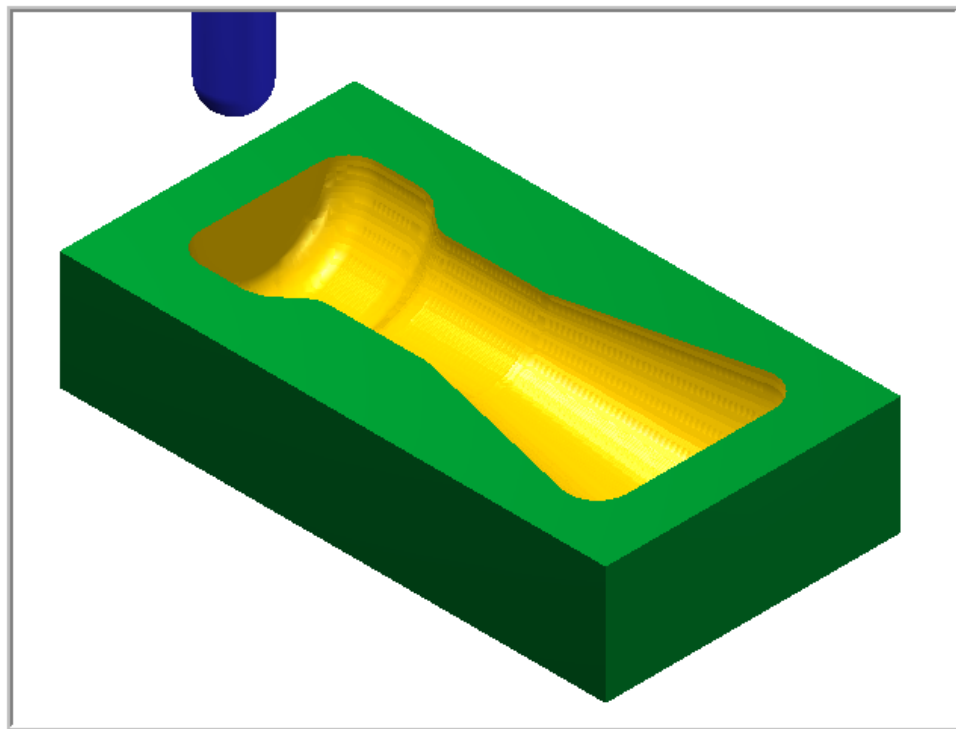


Mastercam X³

TRAINING

GUIDE



MILL-LESSON-9

SURFACE POCKET AND SURFACE

FINISH PARALLEL

camInstructor

Objectives

You will create the geometry for Mill-Lesson-9, and then generate the toolpaths to machine the part on a CNC vertical milling machine. This Lesson covers the following topics:

➤ **Create a 3-dimensional drawing by:**

Creating lines.
Creating arcs.
Trimming geometry using Divide.
Creating a revolved surface.

➤ **Establish Stock Setup settings:**

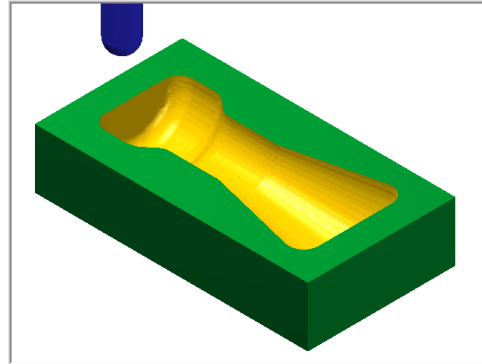
Stock size using Bounding Box.
Material for the part.
Feed calculation.

➤ **Generate a 3-dimensional milling toolpath consisting of:**

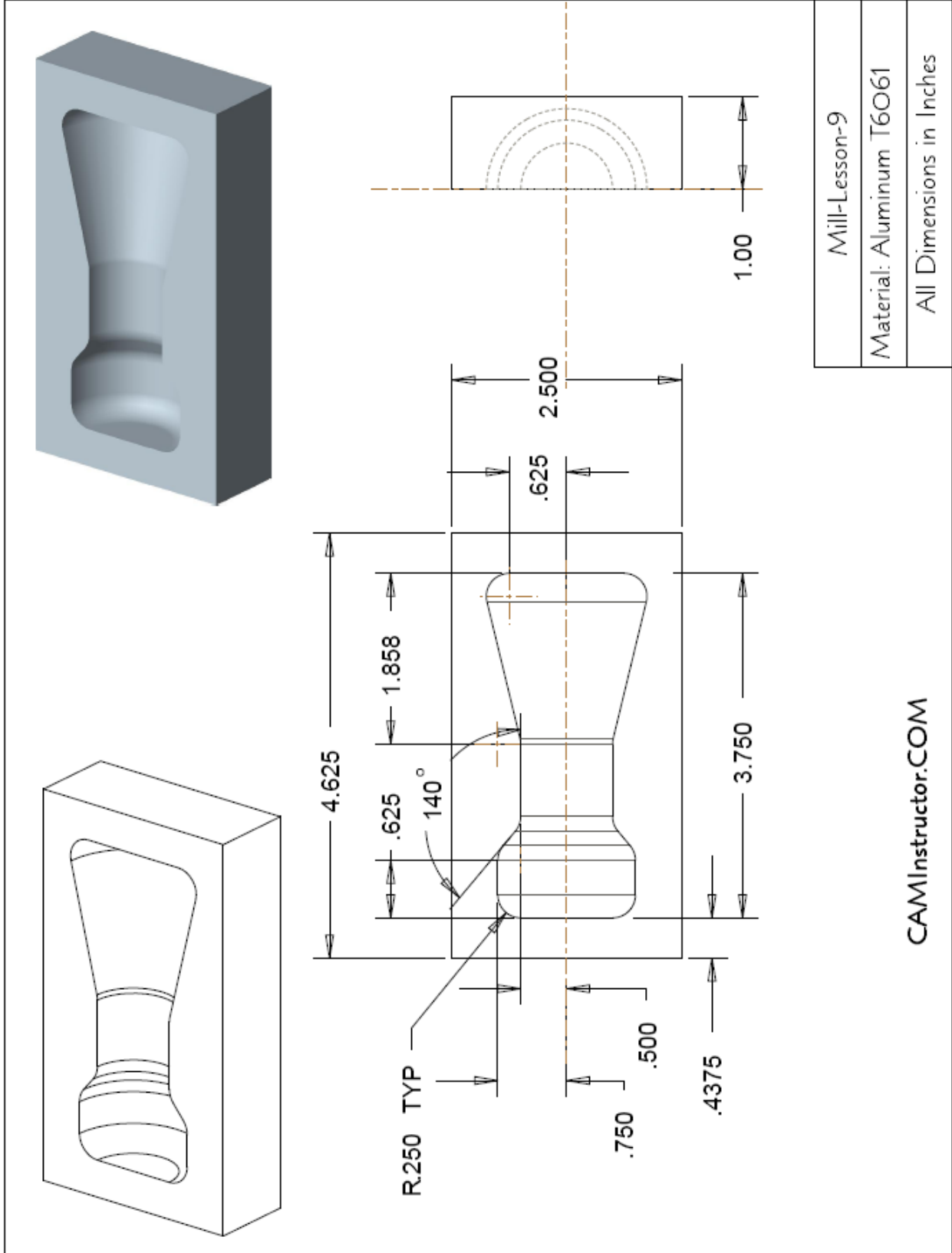
Surface pocket.
Surface finish parallel.

