

Boolean Solids Tutorial

Introduction

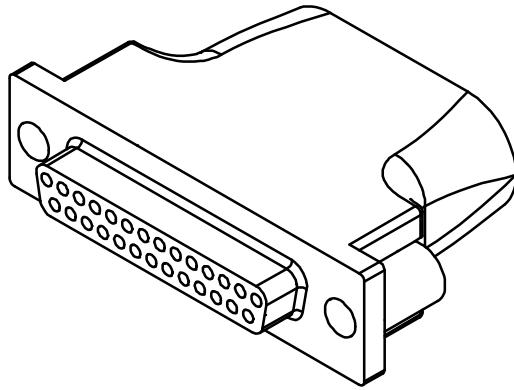
The CADMAX Solid Master Tutorial is a great way to learn about the benefits of constructive (boolean) solid modeling with CADMAX. We have assembled four typical parts that you will be able to construct using CADMAX Solid Master. Each part should take between 20-40 minutes to complete.

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.

27-Pin DIN Connector

In this section, you will use CADMAX Solid Master to build a 27-pin DIN connector. Your final part should look similar to this:



Draft Connector Base Profile

1. Open the drawing CONNECT and click on **Edit > Surfaces and boolean solids** or click on the 3D icon on the Ribbon bar.
2. Starting in the top view, draft the profile shown at right.

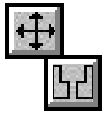


3. Click on **Draw > Line**, and set -Connect? 'on'. Click at a start point in the lower left side of the top view. Then at the keyboard enter:
< Ctrl+ -> 2.2
< Ctrl+ PageDown> .125
< Ctrl+ -> .1875
< Ctrl+ PageDown> .44
< Ctrl+ -> .1875
< Ctrl+ PageDown> .75

4. Right click, then click on **Select All In**, and using a rubberband box, fully enclose all of the geometry except the 2.2" line.



5. Click **CPL > Align to View**, click on the side view to align the CPL to the side view (lower right view) .



6. Click **Modify > Mirror**, and set -Move Which? to 'Copy'. To mirror the selected geometry about the midpoint of the 2.2" line, click on the **Midpoint** snap icon in the Quick Snap tool bar, then click anywhere on the 2.2" line.



7. Right click, then click **Clear**.



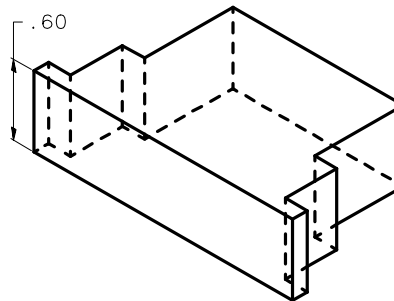
8. Click **Draw > Line**, and draw a line to close the profile as in the figure to the right.

Extrude Connector Profile

1. Right click, then click **Select All In**, and using a rubberband box, fully enclose the entire profile.



2. Click **Modify > Sweep > Linear Surfaces**, set -Sweep? to 'ends only', and -Make Solids? 'on'. Click anywhere as a pick up point, then type < Ctrl+ !> .60 to extrude the profile.



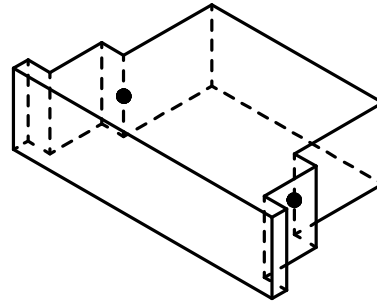
Add Fillets to Connector Base



1. Zoom in on the isometric view using the Quick Tool bar on the right side of the screen and click **Resume** when done or click on the next function.



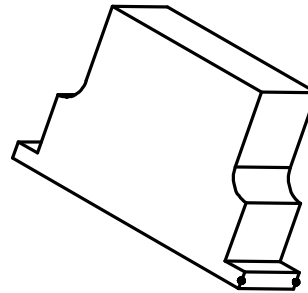
2. Click **Hidden dashed** in the Quick 3DView tool bar, then click on the isometric view.



3. Click **Modify > Corner > Fillet/Chamfer Advanced**, set -Radius? to '.1875', and set -Type? To 'Fixed radius'. Click on **Add**, then click on the edges identified by the bullets in the illustration. The specified edges will turn red.

4. Click **Done** in the Fillet/Chamfer Advanced Function box to apply the specified fillets.

5. Set -Radius? to '.03125'. Click **Add**, then select the four edges at the lower corners. The illustration shows the edges for two corners. Select the opposite two corners to get all four edges. Zoom in on the drawing in the isometric view to select the far edges.



