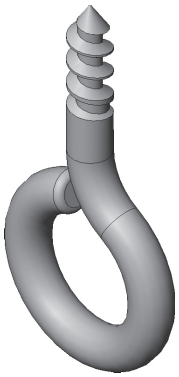
Chapter 15

## CO2 Rail Car

# Eye Screw



## A. Sketch Centerpoint Arc.

Step 1. Click File Menu > New, click **Part Metric** and OK.

Step 2. Click **Front** (plane) in the Feature Manager and click **Sketch** from the Content toolbar, **Fig. 1**.

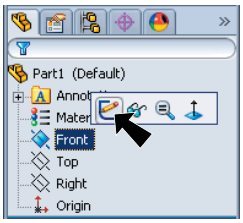



**Fig. 1**

Step 3. Click **Centerpoint Arc** (**S**) in the **Arc flyout** on the Sketch toolbar.

Step 4. Draw a slightly open arc starting from the Origin , **Fig. 2**.

To draw the arc, click the Origin to place the center of the arc. Start the first end point directly above the Origin, then swing the arc to the right around counterclockwise. Click to place the second end point leaving a small gap in the arc, **Fig. 2**.

Use the inferencing line, the dotted line that appears when you draw the arc.

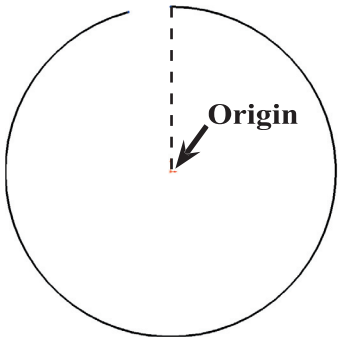



**Fig. 2**

Step 5. Click **Smart Dimension** (**S**) on the Sketch toolbar.

Step 6. Dimension radius of the arc **2.2** as shown in **Fig. 3**.

Step 7. Click Zoom to Fit (**F**) on the View toolbar.

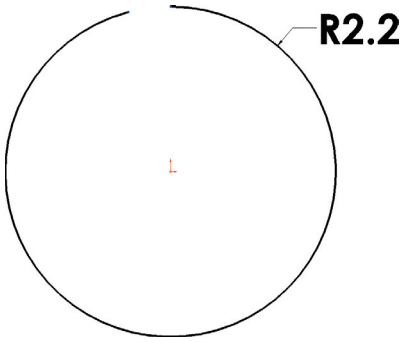



**Fig. 3**

## B. Save as "EYE SCREW".

Step 1. Click File Menu > Save As.

Step 2. Key-in **EYE SCREW** for the filename and press ENTER.

## C. Line.

Step 1. Click **Line**  (**L**) on the Sketch toolbar.

Step 2. Draw line as shown in **Fig. 4**. Draw the line up from the arc endpoint that is directly above Origin.

Step 3. Click **Smart Dimension** 

(**S**) on the Sketch toolbar.

Step 4. Dimension arc gap **.5** and the line **6** as shown in **Fig. 5**. To dimension the gap in arc, click both endpoints of arc, then move cursor out way and click. To Smart dimension the line, click the line, then move the cursor out away from the line and click.

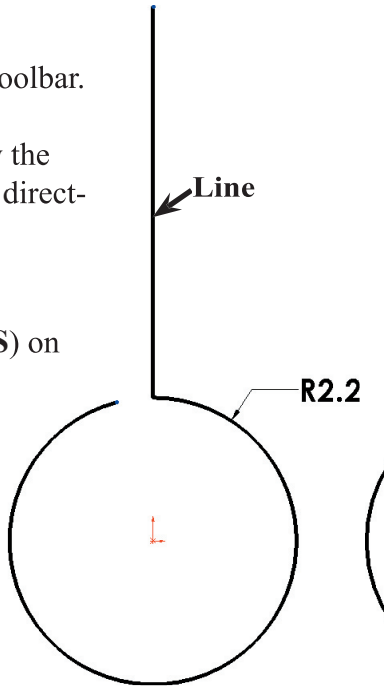


Fig. 4

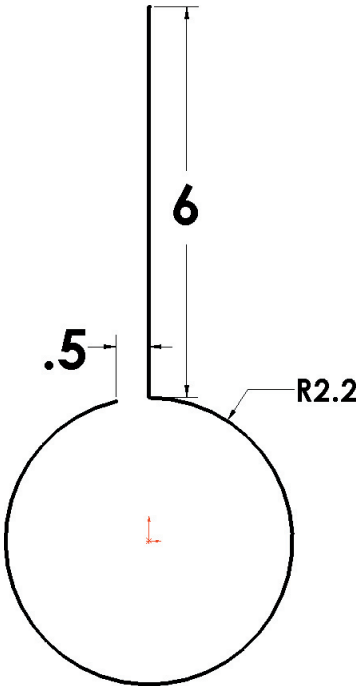


Fig. 5

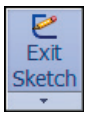
Step 5. Click Zoom to Fit  (**F**) on the View toolbar.

## D. Sketch Fillet.

Step 1. Click **Sketch Fillet**  (**S**) on the Sketch toolbar.

Step 2. Set the **Radius**  to **2** in the Sketch Fillet Property Manager, **Fig. 6**.

