

HOW TO CREATE A SWARF IN FUSION FOR THE TORMACH PCNC440 MILL WITH THE ARC4

V1

DECEMBER 4TH - 2024

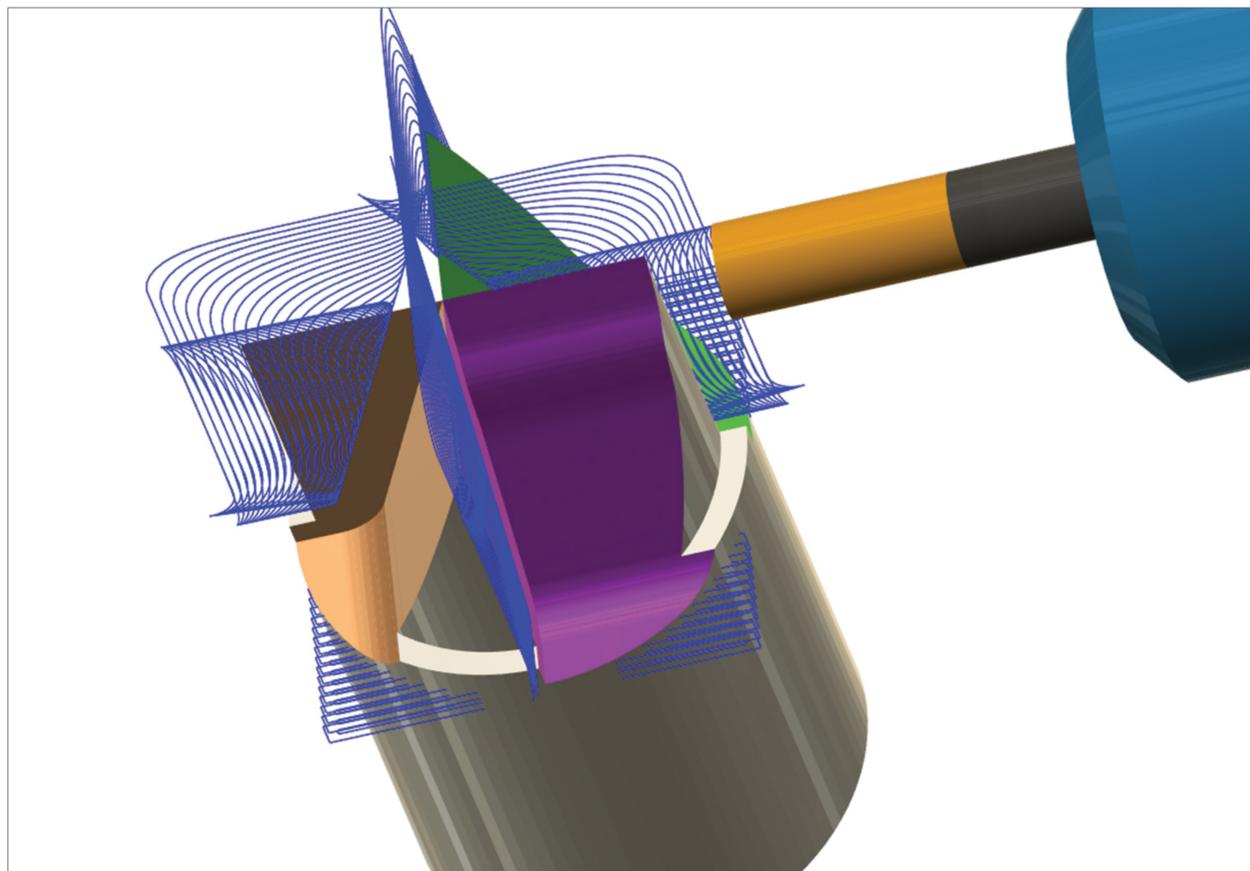


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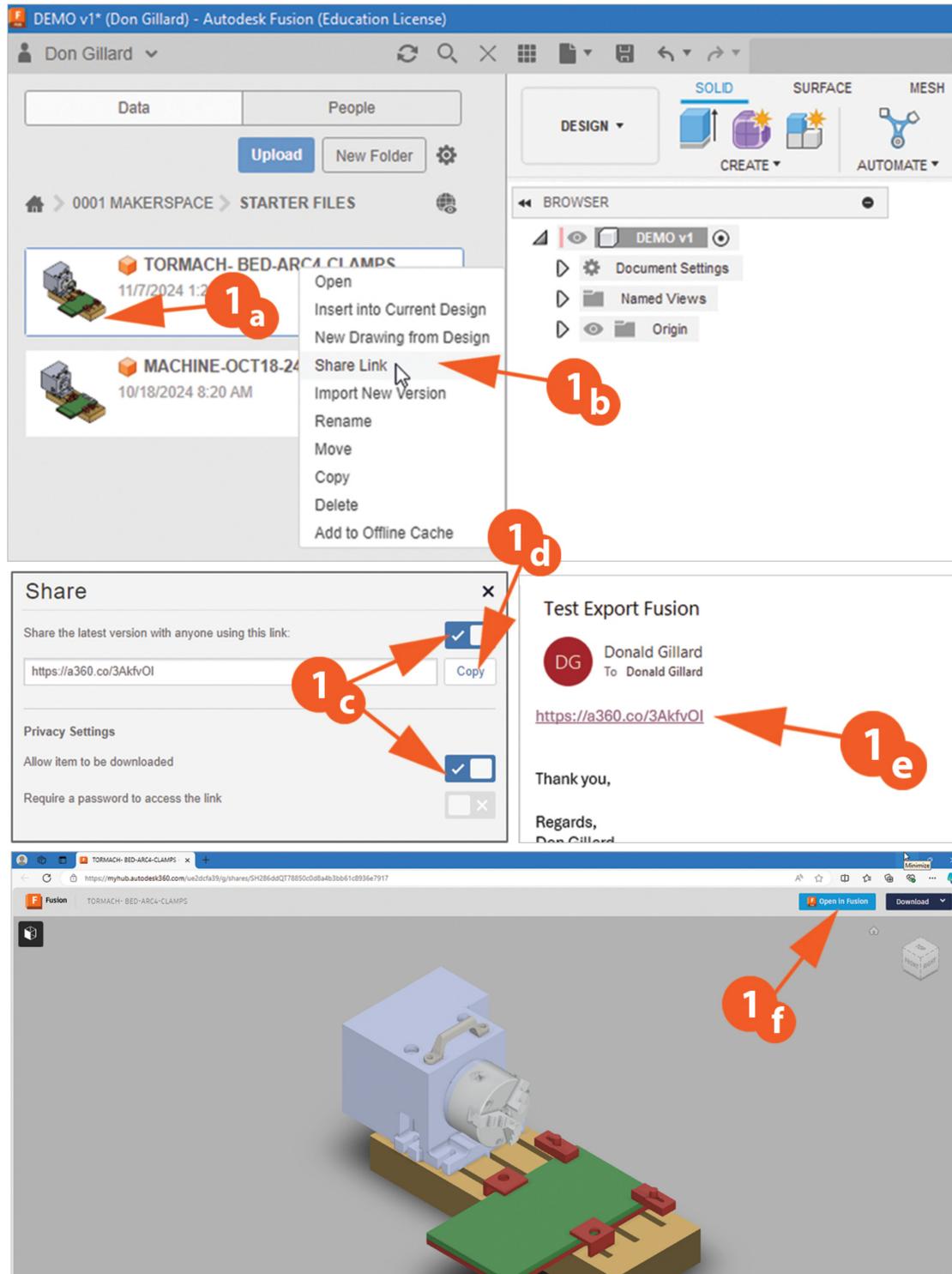
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1

Exporting A Model

To export a Fusion drawing/model.

1a - Right click on the model for export.

1b - Select Share Link.

1c - Click the boxes as shown.

1d - Copy the link and email to the recipient.

Importing The ARC4 Model

1e - Click on the shared **Link** in your email.

1f - From the pop-up viewer, Click on **Open In Fusion**.

Save the file to a folder of your choice.

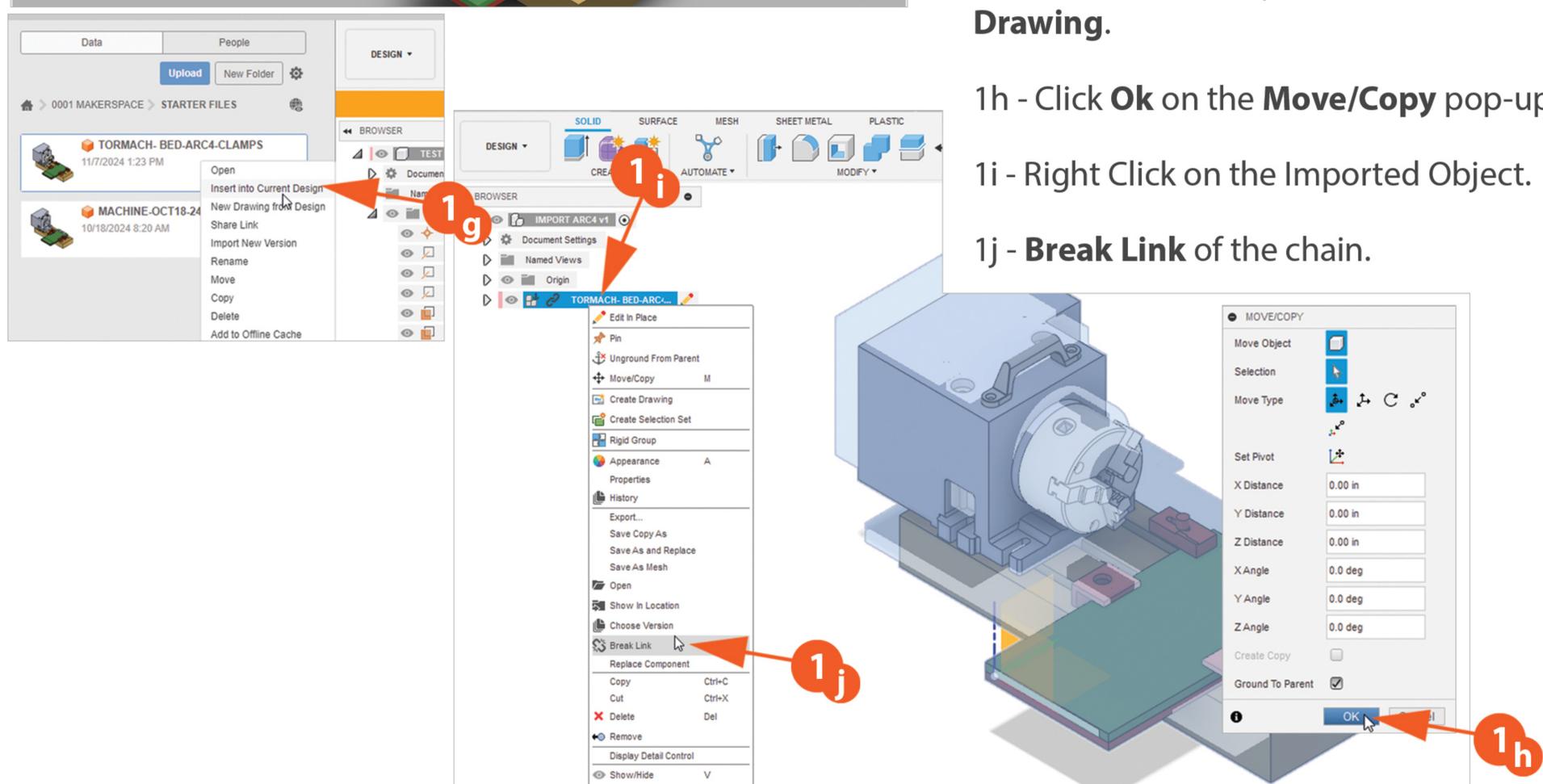
You can now either use this file to start and build your object (just open it)....

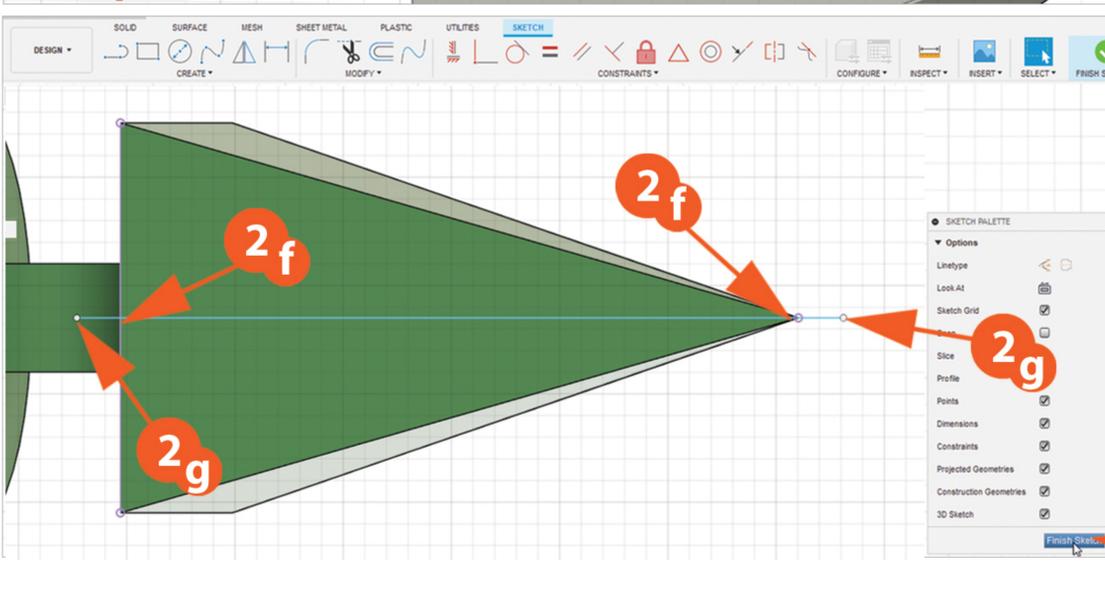
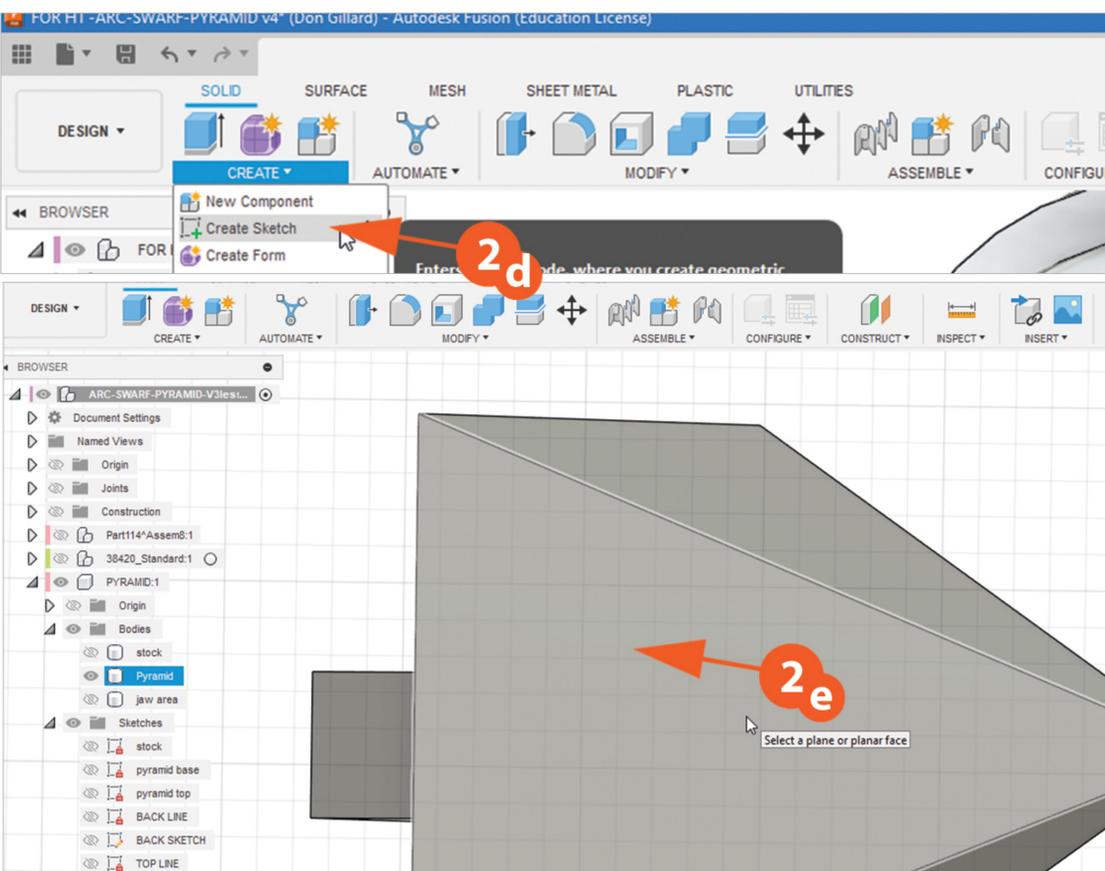
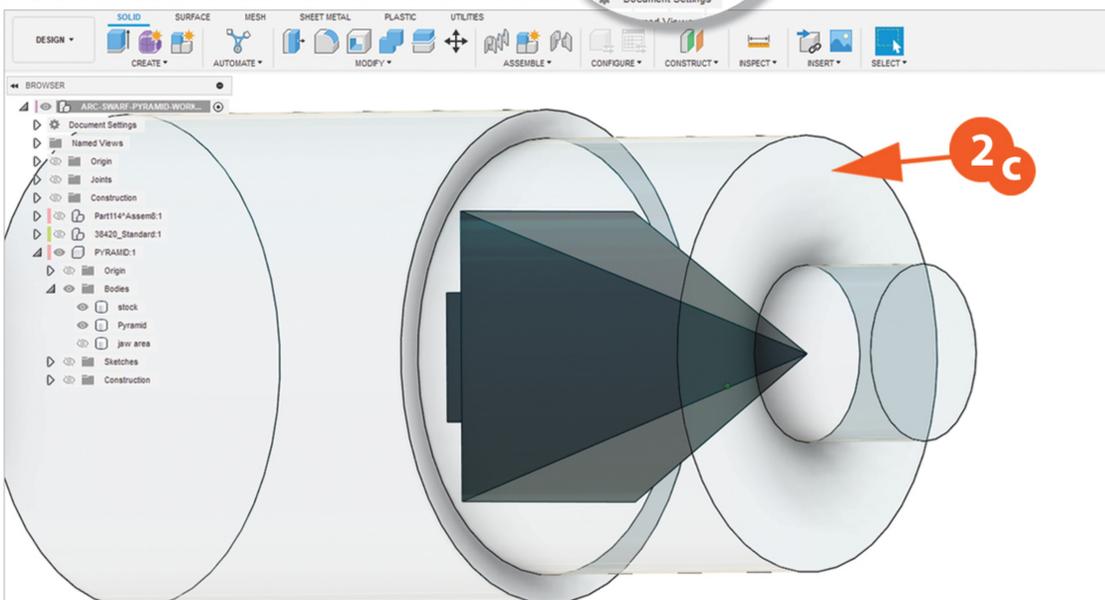
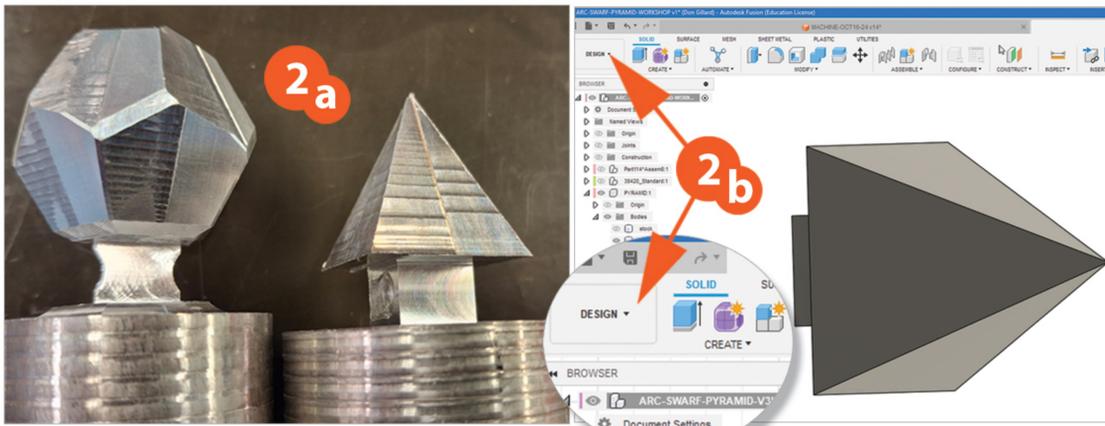
1g - Or you can import it into an existing file. Have your existing file open in Fusion, Click on the file in the viewer, **Insert Into Current Drawing**.

1h - Click **Ok** on the **Move/Copy** pop-up.

1i - Right Click on the Imported Object.

1j - **Break Link** of the chain.





2

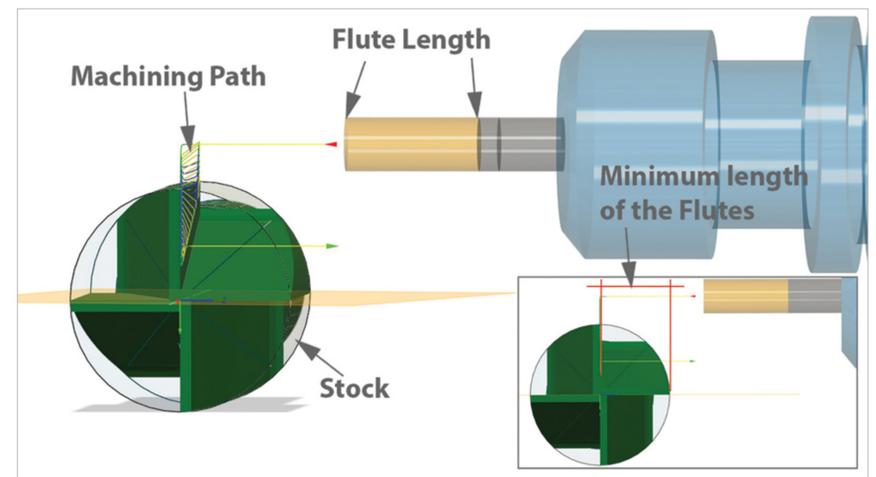
Setting Up Your Object & Sketches

2a - Samples of a dodecahedron & a pyramid. Both were created with swarfing (side cutting) operations.