6. Click **Done** to apply the specified fillets.

Note: You change the orientation of a view or how a view is displayed in order to see boundaries that are not visible in a view. The Quick View menu on the right side of the screen contains functions to change a view to wireframe, hidden, hidden-dashed, shaded or unshaded. Following are the icons that permit you to change how a view is displayed. To operate these functions, click on the icon, then click on the view to change.



Wireframe view



Shaded View



Hidden view



Unshaded View



Hidden dashed view

To rotate a view, use dynamics. Click on the **Dynamic View Roll** icon, then click on the view to roll, then click on roll about point to start the roll. Normally, the roll about point is on geometry in the model. Drag the cursor in the direction of the roll and click again to anchor the view at the new orientation. Use **Previous View** to return the view to its original orientation.

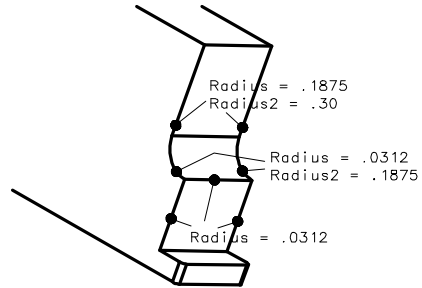


Dynamic view roll



Previous View

7. Set -Radius? to '.03125'. Click **Add**, then select the three edges shown in the illustration with a single radius of .0312.
8. Set -Radius2? to '.1875' and set -Type? to 'Variable linear' for a variable linear radius fillet which will start at .0312 and end at a radius of .1875. Click **Add**, then select the next two edges indicated in the illustration near the location of the bullets on the line.

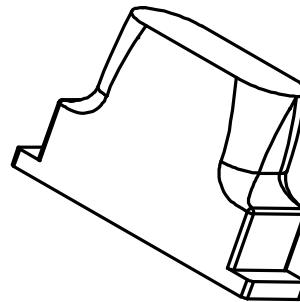


Note: When applying a variable radius fillet, the -Radius? is applied to the end of the edge that is closest to the point you select and the opposite end uses -Radius2?.

9. Set -Radius? to '.1875' and Set -Radius2? to '.3'. Click **Add**, then select the last two edges indicated in the illustration near the location of the bullets on the line.
10. Click **Done** to apply the specified fillets.
11. Repeat Steps 7-10 on the other side of the connector body.



12. Click on the **Hidden** icon in the Quick 3DView tool bar, then click on the isometric view to make it hidden.



Place initial holes for post holes

1. Zoom to the front view.
2. Click **3DView > View Control > Orient**, set -Angle? to '180' and set -Rotate Axis? to 'model x'. Click on the front view to get a rear view of the connector.
3. Using the illustration as a guide, right click, then click **Select Element** and select the line indicated by the bullet on the left edge of the connector.
4. Right click, then click **Move**. Pick anywhere as a pick up point and type < Ctrl+ → > .15.



5. Click **Select > Clear** or right click, then click **Clear**.
6. Using the illustration as a guide, right click, then click **Select Element**. Select the line on the right edge of the connector.
7. Right click, then click **Move**. Pick anywhere as a pick up point and type < Ctrl+ ← > .15.
8. Click **Select > Clear** or right click, then click **Clear**.



9. Click **Draw > Circle > Center Radius**, set -Radius? to '.15' and -Circle Plane? to 'view'.
10. Click on the Quick Snap **Midpoint** icon, then click on one of the lines just added to insert the circle on the midpoint of the construction line. Repeat this step for the other line.



11. **Select** the two construction lines just added and **Erase** them.

Extrude holes



1. **Select** the two circles just added.



2. Click on **Modify > Sweep > Linear Surfaces**, click anywhere in the view as a pick up point and type < Ctrl+ PageDown> .375 as the put down point.



3. Click **Select > Select > Solid**, and click on the two objects just added.



4. Click **Draw > Solid > Add**, set -Remove Excess Edges? 'on', and click on the main connector body to add the selected solids to the connector.



5. Click **Draw > Circle > Center Radius**, set -Radius? to '.15', set -Auto Select? 'on' by clicking on the Auto Select icon on the Ribbon bar.



6. Click on the **Center point** snap icon in the Quick Snap tool bar, then click on one of circles at the top of the posts in the front view to insert the circle. Repeat this step on the other side. Set -Auto Select? 'off'.



