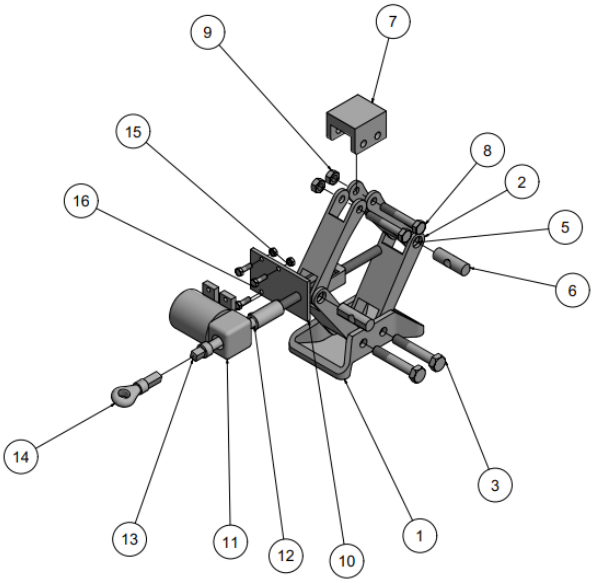
Project 1

Car Jack Assembly



In this project, you will create components for a Car Jack assembly and then assemble them, refer to Figure P1-1. An exploded view of the assembly is shown in Figure P1-2. You need to create all the components as separate part files. The views and dimensions of the components are shown in Figures P1-3 through P1-18. **(Expected time: 3 hr 30 min)**

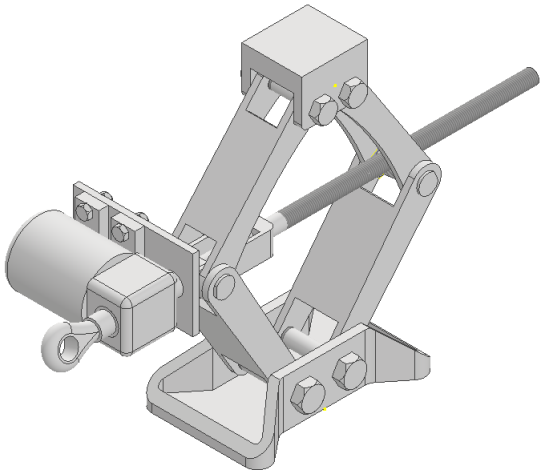
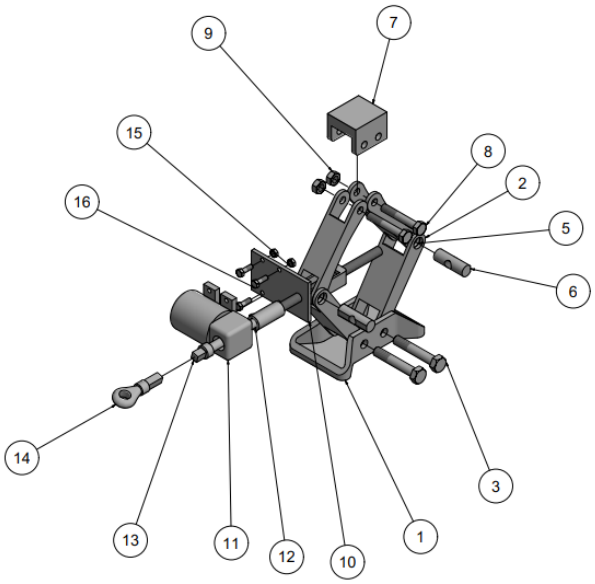


Figure P1-1 *The Car Jack assembly*



PARTS LIST		
ITEM	PART NUMBER	QTY
1	Jack Base	1
2	Jack Bottom leg	2
3	M12X1.75 Hex Bolt	2
4	M12X1.75 Nut	2
5	Jack upper leg	2
6	Jack Pin with thread	2
7	Jack Cap	1
8	M10X1.5 Hex Bolt	2
9	M10X1.5 Nut	2
10	Screw Base	1
11	Jack Motor Case	1
12	Jack Rotor	1
13	Jack Screw	1
14	Manual Screw	1
15	M6X1.0 Nut	4
16	M6X1.0 Hex Bolt	4

Figure P1-2 *The exploded view of Car Jack assembly*

The following steps are required to complete this project:

a. Create all components of the assembly as separate part files and save them in the *Car Jack Assembly* folder.
b. Start a new metric assembly file and then place Jack Base and two instances of Jack Bottom Leg by using the **Place** tool.
c. Assemble Jack Base with instances of Jack Bottom Legs using assembly constraints.
d. Place two instances of Nut and Bolt. Assemble the instances of Bolt with Jack Bottom Legs and then assemble Bolts with Nuts.
e. Next, place two instances each of Jack Upper Leg in the assembly. Assemble them with Jack Bottom Legs.
f. Place two instances of Jack Pin and assemble both Jack Upper Leg and Jack Bottom Leg using it.
g. Place Jack Cap in the assembly and assemble it with both Jack Upper Legs.
h. Place two instances of Nut and Bolt in the assembly. Now, assemble both Jack Upper Legs and Jack Cap with Nuts and Bolts.
i. Next, assemble components using assembly constraints.

