

# Boolean Solids Tutorial

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## Introduction

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The CADMAX Solid Master Tutorial is a great way to learn about the benefits of constructive (boolean) solid modeling with CADMAX. We have assembled four typical parts that you will be able to construct using CADMAX Solid Master. Each part should take between 20-40 minutes to complete.

The tutorial assumes that you already have some familiarity with CADMAX. In you are unfamiliar with CADMAX, review the *Getting Started* section first. Here are several additional suggestions before getting started:

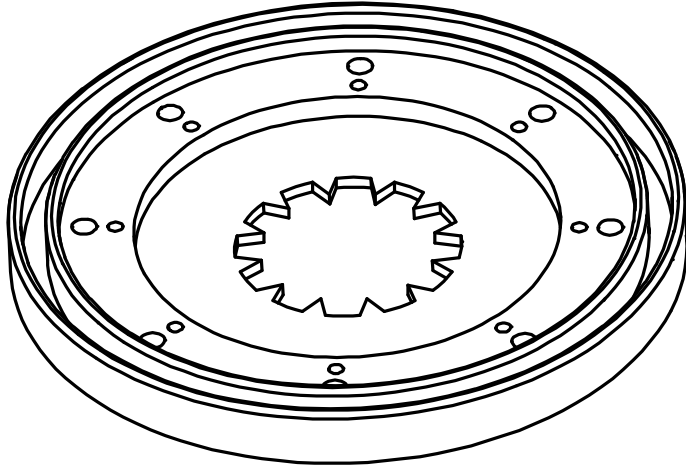
- ! In the tutorial there are several conventions that are used with text. The text **Draw > Circle > Center Radius** means to click on the Draw menu, hold the cursor over the Circle function until the Circle sub-menu pops, then click on Center Radius.
- ! When you see a statement that starts with the word “set”, this means you are to set a modifier value in the currently displayed Function box. For example, in the Line function box, you will see a -Connect? modifier. When you see the statement, “Set -Connect? to off”, this means you should set it off by clicking on the word Connect if it isn’t already off.
- ! Sometimes you will be asked to set a specific value for a modifier. For example, in the Circle Function box you will see a modifier called -Radius? with a combo box below it and a history arrow. When you see the statement, “Set -Radius? to .25”, this means you should click in the -Radius? text field and type in the value or use the history arrow to select previous value.
- ! When an instruction includes an arrow key ( → ← ↑ ↓) followed by a number, hold down the Ctrl key before pressing the specified arrow. For example, < Ctrl+ → > 1 means hold down the Ctrl key and press →, then release the keys and press 1. After you type in the value, press **Enter**.
- ! Context sensitive prompts are available for each function in the message area at the bottom of the screen. Help is available by pressing F1.
- ! In the tutorial, we recommend when you should zoom in or out on the drawing to get better views of your work. In addition to our recommendations, you should feel free to use the View menu to Zoom around the drawing as you feel is appropriate. Press F10 to go to previous zooms or F11 to make a new zoom or use the View shortcut icons on the right side of the display.
- ! To load a specified drawing, press F4 to Open a drawing. The drawings that you will be asked to open are located in the \SAMPLES sub-folder under the folder that you installed CADMAX.

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## Clamp Ring

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The first solid drawing you will model is a clamp ring as shown in the figure below.



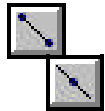
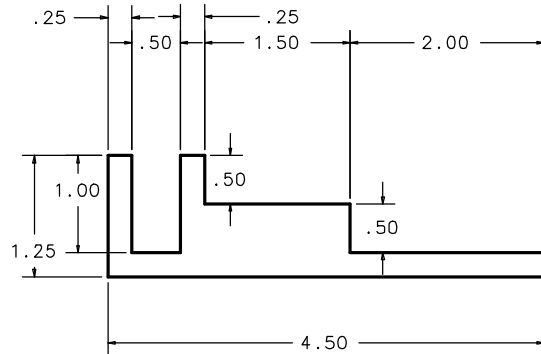
## Draft Clamp Ring Profile

1. Open the drawing CLAMPRNG.
2. Click on **Edit > Surfaces and boolean solids** or click on the 3D icon on the Ribbon bar.