➤ **Inspect the toolpath using Mastercam's Verify and Backplot by:**

Launching the Verify function to machine the part on the screen.
Generating the NC- code.





MILL-LESSON-9 DRAWING



TOOL LIST

- ☉ 0.500 diameter bull end mill with a 0.125 corner radius to rough machine the pocket.
- ☉ 0.500 diameter ball end mill to finish machine the pocket.

Tool List of MILL-LESSON-9.MCX							
Proj./Part No.:	0	Date	: 06/23/08				
Drawing No.:	1	Customer	: -				
Prog. No.:	9	Programmer	: 1				
<hr/>							
	Tool type :	0.5 Endmill13 Bull 1/2 BULL ENDMILL 0.125 RAD					
	Manufact.code :						
	Chuck :						
	Tool Number :	1		Feedrate :	12		
	Diameter :	0.5	RPM :	2500	Plunge feed r.:	12	
	Corner radius :	0.125	Tip angle :	0	Diam. offset :	1	
	Flute length :	1	Material :	ALUMINUM ...	Length offset :	1	
	Overall length:	3	No flutes :	4			
	Tool type :	0.5 Endmill12 Sphere 1/2 BALL ENDMILL					
	Manufact.code :						
	Chuck :						
	Tool Number :	2		Feedrate :	15		
	Diameter :	0.5	RPM :	2500	Plunge feed r.:	15	
	Corner radius :	0.25	Tip angle :	0	Diam. offset :	2	
	Flute length :	1	Material :	ALUMINUM ...	Length offset :	2	
	Overall length:	3	No flutes :	4			

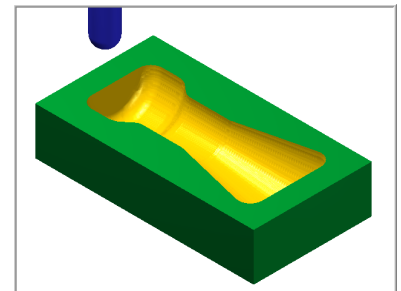
MILL-LESSON-9 - THE PROCESS

Geometry Creation

- TASK 1:** Setting environment
- TASK 2:** Create geometry
- TASK 3:** Trim the geometry
- TASK 4:** Create the revolved surface
- TASK 5:** Create boundary curves
- TASK 6:** Save the drawing

Toolpath Creation

- TASK 7:** Define the rough stock using stock setup
- TASK 8:** Rough the pocket using surface pocket
- TASK 9:** Finish the pocket using surface finish parallel
- TASK 10:** Verify the toolpath
- TASK 11:** Save the updated MCX file
- TASK 12:** Post and create the CNC code file



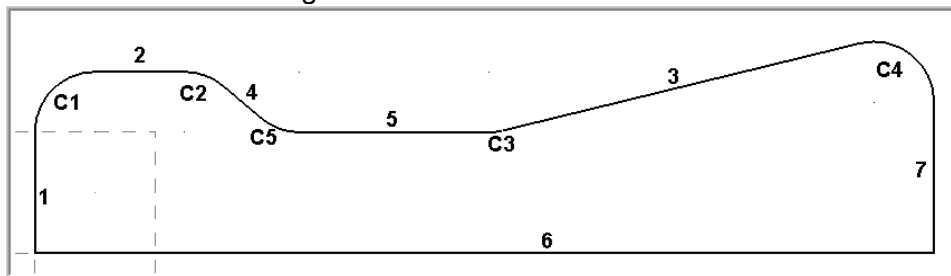
TASK 1: SETTING THE ENVIRONMENT

Before starting the geometry creation you should set up the grid, toolbars and machine type as outlined in the **Setting the environment** section at the beginning of this text:

1. Set up the Grid. This will help identify the location of the origin.
2. Customize the toolbars to machine a **3D part**.
3. Set the machine type to a Haas Vertical Spindle CNC machine.