2b - Build your object in Fusion **Design Module** that is appropriate for swarfing, or parts of it are.

The actual size is very limited due to the tool bit clearance and machining area of the tool. Check your tool bit **Flute Length**, that will be the maximum depth of 48% of the depth the tool can go into your **Stock**. See drawing below.

2c - Create an Object for your exact **Stock** size and shape.



We now need to create sketches and construction lines to properly orientate the bit and machining operations. Due to the bit length not being long enough for the full side operation, each side must be divided into half.

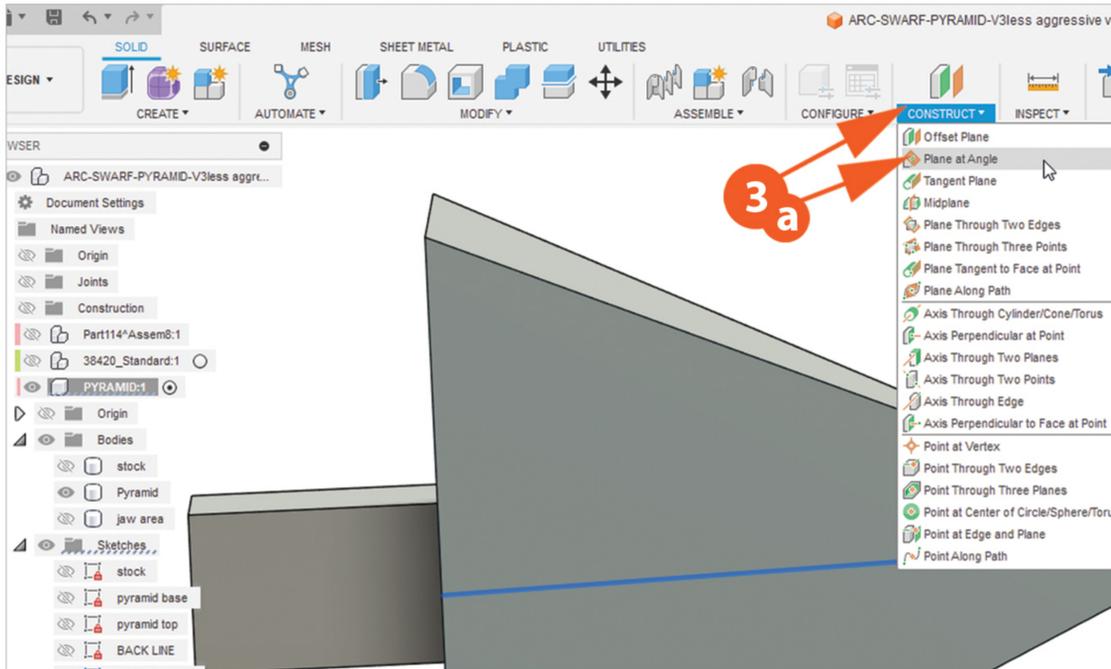
2d - **Create Sketch.**

2e - Select the left or right side of your object.

2f - Draw a line from the center of the bottom, to the center of the tip.

2g - Extend the lines .5" from each of the ends.

2h - Close the Sketch. Name the **Sketch Set1-1**.



3

Construction Plane

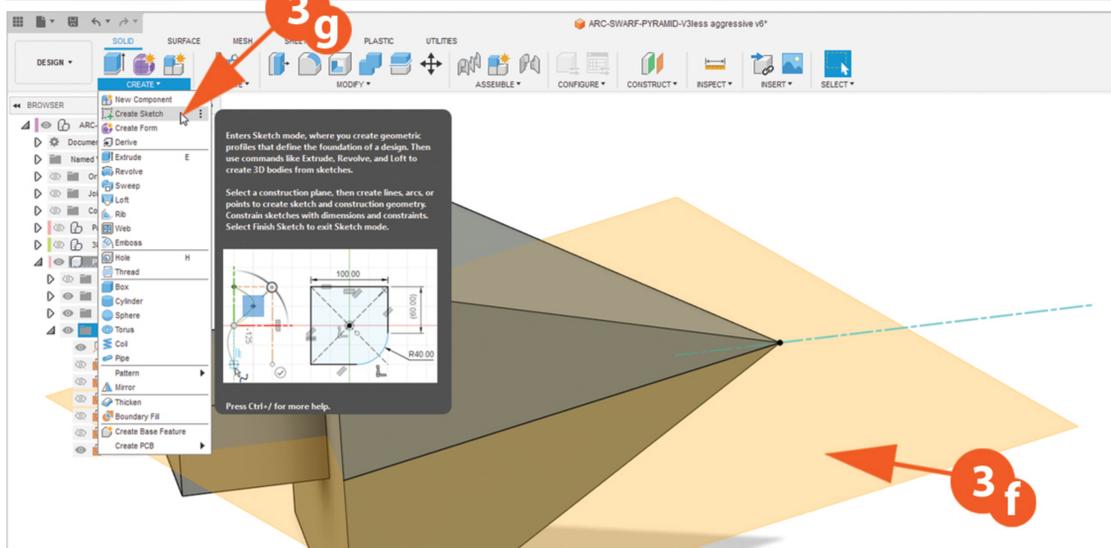
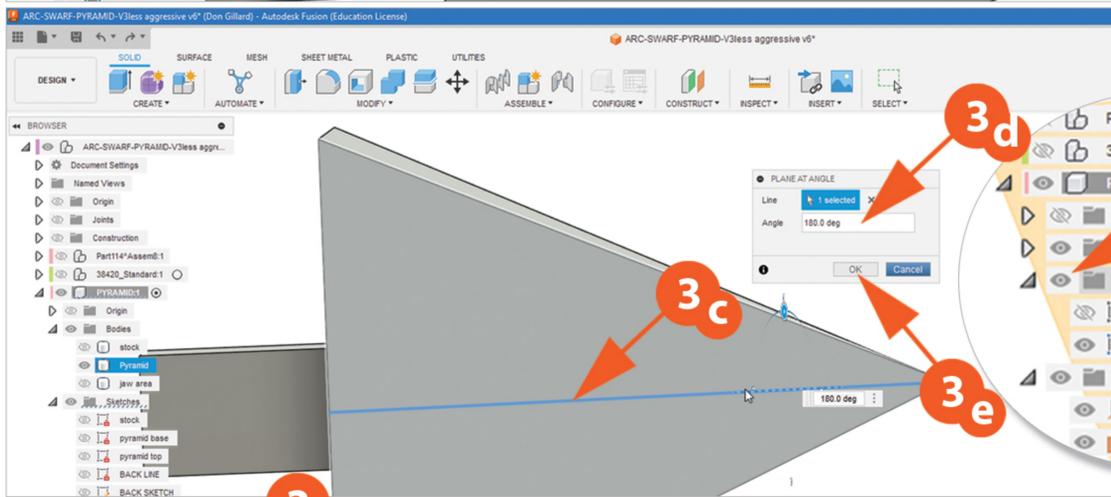
3a - Select **Construct/ Plane At Angle**.

3b - Make sure your Sketch is visible.

3c - Select your **Sketch/ Line** that you just made.

3d - **Angle** should be **0** deg.

3e - Click **Ok**.



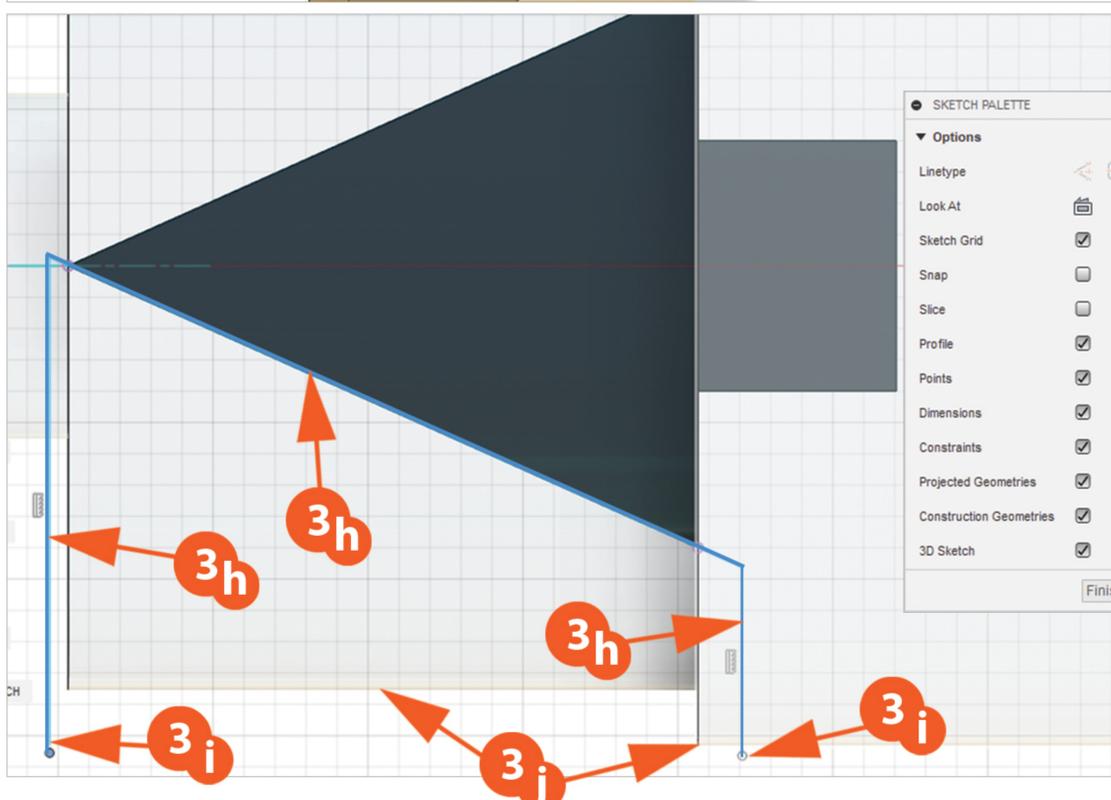
3f - You should now see the yellow **Construction Plane**.

Create Sketch For Manufacture Module

3g - Select **Create/ Create Sketch**.

3f - Click on the **Construction Plane**.

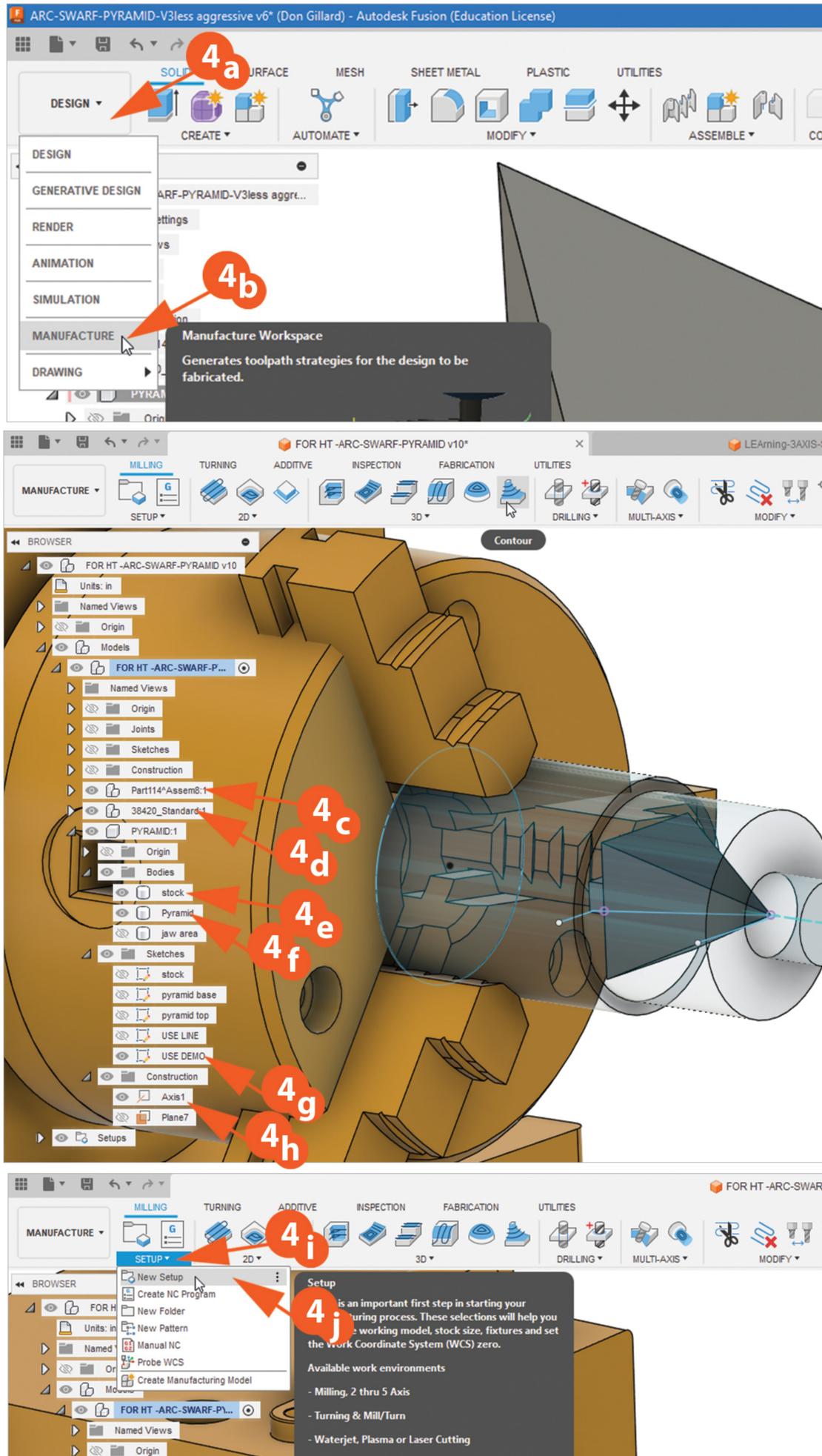
You will now be in the Top View of your machining plane.



3h- Create the 2 lines as shown, using the original sketch line you made, to click the new lines to.

3i - The vertical lines should extend past the **Stock** (3j).

3k - Click on **Finish Sketch**. name the **Sketch Set1-2**.



4

Manufacture Module

4a - Click on the **Design** Module button & change it to the...

4b - **Manufacture** Module Button.

Make sure the following are visible (during the Initial setup, as you will need to select some of them):

4c - **Part114** (Base of the Arc4).

4d - **3840** (The clamping area of the Arc4).

4e - **Bodies**/ The Body of your **Stock**.

4f - **Bodies**/ The Body of your **Object** (example here is the Pyramid).

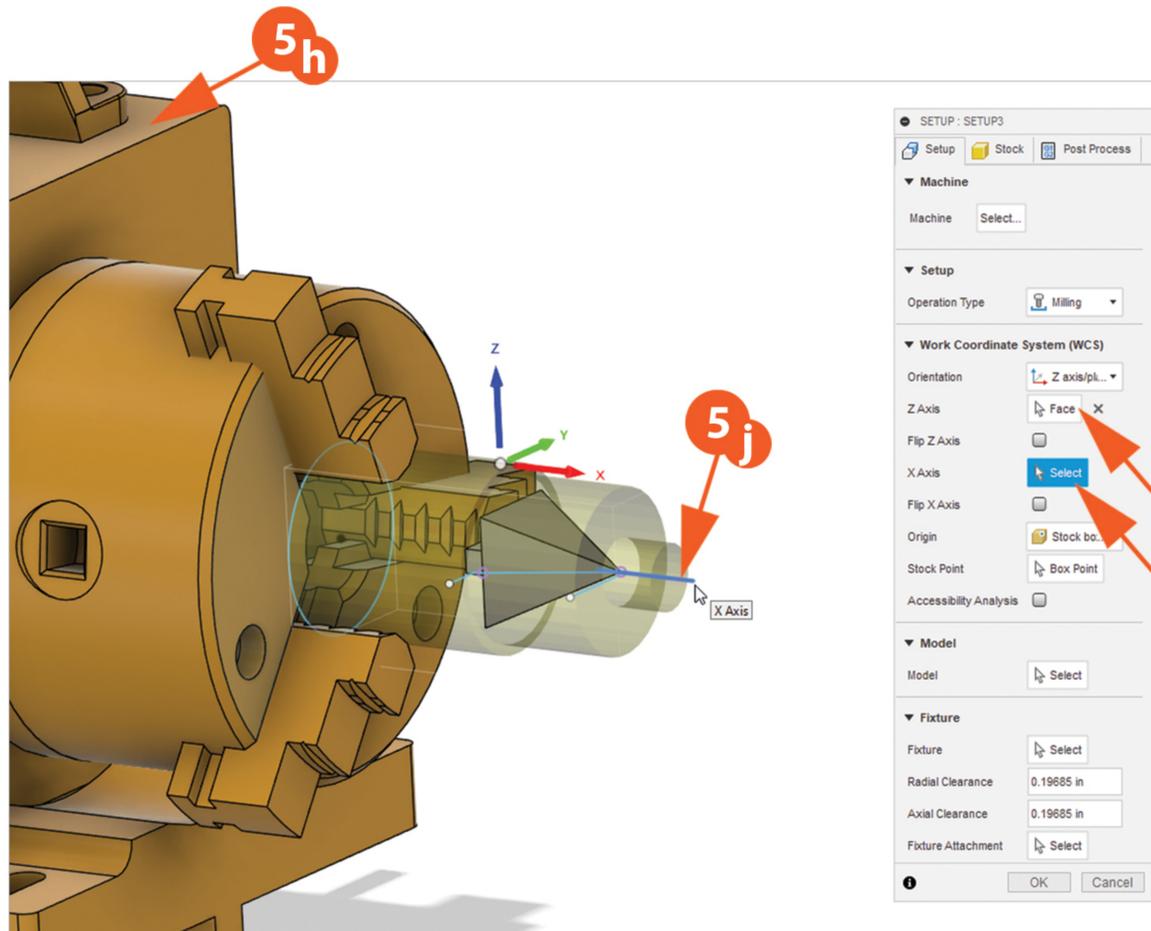
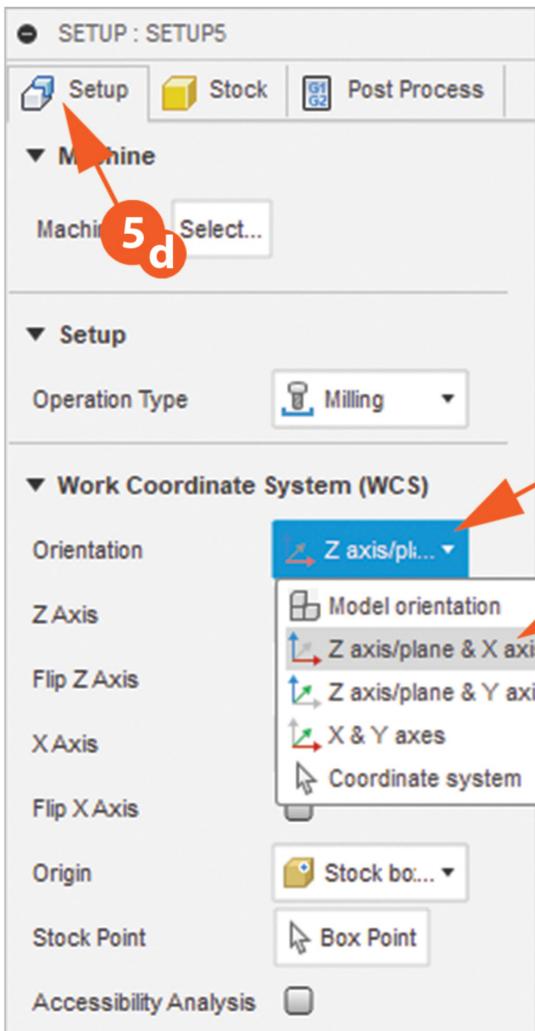
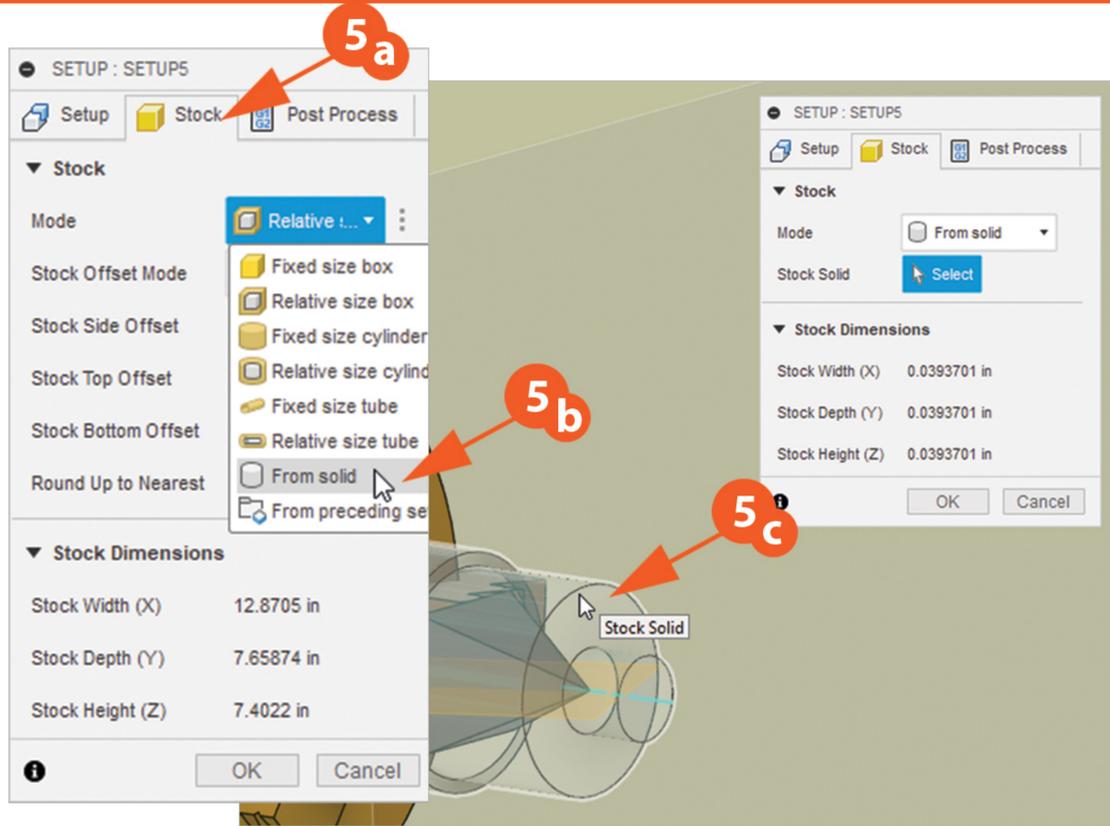
4g - **Sketches**/ The 3 line sketch you made.

