

1. Start a new job, a bit bigger than you want the clock to be. Set your Zero's where you normally would, I like to have mine in the centre and top of material. Set your resolution to very high

Job Setup

Job Type

1  Single Sided
 Double Sided

Job Size

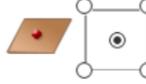
 Width (X): 450.0 mm
Height (Y): 450.0 mm
Thickness (Z): 25.0 mm

Units inches mm

Z Zero Position

 Material Surface
 Machine Bed

XY Datum Position

 Use Offset
X: 0.0
Y: 0.0

Design Scaling

Scale design with job size

Modeling Resolution

 Very High (7 x Slower)
4 million points

Appearance

 Walnut
Solid Color:

OK Cancel

2. Click the **Draw Circle** , Create a circle at coordinates 0,0 that will be the outline of the clock. I want my clock to be 400mm in diameter

Draw Circle

Center Point

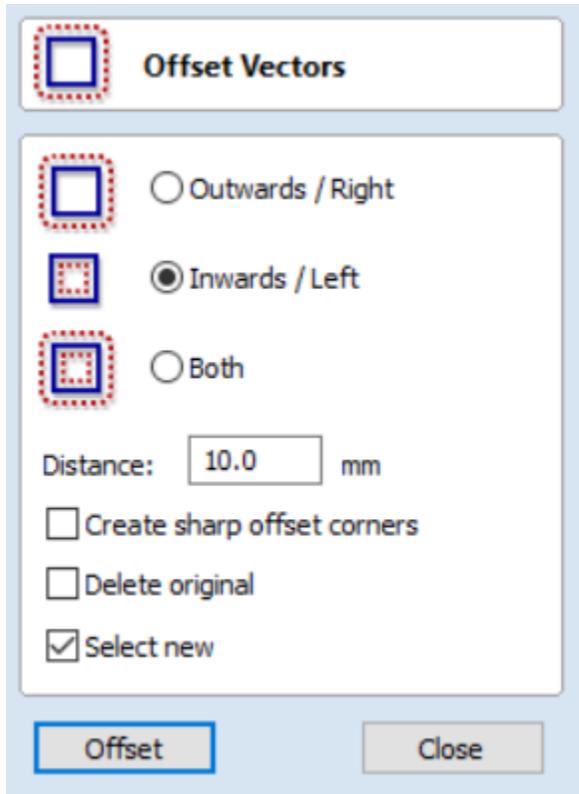
 X: 0.0 Y: 0.0

 Radius Diameter
D: 400.0 mm

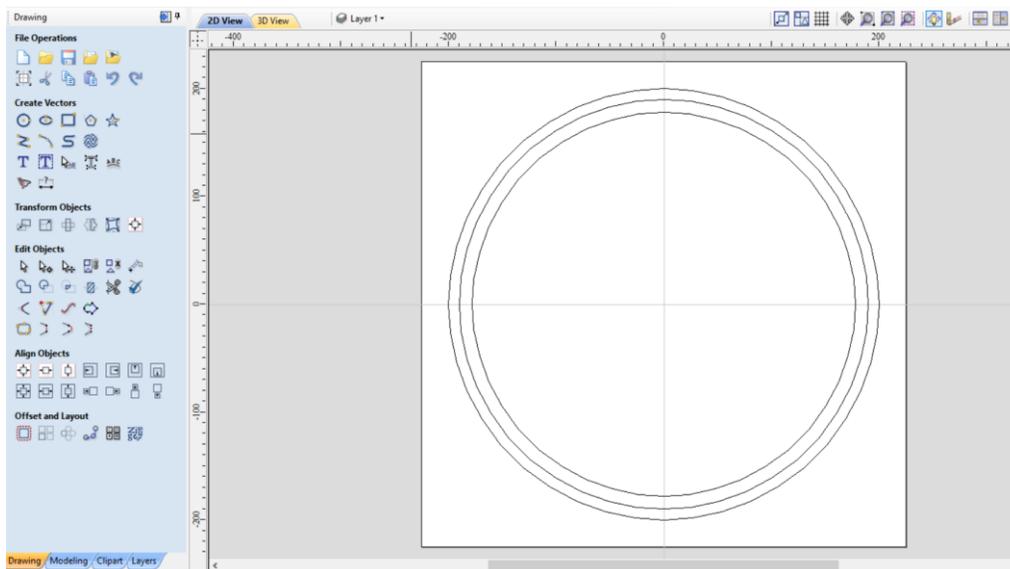
To edit an existing shape
hold shift while selecting

Apply Close

3. we now want to make two slightly smaller circles, you can either just draw them free hand to a size that suits, or use the Offset tool . Select **Inwards/Left**, set distance to 10mm, and tick **Select new**. Click **Offset** to create a new circle, this will now select the newly created circle. Now change the Distance to 12mm and click **offset** again to create the last circle. Click **Close**



4. Your Geometry should now look like this. Select the three circles, Right-Click and select **Move to layer > New Layer** then call the layer something like 'circles'

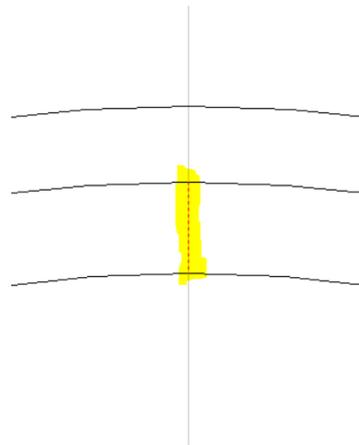
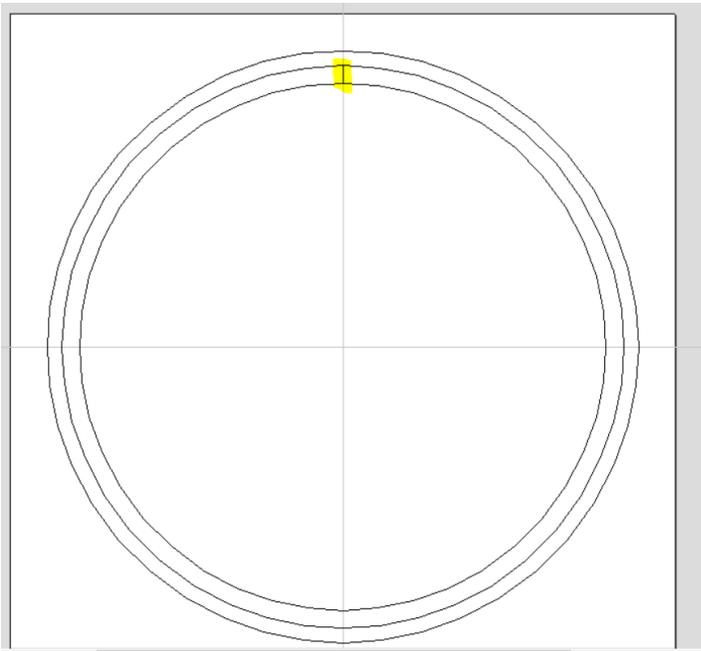


5. It is very important that all the geometry is exactly centered, as we are going to rotate the numbers around the center of the job. To confirm this at any stage, select all geometry you want to center and

