Inside:
Supplemental
Files on CD

Assembly Modeling with SolidWorks 2006

For the Intermediate SolidWorks User

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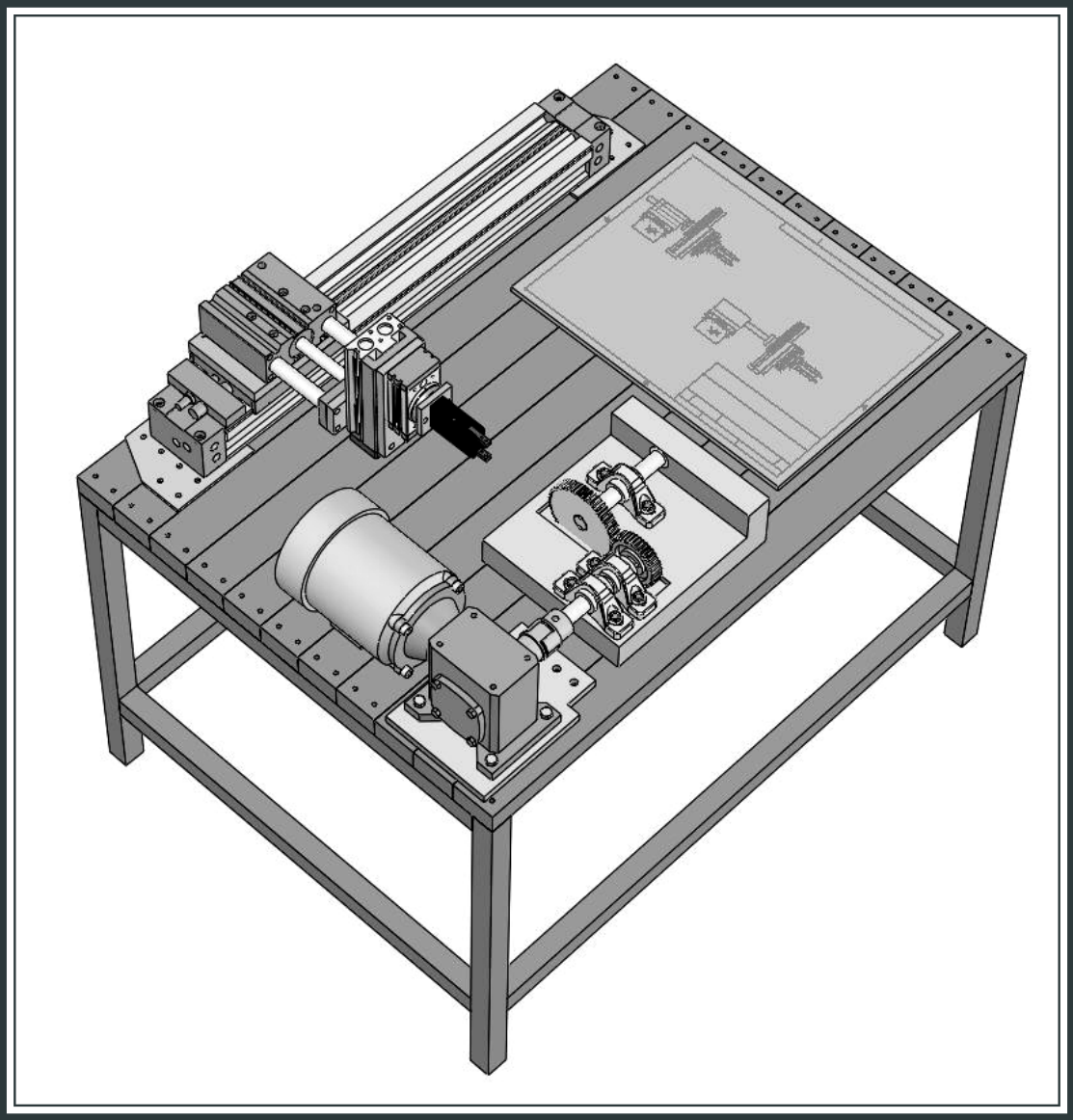

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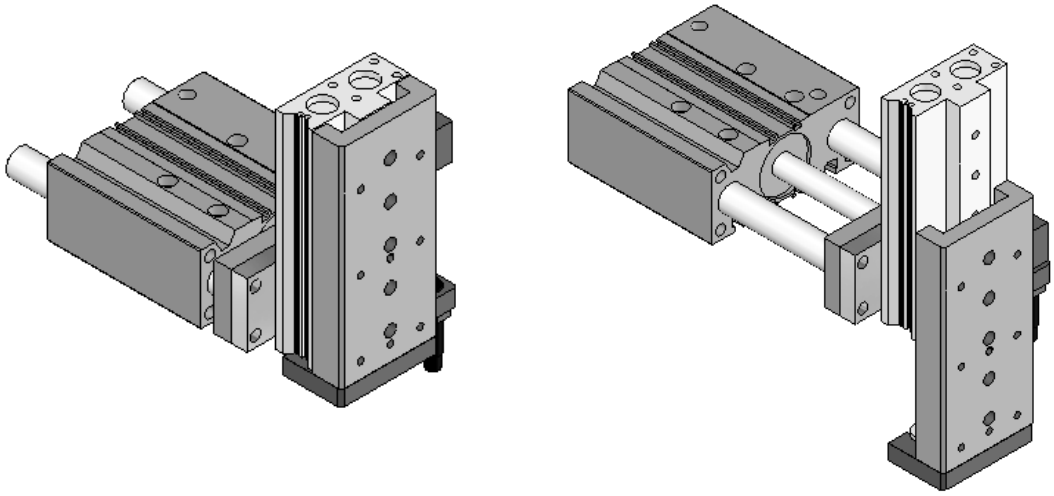
Project 3

Top Down Design – In-Context



Below are the desired outcomes and usage competencies based on the completion of this Project.

Project Desired Outcomes:	**Usage Competencies:**
• 2AXIS-TRANSFER assembly.	• Ability to create assemblies with multiple configurations.
• PLATE-B part.	• An understanding of In-Context methods in a Top-Down assembly modeling approach.
	• Ability to create, lock and redefine External references.
• Configurations for the GUIDE-CYLINDER, SLIDE-TABLE, and 2AXIS-TRANSFER assemblies.	• Knowledge to develop and incorporate assembly configurations at various levels with the ConfigurationManager and Design Table.
	• Ability to create and modify Mates related to configurations.

Notes:

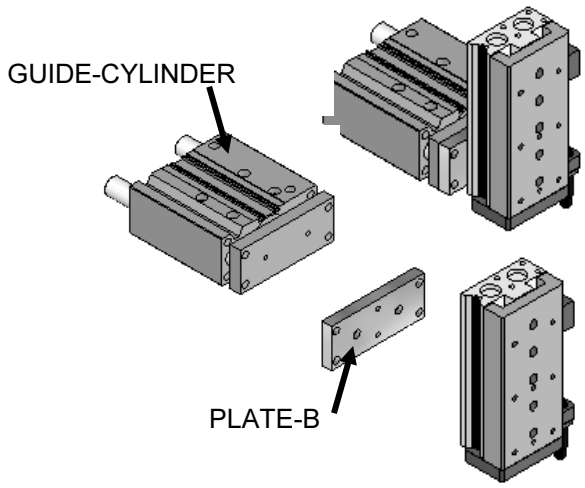
Project 3 – Top-Down Design – In-Context

Project Objective

Create the 2AXIS-TRANSFER assembly. Design the PLATE-B part In-Context of the GUIDE-CYLINDER and SLIDE-TABLE assemblies. The new part develops In-Context features.

Utilize the ConfigurationManager to create configurations for the GUIDE-CYLINDER and SLIDE-TABLE.

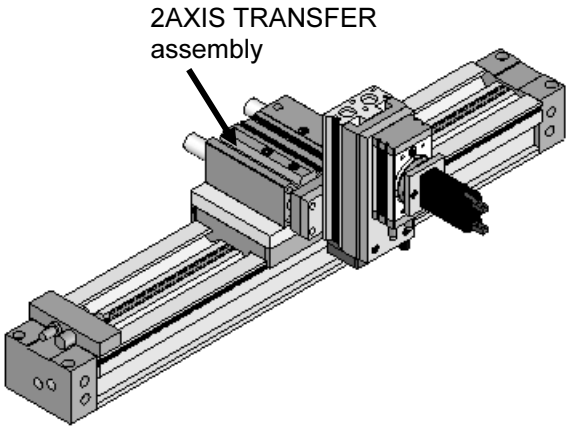
Utilize a Design Table to create configurations for the new 2AXIS-TRANSFER assembly. The 2AXIS-TRANSFER assembly is the second component in the 3AXIS-TRANSFER assembly.



2AXIS-TRANSFER assembly

On the completion of this project, you will be able to:

- Apply a Top-Down Design assembly modeling approach to develop components In-Context of the assembly.
- Review External reference and InPlace Mate syntax to create the PLATE-B part.
- Apply a Bottom-Up Design assembly modeling approach to assemble additional components.
- Select the appropriate hole types and fasteners required in the assembly.
- Obtain the required dimensions, measure, and insert features.
- Calculate the interference between components and edit Mates and redefine External references.
- Add configurations to assembly components with the ConfigurationManager.
- Develop a Design Table and utilize parameters to control configurations and state.



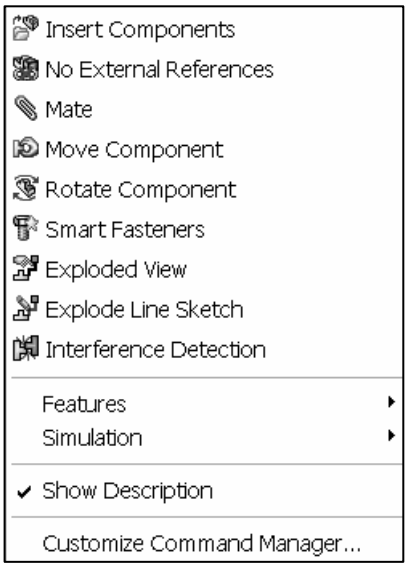
3AXIS-TRANSFER assembly

SolidWorks Tools and Commands

In Project 3, utilize the following SolidWorks tools and commands.

SolidWorks Tools and Commands:		
$Configuration	Edit Part, Edit Sub-assembly	Rename
$STATE	Extrude Boss/Base	Replace Components
Add Configuration	Feature Palette	Replace Mate Entities
Autodimension	Fixed/Float	Rotate Component
Coincident Mate	Hide	Section view
Component Pattern	Hole Wizard	Selection Filters toolbar
Component Properties	InPlace Mate	Select Other
Concentric Mate	Interference Detection	Shortcut keys
Configurations	Insert Component, New Part	Show
Customize keyboard	List External References	Show Update Holders
Design Library	Lock All	Sketch relations: On Entity, Midpoint, Coincident, Horizontal, Vertical
Design Table	Mate Types	Sketch tools: Centerline, Dimension
Dimensions/Relations toolbar	Measure	SmartMate
Display/Delete Relations	Move Component	Suppress/Set to Resolved
Distance Mate	Move with Triad	Suppress/Unsuppress
Do not create External References	New view	Suspend Automatic Rebuild
Edit Component	Open part, Open assembly	View Planes, Origins, Temporary Axis

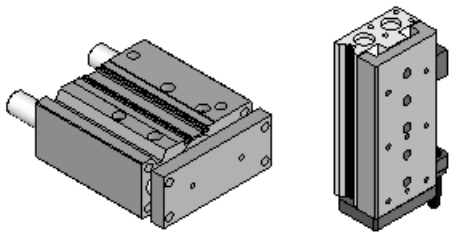
Build modeling skill and speed. Project 3 primarily utilizes Pop-up menus and Shortcut keys to execute the tools in the Assembly toolbar.



Project Overview

The 2AXIS-TRANSFER assembly is the second sub-assembly for the 3AXIS-TRANSFER assembly.

The 2AXIS-TRANSFER assembly combines the GUIDE-CYLINDER assembly and the SLIDE-TABLE assembly.



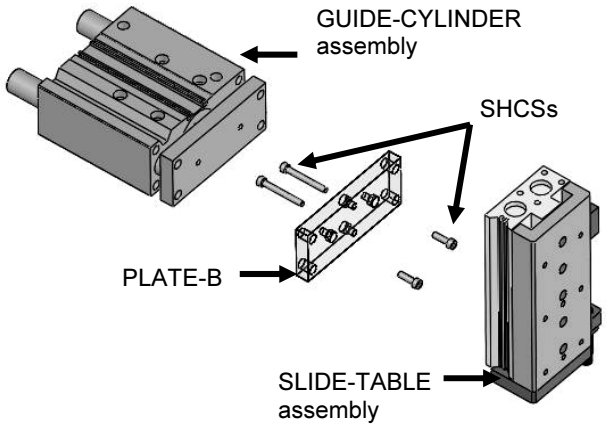
GUIDE-CYLINDER assembly

SLIDE-TABLE assembly

The SLIDE-TABLE assembly vertically lifts the GRIPPER 100mm. The GUIDE-CYLINDER assembly moves 100mm horizontally.

The SLIDE-TABLE assembly cannot be fastened directly to the GUIDE-CYLINDER assembly.

Design the PLATE-B part as an interim part to address this issue. Create PLATE-B In-Context of the GUIDE-CYLINDER assembly.



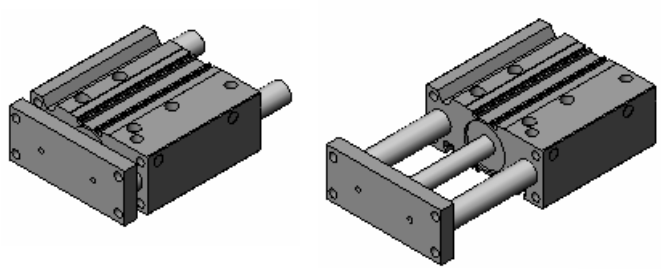
2AXIS-TRANSFER assembly

The 2AXIS-TRANSFER assembly consists of the following models:

- GUIDE-CYLINDER assembly.
- PLATE-B part.
- SLIDE-TABLE assembly.
- SHCS.

Add the configurations for the GUIDE-CYLINDER, SLIDE-TABLE, and 2AXIS-TRANSFER assemblies to represent physical positions.

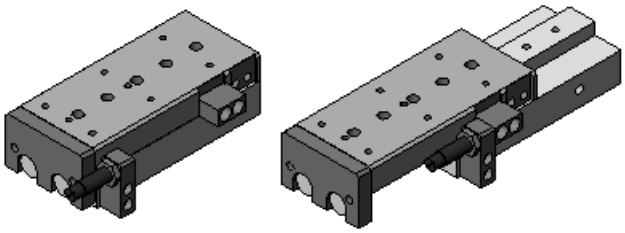
Utilize the ConfigurationManager to create the GUIDE-CYLINDER configurations named; Default, Normal, and Extended.



Normal Extended

GUIDE-CYLINDER Configuration

Utilize the ConfigurationManager to create the SLIDE-TABLE configurations named; Default, Normal, and Extended.



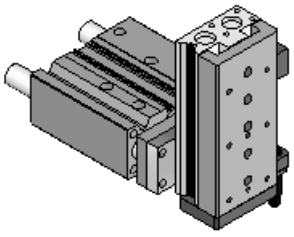
Normal Extended

SLIDE-TABLE Configurations

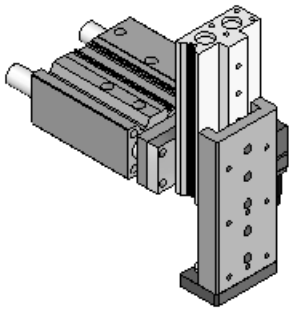
Combine the GUIDE-CYLINDER Normal configuration and Extended configuration with the SLIDE-TABLE Normal configuration and Extended configuration to create the following four 2AXIS-TRANSFER configurations:

1. Normal-Normal.
2. Normal-Extended.
3. Extended-Normal.
4. Extended-Extended.

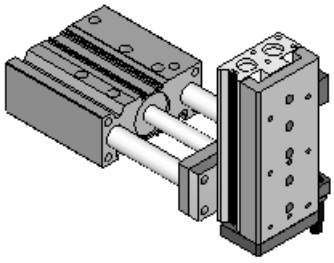
The GUIDE-CYLINDER configuration is listed first, followed by the SLIDE-TABLE configuration.



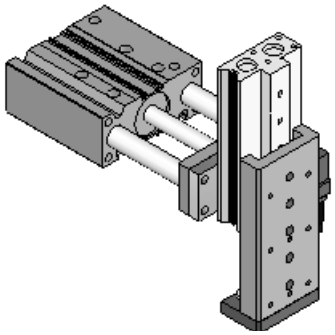
Normal-Normal



Normal-Extended



Extended-Normal

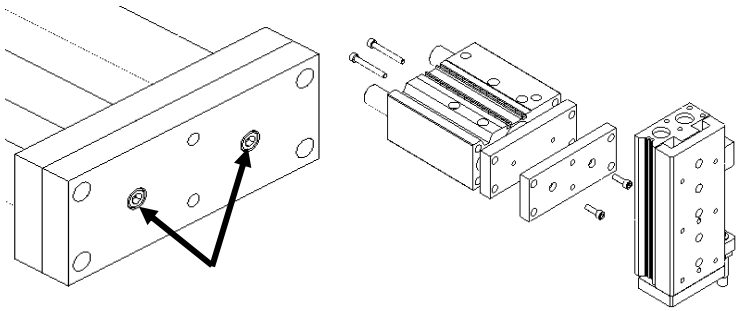


Extended-Extended

Create the fifth 2AXIS-TRANSFER configuration named Fastener.

Un-suppress the SHCSs in the Fastener configuration.

Suppress the SHCSs in the other four configurations.



Fastener

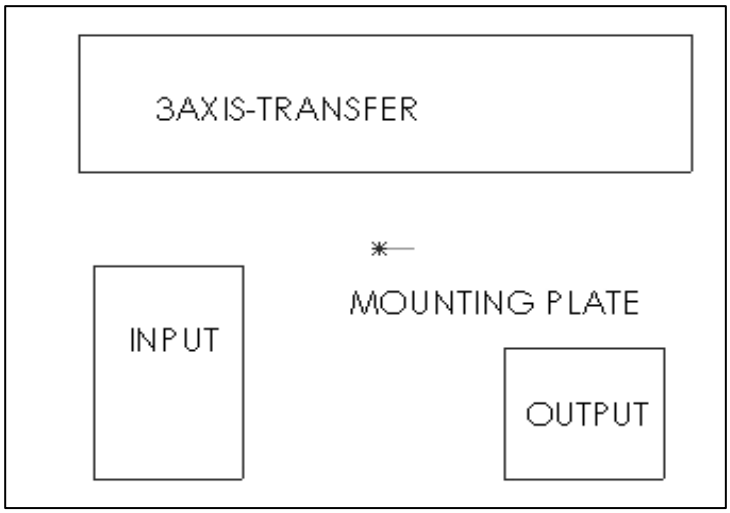
2AXIS-TRANSFER Configurations

Top Down Design Assembly Modeling Approach

In the Top Down design assembly modeling approach, the major design requirements are translated into assemblies, sub-assemblies, and components. You do not need all of the required component design details. The model requires individual relationships between components. There are two methods to begin a Top Down design assembly approach:

- Method 1: Start with a Layout Sketch in the assembly.
- Method 2: Start with a component in the assembly.

In Method 1, all major components are positioned based on a 2D sketch. Relationships between sub-assemblies must be maintained for proper fit. Utilize Method 1 in Project 6.



Delivery Station Layout Sketch

In Method 2, relationships are derived from an existing component in the assembly. Utilize Method 2 for the PLATE-B part.

Develop the PLATE-B part In-Context of the existing GUIDE-CYLINDER assembly. The PLATE-B part contains In-Context relations.

An In-Context relation is a reference between a sketch entity in a part and an entity in another component. Relations that are defined In-Context are listed as External references. In-Context relations and External references are powerful tools in the design phase. Begin with an empty part and utilize existing components in the assembly.

Determine the geometric and functional requirements of the part.

Mastering assembly modeling techniques with In-Context relations requires practice and time. Planning and selecting the correct reference and understanding how to incorporate changes are important.

Explore various techniques using InPlace Mates and External references developed in the context of an assembly.

Assembly Modeling Techniques with InPlace Mates:
1. Plan the Top-Down design method. Start from a Layout sketch or with a component in the assembly.
2. Prepare the references. Utilize descriptive feature names for referenced features and sketches.
3. Utilize InPlace Mates sparingly. Load all related components into memory to propagate changes. Do not use InPlace Mates for purchased parts or hardware.
4. Group references. Select references from one component at a time.
5. Ask questions! Will the part be used again in a different assembly? If the answer is yes, do not use InPlace Mates. If the answer is no, use InPlace Mates.
6. Will the part be used in physical dynamics or multiple configurations? If the answer is yes, do not use InPlace Mates.
7. Examine how to redefine External references. Use List References and Lock References to locate and protect geometry. Existing references do not update in a locked state. Locate the locked references. Create new references for the sketch and the feature.
8. Reduce the size of the FeatureManager. Hide Update Holders for In-Context features.
9. Work in the Edit Part mode to obtain the required external references in the assembly. Create all non-referenced features in the Part, not in the assembly.
10. Obtain knowledge of your company's policy on InPlace Mates or develop one as part of an engineering standard. .
11. Use the Break All command from keeping External references from updating.

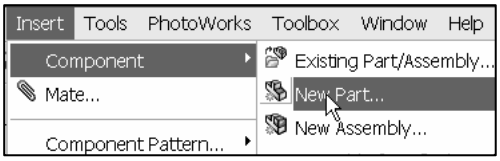
Note: The Break All command is not utilized in this project. The authors prefer other techniques based on experience.

2AXIS-TRANSFER assembly

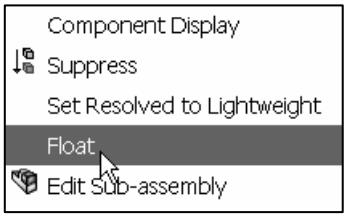
Create an assembly called 2AXIS-TRANSFER assembly.

Determine the specific features required to create the PLATE-B part using the Top Down design assembly approach.

Utilize Insert, Component, New Part from the Main menu to create PLATE-B In-Context of the GUIDE-CYLINDER assembly.

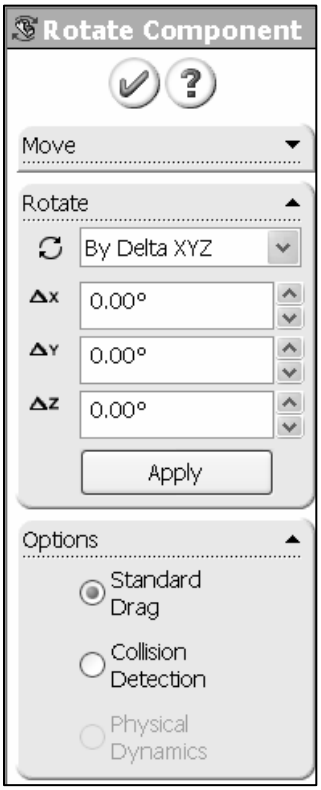


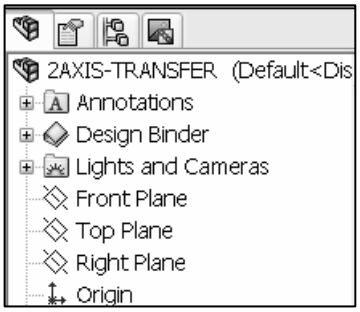
Redefine the orientation of the GUIDE-CYLINDER assembly. The Float option removes the Fixed constraint in the FeatureManager.



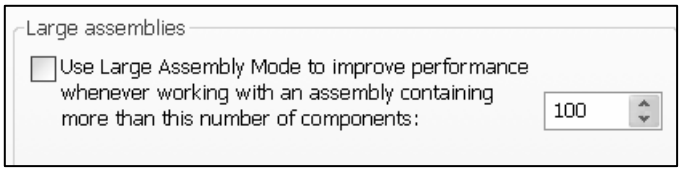
Utilize the 2AXIS-TRANSFER default reference planes: Front Plane, Top Plane, and Right Plane. The reference planes provide an accurate method to locate the first component in an assembly at the required orientation.

Note: To rotate a component by an exact value, select Rotate Component. Select the By Delta XYZ option. Enter an angular value.





Deactivate the Large Assembly Mode.



Activity: 2AXIS-TRANSFER assembly

Close all documents.

1) Click **Window**, **Close** All from the Main menu.

Deactivate the Large Assembly Mode.

2) Click **Tools, Options** from the Main menu.

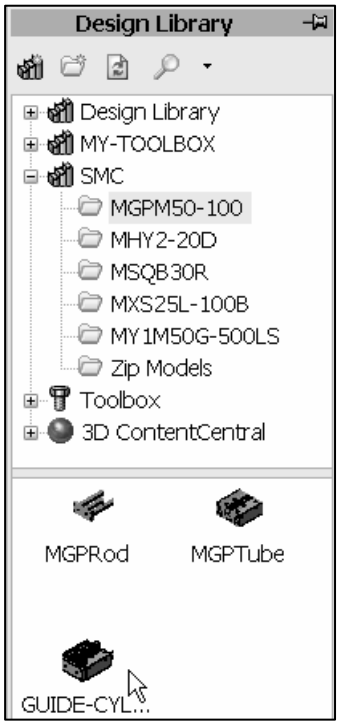
3) Click **Assemblies**. Uncheck **Use Large Assembly Mode**.

4) Click **OK**.

Open the GUIDE-CYLINDER assembly from the Design Library.

5) Double-click **MGPM50-100** from the SMC folder.

6) Click and drag **GUIDE-CYLINDER** into the Graphics window. The GUIDE-CYLINDER assembly is displayed in the Graphic window.

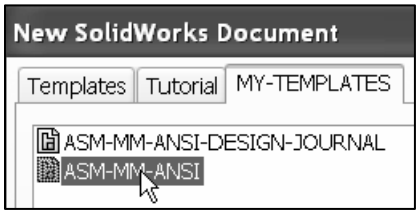


Create a new assembly.

7) Click **Make Assembly from Part/Assembly** from the Standard toolbar.

8) Select the **MY-TEMPLATES** tab.

9) Double-click **ASM-MM-ANSI**. The Insert Component PropertyManager is displayed.



10) Click **View**, check **Origins** from the Main menu.

11) Click a **position** to the left of the new assembly Origin. Do not click the assembly Origin.

12) If required, click **View**. Uncheck **Planes** to hide all planes.