Creating the Components

1. Create all components of Car Jack assembly as separate part files, refer to Figures P1-3 through P1-18 and save them.

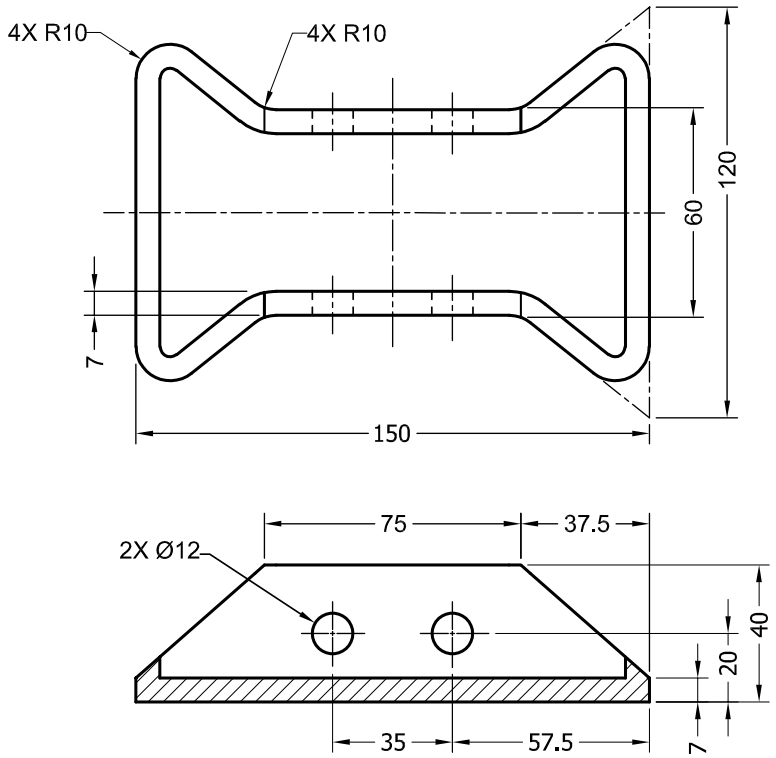


Figure P1-3 *Orthographic views and dimensions of Jack Base*

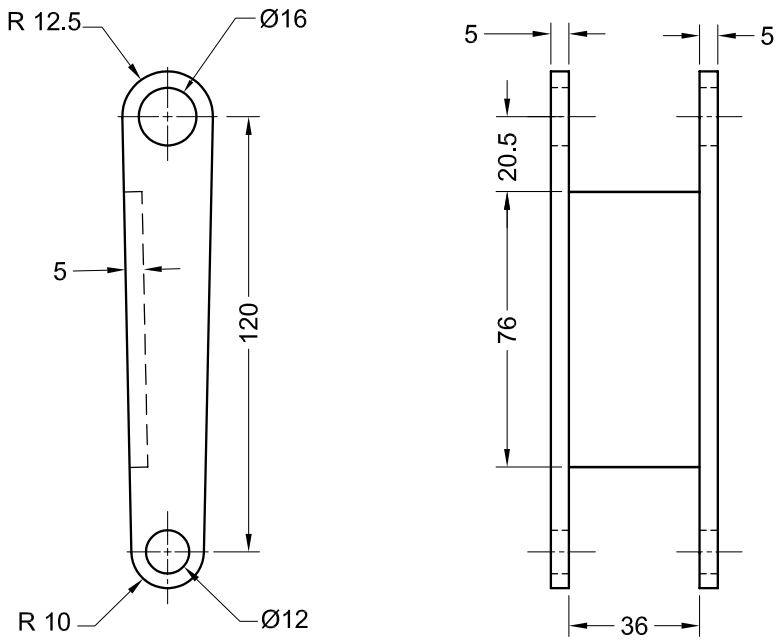


Figure P1-4 *Orthographic views and dimensions of Jack Bottom Leg*

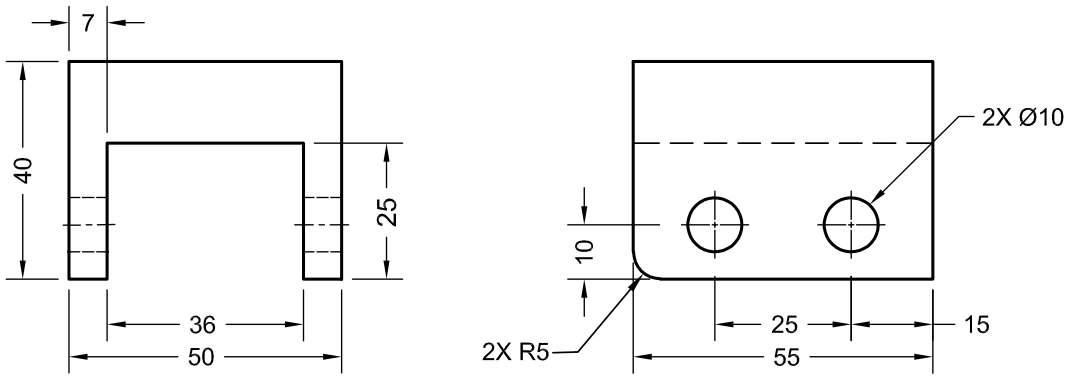


Figure P1-5 *Orthographic views and dimensions of Jack Cap*

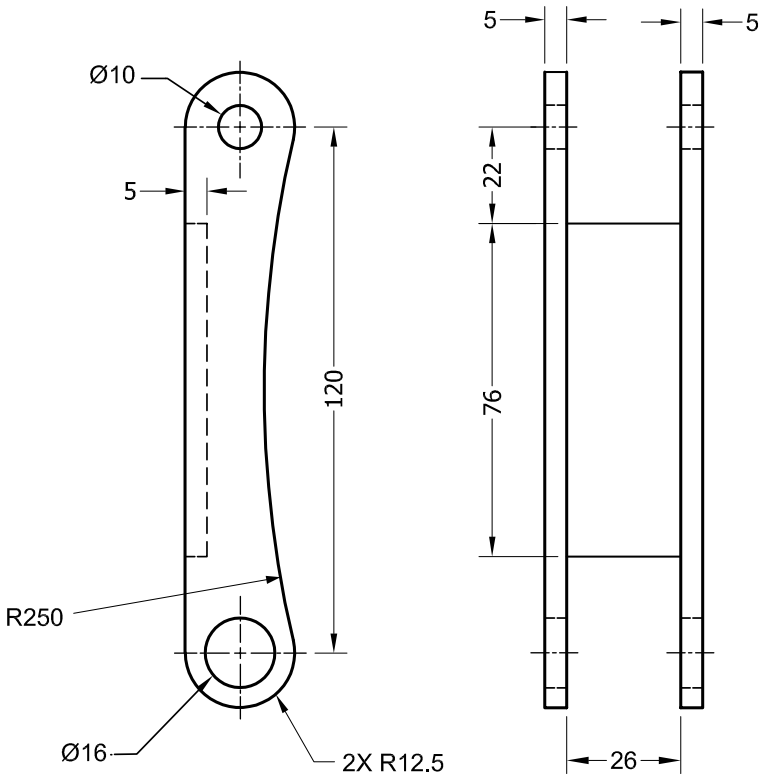


Figure P1-6 *Orthographic views and dimensions of Jack Upper Leg*

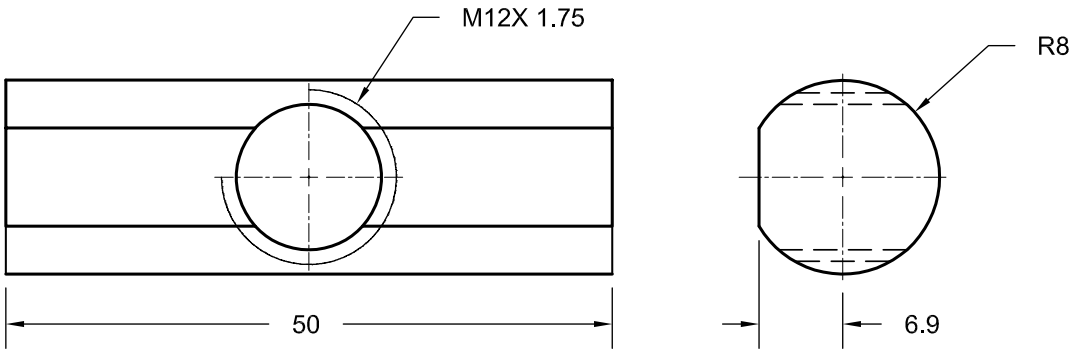


Figure P1-7 *Orthographic views and dimensions of Jack Pin with thread*

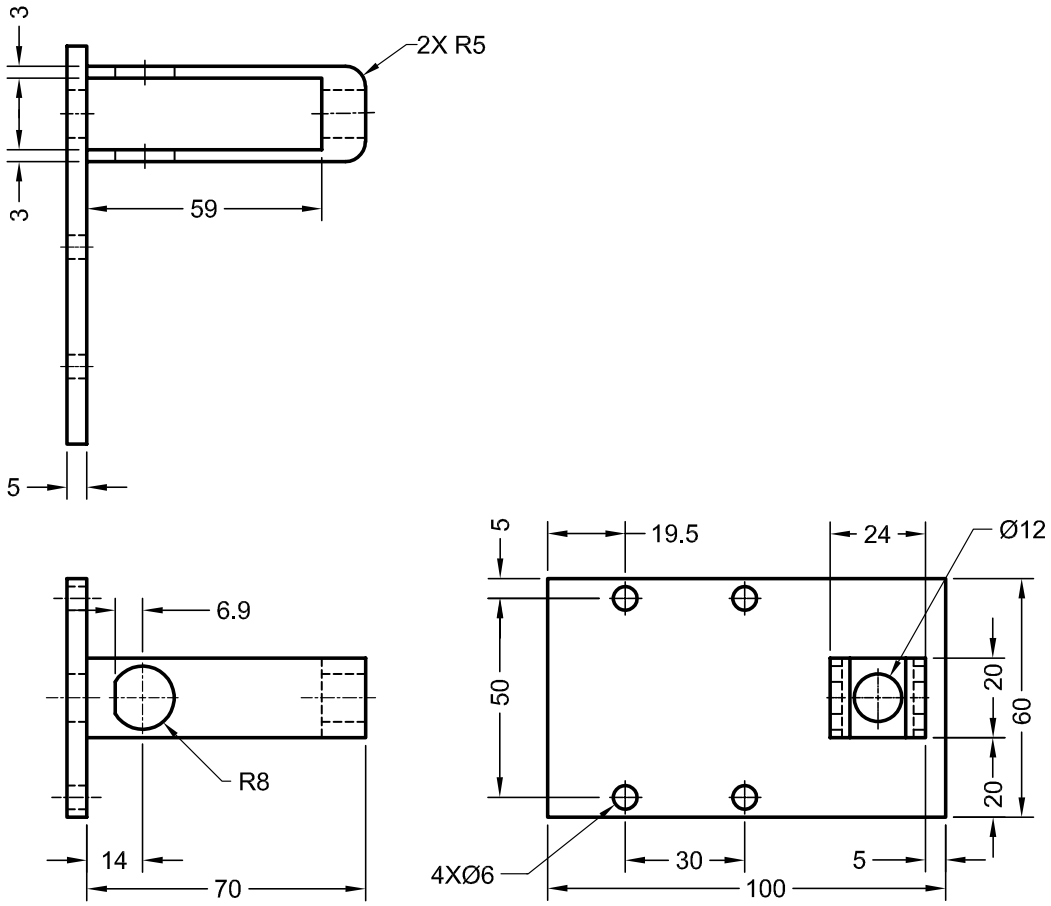


Figure P1-8 *Orthographic views and dimensions of Screw Base*

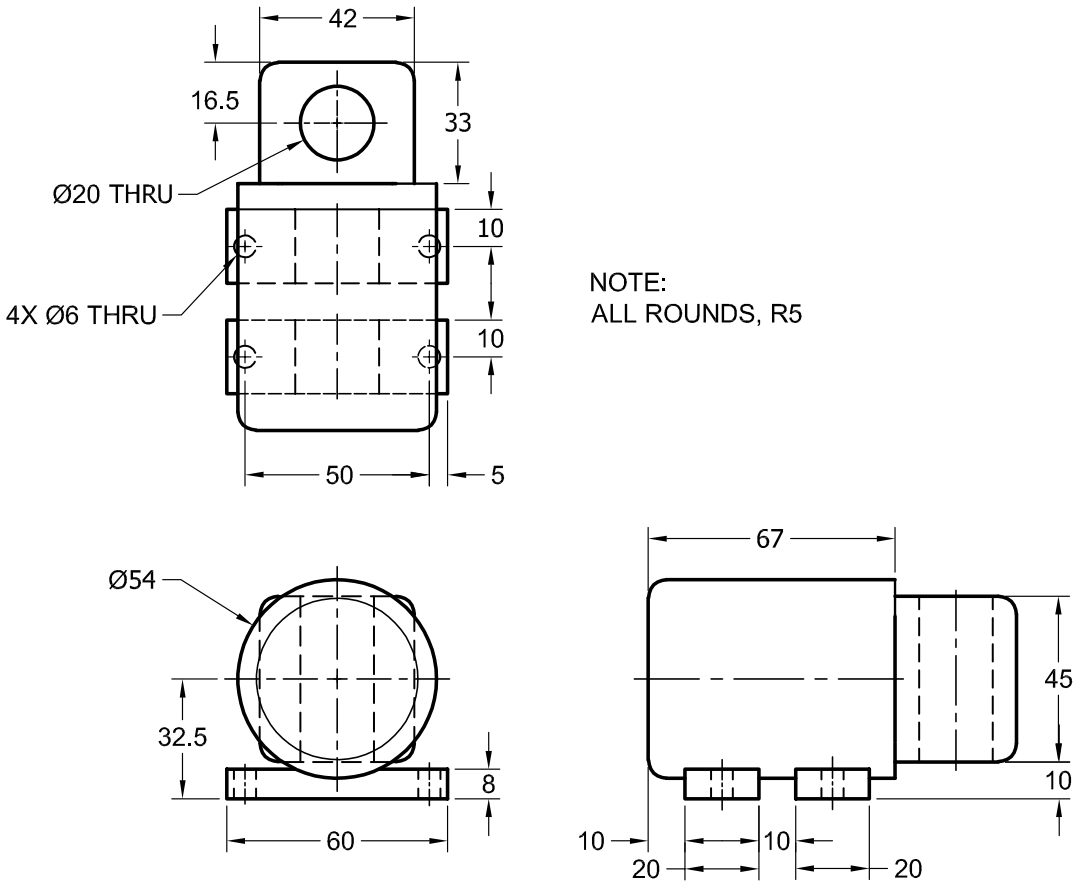


Figure P1-9 *Orthographic views and dimensions of Jack Motor Case*

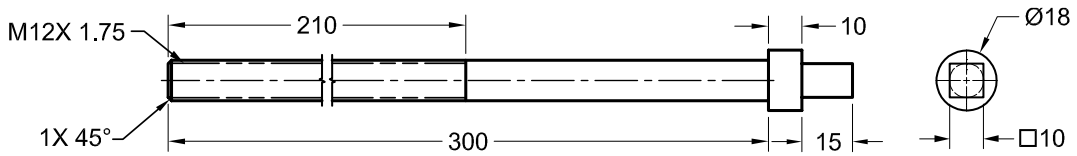


Figure P1-10 *Orthographic views and dimensions of Jack Screw*

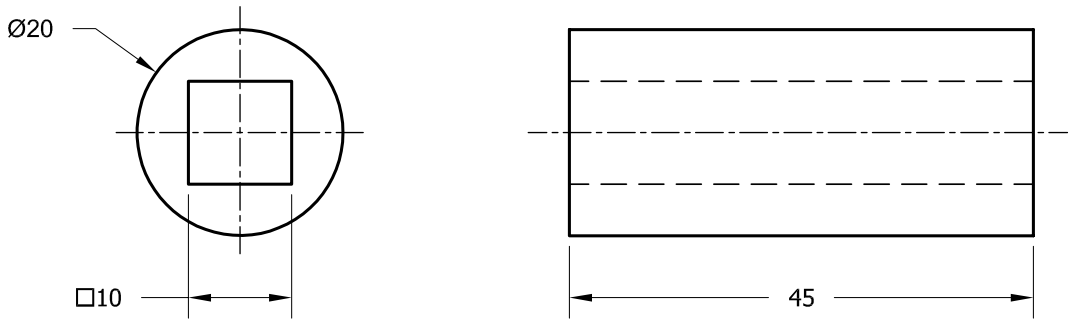


Figure P1-11 *Orthographic views and dimensions of Jack Rotor*

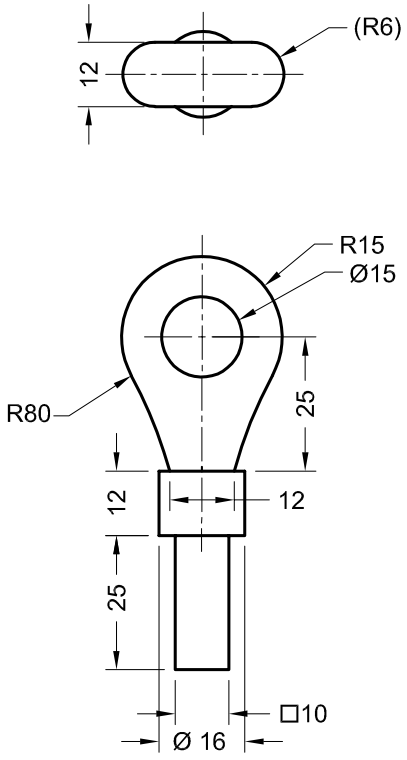


Figure P1-12 *Orthographic views and dimensions of Manual Screw*

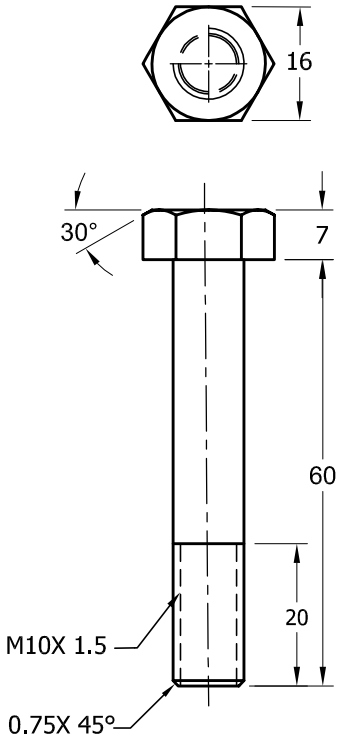