4h - **Construction**/ **Axis 1** (center of the Arc4).

Setup

4i - Click **Setup**.

4j - **New Setup**.



5

Setup

5a - On the pop-up, Select the next tab, **Stock**.

5b - Click on **From Solid**.

5c - Select your **Stock**.

5d - Go back to the **Setup** tab.

5e - In the **Work Coordinate System** section, click on the **Orientation** dropdown.

5f - Select **Z Axis/plane & X Axis**.

5g - Click on **Z Axis/Select**.

5h - Click on the top of the **Arc4**.

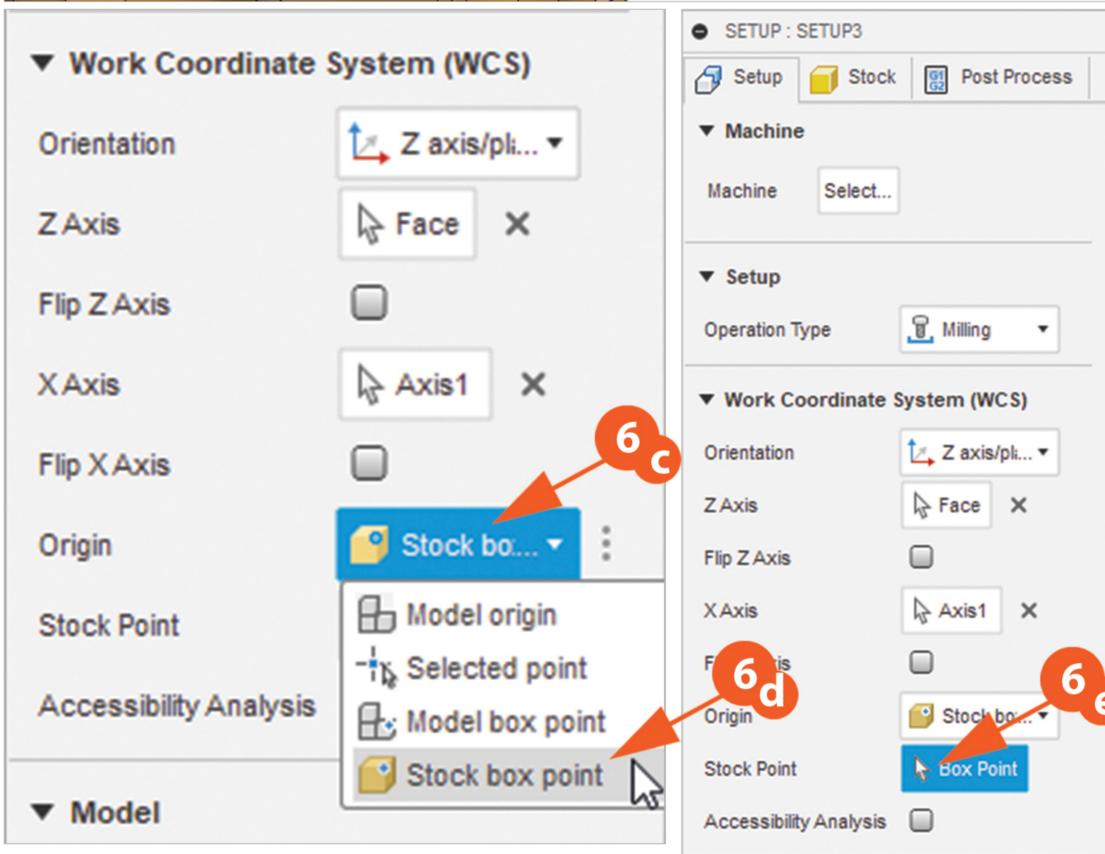
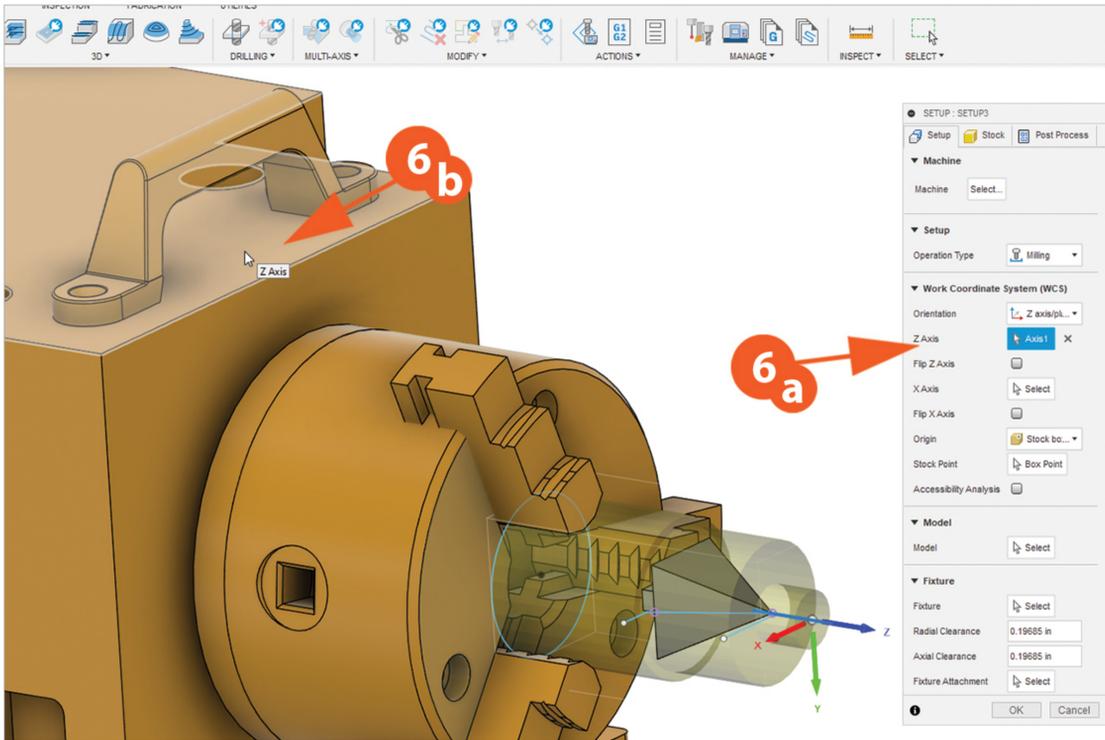
5i - Click on **X Axis/Select**.

5j - Select the **Construction Axis1**.

6

6a - Click on the **Z Axis**.

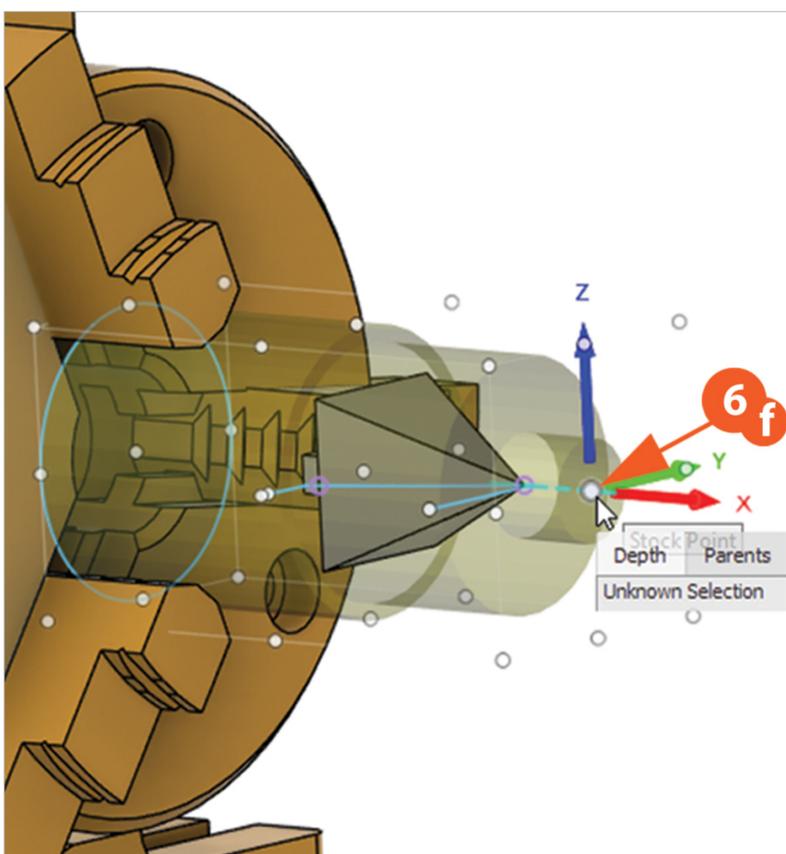
6b - Select the top of the **Arc4**.



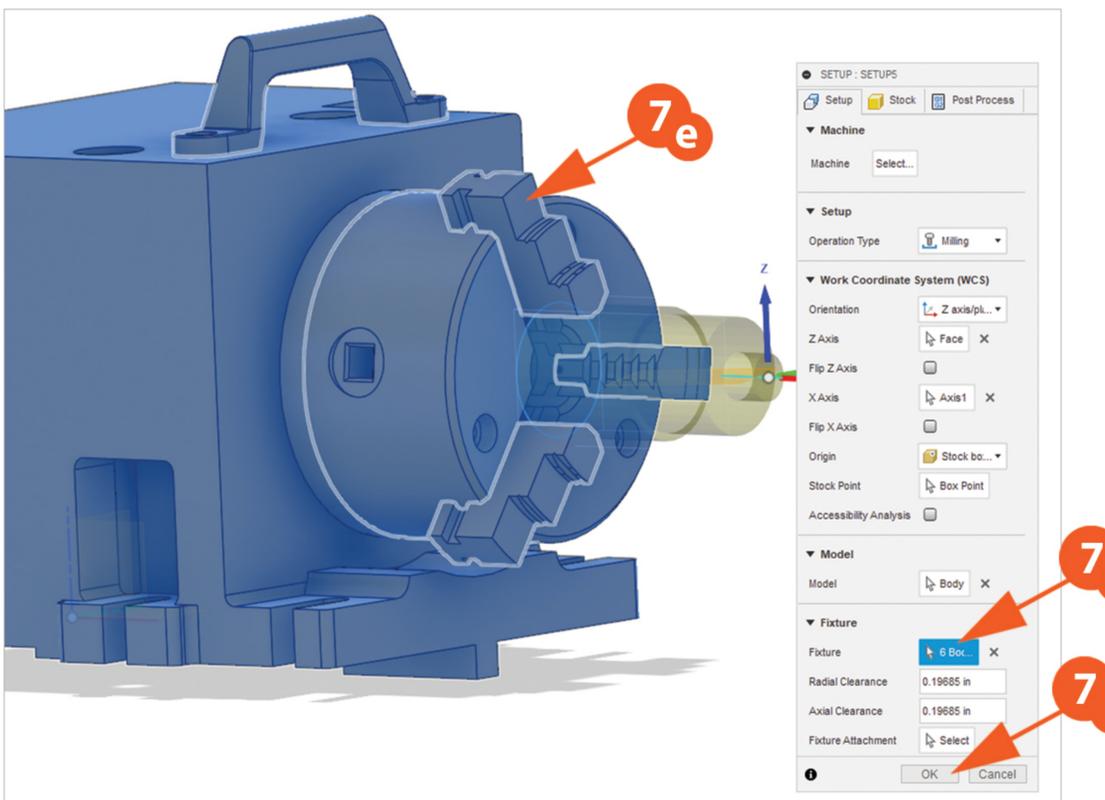
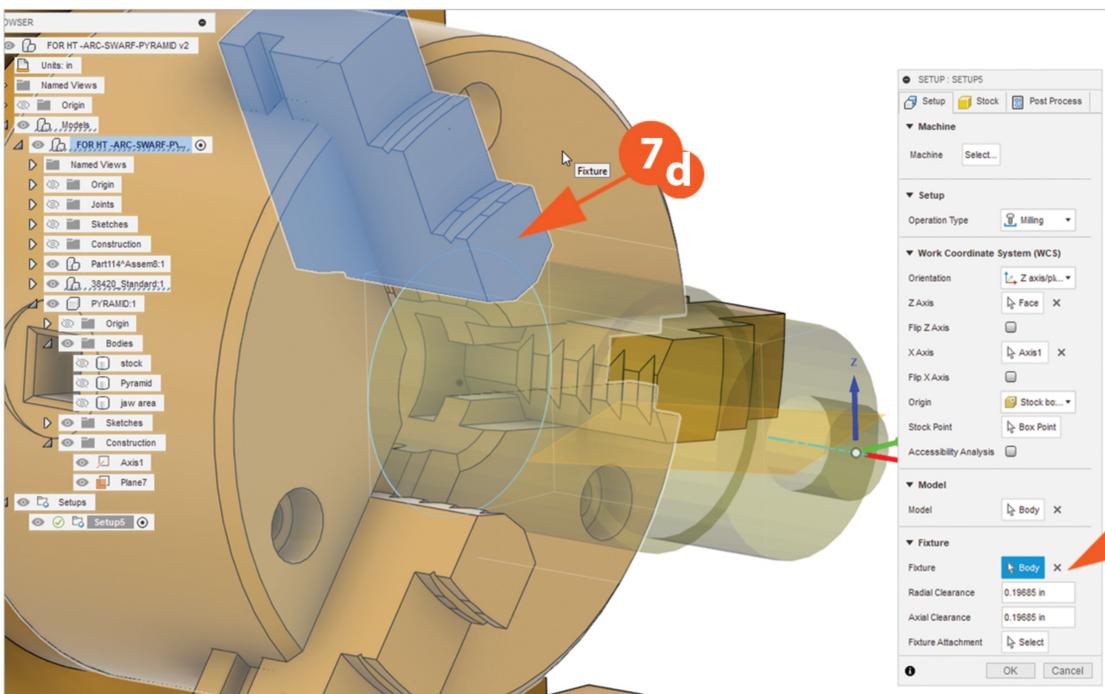
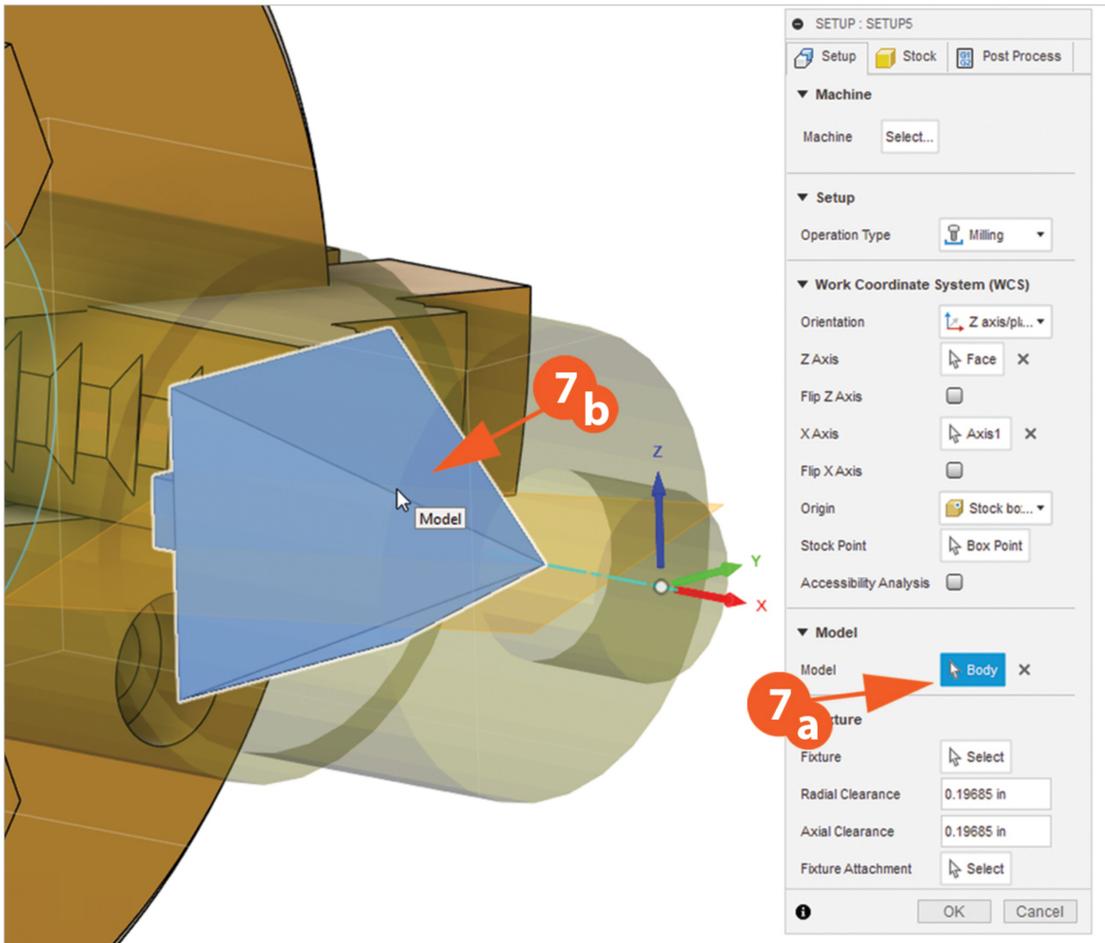
6c - Click on the **Origin** drop down.

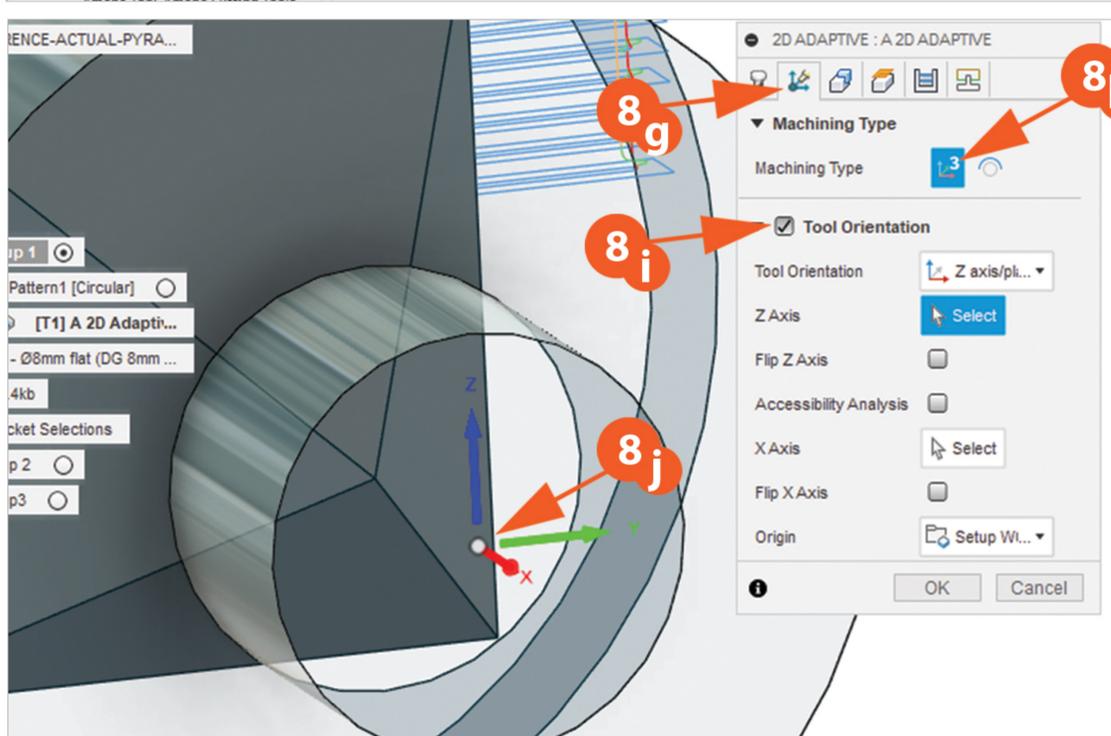
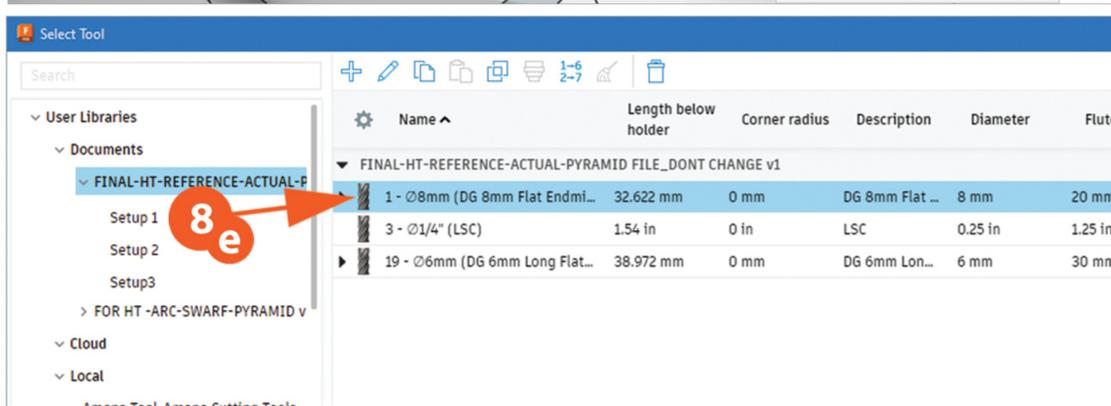
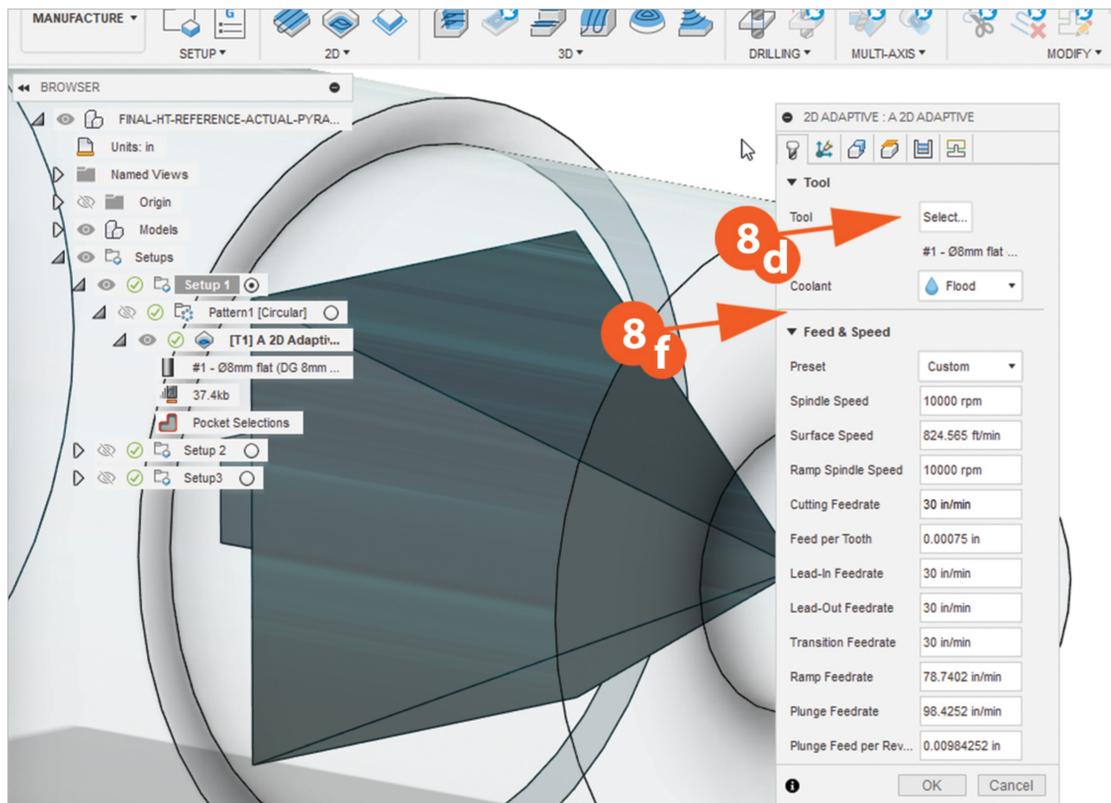
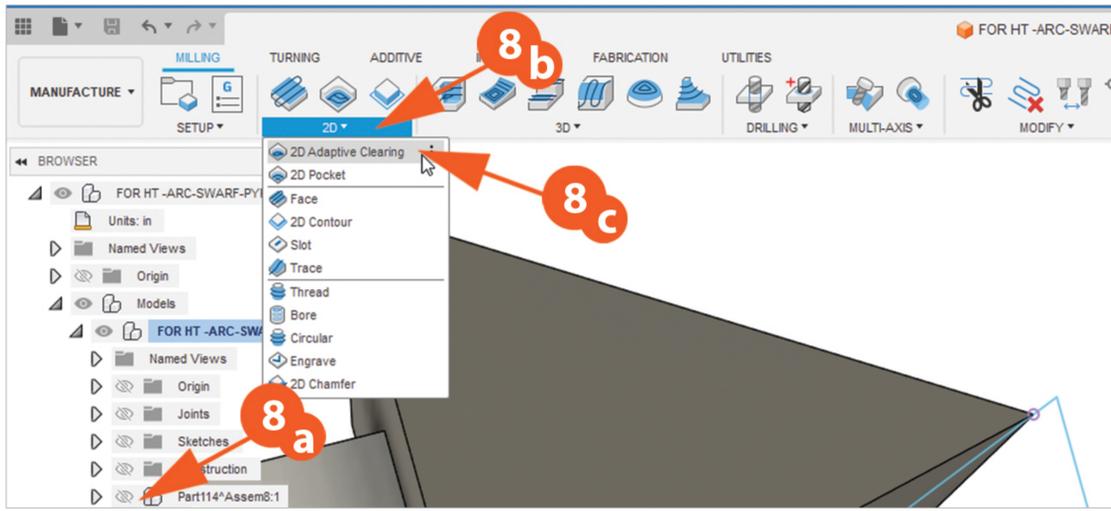
6d - Select **Stock Box Point**.