Step 3. Click the corner shown in **Fig. 7** where the arc and line intersect and click OK **twice**  .

Step 4. Click **Exit Sketch** 

on the Sketch toolbar.

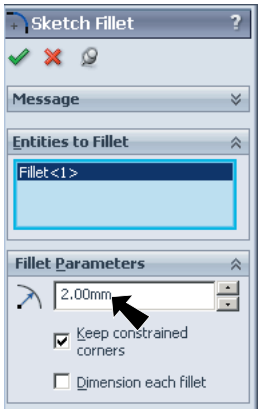


Fig. 6

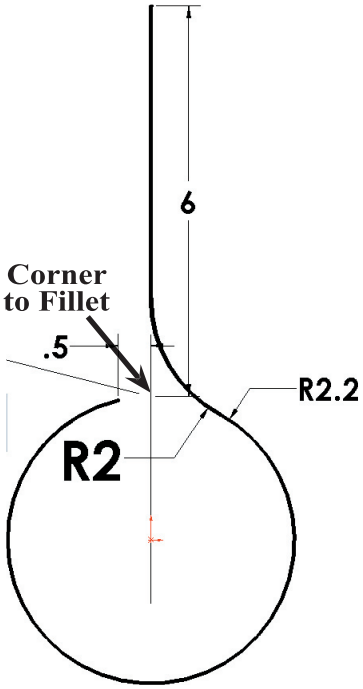
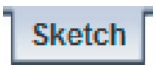


Fig. 7

## E. 3D Sketch Profile.

Step 1. Click **Isometric**  on the Standard Views toolbar. (**Ctrl-7**)

Step 2. Click **Top**  (plane) in the Feature Manager, **Fig. 8**.

Step 3. Click **Sketch** 

on the Command Manager toolbar.

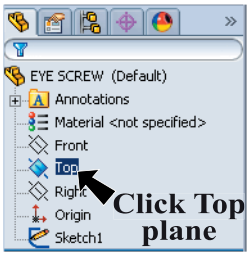


Fig. 8

Step 4. Click **3D Sketch**  in the **Sketch flyout**  on the Sketch toolbar. Be sure to click the **flyout arrow**  to select 3D Sketch.

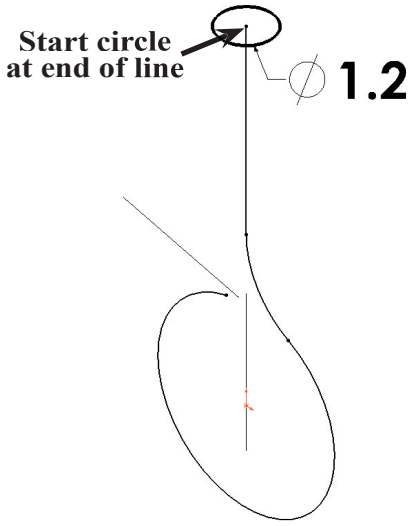


**Fig. 9**

Step 5. Click **Circle**  **(S)** on the Sketch toolbar.

Step 6. Draw a circle starting at the top endpoint of the line in sketch, **Fig. 9**.

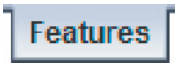
Step 7. Click **Smart Dimension**  **(S)** on the Sketch toolbar.

Step 8. Dimension the circle **1.2** diameter as shown in **Fig. 9**.

Step 9. Exit the **3D Sketch.** To Exit, click  in the **Sketch flyout**  on the Sketch toolbar. Click the **flyout arrow**  then 3D Sketch.

Step 10. Save. Use **Ctrl-S**.

## F. Sweep.

Step 1. Click **Features**  on the Command Manager toolbar.

Step 2. Click **Swept Boss/Base**  on the Features toolbar.

Step 3. In the Swept Boss/Base Property Manager:

for **Profile**  field, click **circle** in the 3D Sketch**, Fig. 11**

for Path  field, click any geometry in **Sketch1 (line, arc or fillet)**, **Fig. 11**

click OK 

Step 4. Save. Use **Ctrl-S**.

**Fig. 10**

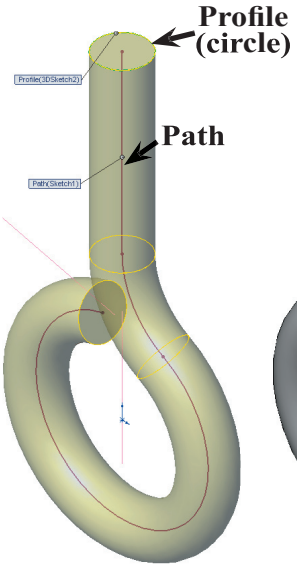


**Fig. 11**

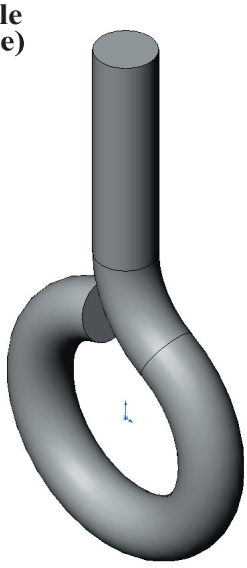


**Fig. 11**

## G. Fillet Edge.

Step 1. Click **Fillet** 

on the Features toolbar.

