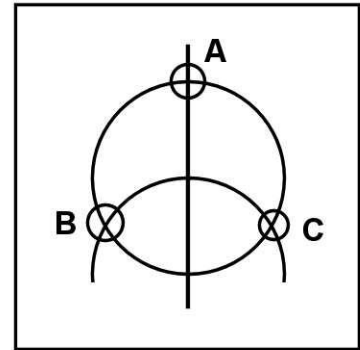


## Basic Multi-Axis Turning

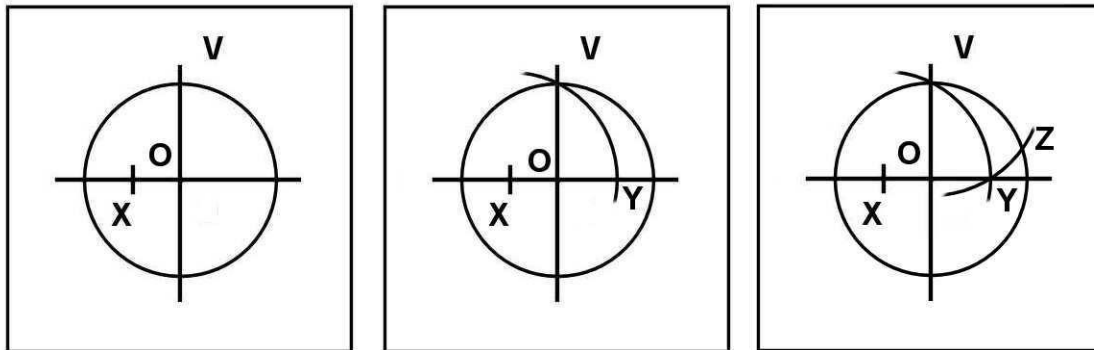
### Finding multiple centers by dividing a circle into equal multiple parts:

**2 centers** - Using a set of dividers or a compass draw a circle. Draw a line through the center point, dividing the circle in half. The points where the line intersects the circle are your centers. **4 centers** – draw an additional line perpendicular to the first line, the points where both lines intersect the circle are your centers.



**3 centers** – Use a compass to draw a circle. Draw a line through the center point dividing the circle in half. One of the points (A) where the line intersects the circle will be one of your 3 centers. Using the compass set to the same radius and the pivot on the point opposite the point above and scribe an arc that passes through the center point and intersects the circle on both sides of the center line (B & C). A B & C are your 3 centers.

**5 centers** - Use a set of dividers or 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.

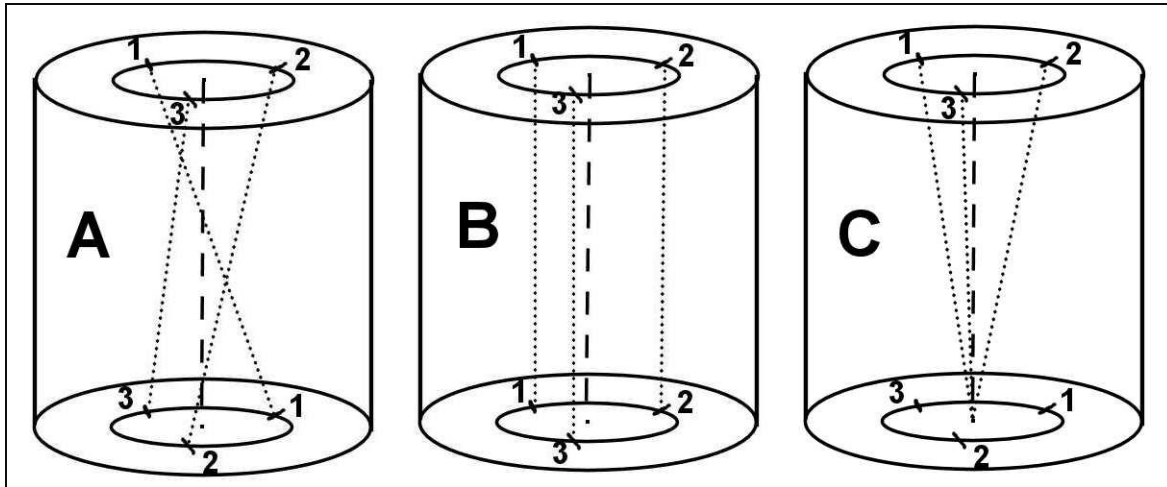
4 possible options are laid out below using 2 centers. The upper left layout can result in somewhat oval shape and can be used for tool handles where a round shape is not desired. The upper right layout will result in the piece having a 180 degree twist, both ends will be somewhat oval in shape but it 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.



## Basic Multi-Axis Turning



3 possible options are laid out below using 3 centers, similar results can be achieved with 4 or more centers.



Layout A will give us a 3 sided piece with each side having a 120 degree twist. 4 centers would have a 90 degree twist, 5 centers would have a 72 degree twist. More than 5 centers are possible but as additional centers are added the closer to round the final shape will appear.

Layout B will give us a 3 sided piece with all 3 sides being parallel.

Layout C will give us a 3 sided piece with each side converging at the bottom.

### Tips and tricks:

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.

An easy way to number the centers for the 3 sided piece with a twist (layout A above) is to number the top side 1 – 3 going clockwise and number the bottom side going counter clockwise after putting point 1 opposite point 2 or 3.

The direction of the twist can be controlled when numbering the bottom side, in the example above point 1 on the bottom is opposite point 2 on the top, putting point 1 on the bottom opposite point 3 on the top would result in the piece twisting in the opposite direction.

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.

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