Figure P1-13 *Orthographic views and dimensions of the M10X 1.5 bolt*

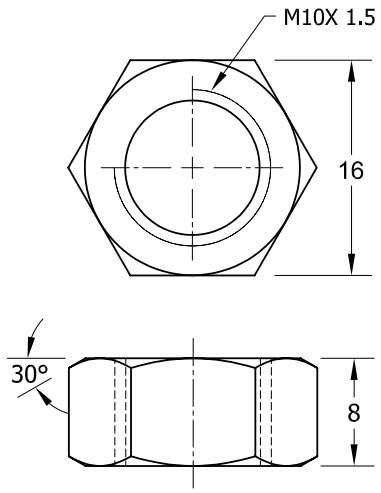


Figure P1-14 *Orthographic views and dimensions of the M10X 1.5 nut*

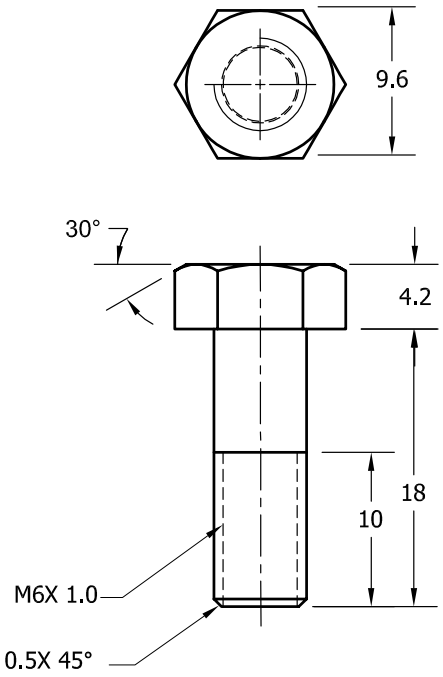


Figure P1-15 *Orthographic views and dimensions of the M6X 1.0 bolt*

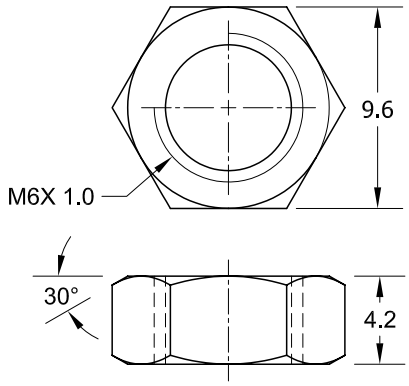


Figure P1-16 *Orthographic views and dimensions of the M6X 1.0 nut*

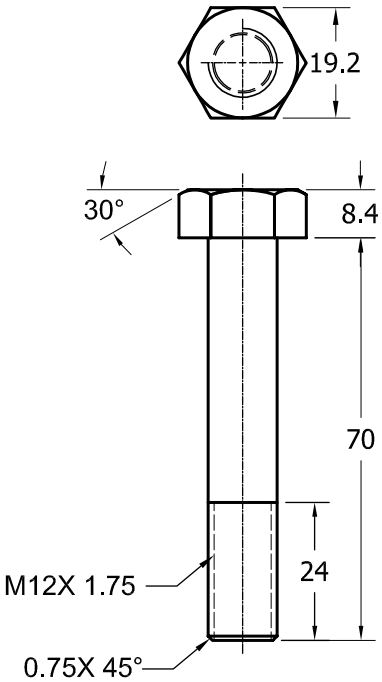


Figure P1-17 *Orthographic views and dimensions of the M12X 1.75 bolt*

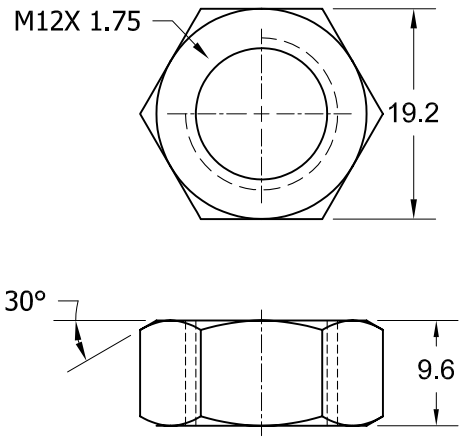


Figure P1-18 *Orthographic views and dimensions of the M12X 1.75 nut*

Placing Jack Base and Jack Bottom Leg in the Assembly

You need to start a new assembly file and then place Jack Base in the assembly. Next, you need to place two instances of Jack Bottom Leg in the same assembly.

1. Start a new metric assembly file and then choose the **Place** tool from the **Component** panel of the **Assemble** tab; the **Place Component** dialog box is displayed.

2. Browse to the *Car Jack* folder and double-click on **Jack Base**; the Jack Base gets attached to the cursor. Click in the graphics window to place it and press the ESC key to exit the **Place** tool.

