Alan Stratton 9/20/2020

Objective: To turn a perfect sphere or ball out of wood or other material using usual and customary tools. More to the point. Not to have to purchase an expensive single purpose jig.

Preliminary Notes: A sphere is the 3-dimensional equivalent of a circle – a slice from a sphere yields a circle.
A cube is the 3-dimensional equivalent of a square. A slice parallel to one side of the cube yields a square.

A cylinder is the 3-diensional equivalent of a rectangle with a rotation thorough the centerline. A slice through the axis of the cylinder yields a rectangle.

In woodturning, the lathe transforms our 2-dimensional image into a 3-dimensional shape.

This process combines cutting an octagon with a finishing process that perfects the sphere.

Let's cover some theory first for background.

Definitions

Jig : a device used to maintain mechanically the correct positional relationship between a piece of work and the tool or between parts of work during assembly

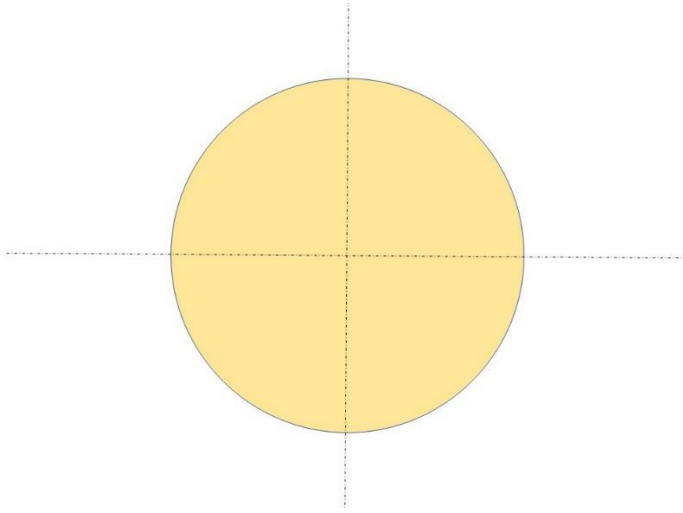**Process:** a series of actions or operations conducing to an end

-https://www.merriam-webster.com/dictionary/

From sphere to Octagon

Let us start with the end in mind
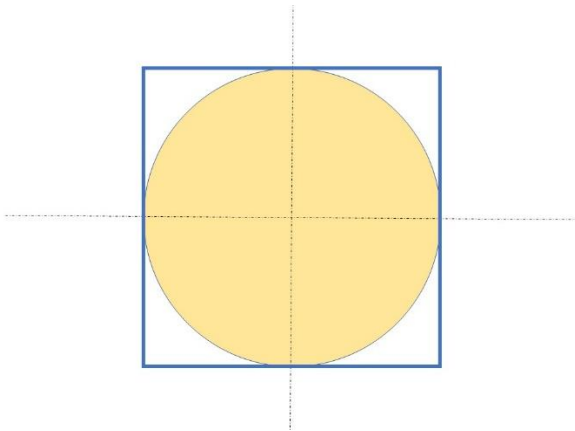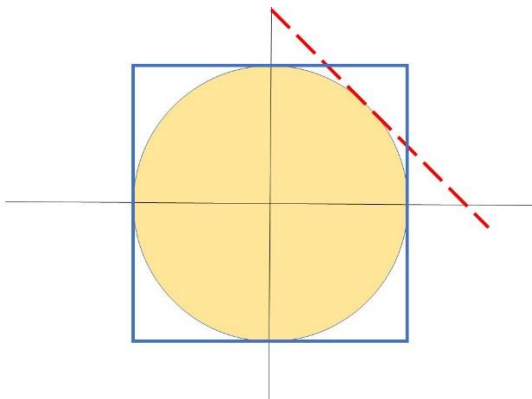
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We want to cut a sphere. On paper, this is a circle.