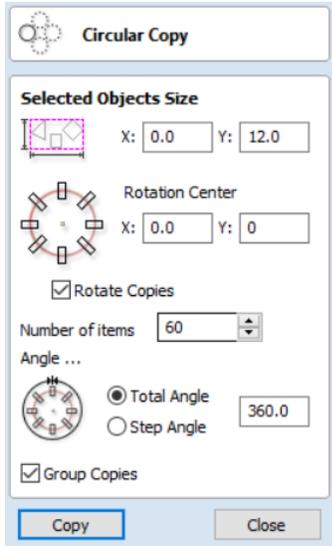
click the **Center Tool** 

6. To create the 60 notches in the face, we will select the **Polyline tool** 

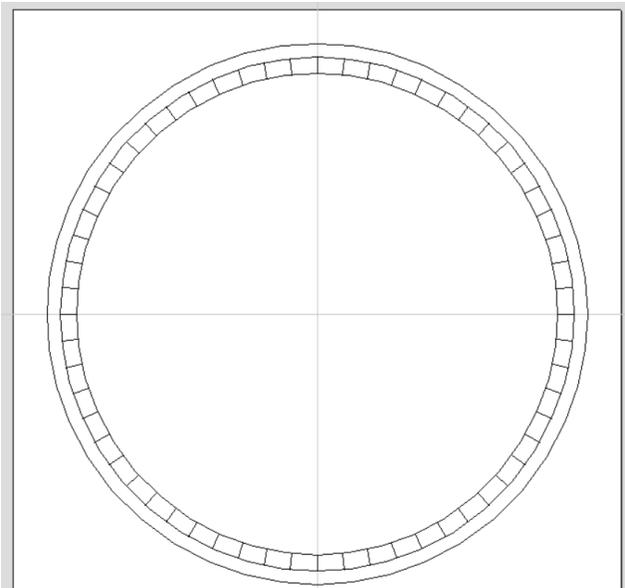
Draw a line at the 12 O'clock position between the two smaller circles using the auto-snap to align it to the job center, and to snap to each circle (the Cursor will change to a crosshair with a circle at the centre to show that it is snapping). Click **Close**



7. Click **Circular Copy**  then select the vertical line we just created. Change **Rotation Center** to X0 Y0, ensure **Rotate Copies** is ticked, input number of copies (I went with 60 – 5 lines between each hour on the clock. $5 \times 12 = 60$) and ensure group copies is ticked. Click **Copy**, then click **Close**



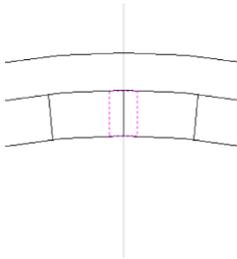
8. The resulting geometry should look like this. Select the group of 60 lines, Right-Click and select **Move to layer > New Layer** then call the layer something like '60 lines'



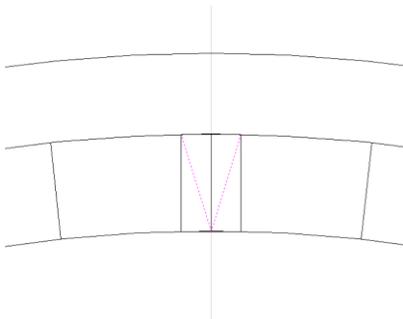
9. These 60 lines are now grouped, we want to ungroup them, select the group then right click and select **Ungroup Objects > Ungroup onto groups layer**.

10. To create a triangle for each hour mark, Draw a rectangle  at the 12 O'Clock position, that is snapped to the two smaller circles – similar to the line we created in prior step. Don't put too much effort into making sure it's centered, just create a rectangle the width you want, then with the rectangle selected click the **Center Horizontal** tool  to center it.

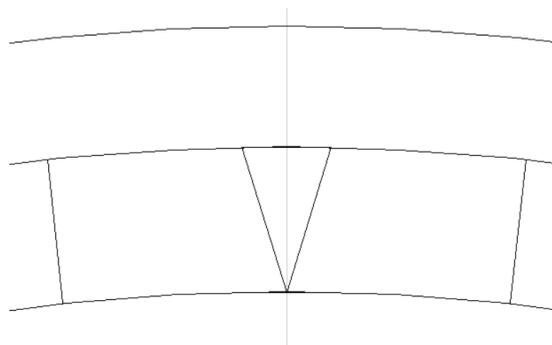
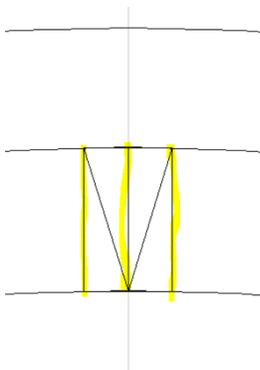
The Rectangle should look like this at the 12 O'clock position



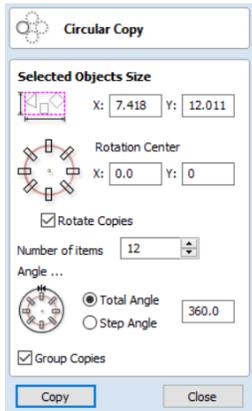
Now draw two lines using the **polyline** tool to create a triangle



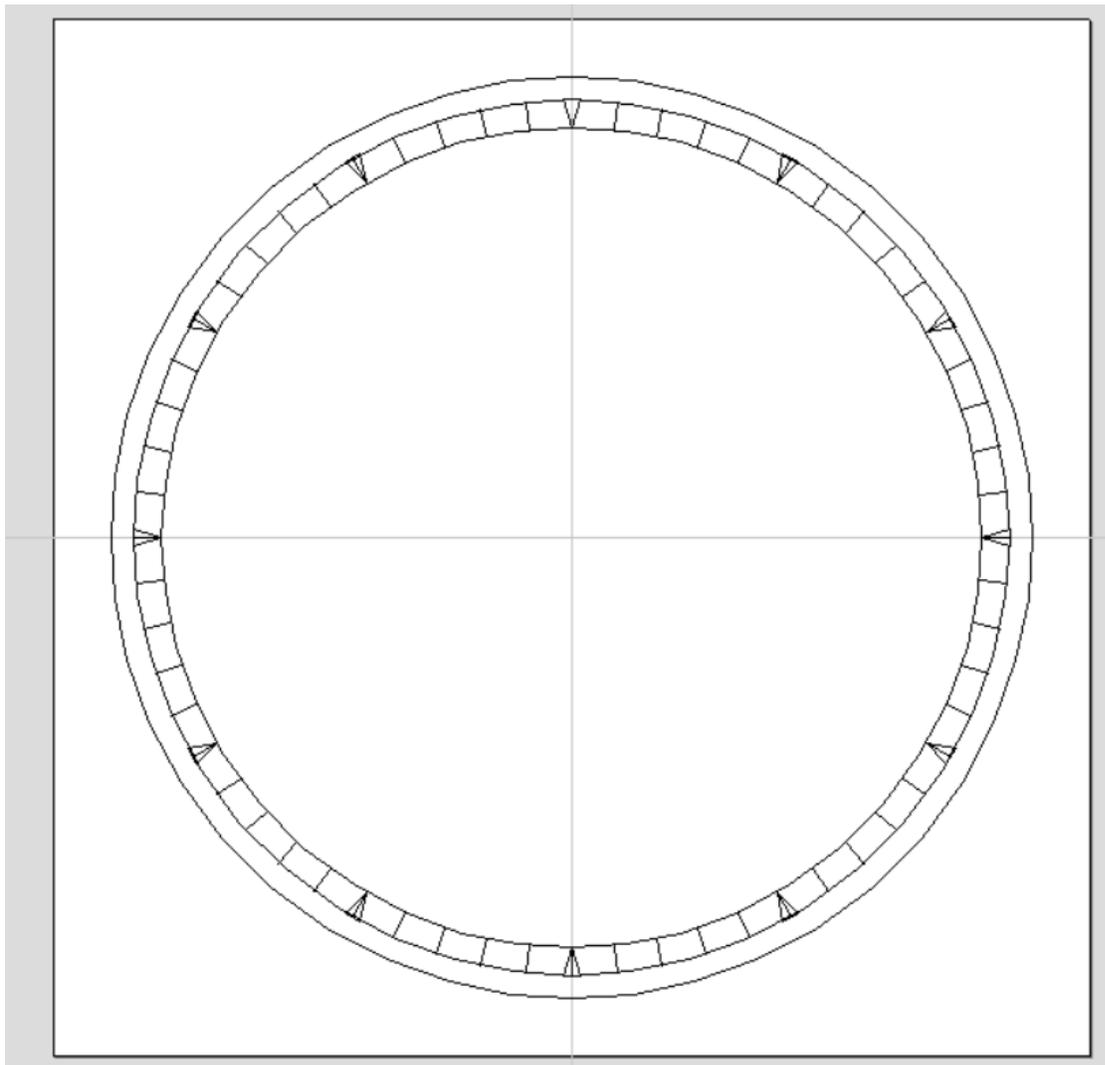
Now using the **Interactive Trim** tool , trim the three vertical lines away to leave a triangle