Display an Isometric view.

13) Click **Isometric** view.

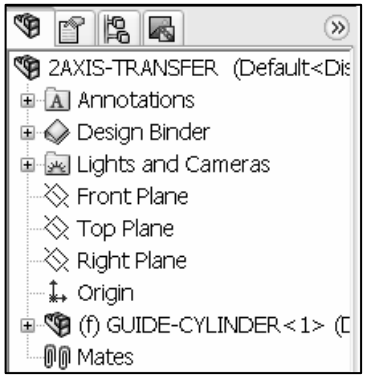
Save the assembly.

14) Click **Save**.

15) Select **DELIVERY-STATION** for Save in: file folder.

16) Enter **2AXIS-TRANSFER** for File name.

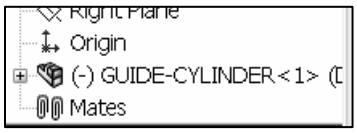
17) Click **Save**. The 2AXIS-TRANSFER FeatureManager is displayed. Click **View**, un-check **Origins** from the Main menu.

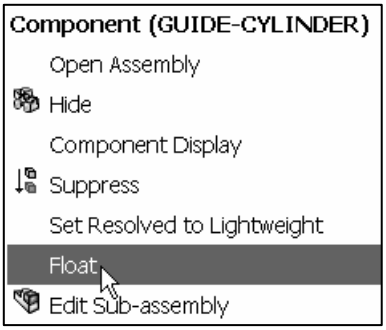


Float the GUIDE-CYLINDER.

18) Right-click **GUIDE-CYLINDER** from the FeatureManager.

19) Click **Float**. The GUIDE-CYLINDER entry changes from fixed, (f) to under-defined, (-).





Rotate the GUIDE-CYLINDER.

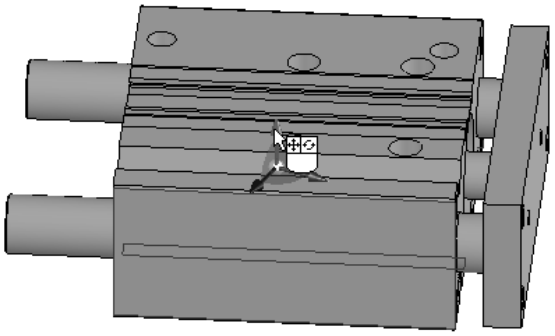
20) Right-click **GUIDE-CYLINDER** from the FeatureManager.

21) Click **Move with Triad**.

22) Hold the **right mouse button** down on the green vertical arrow.

23) Drag the **mouse pointer** to the left to rotate the component as illustrated.

24) Release the **right mouse button**.



Mate the GUIDE-CYLINDER. Create a Coincident mate.

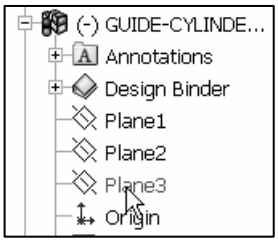
25) Expand **GUIDE-CYLINDER** from the FeatureManager.

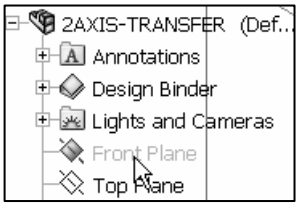
26) Click **GUIDE-CYLINDER\Plane3**.

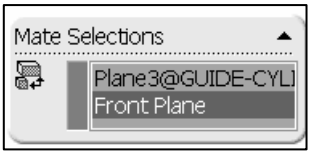
27) Click **Mate** Mate . The Mate PropertyManager is displayed.

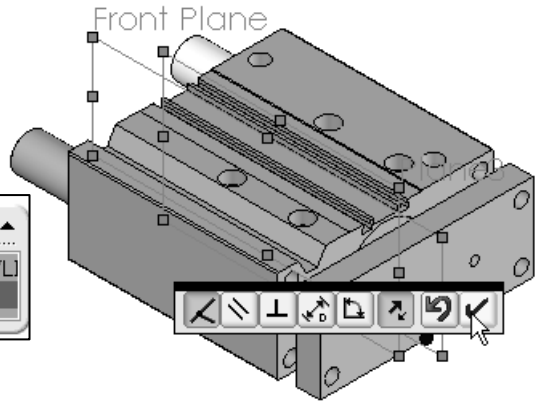
28) Click **2AXIS-TRANSFER\Front Plane**. Coincident is selected by default.

29) Click ✔.







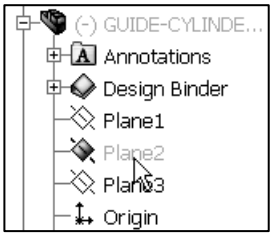


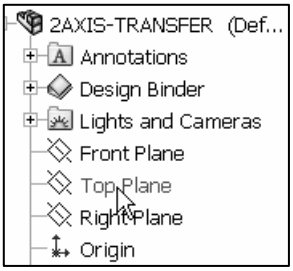
Create the second Coincident mate.

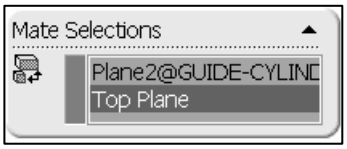
30) Click **GUIDE-CYLINDER\Plane2**.

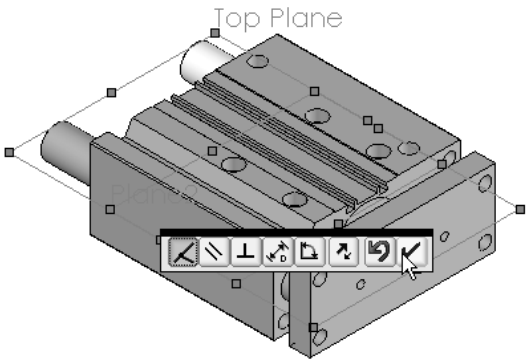
31) Click **2AXIS-TRANSFER\Top Plane**. Coincident is selected by default.

32) Click ✔.









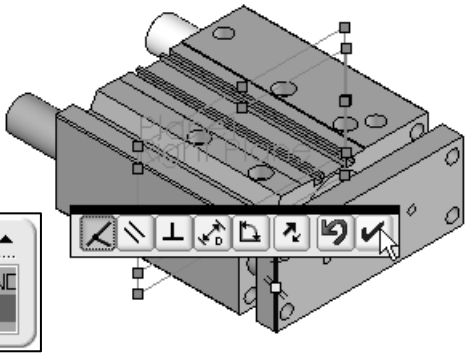
Create the third Coincident mate.

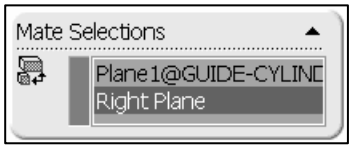
33) Click **GUIDE-CYLINDER\Plane1**.

34) Click **2AXIS-TRANSFER\Right Plane**. Coincident is selected by default.

35) Click ✔.

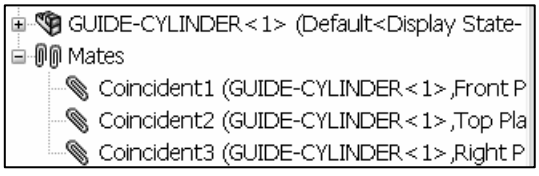
36) Click **OK**  from the Mate PropertyManager.



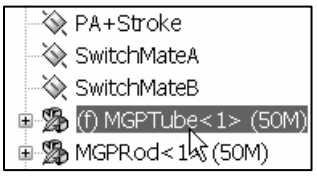


Expand the Mates.

37) Expand **Mates** from the FeatureManager. View the 3 Mates. The GUIDE-CYLINDER is fully defined in the 2AXIS-TRANSFER assembly.



The Fix option provides a fast technique in assembly modeling. As models become more complex, it is difficult to determine where the component Origin is in space. Mating the first component to three planes takes more time but provides orientation flexibility and greater accuracy.



Hide the MGPTube component.

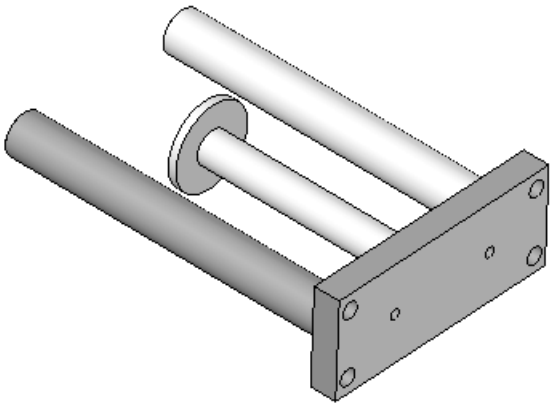
38) Right-click **MGPTube<1>** from the FeatureManager.

39) Click **Hide**.

Expand the MGPRod part.

40) Expand **MPGRod<1>** from the 2AXIS-TRANSFER FeatureManager. If required, Set to Resolve.

41) Click **MountHoles2** from the FeatureManager. The four holes are selected in the Graphics window and displayed in green.



The PLATE-B part references the MountHoles2 feature.

In-Context, External References, and InPlace Mates

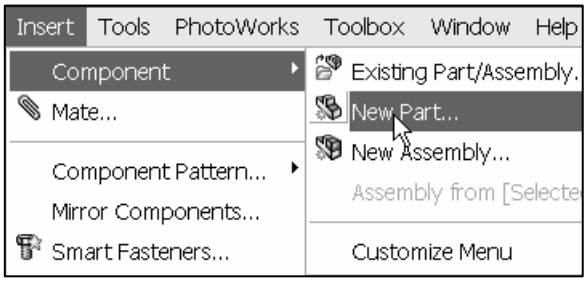
An In-Context relationship is a geometric relationship between a sketch entity in one part, and a feature on a component in the assembly.

An External reference is a relationship that exists between a sketch entity and geometry outside the sketch. Example: The GUIDE-CYLINDER utilizes reference planes to develop the Base Extrude feature for the MGPTube.

An External reference develops an In-Context relationship when geometry is referenced outside the part. Example: Create the new PLATE-B part in the context of the 2AXIS-TRANSFER assembly that references the MGPRod component.

Components added in the context of an existing assembly automatically receive an InPlace Mate. The InPlace Mate is a Coincident Mate created between the Front Plane of a new component and the selected planar geometry of the assembly. The component is fully defined; no additional Mates are required to position the component. By default, SolidWorks uses the default templates for new parts and assemblies developed In-Context of an existing assembly.

To select a custom Template, define the System Options, Document Templates option before you insert a new component into the assembly.



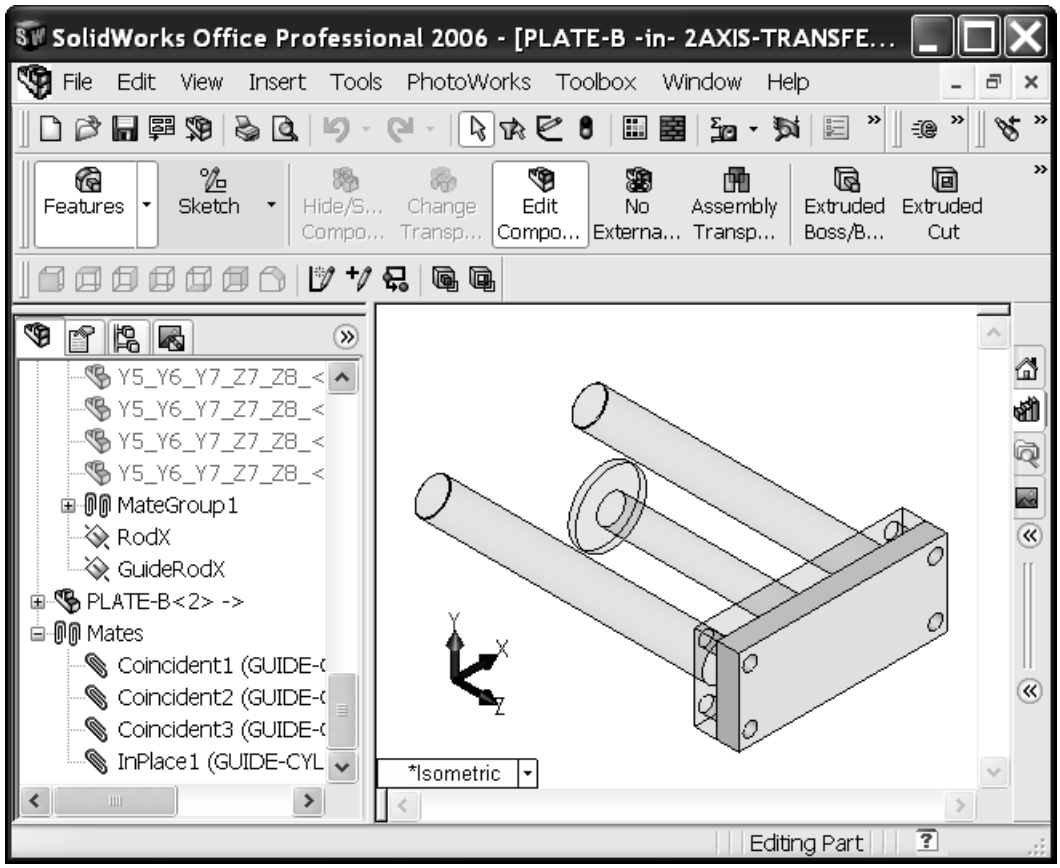
Create the PLATE-B part In-Context of the 2AXIS-TRANSFER assembly, select Insert, Component, New Part

Select the custom Part Template from the MY-TEMPLATES folder.

Enter PLATE-A for the new part.

Select the MGPRod right face to create an InPlace Mate reference with the PLATE-B Front Plane. SolidWorks automatically selects the Edit Component 

icon when inserting a new component. The PLATE-B blue text appears in the FeatureManager. The default blue color indicates that the part is actively being edited.



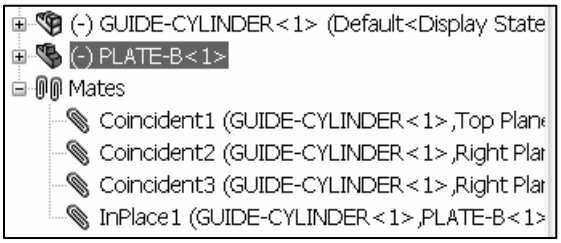
The right face of the MGPRod part is the current Sketch plane. The current sketch name is Sketch1. The current Graphics window title displays the sketch and name.

Example:

"Sketch1 of PLATE-B -in- 2AXIS-TRANSFER."

PLATE-B is the name of the component created in the context of the 2AXIS-TRANSFER assembly. SolidWorks automatically selects Sketch 

.



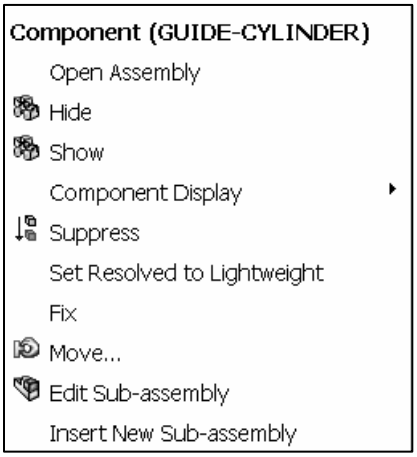
The Mate, InPlace1 (GUIDE-CYLINDER<1>, PLATE-B<1>) fully defines PLATE-B in the 2AXIS-TRANSFER assembly.

The Assembly toolbar, FeatureManager and Pop-up Assembly menu display different options.

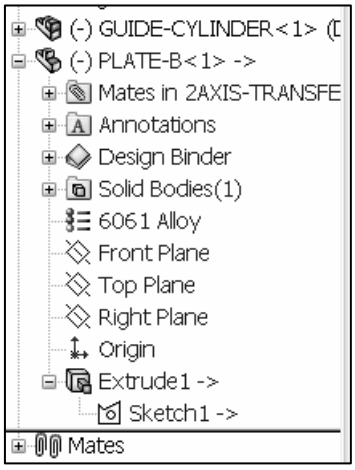
Review Edit Component, Edit Part, and Edit Sub-assembly tools.

- For parts and assemblies, utilize the Edit Component 

from the Assembly toolbar.
- For parts only, utilize Edit Part and Open Part.
- For assemblies only, utilize Edit Sub-assembly and Open Assembly.



SolidWorks creates External references from the PLATE-B part to the GUIDE-CYLINDER assembly.



Example: The Extrude1 feature develops an External reference from the sketch plane. Sketch1 develops External references from the Convert Entities Sketch tool.

The No External References 

option develops no InPlace Mate or External references. Select this option before you select Insert, Component, New Part from the Main menu. Customize the Assembly toolbar in the next activity to include this important option.

The procedure to create a component in the context of an assembly with no External references is the same as creating a new part with External references. Select a Sketch plane and create the sketch.

If you utilize Convert Entities and Offset Entities Sketch tools, no External references develop. The new part requires dimensions and relations to fully define the geometry and Mates to constrain its position in the assembly. The Do not create External references option toggles on and off. Insert this option into the Assembly toolbar.

Activity: In-Context, External References, and InPlace Mates

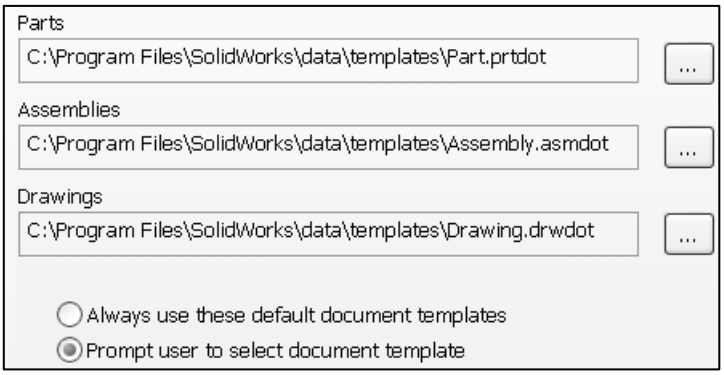
Set the Default Template option.

42) Click **Tools**, **Options**, **System Options** tab from the Main menu.

43) Click **Default Templates**.

44) Check **Prompt user to select document template**.

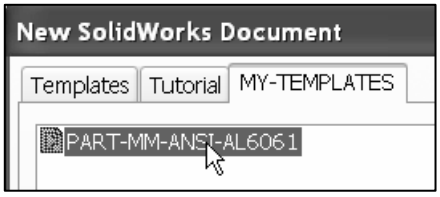
45) Click **OK** from the System Options box.



Insert the new PLATE-B part.

46) Click **Insert**, **Component**, **New Part** from the Main menu.

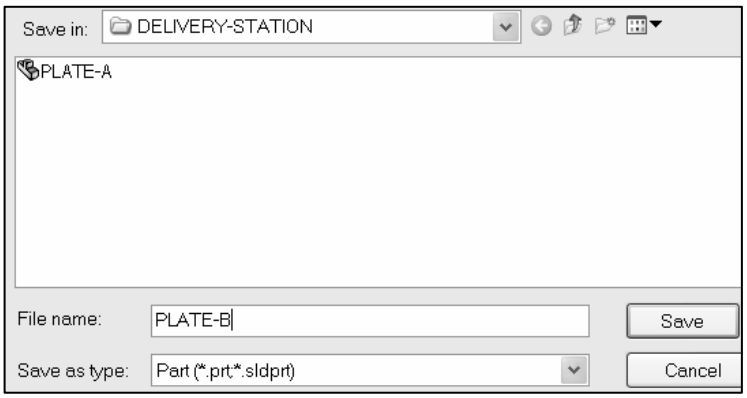
47) Double-click **PART-MM-ANSI-AL6061**.



48) Select **DELIVERY-STATION** for Save in: file folder.

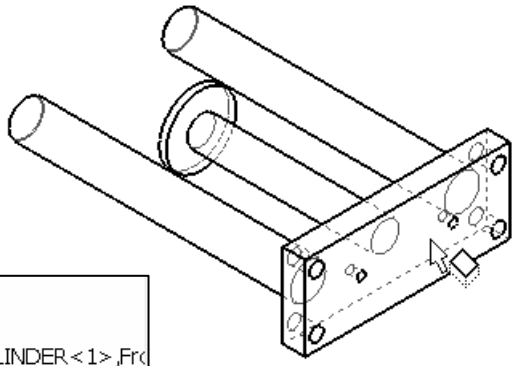
49) Enter **PLATE-B** for file name.

50) Click **Save**.

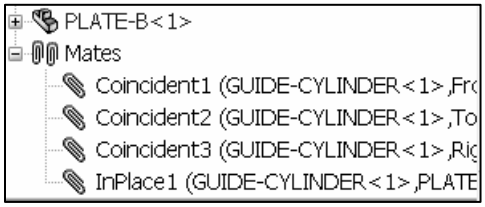


Locate the new part with an InPlace Mate.

51) The Component Pointer icon is displayed on the mouse pointer. The PLATE-B component is empty and requires a sketch plane. Click the **right** face of the MGPRod part as illustrated. SolidWorks creates the InPlace1 Mate.



52) Click **Hidden Lines Visible**.

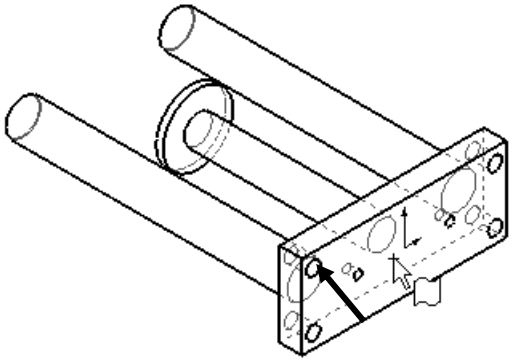


Convert existing edges.

53) Click the **right face**.

54) Click **Convert Entities** Convert from the Sketch toolbar.

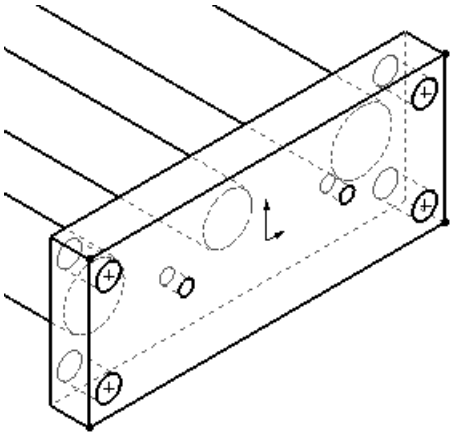
55) Click the **top left MountHoles2 circle**.



56) Hold the **Ctrl** key down.

57) Select the **three MountHoles2 circles**.

58) Release the **Ctrl** key.



59) Click **Convert Entities** 

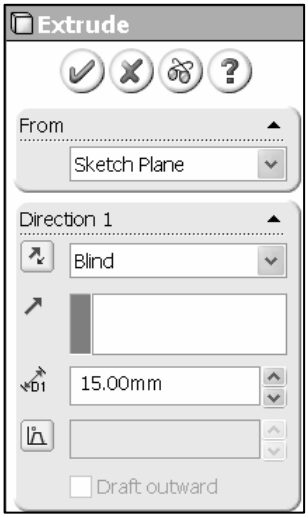
.

Extrude Sketch1.

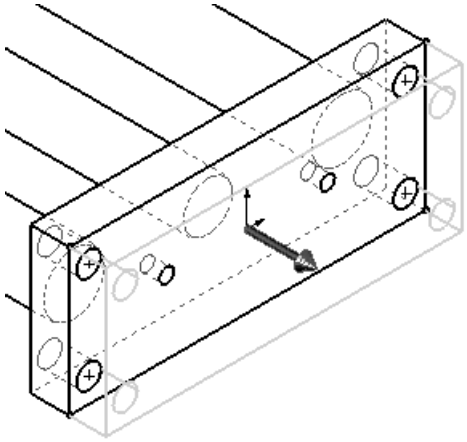
60) Click **Extruded Boss/Base** 

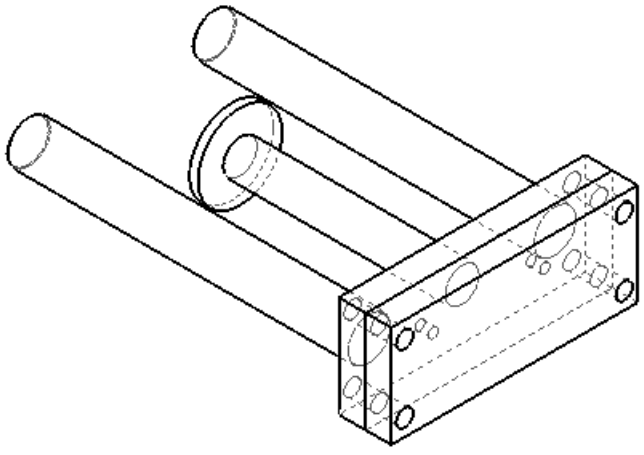
from the Features toolbar.

61) Enter **15** for Depth.



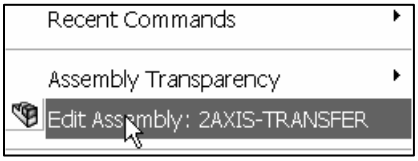
62) Click **OK**  from the Extrude PropertyManager. The name of PLATE-B is displayed in blue. The PLATE-B part is edited In-Context of the 2AXIS-TRANSFER assembly.





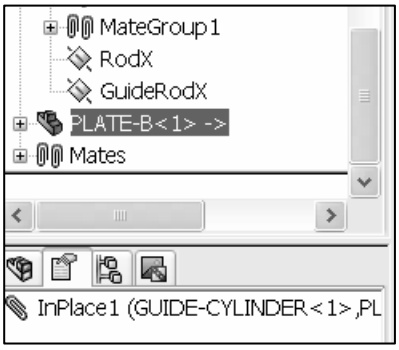
Return to the 2AXIS-TRANSFER assembly.

63) Right-click a **position** in the Graphics window.



64) Click **Edit Assembly: 2AXIS-TRANSFER**.

65) Right-click **PLATE-B** from the FeatureManager.



66) Click **View Mates**. The InPlace1 Mate lists the component references; GUIDE-CYLINDER<1>, PLATE-B<1>.

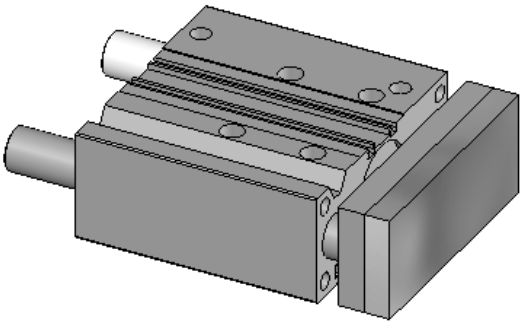
Display the MGPTube part.

