Deep Exploration 5.0 Tutorial

Materials, Disassembly Animation and Steps

Welcome to the world of 3D with Right Hemisphere!

The aim of this tutorial is to learn how to use Deep Exploration CAD Edition to:

- Clean up a model and fix two common errors for better display.
- Differentiate the scene's objects by applying materials and reducing the file size.
- Create a disassembly animation and turn it into a number of steps.
- Publish the file to a PDF document.

Assumptions

Certain assumptions have been made regarding this tutorial:

- You should be familiar with 3D concepts.
- You should be familiar in the use of Deep Exploration.
- Note that the display of the model on your computer during this tutorial may be different depending on the graphics card installed on your computer, the screen geometry, and the colors and placement of objects that you choose.

Features Covered

- Cleaning up a model.
- Differentiating objects.
- Reducing polygons.
- Create a disassembly animation.
- Creating steps.
- Saving to a PDF document.

Requirements

The following software and files are required for this tutorial are:

- Deep Exploration CAD Edition version 5.0..x.
- The PDF Publishing Module.
- A 3D file accessible to your computer.

Completion Time

This tutorial should take approximately 1 hour to complete.

Before You Begin

- Save the Gearbox-8.rh, Gearbox-8a.rh, Gearbox-8b.rh, Gearbox-8c.pdf, and Materials-1.rhm files that are delivered with this tutorial to My 3D Models folder. This folder is created when you install Deep Exploration.
  - Gearbox-8.rh, Gearbox-8a.rh, Gearbox-8b.rh, and Materials-1.rhm are the files required to complete this tutorial. Gearbox-8c.pdf can be used to compare your end results.
- Ensure the PDF Publishing Module is installed on your computer.

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Cleaning Up the Model

The model used in this procedure contains a number of common errors. The procedure corrects these errors and colors the model appropriately.

Note: Depending on the origin of a model, it may not be possible to clean it up completely to make it perfect for display.

Procedure: Cleaning Up the Model

1 Open the Gearbox-8.rh file and examine the model for obvious mesh errors. You will notice that the casing looks correct.

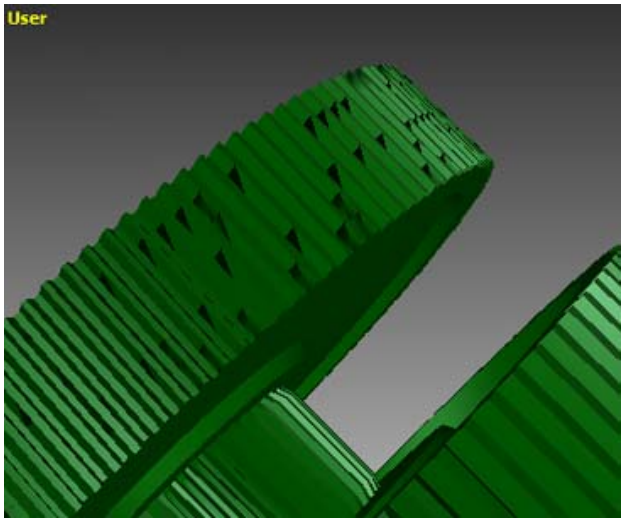
2 Make the casing invisible by doing one of the following:

- Select each of the gearbox 'TOP' and 'BOTTOM' objects in the viewport and press H on your keyboard.

  Note: The H key toggles the visibility of selected objects.

- Clear the 'TOP' and 'BOTTOM' check boxes in the Scene tree.

3 Notice that there is a shading error on the GEAR2 object; all the edges are there but they look chipped.

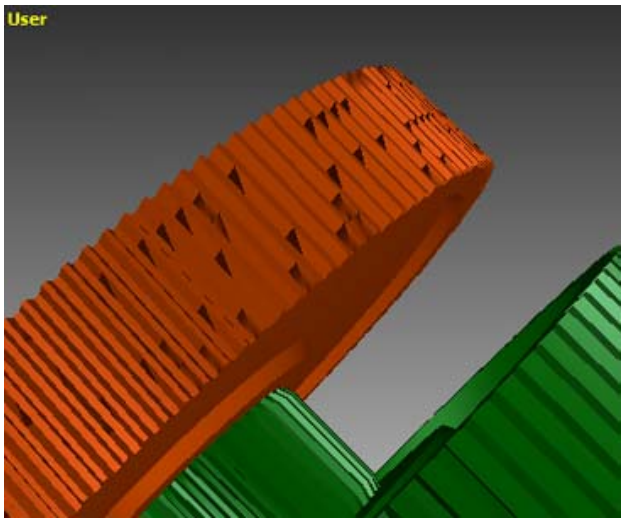


The solution is to unify the normals to ensure all the faces point the same way.

4 Select the GEAR2 object. Note that if you do not select the gear, all objects will be processed which could take some time.

Tip: When you select the object, it is highlighted with the color assigned to the 'Selection highlight' element in the Tools > Options dialog. You can modify this color at any time.

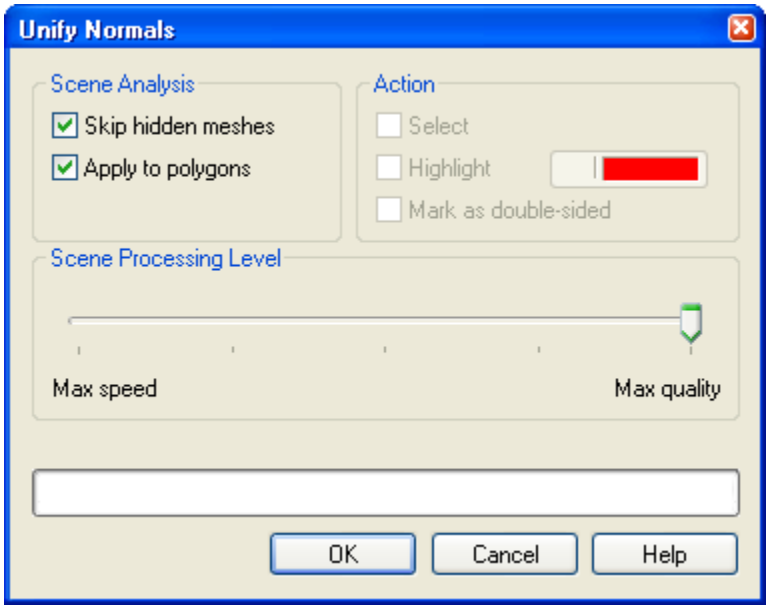
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5 Click **Unify Normals**  on the CADTools toolbar. The Unify Normals dialog is displayed.

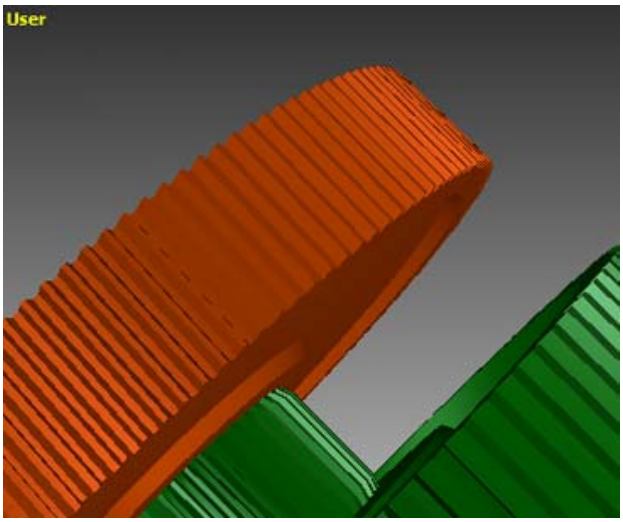
6 Select the 'Apply to polygons' check box and ensure the quality is at its maximum.

Note: As the model is one surface with certain individual polygons flipped in the wrong direction, we should use this option. If all the objects were inside out, leaving this option clear would make the processing much faster.



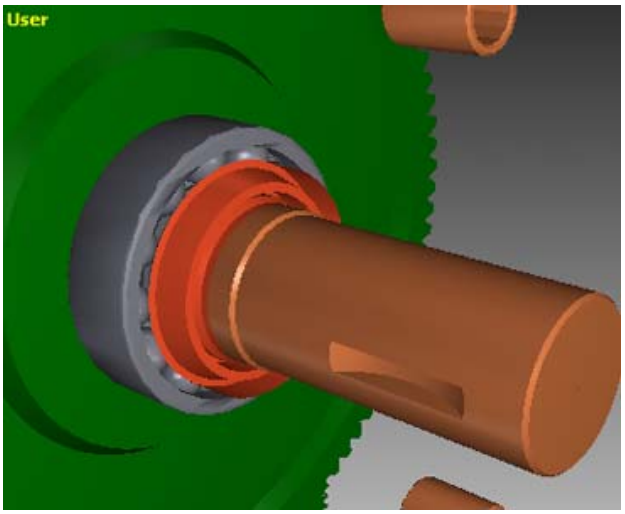
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7 Click **OK**. The normals are unified and the object's edges display correctly.



