Mastercam X9

TRAINING GUIDE

FOUR-AXIS-LESSON-1

SETTING UP FOR FOUR AXIS

camInstructor

Objectives

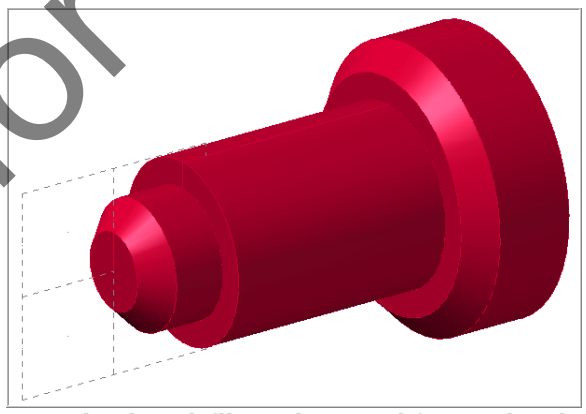
In **Four-Axis-Lesson-1** you will setup the part prior to completing the machining operations in **Four-Axis-Lesson-2.**

This lesson will involve the re-orientation of geometry from an existing file and assigning new Levels. You will also create new wireframe and solid geometry that will be used as an STL file to verify the completed machining operations in Four-Axis-Lesson-2.

The part will be held in a rotary indexer as shown below. These types of indexes can utilize collets or a three-jaw chuck. This Lesson covers the following topics:

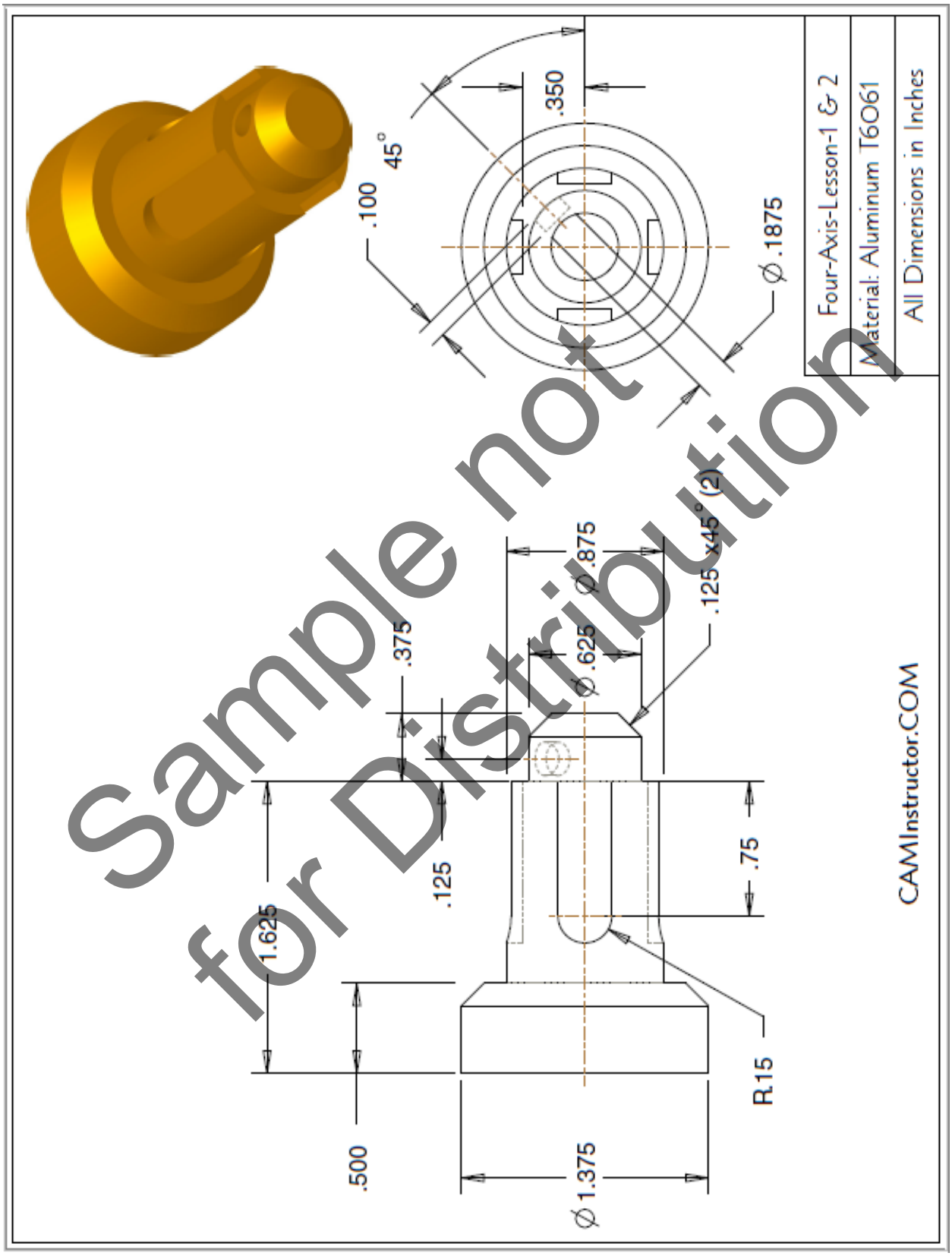
➲ **Open an existing file containing:**
The solid geometry for the part

➲ **Establish Stock Setup settings:**
Create a Stereo Lithography (STL) file to be used for toolpath verification
Material for the part
Feed calculation



Stereo Lithography (STL) file to be used for toolpath verification

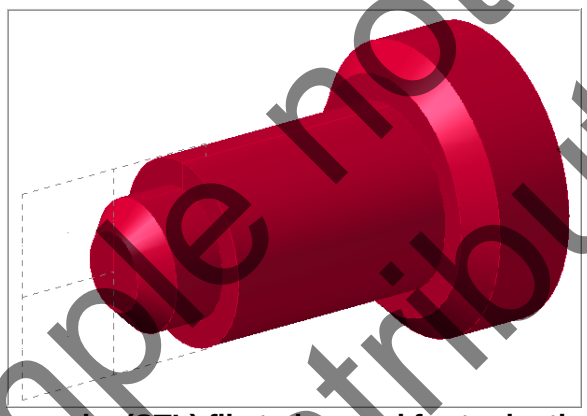
FOUR-AXIS-LESSON-1 DRAWING



FOUR-AXIS-LESSON-1 - THE PROCESS

Toolpath Setup

TASK 1: Setting the environment
TASK 2: Introduction - Watch the video
TASK 3: Open an Existing file from the Multimedia DVD
TASK 4: Identify the entities on each level
TASK 5: Re-orient the geometry
TASK 6: Create new wireframe geometry for the Solid Revolve
TASK 7: Create the Solid Revolve
TASK 8: Use the Solid Revolve to create the STL file that will be used to verify the toolpaths



Stereo Lithography (STL) file to be used for toolpath verification

➲ **Please Note:**
Before working through these lessons you may find it useful to review the material in the **Work Coordinate Systems (WCS)** section of the multimedia DVD that came with this text.

If you are using the Online Course the Work Coordinate System (WCS) material is located in "My Courses" as a separate course.

TOOLPATH SETUP

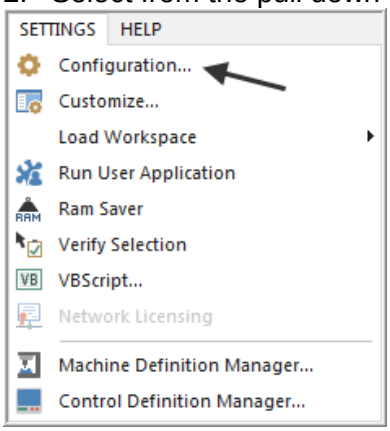
TASK 1:
SETTING THE ENVIRONMENT

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:

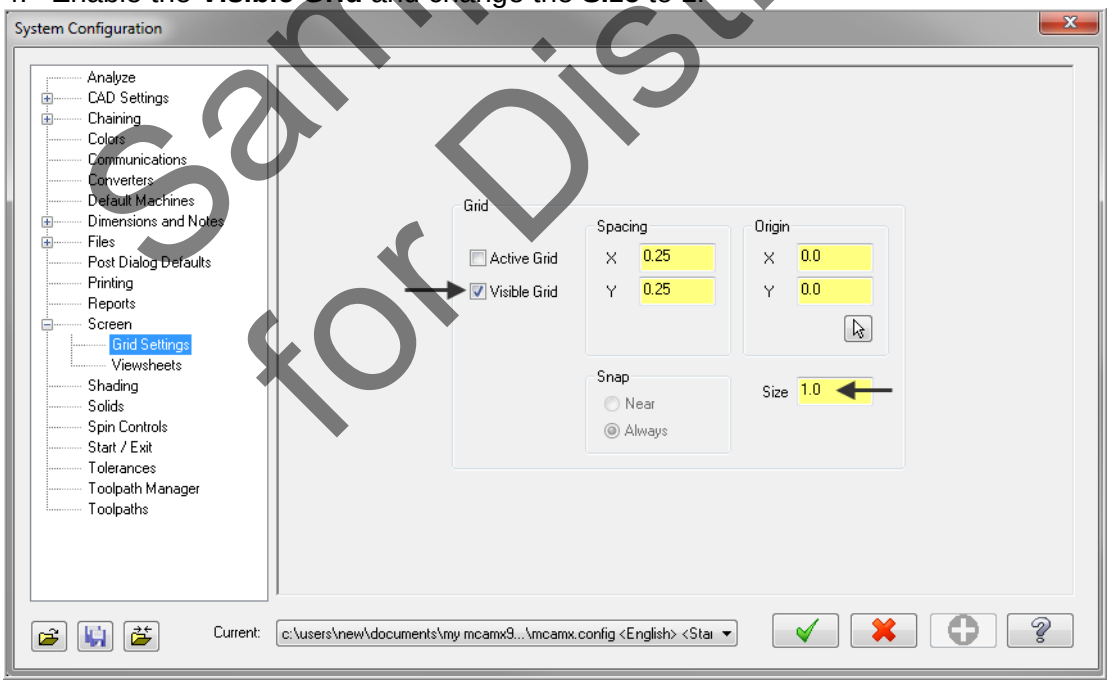
1. Set up the Grid. This will help identify the location of the origin.
2. Load the Workspace – **SETTINGS>Load Workspace>4-5 Axis Toolpaths** to machine a 4-5 axis part.