67) Expand **GUIDE-CYLINDER<1>** from the FeatureManager.

68) Right-click **MGPTube** from the FeatureManager.

69) Click **Show**.

70) Click **Shaded With Edges**.



Save the 2AXIS-TRANSFER assembly.

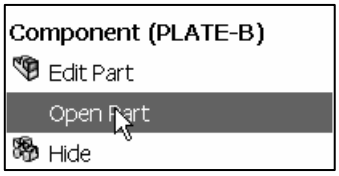
71) Click **Isometric** view.

72) Click **Save** from the Main menu.

Open PLATE-B.

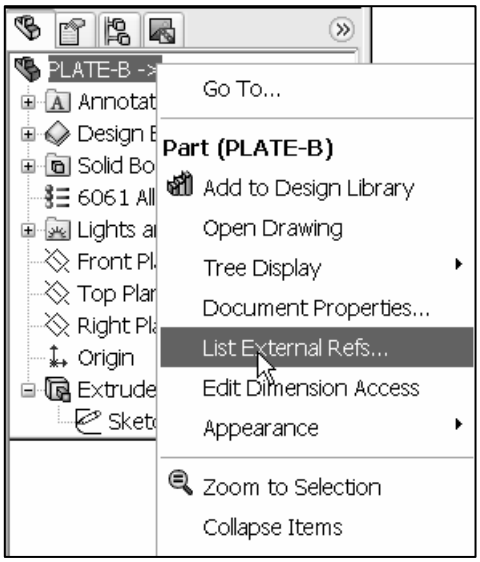
73) Right-click **PLATE-B** from the FeatureManager.

74) Click **Open Part**. PLATE-B is displayed in the Graphics window.



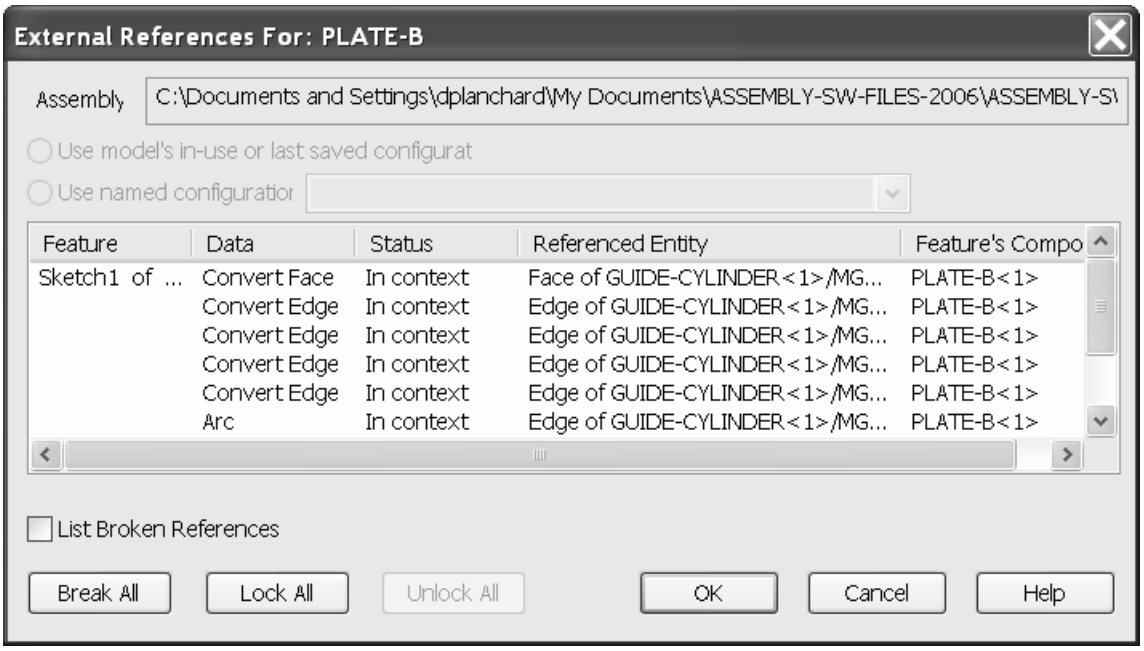
Review External references in PLATE-B.

75) The "->" symbol indicates that there are External references for the PLATE-B part. Right-click **PLATE-B**.



76) Click **List External Refs**. The External Reference list contains the Feature, Data, Status, Reference Entity, and Feature Component. All External references are defined.

77) Click **OK**.



Customize the Assembly toolbar.

78) Click **Tools**, **Customize** from the Main menu. The Customize box is displayed.

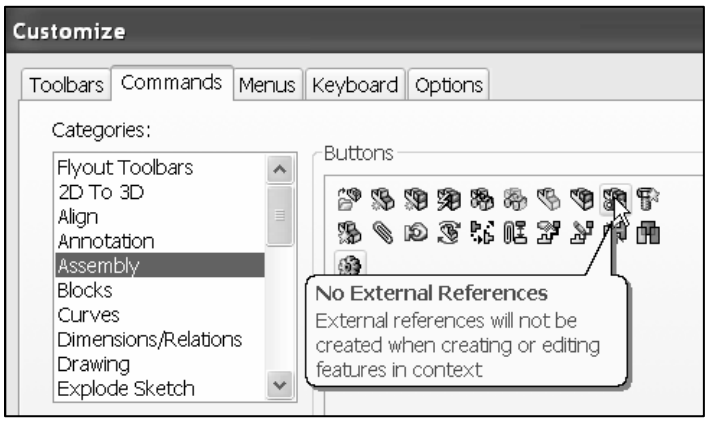
79) Click the **Commands** tab.

80) Select **Assembly** from the Categories list.

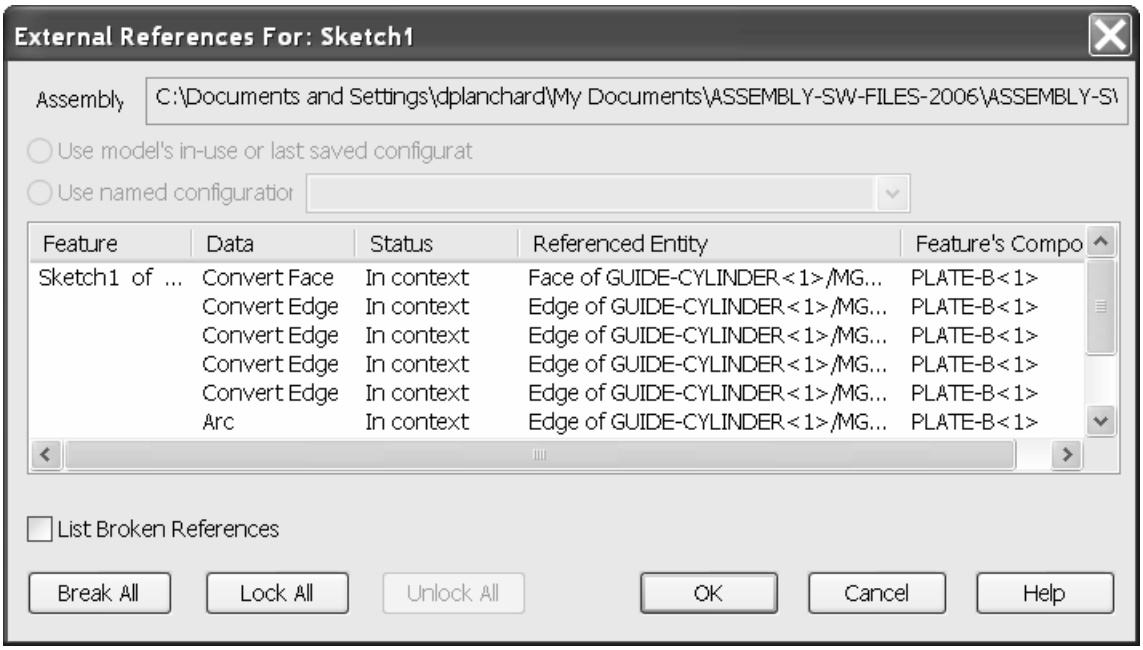
81) Click the **No External References** icon.

82) Drag the **icon** into the Assembly toolbar.

83) Click **OK**.



Base-Extrude Sketch1 contains three types of External references.



Convert Face entry occurs when you select the sketch plane. Convert Edge and Arc entries occur when you select Convert Entities in Sketch1. The Data column lists External references.

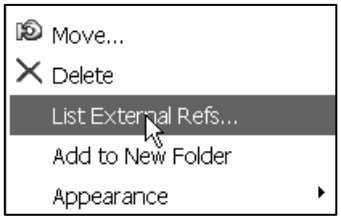
- Convert Face.
- Convert Edge.
- Arc.

The Convert Entities of the MGPRod's right face results in four Convert Edge references. The four Convert Edge references are:

- Bottom Horizontal Line.
- Right Vertical Line.
- Top Horizontal Line.
- Left Vertical Line.

There are four Arc references. The Convert Entities of the four MountHoles2 circles created the Arc references.

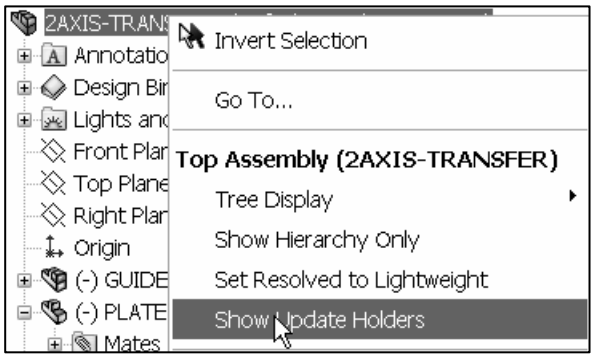
From the 2AXIS-TRANSFER assembly, utilize two additional methods to access External references.



Method 1: Right-click on a component in the FeatureManager or in the Graphics window. Click List External Refs.

Method 2: Right-click on the top level assembly icon. Click Show Update Holders.

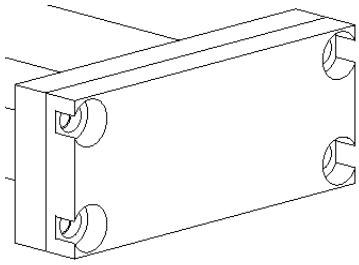
SolidWorks creates an Update Holder for each External sketch reference. The Update Holders are displayed at the bottom of the FeatureManager.



The Update Holder entry contains the option to List External Refs. Reduce the size of the FeatureManager. Select the default Hide Update Holders.

Hole Selection

Hole selection becomes an important decision in machine design. You decide on the hole type, placement, and feature selection. Four ∅10mm SHCSs fasten the PLATE-B part to the GUIDE-CYLINDER assembly. Should the holes utilize a counterbore? Answer: No. The holes are too close to the edge of the PLATE-B part. Do you enlarge PLATE-B to accommodate the counterbore? Answer: No. Increasing the part size adds additional weight and cost.



You must decide whether to create the PLATE-B holes in a Top Down design approach with External references, or a Bottom-Up Design approach with no External references.

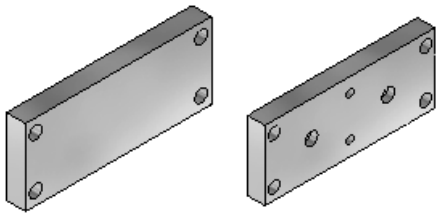


PLATE-B

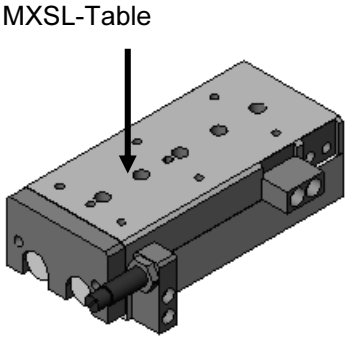
Examine the SLIDE-TABLE assembly to determine the fastener type. Are additional holes required to mount the SLIDE-TABLE assembly to PLATE-B? Answer: Yes. Add two additional holes.

There are two major components in the SLIDE-TABLE assembly:

1.) MXSL-Body.

2.) MXSL-Table.

The MXSL-Body back face mates to the PLATE-B front face. Simplify the mate process. Hide the MXSL-Table.



SLIDE-TABLE assembly

Utilize BodyThruHole4 and BodyThruHole5, closest to the bottom face. Create two M6 Cbores in the PLATE-B part that correspond to the ThruHoles in the MXSLTable. No External references are created in this Bottom Up approach.

Minimize the use of External references from multiple parts. Multiple part references lead to problems in higher levels of the assembly. External references require additional modification when dissolving components and forming sub-assemblies used in other projects.

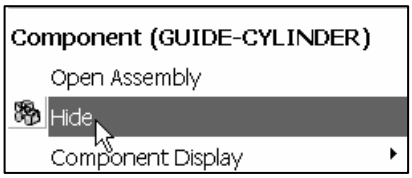
Avoid unnecessary references. Do not work continuously in Edit Component mode for the individual part. Open the part. Insert additional features at the part level. The individual part is less complex than an assembly. Rebuild time is quicker.

Activity: Hole Selection

Hide the GUIDE-CYLINDER assembly.

84) Return to the 2AXIS-TRANSFER assembly. Click **Window**, **2AXIS-TRANSFER** from the Main menu.

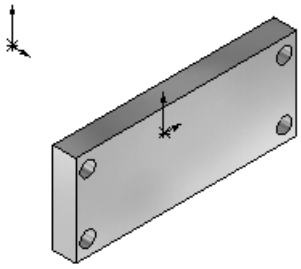
85) Right-click **GUIDE-CYLINDER** from the FeatureManager.



86) Click **Hide**. PLATE-B is displayed in the Graphics window.

Display the Origin.

87) Click **View**, **Origins** from the Main menu.



Note: Do not suppress the GUIDE-CYLINDER assembly. The Mates will be suppressed and the 2AXIS-TRANSFER assembly will no longer be constrained.

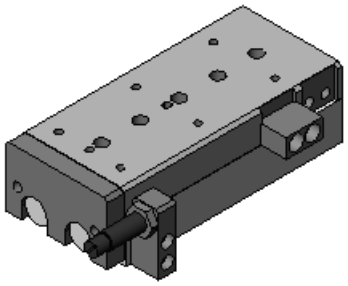
Note: The 2AXIS-TRANSFER assembly determines the location of the PLATE-B Origin.

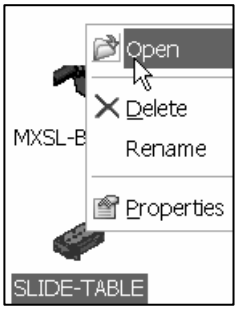
Open the SLIDE-TABLE assembly.

88) Double-click the **SMC\MXS25L-100B** folder from the Design Library.

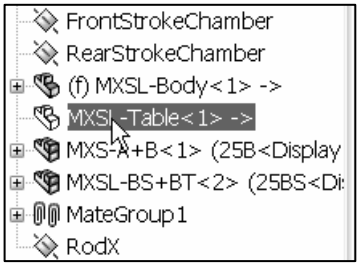
89) Right-click **SLIDE-TABLE**.

90) Click **Open**. The SLIDE-TABLE is displayed in the Graphics window.





Determine the SLIDE-TABLE/MXSLBody Thru Hole locations.

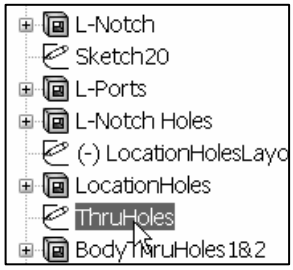


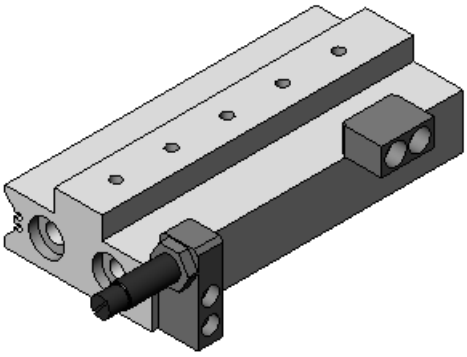
91) Right-click **MXSL-Table<1>** from the FeatureManager.

92) Click **Hide**.

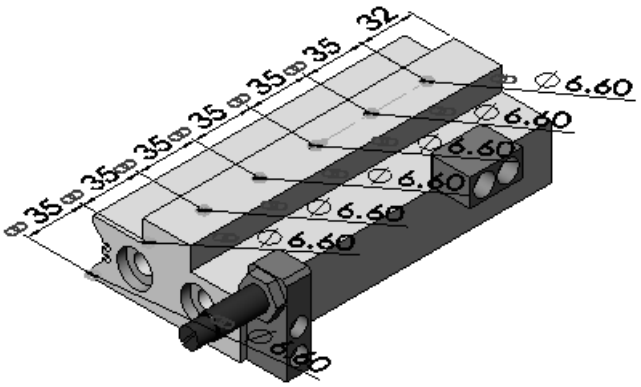
93) Right-click **MXSL-Body<1>** from the FeatureManager.

94) Double-click **MXSL-Body<1>** from the FeatureManager to view the ThruHole sketch.





95) Double-click **ThruHoles** from the FeatureManager. The ∅6.6mm holes are spaced 35mm apart and 32mm from the MXSLBody Top face.

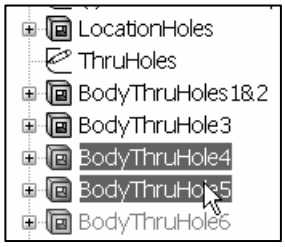


96) Click **BodyThruHole4** and **BodyThruHole5** to display the Thru Hole feature.

Display the SLIDE-TABLE/MXSL-Table part.

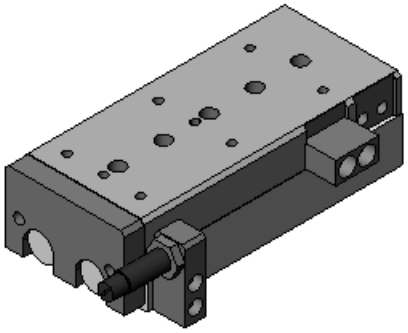
97) Right-click **SLIDE-TABLE/ MXSL-Table** from the FeatureManager.

98) Right-click **Show**.



Display an Isometric view.

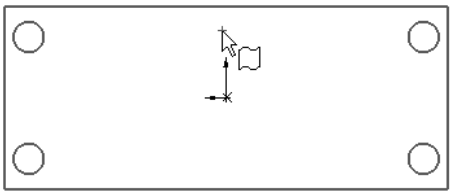
99) Click **Isometric** view.



Open the PLATE-B part.

100) Click **Window**, **PLATE-B** from the Main menu. PLATE-B is displayed.

101) Click **Hidden Lines Visible**.

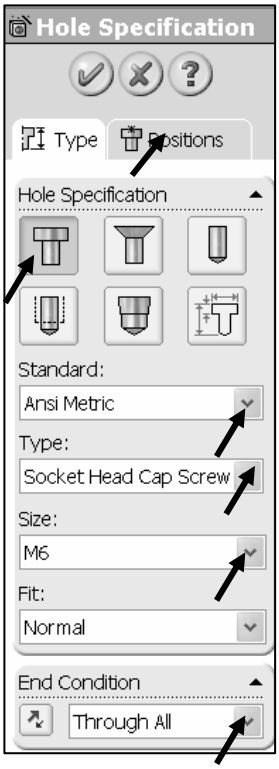


Add two Cbore Holes to the back face of the PLATE-B part. Use the Hole Wizard.

102) Click **Back** view.

103) Click the **back face** above the Origin.

104) Click **Hole Wizard** from the FeatureManager.



Create Cbore Hole1.

105) Click **Counterbore** for Hole Specification.

106) Select **Ansi Metric** for Standard.

107) Select **Socket Head Cap Screw** for Type.

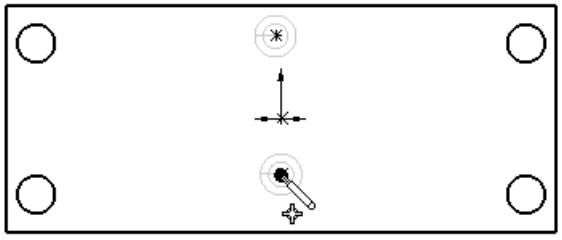
108) Select **M6** for Size.

109) Select **Through All** for End Condition.

110) Click the **Positions** tab.

Create a Cbore Hole2.

111) Click a **position** below the Top plane, aligned with the Origin. The center point of Cbore Hole2 is displayed in blue. Note: Blue indicates that dimensions and relations are required.



Add a Vertical relation.

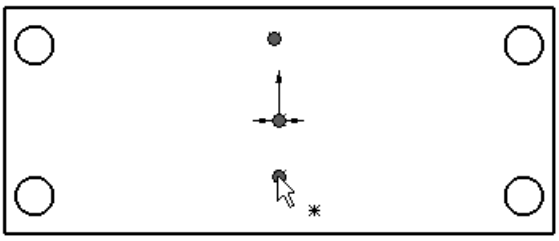
112) Right-click **Select** in the Graphics window.

113) Click the **Origin**.

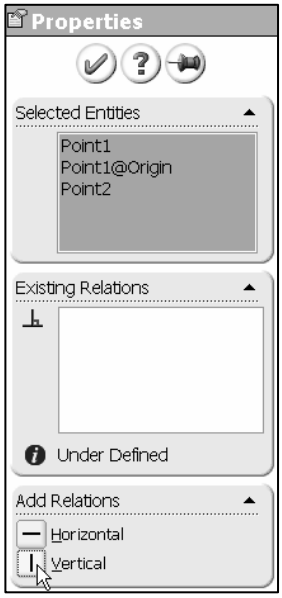
114) Hold the **Ctrl** key down.

115) Click the **Hole1 center point** and **Hole2 center point**.

116) Release the **Ctrl** key.



117) Click **Vertical** from the Add Relations box.

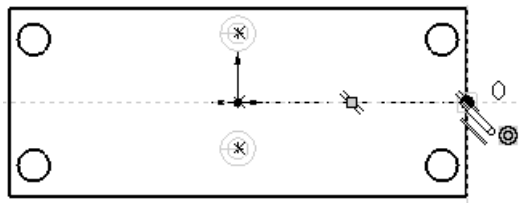


118) Click **OK** from the Properties PropertyManager.

Add a Symmetric relation.

119) Click **Centerline** Centerl... from the Sketch toolbar.

120) Sketch a **horizontal centerline** from the Origin to the midpoint of the right vertical edge as illustrated.



121) Right-click **Select**.

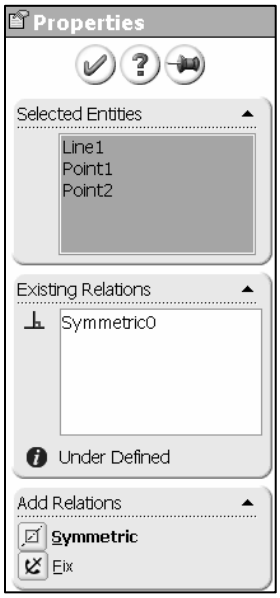
122) Click the **centerline**.

123) Hold the **Ctrl** key down.

124) Click the **Hole1 center point** and the **Hole2 center point**.

125) Release the **Ctrl** key.

126) Click **Symmetric** from the Add Relations box.



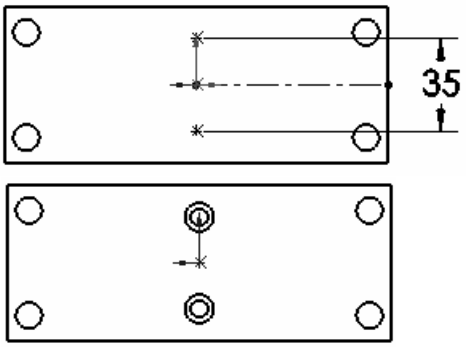
127) Click **OK** from the Properties PropertyManager.

Add a vertical dimension.

128) Click **Smart Dimension** Smart Dimens... from the Sketch toolbar.

129) Click the **Hole1 center point** and the **Hole2 center point**.

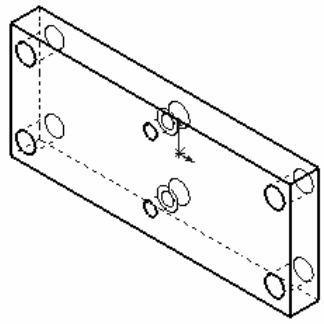
130) Enter **35**. Click ✔. The hole center points are fully defined.



131) Click **OK** from the Dimension PropertyManager.

132) Click **OK** from the Hole Position PropertyManager.

Display an Isometric view.
133) Click **Isometric** view.



Save the PLATE-B part.
134) Click **Save** from the Main menu.

Return to the 2AXIS-TRANSFER assembly.
135) Click **Window**, **2AXIS-TRANSFER** from the Main menu. Click **Yes** to the Rebuild now message.

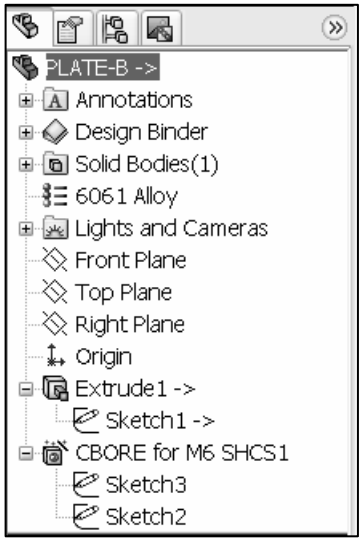
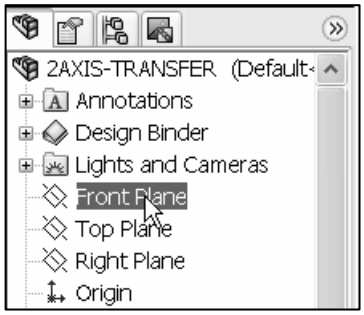


PLATE-B changed by adding two Cbore Holes. The 2AXIS-TRANSFER assembly contains the PLATE-B part. Utilize a Section view to display the new Cbores.

Update the 2AXIS-TRANSFER assembly.
136) Right-click **GUIDE-CYLINDER** from the FeatureManager.

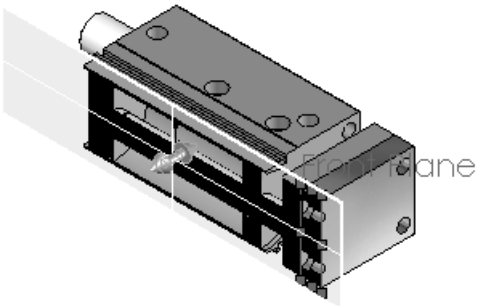
137) Click **Show**.