Step 2. Set the **Radius**  to **.2** in the Fillet Property Manager, **Fig. 13**.

Step 3. Click inside edge at end of sweep and click OK  in the Property Manager, **Fig. 14**.

Step 4. Save. Use **Ctrl-S**.

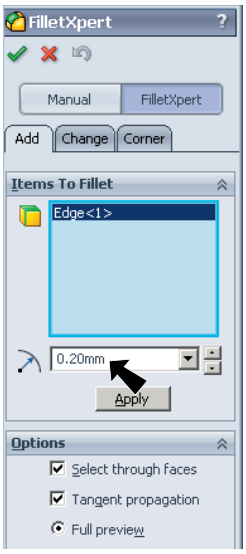



Fig. 13

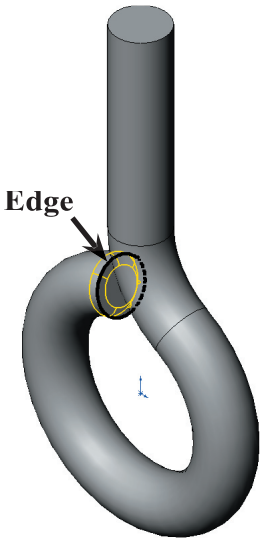



Fig. 14

## H. Threads Sketch for Sweep Cut.

Step 1. Click the **top face** and click **Sketch**  on the Content menu, **Fig. 15**.

Step 2. Click **Offset Entities** 

on the Sketch toolbar.

Step 3. In the Offset Entities Property Manager set:
**Distance to .27**

The yellow offset circle should be on the inside of the face, **Fig. 17**. If it is not, check Reverse. Click OK  .

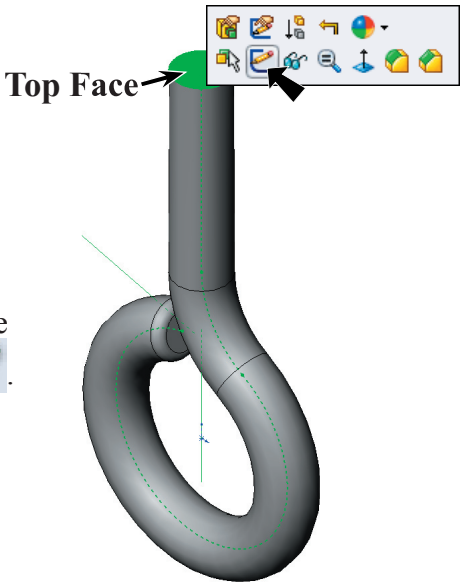



Fig. 15

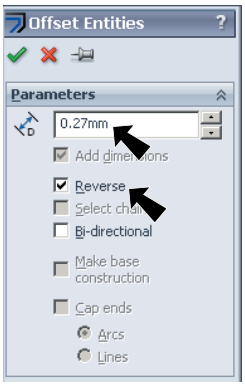



Fig. 16

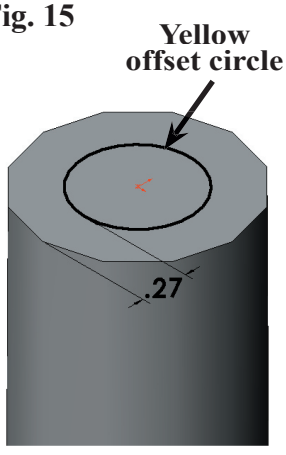



Fig. 17

## I. Helix for Sweep Cut.

Step 1. Click Insert Menu > Curve > Helix/Spiral.

Step 2. In the Helix/Spiral Property Manager set:

under Defined By
select **Pitch and Revolution**

under Parameters
select **Variable Pitch**

under Region Parameters
set **Pitch to .7 all rows**
**click in Row 2 of Rev column and set to 4 and Dia .66**
**click in Row 3 of P column and set to .7, Rev 5 and Dia to 1.2**

check **Reverse direction**

**Start angle to 270**

check **Counterclockwise**

click OK  , **Fig. 18**.

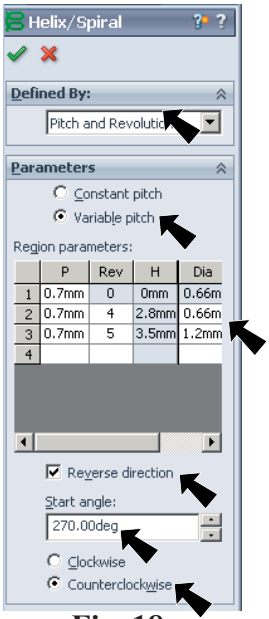


**Fig. 18**

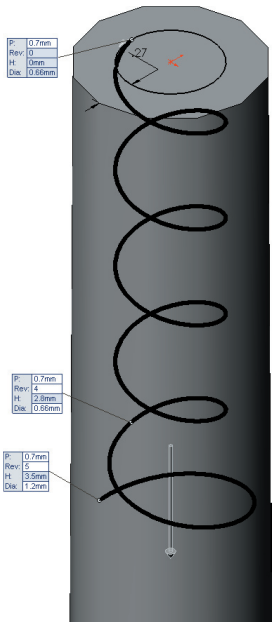


**Fig. 19**

## J. Sketch Thread Profile.

Step 1. Click **Front**  (plane) in the Feature Manager and click **Sketch**  from the Content toolbar, **Fig. 20**.