8 Rotate the model and select the SEAL object. Notice that it looks 'inside out'.

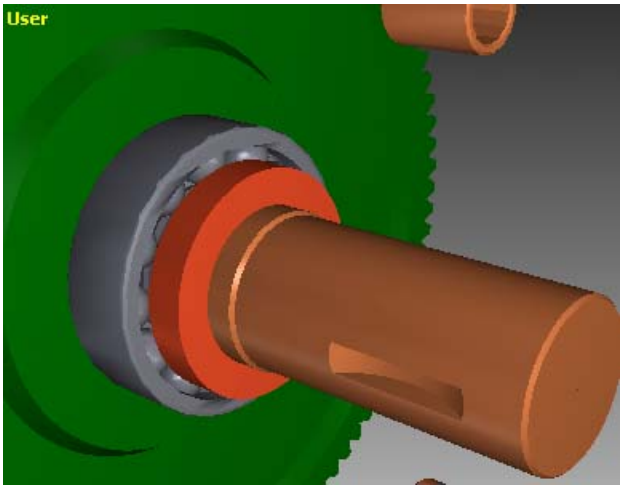
Tip: Use CTRL+H to turn the back-face rendering off to see this clearly.



To correct this, we invert the normals and faces to display the object around the right way.

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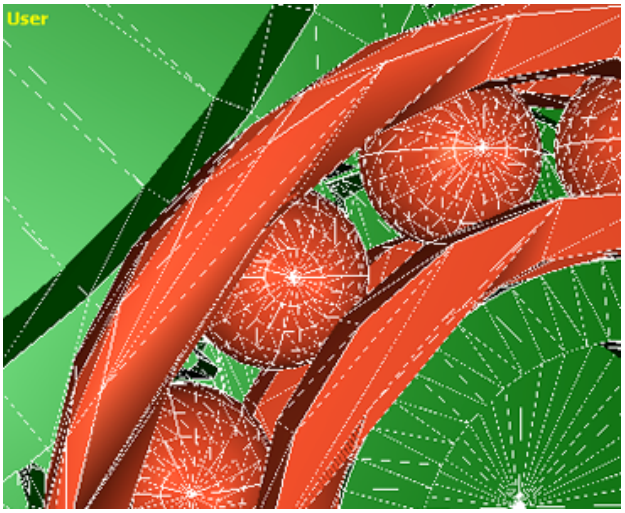
9 Select Click **Invert Faces and Normals**, , on the CADTools toolbar. The faces and normals are inverted and the object displays correctly. The remaining objects look good enough for us to use.



If we look closely at the shading on the bearing (BALLB1 object), we can see that the model was incorrectly tessellated.

10 Do one of the following to help us see the tessellation:

- Choose **Display > Solid Wireframe** on the menu bar.
- Click **Solid Wireframe**  on the Display toolbar.
- Press CTRL+7 on your keyboard.



The only solution for this kind of error is to have a properly tessellated original model. You should try getting the original CAD model and importing it directly to correct it.

While examining the model in Solid Wireframe mode, we can also see that there many polygons in the scene. We will reduce the number of these later in this tutorial, as we do not need so many polygons for our purposes.

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11 Display the model in Solid mode again.

12 Before continuing to the next phase of this tutorial, enable the **TOP** and **BOTTOM** objects in the scene, i.e. tick the relevant checkbox next to the object.

You have just completed correcting certain errors in the model. We can now assign some materials to differentiate the objects.

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Applying Materials

The objects are difficult to differentiate in the scene. Currently, this file only contains three material definitions. We now apply some new materials to the model and make the case transparent so we can see the internal workings.

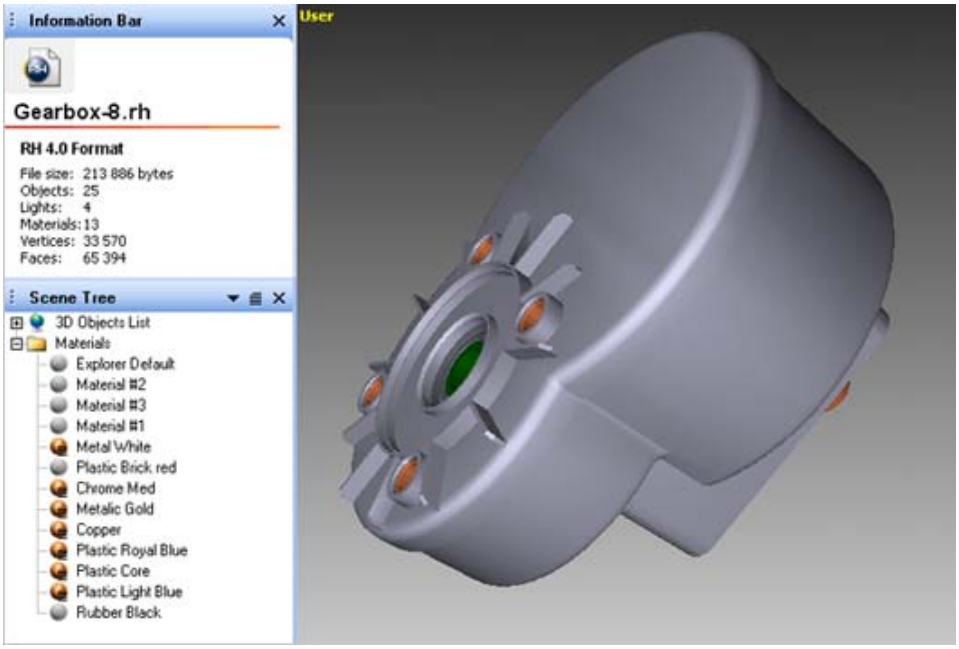
Procedure: Differentiating Objects

1 Open the Materials folder in the Scene tree. Notice that there are only four materials in the scene.

2 Do one of the following to merge the **Materials-1.rhm** file into the scene:

- Choose **File > Merge File** on the menu bar, navigate to and select the .rhm file, and then click **Open**.
- Drag the .rhm file anywhere in the viewport.

Notice that nine new materials have been added to the Materials folder.



3 Select the TOP and BOTTOM parts of the grey casing and assign the 'Metal White' material to them by doing one of the following:

- Select the objects in the viewport or Scene tree, and then drag the material anywhere in the viewport.
- Drag the material onto each object in the viewport, without selecting the objects.

4 Double-click the 'Metal White' material in the Scene tree and modify the opacity to **20**. The result is an external shell that you can see through.

Now we will change the gear colors to make them clearer. Notice in the Scene tree that the model contains a number of sub-objects. These are unusual in how they are set up so, let us look at them more closely.

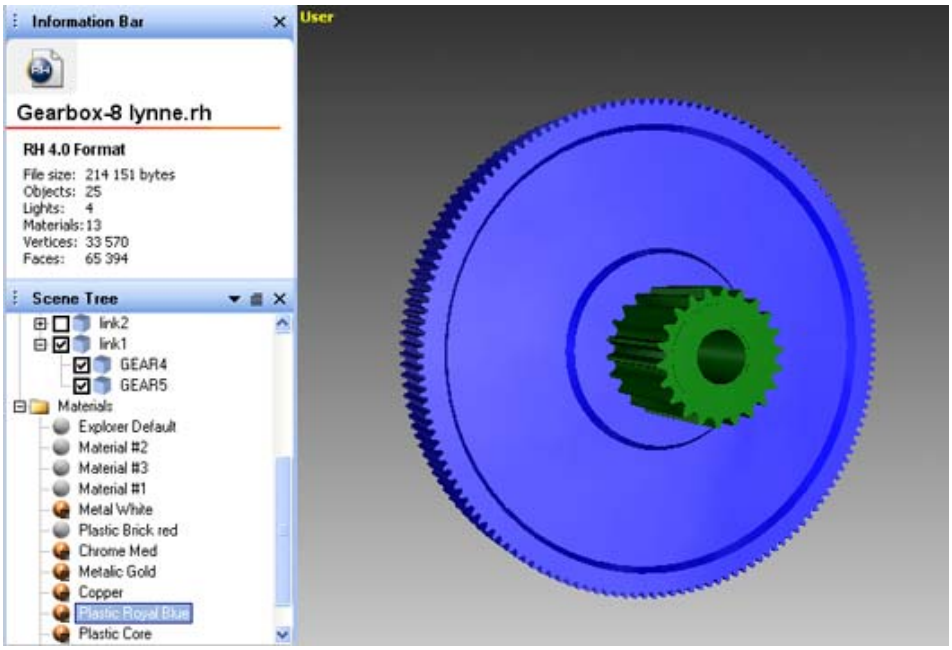
5 Select the link1 object (the small green object at the center of the gear).

6 Right-click in the viewport and click **Hide All Objects** to make all other objects invisible.

7 Expand the link1 object in the Scene tree and rotate the model to see the two gear objects clearly.

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8 Drag the **Plastic Royal Blue** material onto the **GEAR4** object.



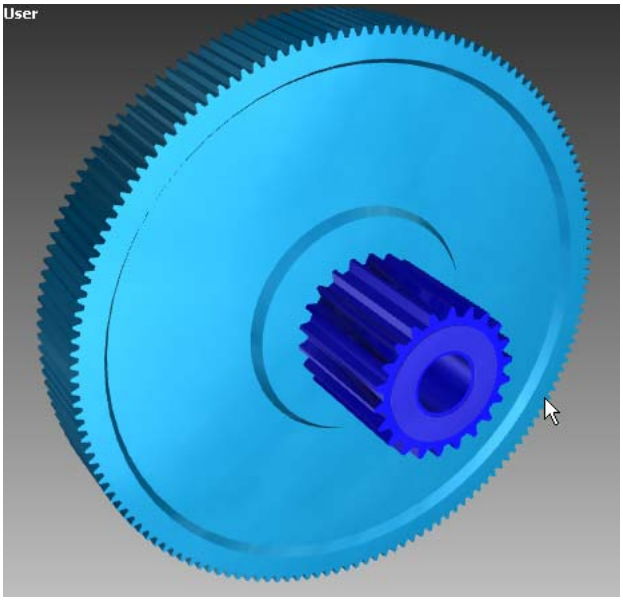
9 Drag the **Plastic Light Blue** material onto the link.