View the Cbore Hole in the 2AXIS-TRANSFER assembly.
138) Click **Front Plane** from the 2AXIS-TRANSFER FeatureManager.

139) Click **Section View** from the View toolbar. The Cbores are on the back face of the PLATE-B part.

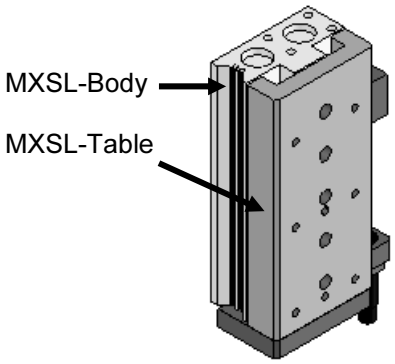
140) Click **Cancel** from the Section View PropertyManager to display the Full view.



Conserve design time. There are numerous Front Plane, Top Plane, and Right Plane entries in an assembly FeatureManager. Each component contains these reference planes. How do you select the correct Plane? Answer: Locate the component in the FeatureManager. Expand the component entry. Select the reference plane directly below the component name.

Mating the SLIDE-TABLE assembly

The SLIDE-TABLE assembly fastens to the PLATE-B Cbores. Open the SLIDE-TABLE and 2AXIS-TRANSFER assemblies if required. Utilize Tile Horizontally and drag the SLIDE-TABLE assembly icon into the 2AXIS-TRANSFER assembly. Position the SLIDE-TABLE in its approximate orientation before creating a Mate.



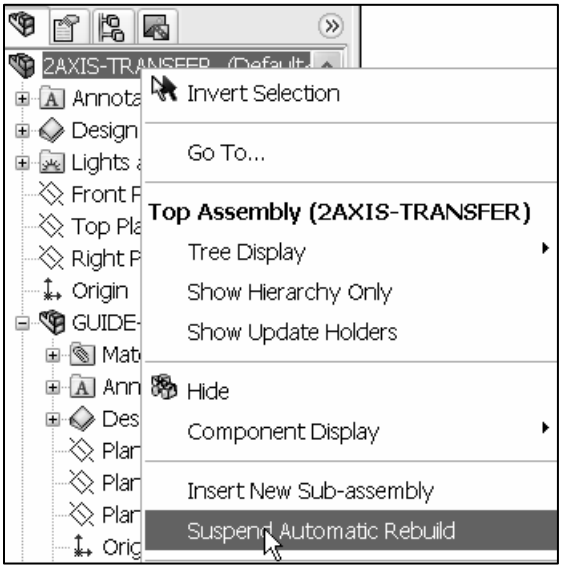
Hide components when not required. Do not suppress the GUIDE-CYLINDER assembly. Suppressing components suppresses Mates, resulting in parts being free to move and rotate.

There are many holes on the MXSL-Body part. What holes do you assemble to PLATE-B? Answer: The two bottom holes on the MXSL-Body part.

Investigate the physical behavior of the SLIDE-TABLE assembly. What part moves? What part remains static? Answer: The MXSL-Table part linearly translates and the MXSL-Body part is fixed.

The Suspend Automatic Rebuild defers the updating of Mates in the top level 2AXIS-TRANSFER assembly.

Utilize this option to create and change multiple Mates. The Rebuild command from the Standard toolbar controls the update of the deferred Mates.



Utilize a Section view to see the PLATE-B Cbores and the BodyThruHole4 and BodyThruHole5.

Utilize the Use for positioning only option to move and rotate components based on the Mate type. The Mate is not created or added to the FeatureManager.

Activity: Mating the SLIDE-TABLE assembly.

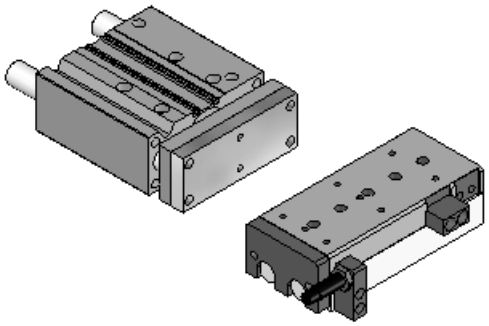
Insert the SLIDE-TABLE assembly.

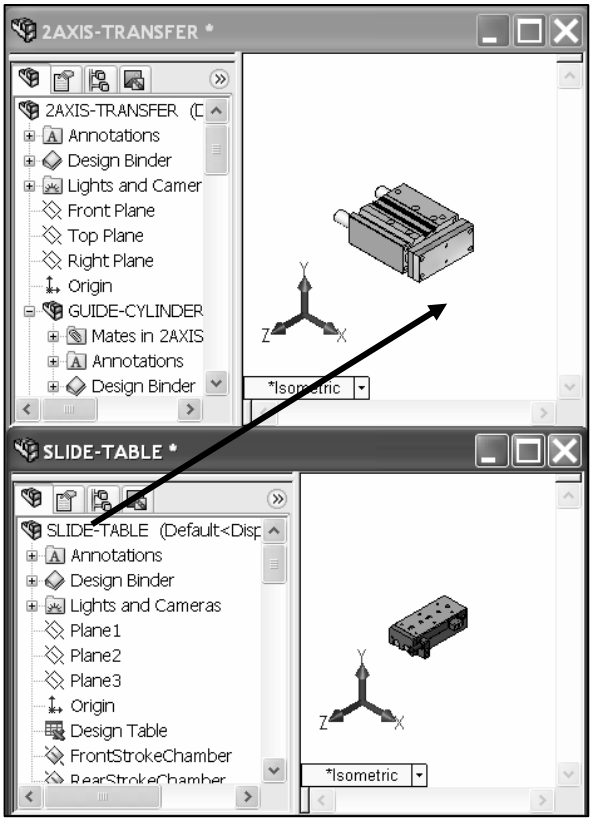
141) Click **Window**, **Tile Horizontally** from the Main menu.

142) Click and drag the **SLIDE-TABLE assembly icon** into the 2AXIS-TRANSFER assembly.

143) Click a **position** in front of the PLATE-B part as illustrated.

144) **Maximize** the 2AXIS-TRANSFER assembly.





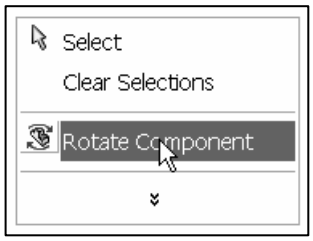
Move and Rotate the SLIDE-TABLE assembly.

145) Right-click **SLIDE-TABLE** from the FeatureManager.

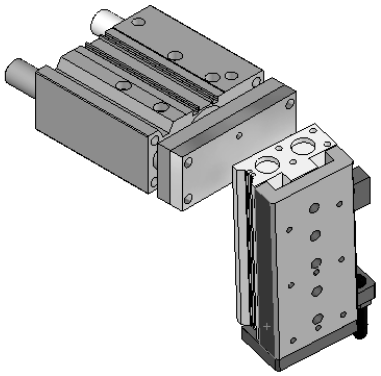
146) Click **Move**.

147) Right-click in the **Graphics window**.

148) Click **Rotate Component**.



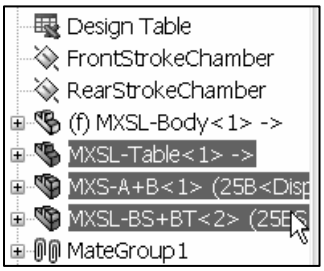
149) Click and drag the **SLIDE-TABLE** assembly in front of the PLATE-B part as illustrated.



150) Click **OK** from the Rotate Component PropertyManager.

Hide all Components that are not required.

151) Expand **SLIDE-TABLE** from the FeatureManager.



152) Click **MXSL-Table<1>**.

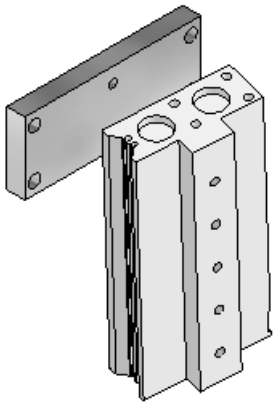
153) Hold the **Shift** key down.

154) Click the **MXSL-BS+BT<2>**.

155) Release the **Shift** key. The MXS-A+B is selected automatically with Shift-Select.

156) Hold the **Ctrl** key down.

157) Click the **GUIDE-CYLINDER** assembly from the FeatureManager.



158) Release the **Ctrl** key.

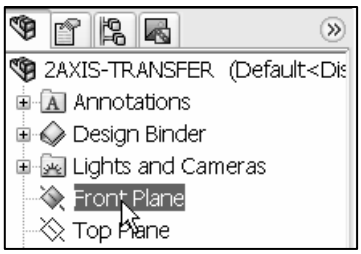
159) Right-click **Hide**.

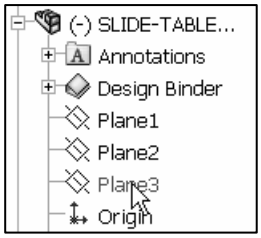
Display an Isometric view.

160) Click **Isometric** view.

Create a Coincident mate.

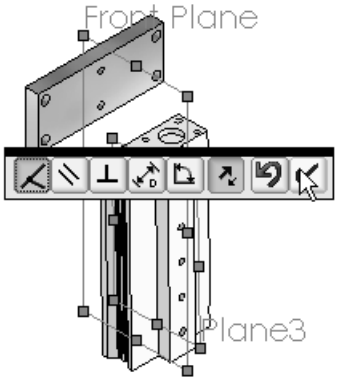
161) Click **Front Plane** from the 2AXIS-TRANSFER FeatureManager.



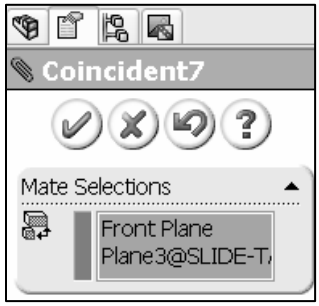


162) Click **Mate** Mate from the Assembly toolbar. The PropertyManager is displayed.

163) Click SLIDE-TABLE/**Plane3**.



164) Click the **Use for positioning only** option. Coincident is selected by Default.



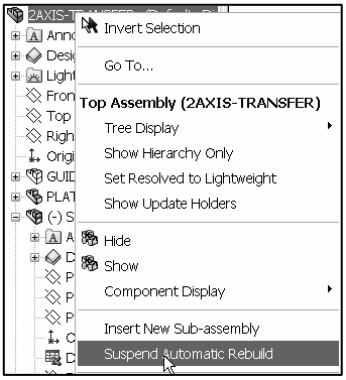
165) Click ✔. Do not move or rotate the MXSL-Body.

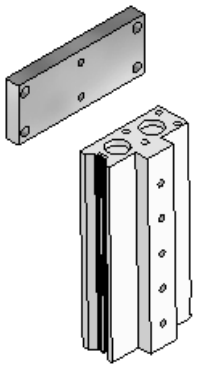
166) Click **OK** from the Mate PropertyManager.

Defer the Mates.

167) Right-click **2AXIS-TRANSFER** from the FeatureManager.

168) Click **Suspend Automatic Rebuild**.



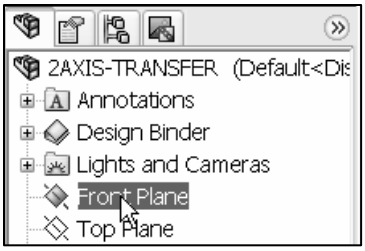


Display the Section view.

169) Click **Front Plane** from the 2AXIS-TRANSFER FeatureManager.

170) Click **Section view** .

171) Click **OK** from the Section View PropertyManager.



Insert a Concentric Mate.

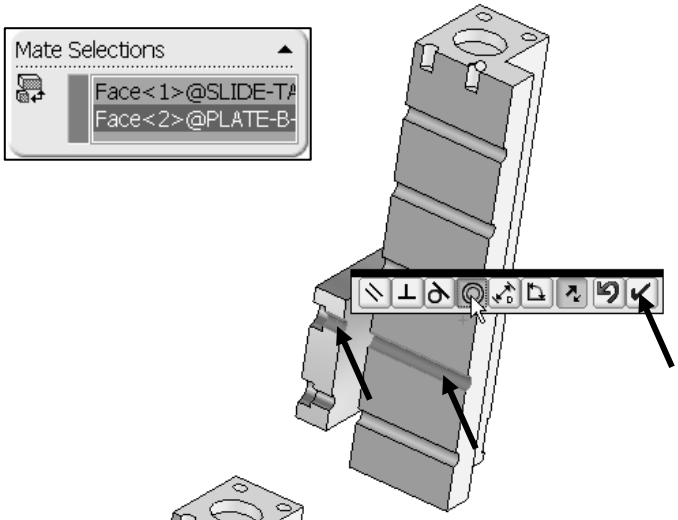
172) Click the **BodyThruHole4 cylindrical face** as illustrated.

173) Click **Mate** from the Assembly toolbar.

174) Click the top **PLATE-B Cbore cylindrical face**.

175) Click **Concentric**.

176) Click .



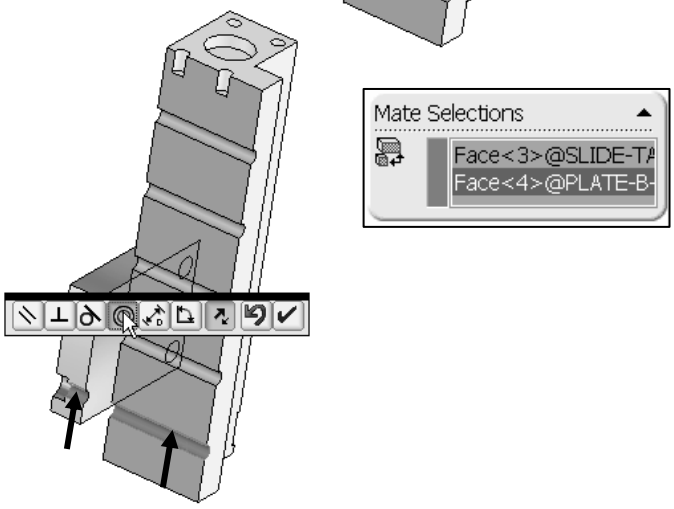
Insert the second Concentric Mate.

177) Click the **BodyThruHole5 cylindrical face**.

178) Click the bottom **PLATE-B Cbore cylindrical face**.

179) Click **Concentric**.

180) Click .



Insert a Coincident Mate.

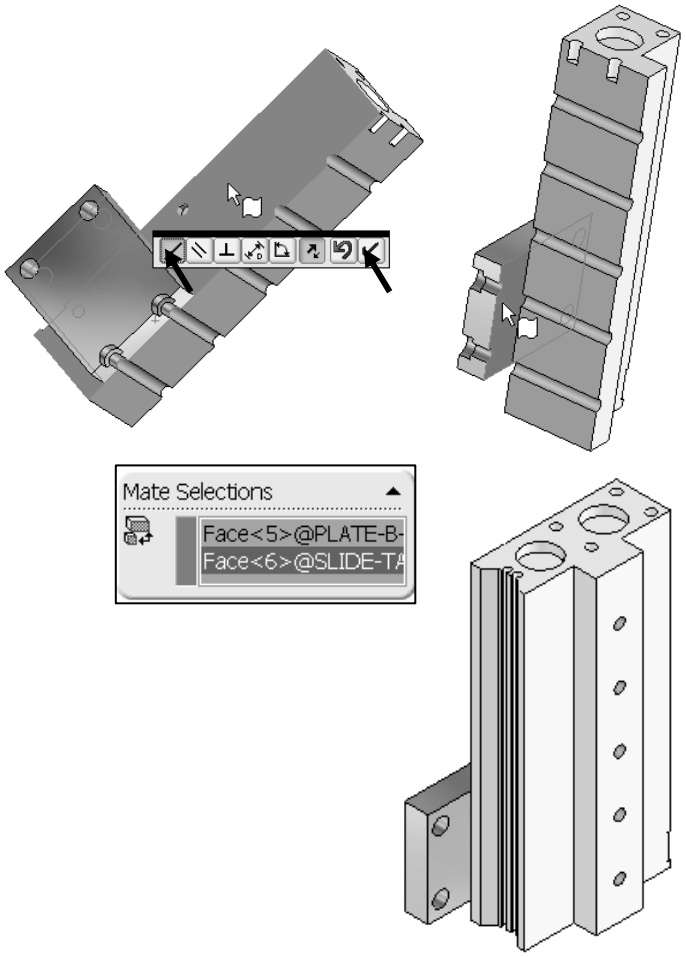
181) Click the **PLATE-B front face**.

182) Click the **MXSL-Body back face**.

183) Click **Coincident**.

184) Click ✔.

185) Click **OK** from the Mate PropertyManager. The SLIDE-TABLE is fully defined.



Display an Isometric view.

186) Click **Isometric view**.

187) Click **Section view**.

Save the 2AXIS-TRANSFER assembly.

188) Click **Save**.

Fasteners

The 2AXIS-TRANSFER assembly requires two different length fasteners.

- Insert two M6x1.0 SHCSs between the PLATE-B part and the SLIDE-TABLE assembly.
- Insert two M6x1.0 SHCSs between the PLATE-B part and the GUIDE-CYLINDER assembly.
- Create an assembly-sketched pattern for the fasteners.

Inserting fastener components simulates the assembly process in manufacturing. Assemble the PLATE-B part to the SLIDE-TABLE assembly. The individual SHCSs were created from SolidWorks Toolbox and stored in the MY-TEMPLATE\SHCS folder.

The Mate References in the SHCS create the Concentric\Coincident SmartMate when dragged to the PLATE-B hole. Utilize the components located in the SHCS folder instead of SolidWorks\Toolbox to practice Replace and Redefine options.

Activity: Fasteners

Measure the thread length distance.

189) Click **Top** view.

190) Click **Hidden Lines Visible**.

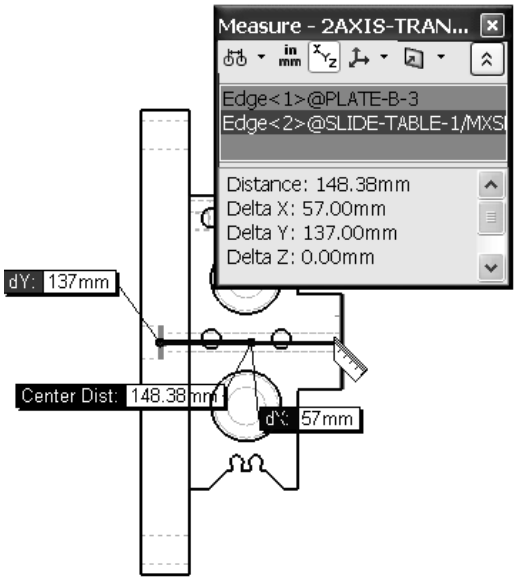
191) Click **Tools**, **Measure** from the Main menu.

192) Click the **inside edge** of the PLATE-B Cbore Hole.

193) Click the **bottom edge** of the hole. The Delta X distance is 57mm. Utilize a 50mm thread length for the SHCS.

194) Click **Close**.

195) Click **Shaded With Edges**.



Position the model.

196) **Rotate** PLATE-B as illustrated.

197) Zoom in on the **bottom Cbore**.

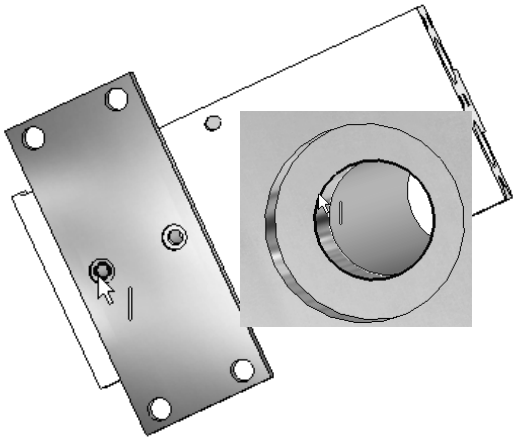
Insert two M6 Hex SHCS from the Design Library.

198) Click the **MY-TOOLBOX\SHCS** folder.

Insert the first Hex SHCS.

199) Click and drag the **B18.3.1M-6x1.0x50 Hex SHCS** to the bottom Cbore. The Coincident\Concentric icon is displayed.

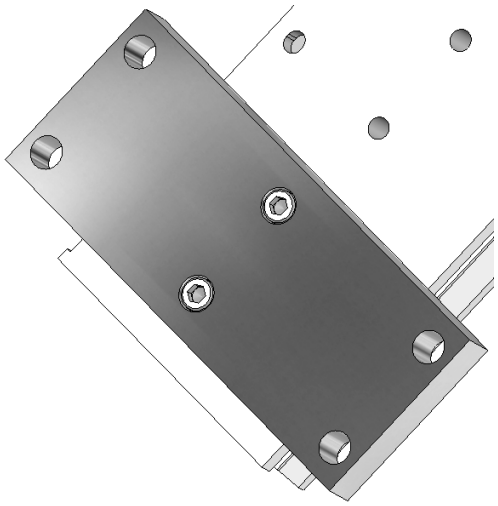
200) Release the mouse pointer on the **inside circular edge** as illustrated.



Insert the second M6Hex SHCS from the Design Library.

201) Drag the **B18.3.1M-6x1.0x50 Hex SHCS** to the top Cbore.

202) Click on the **inside circular edge** as illustrated.



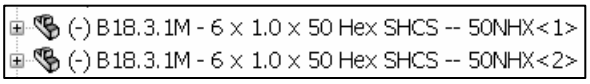
203) Click **Cancel** from the Insert Component PropertyManager.

Fit the Model to the Graphics window.

204) Press the **f** key.

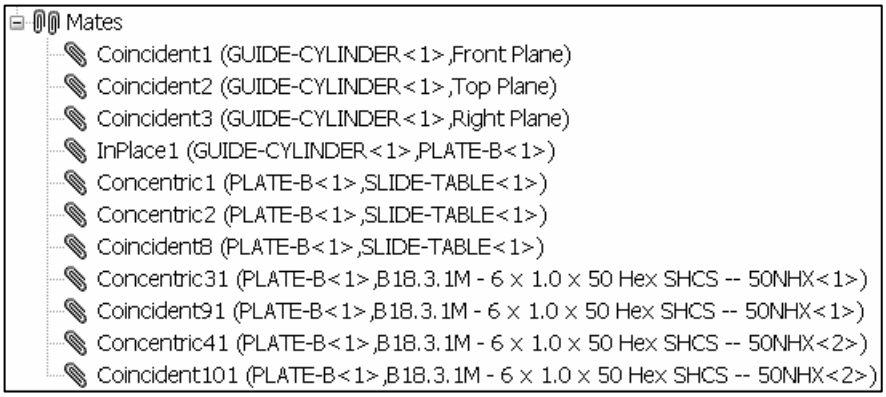
View the created Mates.

205) Expand **Mates** from the FeatureManager.



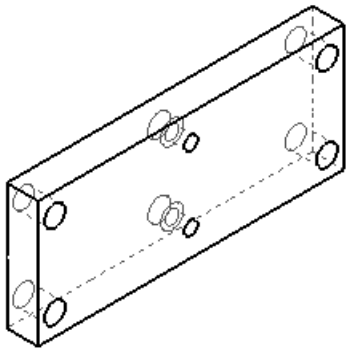
Two instances of the M – 6 x 1.0 x 50 SHCS have been added to the FeatureManager. The B18.3.1M -6 x 1.0 x 50 Hex SHCS<1> is the first instance. The B18.3.1M – 6 x 1.0 x 50 Hex SHCS<2> is the second instance. Each time you insert a SHCS, in the same session of SolidWorks, the instance number is incremented. Your instance numbers <1>, <2>, may be different if a SHCS was deleted.

Dragging the SHCS into the assembly and referencing the Cbore circular edge created four SmartMates. Your numbers may be different if a Mate was deleted.



Hide and Show components.

206) Click **SLIDE-TABLE** from the FeatureManager.



207) Hold the **Ctrl** key down.

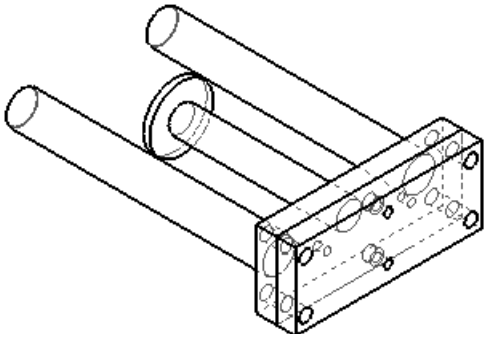
208) Click **B18.3.1M-6x1.0x50Hex SHCS <1>** from the FeatureManager.

209) Click **B18.3.1M-6x1.0x50Hex SHCS<2>** from the FeatureManager.

210) Release the **Ctrl** key.

211) Right-click **Hide**. Click **Hidden Lines Visible**.

212) Right-click **GUIDE-CYLINDER** from the FeatureManager.



213) Click **Show**.

214) Right-click **MGPTube** from the FeatureManager.

215) Click **Hide**. PLATE-B and the MGPRod parts are displayed.

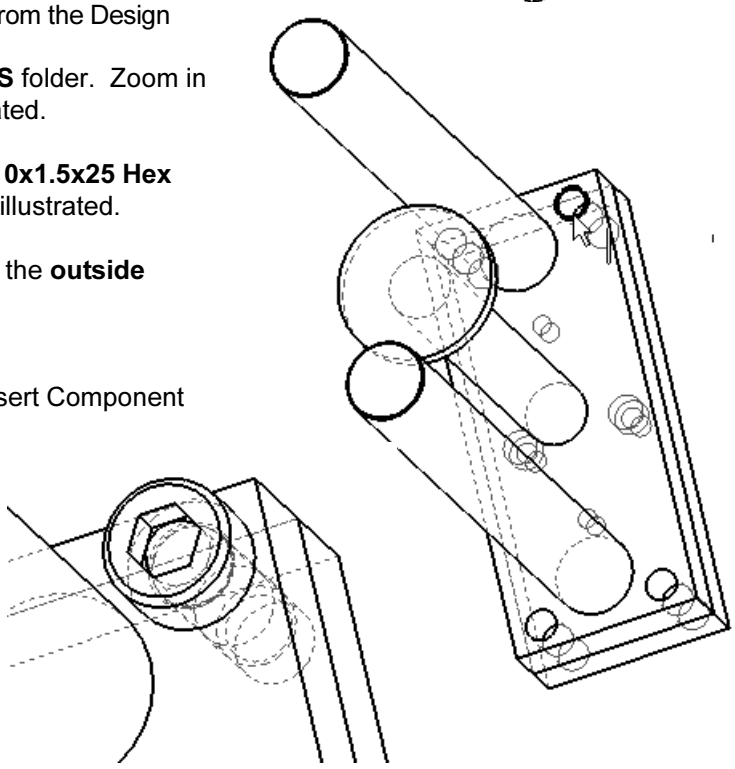
Add an M10x1.5 SHCS to PLATE-B from the Design Library.