SET THE DISPLAY OF THE GRID:

1. Launch Mastercam.
2. Select from the pull down menu **SETTINGS>Configuration.**



3. From the window on the left side of this window expand the Screen topic by selecting the + sign and then select **Grid Settings.**
4. Enable the **Visible Grid** and change the **Size** to 1.

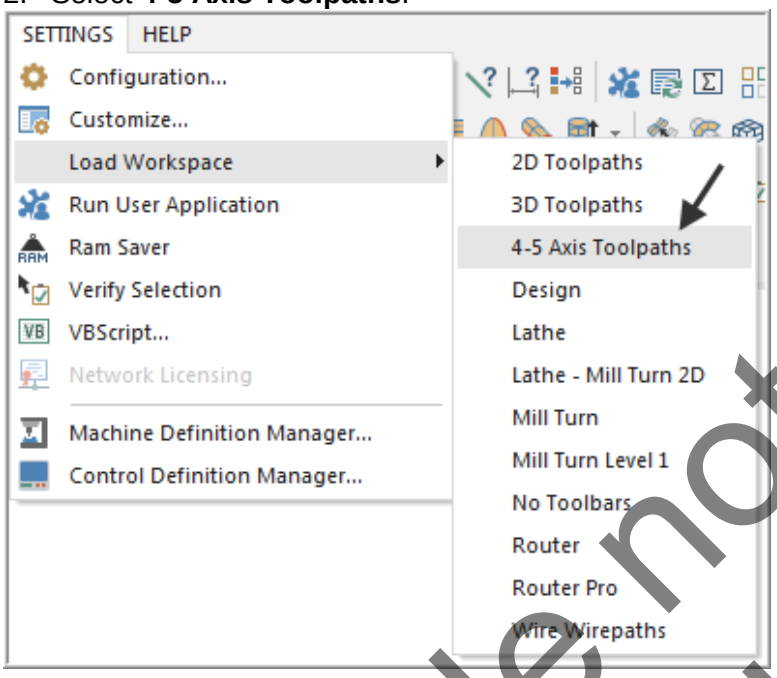


5. Select the OK button  to complete this function.

6. When prompted to "**Save settings to configuration file"** select **Yes**.

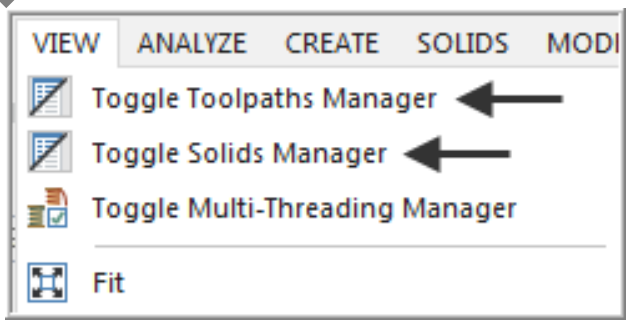
SET THE TOOLBARS REQUIRED FOR A 4-5 AXIS PART:

1. Select from the pull down menu **SETTINGS>Load Workspace.**
2. Select **4-5 Axis Toolpaths**.



3. **Close** the **Toolpaths/Solids** Manager by clicking the **Close** button in the upper right corner. To open the Managers again, choose **View**, **Toggle Toolpaths Manager** or **View**, **Toggle Solids Manager**.

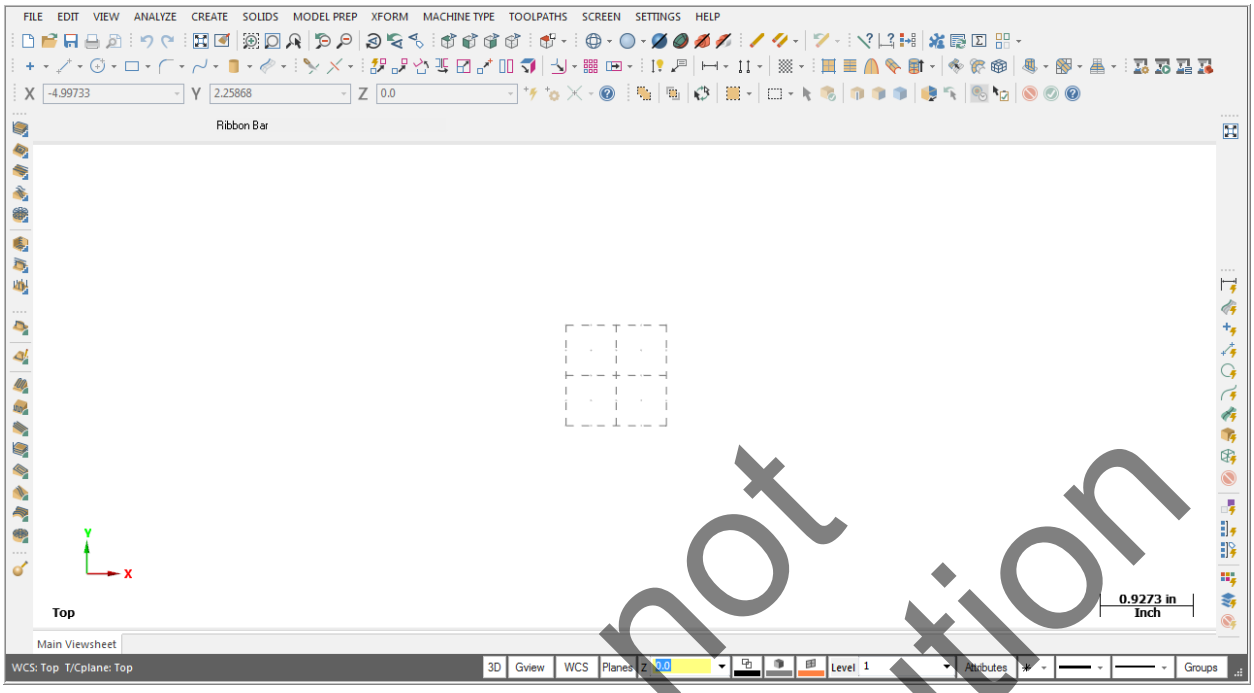
➲ You can also Show or Hide the Toolpaths Manager pane on the left of the screen by pressing **Alt + O** on your keyboard. Pressing **Alt + O** acts like a toggle switch between Show and Hide



Note: Your settings for the Managers are modal between Mastercam sessions. This means that Mastercam "remembers" and maintains the position and size of the Managers, even if you close and re-open Mastercam.

By default, the Toolpaths and Solids Manger are docked to the left side of the graphics window. You can undock the Managers and dock them where you like. To do so, drag the Manager pane to a screen position or to one of the docking icons that appear as you drag.

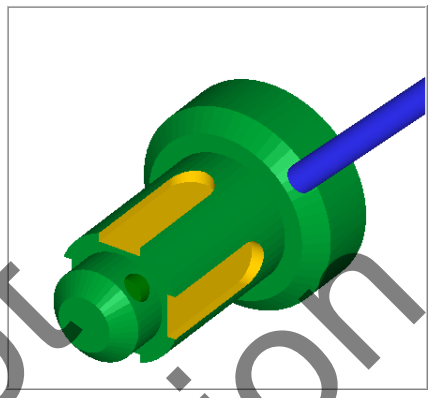
4. The Mastercam interface will be displayed as shown below when the operations Manager is hidden.



TASK 2: INTRODUCTION – WATCH THE VIDEO

1. Before you start to work on this Lesson review the Introduction video on the multimedia DVD that came with this text. You will find the video in the **"Four-Axis-Lesson-1**" section, it is entitled **Introduction - 2 Minutes**. If you are using the Online Course content the video is available in this Lesson on the online content screen.

➲ The video will review the techniques that will be used to setup this part prior to machining the two toolpaths utilizing the indexing table.

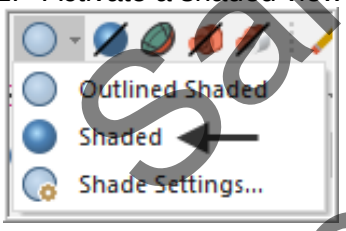


TASK 3:
OPEN AN EXISTING FILE FROM THE MULTIMEDIA DVD

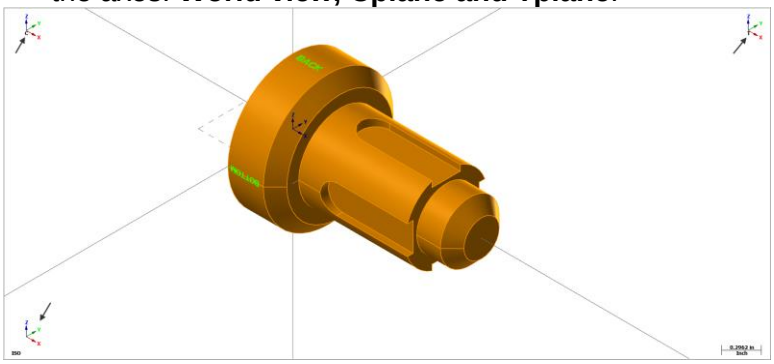
➲ If you are using a Training Guide to go through this Lesson the required file is on the multimedia DVD that came with this text in a folder called Mastercam Files. If you are using the Online Course content the file is available in this Lesson on the online content screen.

➲ The file will contain the solid geometry of the part. The part is already setup for a: **GENERIC HAAS 4 AXIS MILL.**

1. Select **FILE>Open… Four-Axis-Lesson-1**
2. Activate a shaded view by selecting the icon at the top of the screen.



3. If required, select an Isometric view  and then Screen Fit  .
4. Hit **F9** on your keyboard to display the coordinate axes. Now select **Alt-F9** to display all of the axes: **World view, Cplane and Tplane**.



