in Figure #10.

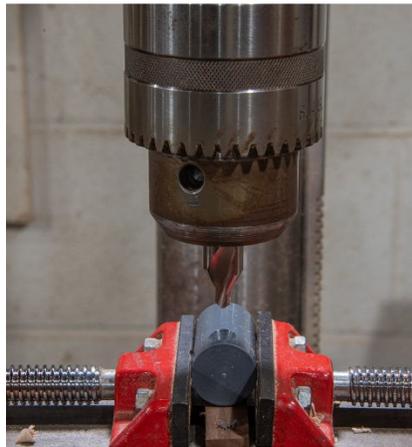


Figure #9: Use a combined drill and countersink to start a hole.



Figure #10: Drill through the body with a 1/2" drill bit.

Cut out a square of 2mm craft foam that is larger than the face of the body. Place the foam on a disposable surface and spray it with 3M #77. When the spray adhesive becomes tacky press the craft foam onto the face of the body and trim away the excess with scissors as in Figure #11.



Figure #11: Apply 2mm craft foam to the face of the body.

Mount a Oneway pattern tailstock center in your tailstock. Insert a roofing nail to lock rotation as in Figure #12. Do not use the supplied lock/knockout rod as it could dangerous if the tailstock center were to start spinning in the tailstock. Wind some blue masking taper around the tailstock center to keep the nail in place as in Figure #13.



Figure #12: Insert a roofing nail to lock the tailstock center rotation.

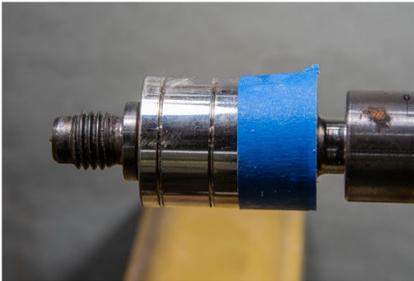


Figure #13: Tape the roofing nail in place.

Mount the body on the threads of the tailstock center being certain to screw all the way on so that the face of the body registers on the flange of the center. Mount a drill chuck in the taper of your headstock. Mount a 3/16" drill in the drill chuck. I've modified my drill chuck so I can choke up on smaller drill bits. Your machinist friends may be horror stricken, but please don't sic them on me. The stresses from drilling steel are quite different from drilling wood or plastic. You could also use a combined drill and countersink with the correct size nose. Turn the lathe on and carefully drill through the craft foam and face of the body through to the cross hole as in Figure #14. This completes the body.



Figure #14: Drill an axial hole through the foam and body face.

Make the mirrored bevel

Cut a turning square of maple or other hardwood about 5/8"x5/8"x3". Mount the

square in a chuck so that about half of it is proud of the chuck jaws as in Figure #15. Turn the end round, checking frequently with the 1/2" hole in the body until it fits snugly as in Figure #16.

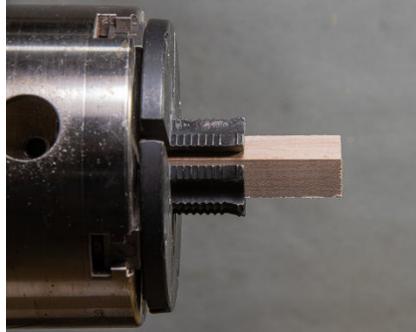


Figure #15: Mount a turning square in the chuck.

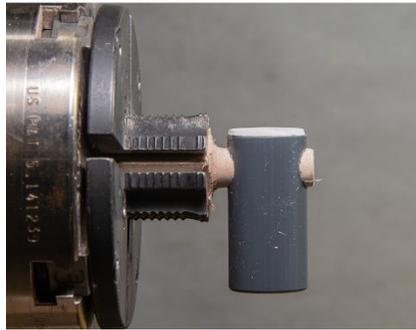


Figure #16: Turn half of the blank until it fits snugly in the body.

Remove the blank from the chuck. Insert it into the half inch hole in the body. Use a pencil to mark the blank through the axial hole in the body. Use a combination square or other tool to draw a 45° line through the mark on the blank. Then cut the bevel as in Figure #17. As half of the blank is left square, you should be able to cut the bevel without worrying about that the blank rotating.

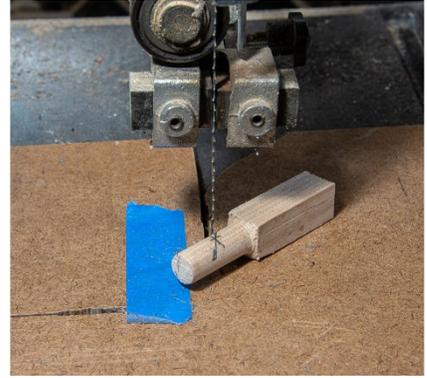


Figure #17: Cut a 45° bevel on the blank.

Cut a mirror that will fit on the bevel. I used some polished sheet steel. Use CA glue to glue a mirror on the blank as in Figure #18. Figure #19 shows the completed Sphere Alignment Center with the body mounted on a Oneway tailstock center.



Figure #18: Glue a mirror on the bevel.



Figure #19: The completed Sphere Alignment Gauge.

Using the Sphere Alignment Gauge

To use the Sphere Alignment Gauge with a sphere chuck, first mark the sphere where you want the axis to be. You can use pencil. If the wood you are using can be dented by regular pencils try using a softer pencil such as an 8B.

Soft pencils can be found among drawing supplies. You can also apply a piece of masking tape to the sphere and use an ultra fine point Sharpie.

Adjust the position of the mirrored bevel in the body until it looks like the image of the axial hole is centered in the half inch hole of the body. Hold the sphere loosely in the sphere chuck and bring the tailstock mounted sphere alignment center close to the sphere. Turn the sphere so that the mark looks centered in the axial hole image. Advance the tailstock ram so that the sphere is pushed firmly into the sphere chuck, checking to make sure that the image of the mark remains centered in the axial hole as in Figure #20. Turn on the vacuum to the chuck, or use blue tape to fasten the sphere in the chuck, or both. You can now back off the Sphere Alignment Center. If a more secure mounting is desired and you don't need access to the axis of the sphere you can remove the beveled mirror from the body and leave the center engaged.



Figure #20: Center the image of the mark in the axial hole.

You can also use the Sphere Alignment Center with a cup chuck. Just remove the beveled mirror before turning on the lathe and leave the center engaged. Unless you're going to be very aggressive only one end needs to be a cup.