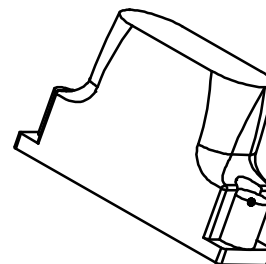
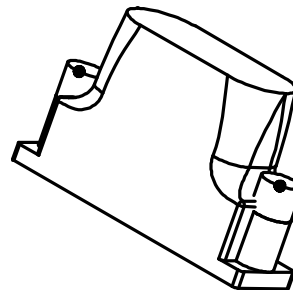
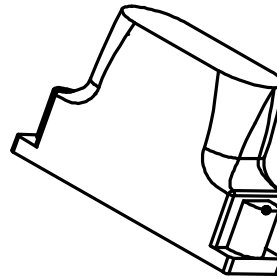
7. Click on **Modify > Sweep > Linear Surfaces**, click anywhere in the view as a pick up point and type < Ctrl+ PageDown> .25 as the put down point.



8. Click **Select > Select > Solid**, and click on the two objects just added.



9. Click **Draw > Solid > Subtract**, and click on the main connector body.



Cut holes



1. Click **Draw > Circle > Center Diameter**, set -Diameter? to '.1875', set -Auto Select? 'on' in the Ribbon bar.



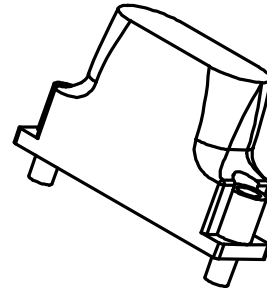
2. Click on the **Center point** snap icon, then click on one of circles at the top of the posts in the front view to insert the circle. Repeat this step on the other side. Set -Auto Select? 'off'.



3. Click on **Modify > Sweep > Linear Surfaces**, click anywhere in the view as a pick up point and type < Ctrl+ PageUp> 1 as the put down point.



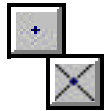
4. Click **Select > Select > Solid**, and click on the two objects just added.



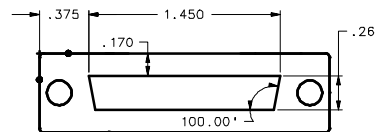
5. Click **Draw > Solid > Subtract**, and click on the main connector body.

Draft connector profile

1. Click **3DView > View Control > Orient**, set -Axis? to 'model x', and set -Angle? to '180'. Click on the front view to rotate the view back to being a front view.



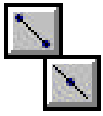
2. Click **Draw > Point > Intersection**, then in the front view click on the left vertical line, and the top horizontal as illustrated by the bullets in the view to the right. This will place a point at the intersection of the two lines.



3. Click **Draw > Line**, and click on the point that was just inserted into the drawing to set the point as the reference point.

4. Click **Draw > Line** again, then type:
< Ctrl+ →> .375, < Ctrl+ ↓> .17 for the first point and < Ctrl+ →> 1.45 for the second point.

5. Select the line just created, right click then click **Copy**. Click anywhere as the pick up point, then type < Ctrl+ ↓ > .26.
6. Right click, then click **Clear**.



7. Click **Draw > More Lines > 1 Pt Construction**, set -Construction Size? to 'use length', set -Angle? to '-80', and set -Length? to '1'. Click on the left endpoint of the upper horizontal line in the front view to insert a line. Set -Angle? To '-100', and click on the right endpoint of the upper horizontal line.

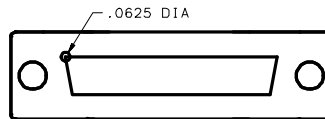


8. Click **Modify > Corner > Fillet Curve**, set -Trim? to 'both' and set -Radius? to 'none'. Click on the bottom horizontal line and one of the angled lines to trim them to a corner. Repeat this sequence on the opposite side to complete the outline.

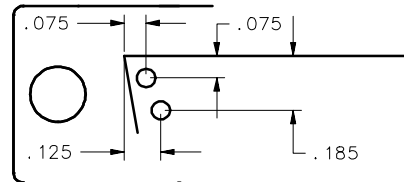
Draft connector holes



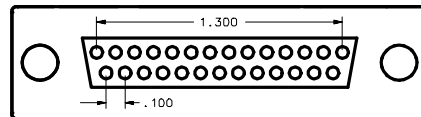
1. Click **Draw > Circle > Center Diameter**, set the -Diameter? to '.0625', and place the circle at the point indicated in the illustration.
2. Right click, click **Select**, and select the circle, right click again and click **Copy**. Click anywhere in the view as a pick up point and type:
< Ctrl+ → > .075, < Ctrl+ ↓ > .075
< Ctrl+ → > .05, < Ctrl+ ↓ > .11



3. Click **Modify > Erase Element** to erase the original circle, then click on the construction point in the upper left of the front view to erase it.