6e - Click on the Box Point button.



6f - Click on the sphere at the center end of your stock.





8

8a - Hide everything except for your **Model**.

8b - Select the **2D** drop down menu.

8c - Select **2D Adaptive Clearing**.

8d - From the pop-up Select **Tool**.

8e - Select your tool from your tool list.
I used the #1 bit here, 8mm (.3").
It should have a stick out of 1" minimal.

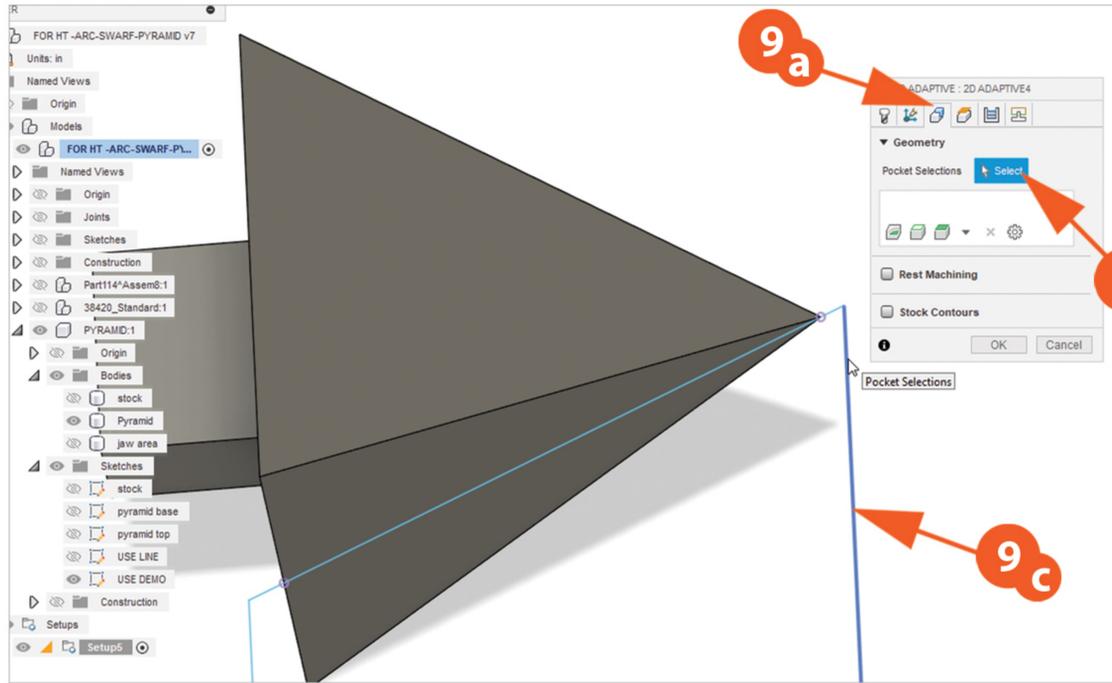
8f - Input the following for 6061 Aluminum:
Coolant = Flood.
Spindle Speed = 10000 rpm.
Cutting feed Rate = 25 in/min.

8g - Click on the next tab, **Multi-Axis**.

8h - The **3-Axis** icon should be selected.

8i - Check **Tool Orientation**.

8j - The Gimbal/**3D Icon** should look like this.
ie X pointing out from the Arc4 center axis and
the Z axis pointing up or 90 degrees from the
sketch/machining plane.

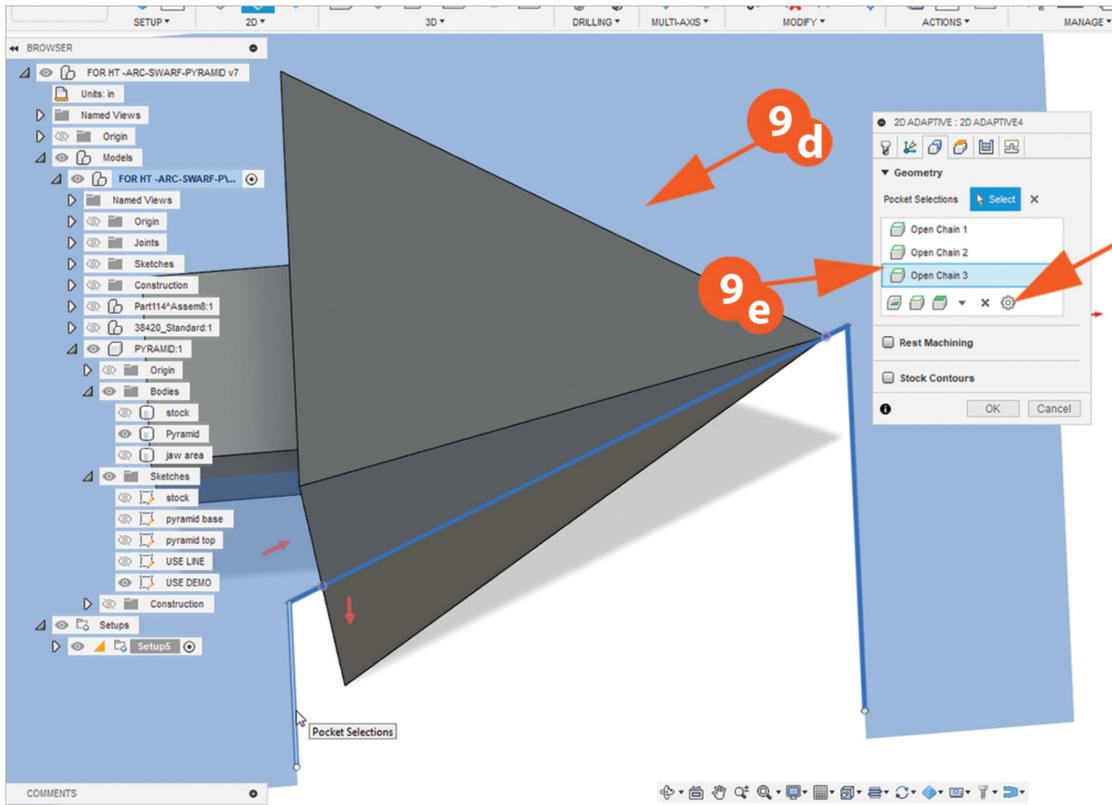


9

9a - Click on the 3rd tab, **Geometry**.

9b - Click on **Pocket Selections**.

9c - Select the 3 lines of your both Set1 sketches.



9d - If the selection area in blue looks like this, you will have to reverse it.

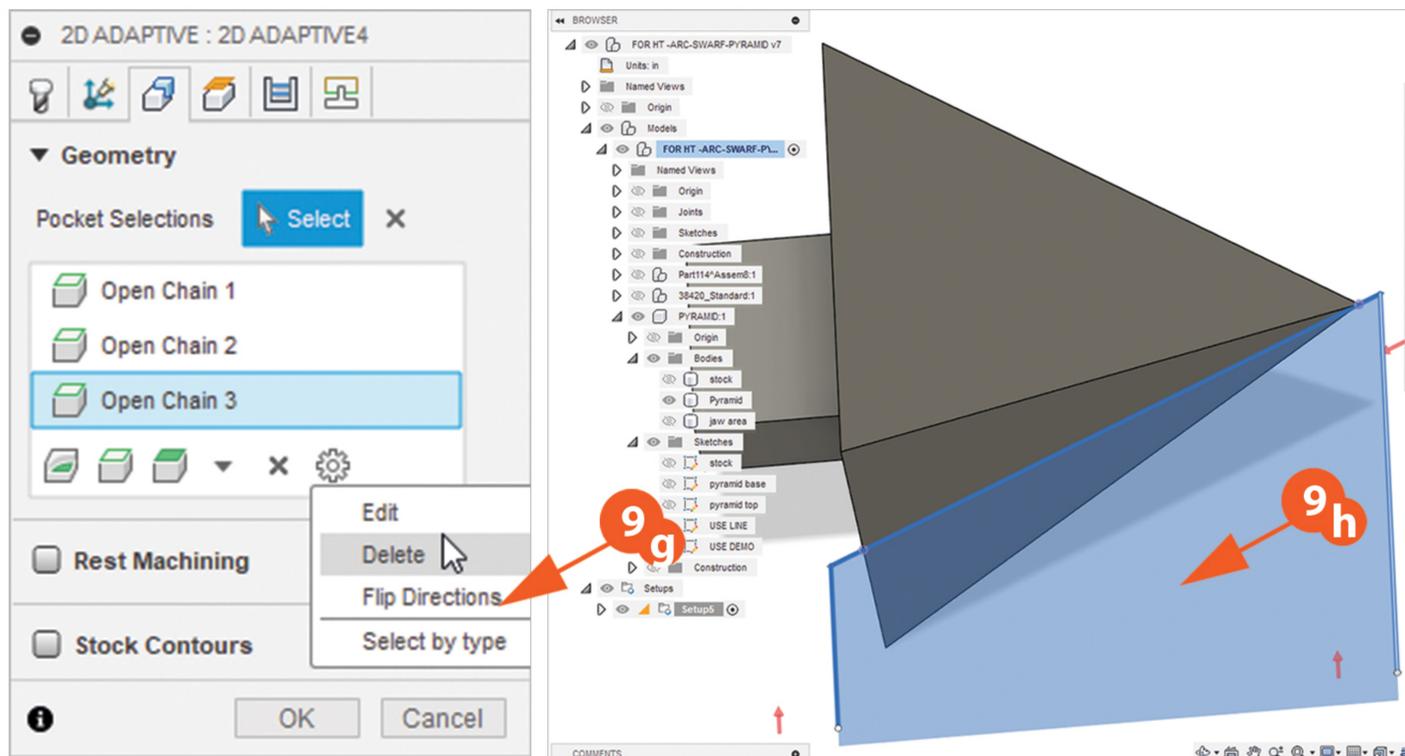
9e - Click on one of the open chains.

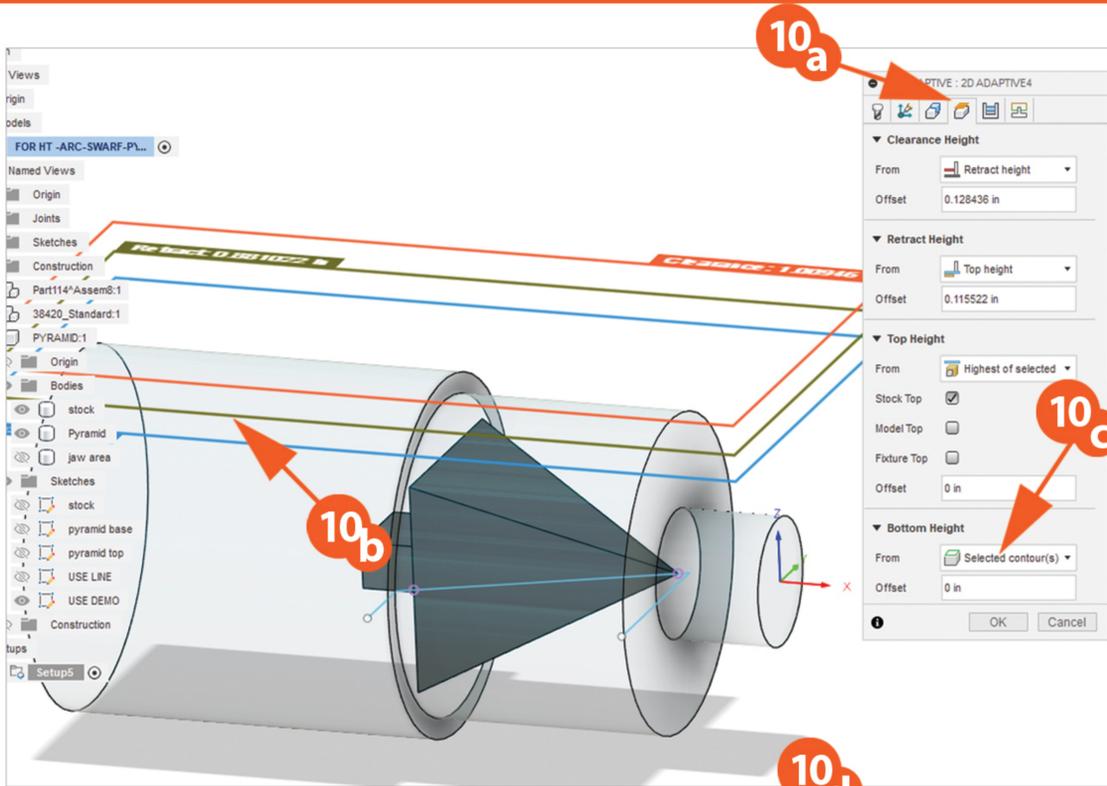
9f - Then the **Geometry Selections** Gear Icon.

9g - Click on **Flip Directions**.

Repeat for each **Open Chain**.

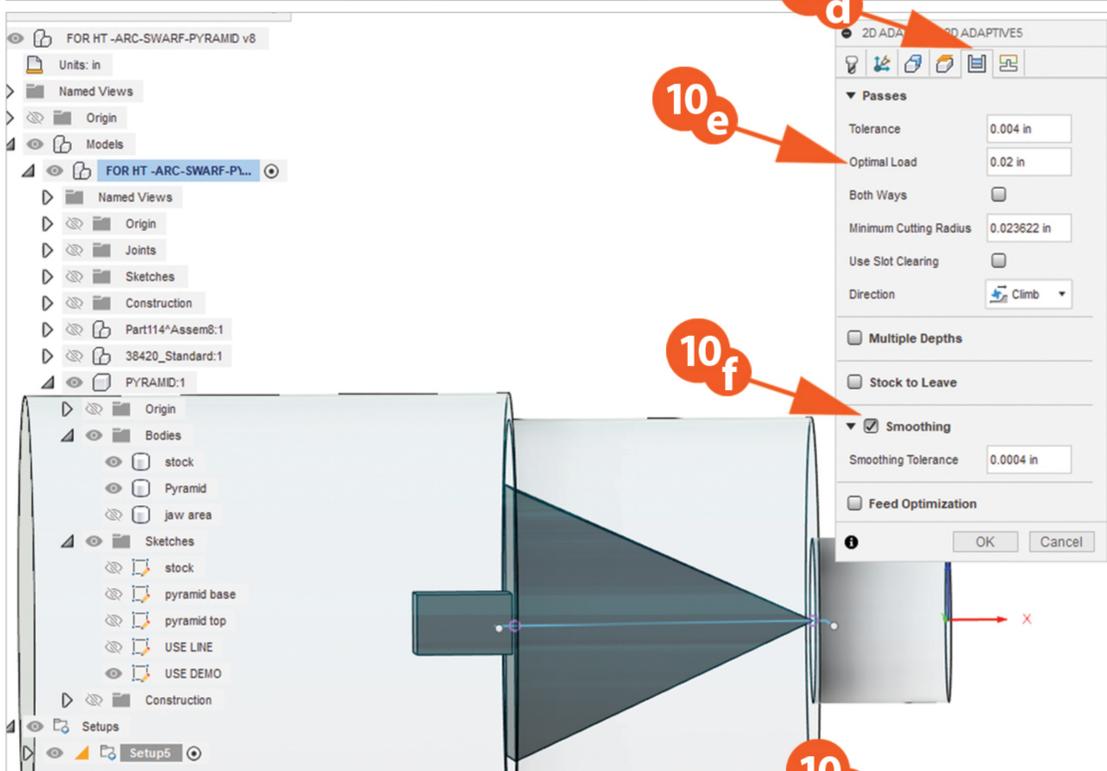
9h - The blue should now appear only in your machining area.



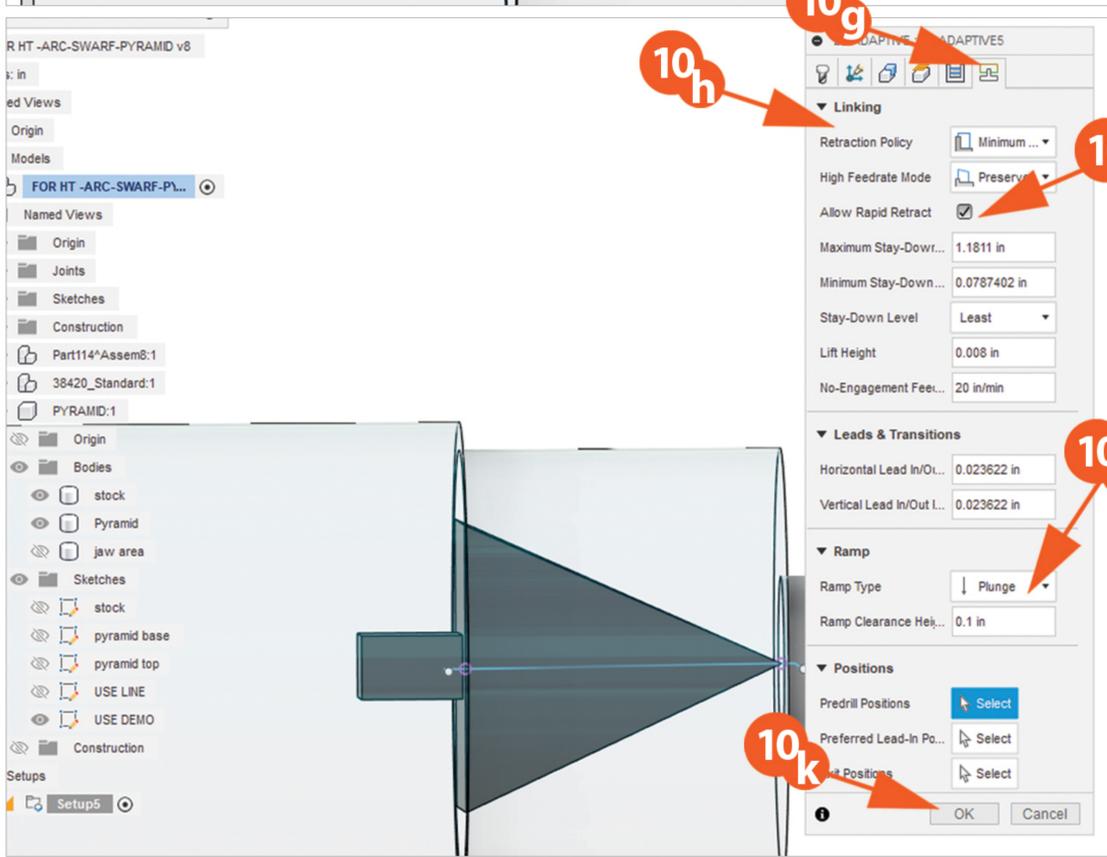


10

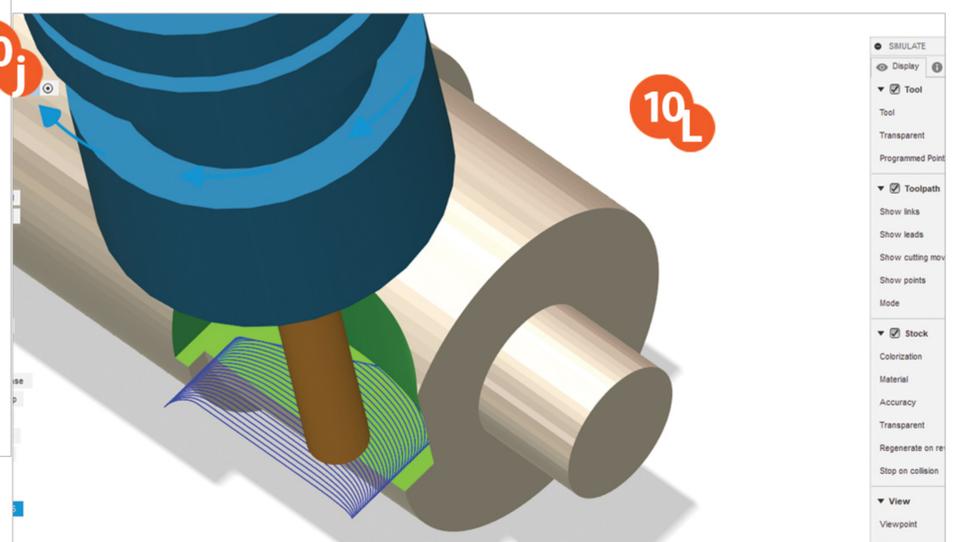
- 10a - Click on the 4th tab, **Heights**.
- 10b - You should see these 3 coloured lines and in this order.
- 10c - Bottom height should be **Selected Contours**.