Step 2. Click **Normal To**  on the Standard Views toolbar. (**Ctrl-8**)

Step 3. Zoom in around **top end of the eye screw**, **Fig. 21**. To **zoom**, hold down **Shift key** and drag with middle mouse button (wheel). To **pan**, hold down **Ctrl key** and drag with middle mouse button (wheel).

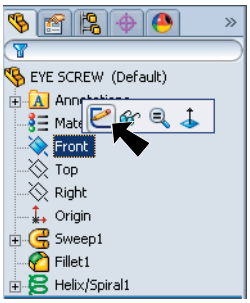


**Fig. 20**

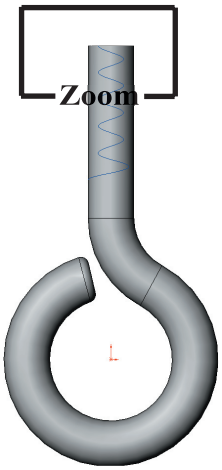
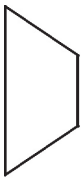


**Fig. 21**

Step 4. Click **Line** (**L**) on the Sketch toolbar.

Step 5. Draw four lines as shown in **Fig. 22**. Draw the side lines vertical. Keep sketch out in space and not attached to the eye screw.



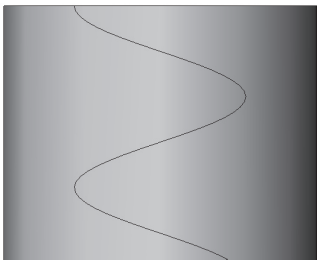


**Fig. 22**

## K. Add Equal Relations.

Step 1. **Right click drawing and click Select** from menu to unselect Line tool.

Step 2. Select **top and bottom lines**. Use **Ctrl click**. To Ctrl click, hold down the Ctrl key and click both lines, **Fig. 23**.

Step 3. Click **Make Equal** (=) on the Content menu.

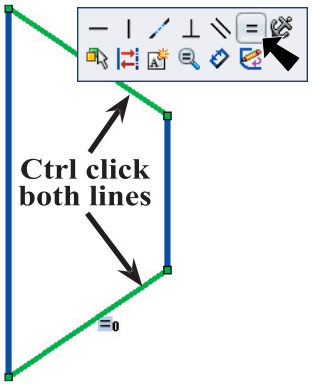



**Fig. 23**

## L. Smart Dimension.

Step 1. Click **Smart Dimension** (**S**) on the Sketch toolbar.

Step 2. Dimension the left line **.65** and the top **.28** as shown in **Fig. 24**.

Step 3. Dimension the angle **56° degrees** between the left line and bottom line as shown in **Fig. 25**. To dimension the angle, click both lines then move the cursor inside and click. Key-in **56** for the dimension and press ENTER.

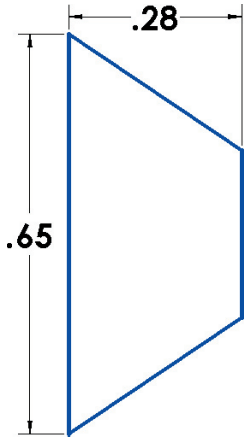



**Fig. 24**

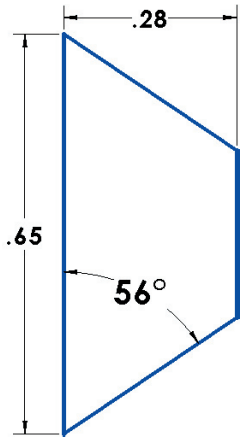



**Fig. 25**

## M. Add Pierce Relation.

Step 1. **Right click drawing and click Select** from menu to unselect Smart Dimension.

Step 2. Select the **bottom right endpoint of the sketch and helix**. Use **Ctrl click**. To Ctrl click, click the **bottom right endpoint of the sketch**, then hold down the Ctrl key and click **helix** (not the endpoint of the helix), **Fig. 26**.

Step 3. Click **Make Pierce** on the Content menu, **Fig. 26**. Make Pierce adds a Pierce relation between sketch and helix, **Fig. 27**.

Step 4. Click **Exit Sketch** on the Features toolbar.

Step 5. Save. Use **Ctrl-S**.

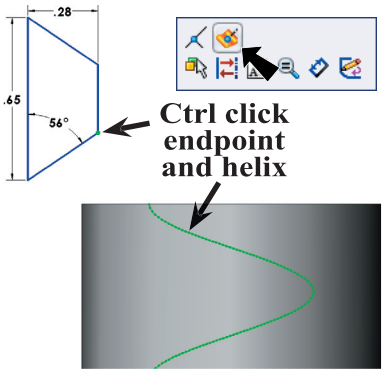



Fig. 26

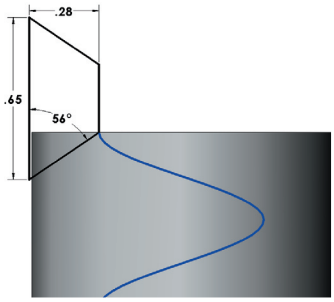



Fig. 27

## N. Sweep Cut Helix.

Step 1. Click **Features** on the Command Manager toolbar.