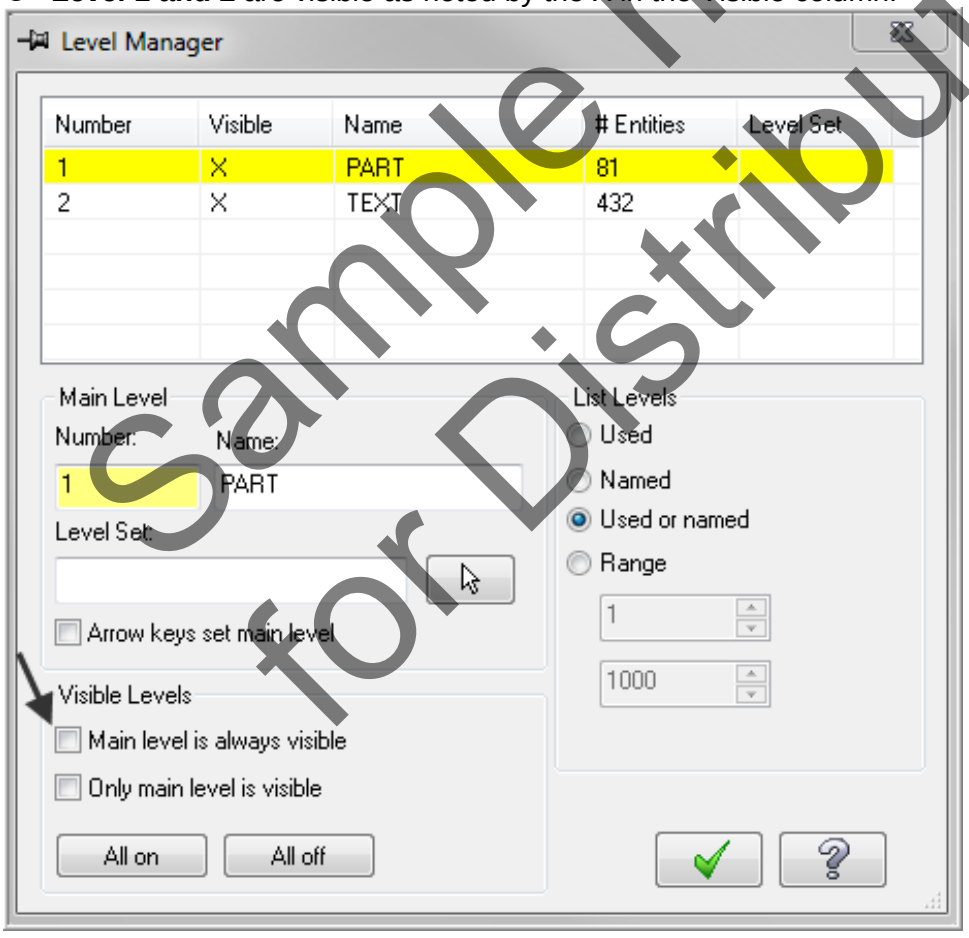
TASK 4:
IDENTIFY THE ENTITIES ON EACH LEVEL

- Before you start to work on the toolpaths lets first identify the entities on each Level.

- Levels are a primary organizational tool in Mastercam. A Mastercam file can contain separate levels for wireframe, surfaces, drafting entities, and toolpaths.
- By organizing your files into levels, you can more easily control which areas of the drawing are visible at any time and which parts are selectable so that you do not inadvertently make changes to areas of the drawing you do not want to change.

1. From the **Status** bar at the bottom of the screen select **Level**.

- The Level Manager dialog window will now appear.
- As you can see in the picture below there are two Levels in this part.
- **Level 1** contains the Part geometry
- **Level 2** contains the Text, **TOP, BOTTOM, BACK and FRONT**. This is on the part to help you with the orientation of the part as you work through creating the toolpaths
- **Level 1 and 2** are visible as noted by the X in the Visible column.

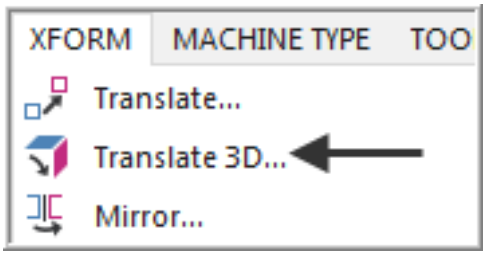


2. Turn off **Make main level always visible** as shown above.
3. Select the OK button to exit the **Level Manager** dialog box.

TASK 5:
RE-ORIENT THE GEOMETRY

➲ In this task you will re-orient the geometry. This task will re-position the geometry in the appropriate place to be machined in the four axis indexer.

1. Select **XFORM>Translate 3D…**

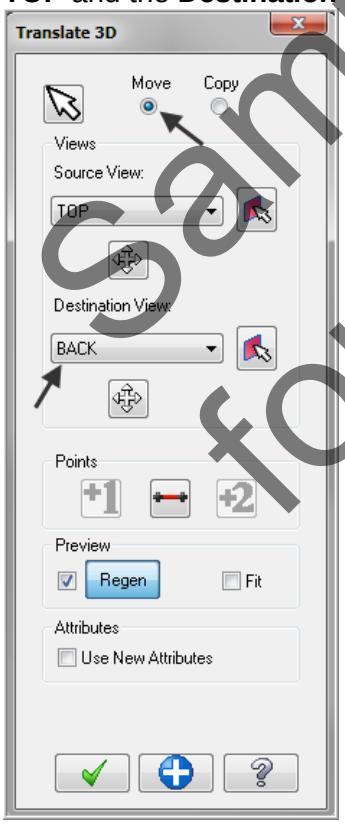


➲ **XFORM>Translate 3D**
Allows you to move or create copies of selected entities between views (from one plane to another).

This translation does not alter the entities' orientation, size, or shape.

2. You are first prompted to **Translate: select entities to translate**. On the **General Selection** toolbar ensure the **Entity selection** is set to **In** and the **Selection methods** is set to **Window**. Now draw a window around all the geometry to capture all the geometry.

3. Now click on the green **End Selection** icon  to move onto the next step.
4. The **Translate 3D** dialog box appears. Activate **Move**. The **Source View** should be set to **TOP** and the **Destination View** should be set to **BACK** as shown below



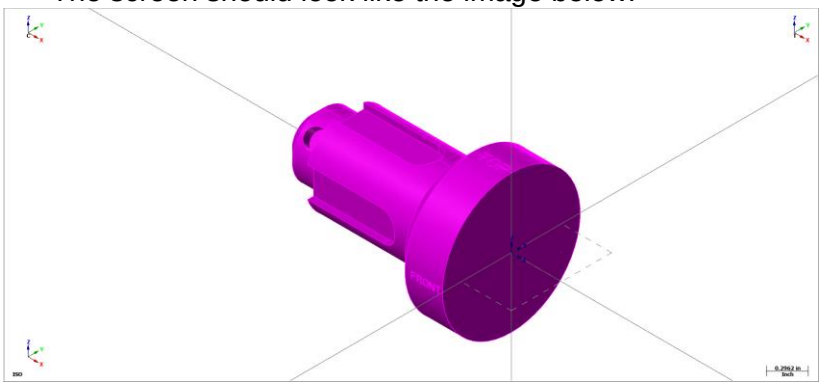
➲ **Source View**
Defines the source plane for the selected geometry. Use the drop-down menu to select an existing named plane or the Plane Selection icon  to bring you to the Plane Selection dialog box. The source plane will default to the plane of the selected geometry.

➲ **Destination View**
Defines the destination plane for the selected geometry. Use the drop-down menu to select an existing named plane or the Plane Selection icon  to bring you to the Plane Selection dialog box. The destination plane will default to the selected source plane.

Tip:
In this example we are **not** going to activate **Use New Attributes.**
But for future use it can be activated and used to create geometry in a unique color and on a specified level.

5. Click on the **OK** button  .

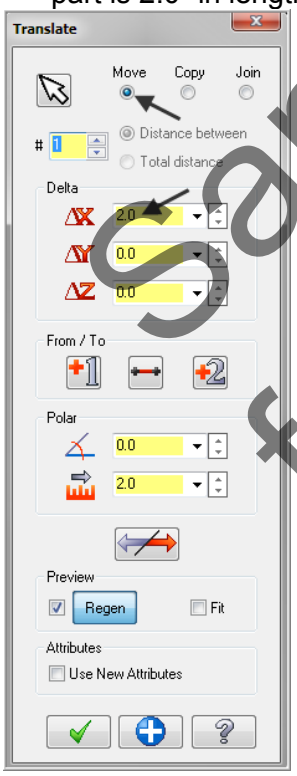
6. Select the Screen Fit icon found at the top of the screen to fit the part to the screen  . The screen should look like the image below:



➲ Next you will use **XFORM>Translate** to position origin at the center of the left face

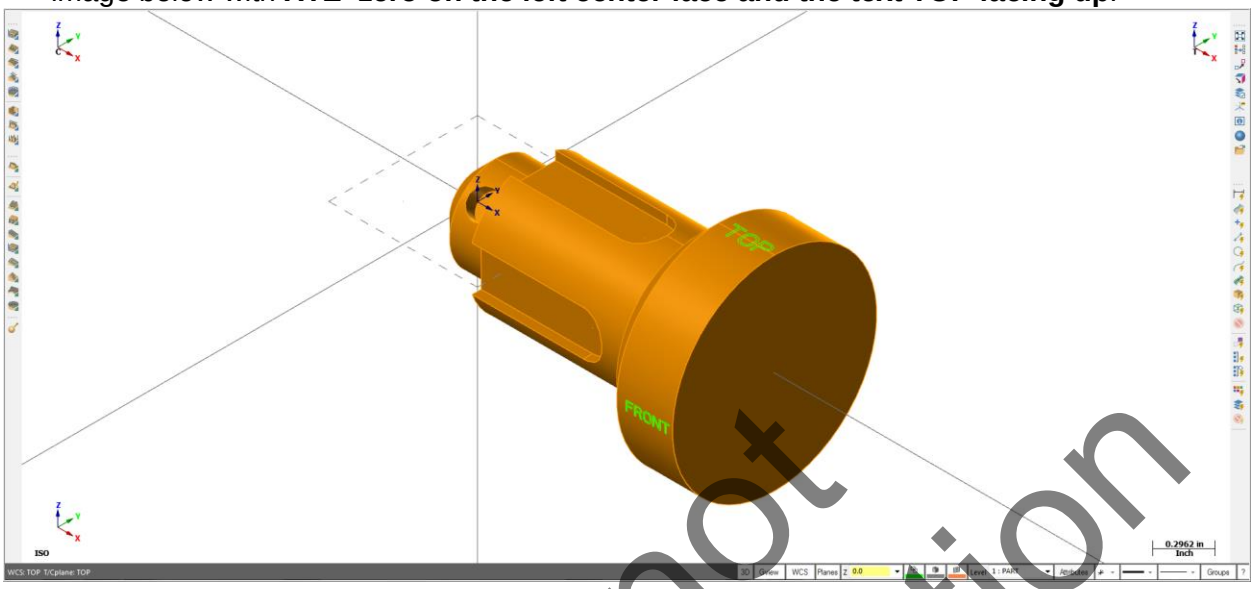
7. Select **XFORM>Translate**
8. You are first prompted to **Translate: select entities to translate**. On the **General Selection** toolbar ensure the **Entity selection** is set to **In** and the **Selection methods** is set to **Window**. Now draw a window around all the geometry to capture all the geometry.

