Sphere Template

Introduction

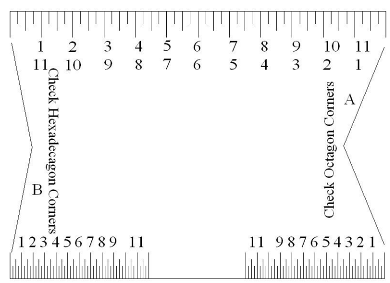
At a symposium several years ago I watched a demo by Myron Curtis on turning spheres. Myron started by turning a cylinder exactly as long as its diameter—the cylinder would have a square cross-section. Then he consulted a table to find a distance which he measured from each corner and marked on the cylinder. He then removed the corner, cutting from line to line—yielding an octagonal cross-section . Then he consulted the table again for a new distance to be measured each way from the resulting corners. These corners were then cut away from line to line, yielding a hexadecagon (16 sided) cross-section.

I don't like consulting tables. Or particularly doing math all the time if I don't have to, so sometime after I got home I used my CAD program to draw up a template where the proper measurements can be read off a scale. After making the cylinder one simply measures the diameter. The larger scale is used (it reads from both ends) to directly mark the proper distance. The corners are removed. Then the smaller scale is used to mark the proper distance from the new corners.

Making the Template

The template is Drawing1. Even if what you're reading has a copy of the template I suggest you download the pdf file from my web site and print out the pdf, as it will be more accurate that way. You can print the template out onto large label stock, or plain paper. Find a suitable substrate to fasten the template to. You can use very thin wood, or plywood, cereal box cardboard, etc. I used aluminum flashing as it's sturdy but can be cut out with scissors. If you used label stock, just attach the label to the substrate. If you use plain paper, use spray adhesive to attach the label. Cover the whole front surface of the template with clear tape (2" packing tape for instance). Then cut out the template.

The Template in pdf format.



Drawing1: The Template for illustration. I suggest you download and print the pdf in the link above.

Using the Template

Begin by turning a cylinder that is the diameter of the sphere that you want. You can turn between centers or hold the work in a chuck—there's no difference to the procedure other than having two or one nub to deal with. Measure the diameter of the cylinder with calipers and use the calipers to transfer the measurement to the cylinder as in Fig01. Make parting tool cuts just outside each mark, then clean up the parting tool cuts with skew or spindle, ending up right on the lines. This procedure is very sensitive to starting conditions—the cylinder has to have a square cross-section so be sure that your end cuts are perpendicular to the lathe axis. You'll need to taper the nubs holding the future sphere to gain access so you can measure and mark on the ends.

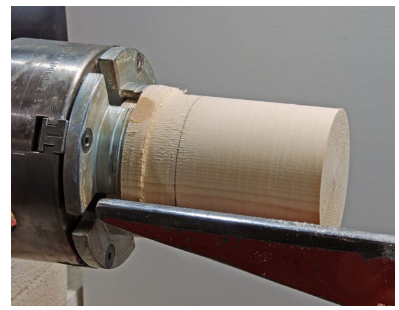


Fig01: After turning a cylinder and marking out a length that is exactly the same as the diameter.

Thinking of the work as half a cross-section, you have two corners, one at each end. Use the larger scale of the template to measure in both directions from each corner of the cylinder as in Fig02. If you haven't cut the nubs thin enough, then go back and cut them smaller, don't guess at this stage. Next use a spindle gouge or other tool to cut away the corners from line to line. Don't try to hog it all off at once, instead make a series of parallel cuts, adjusting as you go to end up with a straight, not curved, cut from line to line as in Fig03. This yields an octagonal, or 8 sided cross-section. You can double check your work by using the more acute end of the template to check the angle at each corner.

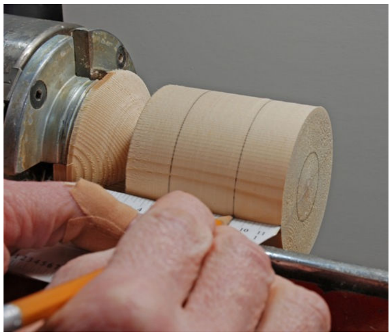


Fig02: Using the larger scale to measure away from edge of the cylinder.

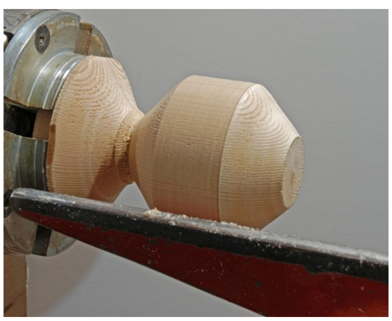


Fig03: After turning away the corners between the lines.

Thinking of the work as half a cross section, you now have 4 corners. Using the smaller scale, measure in both directions from each corner as in Fig04. Now turn away the corners from line to line, as in Fig05. The result in cross section will be a hexadecagon, or 16 sided polygon. You can double check your work using the more obtuse angle on the end of the template to check the angle at each corner.