Let us build it up by encompassing our circle with a box – the box is a square. Our circle (Sphere) and a square (cube) share some essential properties: The diameter of the circle is the same as the length and width of the square. This is useful.
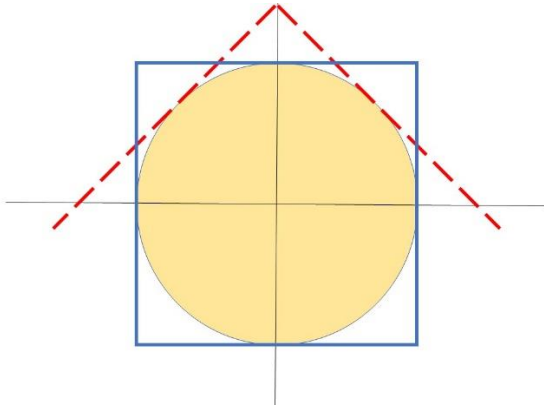
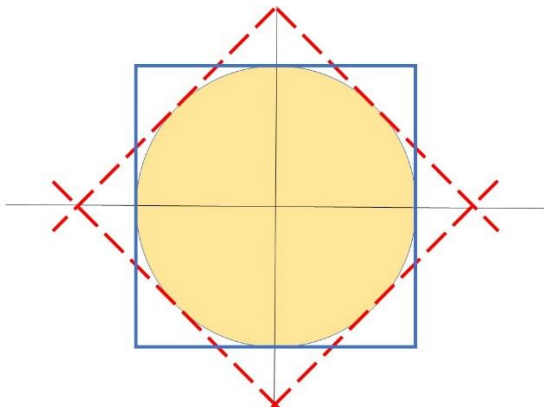Next we need to cut corners off the square to get closer to the circle.
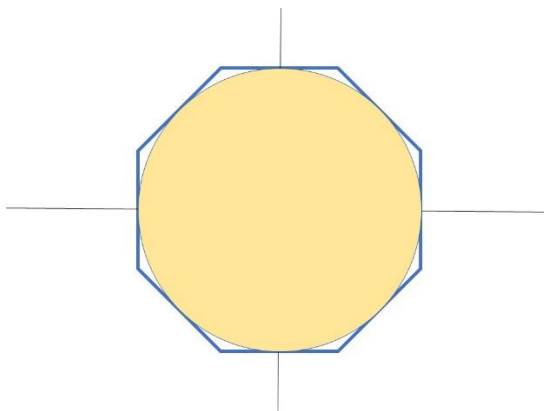
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Then move to the other side(left) and cut another corner off.

Our lathe, being the handy tool that it is, take care of the other two corners auto-magically.

Once we clean up out diagram, we find that we have an octagon now enclosing our circle.

At this point, we only need to round off the corners to find our circle.

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From cylinder to sphere.

Now that we have built a circle up to an octagon, let us go the other way. Let us start with a piece of wood. This wood, we turn into a cylinder that is big enough to contain our sphere but probably longer.

Our circle is inside the wood, we need to cut away the extra wood.

The darker rectangle in this diagram represents the turning axis and the temporary nubs that result from the drive and live centers.
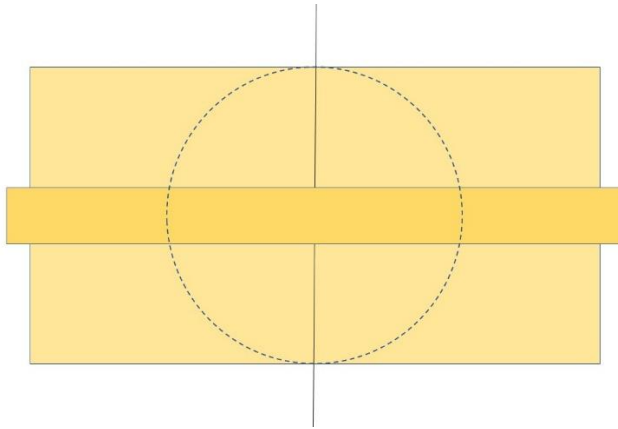
Remember the common dimensions: width = diameter and length = width, in whatever order they need to be in.
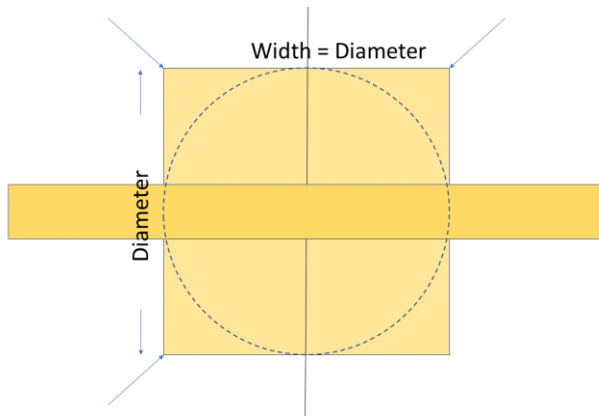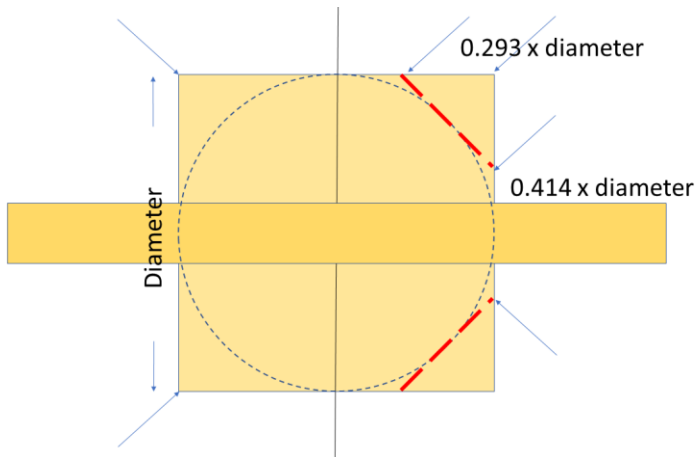
Next, we need to start cutting corners. But, where do we start and end the cut? It needs to be at a 45 degree angle, but where?