9. Now click on the green **End Selection** icon  to move onto the next step.
10. The **Translate** dialog box appears. Activate **Move** and input **2.0 for the Delta X** value. The part is 2.0" in length so this translation will position Z zero on the left face.

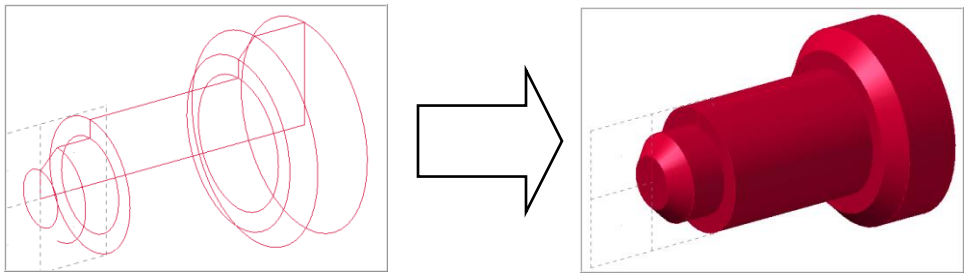


11. Click on the **OK** button  .
12. Click on the **Clear Colors** icon  .

13. Select the Screen Fit icon to fit the part to the screen  . The screen should look like the image below with **XYZ zero on the left center face and the text TOP facing up**.



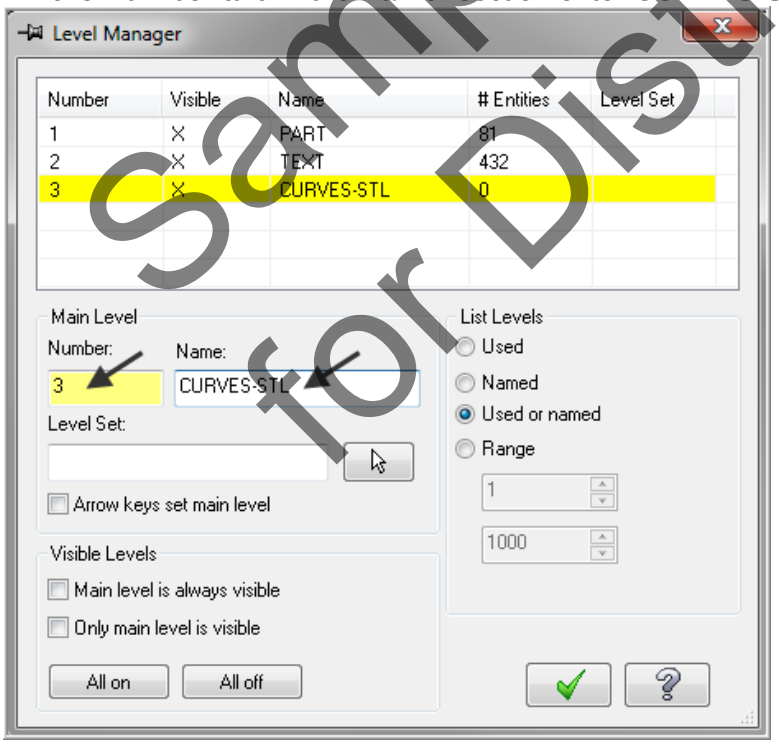
TASK 6:
CREATE NEW WIREFRAME GEOMETRY FOR THE SOLID REVOLVE



- In this task you will create a new level and wireframe geometry that will be used later to develop a Solid Revolve. This Solid Revolve will then be used to create an STL file that will be used to verify the toolpaths.
- Using Create curve on edge you will use the existing geometry to develop a Solid Revolve that **represents the finished part minus the slots and hole**.
- STL is an acronym for Stereo Lithography, a 3D model file type developed by 3D Systems, Inc. An STL file is composed of triangular facets of data that represent surface and solid models.

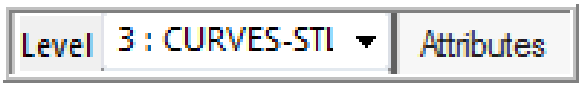
1. Hit **F9** on your keyboard to **remove the display** of the coordinate axes. Now select **Alt-F9** to **remove the display** of all of the axes: **World view, Cplane and Tplane**.
2. From the **Status** bar at the bottom of the screen select **Level**.

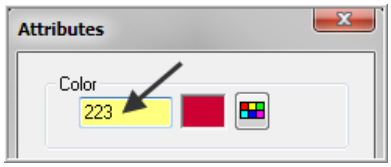
3. The **Level Manager** dialog window will now appear. In the **Main Level** section enter **3 for the Number** and in the **Name:** section enter **CURVES-STL**.



4. Click on the OK button when done  .

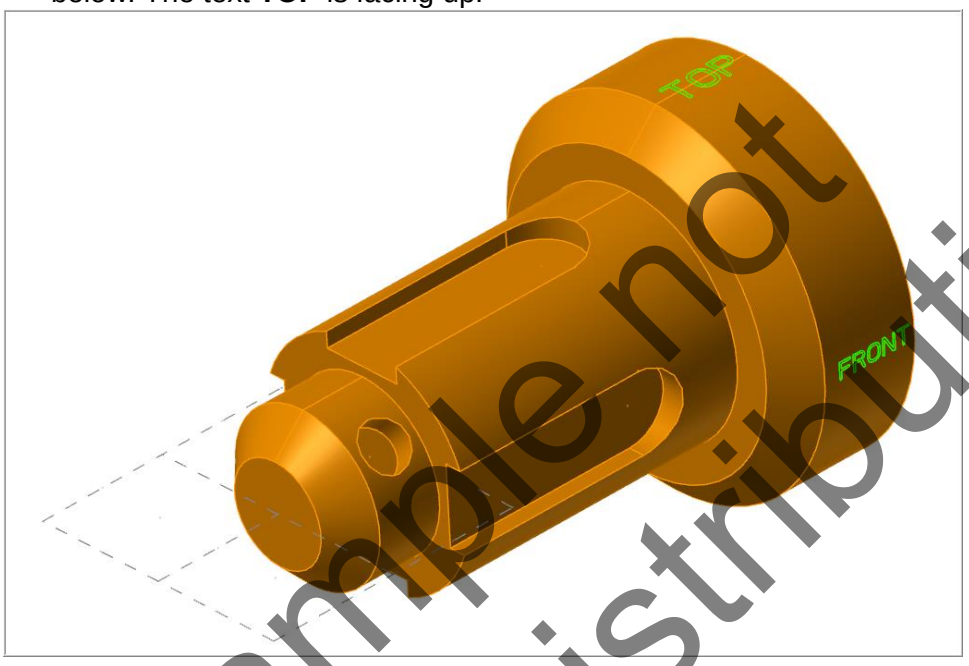
5. On the **Status** bar click on **Attributes** and change the color to **223**.





6. Click on the OK button when done  .

7. Dynamically rotate the display  similar to the display shown below. The text **TOP** is facing up.



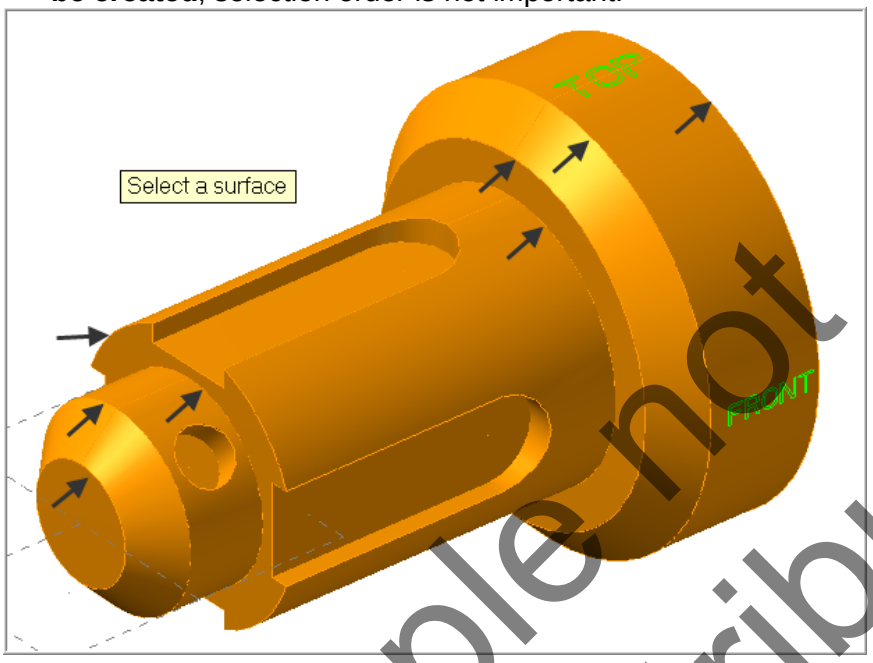
➲ **Dynamic rotation**  or **View**>**Orient** menu and select **Dynamic Rotation**

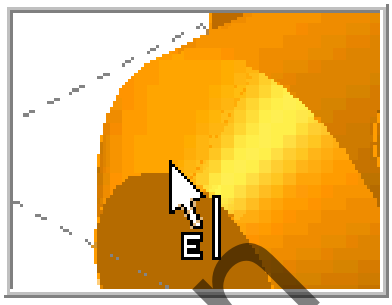
Use this function to dynamically rotate entities in the graphics window around a selected a point or position. Although the geometry appears to move, it remains in the original orientation relative to the system and work coordinate system axes.