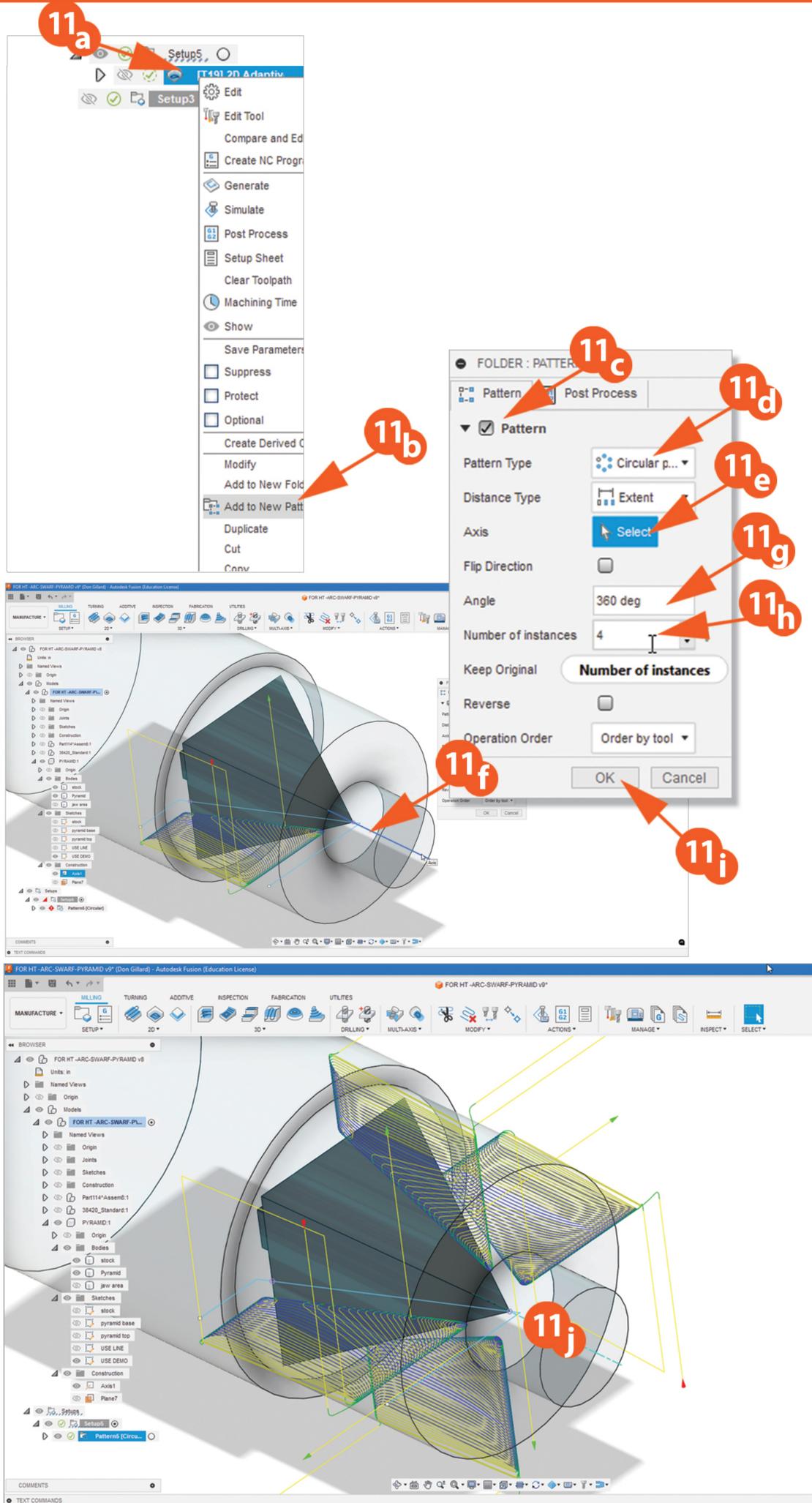
- 10d - Click on the 5th tab, **Passes**.
- 10e - The **Optimal Load** should be .02”.
- 10f - Check the **Smoothing** box.



- 10g - Click on the last tab, **Linking**.
- 10h - Click on **Retraction Policy/Minimal Retraction**.
- 10i - Check **Allow Rapid Retract**.
- 10j - **Ramp Type** should be **Plunge**.
- 10k - Click **Ok**.



- 10L - Preview/Simulate should look like this.



11

11a - Right click on your **2D Adaptive**.

11b - Click on **Add To New Pattern**.

11c - From the pop-up **Check Pattern**.

11d - Pattern Type, select **Circular**.

11e - **Axis** click on select.

11f - Select the **Arc4 Center Axis**.

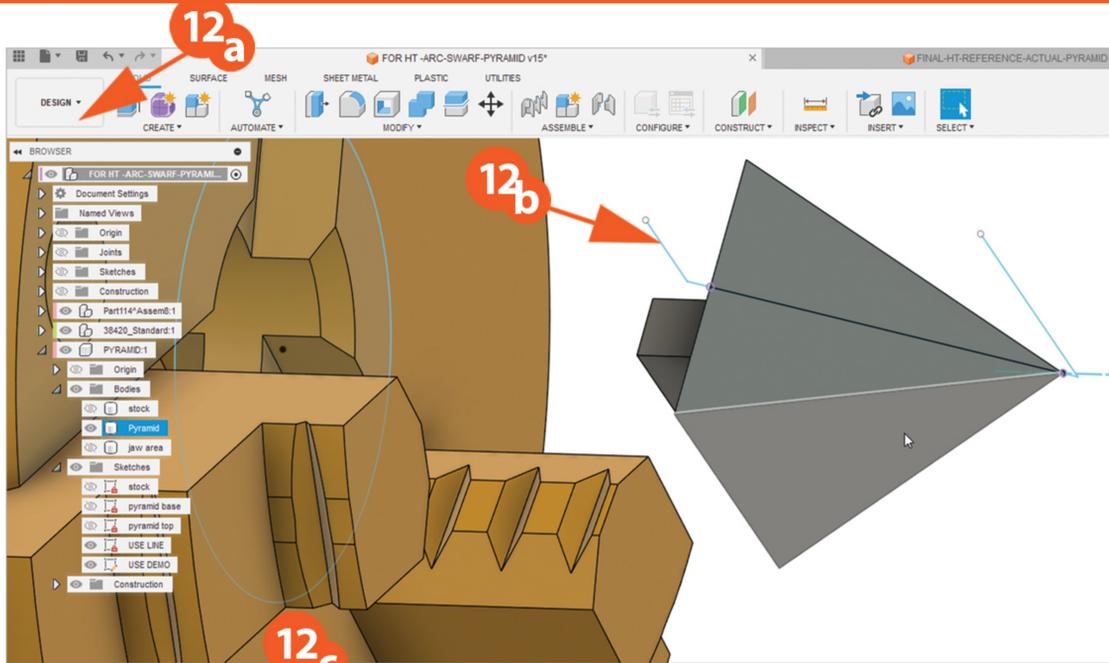
11g - Angle is **360 Deg**.

11h - Number of Instances is **4**.

11i - Click **Ok**.

11j - You should now see 4 machining operations.

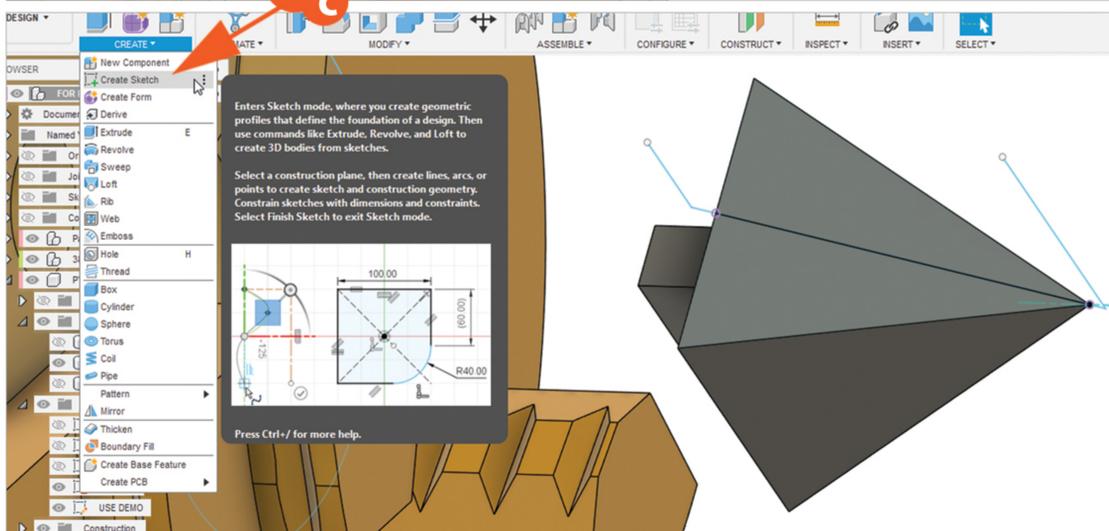
This now completes the machining for 1/2 of the pyramid. We now must repeat the full list of procedures but flip the **Axis** and change the **Sketch/Links** so it will machine the lower half.



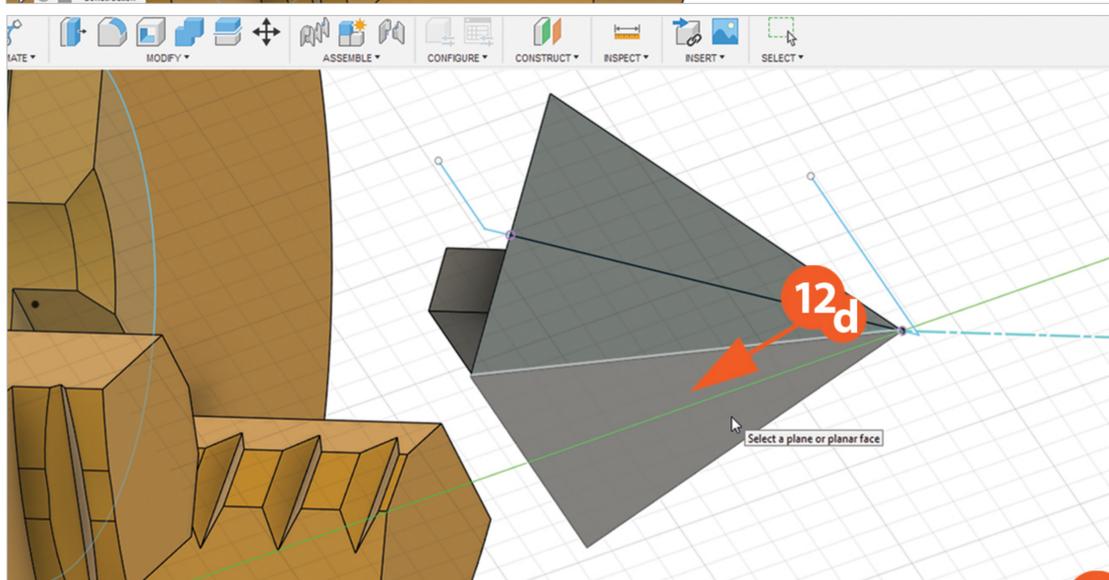
12

12a - Go back to the **Design Module**.

12b - Make sure the original **Set1-1** and **Set1-2 Sketches** are visible.



12c - **Create Sketch**.



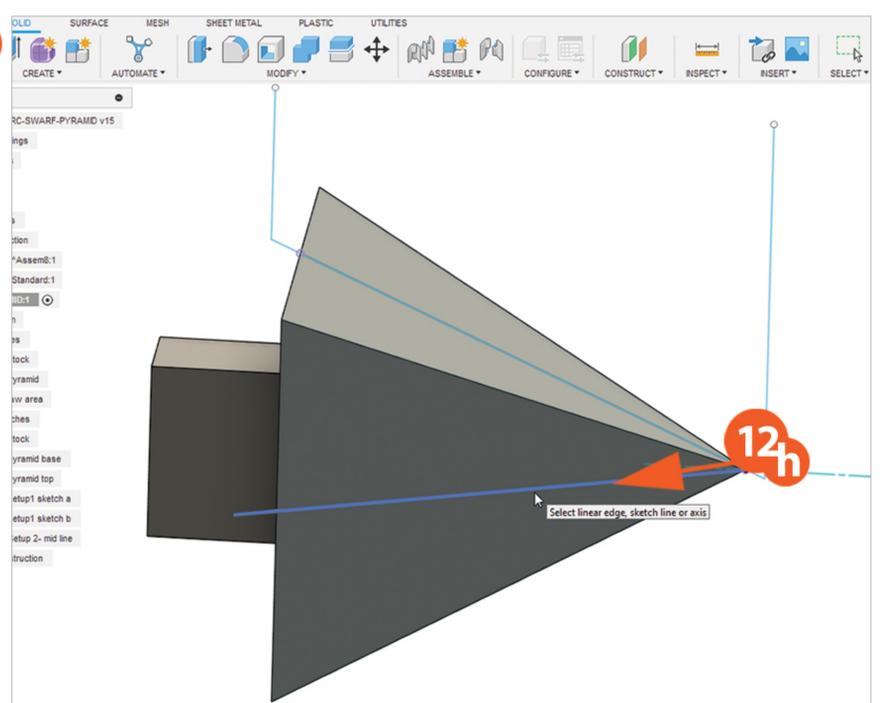
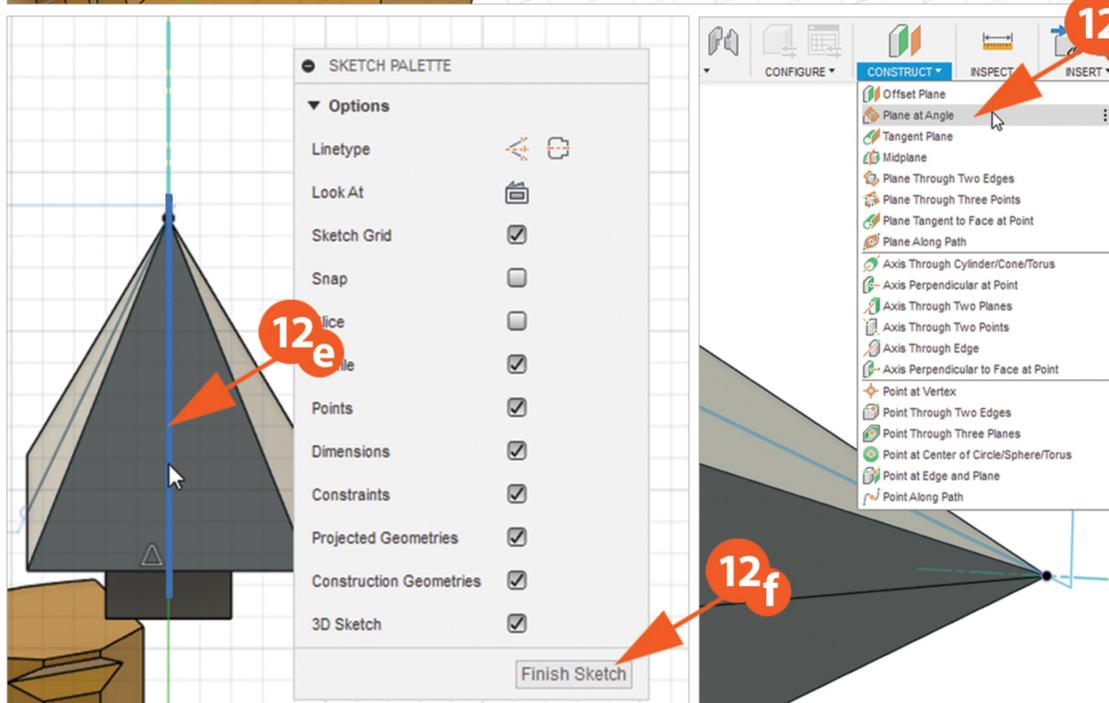
12d - Select the **Top** of the **Pyramid**.

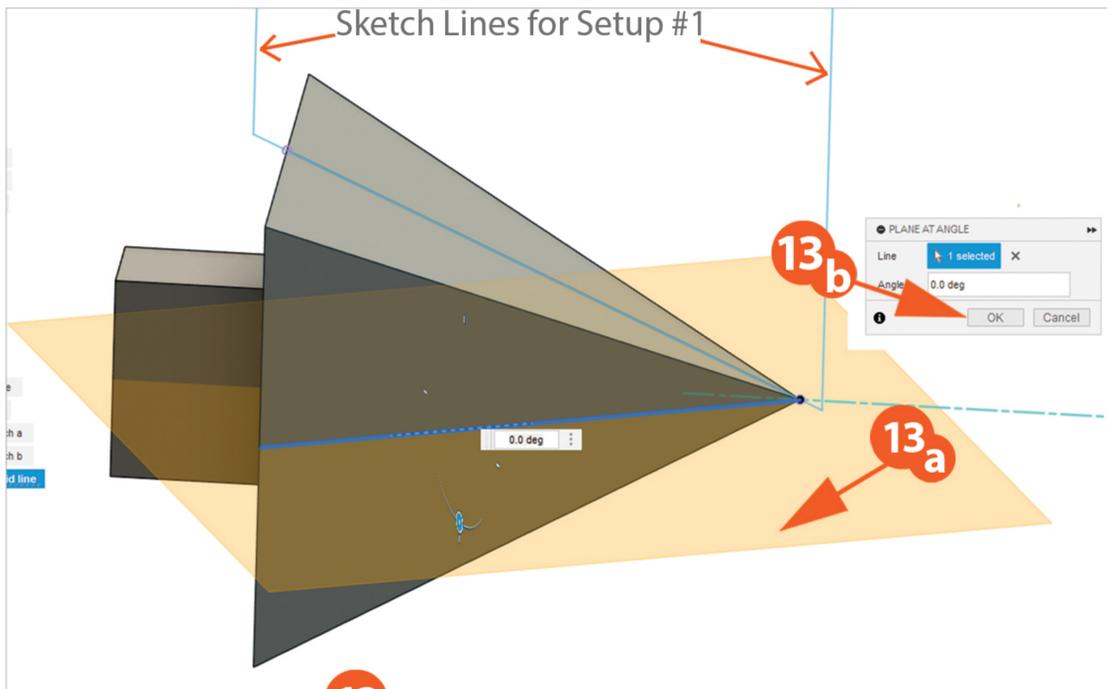
12e - Draw a **Line** from the tip to the bottom middle of the **Pyramid**. Again extend the lines .5" from the end.

12f - **Finish Sketch**. Name it Set2-1.

12g - Select **Construct/Plane At Angle**.

12h - Select the **Sketch Line** you just made.





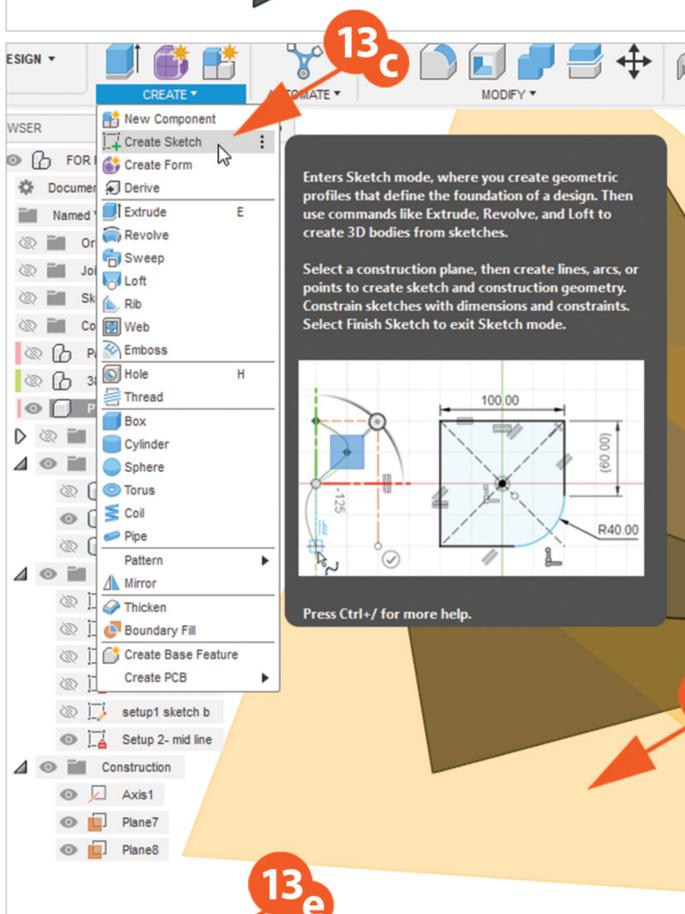
13

13a - You should now see the yellow Construction Plane. It should be at a right angle to your Sketch Lines for Setup 1.

13b - Click **Ok**.

13c - **Create/Create Sketch**.