216) Click the **MY-TOOLBOX\SHCS** folder. Zoom in on the back top hole as illustrated.

217) Click and drag the **B18.3.1M-10x1.5x25 Hex SHCS** to the back top hole as illustrated.

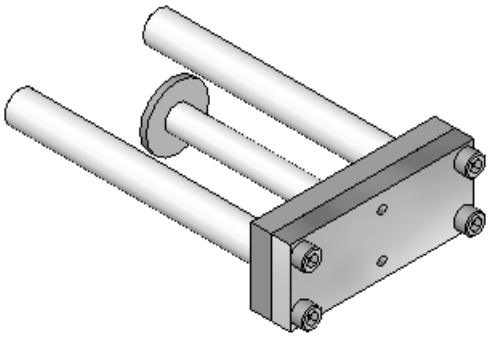
218) Release the mouse pointer on the **outside circular edge**.

219) Click **Cancel** from the Insert Component PropertyManager.



Editing Mates and Redefining Components

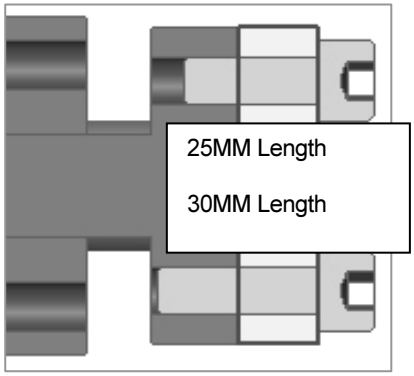
Assemblies require the ability to modify Mates and redefined components.



The 2AXIS-TRANSFER assembly requires four M10 SHCSs to fasten the PLATE-B part to the GUIDE-CYLINDER assembly. Errors occur in the modify process. The goal is to learn how to recognize and correct errors.

A Concentric Mate and Coincident Mate define the SHCS placement. Suppress the Coincident Mate in order to flip the alignment.

Modify the Concentric Mate selections from the GUIDE-CYLINDER top back hole to the PLATE-B bottom front hole with the Replace Mate Entities option. Unsuppress the Coincident Mate. Utilize the Replace Mate Entities option to redefine the Coincident Mate selections.

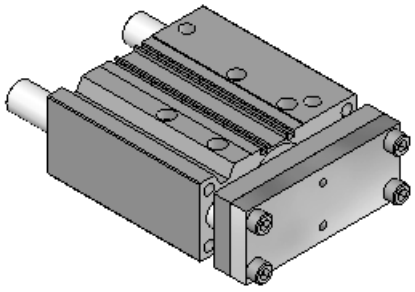


What is the required thread length? Answer: 25mm or 30mm. Try a 25mm SHCS. The 25mm SHCS thread does not provide the minimum engagement of 75% for the MGPRod Plate hole.

Utilize the Replace Component option to modify the 25mm SHCS to a 30mm.

The SHCS fastens PLATE-B to the GUIDE-CYLINDER assembly.

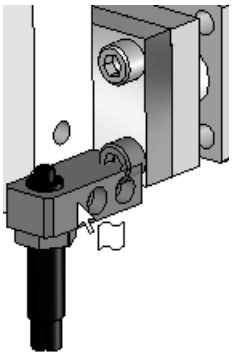
Create a Local Assembly Pattern that corresponds to the MountHoles2 position. Record the dimensions between the holes.



The Local Assembly Pattern of the M10 SHCS requires the 130mm and 40mm dimensions.

Identify the location of the pattern. Locate the pattern at the top level of the 2AXIS-TRANSFER assembly.

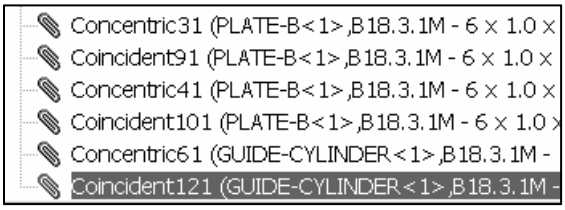
There is a visual interference between the lower right fastener and the SLIDE-TABLE assembly. What is the solution? Answer: Utilize the second set of MGPRod M6 holes, named MountHoles.



Activity: Editing Mates and Redefining Components

Suppress the last Coincident Mate.

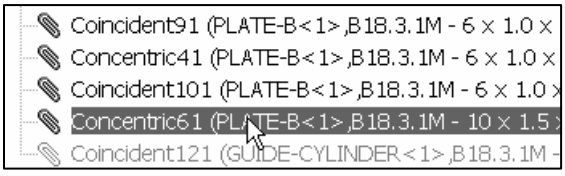
220) Right-click **Coincident** from the FeatureManager as illustrated.



221) Click **Suppress**.

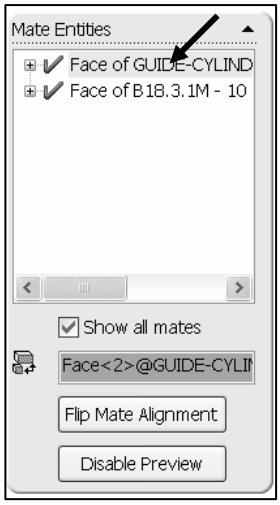
Redefine the Concentric Mate as illustrated.

222) Right-click **Concentric** from the FeatureManager.

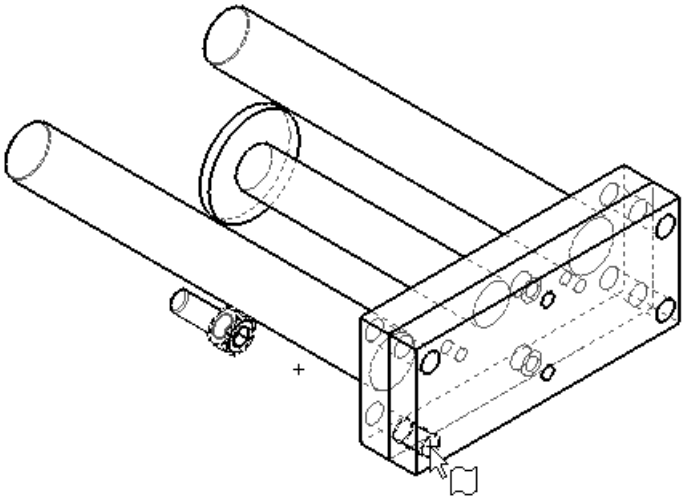


223) Click **Replace Mate Entities**. The Mated Entities PropertyManager is displayed.

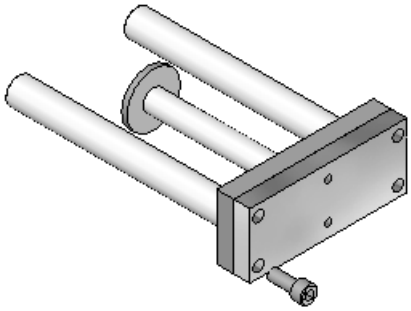
224) Click the **Face of GUIDE-CYLINDER** from the Mate Entities box.



225) Click the **PLATE-B front bottom hole face** as illustrated. The SHCS head points towards PLATE-B. Click the **Flip Mate Alignment** button if required.



226) Click **OK** from the Mated Entities PropertyManager.



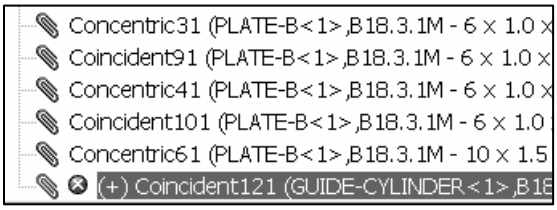
Move the SHCS into position.

227) Click and drag the **SHCS** in front of PLATE-B as illustrated.

228) Click **Shaded With Edges**.

Modify the last Coincident Mate.

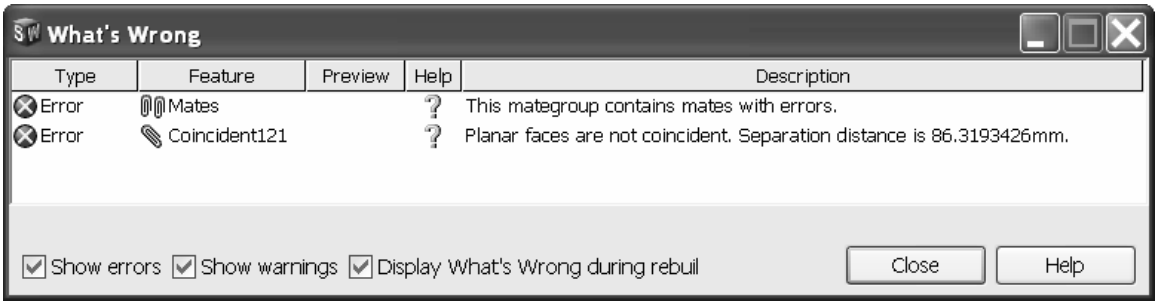
229) Right-click **Coincident** as illustrated.



230) Click **Unsuppress**.

231) Click **Rebuild** from the Main menu.

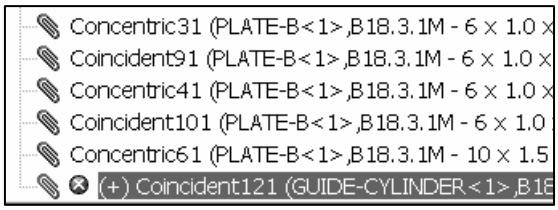
The What's Wrong box displays two errors. The first error is a general error statement about the 2AXIS-TRANSFER Mate group. The 2AXIS-TRANSFER entry displays an error flag in red 2AXIS-TRANSFER. The Mates entry displays an error flag Mates in red.



The second error lists the Feature, Coincident and provides a description about the error condition. The separation distance value is based on the SHCS position in the Graphics window. To maintain coincident faces, utilize Replace Mate Entities and select the front PLATE-B face.

232) Click **Close** from the What's Wrong box.

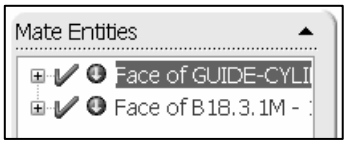
Redefine the Concentric Mate as illustrated.

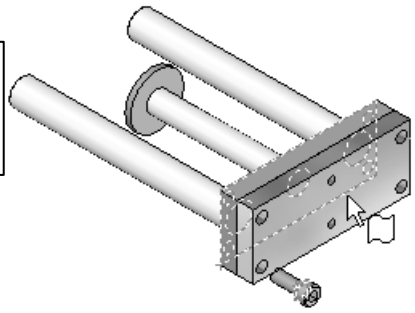


233) Right-click **Concentric** from the FeatureManager.

234) Click **Replace Mate Entities**. The Mated Entities PropertyManager is displayed. Red error flags are displayed on the Mate Entities.

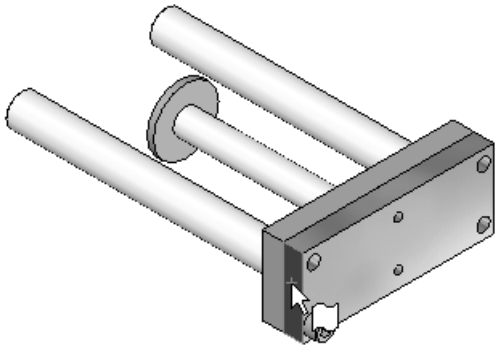
235) Click **Face of GUIDE-CYLINDER** from the Mate Entities box.





236) Click the **GUIDE-CYLINDER front face** as illustrated. Green check marks are displayed on the Mate Entities.

237) Click **OK** from the Mated Entities PropertyManager.



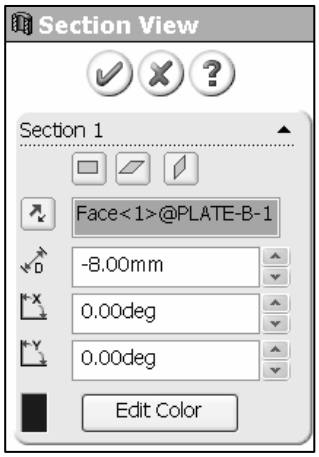
Display an Isometric view.

238) Click **Isometric** view.

Create a Section view.

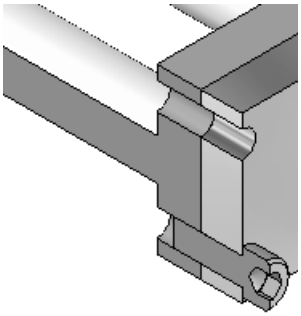
239) Click the **Front** face of PLATE-B.

240) Click **Section View** .

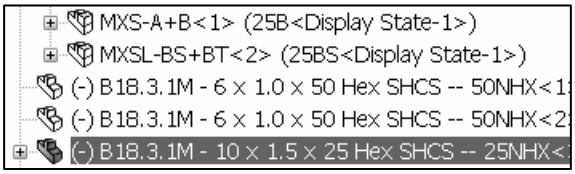


241) Enter -**8** for Offset Distance.

242) Click **OK** from the Section View PropertyManager.

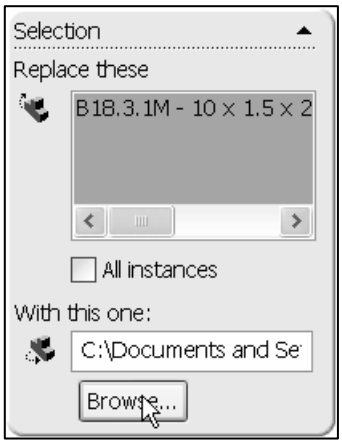


Replace the SHCS.



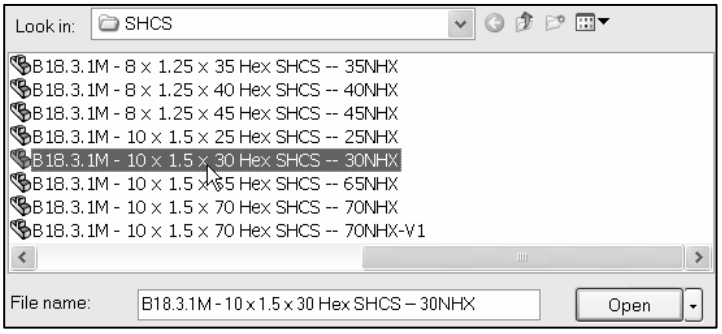
243) Right-click **B18.3.1M-10x1.5x25 Hex SHCS** from the FeatureManager.

244) Click **Replace Components**. The Replace PropertyManager is displayed.



245) Click **Browse** from the Replace PropertyManager.

246) Select **B18.3.1M-10x1.5x30 Hex SHCS** from the MY-TOOLBOX\SHCS folder.



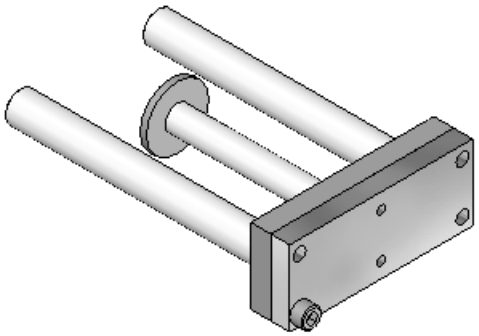
247) Click **Open**.

248) Click **OK** from the Replace PropertyManager.

249) Click **OK** from the Mated Entities PropertyManager

Display the full view.

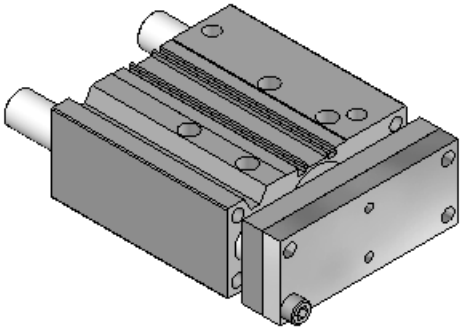
250) Click **Section View** .



Show the MGPTube.

251) Right-click **MGPTube** from the FeatureManager.

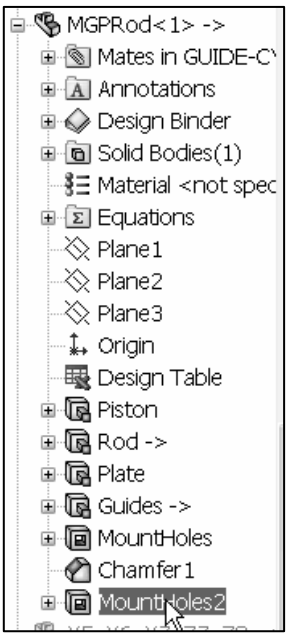
252) Click **Show**.



The Mated Entities PropertyManager displays the Concentric and Coincident references for the Mates.

The SHCS updates in the Graphics window. The FeatureManager displays the new entries with the part icon and Mates entries.

The Mate Entities PropertyManager provides the ability to change Mate selection. Explore additional Mate errors and their recovery in Project 4.

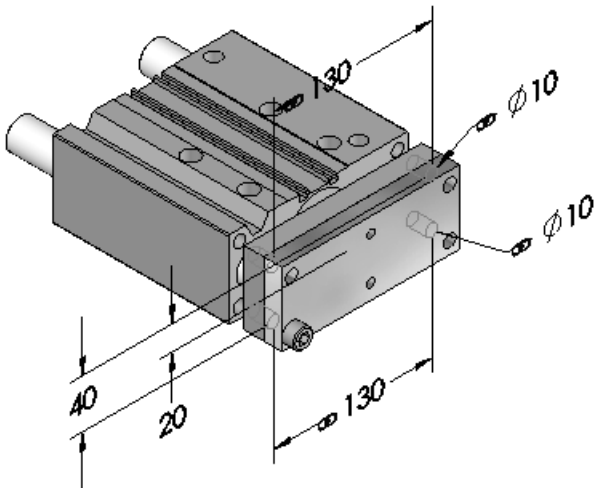


View the dimensions required for a Local Pattern.

253) Expand **GUIDE-CYLINDER** from the FeatureManager.

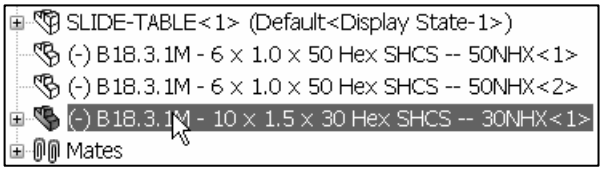
254) Expand **MGPRod**.

255) Double-click **MountHoles2**. View the dimensions.

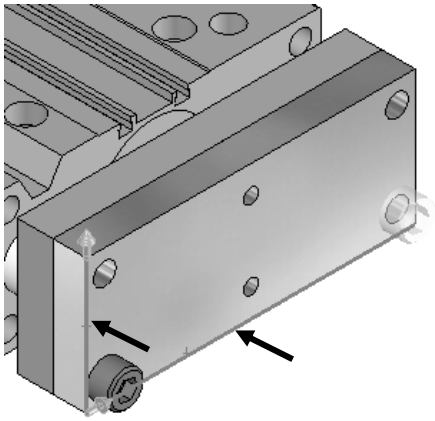


Create a Local Assembly Pattern.

256) Click **B18.3.1M-10x1.5x30Hex SHCS** from the 2AXIS-TRANSFER FeatureManager for the seed component.



257) Click **Insert**, **Component Pattern**, **Linear Pattern** from the Main menu. The Linear Pattern PropertyManager is displayed.



258) Click the **bottom horizontal edge** for Direction 1. The arrow points to the right

259) Enter **130** for Spacing.

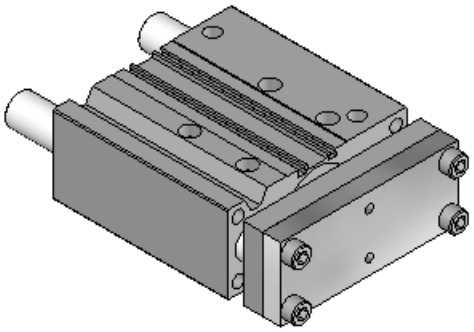
260) Enter **2** for Instances.

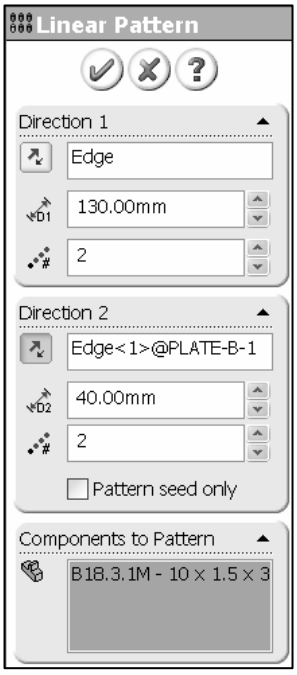
261) Click the **left vertical edge** for Direction 2. The arrow points upward.

262) Enter **40** for Spacing.

263) Enter **2** for Instances.

264) Click **OK** from the Linear Pattern PropertyManager. LocalPattern1 is displayed in the FeatureManager.





Show the SLIDE-TABLE components.

265) Right-click **SLIDE-TABLE** from the FeatureManager.

266) Click **Show**.

267) Expand **SLIDE-TABLE** from the FeatureManager.

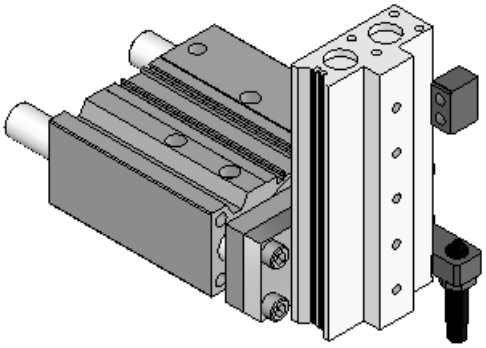
268) Click **MXS-A+B<1>**.

269) Hold the **Ctrl** key down.

270) Select **MXSL-BS+BT<2>**.

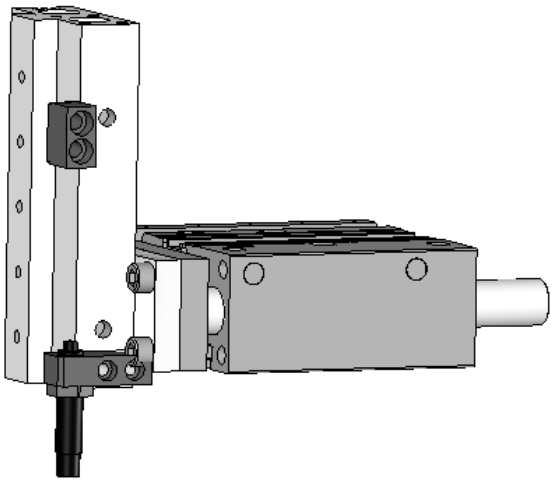
271) Release the **Ctrl** key.

272) Right-click **Show**.



Rotate the 2AXIS-TRANSFER assembly.

273) Rotate the 2AXIS-TRANSFER assembly to view the **MXSL-BS+BT** as illustrated.



Perform an Interference Detection on the assembly.

274) Click **Interference Detection** from the Assembly toolbar.

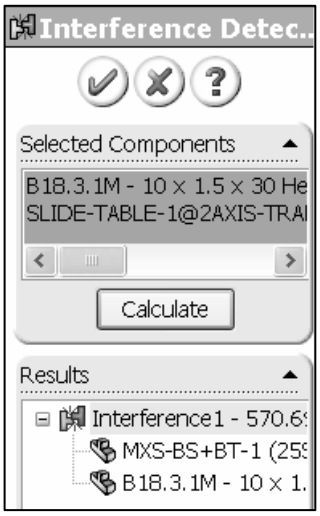
275) Right-click a **position** in the Selected components box.

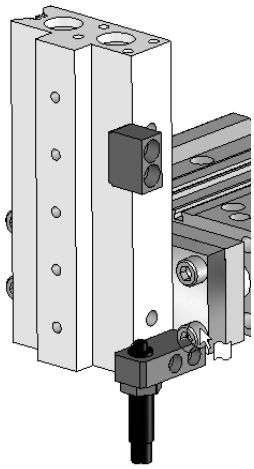
276) Click **Clear Selections**.

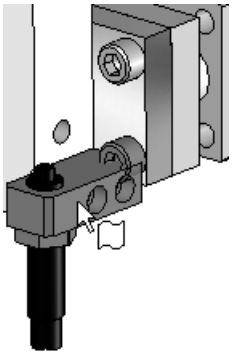
277) Click **B18.3.1M-10x1.5x30 Hex SHCS** from the Graphics window.

278) Click **MXSL-BS+BT** from the Graphics window, as illustrated.

279) Click **Calculate**. The results display the Interference1 volume.



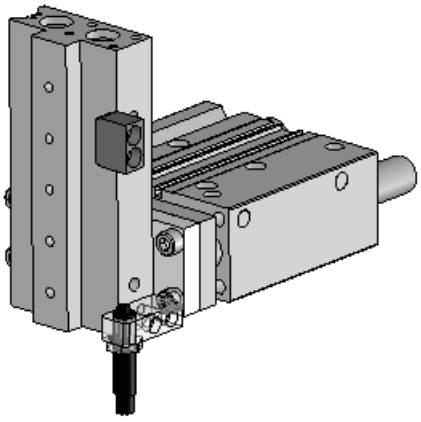




280) Click **OK** from the Interference Detection PropertyManager.

The Interference results in a design decision. Review the four options:

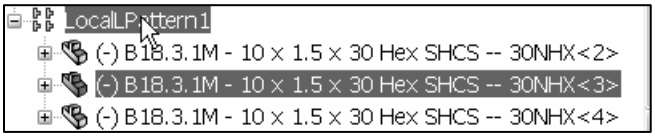
- Modify the positions of the PLATE-B four holes.
- Mount the SLIDE-TABLE to PLATE-B utilizing BodyHole3 and BodyHole4.
- Increase the overall size of PLATE-B and modify the four through holes to countersink or counterbore.
- Locate additional holes on the MGPRod component.



The first option results in modification of a purchased part. The second and third options cause interference with other components. Proceed with the fourth option.

Locate two MountHoles on the MGPRod. Insert two M6 Cbores in PLATE-B with the Holes Wizard.