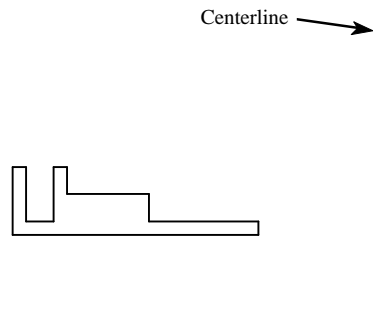
3. Starting in the left side of the front view, draft the profile in the illustration. Click **Draw > Line**, click on a start point for the lower left corner of the profile, then type the following pressing **Ctrl** before pressing on any of the arrow keys, and press **Enter** after each entry:

< Ctrl+ → > 4.5  
 < Ctrl+ ↑ > .25  
 < Ctrl+ ← > 2  
 < Ctrl+ ↑ > .5  
 < Ctrl+ ← > 1.5  
 < Ctrl+ ↑ > .5  
 < Ctrl+ ← > .25  
 < Ctrl+ ↓ > 1  
 < Ctrl+ → > .5  
 < Ctrl+ ↑ > 1  
 < Ctrl+ → > .25  
 < Ctrl+ ↓ > 1.25



4. Click **Draw > More Lines > 1 Pt Construction**, set -System? to 'model', -Construction Size? to 'fill view', -Angle? to '90', -Geometry Attribute?\* to 'Centerline'. Click in about the center of the front view to place a centerline.

\* Note: Set the Geometry Attribute from the Ribbon bar. Click on the Geometry attribute combo box arrow and select the Geometry attribute from the list of available attributes.



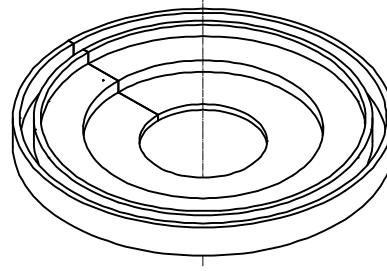
Make sure the centerline is on the same plane as the profile.

5. Set -Geometry Attribute? to 'sheet\_metal'.



- Click **Select > Select All In** and using a rubberband box fully enclose the profile to select it.

Note: You can also right click to display a Pop Up menu and then click on **Select All In**.



- Click **Modify > Sweep > Rotate Surfaces**, set -Sweep? to 'ends-only', -#Steps? to '1', -Angle? to '360', -With? to 'arcs', and -Make Solids? to 'yes'. Click on any two points on the centerline to create the solid.

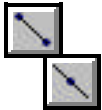
- Notice the original profile is still selected. Click **Select > Select > Surfaces of Selected Boundaries** to select the surface made by the original profile.
- Click Erase to remove the original profile.

## Place Holes in Profile

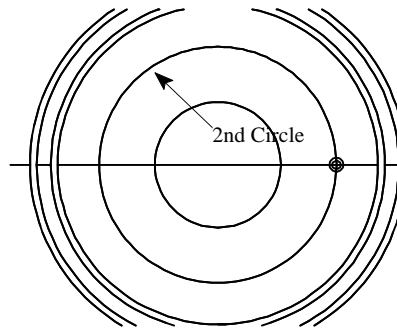
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- Zoom in on the top view. Use the **Zoom 2D** icon located in the Quick Tool bar on the right side of the screen. If necessary, when the zoom is complete, click on **Resume** or click on another function.



- Click **Draw > More Lines > 1 Pt Construction**, set -System? to 'model', -Construction Size? to 'fill view', -Angle? to '0', -Attribute Name? to 'centerline'. Click on the **Center point** icon in the Quick Snap tool bar on the right side of the display and click on the second smallest circle.



- Set -Attribute Name? back to 'sheet\_metal'.



- Click **Draw > Circle > Center, Radius**, set -Radius? to '.125', set -Circle Plane? to 'view', and click on the intersection of the construction line and the circle as shown in the previous illustration. Set -Radius? to '.25', and press Enter to insert the second circle at the same center point as the first circle.

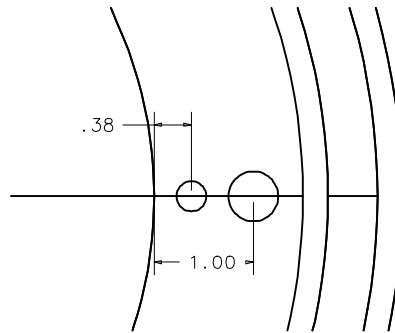
- Use the **Zoom 2D** icon located in the Quick Tool bar on the right side of the screen to zoom in on the two circles that you just inserted into the drawing.



- Click **Select > Select Element**, and click on the larger radius circle just added.



- Click **Modify > Move or Copy**, set -Move Which? to 'nocopy'. Click anywhere as a pick up point and type <Ctrl+ > 1 as the put down point.



- Click **Select > Clear**.

- Repeat steps 6-7 for the smaller radius circle moving a distance of .38.



- Select both circles.