   While placing the component if the orientation of the component is not same as shown in Figure P1-19, then you need to rotate the component. To do so, right-click in the drawing area before placing the component; a Marking menu is displayed. Choose the required option from the Marking menu.

3. Right-click on **Jack Base** in the **Browser Bar** and select the **Grounded** option from the shortcut menu; all DOFs of the component get restricted.

4. Place two instances of Jack Bottom Leg in the current assembly file. Note that Jack Bottom Legs should be floating components.

Assembling the Components

1. Orient the components, as shown in Figure P1-19, by using the **Free Rotate** tool from the **Position** panel of the **Assemble** tab.

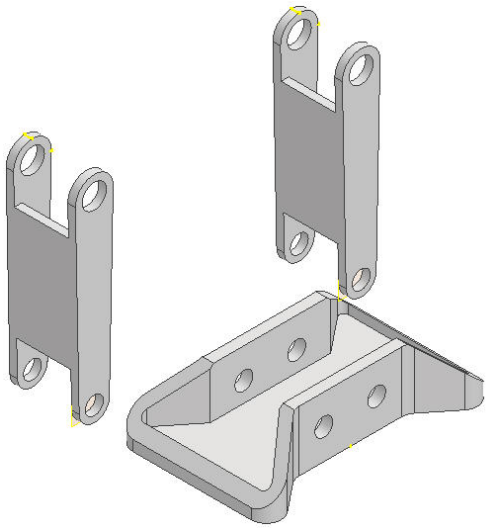


Figure P1-19 *Components placed in assembly environment*

2. Choose the **Constrain** tool from the **Relationships** panel of the **Assemble** tab; the **Place Constraint** dialog box is displayed.

3. Choose the **Insert** constraint from the **Assembly** tab of this dialog box. Next, select the edges of the holes in Jack Base and Jack Bottom Legs, as shown in Figure P1-20; the selected components are aligned with each other axially and are assembled.