10 Clear all objects from selection.

Notice that all three objects are light blue. This is because the link1 object is not an empty group in the hierarchy and itself contains a mesh; so there are three meshes in this group. This link is a small core that holds both gears together in the assembly, and the two gear objects are structured under this link1 object.

Therefore, regardless of applying the royal blue material to one of the gears, the light blue material covers all sub-objects of the object of which it was applied. Therefore, the order is important when applying materials manually; you must apply a material to the link first, and then apply materials to the gears.

11 Drag the **Plastic Royal Blue** material onto the link, and then drag the **Plastic Light Blue** material onto the large gear. The model should look similar to the following image.



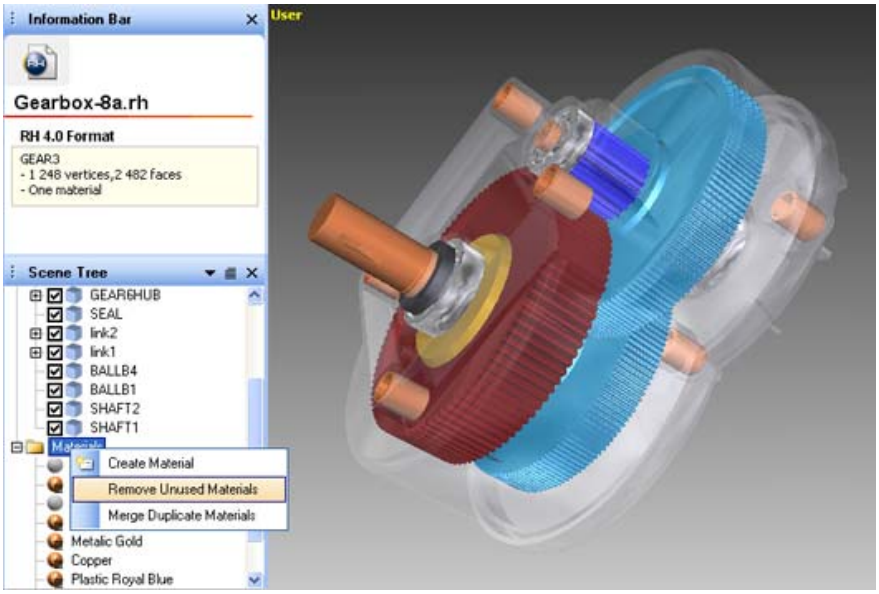
12 Continue to apply the other materials to the different objects in the model until you are satisfied with the overall look. Take note when applying materials to the link2 object as it also has an unusual group structure similar to the link1 object.

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Tip: Turn the objects' visibility on and off to see the overall effect and to make it easier to apply the materials to specific objects.

Tip: Press H on your keyboard to hide and show selected objects.

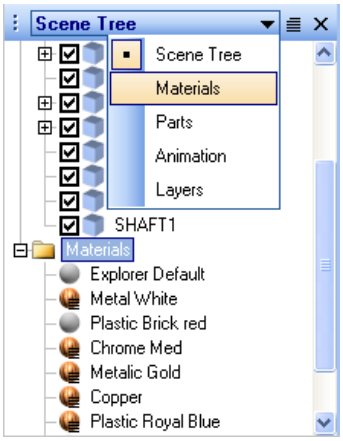
13 Remove any unused materials from the scene. The model should look similar to the following image.



There may be some materials left that you did not expect. If this is the case, you can locate the objects to which they are attached, apply the materials you want, and then remove the unused materials again.

14 Do one of the following to select the objects that use the rogue material:

- Right-click the material and click **Select Objects**.
- Click **Materials** in the Scene Component panel's drop down menu and select the rogue material.



15 Drag another material into the scene. The selected objects material is overwritten.

16 Create new materials and apply them as you require, then remove any unused materials until you are happy with the scene's structure.

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Reducing Polygons

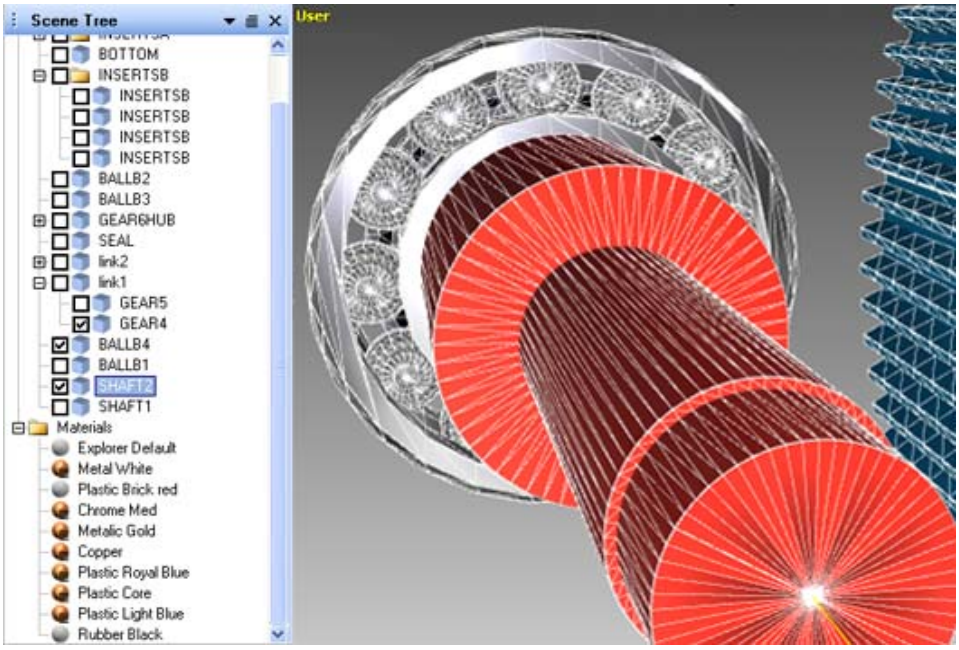
The scene objects are densely tessellated. We may not need all these polygons for our purposes, so we can remove some of them to make the file smaller without compromising visual quality.

Procedure: Reducing File Size

1 Right-click the menu bar and click **Information Bar** to give us more room to display the Scene tree.

2 Hide all the objects, and then show only the GEAR4, BALLB4, AND SHAFT2 objects.

3 Change the display mode to Solid Wireframe and rotate the model so that you have a view similar to the one shown below.

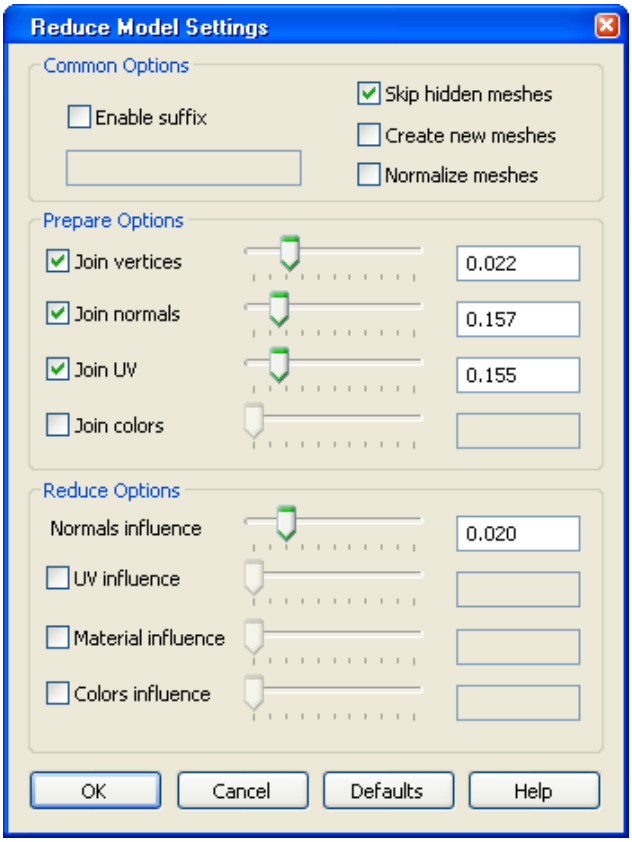


Looking at the large gears, you can see that there are a number of polygons that make up each ridge. These should be able to be removed without causing a loss in visual information.

4 Select BALLB4 and click **Reduce Model** on the CADTools toolbar.

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5 Click **Settings** on the Reduce Model dialog and establish the settings as shown in the following image.



Note: These values are approximate only. Experiment with what happens if you use larger or smaller values. If your model does not contain any UV coordinates, you will not need to preserve them in the reduction and so you can clear the Join UV check box.

6 Click **OK** and then click **Process** to reduce the model. The model is automatically displayed at 100% reduction.

7 Move the slider to the left and notice that the bearings become less detailed, but the outer bearing jacket essentially remains stay the same until the ‘keep’ percentage is approximately 54. At this point, we have reduced the bearings to the maximum possible before the bearing jacket begins to visibly change shape. We could go further depending on the way in which you want to use the file.