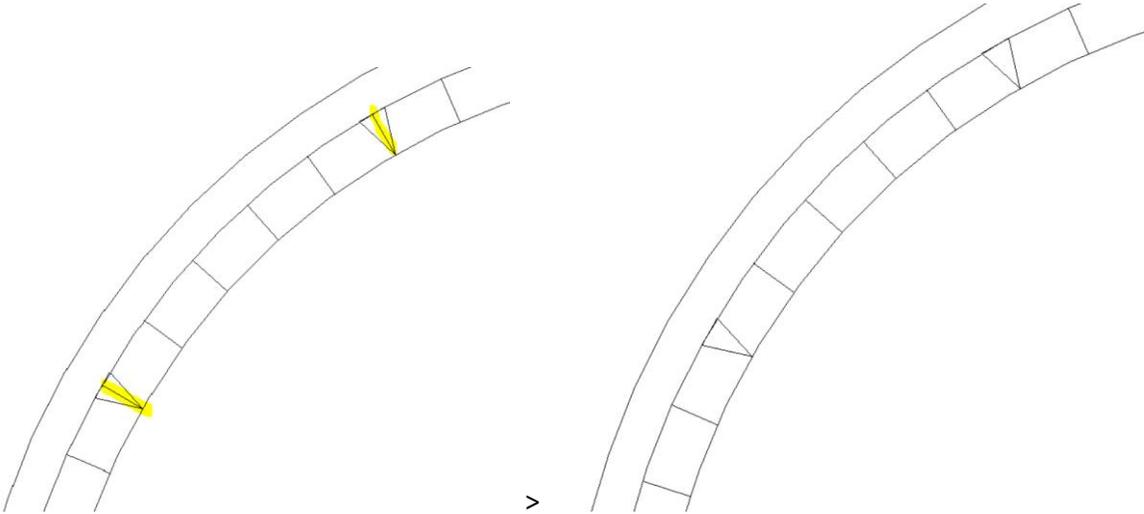
11. to copy the triangle to the hour positions Select **Circular Copy** and ensure the **Rotation Center** is set to X0, Y0, set the number of items to 12, and ensure **Group Copies** is ticked. Click **Copy**, then click **Close**



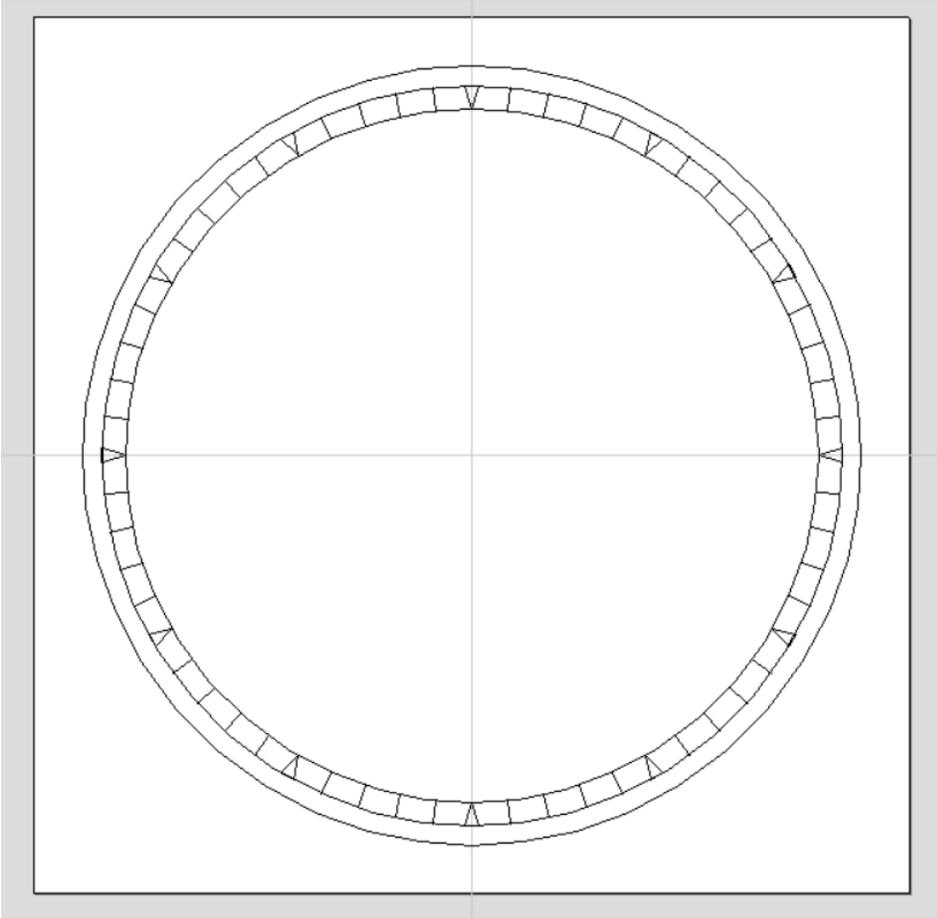
12. Geometry should now look like this



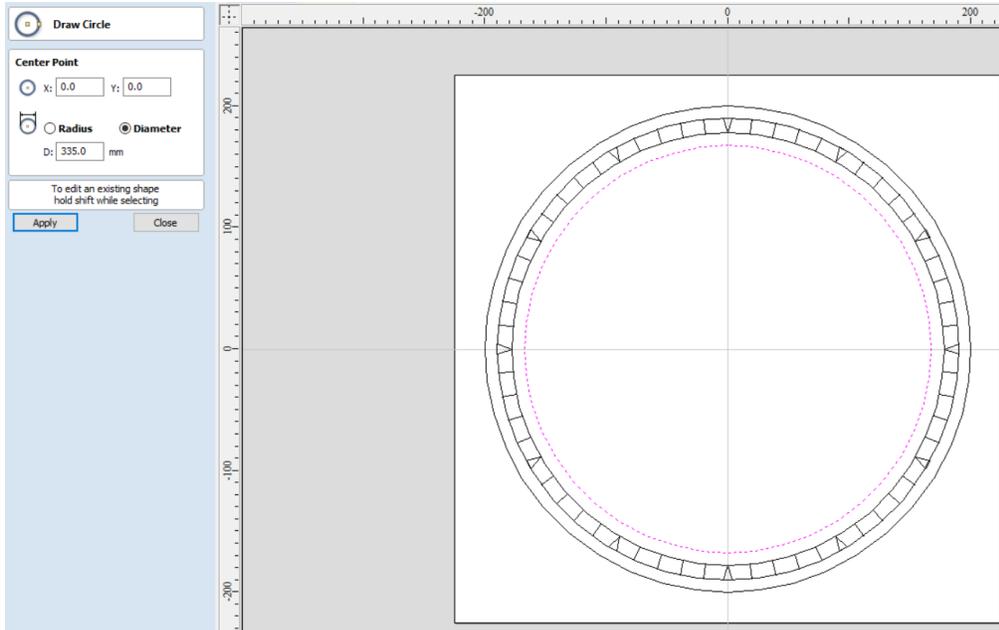
13. Select the **Interactive Trim** tool, then delete the lines from inside the triangles