Step 2. Click **Swept Cut** on the Features toolbar.

Step 3. In the Cut Swept Property Manager:

for **Profile** field, click **sketch, Fig. 29**

click in the **Path** field and click helix

click OK

Step 4. Save. Use **Ctrl-S**.

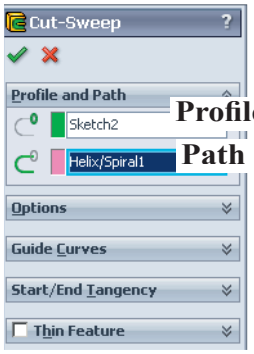



Fig. 28

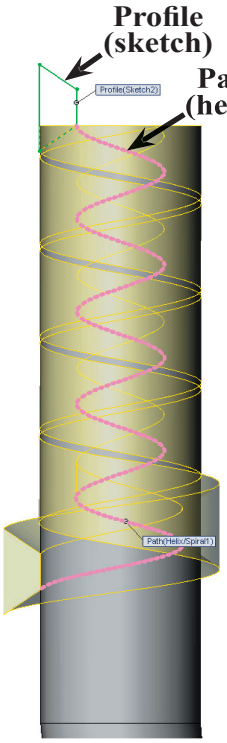



Fig. 29

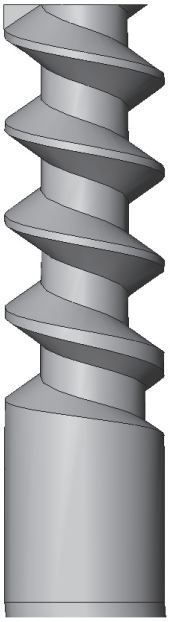


Fig. 30

## O. Chamfer.

Step 1. Click **Isometric** on the Standard Views toolbar. (**Ctrl-7**)

Step 2. Roll the rollback bar to above the **Cut-Sweep**. To rollback Cut-Sweep, click Cut-Sweep in the Feature Manager and click **Rollback** from the Content toolbar, **Fig. 31**.

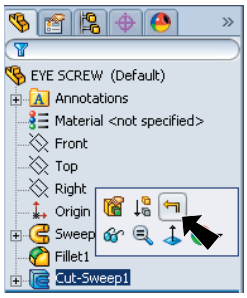


**Fig. 31**

Step 3. Click **Chamfer** on the Features toolbar.

Step 4. In the Chamfer Property Manager set:

**Distance distance**

Depth 1 to **.9**, **Fig. 32**.

Depth 2 to **.6**

Click the **top edge** of the eye screw, **Fig. 33**

Click OK in the Property Manager, **Fig. 34**.

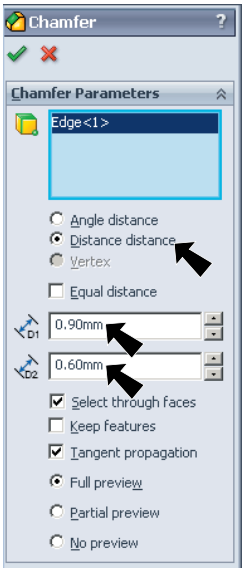


**Fig. 32**

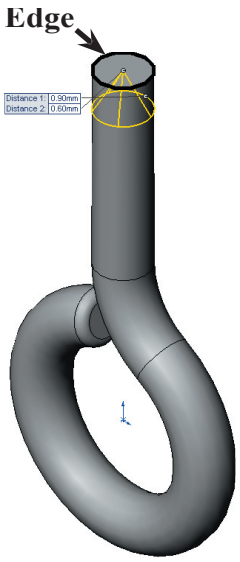


**Fig. 33**

Step 5. Roll forward to display the Cut-Sweep. To roll forward, **right click** Cut-Sweep in the Feature Manager and click **Roll Forward** in the menu, **Fig. 35** and **Fig. 36**.

## P. Material Steel 304.

Step 1. **Right click Material** in the Feature Manager and click **Edit Material**.

Step 2. Expand **Steel** in the material tree and select **Steel AISI 304**. Click **Apply** and **Close**.

Step 3. Save. Use **Ctrl-S**.

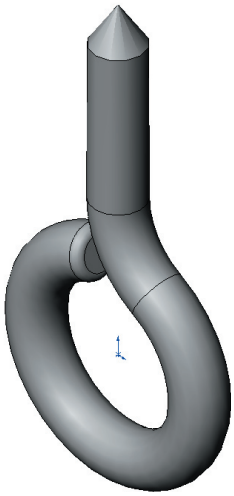


**Fig. 34**

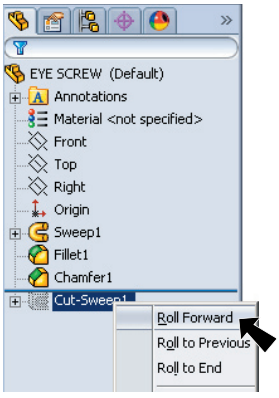


**Fig. 35**

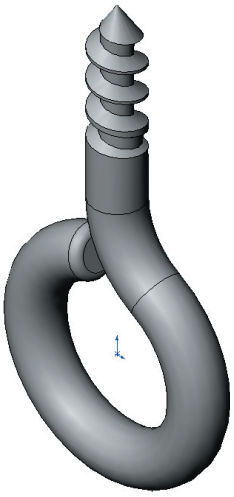


**Fig. 36**

## Q. Open Assembly File.

Step 1. Click File Menu > Open. Select your ASSEMBLY file and click OK.