8 Click **OK** to apply the reduction.

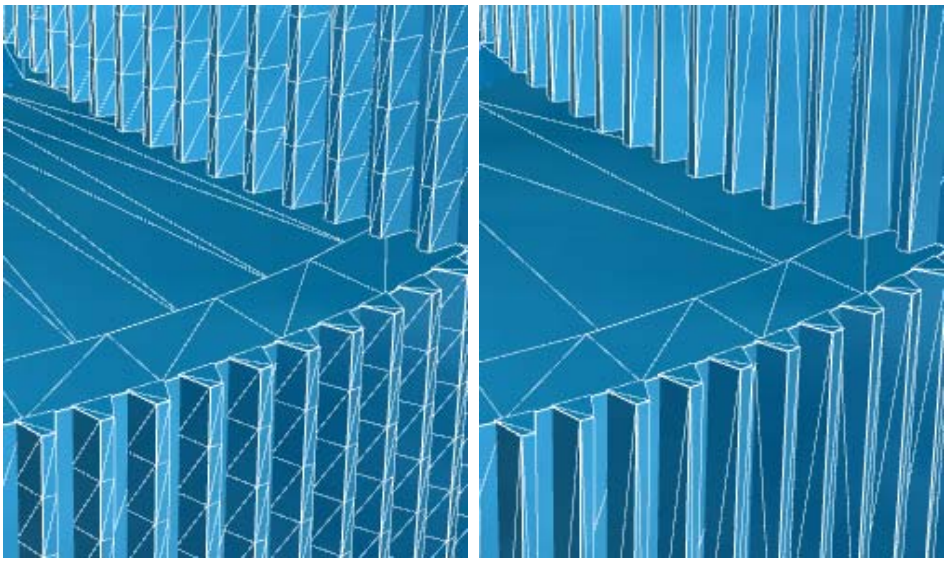
9 Repeat steps 4 through 8 for the following objects and ‘keep’ reductions:

- GEAR2 AND GEAR4 = 30%.
- BALLB1 = 54%.
- SHAFT2 = 50%, SHAFT1 = 60%.

Note: Make the relevant objects visible to see the reductions taking place in the viewport.

The following images show the gears before and after their reduction.

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Before reduction / After reduction

Tip: Frequently you can reduce a model by 50% without seeing a visual discontinuity. Some models can go as low as 30%. If an object is to be seen in close-up, you should avoid reducing it too much.

The resulting file, when saved is 44K faces versus an original 65K faces. Further reduction can be done performed to decrease the model's size. You can also reduce the entire scene at once by ensuring no objects are selected and then performing the reduction.

The scene is now prepared for further animation.

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Create a Disassembly Animation

We want to produce a step-by-step example of how to disassemble this assembly. To do so we will create a number of animations that show this process. Then we will make steps that will also have views associated with them to better illustrate this process. We can also add descriptions to describe actions associated with each step.

We could have reduced the model first and then animated it. However, this workflow is preferred with the least effort and simplest results.

Note that this animation is 1 second in length and has 30 frames.

Workflow Decision Point

The first thing we want to do is remove the lid of the casing. We have two basic approaches we can use; we must choose one based on our business workflow: Do we group the 'insert' objects under the lid or do we move all the objects individually?

This decision is important for Deep Server users because if we regroup we will alter the hierarchy of the scene and, if using this workflow in Deep Server, we would expect to be able to automatically apply the animation we are creating now to a newer version of the same part.

This tutorial describes altering the hierarchy for the bottom of the casing only, so that we can see both workflows. You can choose to follow the procedure and alter only one, or you could alter both objects based on your workflow decision.

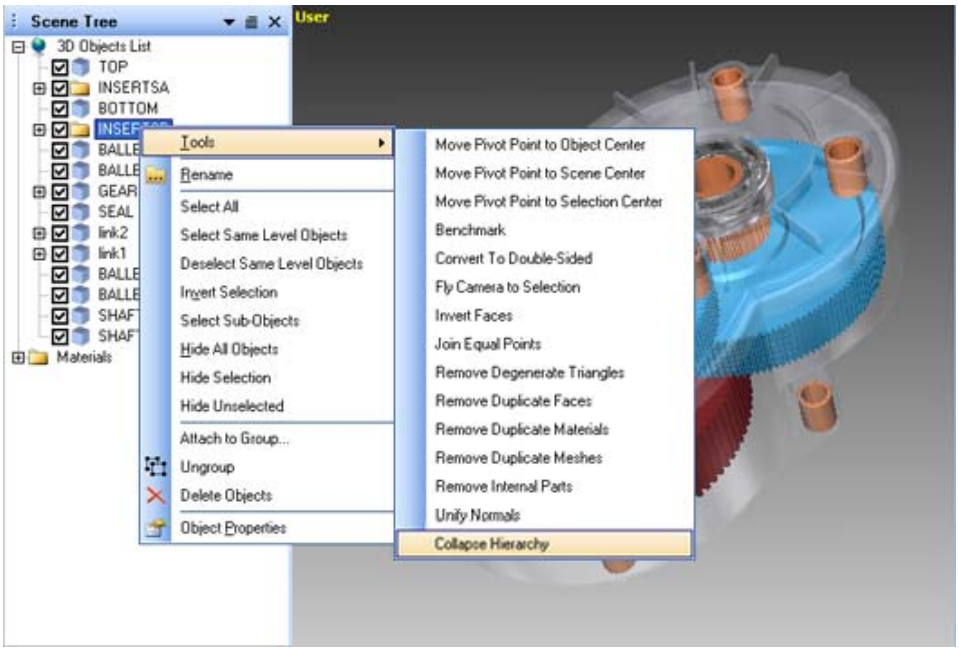
Procedure: Make Disassembly Animations

1 Do one of the following:

- Open the **Gearbox-8a.rh** file.
- Keep the file you have been working on open.

2 Select the **INSERTSB** object group in the Scene tree, and then collapse the hierarchy by clicking **Collapse Hierarchy** from the right-click Tools menu.

Note: You may need to rotate and zoom the model to gain a similar view to the one in the image below.



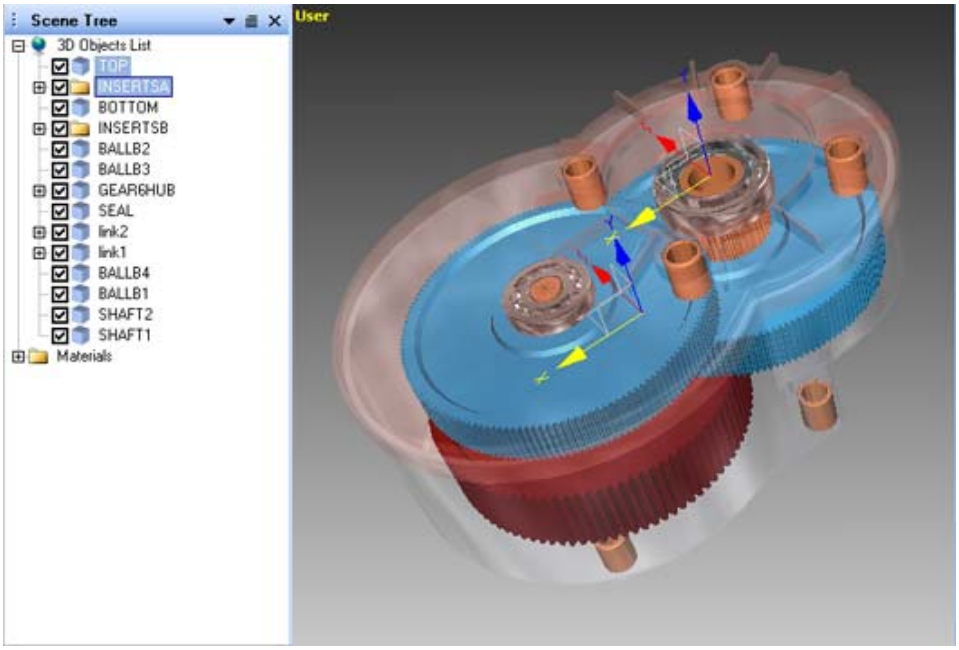
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3 Select the **TOP** object and the **INSERTSA** object group using the CTRL key to select multiple objects.

Note: We do not need to select each INSERTSA sub-object individually as we are moving them as a group. However either approach will work.

4 Click Move  on the 3D Editor toolbar and notice that the pivot points are in separate locations. However, they are pointing in the same direction.

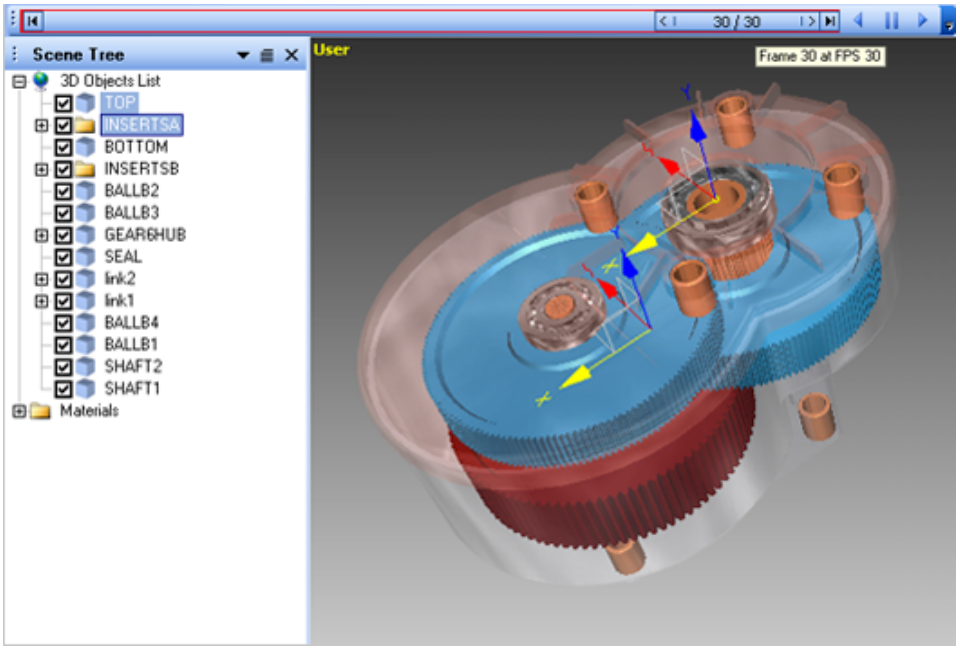
Tip: If they were not pointing in the same direction, we might want to position them in the same place and orientation using the 'Move Pivot Point to Selection Center' tool (right-click viewport > Tools). Remember that you can undo previous operations using CTRL+Z or the Undo tool.