When you choose this function from the view menu or toolbar, you first select an endpoint, point, or a position in space, then move the mouse to rotate entities around the selected point. If you access this function by pressing the Alt key and the mouse wheel at the same time, the cursor position in the graphics window defines the rotation point.

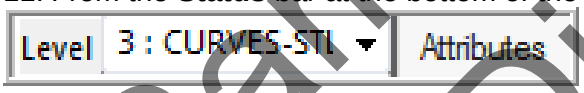
➲ **Create the curves that will be used later to create a Solid Revolve**

8. Select **CREATE>Curve> Curve on one edge**.
9. You will now be prompted to **Select a surface.** Click on each **surface edge** as shown below. **Note** that the visual cue for edge  will appear as you get close to the surface edge, ensure this visual cue appears before selecting the edge. There are **8 edge curves to be created**, selection order is not important.

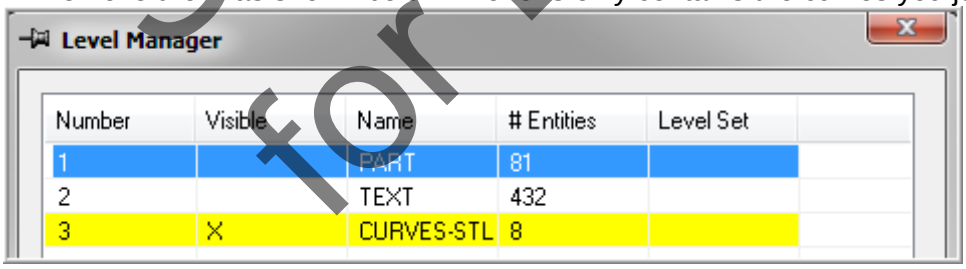




10. Click on the OK button when done  .
11. From the **Status** bar at the bottom of the screen select **Level**.

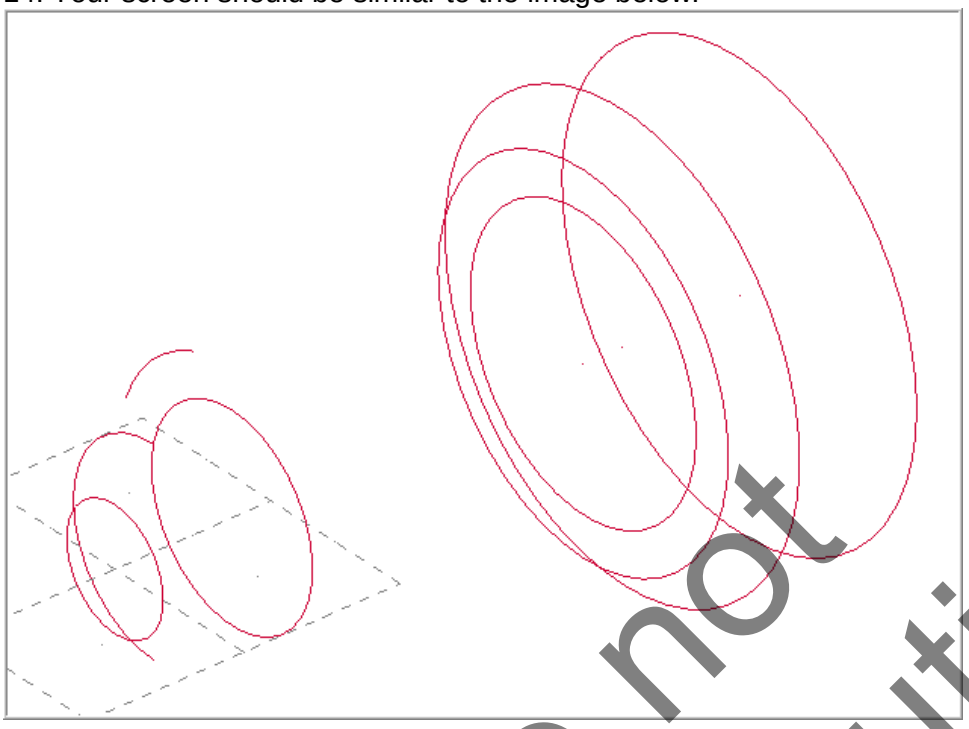


12. Make only **Level 3 visible** as shown below. Click in the **Visible** column for Level 1 and 2 to remove the X as shown below. **Level 3** only contains the curves you just created.



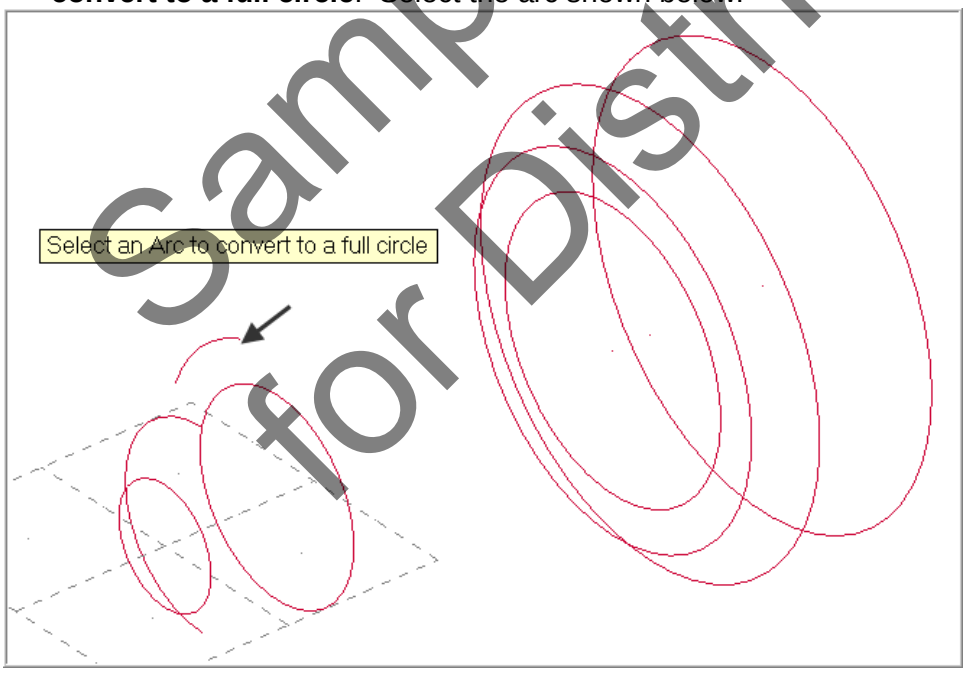
13. Click on the OK button when done  .

14. Your screen should be similar to the image below.



➲ **Use Close Arc to turn the partial arc into a complete circle**

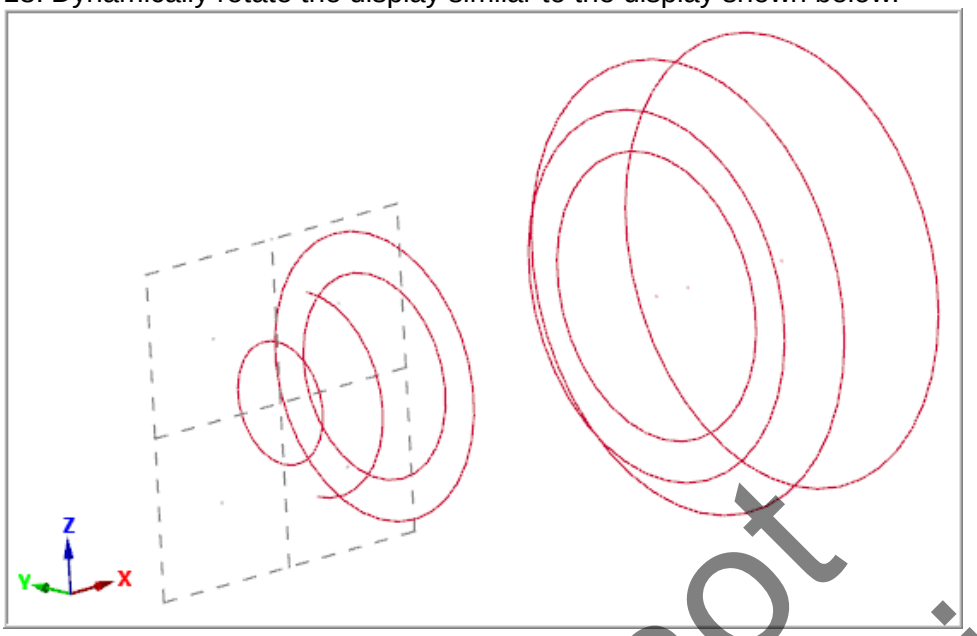
15. Select **EDIT>Trim / Break> Close Arc**. You will now be prompted to **Select an Arc to convert to a full circle**. Select the arc shown below.



16. Now click on the green **End Selection** icon  to convert the arc to a full circle.

17. From the toolbar at the top of the screen select **Front (WCS).**  **Note**: at the bottom of the screen the Tool/Construction plane - **T/Cplane** is now set to **FRONT**.