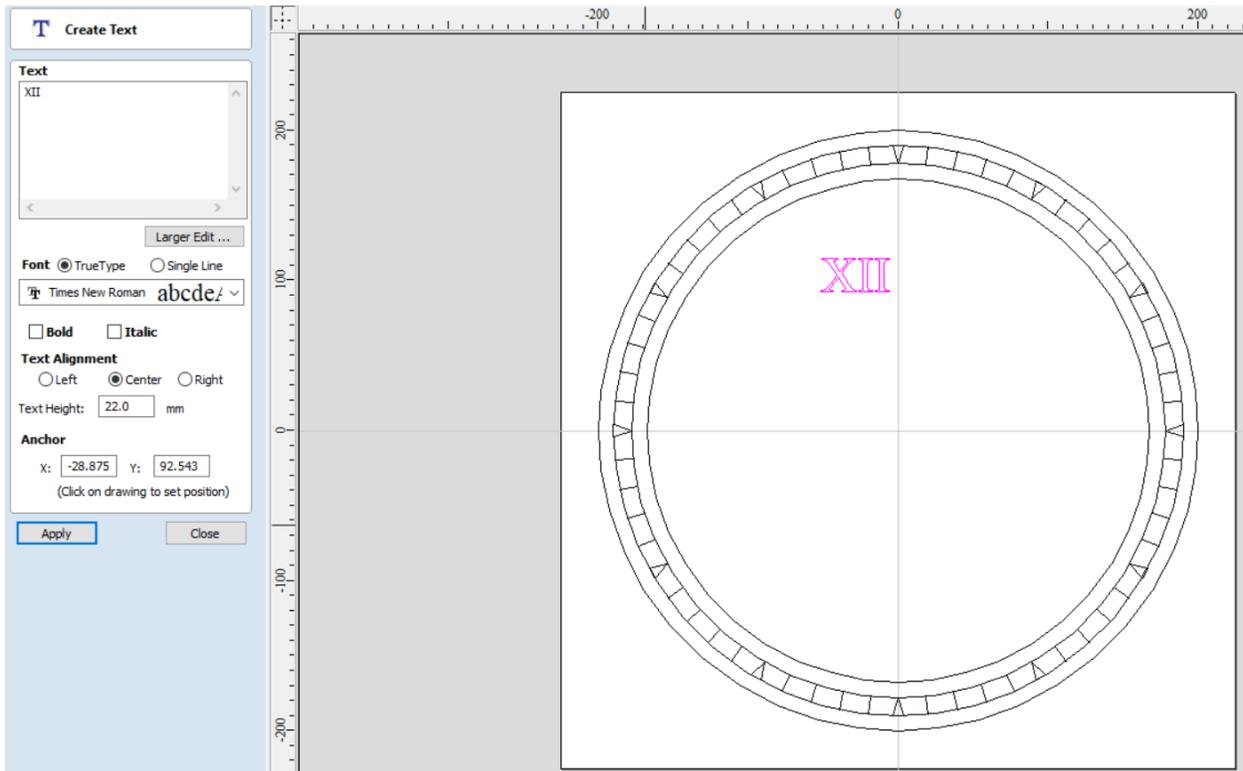
14. The resulting geometry should look like this. Select the group of 12 triangles, Right-Click and select **Move to layer > New Layer** then call the layer something like '12 Triangles'



15. Using the **Circle** tool, create another circle centered on the job centre, approximately where you would like the outside of each roman numeral to be – I went with a diameter of 335mm for this example. Click **Close**.

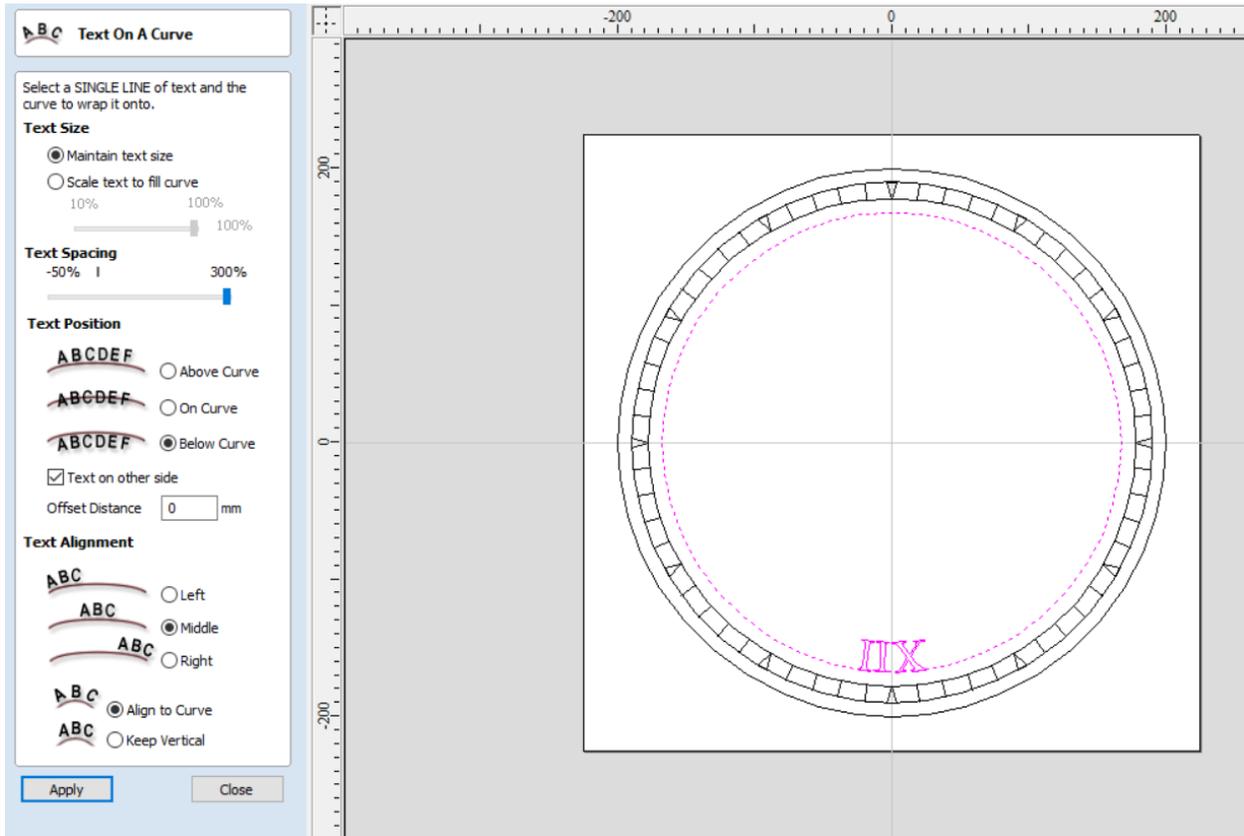


16. Click the **Create Text** tool  and create the numeral 'XII' anywhere on the screen, at a size that suits – I used Times New Roman at 22mm height for this example. Click **Close**