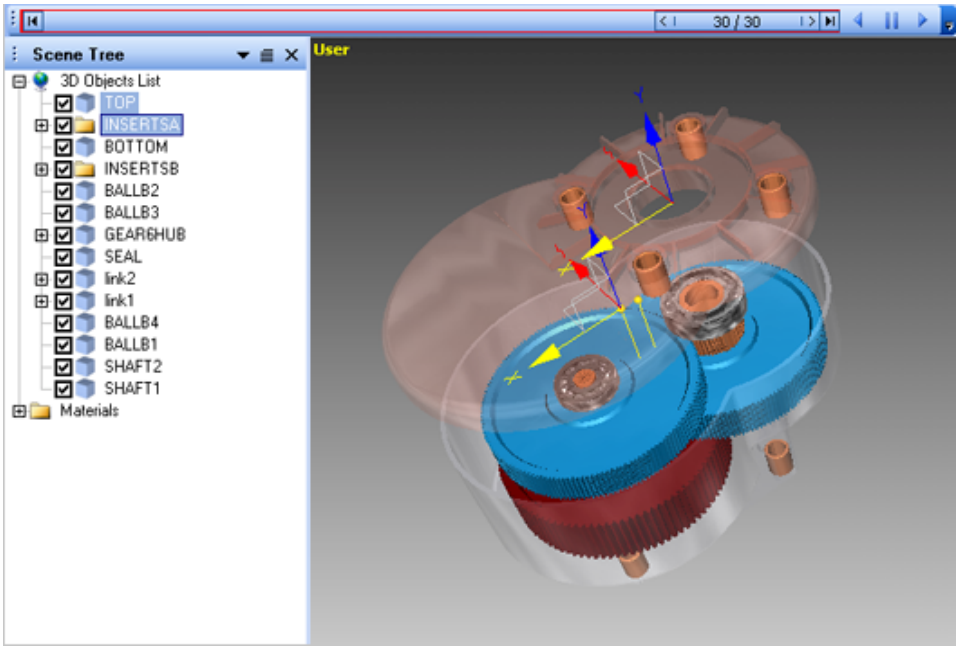
5 Click **Edit Keyframes**  on the 3D Editor toolbar. This ensures that we animate the objects, not move them permanently to a new location. As there is no existing animation on the model, a new animation called Sequence-1 is automatically created, the Animation controls appear with a red outline, and they are set to frame 0.

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6 Move the slider to the last frame (frame 30) to set the new position for the end of the animation. Now if we move the model, we will be setting a new position for the selected objects and they will move to the new position.



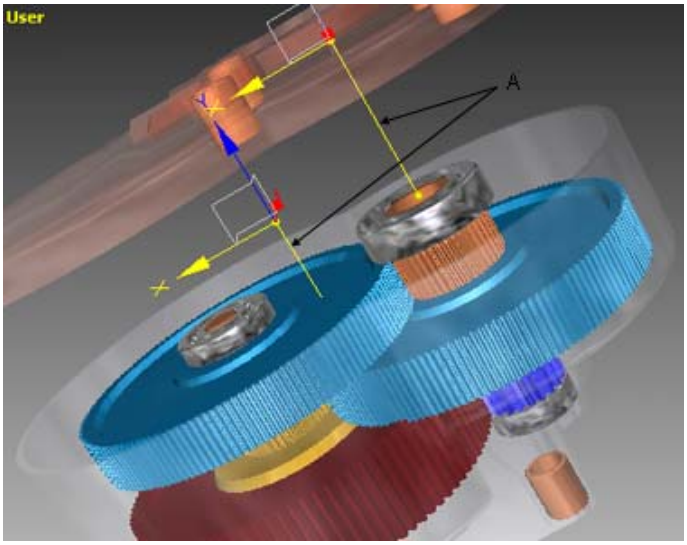
7 Drag the selected objects along the blue Y-axis until you can see a good separation from the remaining objects. Note that axis is highlighted in yellow when selected.



8 Click **Edit Keyframes** again to turn off key frame animation and avoid accidentally creating new keys.

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9 Click Forward  on the Animation controls to play the animation. Note that when animated objects are selected, you can see their motion paths using the 'Show motion paths' check box in the Tools > Options dialog > 3D View tab.

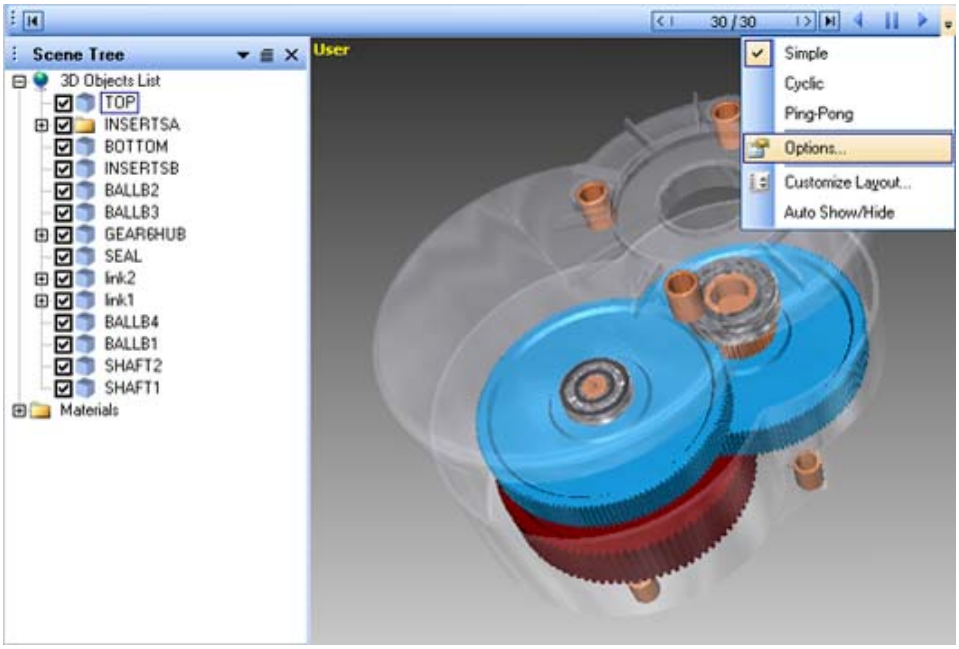


A: Motion paths of selected objects

We now create a new animation sequence, which will move the bottom of the casing away from the gears.

10 Do one of the following to add a new sequence:

- Click **Animation** in the Scene Component panel's drop down menu, right-click in the Animation tree, and then click **Create Sequence**.
- Double-click the Animation controls and click **Add**.
- Click the arrow at the end of the Animation controls, click **Options** from the Menu, and then click **Add**. A new sequence is added.



As soon as the new sequence is added, the current sequence is displayed on the left said of the Animation controls.

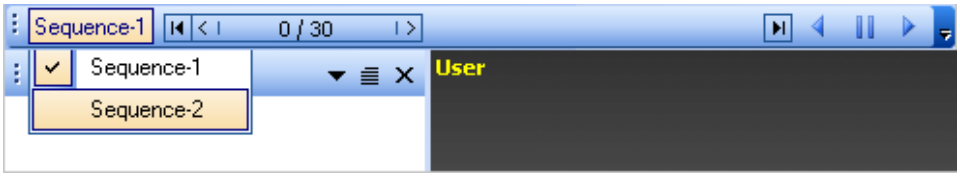


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Note: You can rename the new sequence by right-clicking in the Animation tree and clicking Properties, or by double-clicking the sequence or clicking Edit in the Animation Options dialog.

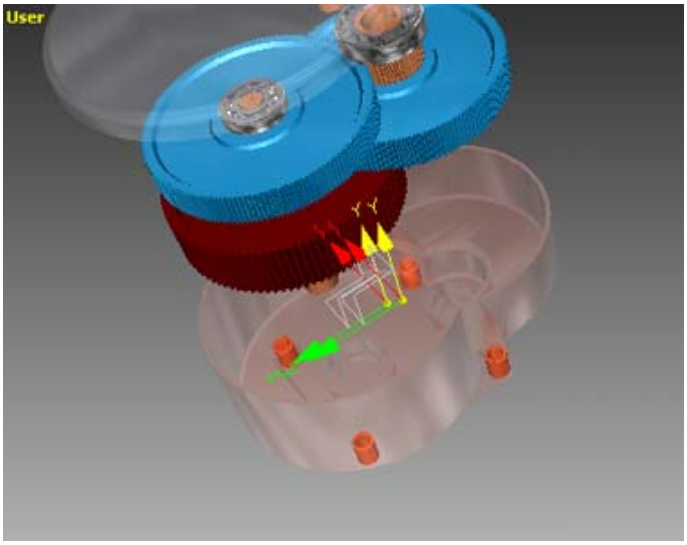
11 Activate the new sequence by doing one of the following:

- Double-click the new sequence in the Animation tree. The sequence name is displayed in bold as it is activated.
- Click the sequence name at the left end of the Animation controls.