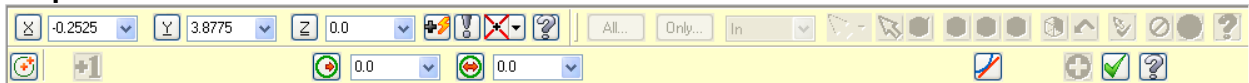
TASK 2: CREATE GEOMETRY - X0 Y0 LOWER LEFT CORNER

- ☞ In this task you will create the geometry that will be used to create the revolved surface. First you will create the circles, C1 through C4 and then create the lines 1 through 7. The arc C5 will be created using Fillet.




☞ Create Circle #1


1. Select **Create>Arc>Circle Center point...**
2. The **Circle Center Point** ribbon bar appears and you are prompted to **Enter the center point**.




3. Before moving on, click in the white space for **radius** and enter a value of **0.25**. Next **click on the icon for radius** on the ribbon bar as shown below. This **locks** in the radius for the circles. To **unlock** click on the icon for diameter.



4. To satisfy this first prompt click on the **FastPoint** Icon on the Auto Cursor ribbon bar .
5. In the white space input the **X (0.25)** and **Y (0.5)** values for the center of the circle and **hit enter**. **Note** that there is a comma between the X and Y values, and you do not need to input the Z value for this example.


6. On the ribbon bar click on **Apply**  to fix the entity.

☞ Create Circle #2



7. To satisfy the prompt **Enter the center point** click on the **FastPoint** Icon on the Auto Cursor ribbon bar.
8. In the white space input the **X (0.625)** and **Y (0.5)** values for the center of the circle and then hit the **enter** key.
9. On the ribbon bar click on **Apply**  to fix the entity.

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➤ Create Circle #3

- To satisfy the prompt **Enter the center point** click on the **FastPoint** Icon on the Auto Cursor ribbon bar.
- In the white space input the **X (3.750-1.858)** and **Y (0.5+0.25)** values for the center of the circle and then hit the **enter** key.
- On the ribbon bar click on **Apply**  to fix the entity.

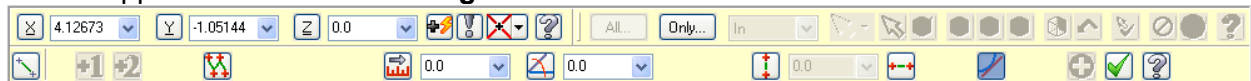
➤ Create Circle #4


- To satisfy the prompt **Enter the center point** click on the **FastPoint** Icon on the Auto Cursor ribbon bar.
- In the white space input the **X (3.750-0.25)** and **Y (0.625)** values for the center of the circle and then hit the **enter** key.
- Click on the OK icon  to complete this feature.
- Now select the **Fit to screen** icon .

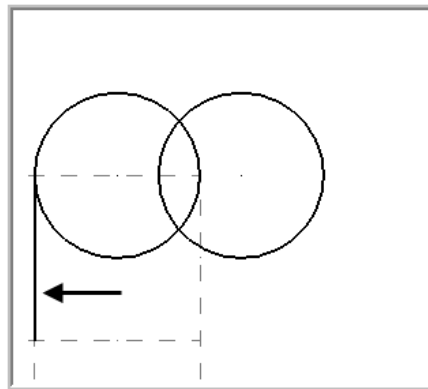
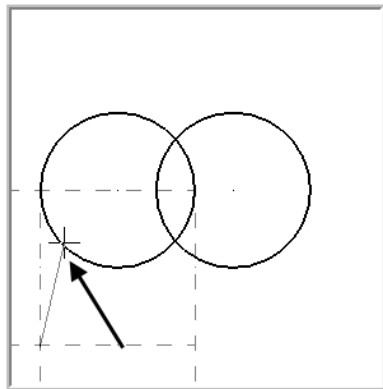
➤ Create Line #1

- Select from the pull down menu: **Create>Line>Line Endpoint...**

- On the graphics screen you are prompted: **Specify the first endpoint** and the Line ribbon bar appears. **Note** that the **Tangent** function is activated.



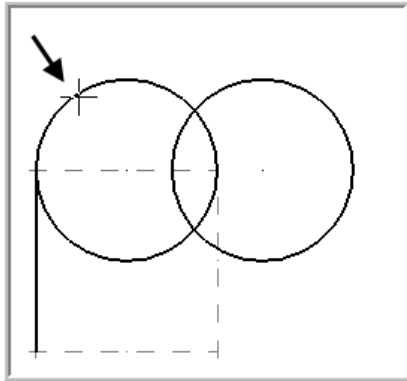
- To satisfy the prompt **Specify the first endpoint** move the cursor over to the **center of the grid** and as you get close to the **Origin (X0Y0)** a visual cue appears.  This is the cue that will allow you to snap to the origin, with this visual cue highlighted **pick the origin**.
- To satisfy the prompt **Specify the second endpoint** move the cursor over the area of the circle shown below. Ensure there is **no visual cue** being displayed and click on this point. As **Tangent** is activated on the line ribbon bar the line will snap to the closest tangency point on the circle as shown below right:



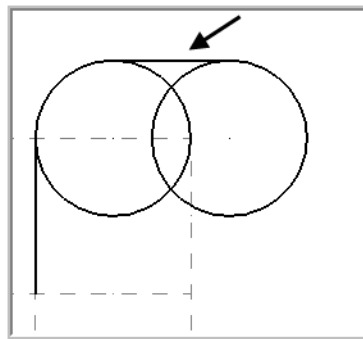
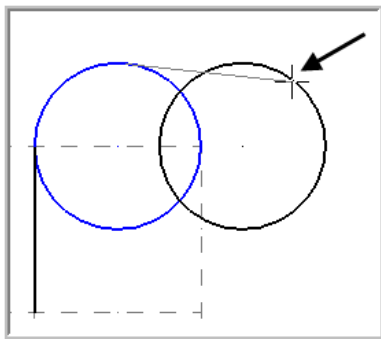
- On the ribbon bar click on **Apply**  to fix the entity.