Delete the M10 SHCS and Local Pattern.



281) Click **B18.3.1M-10x1.5x30 Hex SHCS** from the 2AXIS-TRANSFER FeatureManager.

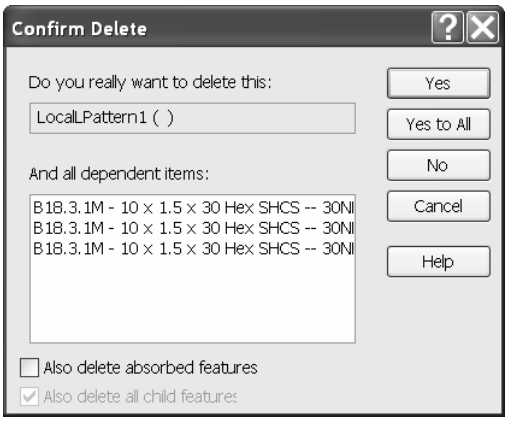
282) Hold the **Ctrl** key down.

283) Click **LocalPattern1** from the FeatureManager.

284) Release the **Ctrl** key.

285) Press the **Delete key**.

286) Click **Yes to All** to delete the dependent Mates.



Hide the SLIDE-TABLE and the GUIDE-CYLINDER/ MGPTube.

287) Click **SLIDE-TABLE** from the FeatureManager.

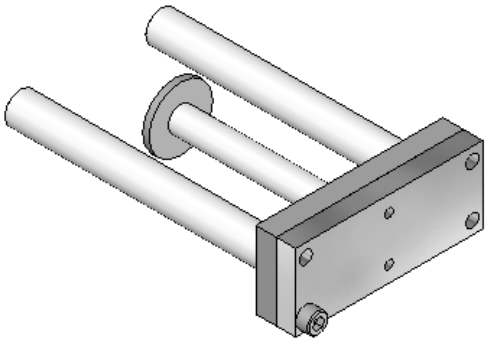
288) Hold the **Ctrl** key down.

289) Click **GUIDE-CYLINDER/MGPTube** from the FeatureManager.

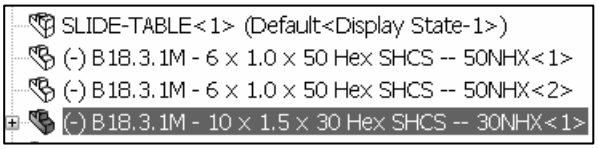
290) Release the **Ctrl** key.

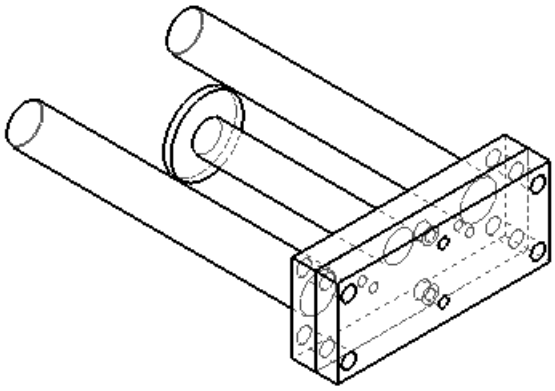
291) Right-click **Hide**.

292) Hide the remaining **B18.3.1M-10x1.5x30 Hex SHCS** as illustrated.



293) Click **Hidden Lines Visible**.

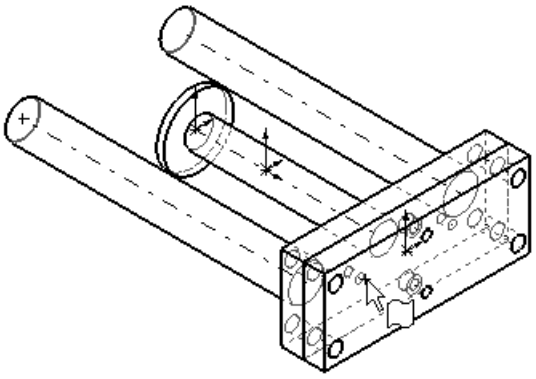




Edit PLATE-B In-Context of the 2AXIS-TRANSFER assembly.

294) Right-click **PLATE-B** from the FeatureManager.

295) Click **Edit Part**. The PLATE-B part name is displayed in blue.



Display Temporary Axes.

296) Click **View**, **Temporary Axes** from the Main menu.

Display the Origins.

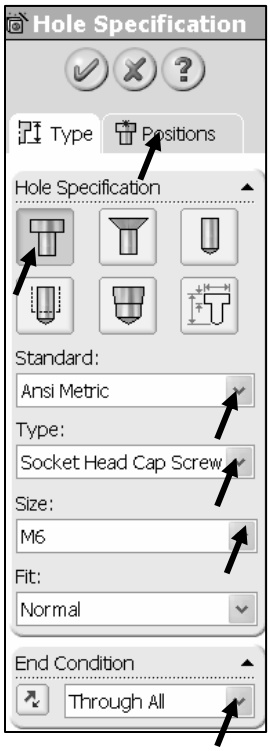
297) Click **View**, **Origins** from the Main menu.

Insert an M6 Cbore. Use the Hole Wizard.

298) Click the **PLATE-B face** to the left of the Origin.

299) Click **Hole Wizard** 

from the FeatureManager.



300) Click **Countbore** for Hole Specification.

301) Select **Ansi Metric** for Standard.

302) Select **Socket Head Cap Screw** for Type.

303) Select **M6** for Size.

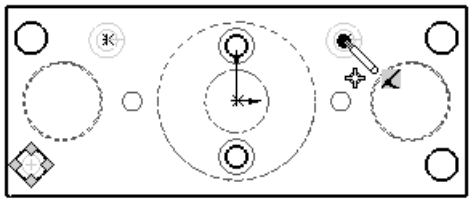
304) Select **Through All** for End Condition.

305) Click the **Positions** tab.

Position the second M6 hole center point.

306) Click **Right** view.

307) Click a **position** to the right of the Origin.

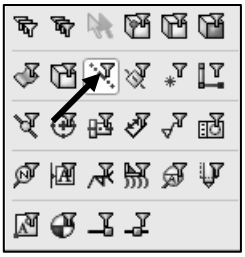


308) Right-click **Select**.

There are two methods to reference the center point of a Hole Wizard hole or Circle Sketch tool. The first method is to "wake up" the center point of an existing hole by dragging the mouse pointer over circular geometry.

A Coincident relationship is inferred. This method requires that the referenced circular geometry and the new center point are on the same plane or face.

The second method utilizes the Temporary axis of an existing hole and the new center point. Work in an Isometric view to display the Temporary axis and the center point. Utilize this method in the next step.

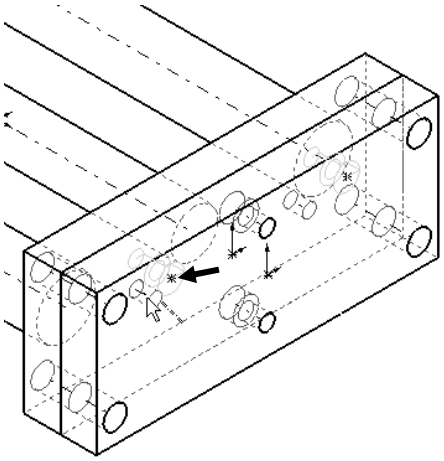


Select the Axis filter.

309) Click **Filter Axes**.

Add a Coincident relation to the left Cbore.

310) Click the **left MGPRod/MountHole Temporary Axis**.



311) Click **Clear All Filters**.

312) Hold the **Ctrl** key down.

313) Select the **left Cbore center point**.

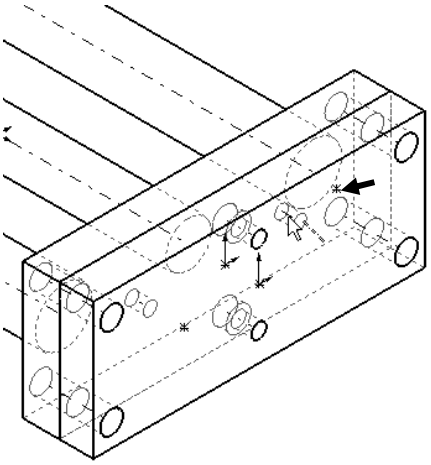
314) Release the **Ctrl** key.

315) Click **Coincident** from the Add Relations box. The hole is fully defined.

316) Click **OK** from the Properties PropertyManager.

Add a Coincident relation to the right Cbore.

317) Click **Filter Axes**.



318) Click the **right MGPRod/MountHole Temporary Axis.**

319) Click **Clear All Filters**. Hold the **Ctrl** key down.

320) Click the **right Cbore center point**.

321) Release the **Ctrl** key.

322) Click **Coincident** from the Add Relations box. The hole is fully defined.

323) Click **OK** from the Properties PropertyManager.

Return to the 2AXIS-TRANSFER assembly.

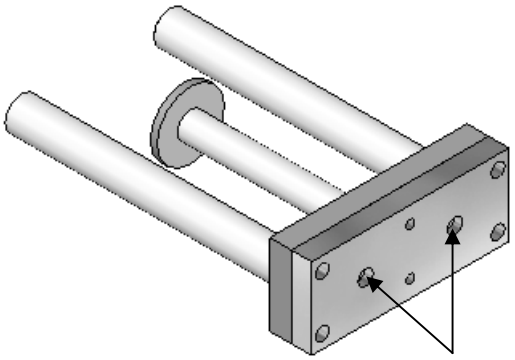
324) Click **OK** from the Hole Position PropertyManager.

325) Click **Shaded With Edges**.

326) Right-click **2AXIS-TRANSFER** from the FeatureManager.

327) Click **Edit Assembly**.

328) Deactivite the **Origins** and **Temporary Axis**.



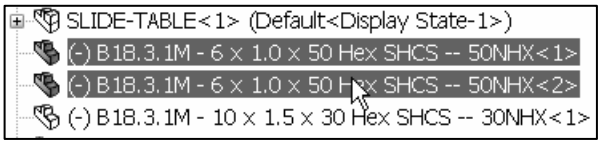
Save the 2AXIS-TRANSFER assembly.
329) Click **Save**.

Size and insert two M6 SHCSs. This action is an exercise at the end of the project. Utilize the four outside mounting holes in a different assembly.

If required, suppress the SHCSs.
330) Click **B18.3.1M – 6 x 1.0 x 50 Hex SHCS <1>** from the FeatureManager.

331) Hold the **Ctrl** key down.

332) Click **B18.3.1M – 6 x 1.0 x 50 Hex SHCS <2>** from the FeatureManager.

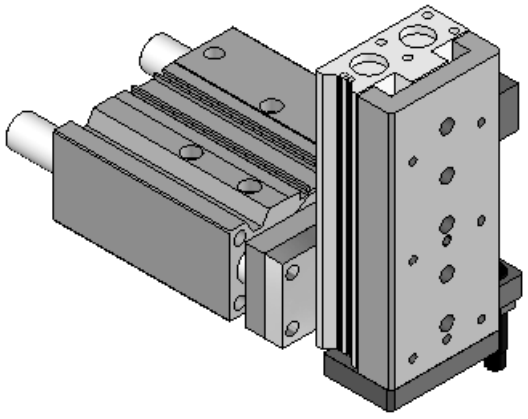


333) Release the **Ctrl** key.

334) Right-click **Suppress**.

Display the Hidden components.
335) Display the **hidden components** as illustrated.

336) Display an **Isometric** view.



Save the model.
337) Click **Save**.

Redefine External References

External references defined in the context of an assembly become out of context when the referenced geometry is either deleted or not loaded into memory.

The company has instituted a policy. Utilize InPlace Mates and External references when required in the initial design phase of an assembly. Redefine all InPlace Mates and External part references before the assemblies, parts, and drawings are released to manufacturing.

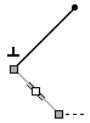
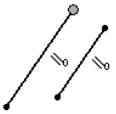
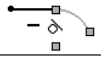
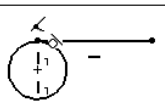
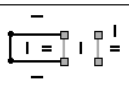
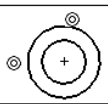
PLATE-B requires that the GUIDE-CYLINDER be loaded into memory. How can a component developed In-Context of an assembly be modified for the independent Bottom-Up design assembly modeling approach? Answer: Redefine all External references. Delete all InPlace Mates. Add dimensions and relations to fully define the PLATE-B sketches. Insert Mates to constrain PLATE-B in the 2-AXIS TRANSFER assembly.

The Lock All command protects the part. New references are created when the part is locked. Existing references are not updated.

PLATE-B FeatureManager lists the locked references with an "*" symbol, after the part name, feature, and or sketch.

Redefine External references with a systematic approach. Review both the feature and the sketch. Start with Sketch1 of the Extrude1 feature. Review geometric relations with Display/Delete Relations. Delete external references. Redefine design intent such as symmetry, dimensions, and geometric relations. Work through the FeatureManager until all external references developed In-Context of an assembly are redefined.

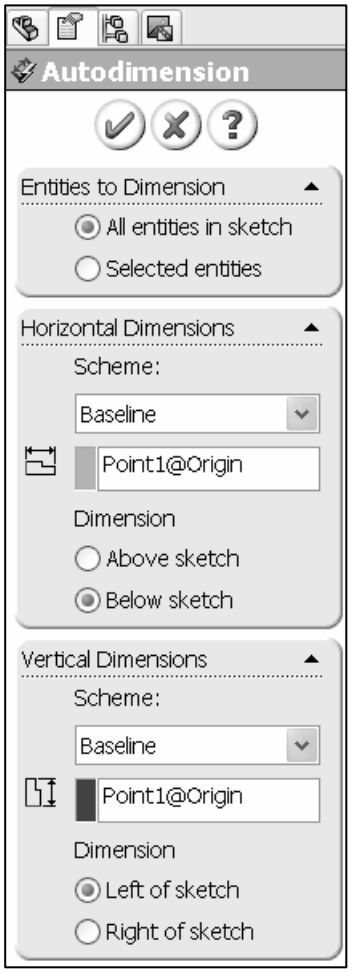
Sketch relation symbols indicate the geometric relations added to a sketch. Check the View, Sketch Entities option to display sketch relations symbols in the sketch. The On Entity  icon is displayed for External references in the Sketch.

Relations	Icons
Horizontal	
Perpendicular	
Parallel	
Horizontal and tangent	
Horizontal and coincident	
Vertical, horizontal, intersection, and tangent	
Horizontal, vertical, and equal	
Concentric	
Horizontal	

In the next activity you will define relations and dimensions. There are two additional Sketch tools that assist you in redefining a sketch.

- Fix.
- Autodimension.

A Fix relation results in the size and location of the selected entities without having to add dimensions or other relations.

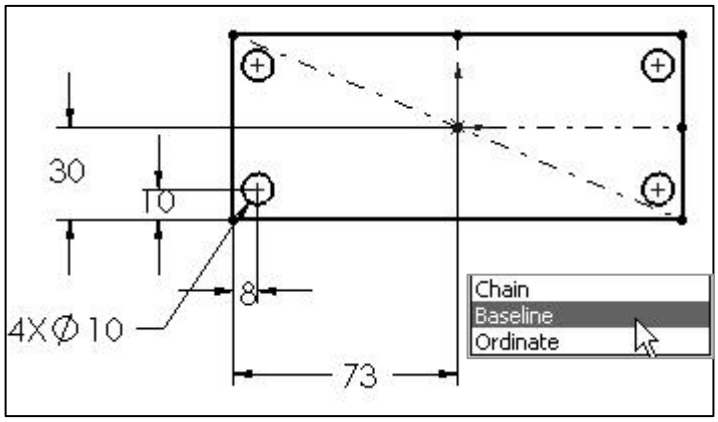


These entities cannot be moved or changed. As easy and tempting as this action may sound, the Fix relation can lead to headaches later on when you want to make a change to a dimension. There are no dimensions to double-click and modify. Therefore, use the Fix relation tool appropriately and sparingly.

The Autodimension tool in the Dimensions/Relations toolbar automatically dimensions sketches and drawings.

Select the dimensioning Scheme option: Chain, Baseline, or Ordinate. Select a reference for the Horizontal Dimensions and Vertical Dimensions.

The Autodimension tool takes into account the defined geometric relations.

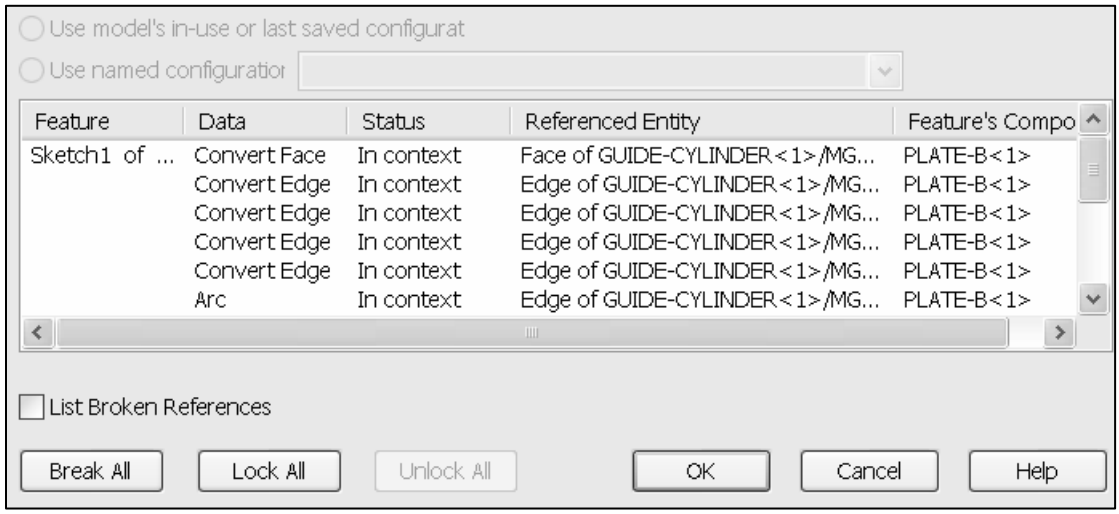


Activity: Redefine External References

Redefine the PLATE-B references.

338) Right-click **PLATE-B** from the 2AXIS-TRANSFER FeatureManager.

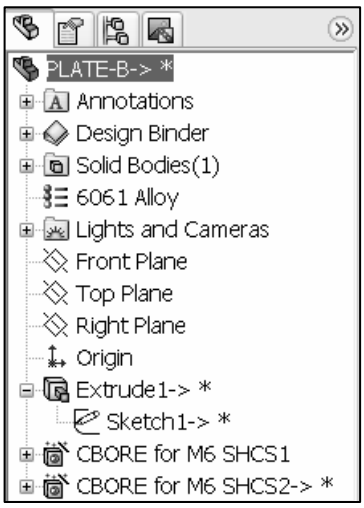
339) Click **List External Refs**. The features and sketches referenced from the 2AXIS-TRANSFER/PLATE-B are displayed.



340) Lock all GUIDE-CYLINDER assembly references. Click the **Lock All** button.

341) Click **OK**. The warning message is displayed, "All external references for the model, PLATE-B will be locked. You will not be able to add any new external references until you unlock the existing references."

342) Click **OK**. The "->*" symbol is displayed next to the part name, PLATE-B in the FeatureManager. PLATE-B contains External references that are locked.



Open the PLATE-B part.

343) Right-click **PLATE-B** from the 2AXIS-TRANSFER FeatureManager.

344) Click **Open Part**. PLATE-B is displayed in the Graphics window.

345) Click **Rebuild**.

Delete the Sketch1 External references.

346) Double-click **Extrude1** from the FeatureManager.

347) Right-click **Sketch1**.

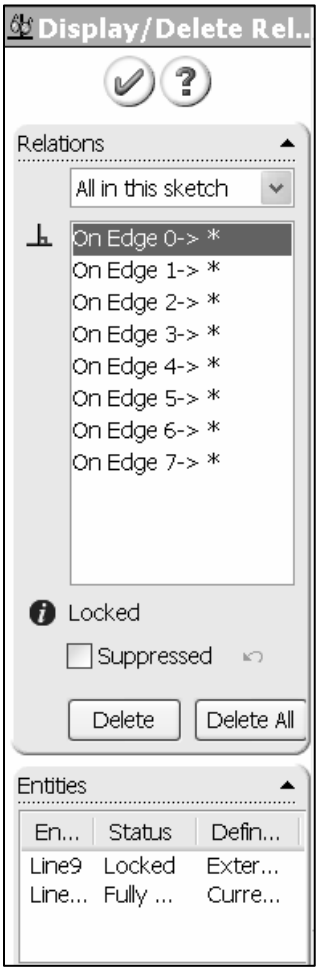
348) Click **Edit Sketch**.

Delete the Locked references.

349) Right-click **Display/Delete Relations**. Delete the 8 On Edge references. The "*" symbol indicates the Lock All command was activated.

350) Click **Delete All** from the Relations box.

351) Click **OK** from the Display/Delete Relations PropertyManager.



The On Entity symbol indicates the Sketch entities with External references.

Redefine the Geometry relations and dimensions.

352) Click **Centerline** from the Sketch toolbar.

353) Sketch a **diagonal centerline** between the upper left corner and the lower right corner.

354) Click **View**, **Sketch Relations** from the Main menu.

Add a Midpoint relation.

355) Right-click **Select**.

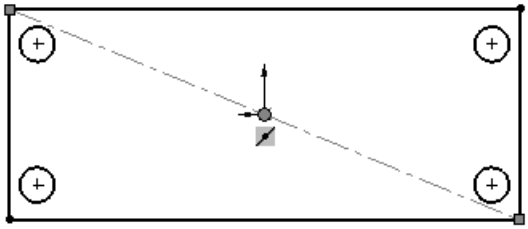
356) Click the **Centerline**.

357) Hold the **Ctrl** key down.

358) Click the **Origin**.

359) Release the **Ctrl** key.

360) Click **Midpoint** from the Add Relations box.



361) Click **OK** from the Properties PropertyManager.

Add a Horizontal relation.

362) Click the **top horizontal** line. Hold the **Ctrl** key down.

363) Click the **bottom horizontal line**. Release the **Ctrl** key.

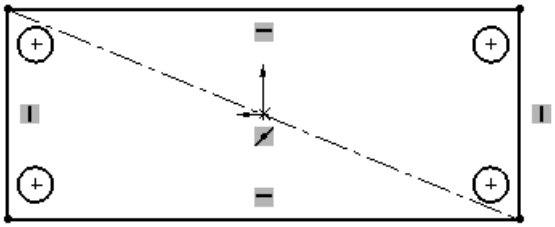
364) Click **Horizontal**.

365) Click **OK** from the Properties PropertyManager.

Add a Vertical relation.

366) Click the **right vertical** line. Hold the **Ctrl** key down.

367) Click the **left vertical** line. Release the **Ctrl** key.



368) Click **Vertical**. Click **OK** from the Properties PropertyManager.

Add dimensions.

369) Click **Smart Dimension** from the Sketch toolbar.

370) Click the **right vertical** line.

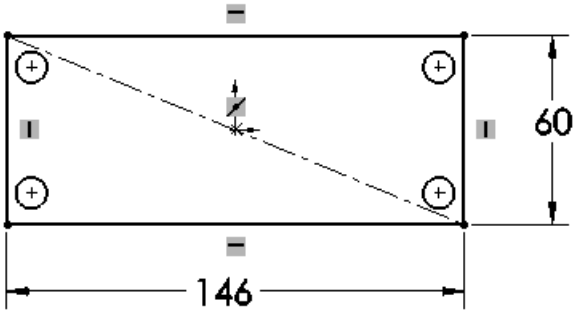
371) Drag the vertical dimension **60** to the right of the profile. Click ✔.

372) Click the **bottom horizontal** line.

373) Drag the horizontal dimension **146** below the profile.

374) Click ✔.

375) Click **OK** from the Dimension PropertyManager. The rectangular sketch is fully defined and is displayed in black. The four circles are undefined and are displayed in blue.



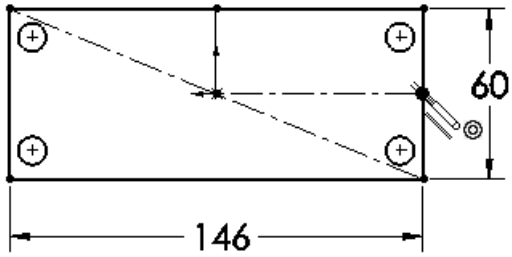
376) Click **View**. Uncheck **Sketch Relations** from the Main menu.

Sketch the Construction geometry.

377) Click **Centerline** Centerl... from the Sketch toolbar.

378) Sketch a **horizontal centerline** from the Origin to the midpoint of the right vertical line.

379) Sketch a **vertical centerline** from the Origin to the midpoint of the top horizontal line.



Add an Equal relation to the four circles.

380) Right-click **Select**.

381) Click the **circumference** of the upper right circle.

382) Hold the **Ctrl** key down. Click the **circumference** of the remaining three circles.

383) Release the **Ctrl** key.

384) Click **Equal**.

385) Click **OK** from the Properties PropertyManager.

Add a Symmetric relationship to the top right and bottom right circles.

386) Click the **horizontal centerline**.

387) Hold the **Ctrl** key down. Click the **top right circle**.

388) Click the **bottom right circle**. Release the **Ctrl** key.

389) Click **Symmetric**. Click **OK** from the Properties PropertyManager.

Add a Symmetric relationship between the top right circle and the top left circle.

390) Click the **vertical centerline**.

391) Hold the **Ctrl** key down. Click the **top right circle**.

392) Click the **top left circle**. Release the **Ctrl** key.

393) Click **Symmetric**. Click **OK** from the Properties PropertyManager.

Add a Symmetric relationship between the top left circle and the bottom left circle.

394) Click the **horizontal centerline**. Hold the **Ctrl** key down.

395) Click the **top left circle**. Click the **bottom left circle**.

396) Release the **Ctrl** key. Click **Symmetric**.

397) Click **OK** Properties PropertyManager.

Add dimensions.

398) Click **Smart Dimensions**.

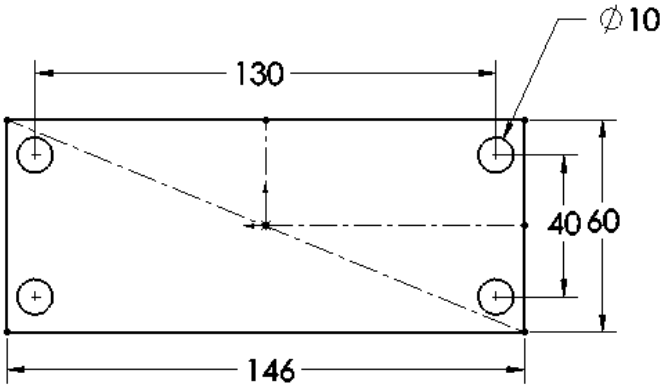
399) Click the **center points** of the two top circles.