12 Press SHIFT+L and then click **Edit Keyframes** to turn on key frame animation and move to the last frame in the new sequence.

13 Move the BOTTOM and INSERTSB parts away from the model.

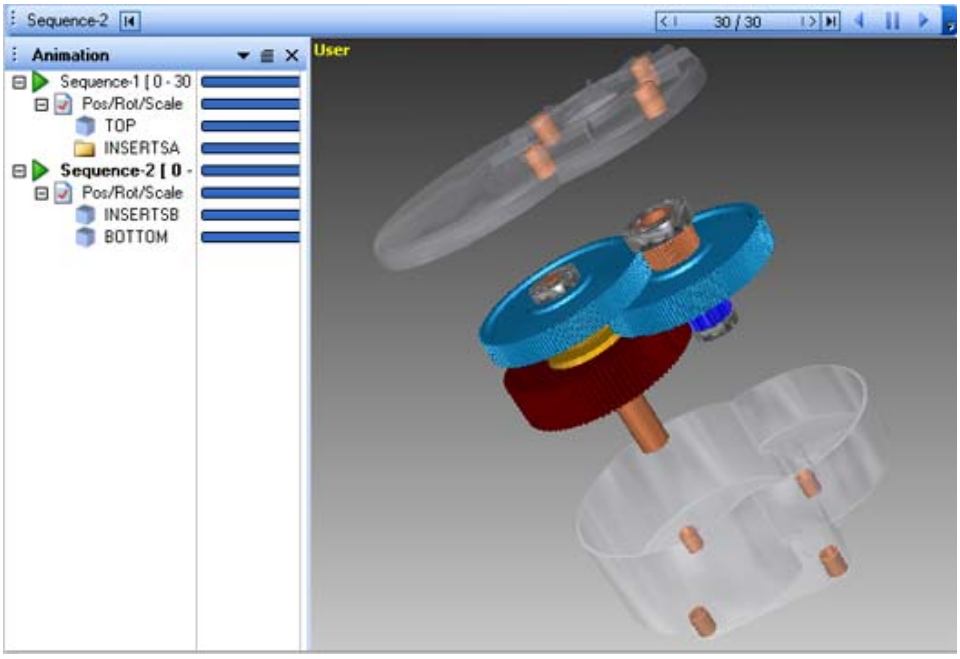


14 Turn off key frame animation when you have finished positioning the objects.

You should now have two sequences, which you can select and play forward. We now expand the sequences in the Animation tree to make it easy to edit and fine-tune the object positions later on.

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15 Open the Animation tree in the Scene Component panel and expand the sequences. Notice that the only objects referenced are the ones that have been moved.



We now disassemble the gears and bearings.

16 Hide the objects we have already animated. That is, the TOP, BOTTOM, INSERTSA, and INSERTSB groups.

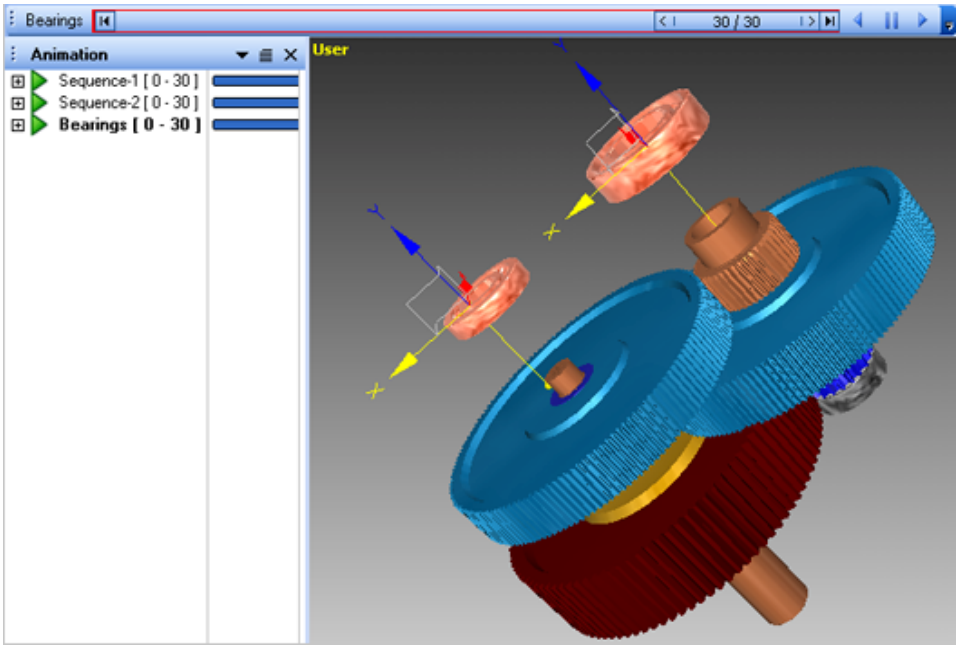
Tip: Remember that you can do this via the object check boxes in the Scene tree or by selecting the objects and pressing H on your keyboard.

17 Do the following to move the two bearings off the end of the shafts:

a) Create a new sequence and call it something meaningful (for example, 'Bearings'), then select it in the Animation controls or Animation tree.

b) Turn on key frame animation and move to the last frame of the sequence.

c) Select BALLB1 and BALLB2 and move the parts to another location similar to the image below.



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This time we leave the Edit Keyframes tool on so that we create sequences efficiently. The approach we take is to make a series of sequences and separate the parts one section at a time.

18 Do the following to move the link clear of the gear's shaft:

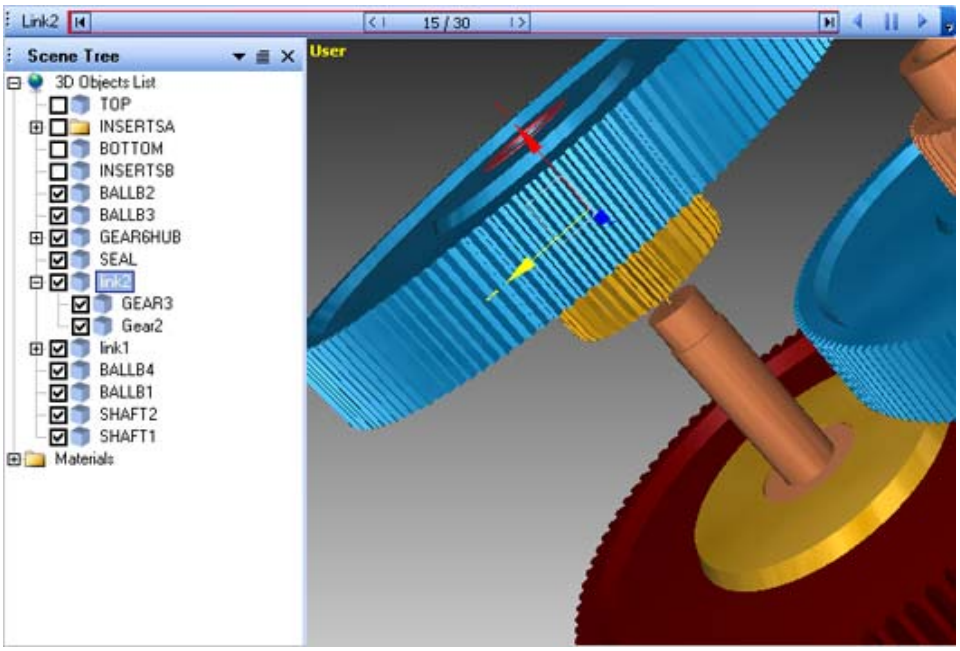
d) Create a new sequence and call it something meaningful (for example, 'Links'), then select it in the Animation controls or Animation tree.

e) Expand the 'link2' gear assembly in the Scene tree.

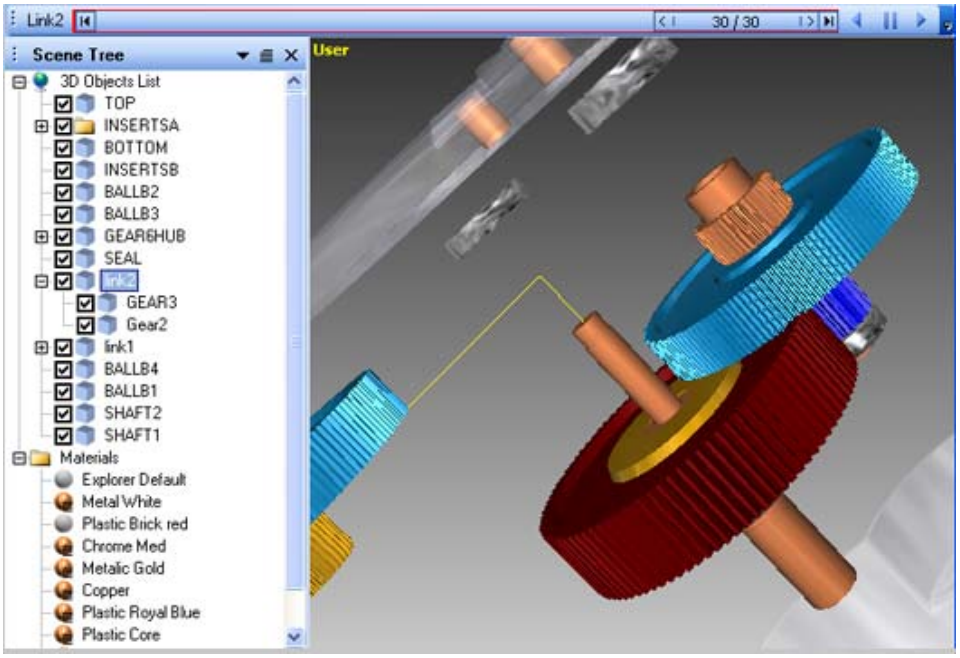
f) Select the link at the center of the gear (link2 object).

g) Move the animation slider to frame 15. This means we can set two movements for this link within the same sequence.

h) Move the link outwards clear of the gear's shaft.



i) Move the animation slider to frame 30 and move the link2 object sideways to clear the scene.