4. Choose the **Apply** button from the **Place Constraint** dialog box to confirm the constraint applied.

5. Select the edges of the other holes in Jack Base and Jack Bottom Leg and choose the **OK** button to apply the constraint and exit the dialog box, refer to Figure P1-21.

6. Similarly, assemble the other instance of Jack Bottom Leg with Jack Base. Note that the Jack Bottom Legs are rotated to achieve the orientation shown in Figure P1-21.

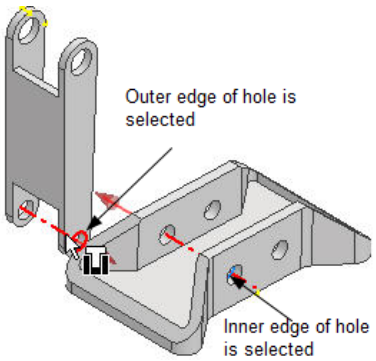


Figure P1-20 *Applying the* ***Insert*** *constraint*

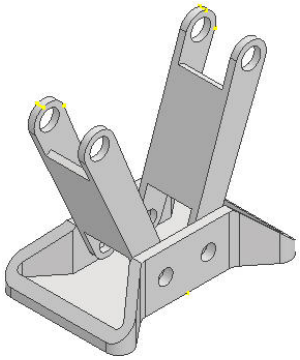


Figure P1-21 *Assembly after assembling the Jack Base with both instances of Jack Bottom Leg*

Assembling the Bolts and Nuts with the Assembly

Next, you need to assemble the Bolts and Nuts with the assembly.

1. Place two instances of M12X 1.75 Hex Bolt and M12X 1.75 Nut in the assembly by using the **Place** tool, refer to Figure P1-22.

2. Invoke the **Place Constraint** dialog box. Choose the **Insert** button from the **Type** area of the **Assembly** tab in this dialog box.

3. Next, select the cylindrical bottom edge of head of M12X 1.75 Hex Bolt and outer edge of the hole of Jack Base, as shown in Figure P1-22; the selected components get axially aligned with each other.