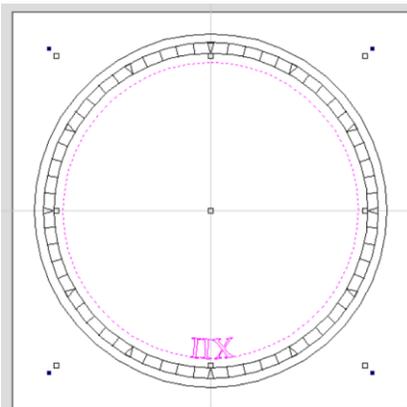


17. Click the **Text on a curve** tool . The options will be greyed out until you have selected both text and a curve or circle. Holding Shift, select the XXI text and the smallest circle, then ensure settings are as below then click Apply. Text spacing is increased so the letters don't overlap. Click **Close**

Note that the 'XII' is in the 6 O'clock position – we will fix that shortly



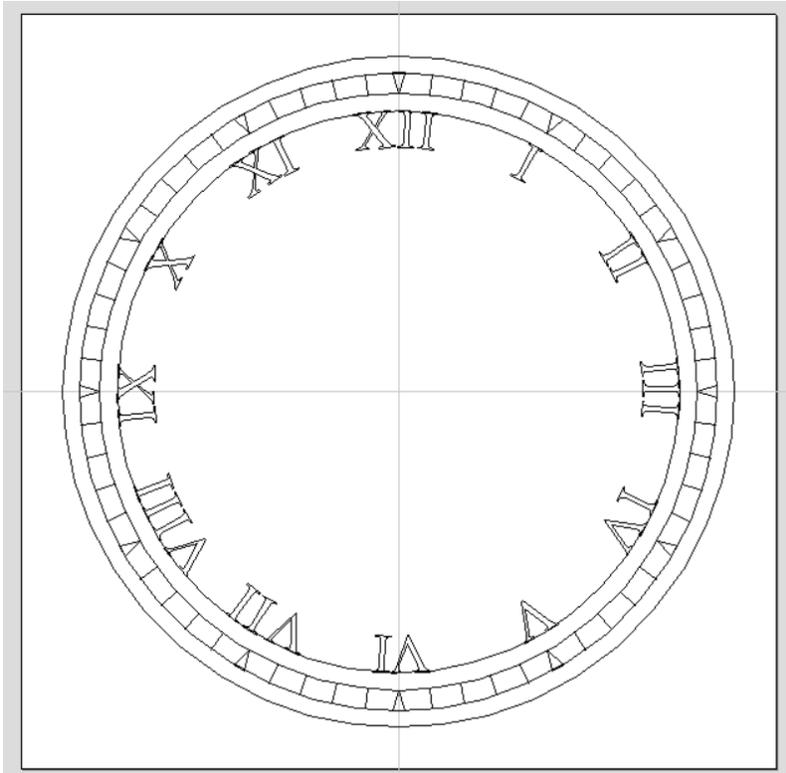
18. Holding shift, Select both the Small circle and the text, release the shift key then click the selection again to get the scale and rotation handles to appear



19. Click and hold the blue Rotation handle  and rotate the selection so 'XII' is in the 12 O'clock position. Holding the **ALT** key while rotating will snap the rotation to 15° increments – very useful for this operation.

20. Repeat steps 16-19 for all 12 Roman Numerals.

Your geometry should now look like this

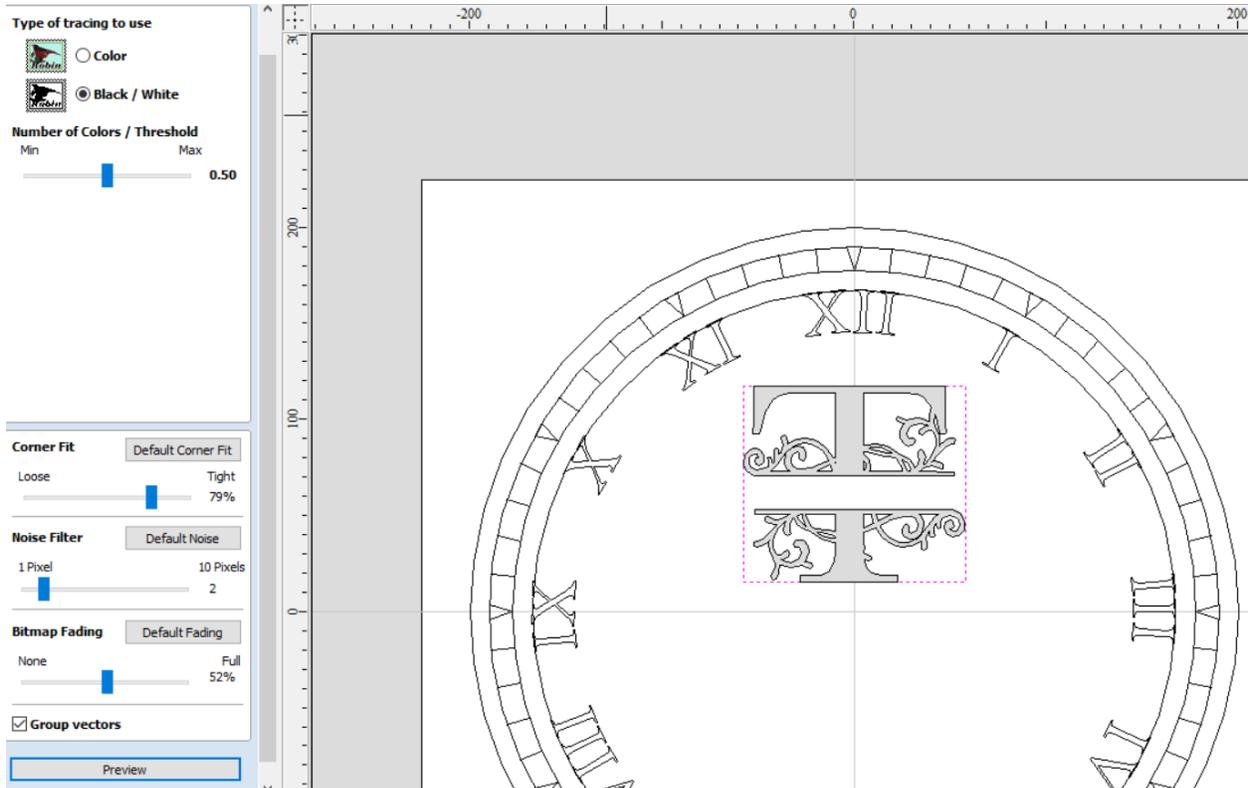


21. Select the smallest circle, Right-Click and select **Move to layer > New Layer** then call the layer something like 'Number Guide Circle'

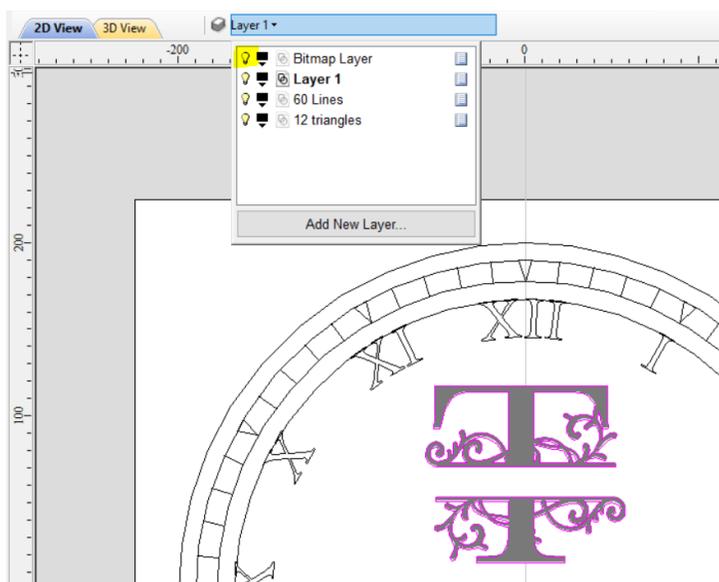
22. Find letter for clockface - Go to <https://3axis.co/dxf/design/> for some options. Don't download the DXF, just right click the image and click save as. (DXF will work but will slow the project right down) Try and use high-resolution, black and white images.