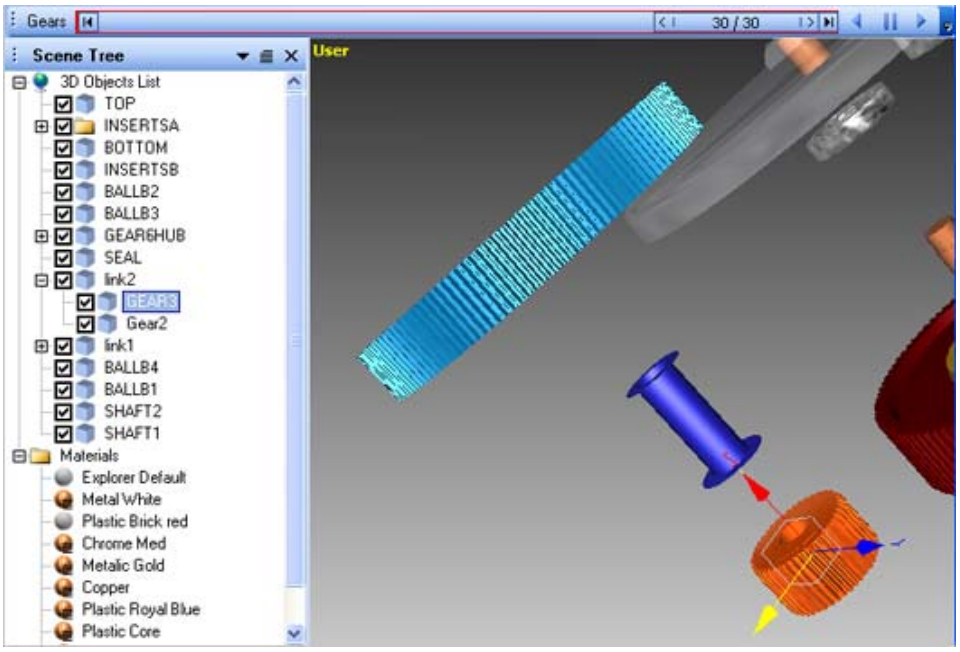
19 Do the following to separate the gear:

j) Create another sequence called Gears and select it.

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k) Move to frame 30.

l) Move GEAR2 and then GEAR3 out from the link's spindle.



m) Turn off key frame animation and click the Select tool on the 3D Editor toolbar. This ensures that no new keys are created and that objects are not moved inadvertently.

Congratulations. We have finished creating the animation.

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Creating Steps

You can examine the sequences by selecting each sequence and playing them forward. Each sequence only moves its associated objects. This may be confusing and so, we now produce a step-by-step example of how to disassemble this assembly so there is a more ordered sense of the entire animation.

This procedure is easiest done after animations have been created, as we create a step for each sequence, modify their viewpoints and object visibility to best display the meaning of the step, and then add instructions for each step.

Procedure: Creating Steps

1 Do one of the following:
- Open the Gearbox-8b.rh file.
- Keep the file you have made open.

2 Show all objects in the scene.

3 Right-click in the Animation tree and click **All Sequences to Start**. All sequences move to their original positions.

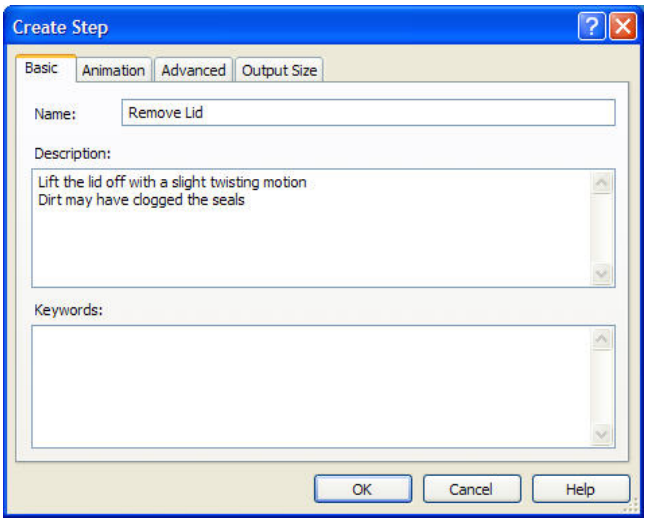
4 Choose **View > Controls and Toolbars > Steps** on the menu bar to display the Steps panel.

5 Do the following to create the first step:

n) Click Create Step  in the Steps panel. The Create Step is displayed.

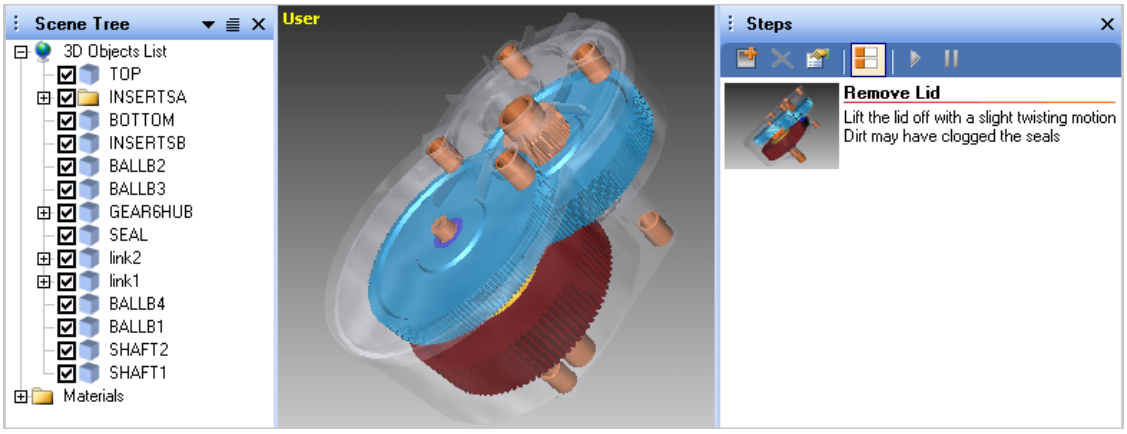
o) Name the step '**Remove Lid**', add a relevant description.

p) In the Animations tab, click **Sequence-1** and then '**Add**', click **OK**.

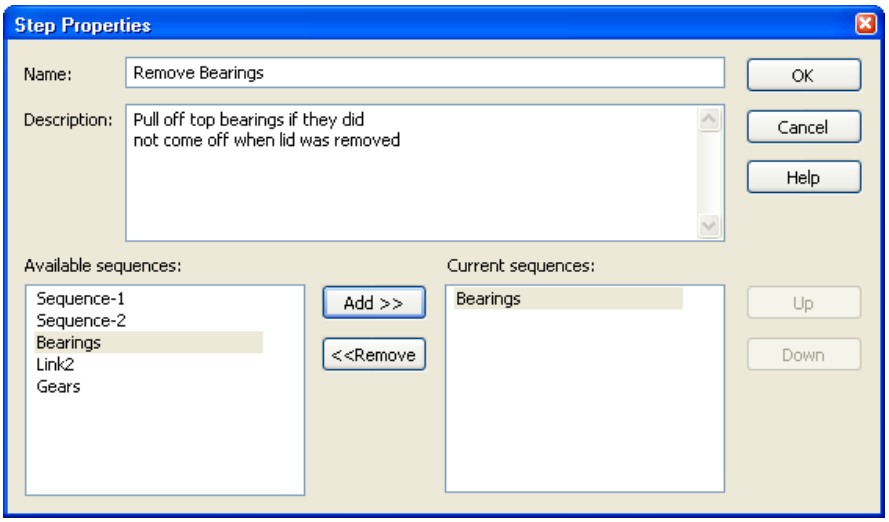


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q) The step thumbnail is displayed in the Steps panel. We will choose a better view and update the thumbnail later.

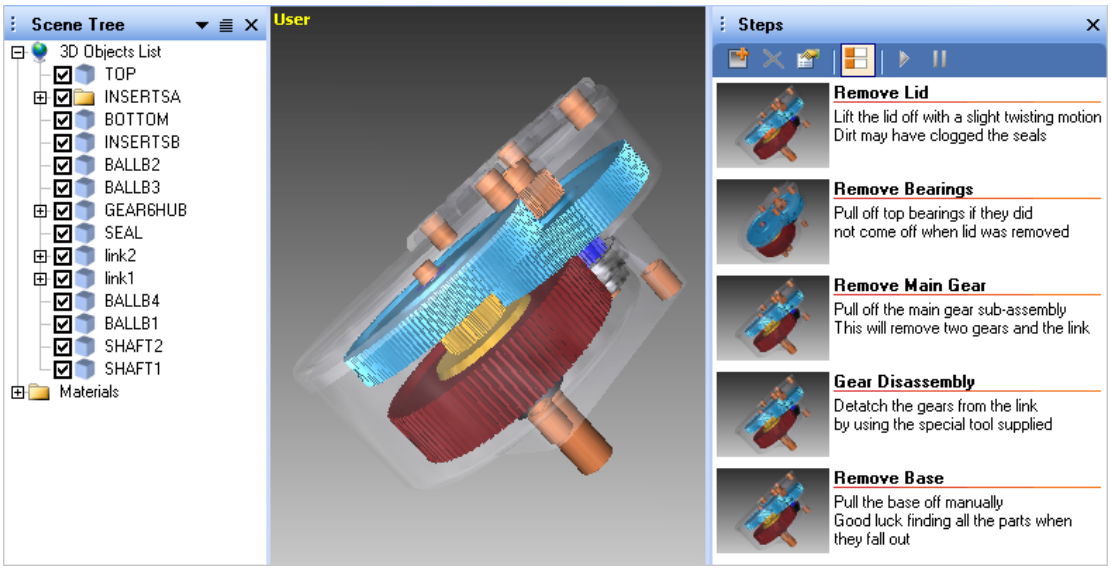


6 Create the second step in the same way using the Bearings sequence.



7 Create steps for the Link2 and Gears sequences.

8 Create the last step for the Sequence2 sequence. The steps should look similar to the following image.



We only added one animation per step; however, several sequences can be added to each step to show procedures that are more complex. Now we create a better view for each step.