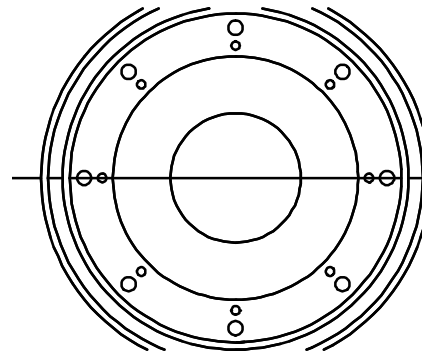
- Zoom back out to show the four views. Click on the **Previous** icon located in the Quick View tool bar on the right.



- Click **Modify > Sweep > Linear, Surfaces**, set -Sweep? to 'ends-only', -# Steps? to '1', and -Make Solids? 'on'. Click anywhere as a pick up point and type <Ctrl+ > 1 to create two solids.



- Click **Select > Select > Solid** and click on the two solids just created.



- Click **Modify > Sweep > Rotate**, set -Sweep? to 'none', -# Steps? to '8', and -Angle? to '360'. In the front view, click on any two points on the vertical construction line to define the rotate about axis.



- Click **Erase** to remove the original swept profiles.



- Click **Select > Select > All Editable Levels** or press Ctrl+ A.





17. Click **Select > Unselect > Solid**, and click on the clamp ring main body.
18. Click **Draw > Solid > Subtract**, and click on the clamp ring main body to put a circular array of holes in the clamp ring.

## Add Clamp Ring Guides

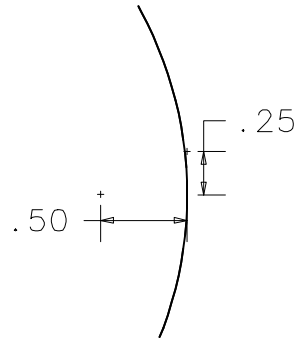
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1. In the top view Select the construction line.



2. Click **Modify > Move or Copy**, set -Move Which? to 'nocopy'. Click anywhere as a pick up point and type < Ctrl+ → > .5 to move the construction line to the depth of inner ring.

Note: You can also Select, Clear, Erase, Move and Copy geometry by right clicking to display the Pop up menu and then selecting the desired function.



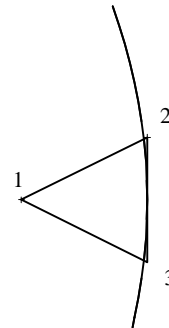
3. Click **Select > Clear**.

4. Zoom in on the intersection of the smallest circle and the construction line on the right side.



5. Click **Draw > Line** and click on the intersection of the inner circle and the construction line to create a reference point.

6. Click **Draw > Line** again and type  
< Ctrl+ ← > .5  
< Ctrl+ → > .5, < Ctrl+ PageDown > .25  
< Ctrl+ PageUp > .5  
Complete the profile by drawing a line to point 1 as shown in the figure.



Note: Just as the arrow keys are used for relative XY, < Ctrl+ PageUp > and < Ctrl+ PageDown > are used to denote relative Z distances.

- Right click and click on **Select All In** and using a rubberband box fully enclose the profile just added to select it.
- Zoom back out to the four views.



- Click **Modify > Sweep > Linear Surfaces**, set -Sweep? to 'ends-only', -# Steps? to '1', and -Make Solids? 'on'. Click anywhere as a pick up point and type < Ctrl+ ↓ > .25 to create a solid that is equal to the width of the bottom of the clamp ring.



- Click **Select > Select > Solid**, and click on the solid just created.

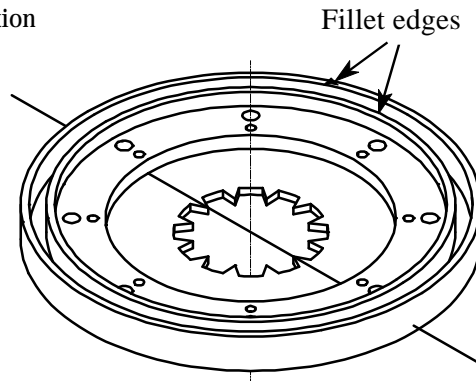


- Click **Modify > Sweep > Rotate**, set -Sweep? to 'none', -# Steps? to '12', and -Angle? to '360'. In the front view, click on two points on the vertical construction line to define the rotate about axis.

- Right click, then click **Erase** to remove the original swept profile.

- Type Ctrl+ A to **Select All Editable**.

- Click **Select > Unselect > Solid**, and click on the clamp ring main body.



- Click **Draw > Solid > Add**, set -Remove Excess Edges? 'on', and click on the clamp ring main body to make the guides part of the main body.



## Add Clamp Ring Fillets

- Using the previous illustration, **Select** the four circles marked on the top edge of the clamp ring.
- Click **Modify > Corner > Fillet Selected Edges**, set -Radius? to '.125', and click **Finish** to complete the part.