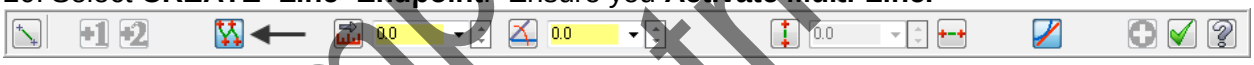
18. Dynamically rotate the display similar to the display shown below.



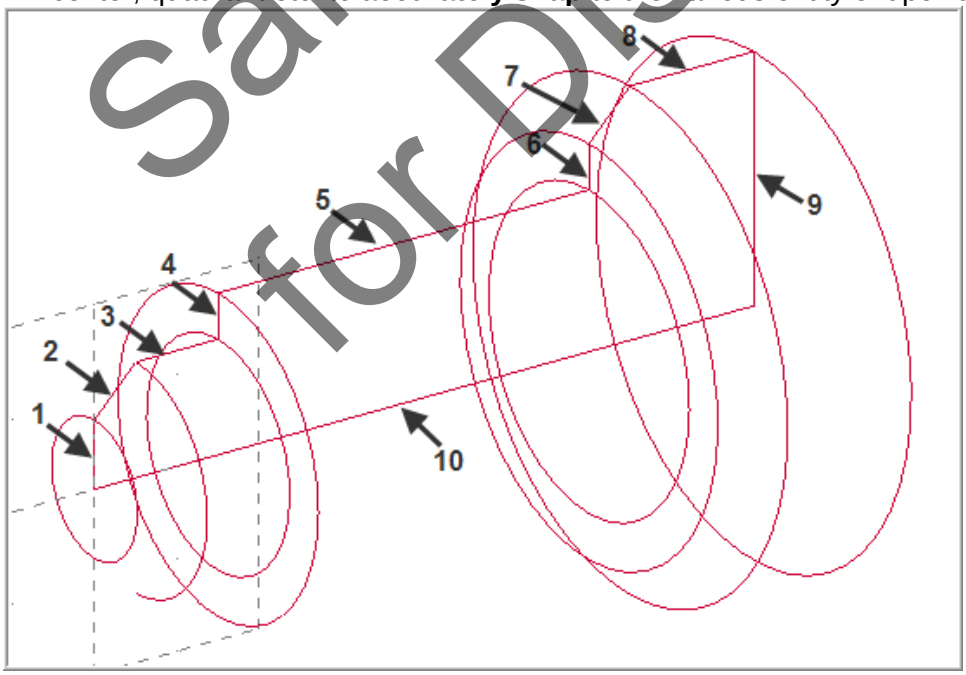
19. On the Status bar ensure to toggle the construction to **2D**.

➲ **Now you will create a series of lines running though the center of the part. These lines will be used in the next Task to create the Solid Revolve.**

20. Select **CREATE>Line>Endpoint**. Ensure you **Activate Multi-Line.**



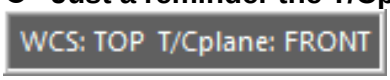
21. Starting at the **Origin** create the ten lines, using the visual cues for endpoint, midpoint, center, quadrant etc. to **accurately snap** to the various entity endpoints.



22. Click on the OK button when done  .

TASK 7:
CREATE THE SOLID REVOLVE

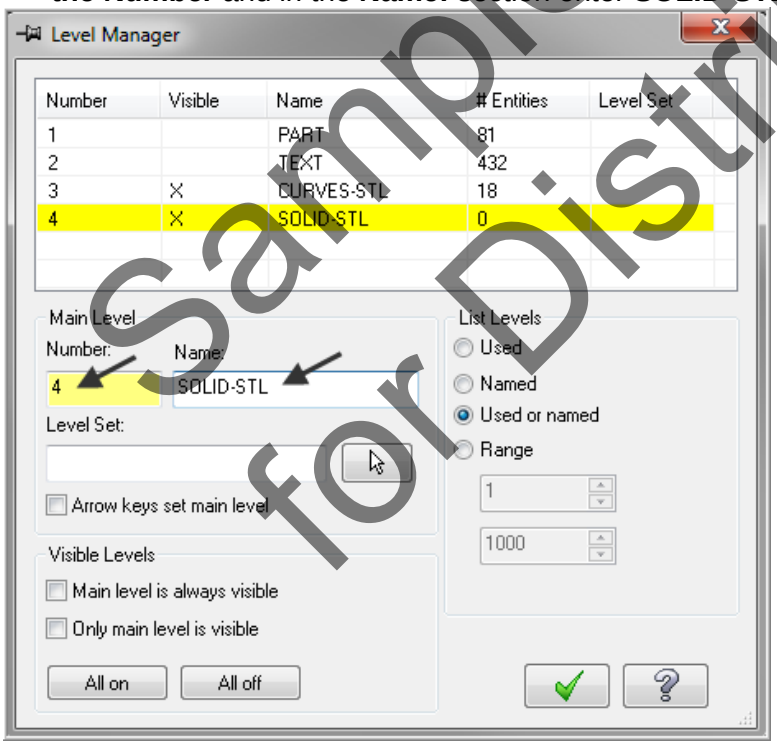
- In this task you will create a Solid Revolve on a new Level. The Solid Revolve will be used later as an STL file for verifying the toolpaths
- STL is an acronym for Stereo Lithography, a 3D model file type developed by 3D Systems, Inc. An STL file is composed of triangular facets of data that represent surface and solid models.
- **Just a reminder the T/Cplane should still be set to Front**



1. From the **Status** bar at the bottom of the screen click on **Solid color** and change the color to **223**.

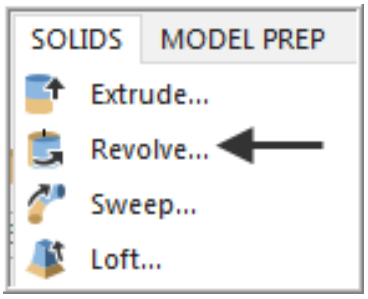
2. From the **Status** bar at the bottom of the screen select **Level**.

3. The **Level Manager** dialog window will now appear. In the **Main Level** section enter 4 **for the Number** and in the **Name:** section enter **SOLID-STL**.



4. Click on the OK button when done  .

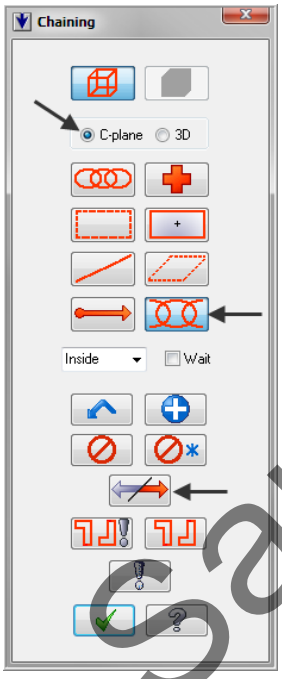
5. Select **SOLIDS>Revolve…**

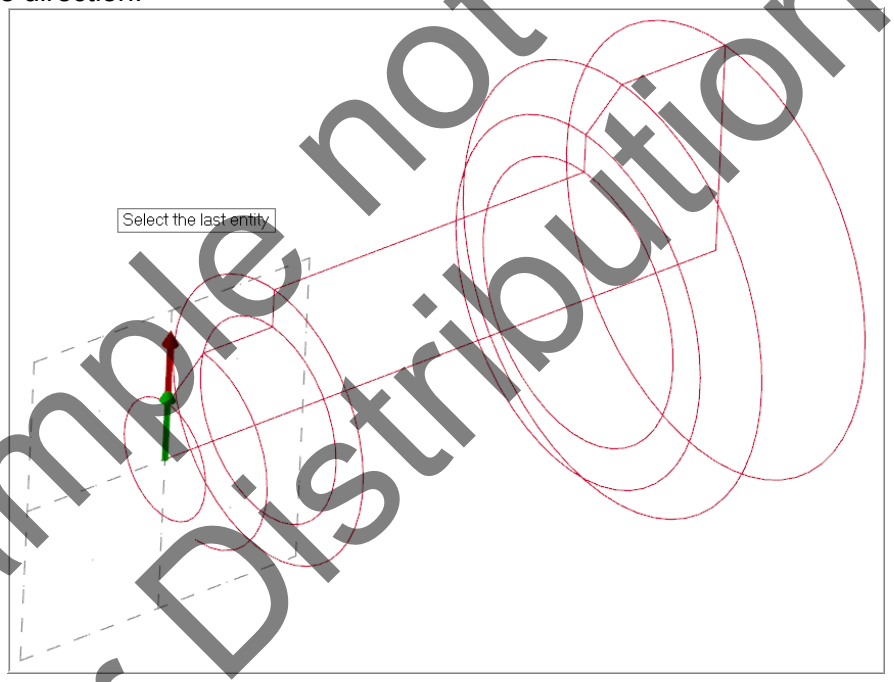


➲ **Solids, Revolve**
The **Solids, Revolve** function lets you revolve planar chains of curves to create one or more new solid bodies, cuts on an existing body, or bosses on an existing body.