Step 2. Click **BODY RAIL** in the Feature Manager and click **Open Part**  from the Content toolbar, **Fig. 37**.

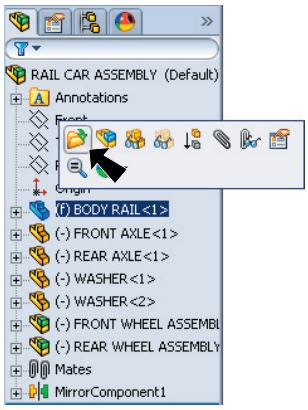


**Fig. 37**

## R. Hole Wizard.

Step 1. Click **Bottom**  on the Standard Views toolbar (**Ctrl-6**).

Step 2. Click **Wireframe**  on the View toolbar.

Step 3. Zoom in around **front axle hole**, **Fig. 38**. To **zoom**, hold down **Shift key** and drag with middle mouse button (wheel). To **pan**, hold down **Ctrl key** and drag with middle mouse button (wheel).

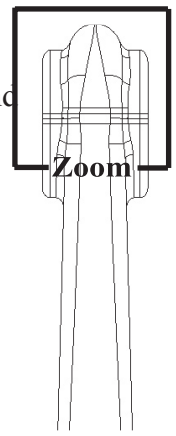
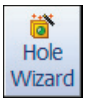


**Fig. 38**

Step 4. Click **Hole Wizard**  on the Features toolbar.

Step 5. In the Property Manager, on the Type tab set:
under Hole Type:
Click **Hole**  , **Fig. 39**
under Standard:
select **Ansi Metric**
under Size:
select **.9**
under End Condition:
set **Blind Depth Hole**  **to 1.5**

**click the Position tab** at the top of the Property Manager.

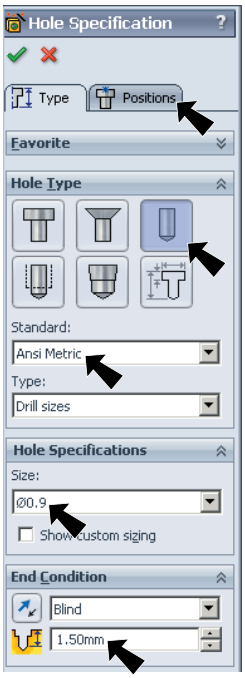


**Fig. 39**

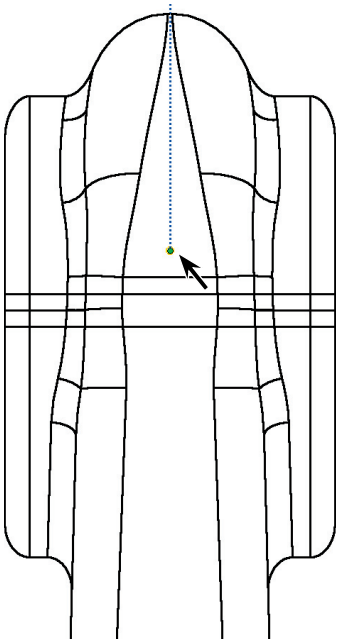


**Fig. 40**

Step 6. Click to place the hole approximately in the center of the body just above the axle hole, **Fig. 40**.

Step 7. Click **Point**  on the Sketch toolbar to **turn off** Point tool.

Step 8. Grab the point in the drawing and drag to activate the inferencing line, the dotted line that appears. Move the point to the inferencing line to align point with the center of the body, **Fig. 40**. Click OK  in the Point Property Manager.

Step 9. Scroll down to the rear axle hole, **Fig. 41**. To scroll hold down **Ctrl and press up arrow key**.

Step 10. Click **Point**  on the Sketch toolbar to **turn on** Point tool.

Step 11. Add a point for the rear eye screw. Click to place the hole approximately in the center of the body just above rear axle hole, **Fig. 41**.

Step 12. Click **Point**  on the Sketch toolbar to **turn off** Point tool.

Step 13. Grab the point in the drawing and drag to activate the inferencing line, the dotted line that appears. Move the point to the inferencing line to align point with the center of the body, **Fig. 41**. Click OK  in the Point Property Manager.

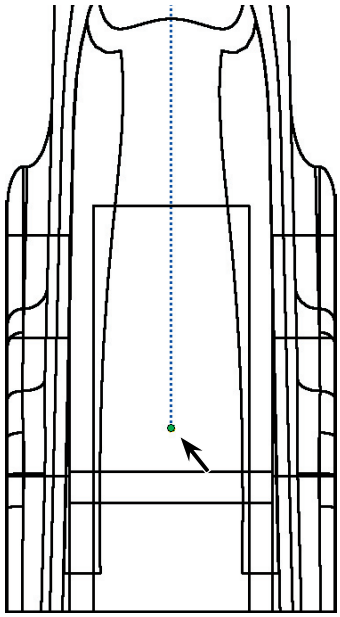


**Fig. 41**

Step 14. Click OK  in the Hole Wizard Property Manager.

Step 15. Click **Shaded With Edges**  on the View toolbar, **Fig. 42**.