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9 Do one of the following to play the first step's sequence:

- Double-click the 'Remove Lid' step in the Steps panel.
- Select the 'Remove Lid' step in the Steps panel, and click Play .

10 Rotate and zoom the scene to better show the sequence.

11 Right-click the step in the Steps panel and click **Update Step**. The new camera position is saved, the thumbnail is updated, and if you play the steps again, the new view is used.

For each step, there is a corresponding layer. Updating steps also sets the visibility in the corresponding layer. Therefore, here we want to set the visibility before updating the next step.

12 Repeat steps 9 through 11 for the 'Remove Bearings' step.

13 Hide the TOP and INSERTSA objects and update the step. Now the objects will be hidden when playing this step but will remain visible when playing the 'Remove Lid step.

14 Hide the TOP, INSERTSA, BALLB1, and BALLB2 objects for the 'Remove Main Gear' step, and then update the step.

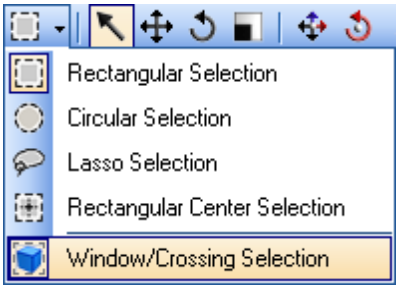
We use another approach to updating the view for the 'Gear Disassembly' step.

15 Do the following to hide the objects we do not want to see for the 'Gear Disassembly' step:

r) Play the step.

s) Open the Layers panel in the Scene Components panel and expand the step.

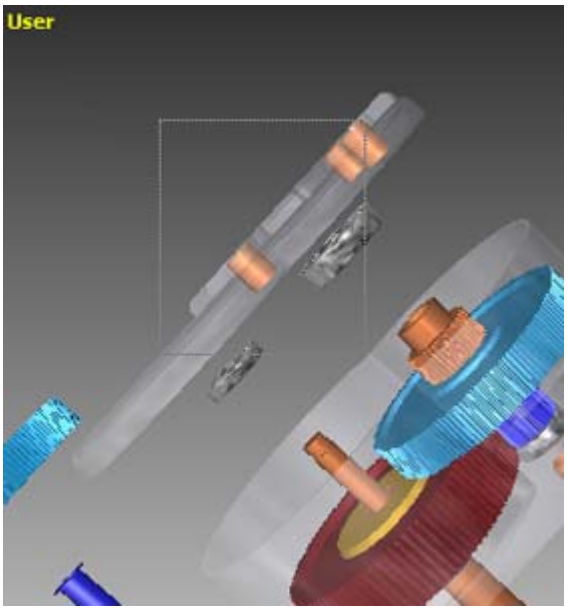
t) Ensure the Window/Crossing Selection tool is selected.



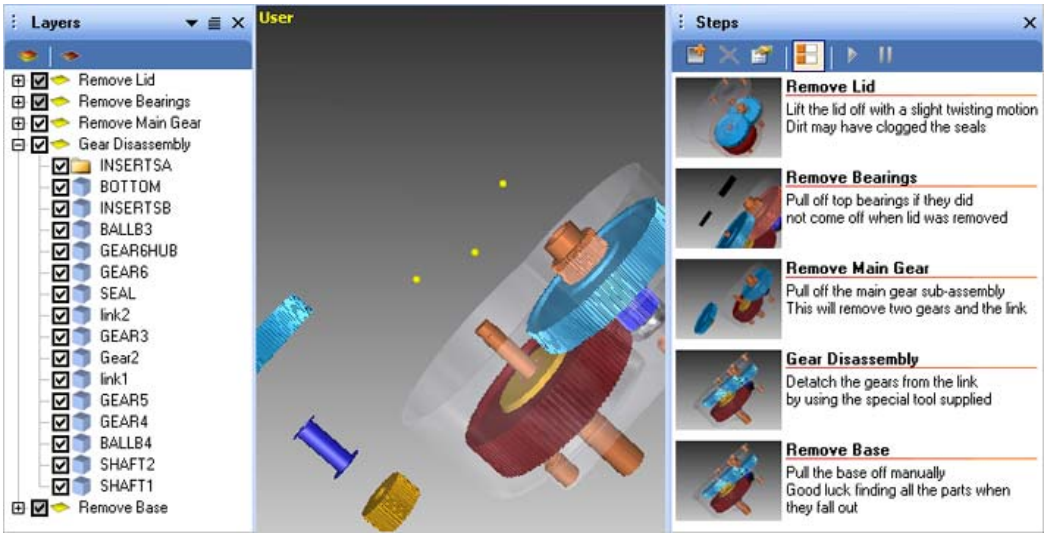
u) Rotate the scene so that you have a clear view of the objects you do not want to see in the step. These are the TOP, and all INSERT and BALL objects.

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v) Press CTRL+L and drag across the objects in the viewport.



w) Right-click over the selected objects in the Layers panel and click **Remove From Layer**. The objects are removed from only the selected step's layer.



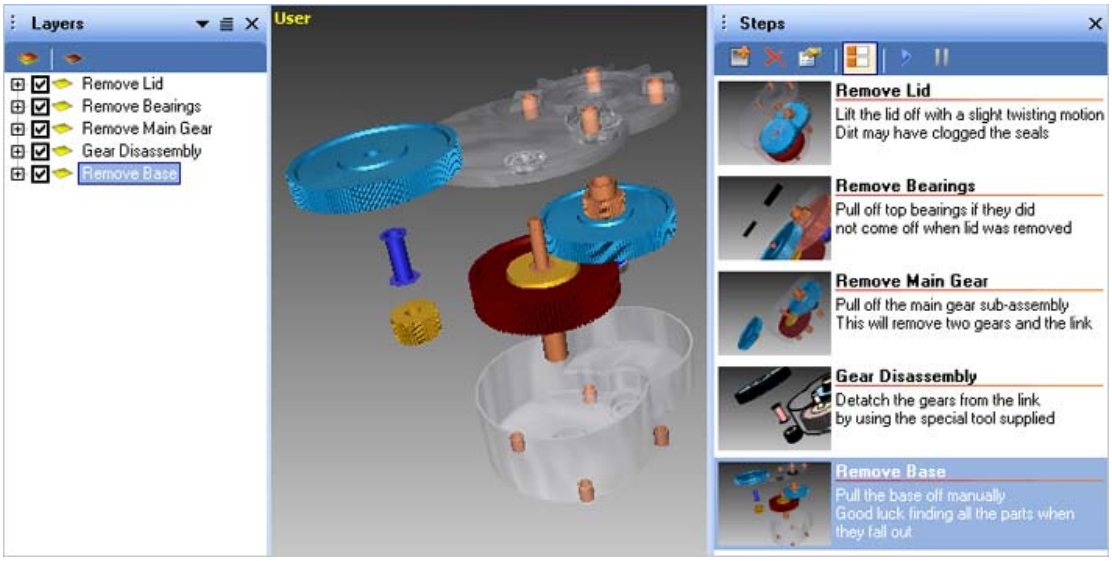
x) Select the **link2** object on the panel and press V on your keyboard to zoom to that object.

y) Rotate the scene until you are happy with the view.

z) Choose **Display > Shaded Illustration** on the menu bar and update the step.

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16 Play the '**Remove Base**' step, rotate the scene for the best view, and update the step. The result should be similar to the following image.



17 Rewind all the animations before saving the file. That is, play the first step and rewind to the first frame of the sequence. This ensures that the file displays the very first frame when it is opened.

18 Save the file.

The steps are now complete and can be played back in any order.

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Saving to a PDF Document

For delivery, we want a PDF document. We will use the PDF Publishing Module to create this document from an existing Right Hemisphere template. Note that new templates can be created and modified using Adobe Designer.

Procedure: Publishing to PDF

1. Choose **File > Save As** from the menu bar.
2. Select the path where you want to save the file.
3. Select Adobe Portable Document 3D (*.pdf) in the 'Save as type' field.
4. Click **Settings** and select the RH Steps Template.
5. Select the 'Start Adobe Acrobat after export' check box, and then click **OK**.
6. Click **Save**. The file is saved and displayed in Adobe Acrobat.

Congratulations! You have just saved the PDF document with animated steps.

You could also choose to save the file as a vector poster image instead of a raster image, and you can manually set any metadata. Any metadata is added into the metadata section of the PDF document.

Note that the new PDF document allows the user to playback the steps and examine the model.

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