4. Choose **Apply** from the **Place Constraint** dialog box to confirm the constraint applied.

5. Select the cylindrical edge of hole of M12X 1.75 Nut and outer edge of hole of Jack Base. Next, choose the **OK** button to apply the constraint and exit the dialog box. Similarly, assemble other instances of M12X 1.75 Hex Bolt and M12X 1.75 Nut, as shown in Figure P1-23.

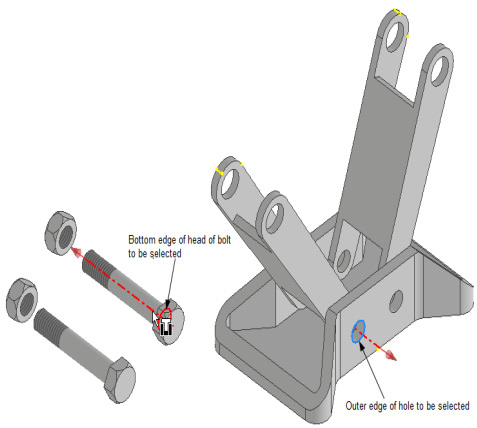


Figure P1-22 *Nuts and Bolts placed in assembly*

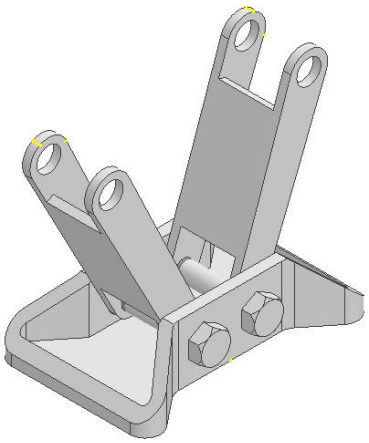


Figure P1-23 *Assembly after assembling bolts and nuts*

Assembling Jack Upper Leg with the Assembly

1. Place two instances of Jack Upper Leg in the assembly using the **Place** tool.

2. Choose the **Constrain** tool from the **Relationships** panel of the **Assemble** tab; the **Place Constraint** dialog box is displayed.

3. Choose the **Insert** button from the **Type** area of the **Assembly** tab in this dialog box. Next, select the cylindrical edges of Jack Upper Leg and Jack Bottom Leg, as shown in Figure P1-24; the selected components get axially aligned with each other.

4. Next, choose **Apply** from the **Place Constraint** dialog box to confirm the constraint applied.

5. Select other cylindrical edges of Jack Upper Leg and Jack Bottom Leg and choose the **OK** button to apply constraint and exit the dialog box. Similarly, assemble other instances of Jack Upper Leg and Jack Bottom Leg, refer to Figure P1-25.

   Note that you need to drag the components to get the orientation shown in Figure P1-25.

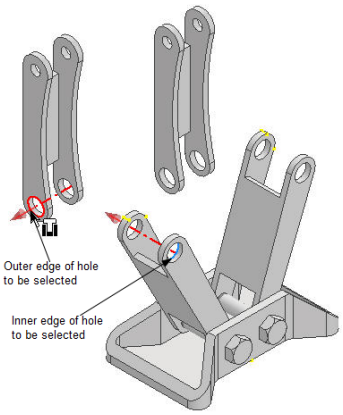


Figure P1-24 *Selecting the edges of holes of Jack Upper Leg and Jack Bottom Leg*

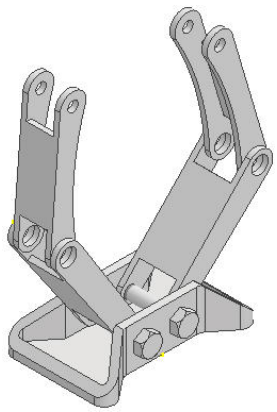


Figure P1-25 *Assembly after assembling Jack Upper Legs and Jack Bottom Leg*

Assembling Jack Pin with the Assembly

1. Place two instances of Jack Pin in the assembly using the **Place** tool.

2. Choose the **Constrain** tool from the **Relationships** panel of the **Assemble** tab; the **Place Constraint** dialog box is displayed.

3. Choose the **Insert** button from the **Type** area of the **Assembly** tab in this dialog box. Next, select the cylindrical edges of Jack Pin and the edge of hole of Jack Bottom Leg, as shown in Figure P1-26.

4. Choose the **Aligned** button from the **Solution** area and enter **-2** in the **Offset** edit box; the selected components get axially aligned with each other with an offset value of -2.

5. Choose **Apply** from the **Place Constraint** dialog box to confirm the constraint applied. Similarly, assemble the other instance of Jack Pin and Jack Bottom Leg and choose the **OK** button; the Jack Pin instances get assembled to the assembly, as shown in Figure P1-27.

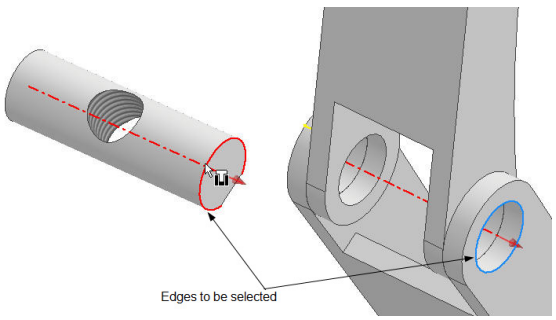


Figure P1-26 *Selecting the edges of hole of Jack Bottom Leg and Jack Pin*

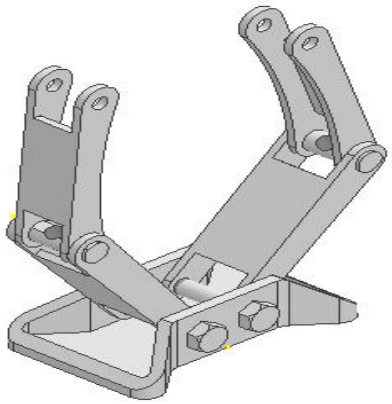


Figure P1-27 *Assembly after assembling Jack Pin*

Assembling Jack Cap with the Assembly

1. Place the Jack Cap in the assembly using the **Place** tool.

2. Choose the **Constrain** tool from the **Relationships** panel of the **Assemble** tab; the **Place Constraint** dialog box is displayed.

3. Choose the **Insert** button from the **Type** area of the **Assembly** tab in this dialog box. Next, select the inner edge of hole of the Jack Cap and the outer edge of hole of the Jack Upper Leg, as shown in Figure P1-28.

4. Choose **Apply** from the **Place Constraint** dialog box to confirm the constraint applied. Similarly, assemble the other holes of Jack Cap and Jack Upper Leg and choose the **OK** button; Jack Cap is assembled to assembly.

   Next, you need to apply the Angle constraint between horizontal surfaces of Jack Cap and Jack Base.

