# Basic multi axis turning

Finding multiple centers by dividing a circle into equal multiple parts:

3 centers –Draw a pair of diagonal lines from corner to corner on find the center of your blank (I find it useful to only mark the very center of the 2nd diagonal). Use a compass to draw a circle. One of the points where the diagonal line bisects the circle will be one of your 3 centers. Set the compass on the other point where the line bisects the circle and draw a circle that passes through the center point and intersects the original circle at 2 points. These 2 points along with the original line that bisects the circle are our 3 points exactly 120 degrees apart.
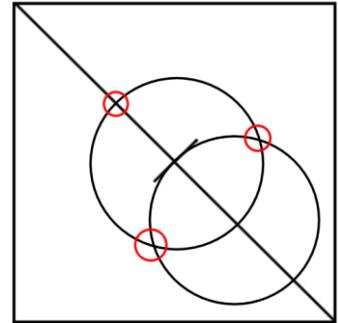
5 centers - Use a compass draw a circle. Draw a line through the center point, dividing the circle in half. Draw a second line 90 degrees to the first line. We will call the intersection of the 2 lines point O, we will call the intersection between the vertical line and the top of the circle point V. Point V is the first of our 5 centers. Next mark a point exactly half way between the center and the outside of the circle. We will call this point X. Set the compass to the distance from point X to point V. Scribe an arc from point V that intersects the horizontal line. We will call this point Y . Now set the compass for the distance from point V to point Y and scribe an arc that intersects the outside circle. This intersection will provide us with our second center (Z). With the compass still set at the distance from point V to point Y we can continue to scribe arcs that intersect the outside circle, each of these will be one of our 5 equally spaced centers.
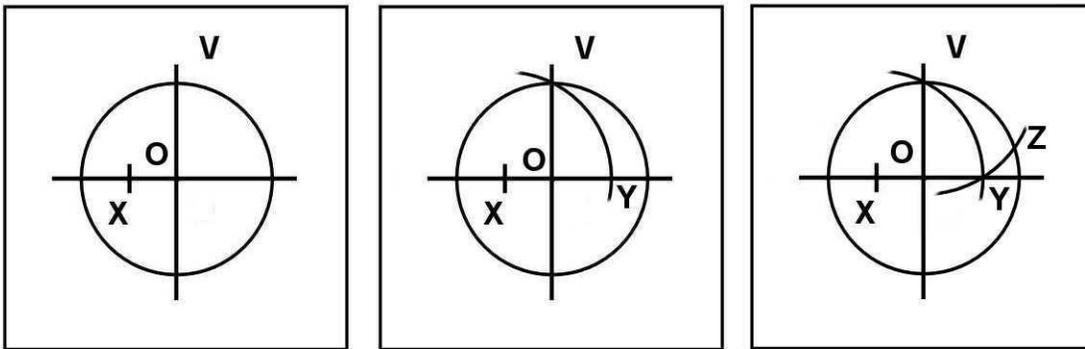
Now that we know how to lay out our centers we need to know what we can do with them.

4 possible options are laid out below using 2 centers. The upper left layout can result in somewhat oval shape and can be used for tool handles where a round shape is not desired. The upper right layout will result in the piece having a 180 degree twist, both ends will be somewhat oval in shape but it will be round or nearly round in the middle as there is only 1 axis right at the center point. The lower left layout is possible using 2 parallel centers and turning what is essentially a large bead on one center and a large cove on the other center. The last layout is done one 2 parallel centers, using the secondary center only for the middle off-axis portion. The cross section at any given point is entirely round.
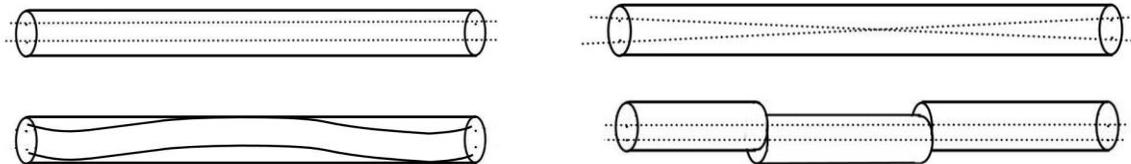
Laying out the twist:
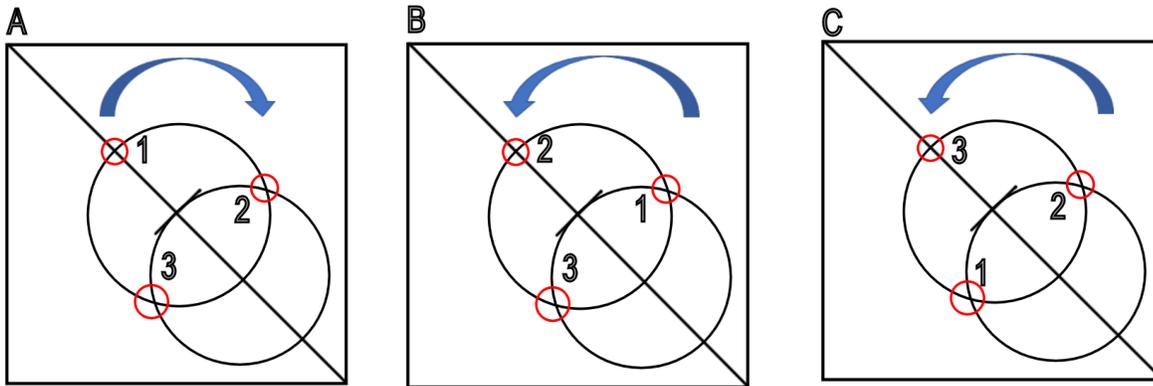
An easy way to number the centers for the 3 sided piece with a twist is to number side A from 1 to 3 **clockwise** starting at the point where the diagonal line bisects the circle. The opposite end of the blank is numbered **counter-clockwise** starting with point #1 at either of the points where the 2 circles overlap. Layout B will give you a twist that from top to bottom rotates from left to right, layout C will give you a twist that rotates from right to left.

Tips and tricks:

- The diagonal lines on both ends of your blank should be parallel. Lines that aren't parallel may lead to undesirable results.
- Offset the compass for the 2nd circle in the same direction on both ends of the blank. I always offset the compass to the lower right. Offsetting the compass in the opposite direction may lead to undesirable results.
- When numbering the centers it's important to number them on the inside of the blank. Numbering them on the outside can result in the numbers being turned away.
- With the center points setup and numbered correctly it's simply a matter of lining up point 1 with point 1, 2 with 2, and 3 with 3 to get the twist that's desired.
- The amount of offset or the diameter of the circle does not need to be a large amount for good results. Setting the points too far from the center of the blank may result in your points being turned away while you're turning one of the other axes.
- A larger diameter circle will result in a finished piece with flatter faces and sharper corners but at the risk of turning away your points.
- Turning all 3 axes with a straight line will result in a piece with a slightly larger diameter in the middle. To counteract this turn a very shallow cove along the entire length of the blank on all 3 centers.
- If the faces are uneven the narrow face is the one that needs more material removed. This will remove material from BOTH adjoining faces making the narrow face wider.
- This layout will provide a 120 degree twist regardless of the length of the blank. A longer blank will result in the slower twist over a longer length. A shorter blank will result in a faster twist over a shorter distance.
- If you happen to turn away your numbers the point you need to use is farthest away from the face you'll be turning.
- To ensure that you're on the correct center on each end rotate the piece by hand, the face that you'll be turning should be closes to the toolrest along the entire length of the blank.