23. Click **Import Bitmap – For Tracing**  then select your image and click **open**

24. Click **Trace Bitmap**  - all options will be greyed out unless your image is selected in the work area. I use the following settings for black and white images. Click **Preview** each time you change settings, then **Apply** and **Close** when complete.



25. Turn off the Bitmap layer to hide the image by clicking the lightbulb



26. Right Click on the newly traced geometry and select **Move to layer > New Layer** then call the layer something like 'Letter'

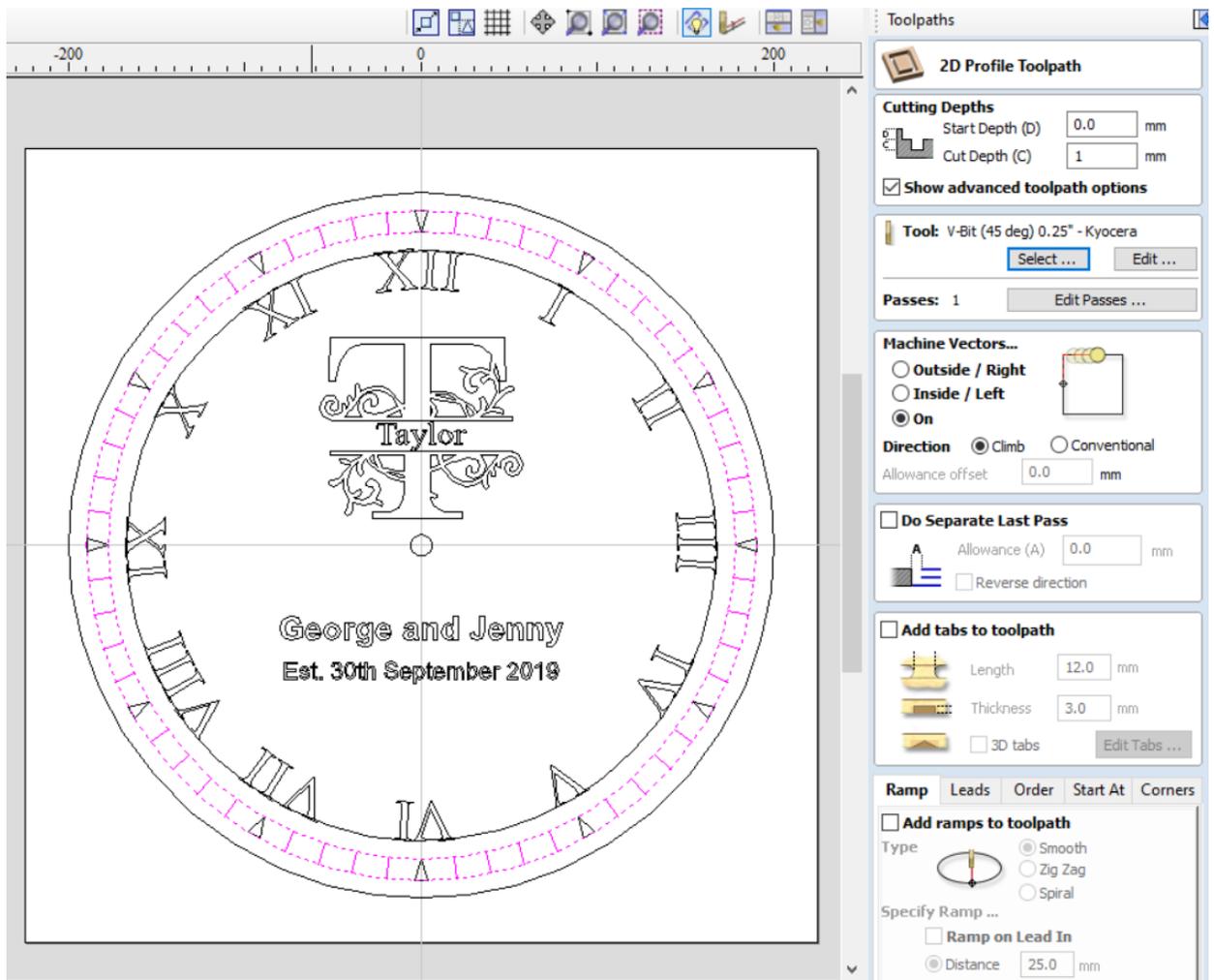
27. Measure up your clock mechanism and create a circle in the center for the shaft (I drew 12mm just for the exercise), and a square to fit the body of the mechanism – Note this square pocket will be machined from the back in a second setup.

28. The rest of the design is really personal. Add any text or other images you want.

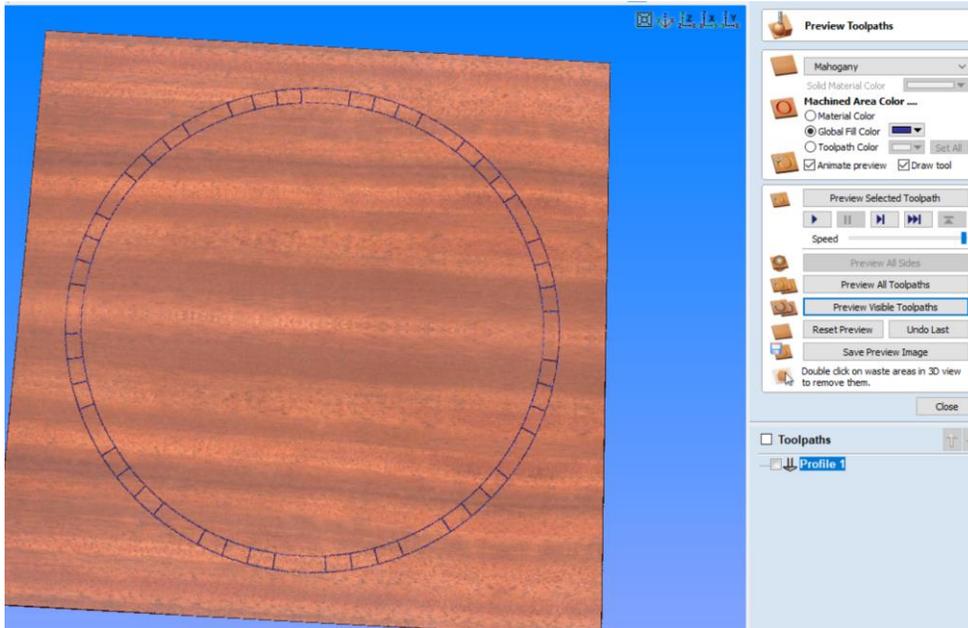
Toolpaths

These toolpaths are for my specific machine, and only to show the process I use, ensure your Zeros, safe distances, speeds and feeds are correct for your machine