➤ **Create Line #2**

22. To satisfy the prompt **Specify the first endpoint** move the cursor over the area of the circle shown below. Ensure there is **no visual cue** being displayed and click on this point. As **Tangent** is activated on the line ribbon bar the line will snap to the closest tangency point on the circle.



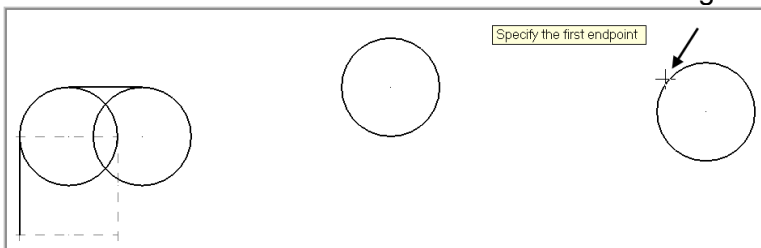
23. To satisfy the prompt **Specify the second endpoint** move the cursor over the area of the circle shown below. Ensure there is **no visual cue** being displayed and click on this point. As **Tangent** is activated on the line ribbon bar the line will snap to the closest tangency point on the circle as shown below right.



24. On the ribbon bar click on **Apply**  to fix the entity.

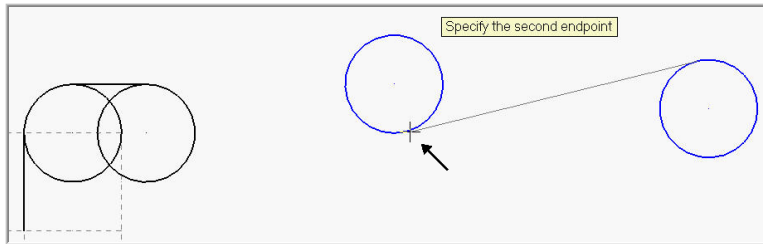
➤ **Create Line #3**


25. To satisfy the prompt **Specify the first endpoint** move the cursor over the area of the circle shown below. Ensure there is **no visual cue** being displayed and click on this point.



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26. To satisfy the prompt **Specify the second endpoint** move the cursor over the area of the circle shown below. Ensure there is **no visual cue** being displayed and click on this point. As **Tangent** is activated on the line ribbon bar the line will snap to the closest tangency point on the circle.



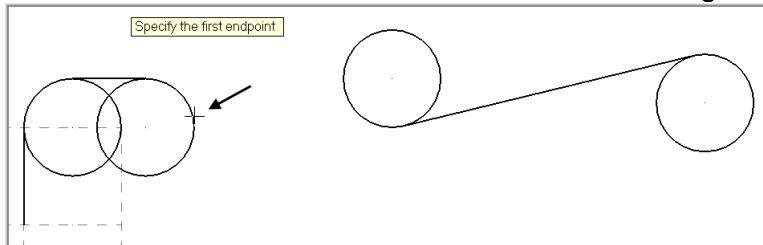
27. On the ribbon bar click on **Apply**  to fix the entity.

☞ Create Line #4

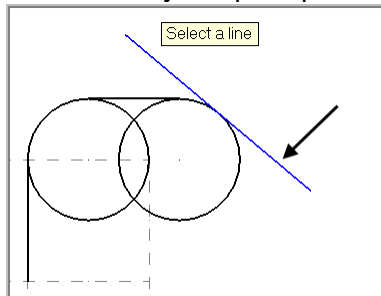
28. Click in the white space for **Length** and enter a value of **0.5** and then hit the tab key. In the white space for **Angle** and enter a value of **-40.0** and hit enter.




29. To satisfy the prompt **Specify the first endpoint** move the cursor over the area of the circle shown below. Ensure there is **no visual cue** being displayed and click on this point.



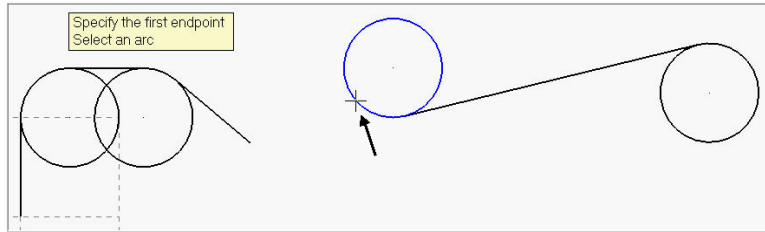
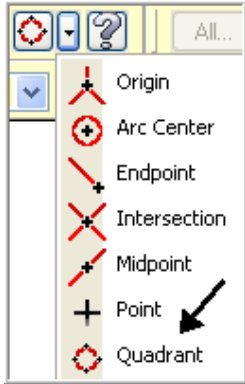
30. To satisfy the prompt **Select a line** pick the lower line as shown below:




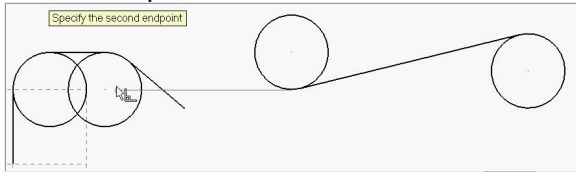
31. On the ribbon bar click on **Apply**  to fix the entity.

➤ **Create Line #5**

32. To satisfy the prompt **Specify the first endpoint** use the **AutoCursor ribbon bar Override drop down list**. Open the drop down and select **Quadrant**. Move the cursor over the area of the circle shown below right and click on the circle:



33. To satisfy the prompt **Specify the second endpoint** move the cursor over to the left of the circle shown below. Ensure the visual cue for **Perpendicular**  is displayed and click on this point.