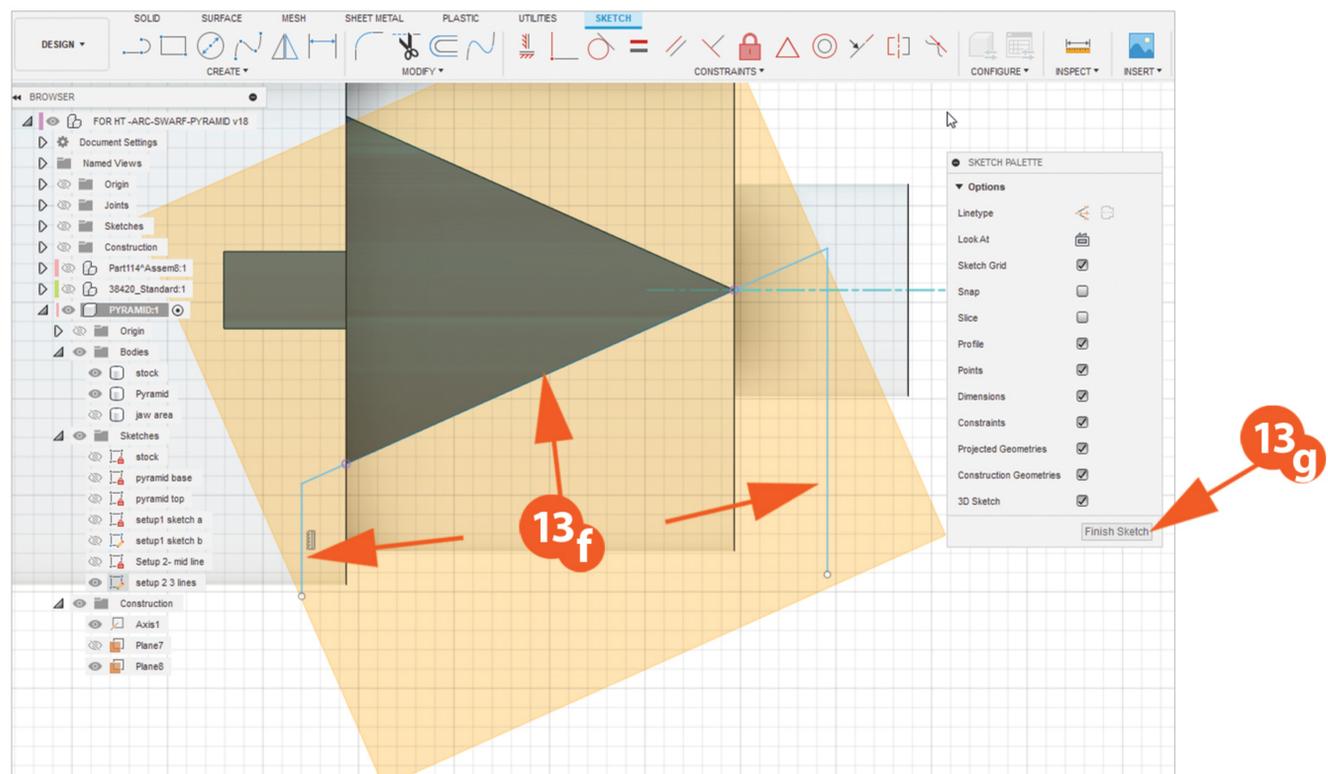
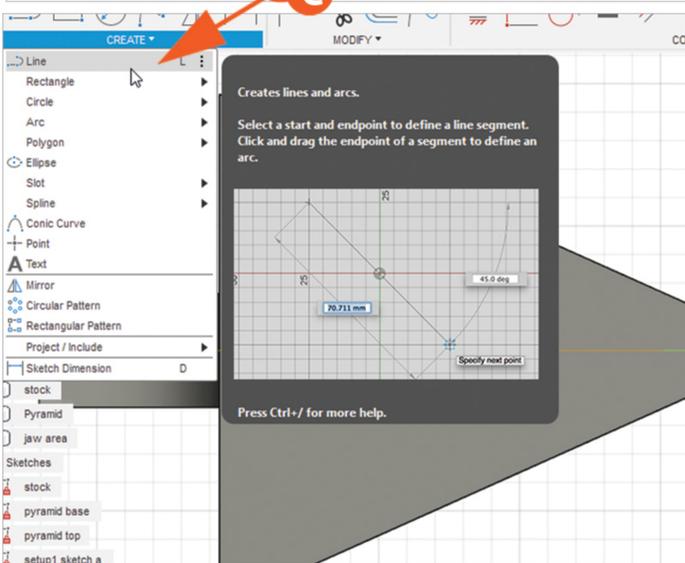
13d - Select the **Construction Plane** you just made.

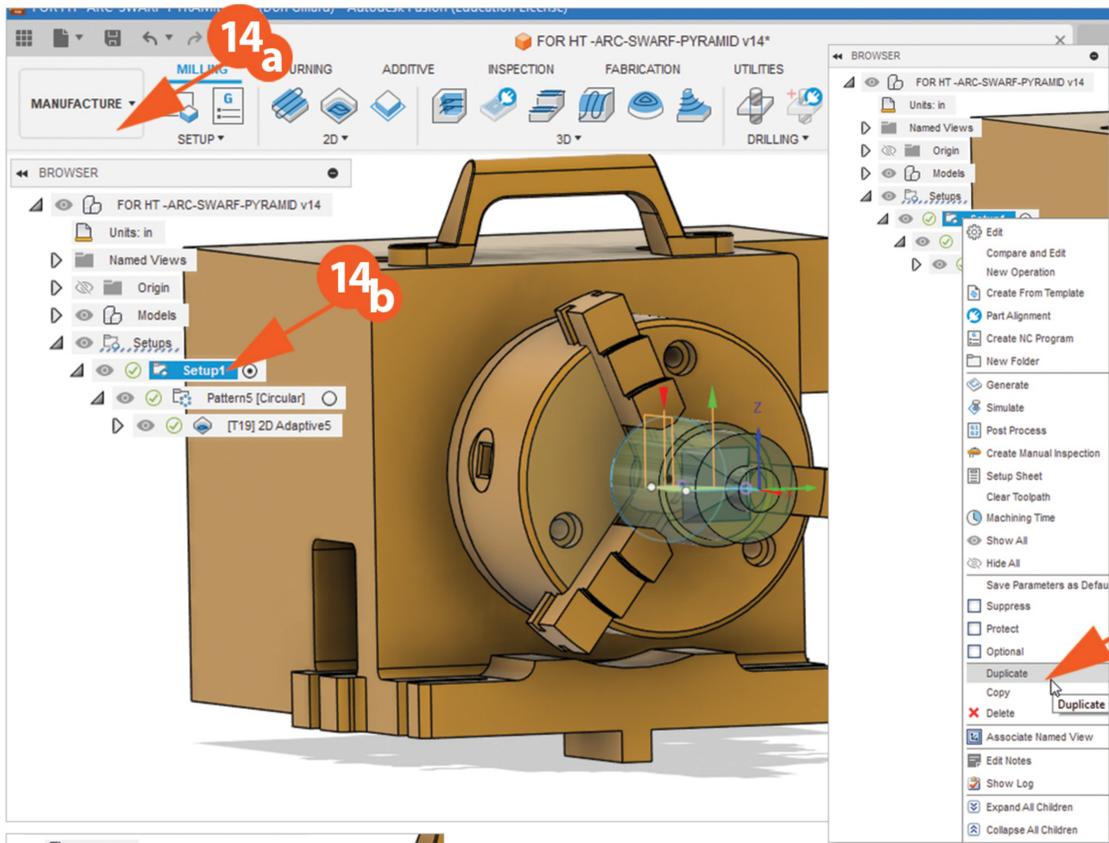


13e - With your stock and model visible, select **Create/Line**.

13f - Create the 2 lines as shown, using the Set2-1 line to click off of. They should extend down past your stock.

13g - **Finish Sketch**.



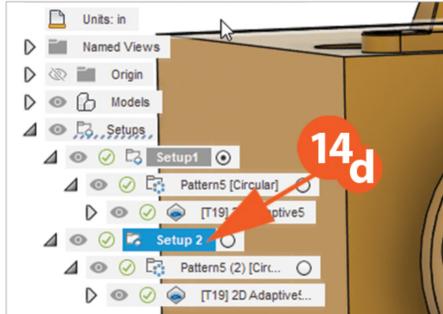


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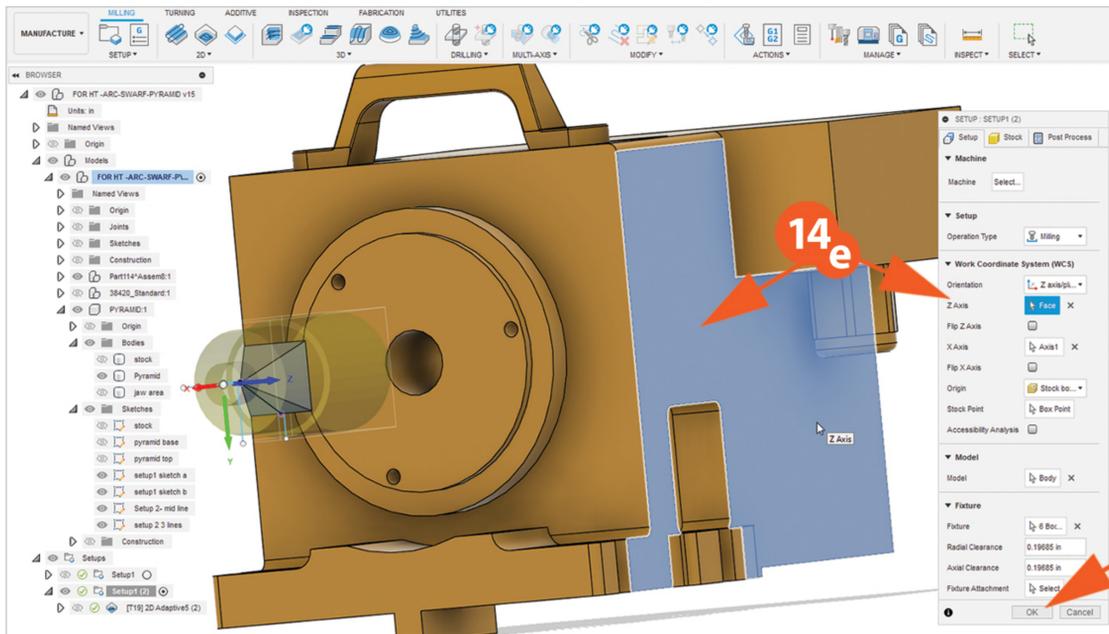
14a - Switch back to the **Manufacture Module**.

14b - Right click on **Setup 1**.

14c - Select **Duplicate**.

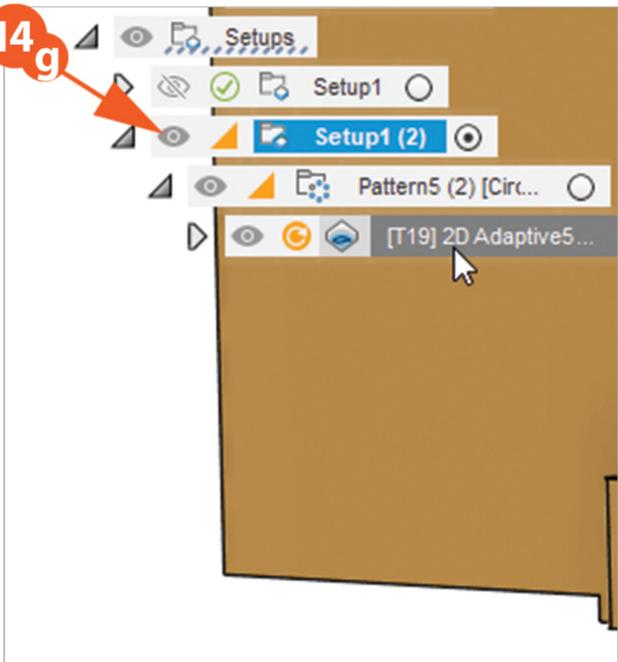


14d - Double click on the new **Setup 2**.

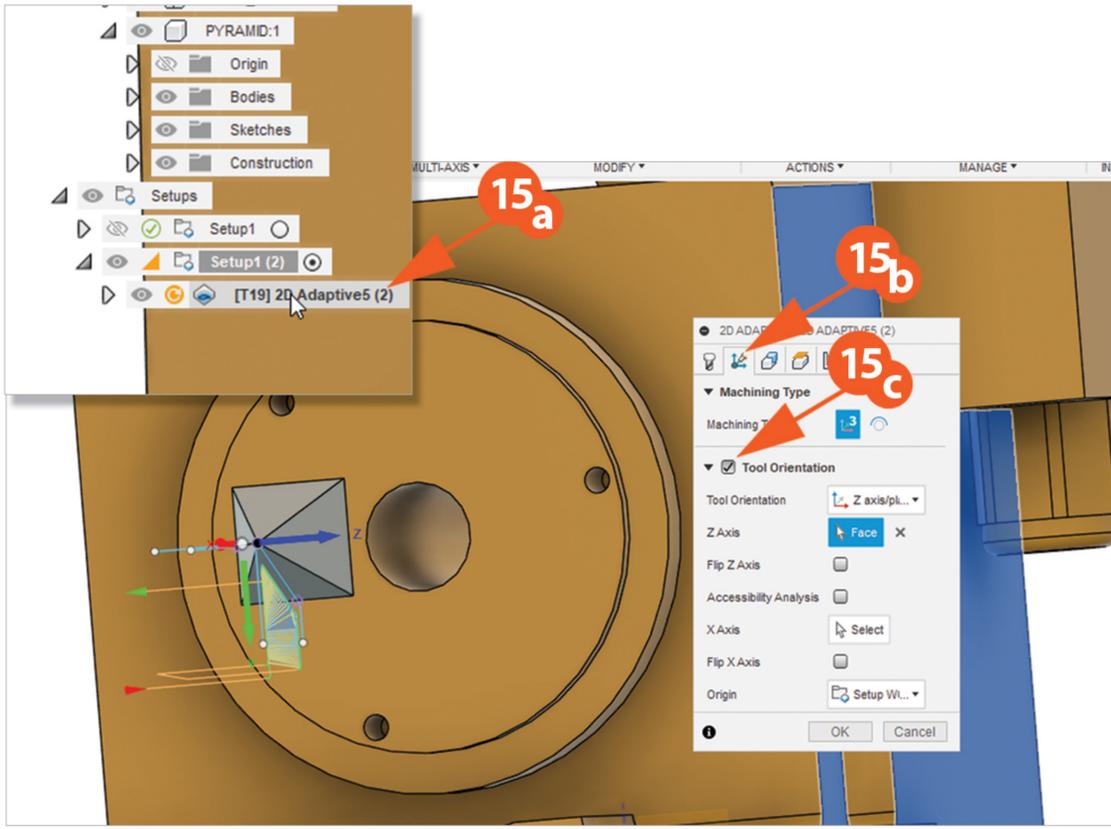


14e - We just need to change the **Z Axis** here. For the **Z Axis** choose the right side of the **Arc4**.

14f - Click **Ok**.

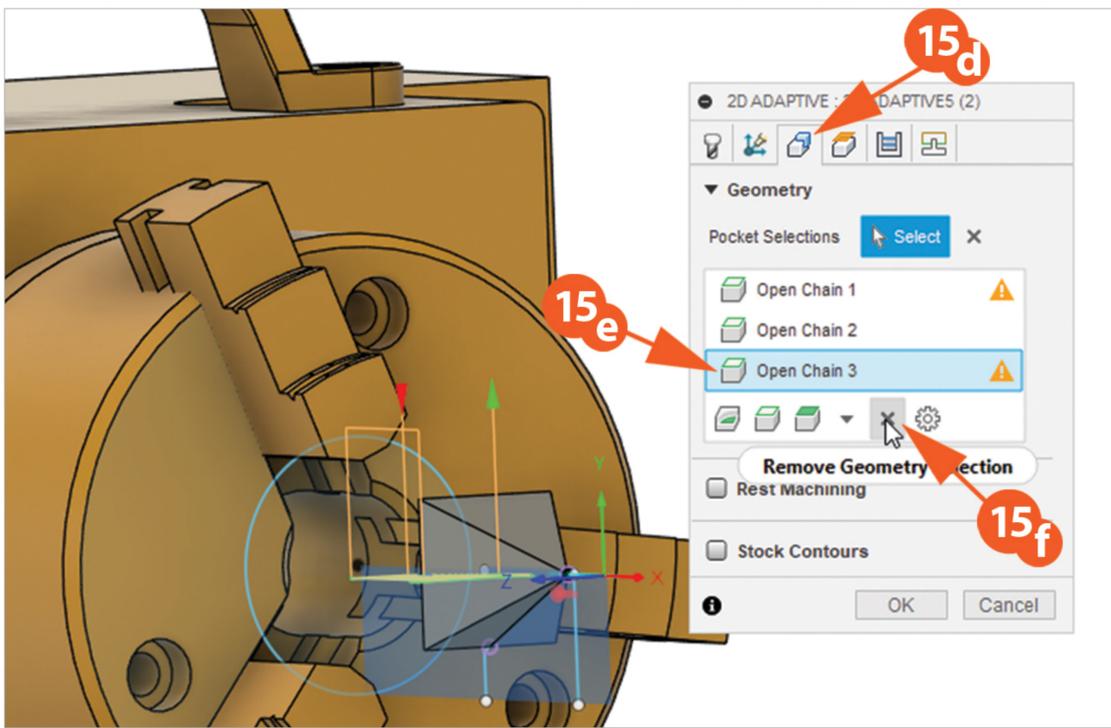


14g - Click on the **Eye** beside **Pattern** under Setup (2) to hide it.

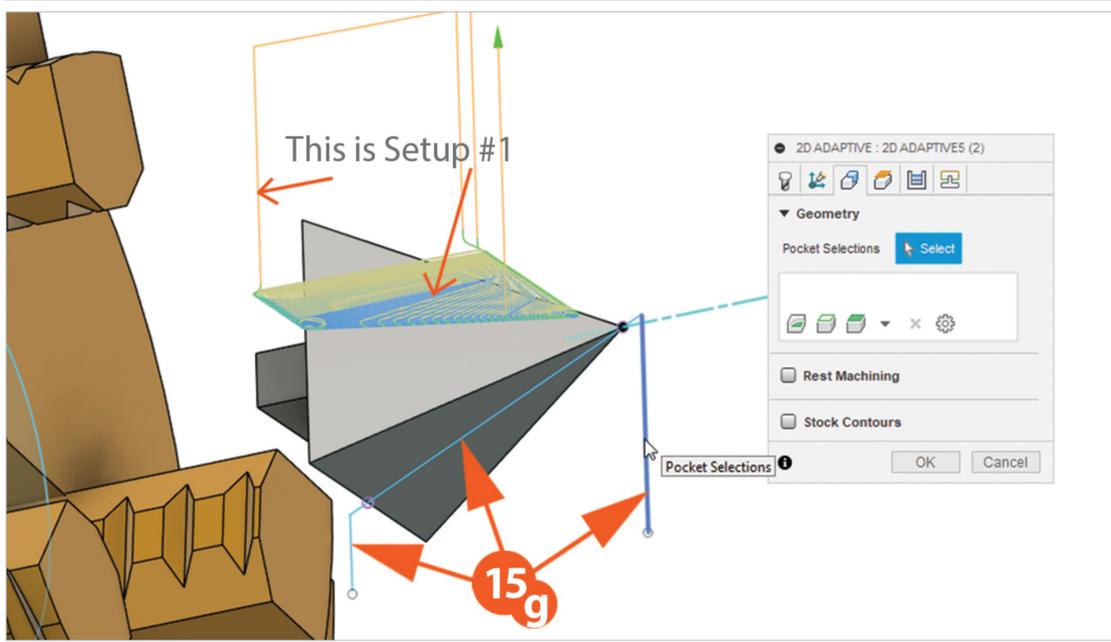


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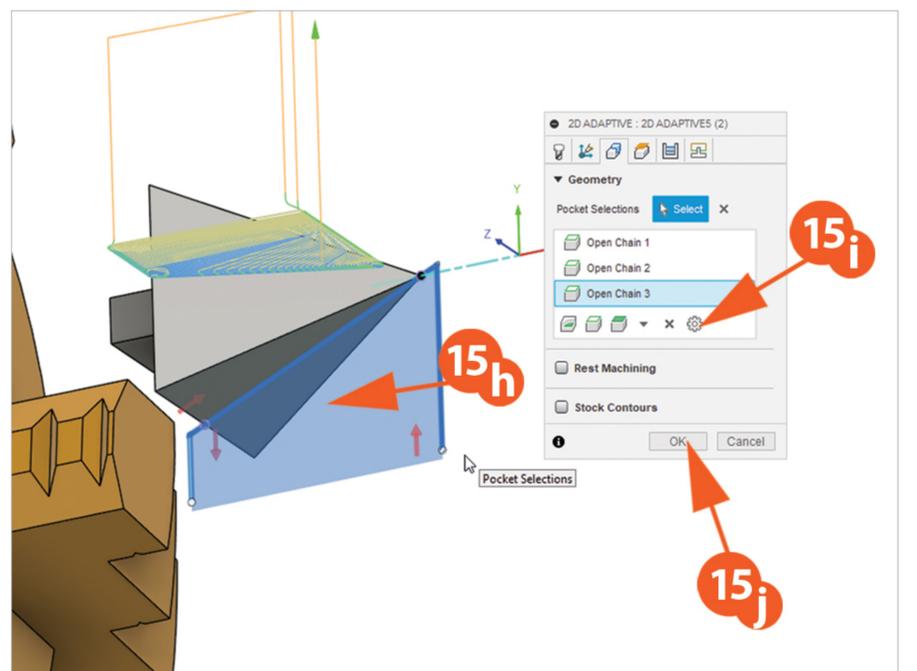
- 15a - Double Click on **2d Adaptive**.
- 15b - Click on the second tab, **Multi-Axis**.
- 15c - Click on the **Tool Orientation Check Box**.