4. Click **Select > Select Element**, and select the two circles just inserted in the drawing.



5. Click **CPL > Align to View**, and click on the front view.



6. Click **Modify > XYZ Step**, set the following modifier values:
 - X Step Size? = .1
 - # X Steps? = 14
 - Y Step Size? = 0
 - # Y Steps? = 1
 - Z Step Size? = 0
 - # Z Steps? = 1



7. Click the **Center point** snap icon, touch the upper circle as the pick up point for the array, then press **Enter** to use the same point as the grid start point.



8. Erase the two original circles and the extra circle on the bottom row.
9. Click **Select > Filters > All Off**. Click **Select > Filters > Edit, and** Set -Lines? 'on', -Arcs? 'on'. If necessary, click on the **Use Filter** icon in the Ribbon bar to depress it and set it on, if it's already depressed, leave it alone.

10. Right click, and click **Select All In**. Working in the front view, place a rubberband box around the profile of the 27-Pin DIN profile that was just constructed.

11. Click **Select > Filters > All On**.



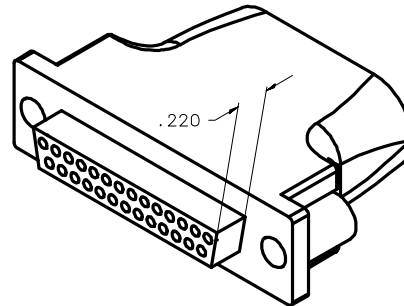
12. Click on **Modify > Sweep > Linear Surfaces**, click anywhere in the view as a pick up point and type < Ctrl+ PageUp> .22 as the put down point.



13. Use **Previous** in the Quick View tool bar to zoom back out to the view of all four views.



14. Click **Draw > Solid > Add**, set -Remove Excess Edges? 'on', and click on the main connector body and the 27-pin connector to join the two solids.



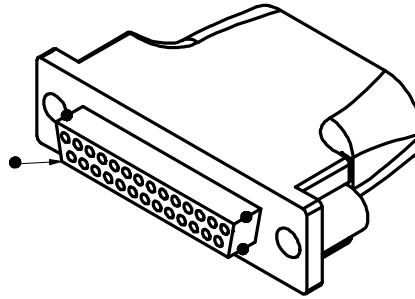
Fillet connector



1. Click on **Select > Select Element** and select the edges shown in the illustration.



Three edges are easy to select. Click **Dynamic View Roll** in the Quick 3DView tool bar, click on the isometric view then click on a point on the connector to roll about. Rotate the view until you can see the hidden edge, then click to place the view.



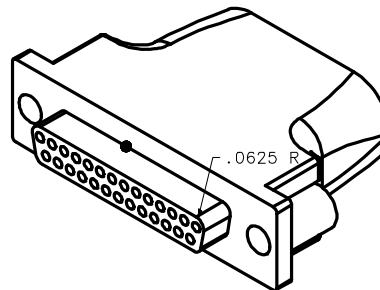
Right click, click on **Select Element** and select the fourth edge.



2. Click **Previous 3DView** in the Quick 3DView tool bar, then click on the isometric view to return it to its original position.



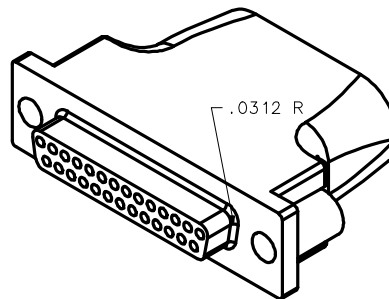
3. Click **Modify > Corner > Fillet Selected Edges**, set -Radius? to '.0625', click **Finish** to apply the fillet to the selected edges.



4. Right click, click **Select Element** and select the edge shown by the bullet in the illustration. Although only one edge was selected, CADMAX will apply the fillet to the entire boundary automatically.



5. Click **Modify > Corner > Fillet Selected Edges**, set -Radius? to '.03125', click **Finish** to apply the fillet to the selected edges.



6. Save the drawing as BODY if you are not running Test Drive. If you are running Test Drive, you can make a Snapshot of your work by clicking **File > Snapshot**.