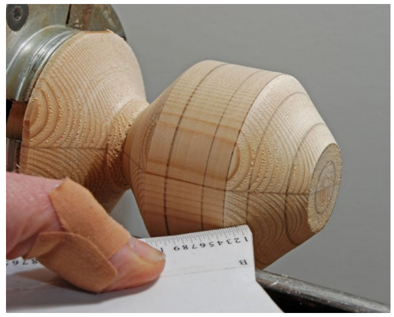


Fig04: Measuring from each corner of the octagon with the smaller scale.

Fig05: After cutting away the corners of the octagon between the lines.

Round over each remaining corner as in Fig06. Then complete the shaping and finish the sphere by sanding with progressively finer abrasives, as in Fig07.

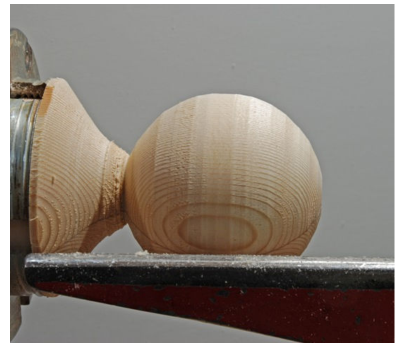


Fig06: After rounding over the corners of the hexadecagon.

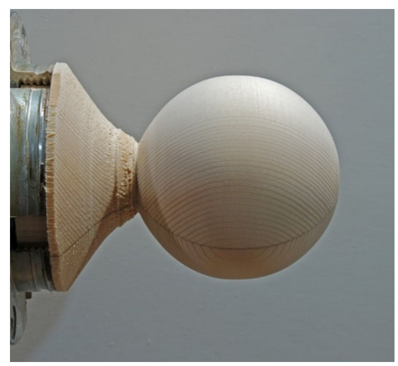
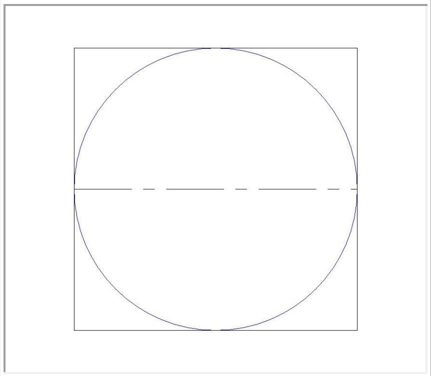


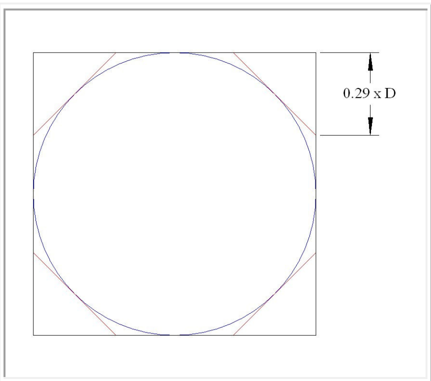
Fig07: After the final shaping with abrasives.

The Geometry

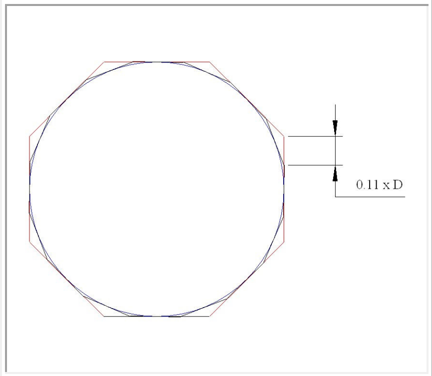
For those of you who like a bit of a theoretical frame to hang rote procedures on, I've done up a few drawings to illustrate what's happening in cross-section. Drawing2 shows the cross-section of the beginning cylinder with the future sphere shown in blue. Drawing3 shows what the larger scale does (it's 0.29:1), measuring 0.29 of the sphere diameter from the corners of the square locates the corners of the octagon that contains the same sphere. Drawing4 shows what the smaller scale does, measuring 0.11 of the sphere diameter from each corner of the octagon locates the corners of the hexadecagon (16 sided) that contains the sphere.



Drawing2: The starting cylinder, in cross-section, containing the sphere in blue.



Drawing3: Measuring a distance equal to 0.29 times the diameter from the corner of the square cross-section locates the corners of the octagon.



Drawing4: Measuring a distance equal to 0.11 times the diameter from the corner of the octagon locates the corners of the hexadecagon.

Author

David Reed Smith is a basement woodturner who lives, turns, tinkers and writes in Hampstead , Maryland . He welcomes comments, complaints and suggestions via email at David@DavidReedSmith.com.