Step 16. Save. Use **Ctrl-S**.

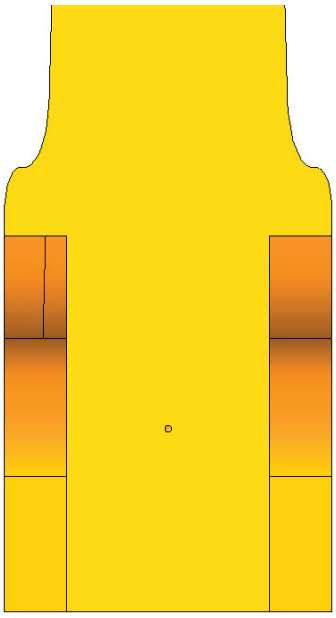
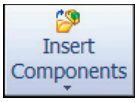


**Fig. 42**

## S. Insert Eye Screws into Assembly.

Step 1. Switch back to the ASSEMBLY file. Use Window Menu > RAIL CAR ASSEMBLY.SLDASM.

Step 2. Hold down middle mouse button (wheel) and drag to **rotate view** as shown in **Fig. 43**.

Step 3. Click **Insert Components** 

on the Assembly toolbar.

Step 4. Click **Keep Visible**  in the Property Manager.

Step 5. Click **Browse** in the Property Manager.

Step 6. Select your **EYE SCREW** file and click Open.

Step 7. Insert two eye screws approximately where the eye screws are positioned in **Fig. 43**. Click OK  in the Property Manager when done.

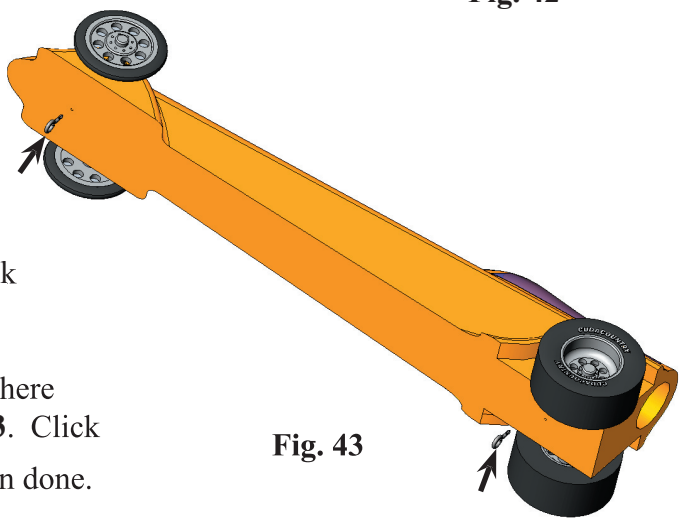


**Fig. 43**

## T. Mate: Eye Screws and Body.

Step 1. Zoom in around **front eye screw and hole**, **Fig. 44**. To **zoom**, hold down **Shift key** and drag with middle mouse button (wheel). To **pan**, hold down **Ctrl key** and drag with middle mouse button (wheel).

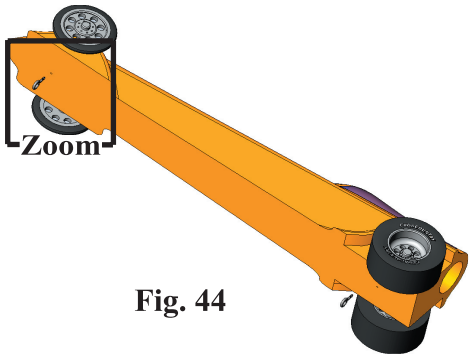


**Fig. 44**

Step 2. Click **Mate** 

on the Assembly toolbar.

Step 3. Click **cylindrical inside face of the hole in body** and **cylindrical face of eye screw** just above the threads, **Fig. 45**.

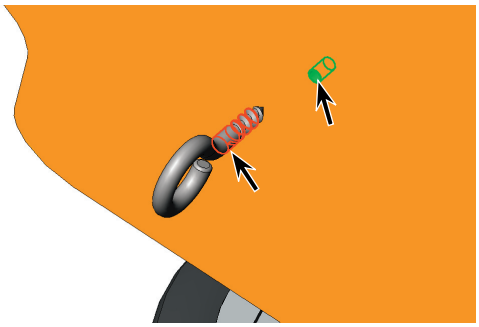
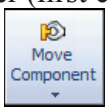


**Fig. 45**

Step 4. Click Add/Finish Mate  in Mate pop-up toolbar to add a **Concentric** mate, **Fig. 46**.

If the becomes hidden inside the body, first close Mate Property Manager. Click the part in Feature Manager (first eye screw). Then, click Move Component 

on the Assembly toolbar and **drag down in drawing area away from any part**. Do not drag on any part. Click OK  in the Property Manager when done with move.

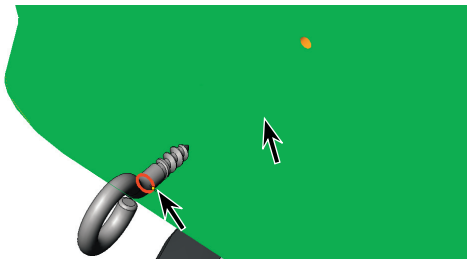


**Fig. 46**

Step 5. If necessary, click **Mate** 

on the Assembly toolbar. Click **bottom face of the body** and **round edge of the eye screw**, **Fig. 46**.