34. On the ribbon bar click on **Apply**  to fix the entity.

➤ **Create Line #6**

35. Click on the **Multi-line** button to activate it.




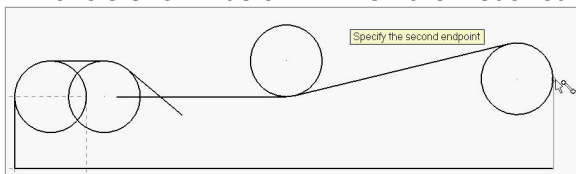
36. To satisfy the prompt **Specify the first endpoint** move the cursor over to the **center of the grid** a visual cue appears.  With this visual cue highlighted **pick the origin**.

37. Click in the white space for **Length** and enter a value of **3.75** and then hit the tab key. In the white space for **Angle** enter a value of **0** and hit enter.



➤ **Create Line #7**

38. To satisfy the prompt **Specify the second endpoint** move the cursor over to the right of the circle shown below. When the visual cue for **Endpoint**  is displayed click on this point.



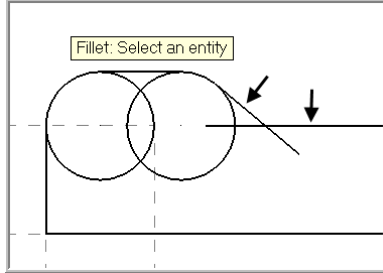
39. Click on the OK icon  to complete this feature.

➤ Create Circle #5

40. Select **Create>Fillet>Fillet Entities...**

41. On the Fillet ribbon bar enter **.25 for the radius**. Ensure the **Style** of radius is set to **Normal** and the trim button is depressed to turn the **trim on**.

42. When prompted to **Fillet: Select an entity**, select the two lines shown below:



43. Click on the OK icon  to complete this feature.

TASK 3:

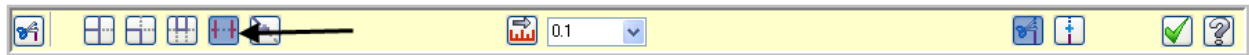
TRIM GEOMETRY


➤ In this task you will trim the geometry using **Divide**. There are many different ways to accomplish this trimming operation, this is just one method. If you make a mistake using **Divide** use the **Undo** button to start over.

➤ Trim the circles

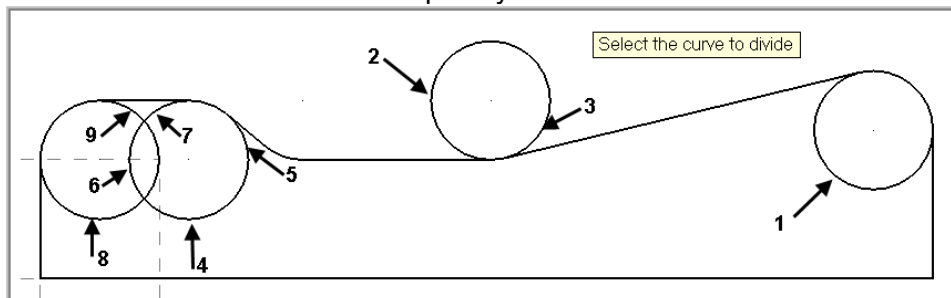
1. Select **Edit>Trim/Break>Trim/Break/Extend**

2. The Trim / Extend / Break ribbon bar appears and you are prompted to **Select the entity to trim/extend**.



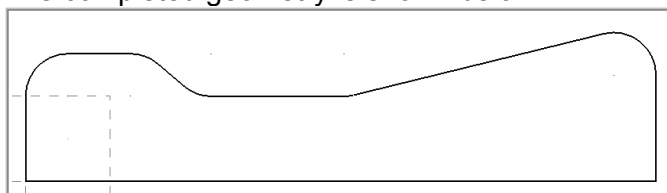
3. Click on the **Divide**  icon to activate it as shown above. Ensure the icon is pressed down to signal that it is activated.

4. The prompt changes to **Select the curve to divide**. Move the cursor over the various circles and select in order and position as shown below. The arc is trimmed back to the two closest intersections as shown below. **Note:** On some of the circles you will need to select them more than once to completely trim them.



5. Click on the OK icon  to complete this feature.

The completed geometry is shown below:



TASK 4: CREATE THE REVOLVED SURFACE

➤ In this task you will create a revolved surface using the geometry you have just created and revolve the geometry 180 degrees about the X axis.

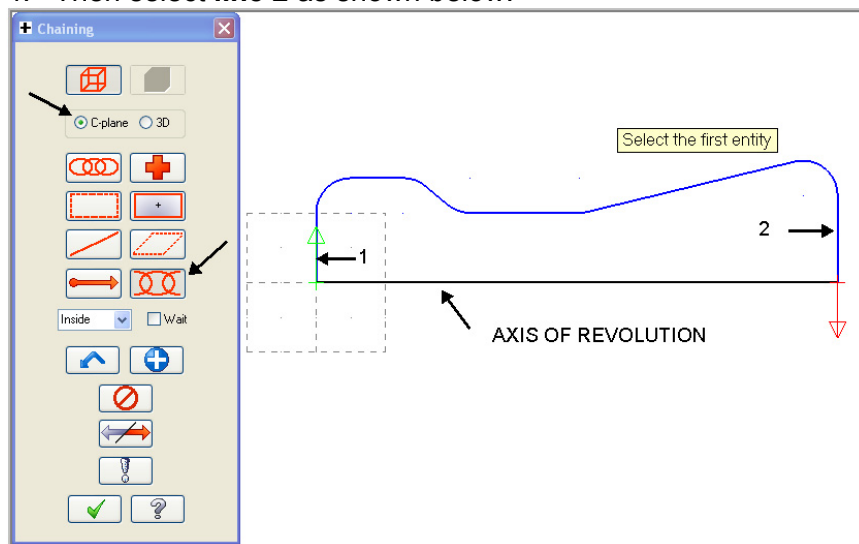
Revolved surfaces are circular in one direction. You will be prompted to chain an entity that the revolved surface will use as a profile. You may choose multiple entities to create many revolved surfaces at a time.