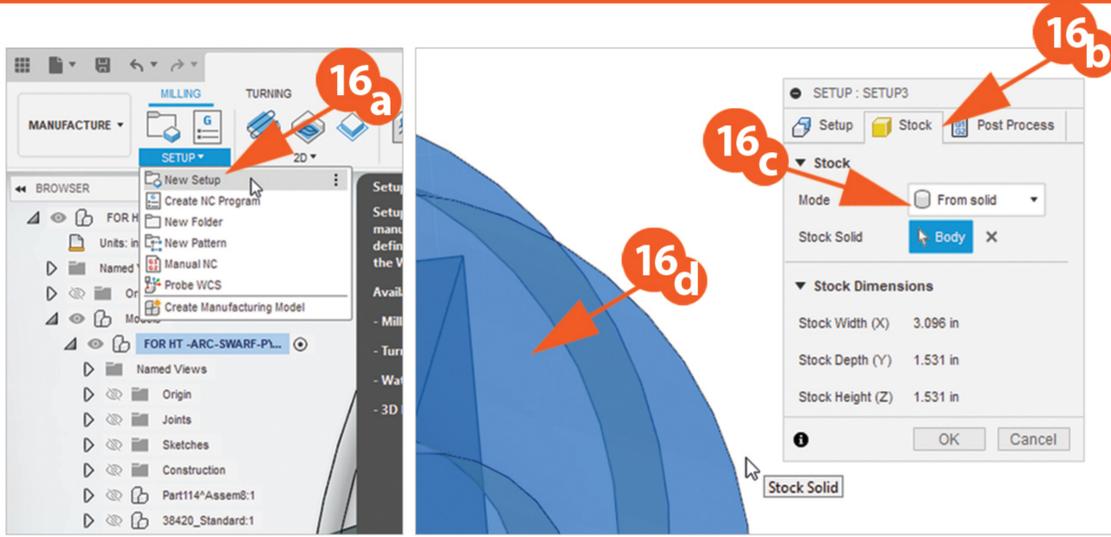


- 15d - Click on the 3rd tab, **Geometry**.
- 15e - Click on each **Chain...**
- 15f - and Click **X** (Remove Geometry Selection) for each **Chain**.



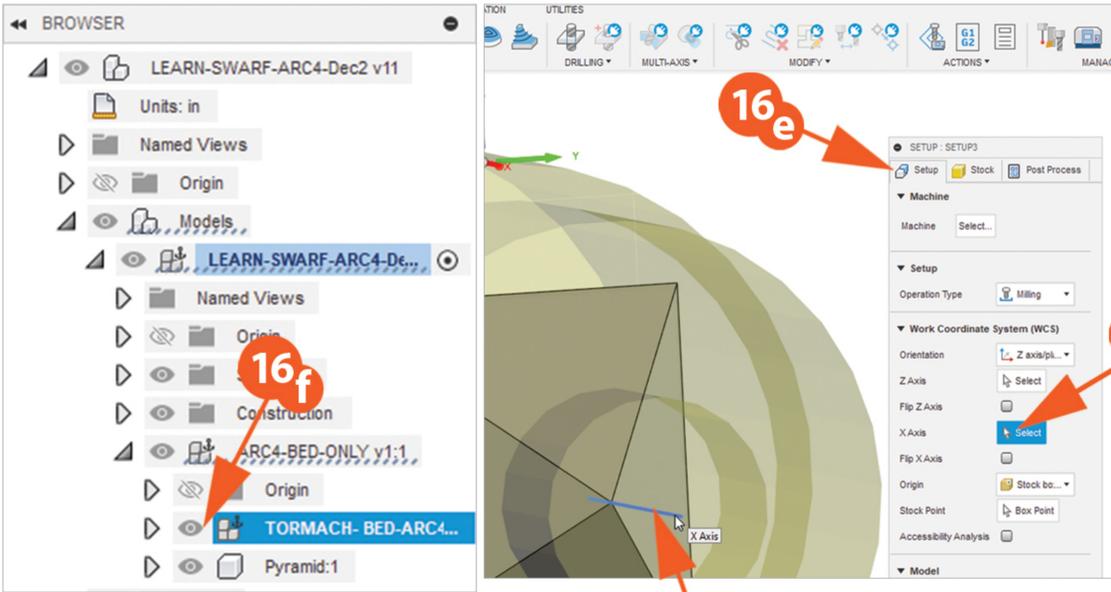
- 15g - Select each of the 3 **Sketch lines** you made for Setup 2.
- 15h - Your selection should look like this. If the blue area is on the outside of this area...
- 15i - Select the **Geometry Selections Gear Icon**, and **Reverse** each **Open Chain**.
- 15j - Click **Ok**.



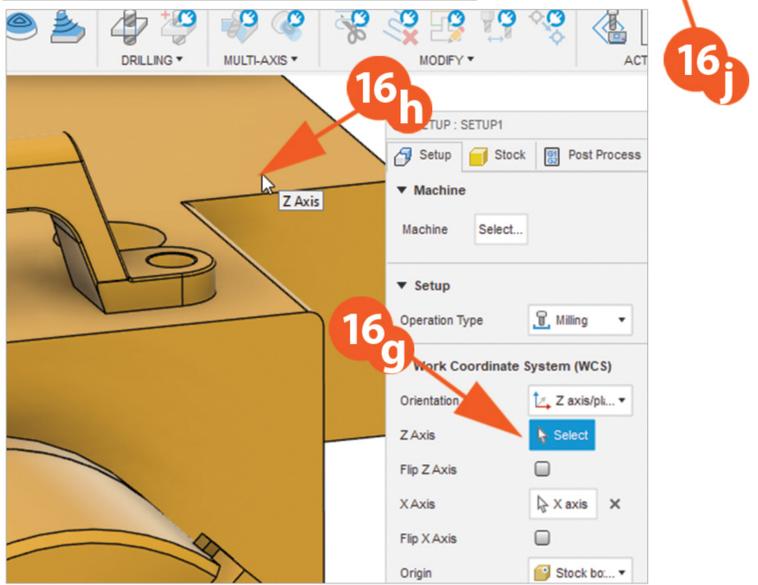


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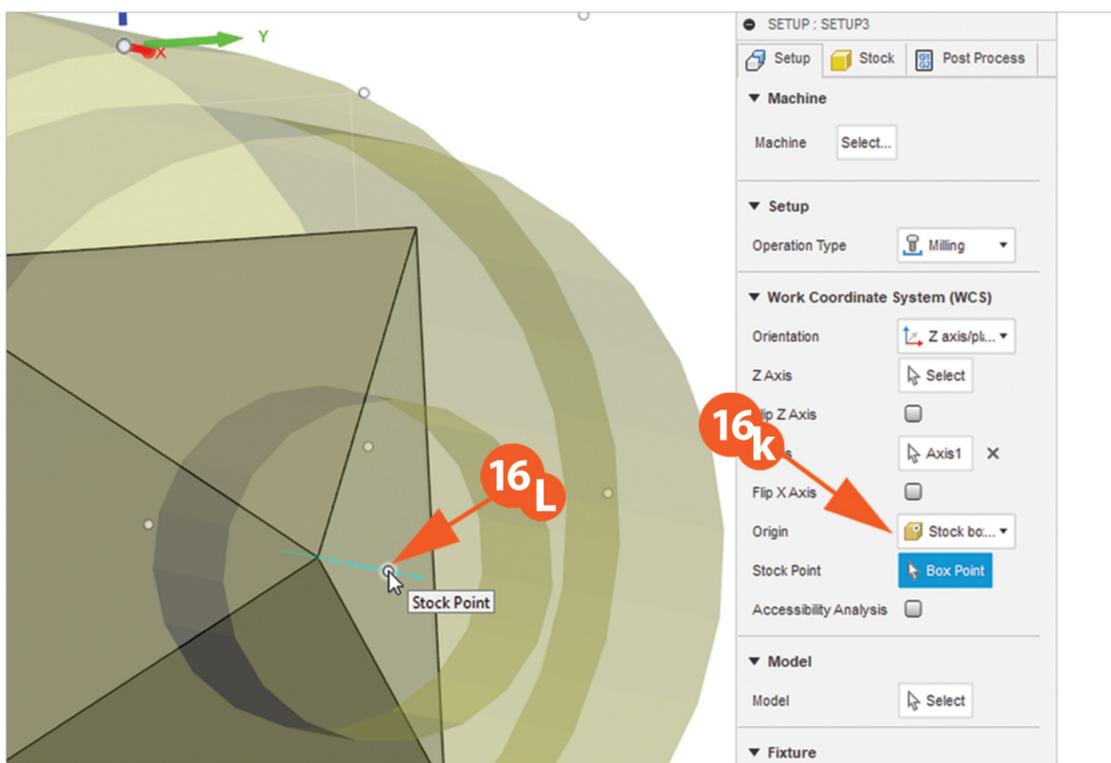
- 16a - Setup/New Setup.
- 16b - Go to the 2nd Tab, **Stock**.
- 16c - Select **Mode/From Solid**.
- 16d - Select your **Stock**.
- 16e - Go to the First Tab, **Setup**.
- 16f - Unhide the **Tormach-Bed-Arc4**.

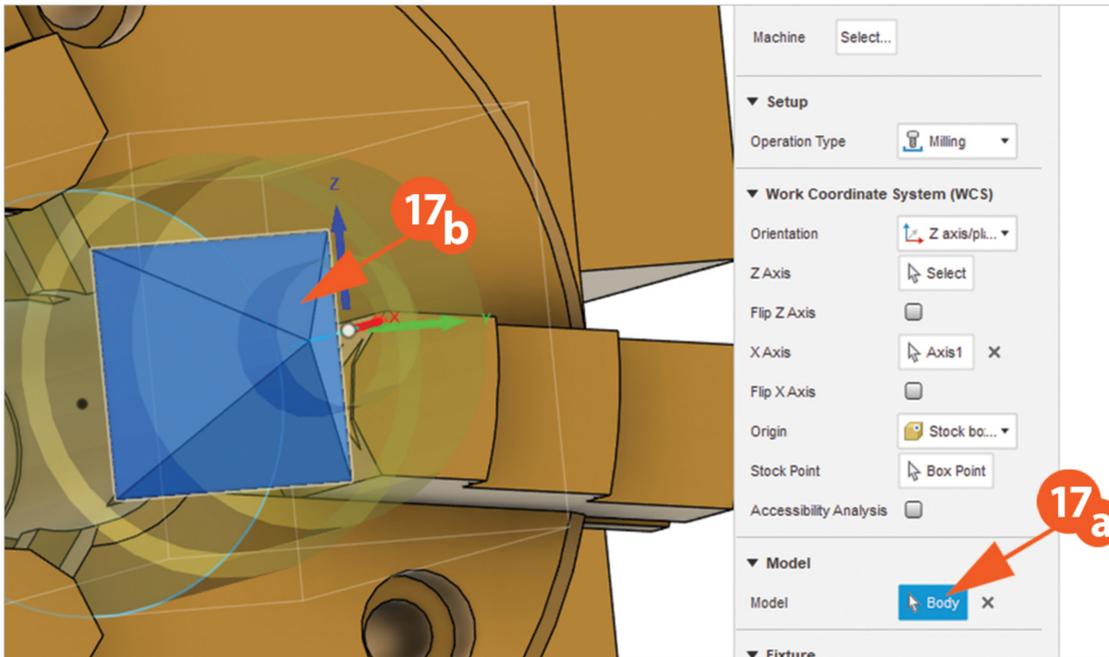


- 16g - Select the **ZAxis/Select...**
- 16h - Click on the top of the Arc4.
- 16i - Select the **XAxis/Select...**
- 16j - Click on the **Center Axis** Construction Line.



- 16k - Click on **Origin/Stock Box Point**.
- 16L - Select the sphere (Box Point) at the center end point of your stock.

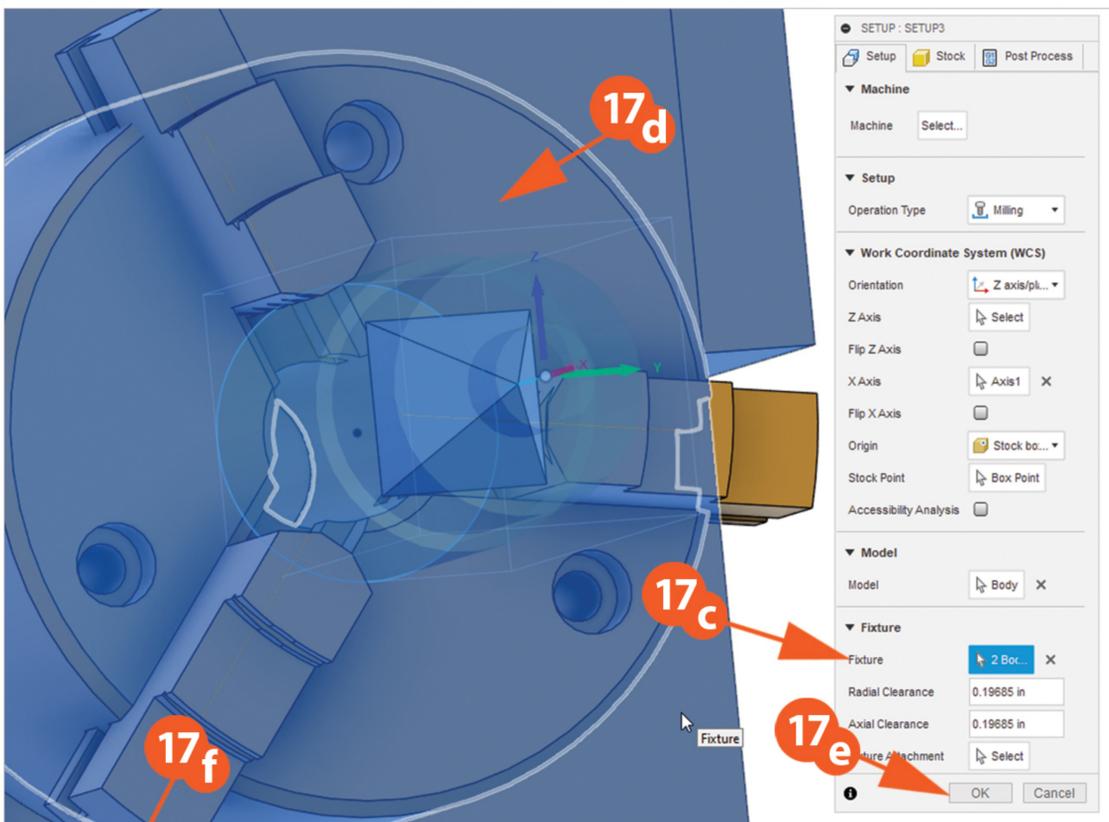




17

17a - Select **Model/Select**.

17b - Choose your **Model/Body** (you may have to hide your stock to be able to select your model).

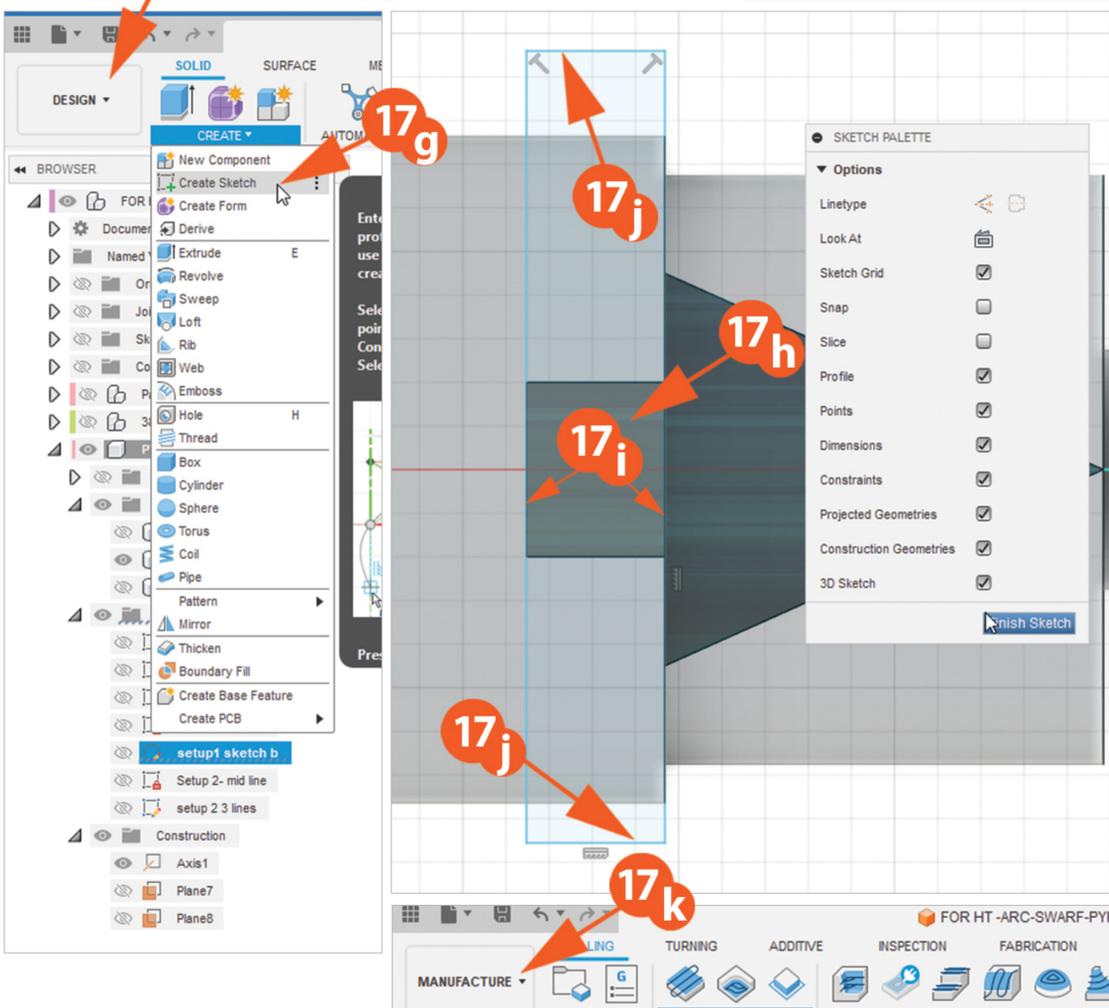


17c - Select **Fixture**.

17d - Select all the parts of the **Arc4** as well as the **Bed**. There will be 6 for the **Arc4** and 1 for the **Bed**.

17e - Click **Ok**.

17f - Switch back to the **Design Module**.



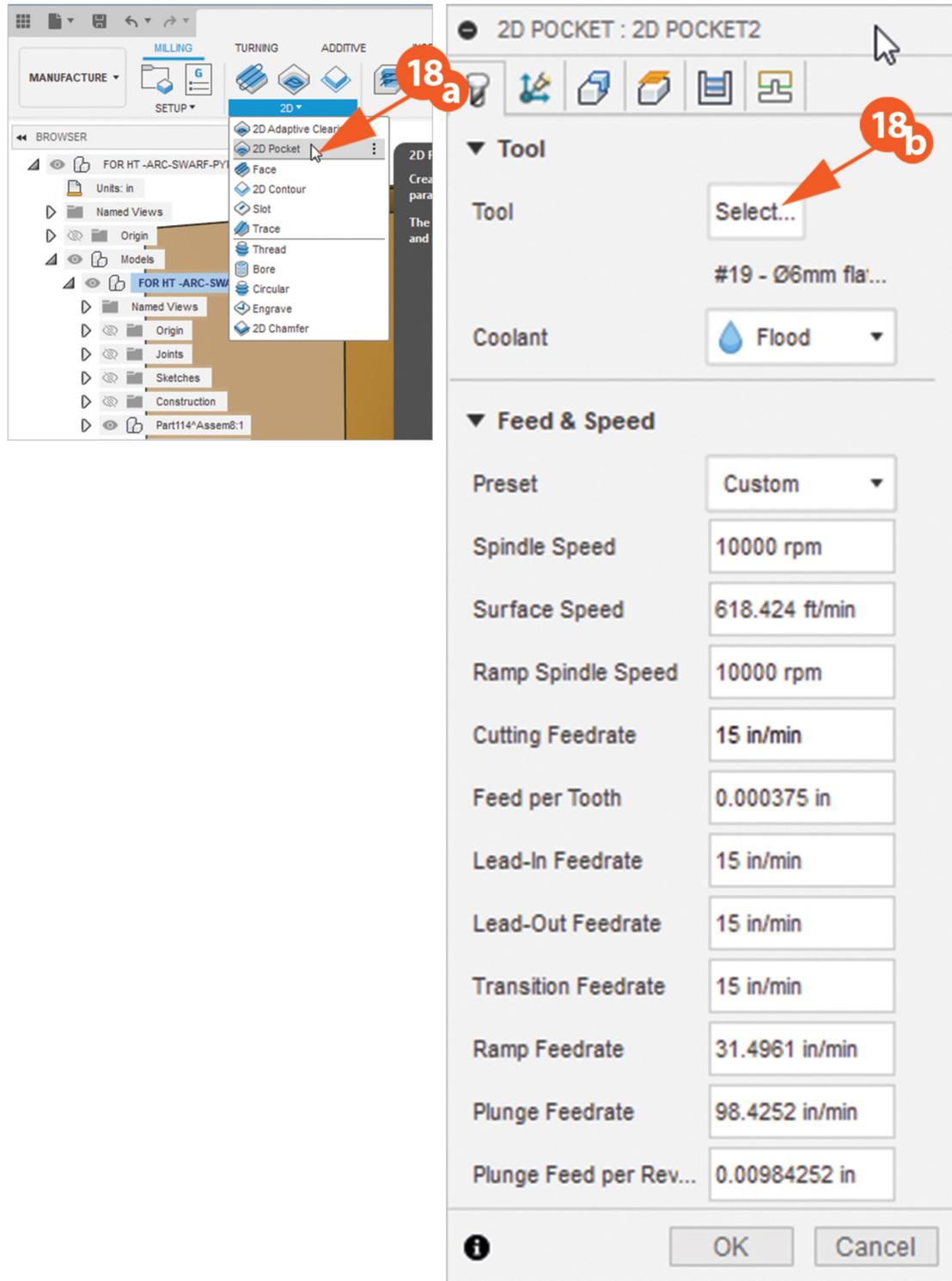
17g - Select **Create/Create Sketch**.

17h - Select the **Parting Rectangles** top surface.

17i - Create a **Rectangle** flush with both ends of the **Part**...

17j - Extending past the **Stock** on the sides.

17k - Return to the **Manufacture Module**.



18

18a - Select **2D/2D Pocket**.

18b - From the pop-up, select **Tool/Select**.

18c - Select the **6mm FEM Long**. It must be an extra long bit for the clearance required for this operation.