5. Invoke the **Place Constraint** dialog box and choose the **Angle** button from the **Type** area of the **Assembly** tab. Next, select the top horizontal surface of Jack Cap and Jack Base, refer to Figure P1-29.

6. Choose the **Undirected Angle** button from the **Solution** area of the **Place Constraint** dialog box and enter **0** in the **Angle** edit box. Next, choose the **OK** button in the **Place Constraint** dialog box to apply the constraint and exit the dialog box.

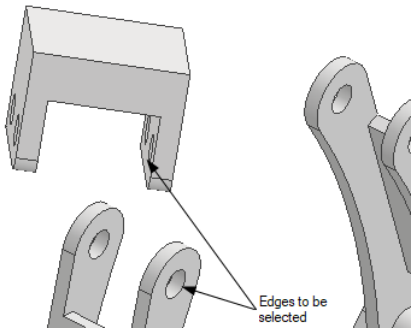


Figure P1-28 *Edges to be selected*

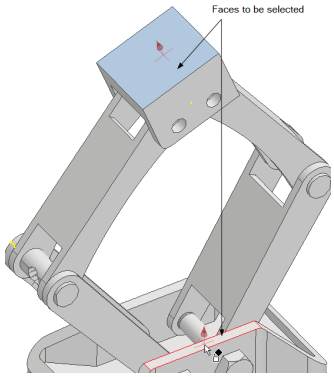


Figure P1-29 *Faces to be selected*

Assembling Bolt and Nut with the Assembly

Next, you need to assemble Bolt and Nut with the assembly.

1. Place two instances each of Hex M10X 1.5 Bolt and M10X 1.5 Nut in the assembly by using the **Place** tool.

2. Invoke the **Place Constraint** dialog box and assemble the instances with Jack Cap, as discussed earlier in the project. The assembly after assembling bolts and nuts is shown in Figure P1-30.

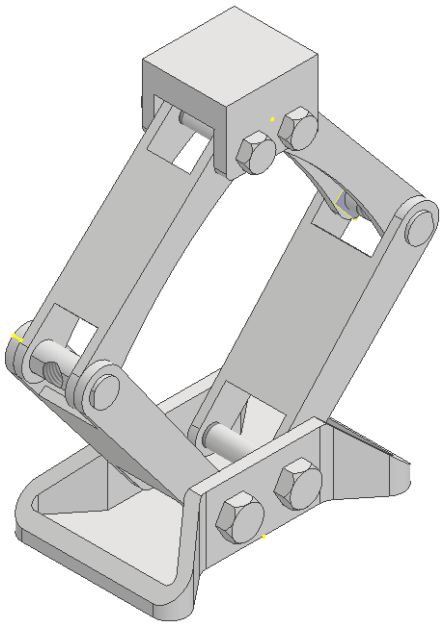


Figure P1-30 *Assembly after assembling bolts and nuts*

Assembling Screw Base with the Assembly

1. Place Screw Base in the assembly using the **Place** tool, refer to Figure P1-31.

2. Choose the **Constrain** tool from the **Relationships** panel of the **Assemble** tab; the **Place Constraint** dialog box is displayed.

3. Choose the **Insert** button from the **Type** area of the **Assembly** tab. Next, select the inner edge of Jack Upper Leg and the outer edge of hole of Screw Base, as shown in Figure P1-31.

4. Enter **1** in the **Offset** edit box and choose the **Apply** button to confirm the constraint applied.

5. Choose the **Mate** button from the dialog box and select the central axis of circular cut of Screw Base and central axis of threaded hole of Jack Pin, refer to Figure P1-31; the selected components get axially aligned with each other.

6. Choose the **Angle** button from the dialog box and select the faces of Screw Base and Jack Base, as shown in Figure P1-32.

7. Next, choose the **Undirected Angle** button from the **Solution** area and enter **0** in the **Angle** edit box.

8. Choose the **OK** button to apply the constraint and exit the dialog box.

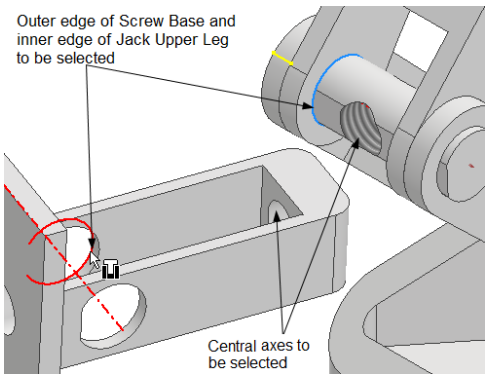


Figure P1-31 *Edges to be selected*

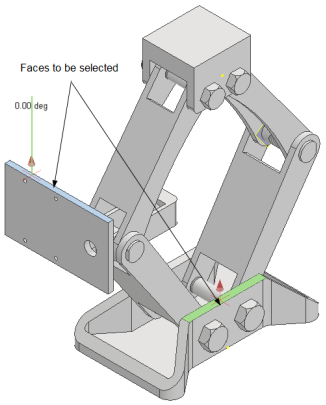


Figure P1-32 *Faces to be selected*

Assembling Jack Motor Case with the Assembly

1. Place Jack Motor Case in the assembly using the **Place** tool.

2. Choose the **Constrain** tool from the **Relationships** panel of the **Assemble** tab; the **Place Constraint** dialog box is displayed.

3. Choose the **Insert** button from the **Type** area of the **Assembly** tab. Next, select the edge of hole of Jack Motor and the hole of the Screw Base, as shown in Figure P1-33.

4. Choose **Apply** from the **Place Constraint** dialog box to confirm the constraint applied.

5. Similarly, align and assemble the other three holes of Jack Motor and Screw Base and choose the **OK** button; Jack Motor Case is assembled with the assembly, refer to Figure P1-34.

Assembling Bolts and Nuts with the Assembly

1. Place four instances of M6X 1.0 Hex Bolt and M6X 1.0 Nut in the assembly by using the **Place** tool.

2. Invoke the **Place Constraint** dialog box and assemble bolts and nuts with Jack Cap as discussed earlier in the project. The assembly after assembling bolts and nuts is shown in Figure P1-34.