Do not worry. All we need to know is that there are two critical measures. Both measures use the diameter to find he corners for our cut. The distance from the top corner to the next corner is 0.293 multiplied by the diameter.

0.293 x diameter

0.414 x diameter

Diameter

One additional multiplication complements the first. The side of the octagon is 0.414 times the diameter. This happens to also be equal to the diameter minus twice the corner distance. We can cut the appropriate corners off now.

0.293 x diameter   0.414 x diameter   0.293 x diameter

Diameter

0.414 x diameter   0.414 x diameter
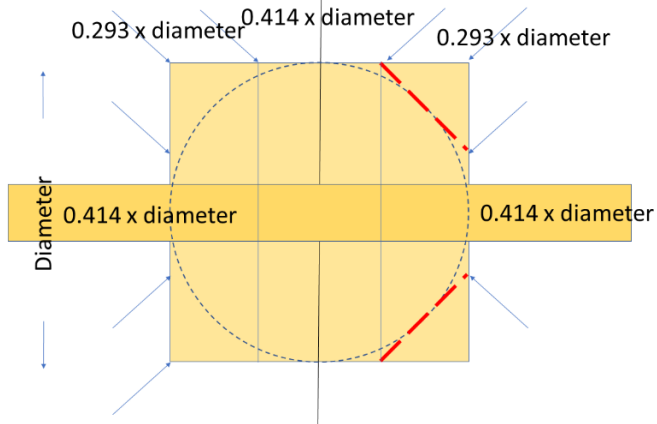
And we are left with an octagon. If we have been relatively accurate, our circle is still inside. We need just a little more work to expose it.

Octagon = 8 sided polygon
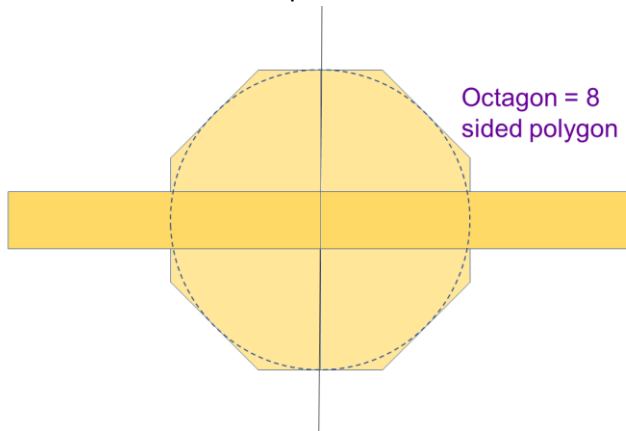
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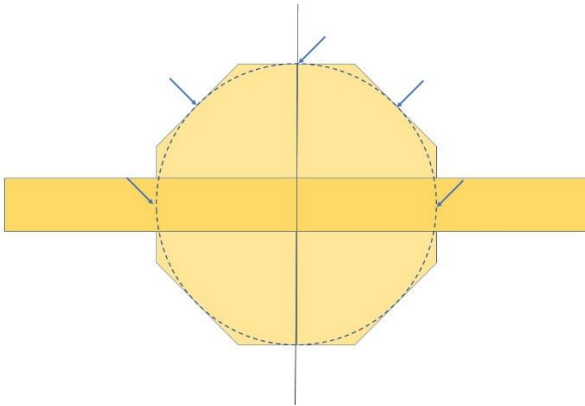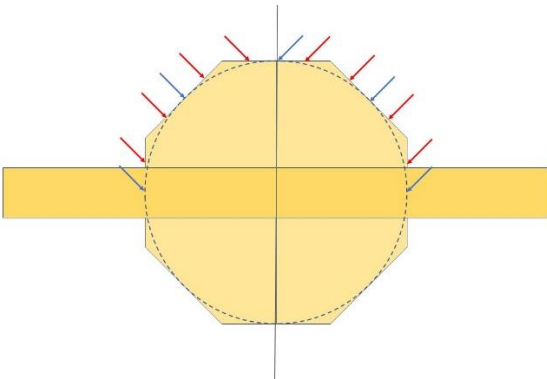We will now transform this octagon a little further. A few marks will help. Make a mark at the mid point of each face of the octagon.

And then make an additional mark between each of those marks and the corners. The red lines are the new lines.

Then cut each corner off. Unfortunately, some of these marks are still embedded in the left and right nubs. That is not a problem right now.