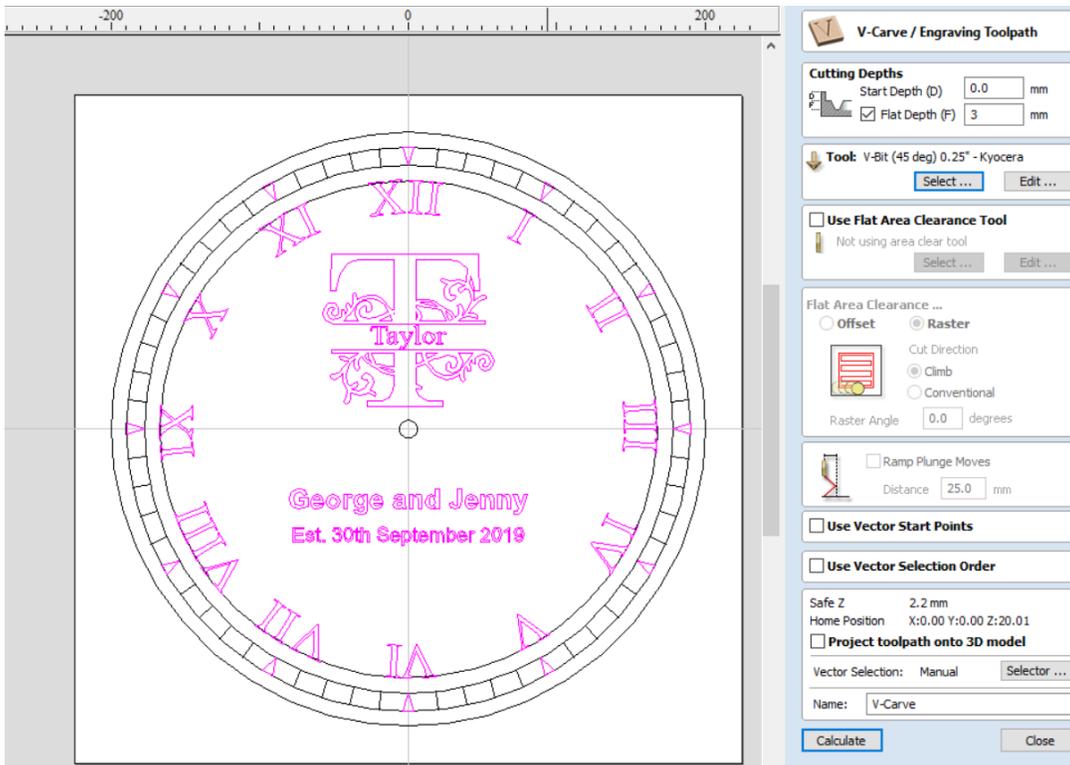
1. Click **Profile Toolpath**  select the 60 lines, and two circles. Select a V bit, set cut depth to 1mm, ensure toolpath is **On** line. Click **Calculate**



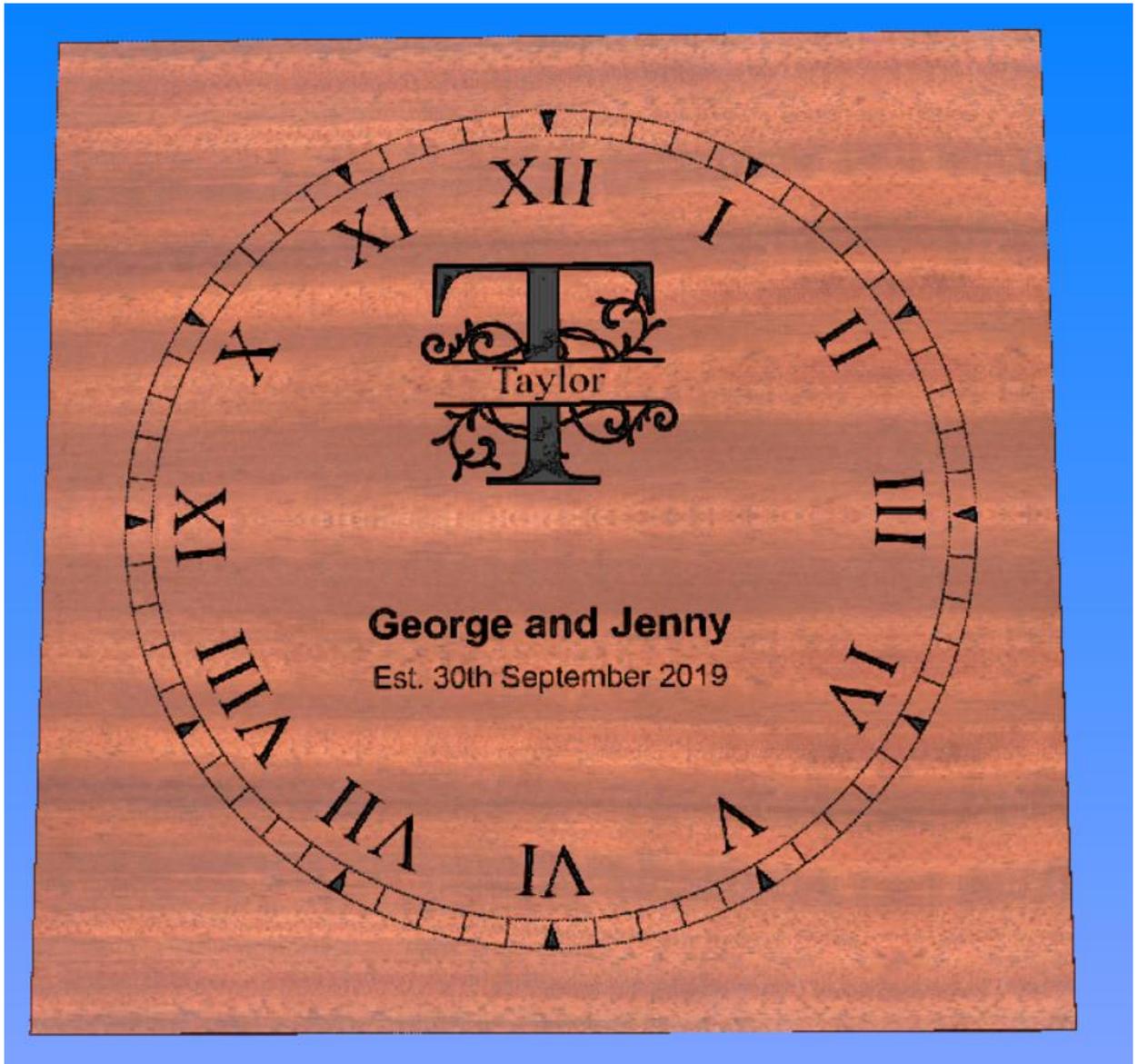
- Once toolpath is calculated and selected in the Preview window, Change **Global Fill Color** to black, then click **Preview Visible toolpath**