You are then prompted to choose a line to use as the axis of rotation and the revolved surface is created.

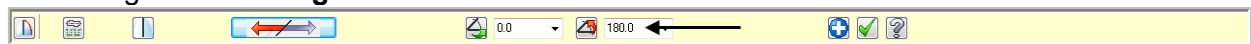
If you have chosen multiple entities, a surface for each entity will be created, each having a different profile and position and all using the same axis of rotation. Click Apply or Enter when done.



➤ Create Revolved Surface

1. Select from the pull down menu: **Create>Surface>Revolved...**
2. On the graphics screen you are prompted: **Select profile curve(s) 1.** In the **Chaining** dialog window select **Partial Chain** as shown below:
3. Select **line 1** and ensure the arrow is pointing upwards. If not click on the reverse icon.
4. Then select **line 2** as shown below:



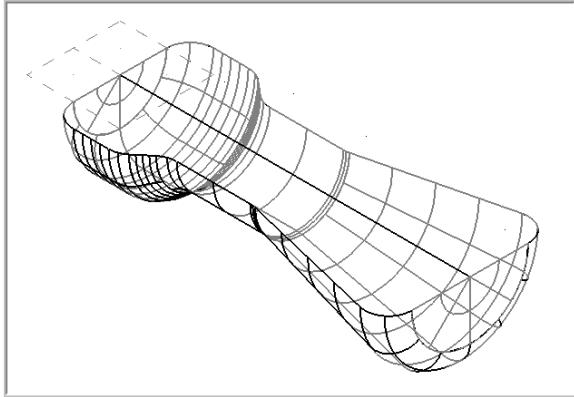
5. Click on the OK icon  in the Chaining dialog window.
6. Change the **End angle** to **180** as shown below and hit enter:



7. Change the graphics view to **Isometric** .
8. The prompt now changes to **Select axis of rotation**, select the line shown in the diagram above in step 4.
9. Select the **Fit to screen** icon .

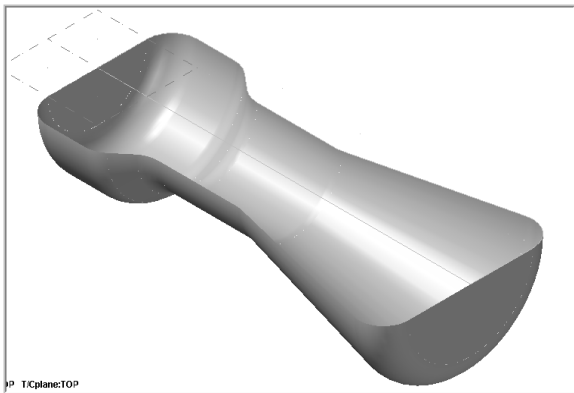
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10. The arrow should be pointing **downwards** and the newly created surface should look like the diagram below: If the arrow is not pointing downwards or the surface does not look like the image below, select the **Reverse** icon on the Revolved surface ribbon bar.




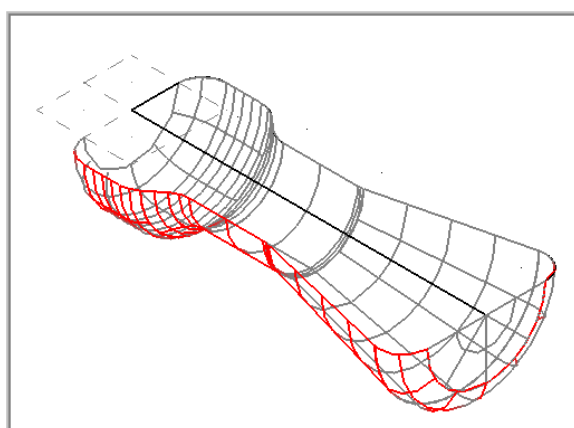
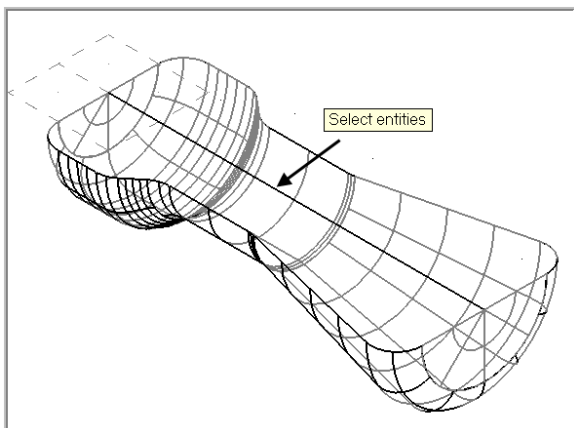
11. Click on the OK icon  to complete this feature.

12. Select the **Shaded icon**  to display the part in shaded mode.



13. Select the **Wireframe icon**  to return to wireframe display.

14. **Delete the axis of revolution** as this will not be required anymore. Select the **Delete entities icon**  and when prompted to **Select entities** pick the line shown below and then hit enter.