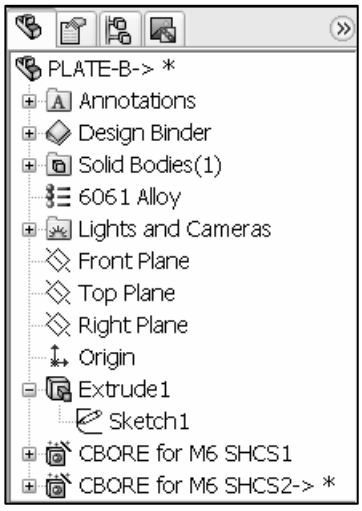
400) Drag the dimension **130** above the profile. Click ✔.

401) Click the **center points** of the two right circles. Drag the dimension **40** to the right of the profile. Click ✔.

402) Click the **circumference** of the top right circle. Drag the diameter **10** off the profile.

403) Click ✔. Click **OK** from the Dimension PropertyManager. The sketch is fully defined and is displayed in black. Click **Exit Sketch**. Click **Rebuild**.

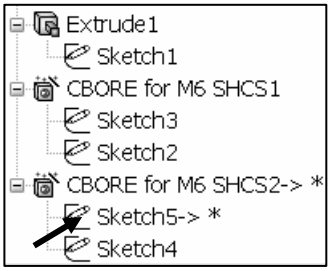




Color indicates that a sketch is under defined (blue), fully defined (black) or over defined (red). The status of a sketch is displayed in the lower right corner of the Graphics window.

The External references are deleted from Extrude1 and Sketch1. Sketch1 is fully defined in the FeatureManager. The In-Context locked "->*" symbol is removed.

Redefine the CBORE for M6 SHCS2.

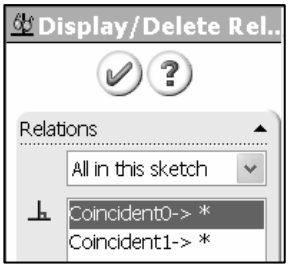


404) Expand **CBORE for M6 SHCS2** from the FeatureManager.

405) Right-click **Sketch5->***.

406) Click **Edit Sketch**.

407) Right-click **Display/Delete Relations**.



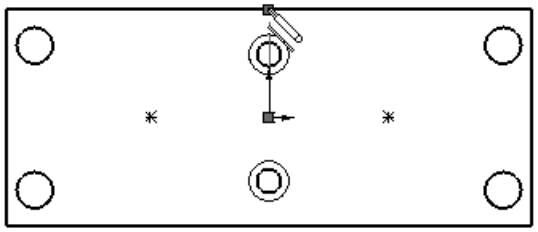
408) Delete the locked **Coincident0->*** and **Coincident1->*** relations.

409) Click **Delete All**.

410) Click **OK** from the PropertyManager.

Sketch a vertical centerline.

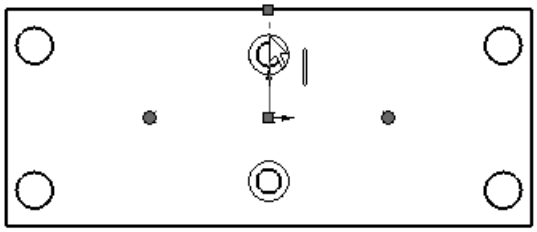
411) Sketch a **vertical centerline** from the Origin to the midpoint of the top horizontal line as illustrated.



Add a Symmetric relation.

412) Right-click **Select**. Click the **left center point**. Hold the **Ctrl** key down.

413) Click the **right center point**. Click the **centerline**. Release the **Ctrl** key.



414) Click **Symmetric**. Click **OK** from the Properties PropertyManager.

Add a Horizontal relation.

415) Click the **Origin**. Hold the **Ctrl** key down.

416) Click the **two center points**. Release the **Ctrl** key.

417) Click **Horizontal**. Click **OK** from the Properties PropertyManager.

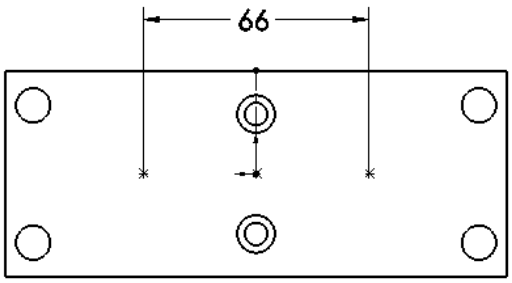
Add dimension.

418) Click **Smart Dimension** Smart Dimens....

419) Click the **two center points**.

420) Drag the dimension **66** above the top horizontal line.

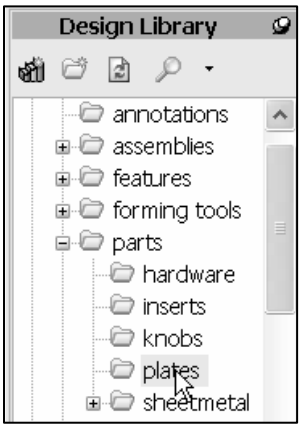
421) Click ✔.

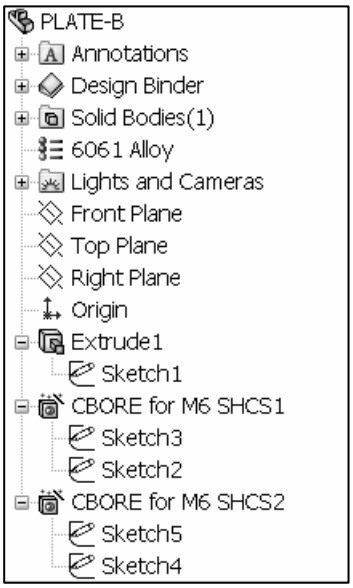


422) Click **OK** . The center points are fully defined. The External references for PLATE-B are redefined.

Close the Sketch.

423) Click **Exit Sketch** .





Save PLATE-B.

424) Click **Save**.

Insert PLATE-B into the plates folder.

425) Click and drag the **PLATE-B** part icon into the plates folder. If required, Pin the Design Library.

426) Click **Save**.

Note: Utilize PLATE-B in other assemblies. PLATE-B contains no External references or InPlace Mates.

Return to the 2AXIS-TRANSFER assembly.

427) Click **Window**, **2AXIS-TRANSFER** from the Main menu.

428) Click **Yes** to update the models.

Find the InPlace Mate with the Go To command.

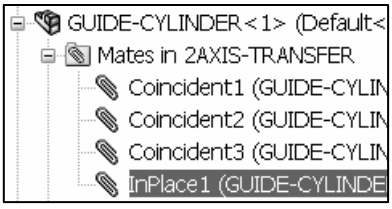
429) Right-click **2AXIS-TRANSFER** from the FeatureManager.

430) Click **Go To**. Enter **InPlace1**.

431) Click **Find Next**. The Mate, InPlace1 is found in the FeatureManager.

432) Click **Close**.

433) Right-click **InPlace1** from the FeatureManager as illustrated.



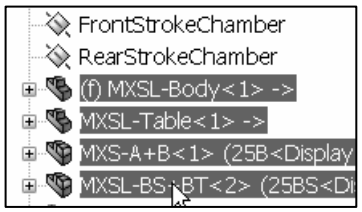
434) Click **Delete**.

435) Click **Yes** to confirm delete.

436) Right-click **2AXIS-TRANSFER icon** from the FeatureManager.

437) Click **Go To**.

438) Click **Find Next**. No other InPlace Mates are found. Click **Close**.



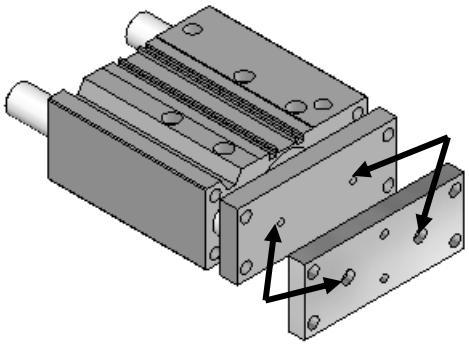
Hide components.

439) Hide the **following components** as illustrated.

PLATE-B is free to translate and rotate. Create three new Smart Mates to fully define PLATE-B in the 2AXIS-TRANSFER assembly.

Move PLATE-B.

440) Click and drag **PLATE-B** in the Graphics window to create a gap between the GUIDE-CYLINDER assembly and the PLATE-B part as illustrated.



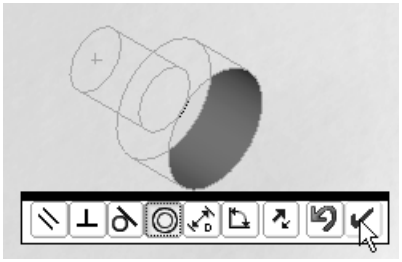
Create the first Concentric SmartMate.

441) Hold the **Alt** key down.

442) Drag the **PLATE-B left hole face** to the GUIDE-CYLINDER left Cbore face. The Coincident\Concentric icon is displayed.

443) Release the **Alt** key. Concentric is selected by default.

444) Click ✔.



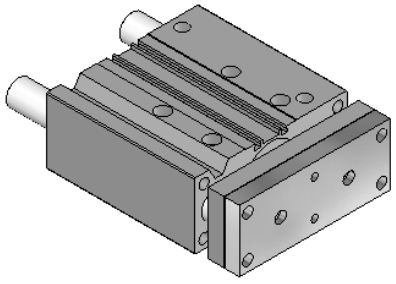
Create the second Concentric SmartMate.

445) Hold the **Alt** key down.

446) Drag the **PLATE-B right hole face** to the GUIDE-CYLINDER right Cbore face. The Coincident\Concentric icon is displayed.

447) Release the **Alt** key. Concentric is selected by default.

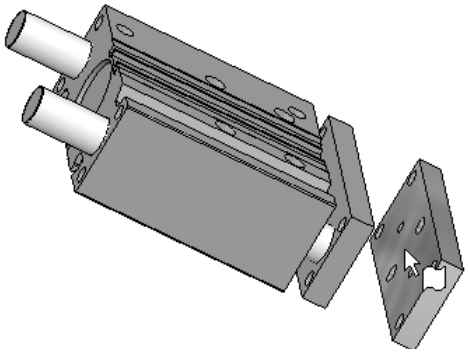
448) Click ✔.



Create the first Coincident SmartMate.

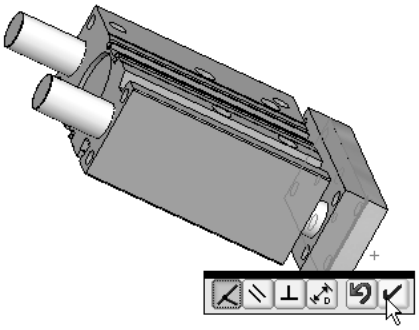
449) Hold the **Alt** key down.

450) Drag the **PLATE-B back face** to the GUIDE-CYLINDER face. The Coincident icon is displayed.



451) Release the **Alt** key. Coincident is selected by default.

452) Click ✔.

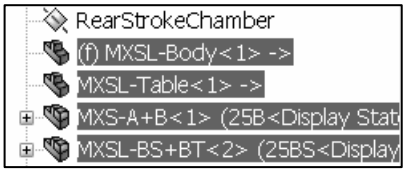


View dependent InPlace Mates and External references.

453) Right-click **2AXIS-TRANSFER** from the FeatureManager.

454) Click **Tree Display**.

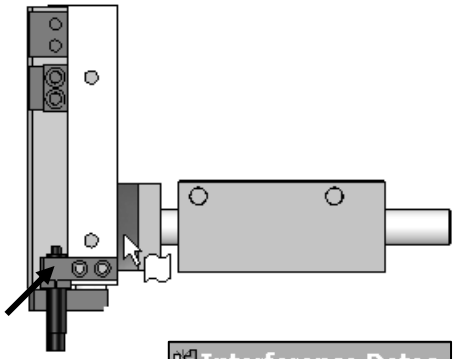
455) Check **View Mates and Dependencies**. The PLATE-B part contains no InPlace Mates or External references. Search for other InPlace Mates. No other InPlace Mates exist. Note: The Go To option also identifies InPlace Mates.



Display the SLIDE-TABLE assembly.

456) Show **MXSL-BODY**, **MXSL-Table**, **MXS-A+B**, and **MXSL-BS+BT**.

457) Click **Show**.



Check for Interference.

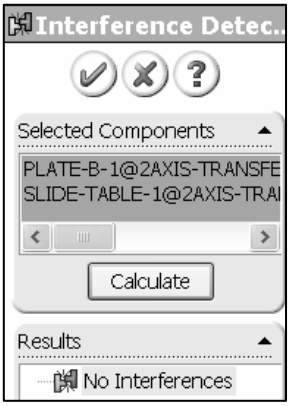
458) Click **PLATE-B** from the Graphics window.

459) Click **Interference Detection** 

from the Assembly toolbar.

460) Click **SLIDE-TABLE/MXS-BS-BT** from the Graphics window.

461) Click **Calculate**. There are No Interferences.



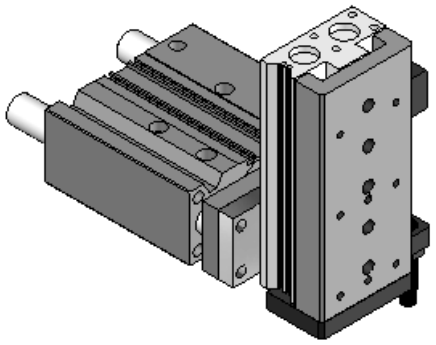
462) Click **OK**  from the Interference Detection PropertyManager.

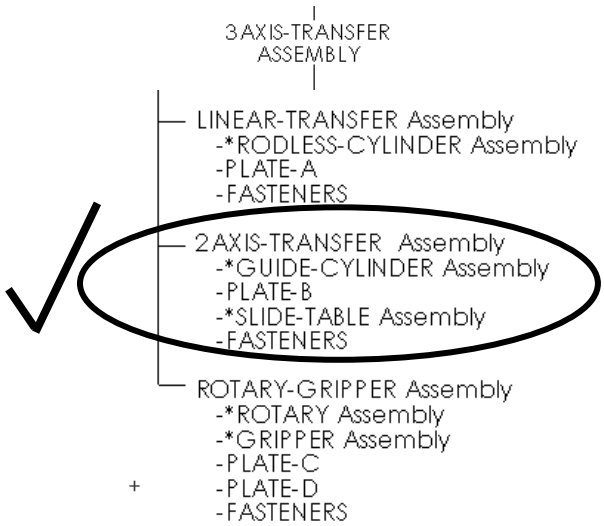
Display an Isometric view.

463) Click **Isometric** view.

Save the 2AXIS-TRANSFER assembly.
464) Click **Save**.

The 2AXIS-TRANSFER assembly is complete. The Default configuration displays the GUIDE-CYLINDER assembly, the PLATE-B part, and the SLIDE-TABLE assembly. All fasteners are suppressed.





Develop the 2AXIS-TRANSFER configurations. Utilize assembly configurations to control visualization of components, Suppress/Resolve states, Color, Mate characteristics, sub-assembly configurations, and part configurations.

Explore the Fastener configuration in the project exercises. The Fastener Configuration contains Resolved and Visible SHCSs.

Organize hardware components. Create folders for fasteners in an assembly. Utilize assembly configuration to control the Suppress state and Display state of fasteners, washers, nuts, and other hardware.

Configurations and Design Tables

Configurations create multiple variations of a part or assembly. A Design Table is an Excel spreadsheet utilized to create multiple configurations of a part or assembly.

Utilize the ConfigurationManager to create two configurations for the GUIDE-CYLINDER and SLIDE-TABLE.

Utilize a Design Table to combine the GUIDE-CYLINDER configurations and the SLIDE-TABLE configurations to create the 2AXIS-TRANSFER configurations.

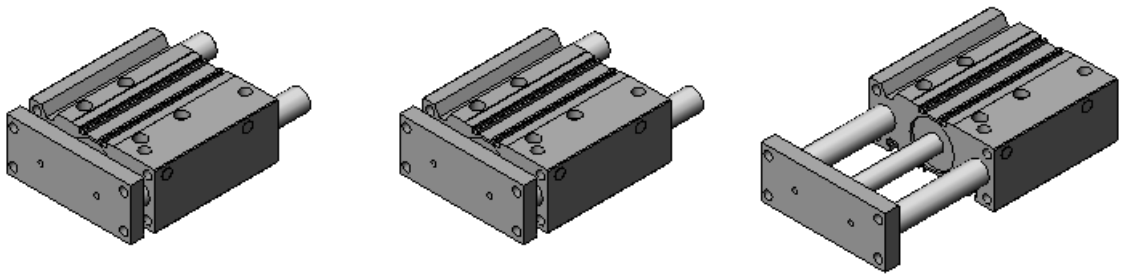
The GUIDE-CYLINDER configurations require a Distance Mate between the GUIDE-CYLINDER/MGPTube part and the GUIDE-CYLINDER/MGPRod part. Review the existing Mates. Modify the existing Coincident Mate to a Distance Mate.

The GUIDE-CYLINDER assembly is in the Default configuration. The current configuration of the GUIDE-CYLINDER assembly is named Default. The Distance Mate value equals 0.

Create two GUIDE-CYLINDER configurations:

- Normal.
- Extended.

The GUIDE-CYLINDER assembly is in the Normal configuration when the Distance Mate value equals 0. The GUIDE-CYLINDER is in the Extended configuration when the Distance Mate value equals 100.



Default Normal Extended

GUIDE-CYLINDER Configurations

The SLIDE-TABLE requires a Distance Mate between the SLIDE-TABLE/MXSL-Body part and SLIDE-TABLE/MXSL-Table part. Modify the existing Coincident Mate to a Distance Mate.

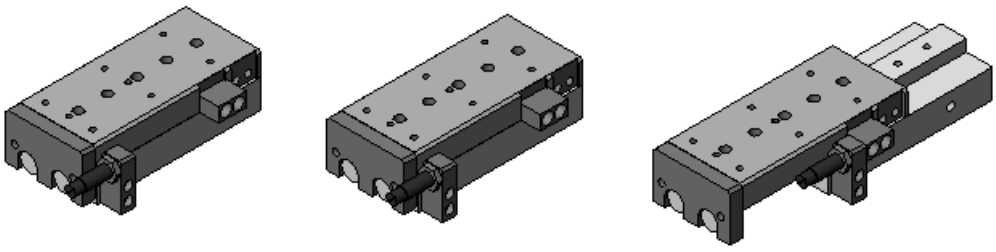
The SLIDE-TABLE assembly is in the Default configuration. The current configuration of the SLIDE-TABLE assembly is named Default. The Distance Mate is 0.

Create two SLIDE-TABLE configurations:

- Normal.
- Extended.

The SLIDE-TABLE assembly is in the Normal configuration when the Distance Mate is 0.

The SLIDE-TABLE assembly is in the Extended configuration when the Distance Mate is 100.

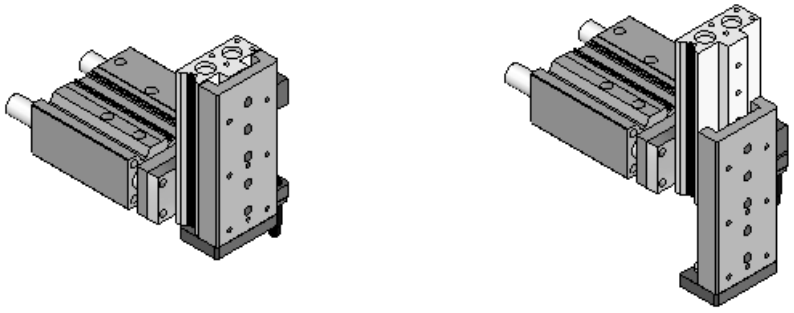


Default Normal Extended

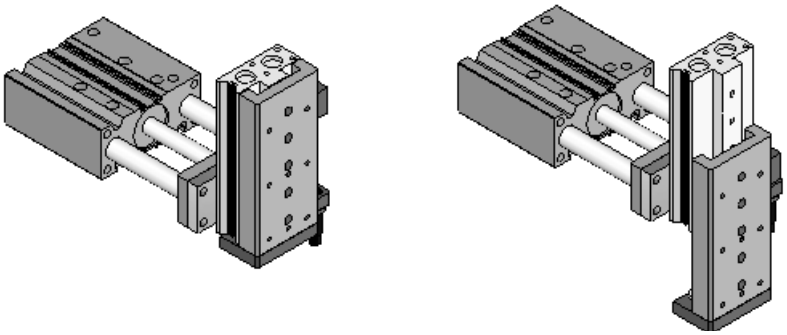
SLIDE-TABLE assembly

Utilize a Design Table to combine the GUIDE-CYLINDER Normal configuration and the GUIDE-CYLINDER Extended configuration with the SLIDE-TABLE Normal configuration and the SLIDE-TABLE Extended configuration.

Create four 2AXIS-TRANSFER configurations: Normal-Normal, Normal-Extended, Extended-Normal, and Extended-Extended.



Normal-Normal Normal-Extended



Extended-Normal Extended-Extended

In the 2AXIS-TRANSFER configurations, the configuration name of the GUIDE-CYLINDER assembly is listed first followed by the configuration name of the SLIDE-TABLE assembly. SHCS are suppressed in the Normal-Normal, Normal-Extended, Extended-Normal, and Extended-Extended configurations.

Develop the Fastener configuration in the project exercises. SHCSs are resolved in the Fastener configuration.

Before creating new configurations with models obtained from other sources, review Design Table properties. The manufacture's Design Table lists the defined properties in Row 2. Example: The Custom Property $PRP@Stroke.

Avoid problems with configurations. Utilize unique names in your configurations that do not conflict with names selected by the manufacturer.

The 2AXIS-TRANSFER assembly requires the Stroke distance to be controlled through 2 positions. Rename the Distance Mate to Distance-Stroke.

The new MGPM12-10 GUIDE-CYLINDER-12MM, downloaded in Project 1, contains only the individual configuration information.

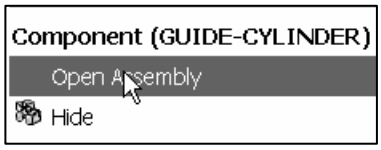
The FeatureManager contains no Design Table. Utilize the ConfigurationManager, Custom Properties, Configuration Specific option to list properties defined in an assembly.

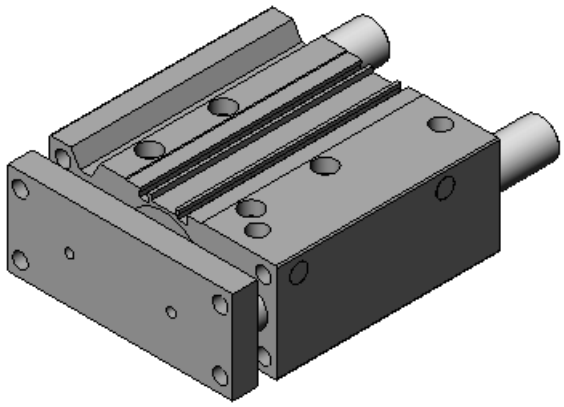
Activity: GUIDE-CYLINDER Configurations and Design Tables

Open the GUIDE-CYLINDER.

465) Right-click **GUIDE-CYLINDER** from the 2AXIS-TRANSFER FeatureManager.

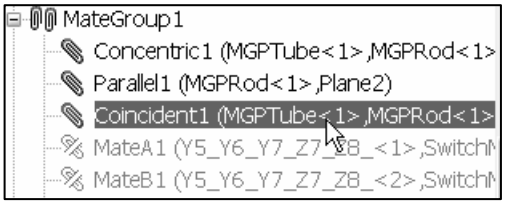
466) Click **Open Assembly**. The GUIDE-CYLINDER is displayed in the Graphics window.





Locate and Redefine the GUIDE-CYLINDER Coincident Mate.

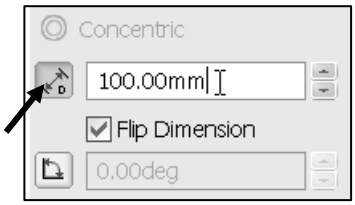
467) Expand **MateGroup1**.



468) Click **Coincident1** as illustrated. The Coincident1 Mate is between the face of the MGPTube part and the face of the MGPRod part.

469) Right-click **Edit Feature**.

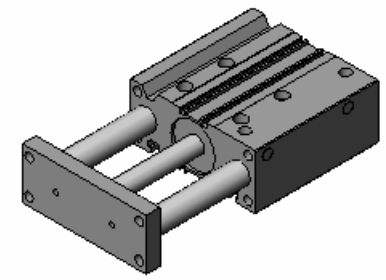
470) Click **Distance** from the Standard Mates box. The Distance value is 0.



471) Enter **100**.

472) Click **OK** from the Distance1 PropertyManager.

473) Click OK from the Mate PropertyManager.

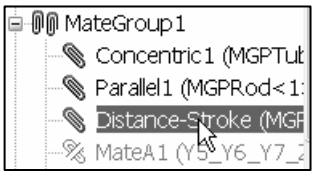


Rename the Distance Mate.

474) Rename the Distance1 Mate to **Distance-Stroke**.

475) Double-click **Distance-Stroke**.

476) Drag the **100** dimension text off the profile.



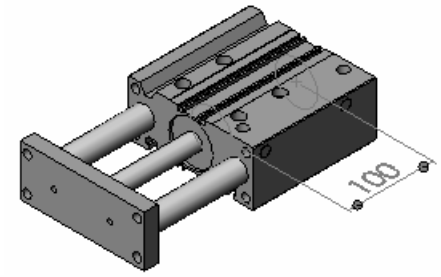
Modify the Distance.

477) Double-click the **100** dimension text.

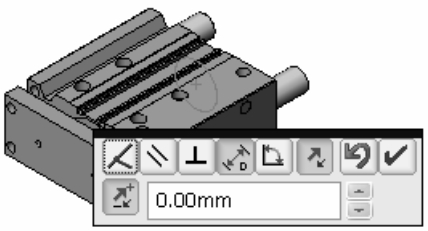
478) Enter **0**.

479) Click **Rebuild**.

480) Click ✔.



481) Click **OK** from the Distance PropertyManager. The Default configuration value is 0 for the Distance Mate named Stroke.