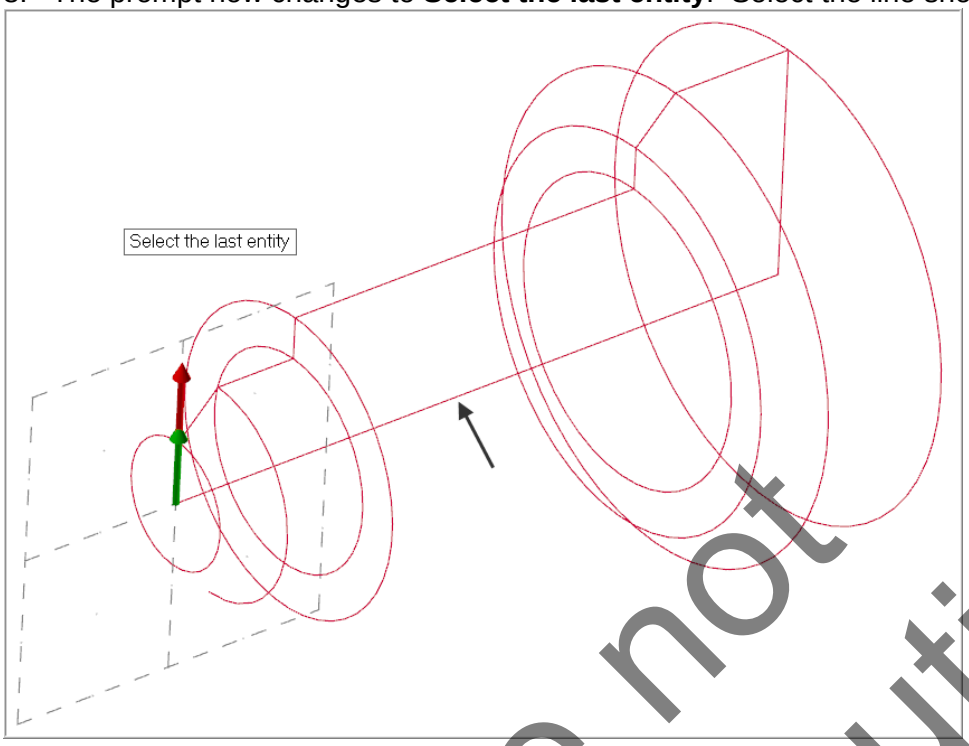
Mastercam revolves chains of curves by driving the shape of the curves about an axis using given start and end angles and other parameters that further define the results.

6. On the screen you will now see the **Chaining dialog box** and in the graphics screen a prompt to **Select chain(s) to be revolved, 1. Activate C-plane** and then select **Partial Chain**. The prompt now changes to **Select the first entity**. Select the line on the far left for the start of the chain as shown below.
7. If the arrows are not pointing upwards select the **arrow** from the Chaining dialog box shown below to reverse the direction.

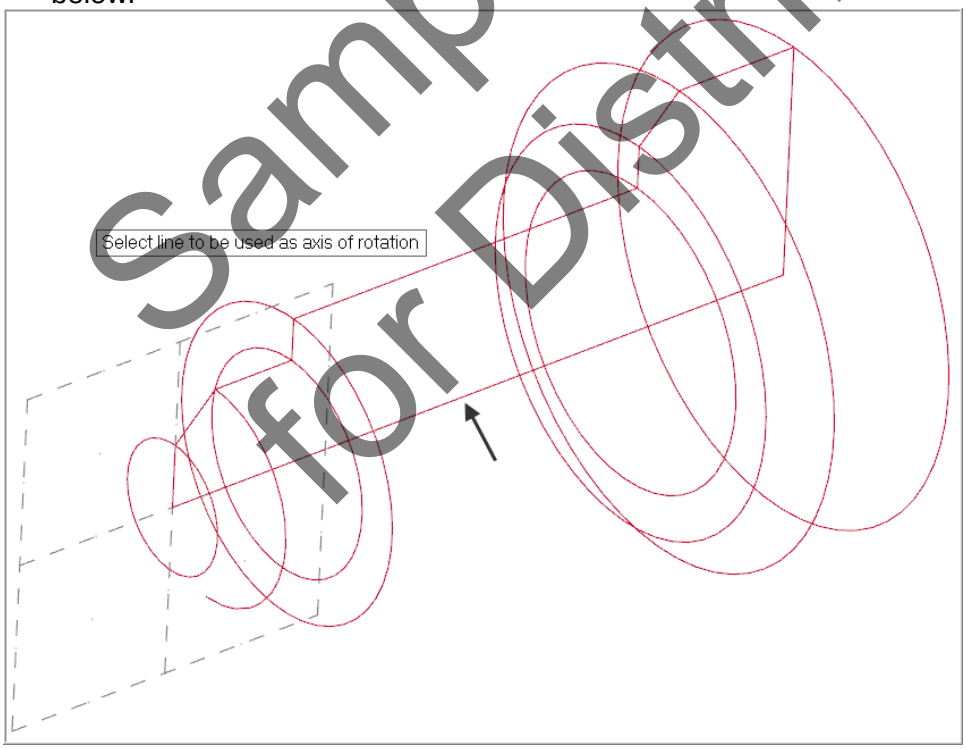




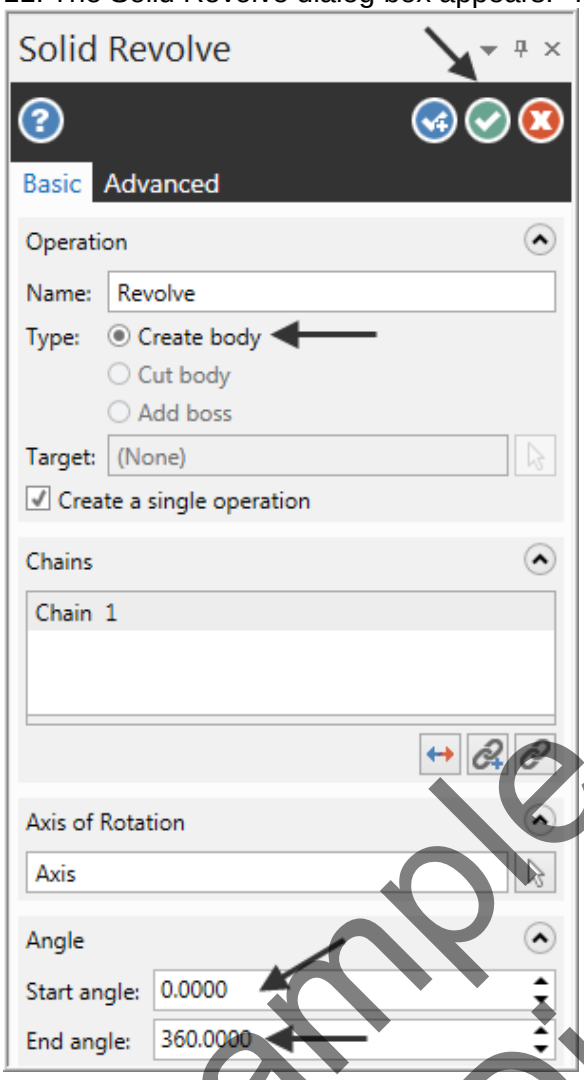
8. The prompt now changes to **Select the last entity**. Select the line shown below



9. Click on the OK button when done .
10. You are now prompted to **Select line to be used as axis of rotation.** Select the line shown below.



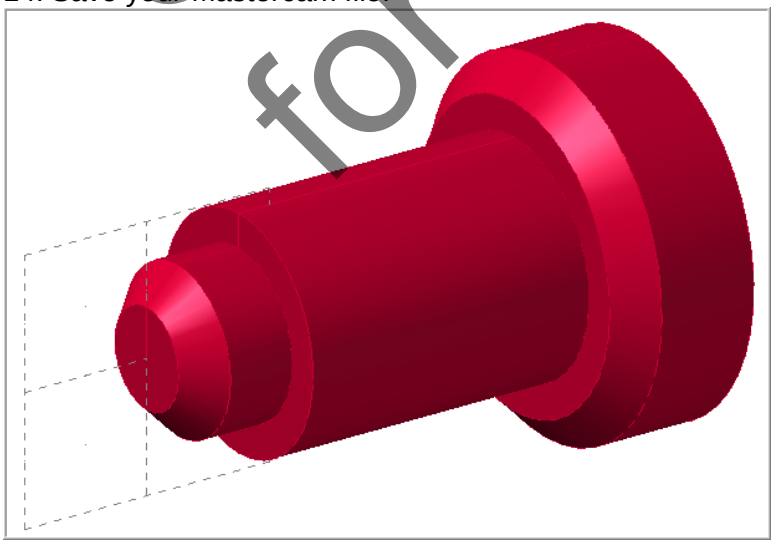
11. The Solid Revolve dialog box appears. The values should be set as below.



➲ **Solid Revolve**
Solid Revolve uses planar chains of curves to create one or more new solid bodies, cuts on an existing body, or bosses on an existing body.

Mastercam revolves chains of curves by driving the shape of the curves about an axis.

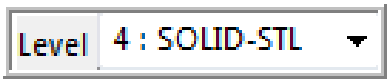
12. Click on the OK button when done.
13. Your Solid Revolve should be created as shown below.
14. Save your Mastercam file.



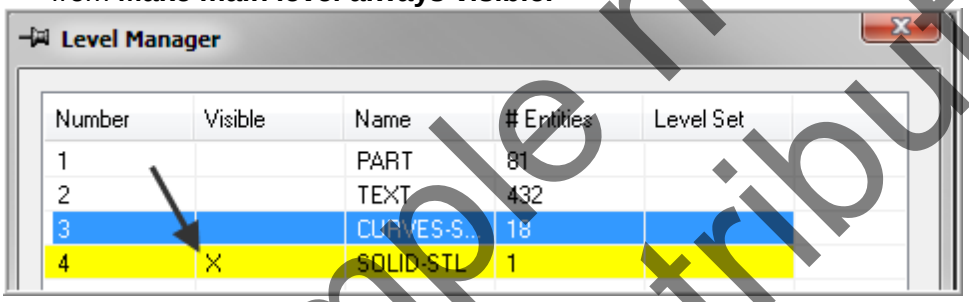
TASK 8:
USE THE SOLID REVOLVE TO CREATE THE STL FILE THAT WILL BE USED TO VERIFY THE TOOLPATHS

- In this task you will hide all levels except SOLID-STL and then use **Save Some** to save the Solid Revolve as a Stereo Lithography File.
- If you are using the **Home Learning Edition (HLE)** of Mastercam you will not be able to use the **Save Some** function. The STL file is supplied on the multimedia DVD that came with this text in a folder called Mastercam Files. If you are using the Online Course content the exercise files are available in this Lesson on the online content screen.

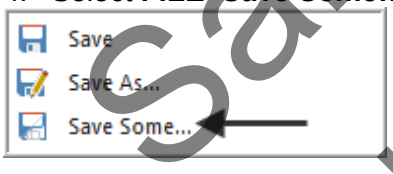
1. From the **Status** bar at the bottom of the screen select **Level**.