TASK 5: CREATE BOUNDARY CURVES

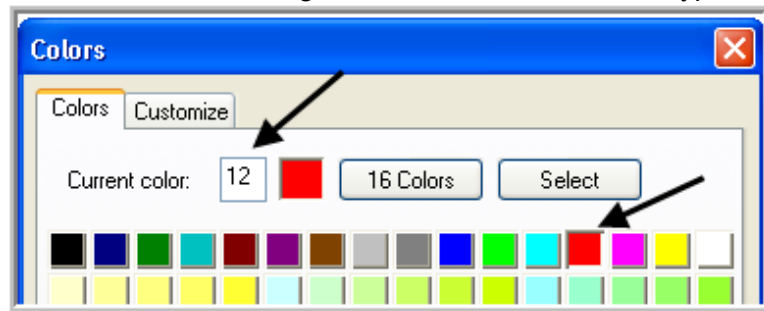
☞ When you machine the Revolved surface you will be prompted to chain an entity that the revolved surface will use as a profile, this task will create that profile.

☞ **Change the current color to enable better visibility of the entities**

1. Select **System color** from the Status bar at the bottom of the screen.



2. In the **Colors** dialog box select the **red** color or type in **12**.



3. Click on the OK icon  to complete this feature.

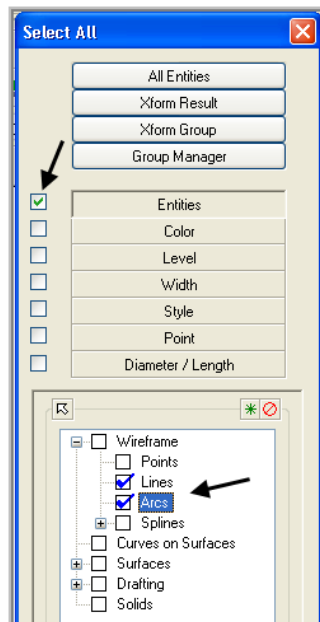
☞ **Mirror the initial contour geometry**

4. Select **Xform>Mirror...**



5. You are first prompted to **Mirror: select entities to mirror**. First select the **All** button on the **General Selection** ribbon bar as shown below:

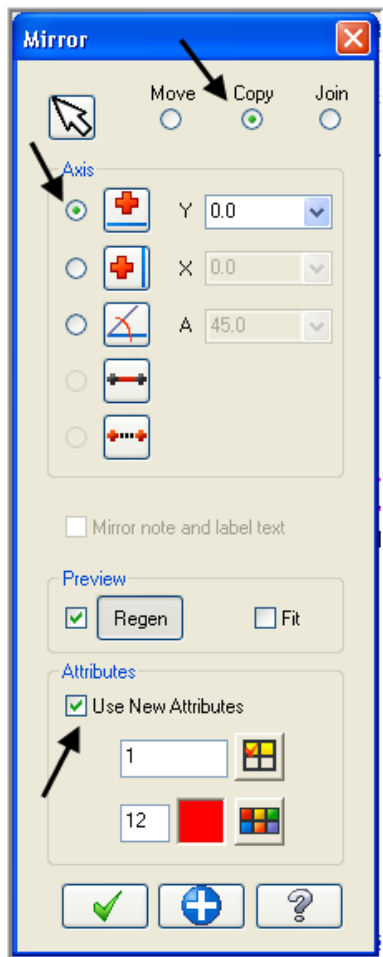



6. The **Select All** dialog box appears on the left of the screen. Check mark the **Entities** box and then check mark **Lines** hold the **Ctrl** key down and then select **Arcs**.




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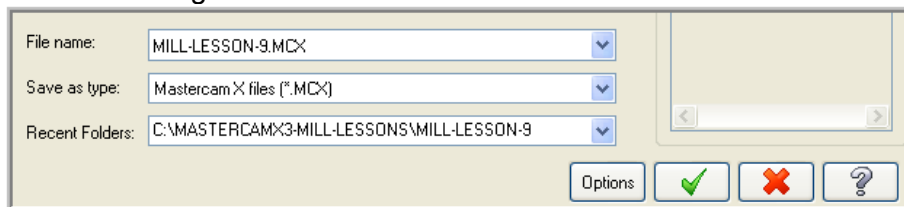
- Click on the OK icon  to complete this feature.
- To move onto the next step you now need to pick the **End Selection** icon .
- After selecting End Selection the **Mirror window** appears. Set the following values as shown below:



- Click on the OK icon  to complete this feature.
- Click on the **Clear Colors** at the top right hand corner of the screen.


TASK 6: SAVE THE DRAWING

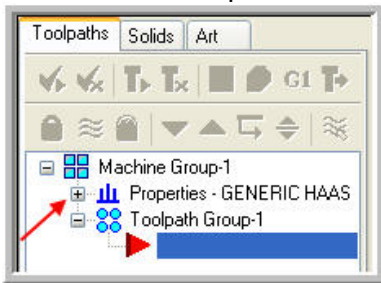
- Select **File**.
- Select **Save as**.
- In the File name box, type **Mill-Lesson-9**.
- Save to an appropriate location.
- Select the green check mark button  to save the file and complete this function.



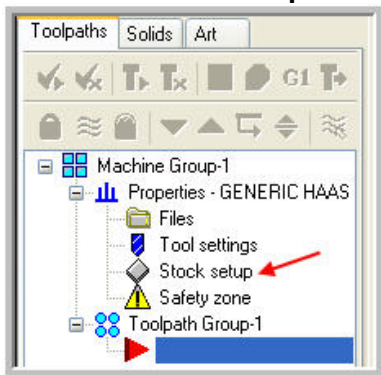
Toolpath Creation

TASK 7: DEFINE THE ROUGH STOCK USING STOCK SETUP

1. **Fit to screen** .
2. Select the **plus** in front of **Properties** to expand the Toolpaths Group Properties. **Alt-O** will **Show/hide** Operations Manager pane.