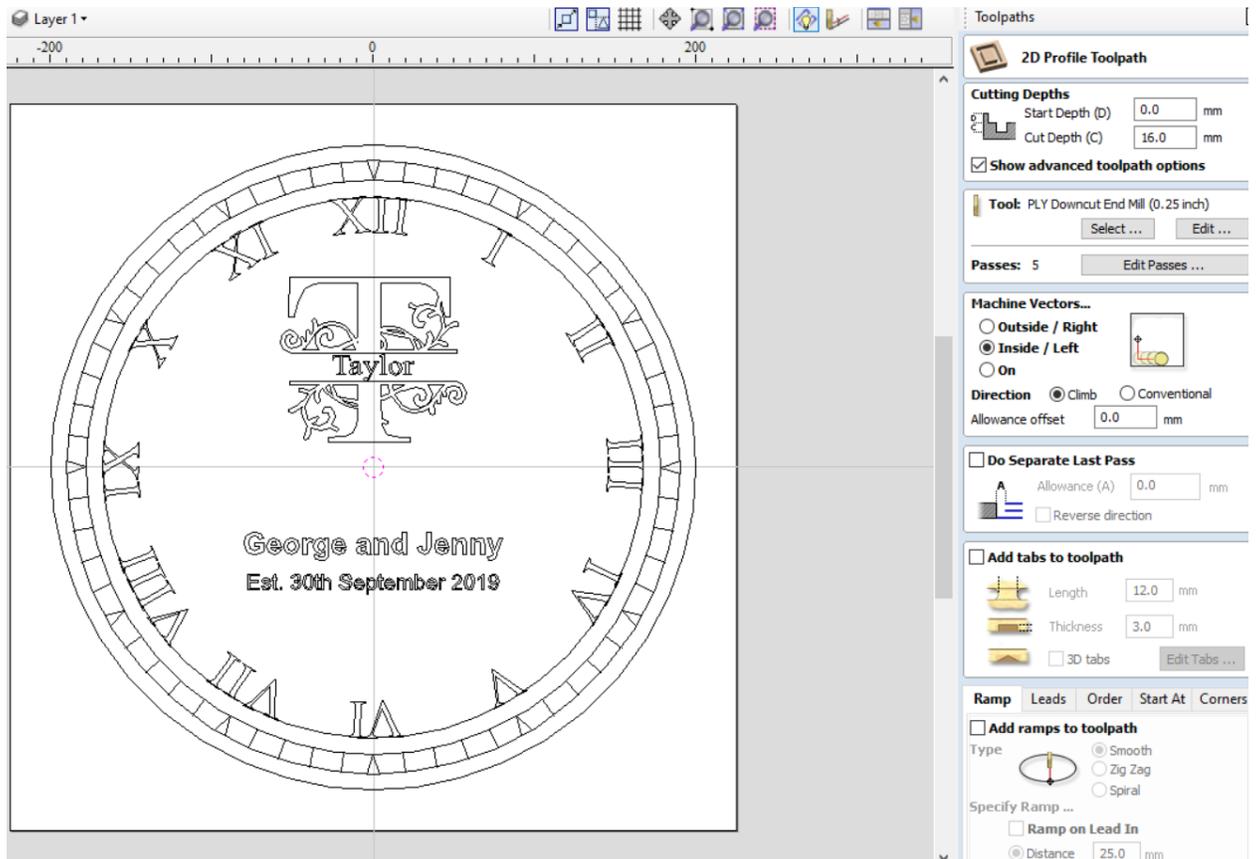
- Select **V-carve / Engraving Toolpath**  then select Triangles, numerals and text, set **Flat Depth** to 3mm. Click Calculate



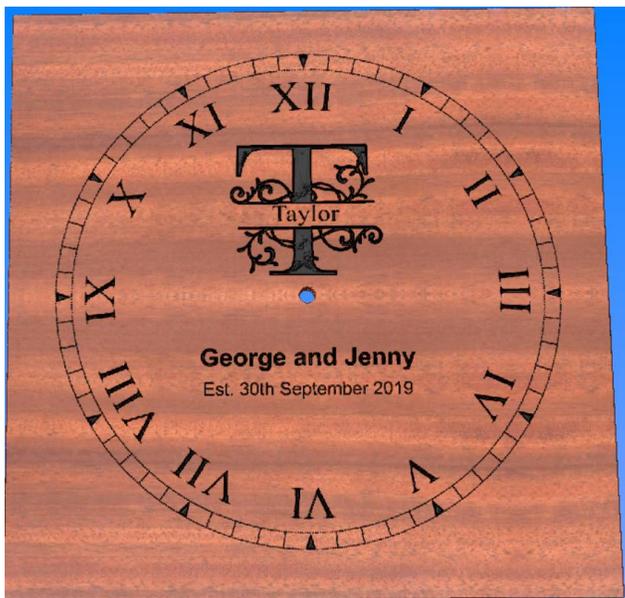
4. Click **preview selected toolpath**



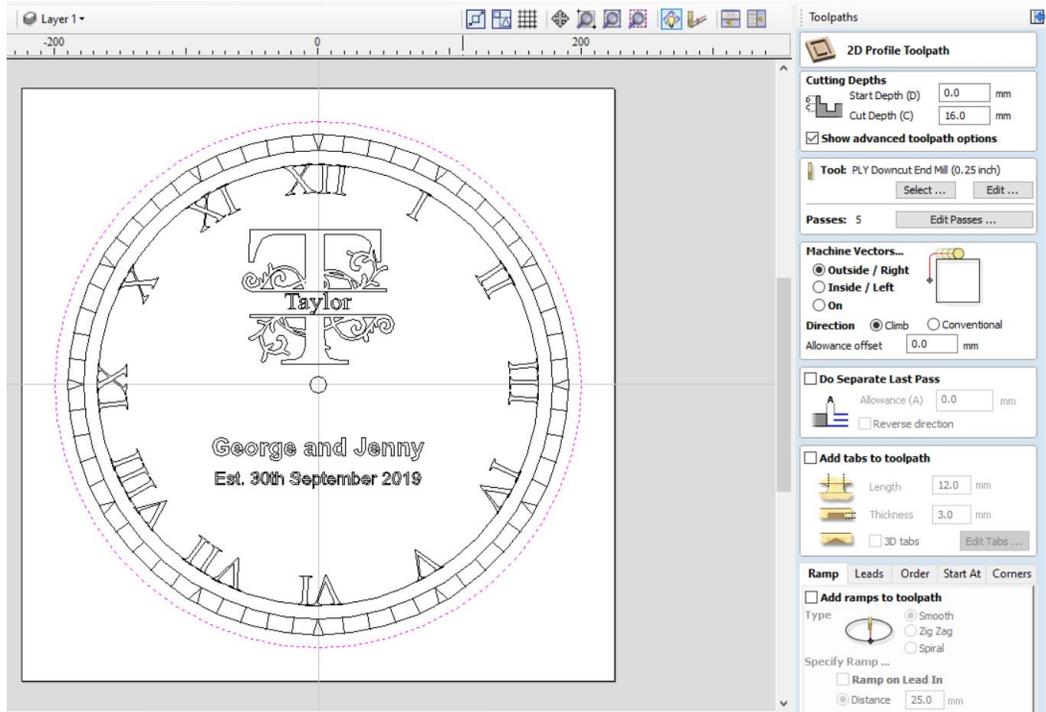
5. Select **profile toolpath**, choose a flat endmill, select small circle geometry for clock mechanism shaft, ensure Cut depth is set to thickness of material, ensure **Inside/Left** is selected. Click Calculate.



6. Click **Preview visible toolpath**



7. Select **profile toolpath**, choose a flat endmill, select outline circle for clock mechanism shaft, ensure Cut depth is set to thickness of material, ensure **Outside/Right** is selected. Be aware that this toolpath will break the clock free from remaining material. Use tabs/hold down methods as required. Click Calculate.



8. Click **Preview Visible Toolpaths**. Double click on scrap material to make it disappear from preview