Hexadecagon = 16 sided polygon
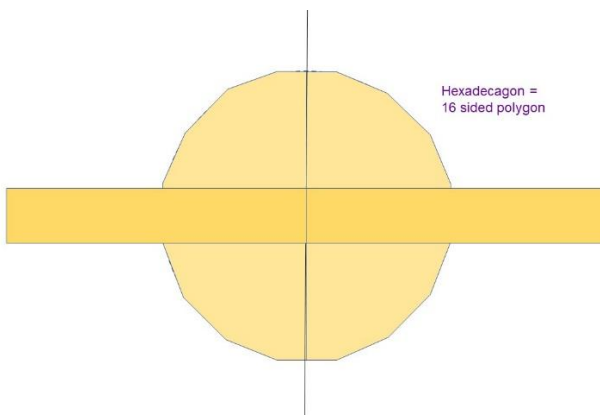
With that completed, we need only round off the remaining bumps by eye. One aid is a large disk say 1 to 2 inches or a large washer. As you move it across the surface and examine the inner edge, you can see ridges and valleys. However, do not spend a lot of time perfecting the surface, that is coming up next.

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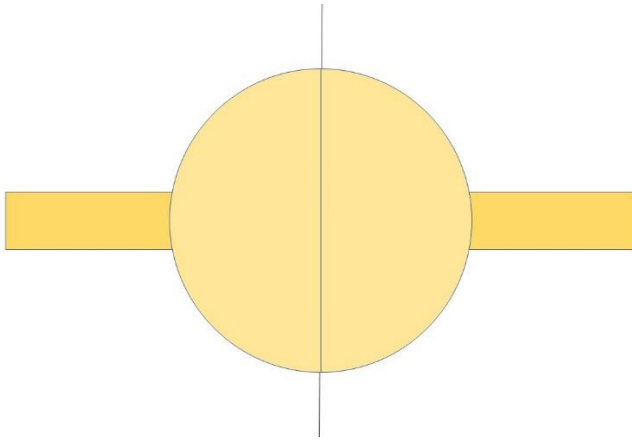
Perfecting the sphere

We do need just a couple of accessories. On the spindle, we need a cup faceplate. I like to thread mine into a piece of poplar with a surface layer that I can refresh as needed. The cup need to be just large enough to hold the sphere somewhere between one quarter to one third of the diameter. Make sure the cup is deep enough that the sphere is seated on the lip.

For the live center, fashion something that will hold the sphere against the cup chuck without marking it. My preference is a rubber stopper that is drilled out to fit the threaded portion. A penny or dime provides further protection. As live centers vary, you may adapt to your tooling.

Accessories

1. Optionally, trim the nubs but be careful. You may be tempted to use a band saw but that is a dangerous move without a proper jig. If you must trim, use a hand saw.

2. Mount the rough sphere to the cup chuck with pressure from the protected live center. Orient the nubs from the drive and live centers so that they are outermost. Position the tool rest to clear the nubs.
3. With very light cuts with a gouge or a scraper, trim down the shadow that appears while the lathe is running at the top of the sphere. This ghost is the imperfections in the sphere. Once we completely git rid of the ghosts, our sphere will be perfect.
   The main thing to remember is not to cut too deeply. It is better to stop short than to over cut.
4. The sphere will still be rough and may appear slightly elongated at the cup and live centers. This is because you have removed wood between these points. Don't worry, the solution is coming.
5. Mark the center or equator of the sphere is the current mount.
6. Loosen the mount and rotate the sphere 90 degrees. If you position one of the original nubs at the top and rotate relative to this point, this will help remove any remaining wood or marks from the nubs. The equator mark is now running from pole to pole or from drive center to live center.
7. Again, gently attack that ghost. Stop periodically to make sure you are leaving that old equator mark. If you cut into this line, additional rotations will be required.
8. Now mark new equator line.
9. Again, rotate the sphere 90 degrees so the new equator line is running from center to center.
10. Very gently, attach that ghost. He should be shrinking to almost nothing.

At this point if you have not overcut, you may be done. There still may be imperfections that will be sanded out next.

However, if there are major defects or marks showing, simply mark a new equator line, remount the sphere, and attack the ghost again. Repeat as necessary.

Sanding to Perfection

1. Using the same cup center and live center adaptors, repeat the same process using 80 grit sandpaper. Do not skip 80 grit. 80 grit is your new scraper. Remember 3 rotations.
2. Repeat with 120 grit sandpaper. Remember 3 rotations.
3. Repeat with 180 grit sandpaper. Remember 3 rotations.
4. Repeat with 220 grit sandpaper. Remember 3 rotations.
5. Repeat with 320 grit sandpaper. Remember 3 rotations.
6. Repeat with whatever grit you usually end with.

Finishing

Apply the finish of your choice.

Each week, I publish a woodturning video on my website.

www.AsWoodTurns.com