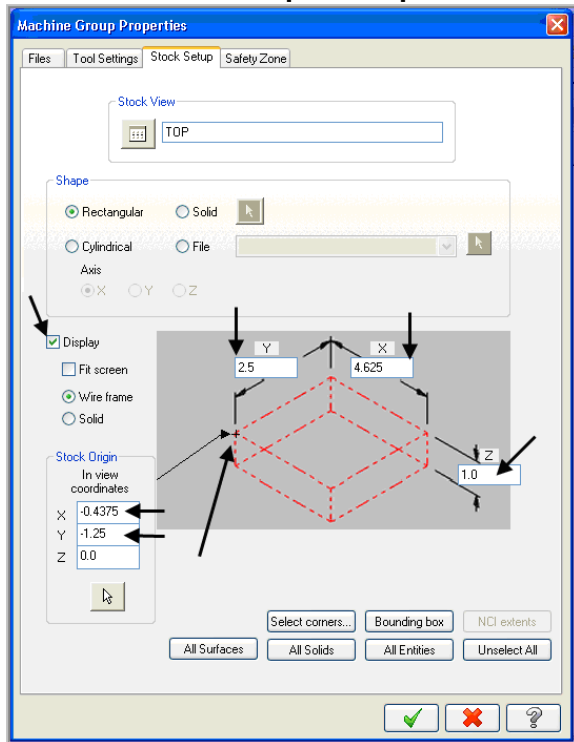


3. Select **Stock setup** in the toolpath manager window.

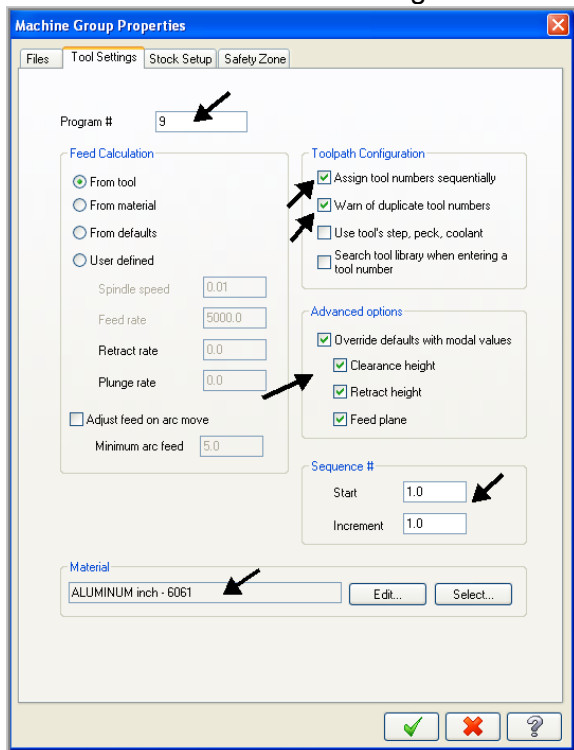



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4. Change the parameters to match the **Stock Setup** screenshot below:
➔ **Z zero is at the top of the part.**



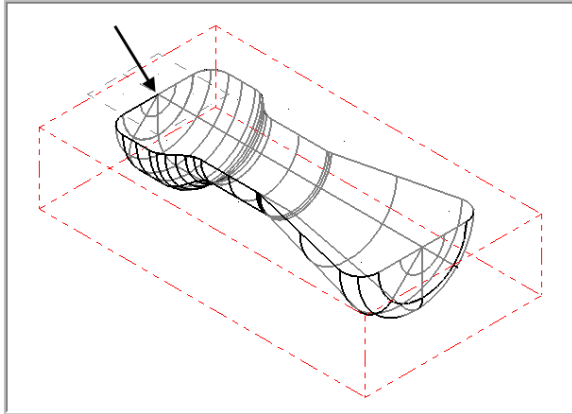
5. Select the **Tool Settings** tab and change the parameters to match the Tool Settings screenshot below. To change the Material type follow the instructions below:



6. To change the Material type to Aluminium 6061 pick the Select button at the bottom of the Tool Settings page.
7. At the **Material List** dialog box open the **Source** drop down list and select **Mill – library**.
8. From the Default Materials list select **ALUMINIUM inch -6061** and then select .

9. Select the OK button  again to complete this Stock Setup function.


Your part should look similar to the screen shot below. With **X0 Y0** at the middle left side and **Z zero** at the **top of the part**.





Surface roughing toolpaths typically use larger tools, multiple stepovers, and multiple step downs to quickly remove larger volumes of stock and leave an even amount of stock for finishing.

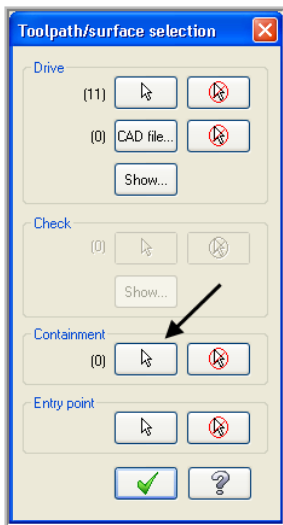
The roughing toolpaths you choose for your part depend on the shape of the part, shape of the stock, and machining situation. Mastercam provides several roughing strategies.

TASK 8: ROUGH THE POCKET USING SURFACE POCKET

- ☞ In this task you will use a 0.5 diameter end mill with a 0.125 corner radius to rough out the pocket.
1. From the menu bar select **Toolpaths>Surface Rough>Pocket...**
 2. When prompted to **Enter new NC name** ensure **Mill-LESSON-9** is entered and then select the OK button .
 3. You are first prompted to **Select Drive surfaces**, select the **All** button on the **General Selection** ribbon bar as shown below:



4. The **Select All** dialog box appears on the screen.
5. Click on the OK icon  to complete and exit this feature.
6. To move onto the next step you now need to pick the **End Selection** icon .
7. Select the **Containment** button from the **Toolpath/surface selection** dialog box.



Use this dialog box to select all the geometry needed for a surface toolpath.

Each surface toolpath requires drive geometry selected from the graphics window or from a CAD file.