2. Make **only Level 4 - SOLID-STL visible** as shown below. **Level 4** contains only the Solid Revolve. Only **Level 4** is visible as noted below by the **X** in the **Visible** column. At the bottom of the Level Manager dialog box ensure (if required) to **remove the check mark** from **Make main level always visible.**

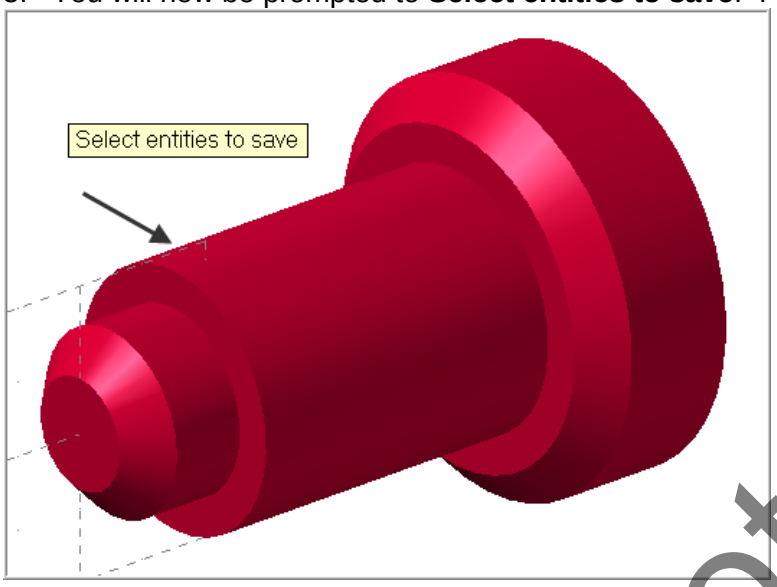


3. Select the OK button  to exit the **Level Manager** dialog box.
4. Select **FILE>Save Some…**

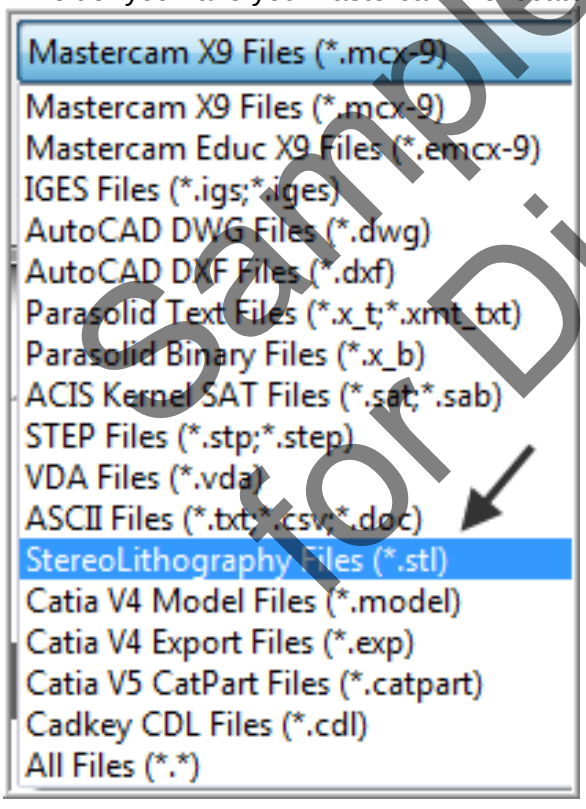


➲ **Save Some…**
When using Save Some, Mastercam lets you choose which entities to include in the file.

5. You will now be prompted to **Select entities to save**. Pick anywhere on the Solid Revolve.

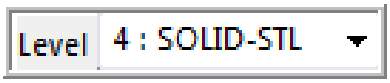


6. Now click on the green **End Selection** icon to move onto the next step.
7. The **Save as** dialog box now appears on the screen. Open up the drop down for **Save as type:** and select **StereoLithography Files (*.STL).**
8. For the File name leave this as **FOUR-AXIS-LESSON-1.STL**. Save the STL file in the same folder you have you Mastercam file located in.

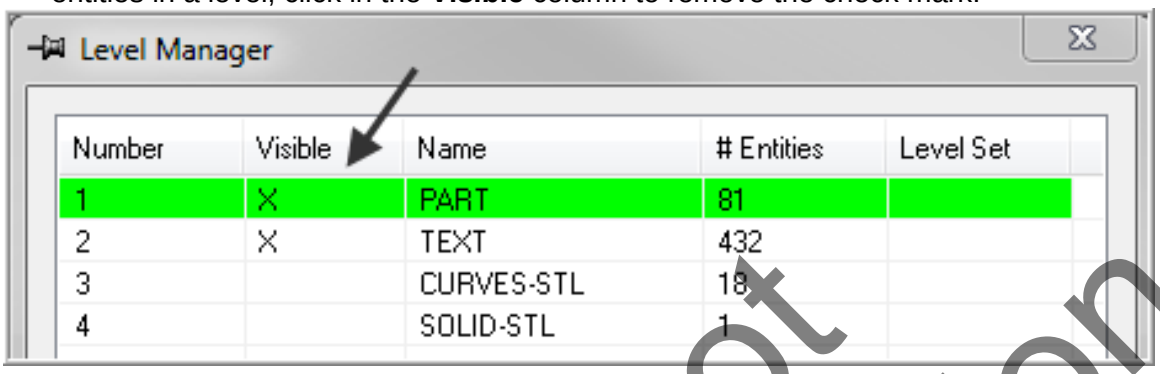


9. Click on the **Save** button when done.

10. From the Status bar at the bottom of the screen select Level.



11. The **Level Manager** dialog window will now appear. Ensure only **Level 1 and 2 Visible**. To **show** entities in a level, click in the **Visible** column to display the check mark. To **hide** entities in a level, click in the **Visible** column to remove the check mark.

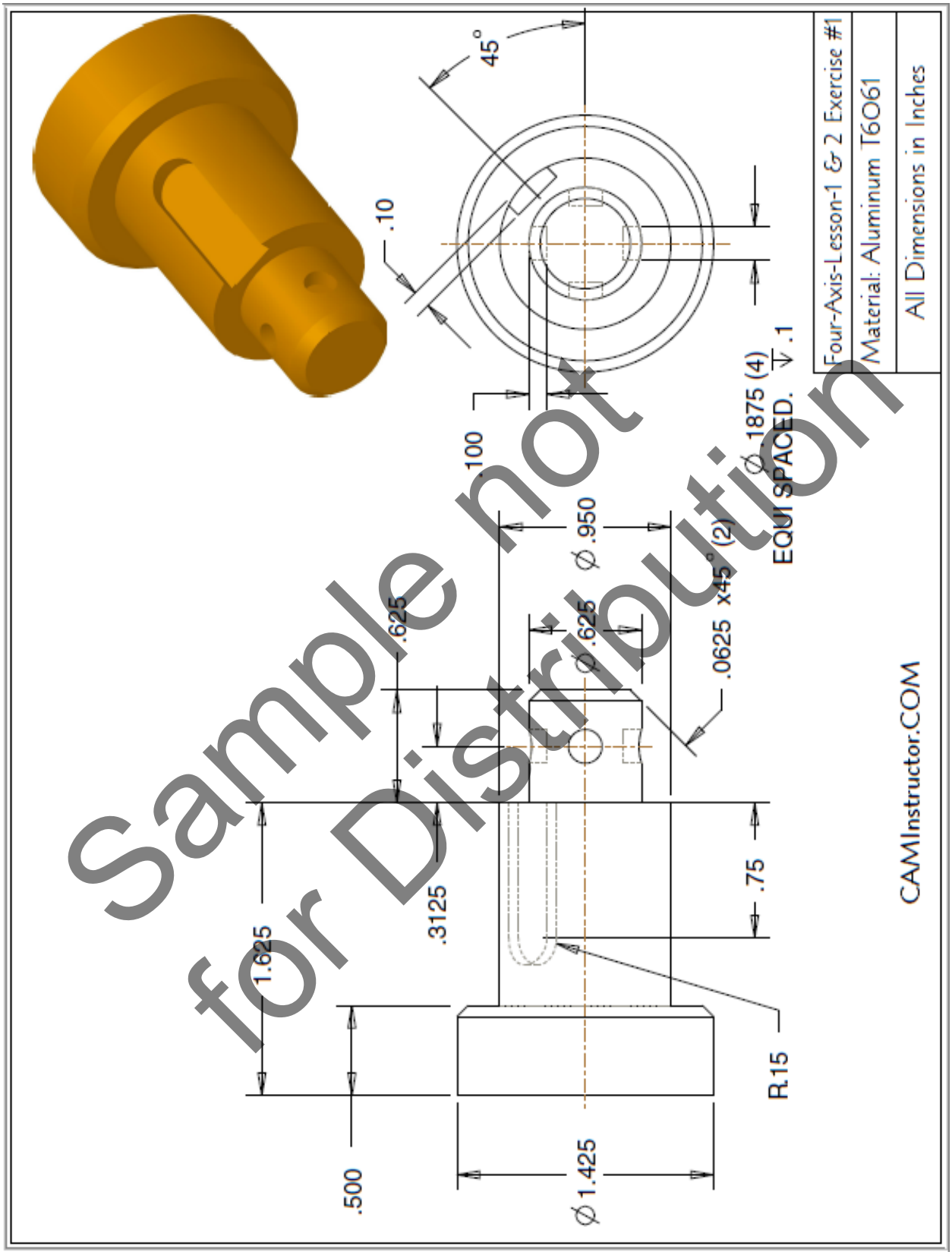


12. Click on Number 1 to make this the Main level.
13. Click on the OK button when done  .
14. Now **Save** your Mastercam file before starting the next lesson.

FOUR-AXIS-LESSON-1 EXERCISES

➲ If you are using a Training Guide the required exercise files are on the multimedia DVD that came with this text in a folder called Mastercam Files. If you are using the Online Course content the exercise files are available in this Lesson on the online content screen.

FOUR-AXIS-LESSON-1 & 2 EXERCISE #1



FOUR-AXIS-LESSON-1 & 2 EXERCISE #2