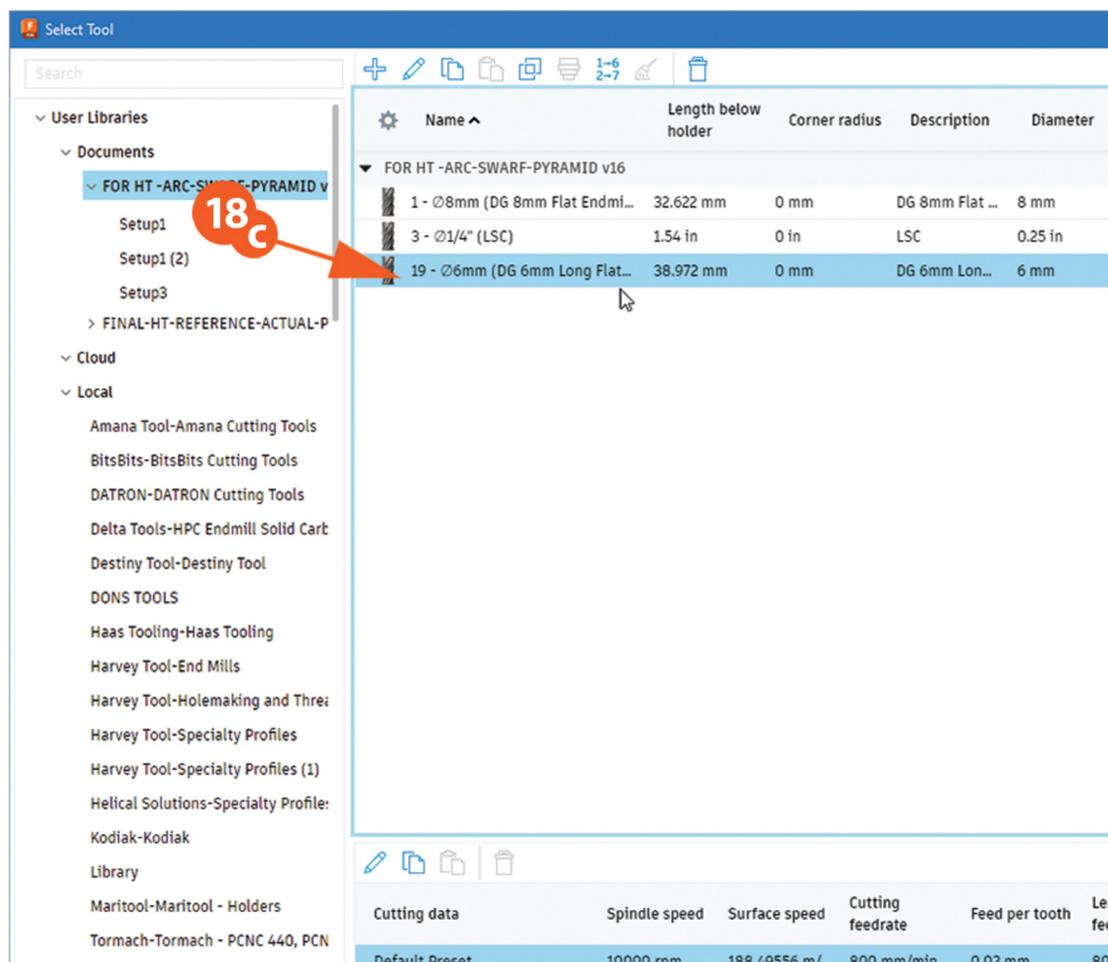
Input the following:

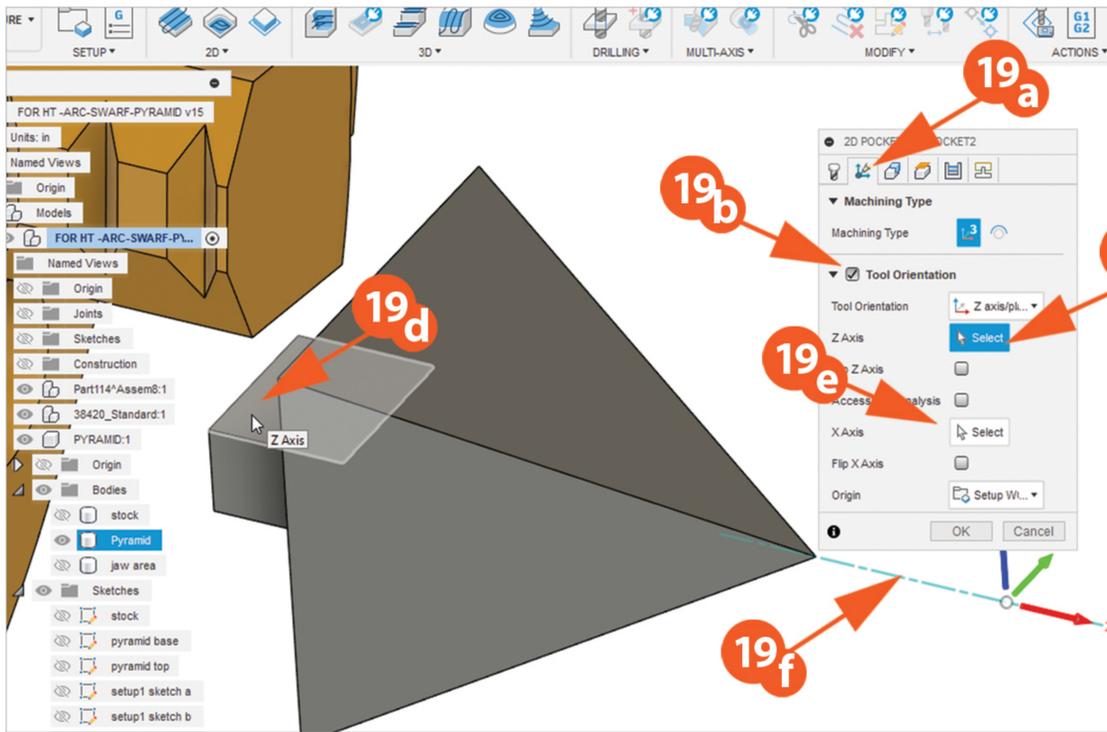
Coolant = Flood

Spindle Speed = 10000

Cutting Feedrate = 15 in/min

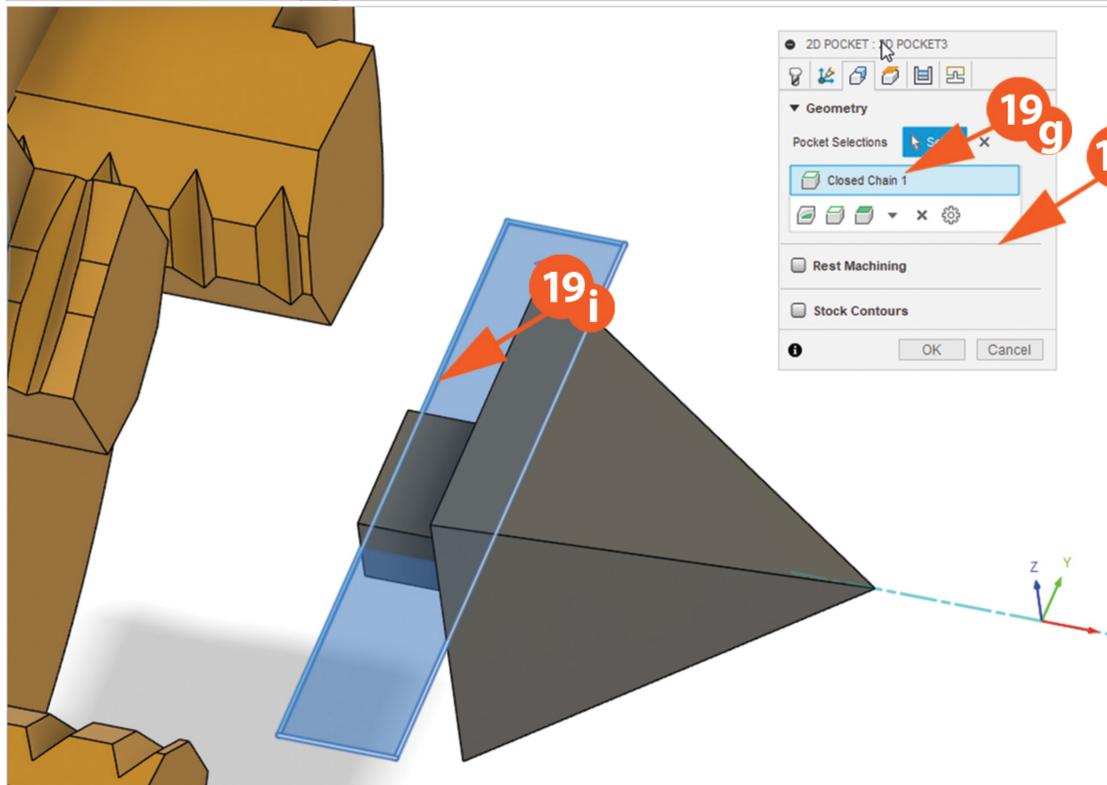
Proceed to tab 2.....



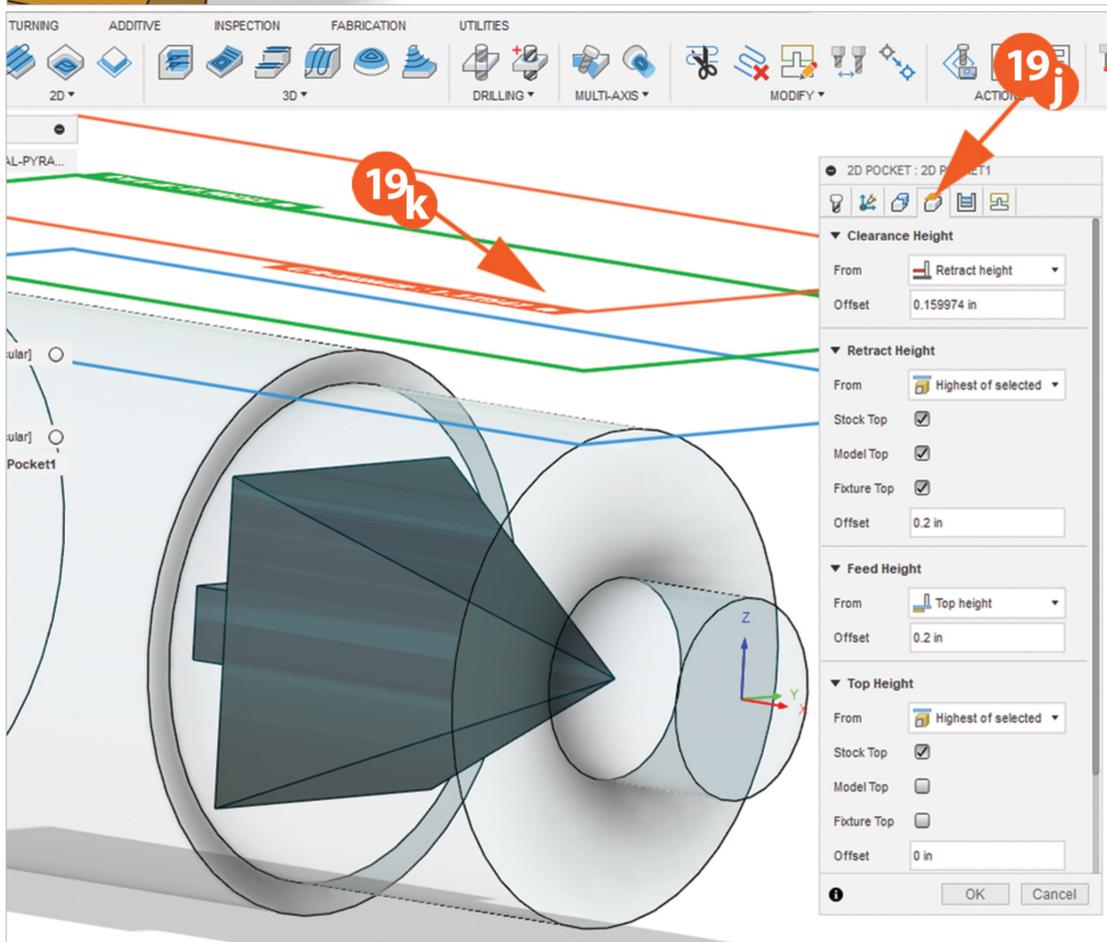


19

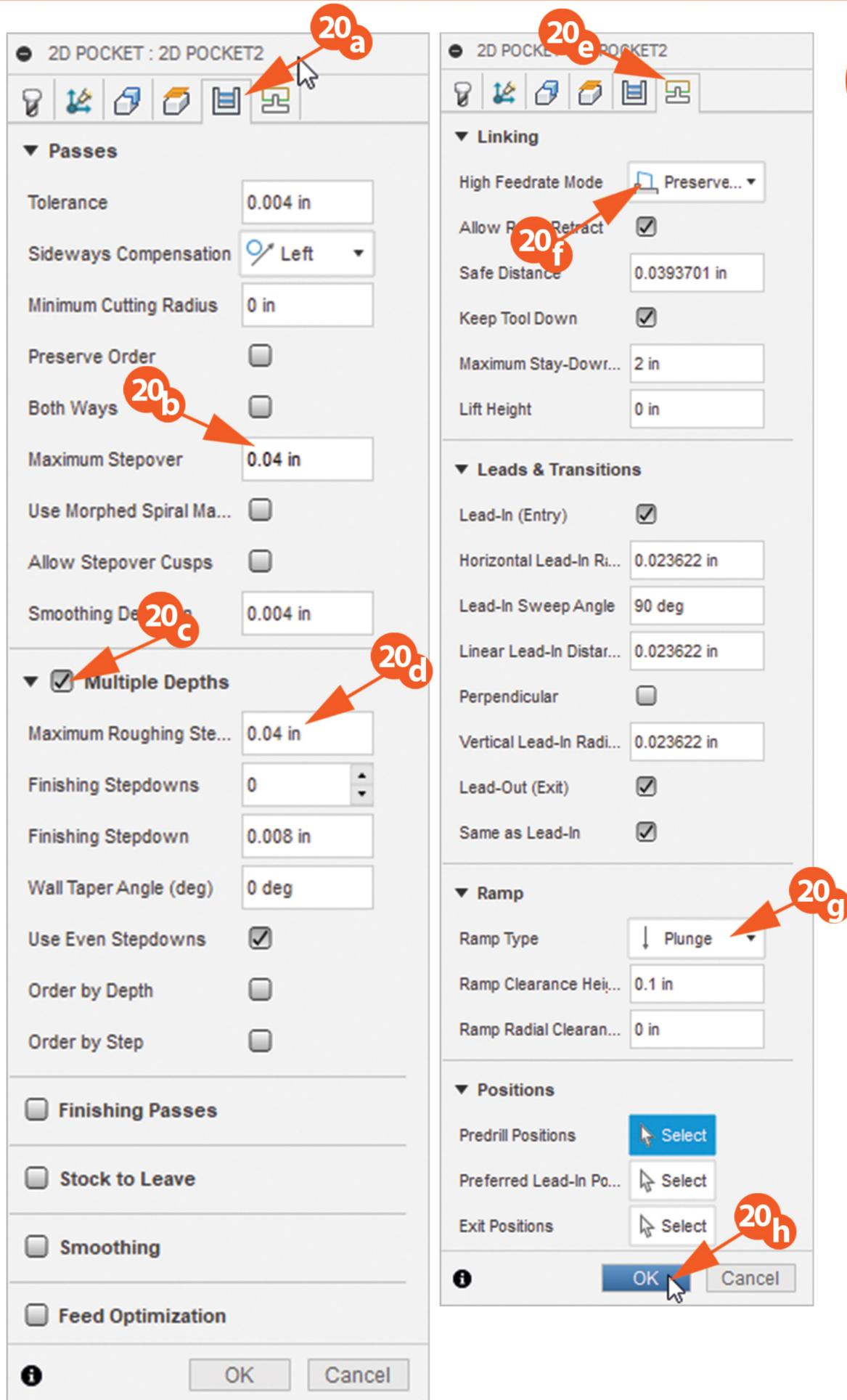
- 19a - Select Tab 2, **Multi-Axis**.
- 19b - Click on the **Tool Orientation** Check Box.
- 19c - Click On **Z Axis/Select**.
- 19d - Select the **Face** for the parting operation.
- 19e - Click On **X Axis/Select**.
- 19f - Select the **Construction Center Line**.



- 19g - Select Tab 3, **Geometry**.
- 19h - Select **Pocket Selections/Select**.
- 19i - Select the **Pocket Sketch**.



- 19j - Select the next tab, **Heights**.
- 19k - Change/select all the heights as follows:
 Top (orange line) = **Clearance**.
 2nd to Top (green or olive) = **Retract**.
 3rd to Top (Blue line) = **Top** (this should be level to your **Stock**).
 Bottom Height = **Selected Contours**.
- Proceed to next tab...



20

20a - Click on the 5th tab, **Passes**.

20b - Enter .04 in for **Maximum Stepover**.

20c - Click on the **Multiple Depths** Check Box.

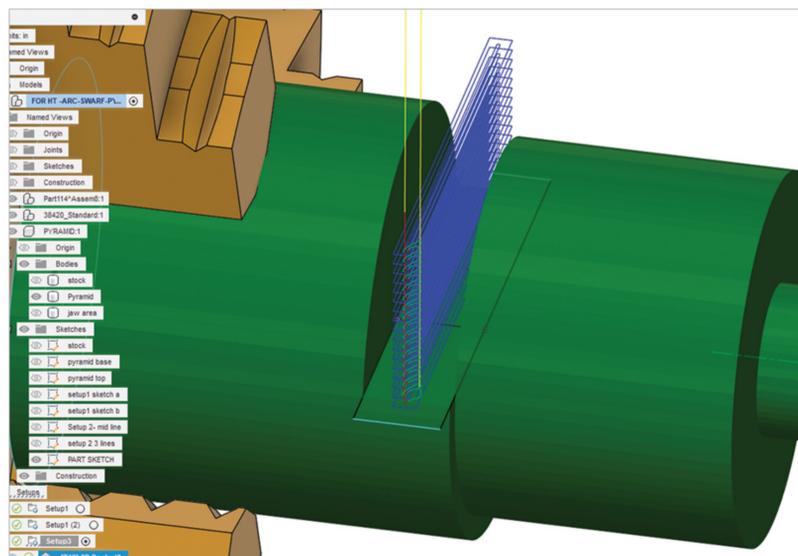
20d - Enter .04 in for the **Maximum Roughing Stepdown**.

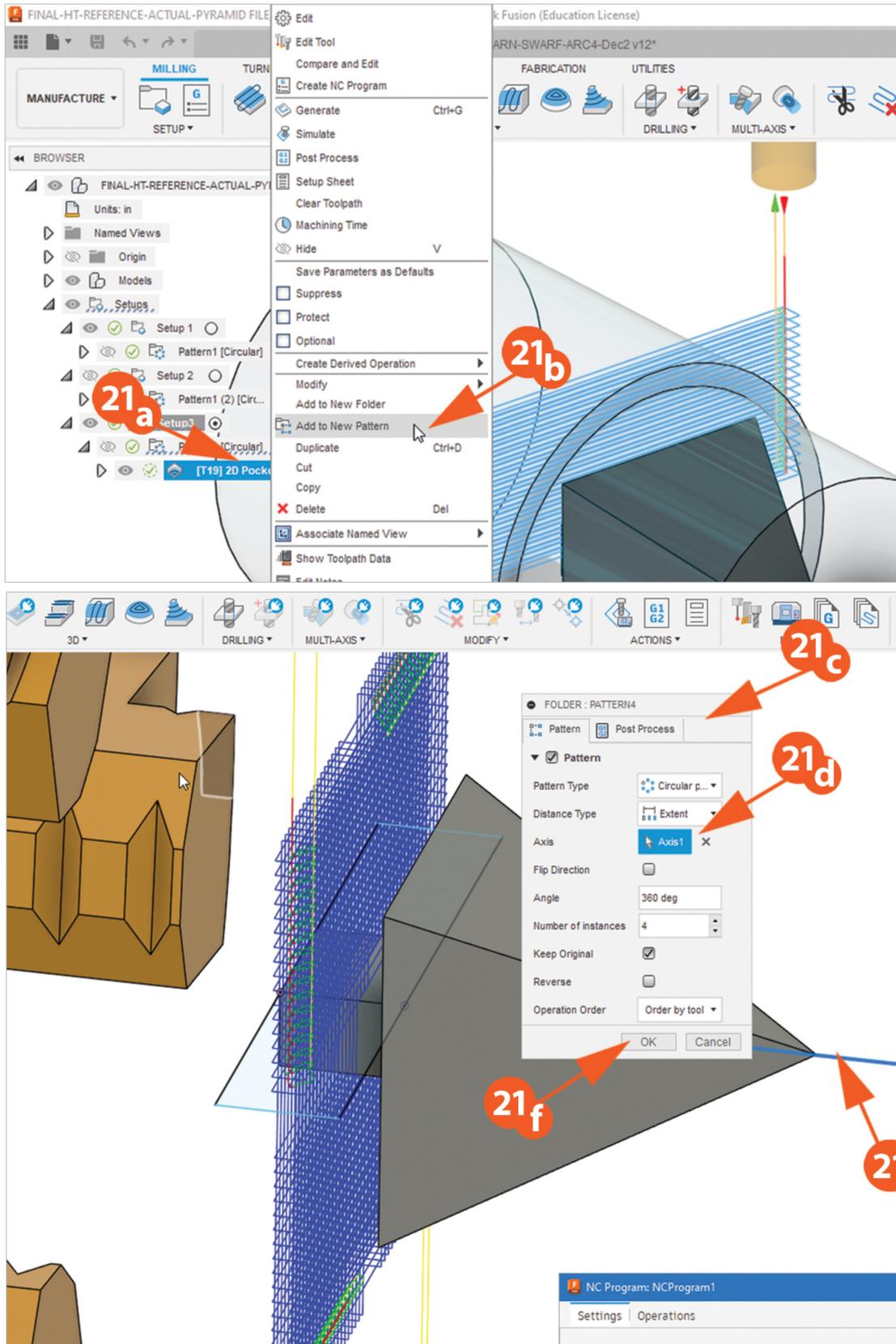
20e - Click on the last tab, **Linking**.

20f - Select **Preserve Rapid Movement** under **High Feedrate Mode**.

20g - Under **Ramp**, **Ramp Type** choose **Plunge**.

20h - Click on **Ok**.





21

- 21a - Right click on your **2D Pocket**.
- 21b - Click **Add To New Pattern**.
- 21c - In the pop-up enter the following:
 Pattern Check = Checked.
 Pattern type = Circular.
 Angle = 360 deg.
 Number Of Instances = 4
- 21d - **Axis/Select**.
- 21e - Select **Axis1**, your **Construction Axis**.
- 21f - Click **Ok**.
- 21g - Right click on the root, **Setups**.
- 21h - Click **Post Process**.
- 21i - Enter the Gcode name, select your folder.
- 21j - Click **Post**.