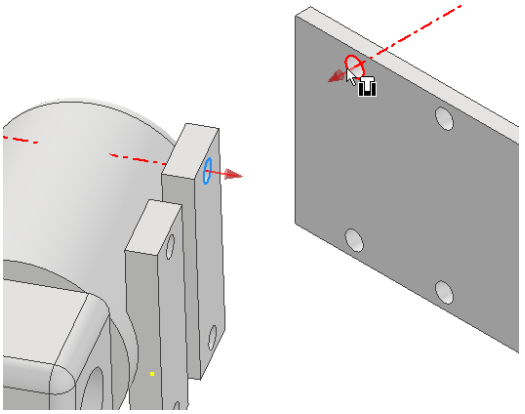


Figure P1-33 *Edges to be selected*

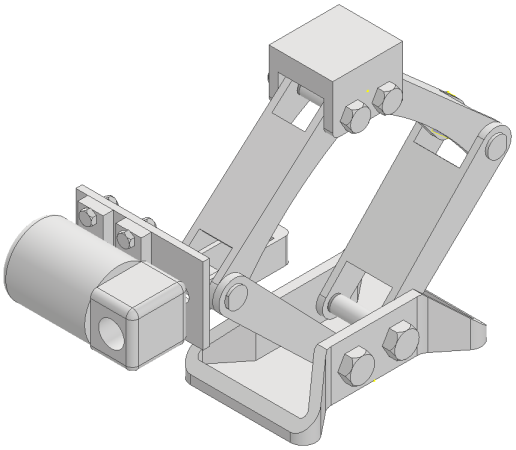


Figure P1-34 *Assembly after assembling Jack Motor, Bolts and Nuts*

Assembling Jack Screw and Jack Rotor with the Assembly

1. Place the Jack Screw and Jack Rotor to the assembly using the **Place** tool and turn off the visibility of Jack Motor Case and Screw Base.

2. Choose the **Constrain** tool from the **Relationships** panel of the **Assemble** tab; the **Place Constraint** dialog box is displayed.

3. Choose the **Mate** button from the **Type** area of the **Assembly** tab in this dialog box. Next, select the central axis of the hole of Jack Pin and central axis of Jack Screw, as shown in Figure P1-35.

4. Next, choose the **Apply** button; the selected components get aligned.

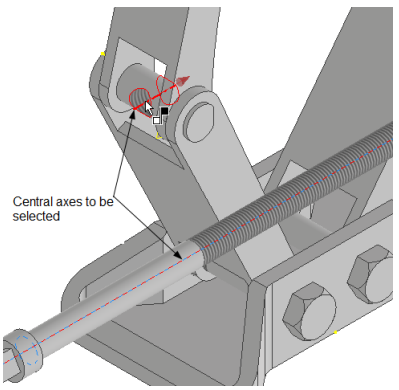


Figure P1-35 *Axes to be selected*

5. Select the central axes of Jack Screw and the other Jack Pin which is on the right side of the assembly.

6. Choose the **OK** button and exit the **Place Constraint** dialog box.

   Next, you need to assemble the cylindrical flat face of the Jack Screw and the front face of the Screw Base.

7. Turn on the visibility of the Screw Base.

8. Invoke the **Place Constraint** dialog box and choose the **Mate** button from the dialog box. Next, select the cylindrical flat face of the Jack Screw and the front face of the Screw Base, as shown in Figures P1-36 and P1-37.

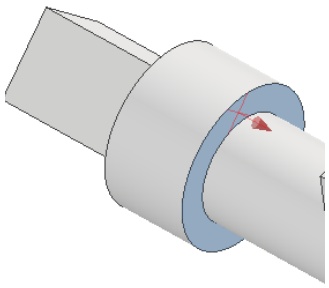


Figure P1-36 *Face of the Jack Screw to be selected*

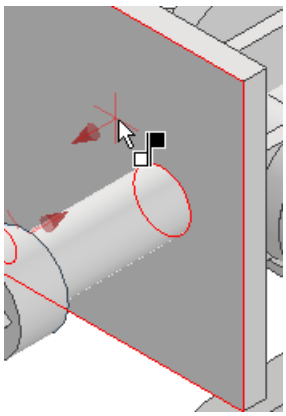


Figure P1-37 *Face of the Screw Base to be selected*

9. Choose the **OK** button to close the dialog box.

   Next, you need to assemble Jack Rotor to Jack Screw

10. Invoke the **Place Constraint** dialog box and choose the **Angle** constraint button.

11. Select the faces of Jack Rotor and Jack Screw, as shown in Figure P1-38.

12. Choose the **Undirected Angle** button from the **Solution** area of the **Place Constraint** dialog box and enter **0** in the **Angle** edit box.

13. Choose the **Apply** button and then choose the **Insert** button from the dialog box

14. Next, select the edges shown in Figure P1-39 and choose the **OK** button; the selected components get aligned and assembled with the assembly.

15. Turn on the visibility of Jack Motor Case and place Manual Screw in the assembly.

16. Next, you need to assemble Manual Screw with Jack Rotor by applying assembly constraints. The final Car Jack assembly after assembling all components is shown in Figure P1-40.

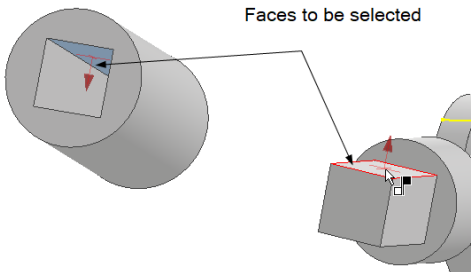


Figure P1-38 *Faces to be selected*

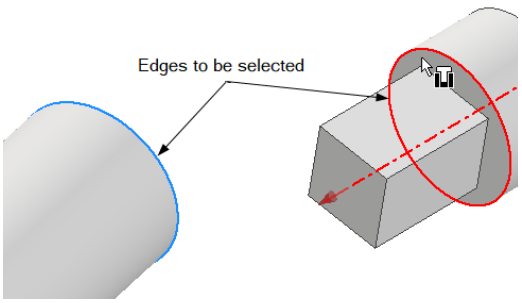


Figure P1-39 *Edges to be selected*

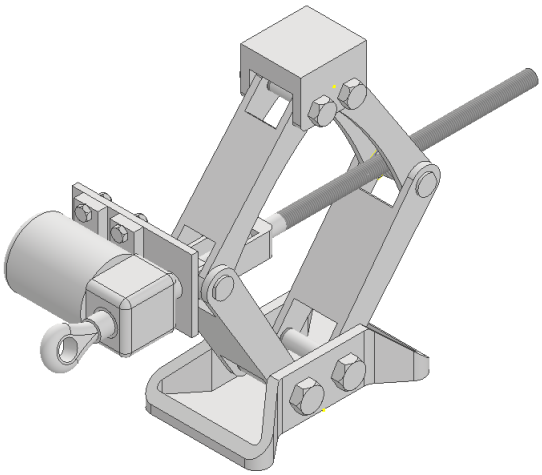


Figure P1-40 *The Car Jack assembly*