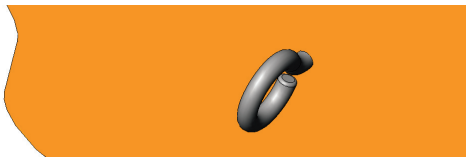


**Fig. 47**

Step 6. Click Add/Finish Mate  in Mate pop-up toolbar to add a **Concentric** mate, **Fig. 47**.

Step 7. Expand the Design Tree (click +) in the top left corner of the drawing area, **Fig. 48**.

Step 8. Click **Right** (plane), **Fig. 48**.

Step 9. Expand **EYE SCREW 1** and click **Right** (plane), **Fig. 48**.

Step 10. Click Add/Finish Mate  in Mate pop-up toolbar to add a **Coincident** mate.

Step 11. Click Zoom to Fit  (**F**) on the View toolbar.

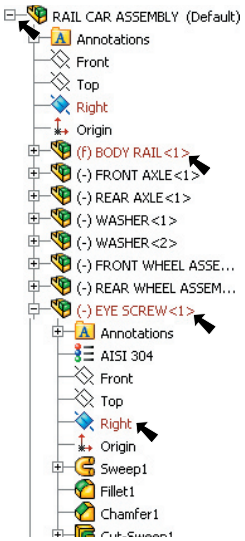


**Fig. 48**

Step 12. Zoom in around **rear eye screw and hole**, **Fig. 49**. To **zoom**, hold down **Shift key** and drag with middle mouse button (wheel). To **pan**, hold down **Ctrl key** and drag with middle mouse button (wheel).

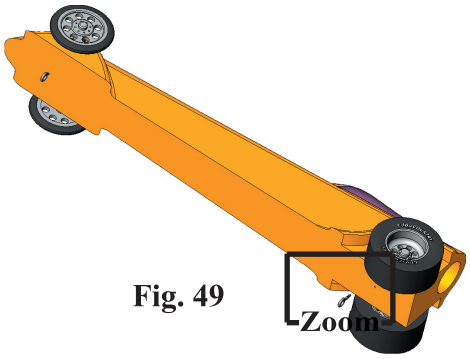



**Fig. 49**

Step 13. Click **cylindrical inside face of the hole in body** and **cylindrical face of eye screw**, **Fig. 50**.

Step 14. Click Add/Finish Mate  in Mate pop-up toolbar to add a **Concentric** mate, **Fig. 51**.

If the eye screw becomes hidden inside the body, first click OK  to close Mate Property Manager. Click the part in Feature Manager (second eye screw).

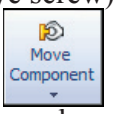
Then, click Move Component  on the Assembly toolbar and drag down in drawing area. Do not drag on any part. If eye screw does not drag out of the body, check that the eye screw is selected in the Feature Manager before you click Move Component.

**Fig. 50**

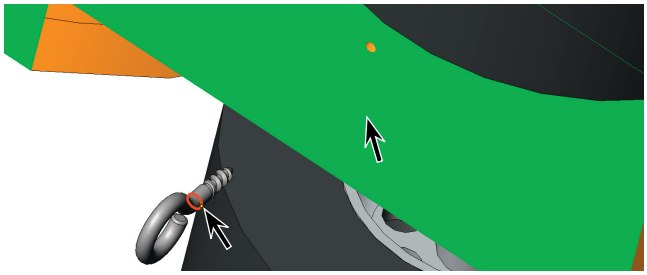


**Fig. 51**

Step 15. If necessary, click **Mate**  on the Assembly toolbar. Click **bottom face of the body** and **round edge of the eye screw**, **Fig. 51**.

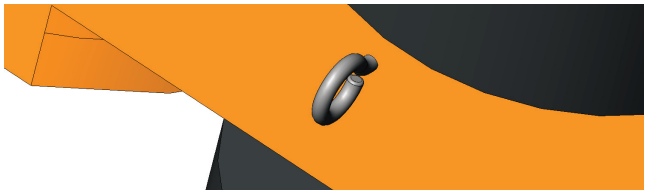


**Fig. 52**

Step 16. Click Add/Finish Mate  in Mate pop-up toolbar to add a **Concentric** mate, **Fig. 52**.

Step 17. Expand the Design Tree (click +) in the top left corner of the drawing area, **Fig. 53**.

Step 18. Click **Right** (plane), **Fig. 53**.

Step 19. Expand **EYE SCREW 2** and click **Right** (plane), **Fig. 53**.

Step 20. Click Add/Finish Mate  in Mate pop-up toolbar to add a **Coincident** mate and OK  in the Property Manager when done.

Step 21. Save. Use **Ctrl-S**.

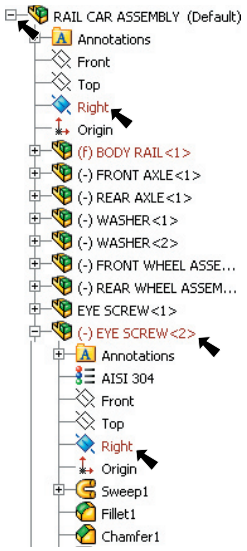



**Fig. 53**