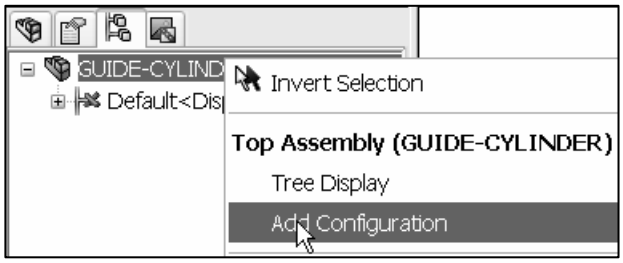


Create the GUIDE-CYLINDER Normal and Extended Configurations.

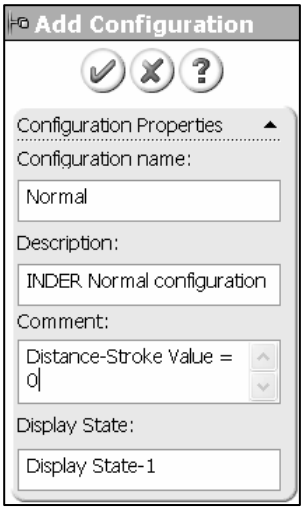
482) Drag the **Split bar** downward to divide the FeatureManager and the Configuration Manager.

483) Click the **ConfigurationManager** icon.

484) Right-click **GUIDE-CYLINDER Configuration(s)**.



485) Click **Add Configuration**. The Add Configuration PropertyManager is displayed.



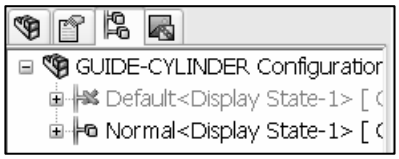
486) Enter **Normal** for Configuration name.

487) Enter **GUIDE-CYLINDER Normal configuration** for Description.

488) Enter **Distance-Stroke Value = 0** for Comment.

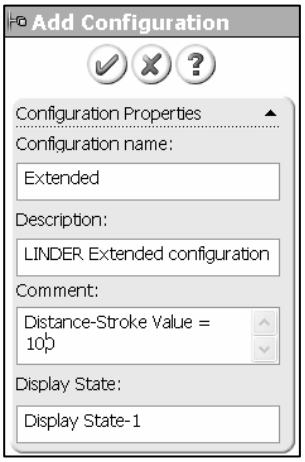
489) Click **OK** from the Add Configuration PropertyManager. The Normal configuration is currently the same as the Default configuration.

490) Right-click **GUIDE-CYLINDER Configuration(s).**



491) Click **Add Configuration**.

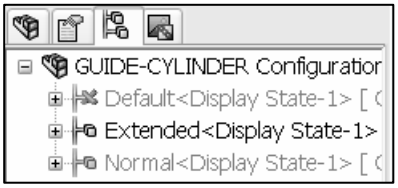
492) Enter **Extended** for Configuration Name. Enter **GUIDE-CYLINDER Extended configuration** for Description.



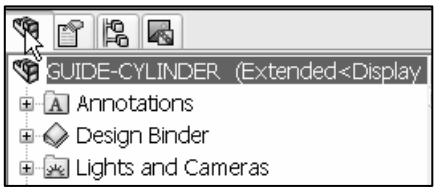
493) Enter **Distance-Stroke Value = 100** for Comment.

494) Click **OK** from the Add Configuration PropertyManager.

Extended [GUIDE-CYLINDER] is the current configuration.

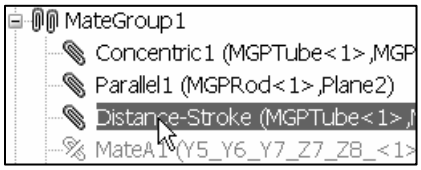


495) Click the **FeatureManager** icon. The configuration name, (Extended) is displayed after the GUIDE-CYLINDER assembly name.



Enter informative comments for future use that explain Mates, parameters, and design intent. Team members on the next project require helpful comments on the GUIDE-ROD assembly.

Modify the Stroke value.



496) Double-click **Distance-Stroke** from MateGroup1.

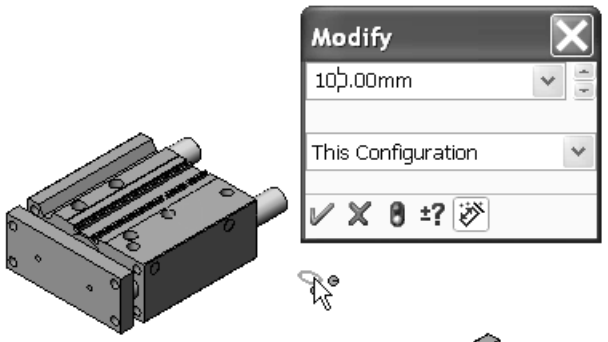
497) Double-click **0**.

498) Enter **100**.

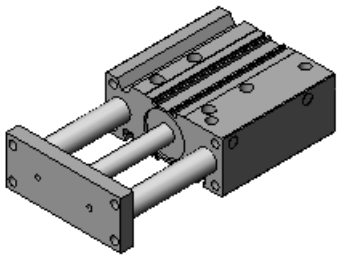
499) Click **This Configuration** from the drop down list.

500) Click **Rebuild**.

501) Click ✔.



502) Click **OK** from the Dimension PropertyManager.

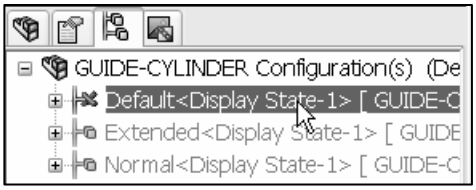


Test the configurations.

503) Click the **ConfigurationManager** icon.

504) Double-click **Normal configuration** and **Extended configuration**. View the configuration.

505) Double click the **Default** configuration. The Default configuration displays the Excel icon, displayed in green.



Return to the assembly FeatureManager.

506) Click the **FeatureManager** icon.

Save the GUIDE-CYLINDER assembly.

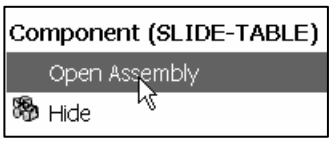
507) Click **Save**.

Return to the 2AXIS-TRANSFER assembly.

508) Open the **2AXIS-TRANSFER** assembly.

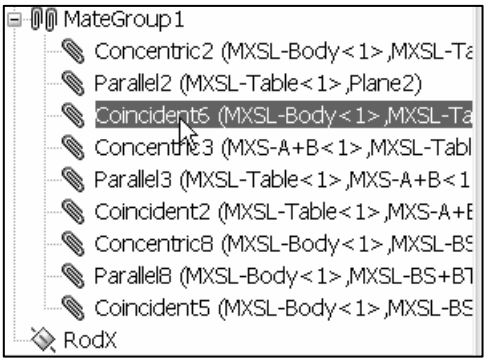
Locate and Redefine the SLIDE-TABLE Mate.

509) Right-click **SLIDE-TABLE** from the 2AXIS-TRANSFER assembly FeatureManager.



510) Click **Open Assembly**.

511) Expand **MateGroup1**.



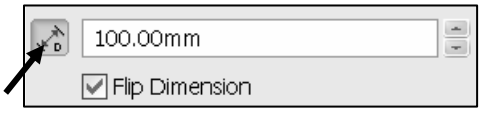
512) Click **Coincident6** Mate as illustrated.

513) Right-click **Edit Feature**.

514) Click **Distance**.

515) Enter **100** for Distance value.

516) Click **OK** from the Distance1 PropertyManager. Click **OK** from the Mate PropertyManager.



Rename the Distance Mate.

517) Rename **Distance1** to **Distance-Stroke**.

518) Double-click **Distance-Stroke**.

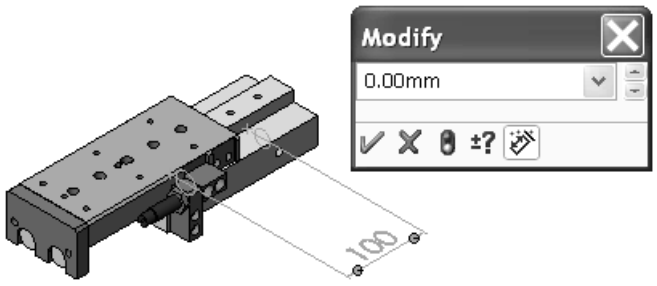
519) Drag the **100** dimension text off the profile.

520) Double-click **100**.

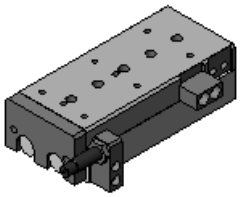
521) Enter **0**. Click **Rebuild**.

522) Click ✔.

523) Click **OK** from the Distance PropertyManager.

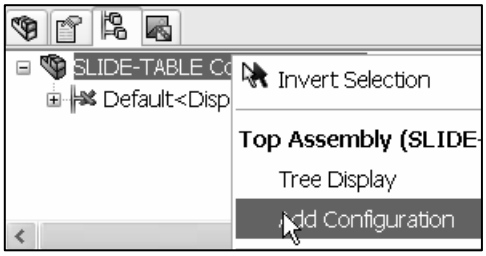


The Distance-Stroke value equals 0 for the Default configuration.



Create the SLIDE-TABLE Normal and Extended Configurations.

524) Drag the **Split bar** downward to divide the FeatureManager and ConfigurationManager.



525) Click the **ConfigurationManager** icon.

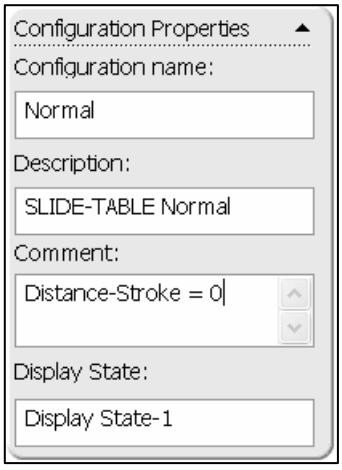
526) Right-click **SLIDE-TABLE Configuration(s)**.

527) Click **Add Configuration**. The Add Configuration PropertyManager is displayed.

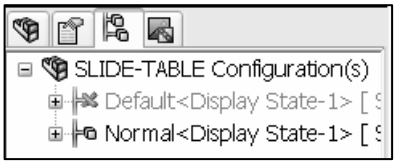
528) Enter **Normal** for Configuration name.

529) Enter **SLIDE-TABLE Normal** for Description.

530) Enter **Distance-Stroke = 0** for Comment.



531) Click **OK** from the Add Configuration PropertyManager. Currently, the Normal Configuration is the same as the Default Configuration.



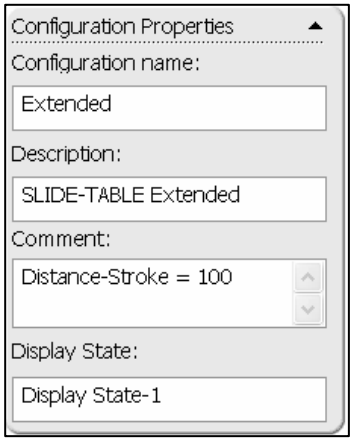
532) Right-click **SLIDE-TABLE Configuration(s)**.

533) Click **Add Configuration**.

534) Enter **Extended** for Configuration Name.

535) Enter **SLIDE-TABLE Extended** for Description.

536) Enter **Distance-Stroke = 100** for Comment.

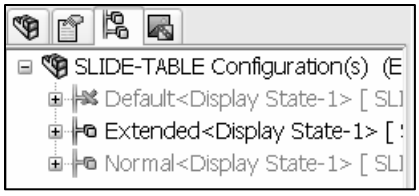


537) Click **OK** from the Add Configuration PropertyManager. Extended [SLIDE-TABLE] is the current configuration.

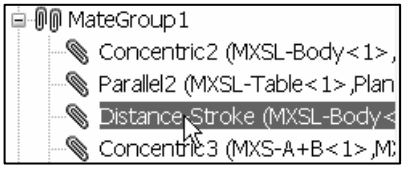
Return to the assembly FeatureManager.

538) Click the **FeatureManager** icon.

The configuration name (Extended) is displayed after the SLIDE-TABLE name.



Modify the Distance-Stroke value.



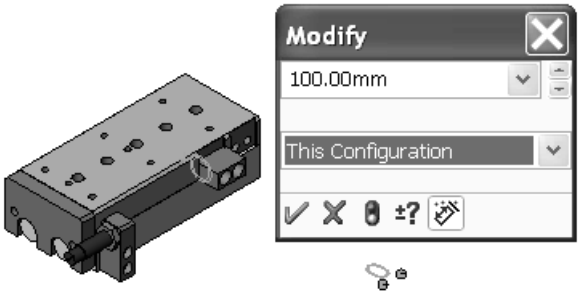
539) Expand **MateGroup1**.

540) Double-click **Distance-Stroke**.

541) Double-click **0**.

542) Enter **100**.

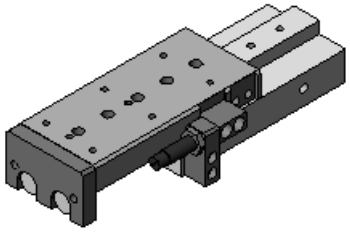
543) Click **This Configuration** from the drop down list.



544) Click **Rebuild**.

545) Click ✔.

546) Click **OK** from the Dimension PropertyManager.



Test the Configurations.

547) Double-click **Normal** configuration and **Extended** configuration. View the configurations.

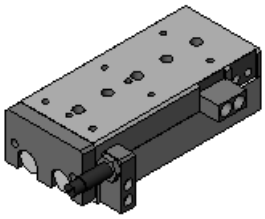
548) Double-click **Default** configuration.

Return to the assembly FeatureManager.

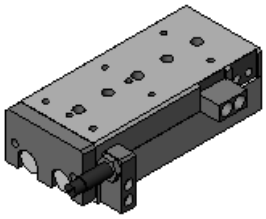
549) Click the **FeatureManager** icon.

Save the SLIDE-TABLE assembly in the Default configuration.

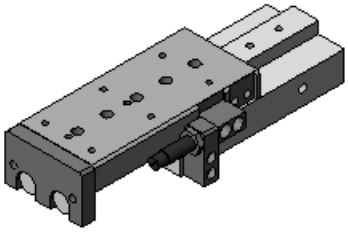
550) Click **Save**.



Default



Normal

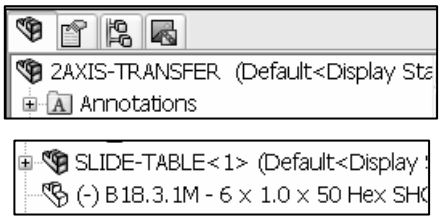


Extended

SLIDE-TABLE assembly

Return to the 2AXIS-TRANSFER assembly.

551) Click **Window**, **2AXIS-TRANSFER** from the Main menu. The GUIDE-CYLINDER(Default) and SLIDE-TABLE (Default) are the current configurations in the 2AXIS-TRANSFER assembly FeatureManager. The SHCSs are displayed in light gray.



552) Drag the **Split bar** downward to divide the FeatureManager and Configuration Manager.

Design Table and 2AXIS-TRANSFER Configurations

A Design Table is an Excel spreadsheet utilized to create configurations and control parameters in a part or assembly. Insert a Design Table to control the Normal and Extended configurations for the GUIDE-CYLINDER and SLIDE-TABLE assemblies.

The 2AXIS-TRANSFER Design Table controls the parameters $Configuration and $STATE for each component in the assembly. The $Configuration parameter is the configuration name. The $STATE parameter is the Suppressed/Resolved state of a component in the assembly. Design Tables utilizing additional parameters at the part and assembly level will be utilized in Project 4.

The model name associated with the Design Table is located in Cell A1. Define the 2AXIS-TRANSFER configuration names in the first column of an Excel spreadsheet. Define the parameters in the second row. Enter values in the Cells that correspond to the configuration name and the parameter name. Leave Cell A2 blank.

Entering individual configurations with the ConfigurationManager is a cumbersome task. Avoid spelling issues. Utilize the Auto-create option to insert SHCS $STATE parameters into the Design Table.

Cell A1

Parameters

	A	B	C	D	E
1	Design Table for: 2AXIS-TRANSFER				
2		$Configuration@GUIDE-CYLINDER<1>	$Configuration@SLIDE-TABLE<1>	$STATE@B18.3.1M - 6 x 1.0 x 20 Hex	$STATE@B18.3.1M - 6 x 1.0 x 20 Hex
3	Default	Default	Default	S	S
4	Normal-Normal	Normal	Normal	S	S
5	Extended-Normal	Extended	Normal	S	S
6	Normal-Extended	Normal	Extended	S	S
7	Extended-Extended	Extended	Extended	S	S
8	Fastener	Normal	Normal	R	R

2AXIS-TRANSFER configuration names

Additional part and assembly parameters control Dimensions, Color, and Comments. All parameters begin with a $, except Dimension.

Enter parameters carefully. The "$", "@" and "<>" symbol format needs to match exactly for the result to be correct in the BOM.

The Summary of Design Table Parameters is as follows:

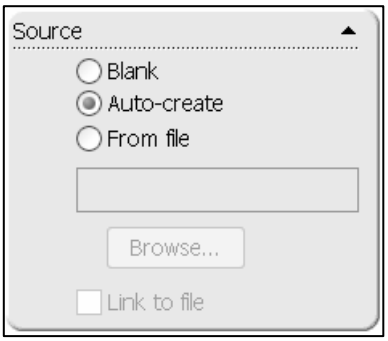
Summary of Design Table Parameters:		
Parameter Syntax (Header Cell)	**Legal Values (Body Cell)**	**Default if Value is Left Blank**
Parts only:		
$configuration@part_name	configuration name	not evaluated
$configuration@<feature_name>	configuration name	not evaluated
Parts and Assemblies:		
$comment	any text string	empty
$part number	any text string	configuration name
$state@feature_name	Suppressed, S Unsuppressed, U	Unsuppressed
dimension@feature	any legal decimal value for the dimension	not evaluated
$parent	parent configuration name	property is undefined
$prp@ property	any text string	property is undefined
$state@equation_number@equations	Suppressed, S Unsuppressed, U	Unsuppressed
$state@lighting_name	Suppressed, S Unsuppressed, U	Unsuppressed
$state@sketch relation@sketch name	Suppressed, S Unsuppressed, U	Unsuppressed
$user_notes	any text string	not evaluated
$color	32-bit integer specifying RGB (red, green, blue) color. See Online Help, color for more info.	zero (black)
Assemblies only:		
$show@component<instance>	Yes, Y No, N	No
$state@component<instance>	Resolved, R, Suppressed, S	Resolved
$configuration@component<instance>	configuration name	Component's "in-use" or last saved configuration. NOTE: If the component uses a derived configuration, and the value is left blank, the configuration used is linked to its parent.

Insert a new Design Table into the 2AXIS-TRANSFER assembly. Insert the configuration names and parameters. The SHCSs are suppressed.

The Design Table PropertyManager is divided into three sections:

- Source.
- Edit Control.
- Options.

Source:



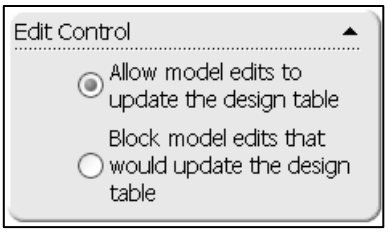
The Blank option inserts an empty Design Table. The designer fills in the parameters.

The Auto-create option automatically creates a new Design Table and loads all different configured parameters and values entered in the ConfigurationManager. In an assembly, the Auto-create option loads the $STATE of components into a Design Table.

Utilize Auto-create with maximum results. The Auto-create option inserts only parameters that are *different*. Example: Create two configurations. The first configuration is the Default. Insert as many parameters into the second configuration. Auto-create will then insert the parameters from the second configuration into the Design Table. The PLATE-D Design Table activity provides an example with multiple parameters.

The From file option utilizes a pre-existing Excel spreadsheet. Browse to locate the spreadsheet. Checking the Link to file check box option means that any changes made in the spreadsheet outside SolidWorks are updated in the model during the next SolidWorks session. If the Allow model edits to update the design table option is checked, the spreadsheet reflects the model changes.

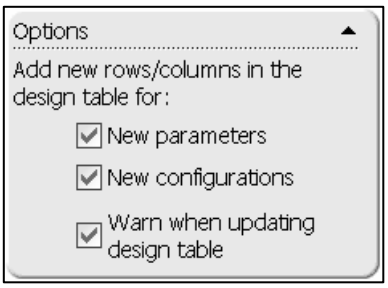
Edit Control:



The Allow model edits to update the design table option results in the Design Table to update when the model changes. Utilize this option in the beginning of the design process to permit changes.

The Block model edits that would update the design table option prohibits any changes that update the Design Table. The GUIDE-CYLINDER Design Table and SLIDE-TABLE Design Table provided by SMC both utilize these options.

Options:



The New parameters option inserts new rows and columns into the Design Table when you add a new parameter to the part/assembly.

The New configurations option inserts new rows and columns into the Design Table when you add a new configuration to the part/assembly.

The Warn when updating design table option produces a warning message that the Design Table will change based on the parameters updated in the part/assembly.

Activity: Design Table and 2AXIS-TRANSFER Configurations

Insert a Design Table.
553) Click **Insert**, **Design Table** from the Main menu.

Select the parameters.
554) Check **Auto-create**.

555) Click **OK**  from the Design Table PropertyManager.

Cell A1 contains the 2AXIS-TRANSFER assembly name.
Cell A3 contains the 2AXIS-TRANSFER Default configuration name.

Insert the $Configuration parameters.

556) Click **Cell B2**.

557) Enter **$Configuration@GUIDE-CYLINDER<1>**.

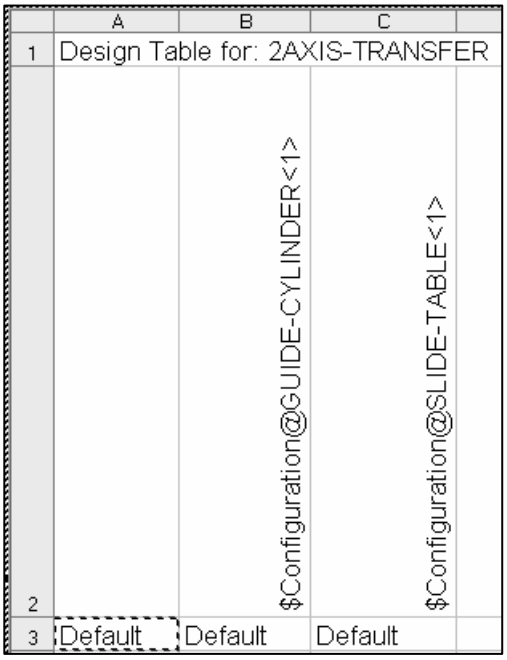
558) Click **Cell C2**.

559) Enter **$Configuration@SLIDE-TABLE<1>**.

Note: If your GUIDE-CYLINDER or SLIDE-TABLE entry in the FeatureManager lists a different instance number in brackets <1>, utilize that number. The component spelling and instance number must match exactly.

560) Copy **Cell A3** to **Cell B3** and **Cell C3**.

Note: Click a position outside the Design Table and you exit EXCEL and return to SolidWorks. To return to the Design Table, right-click Design Table from the FeatureManager. Click Edit Table.



Insert the configuration names.

561) Click **Cell A4**.

562) Enter **Normal-Normal**.

563) Click **Cell A5**.

564) Enter **Extended-Normal**.

565) Click **Cell A6**.

566) Enter **Normal-Extended**.

567) Click **Cell A7**.

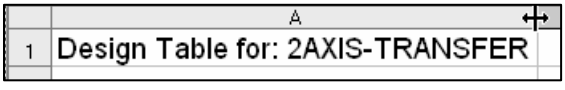
568) Enter **Extended-Extended**.

3	Default	Default	Default
4	Normal-Normal		
5	Extended-Normal		
6	Normal-Extended		
7	Extended-Extended		

Resize Column A

569) Position the **mouse pointer** between the A and B Column header. The mouse pointer displays the Resize icon.

570) Drag the **mouse pointer** to the right until Cell A7 is completely visible.



Enter the values for the GUIDE-CYLINDER configurations.

571) Click **Cell B4**. Enter **Normal**.

572) Click **Cell B5**. Enter **Extended**.

573) Click **Cell B6**. Enter **Normal**.

574) Click **Cell B7**. Enter **Extended**.

Enter the values for the SLIDE-TABLE configurations.

575) Click **Cell C4**. Enter **Normal**.

576) Click **Cell C5**. Enter **Normal**.

577) Click **Cell B6**. Enter **Extended**.

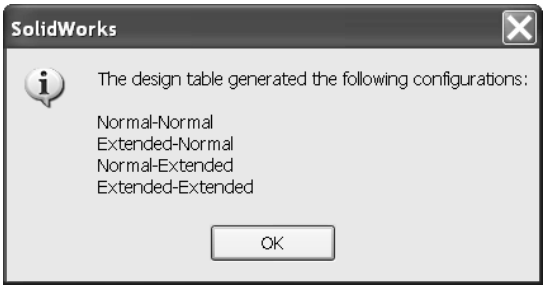
578) Click **Cell C7**. Enter **Extended**.

Default	Default	Default
Normal-Normal	Normal	Normal
Extended-Normal	Extended	Normal
Normal-Extended	Normal	Extended
Extended-Extended	Extended	Extended

Build the configurations.

579) Click a **position** inside the SolidWorks Graphics window.

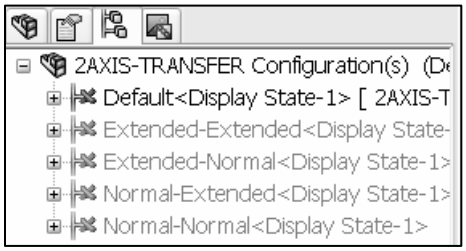
580) Click **OK** to the message: "The design table generated the following configurations:"



View the configurations.

581) Click the **ConfigurationManager** icon.

582) Double-click **Normal-Normal**, **Normal-Extended**, **Extended-Normal** and **Extended-Extended** to verify the position.

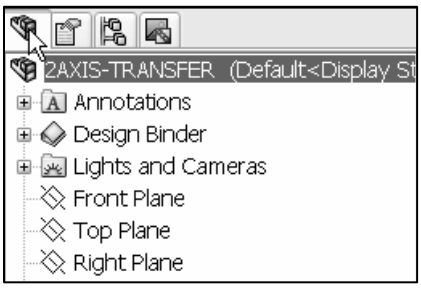


Return to the Default Configuration.

583) Double-click **Default**.

Return to the FeatureManager.

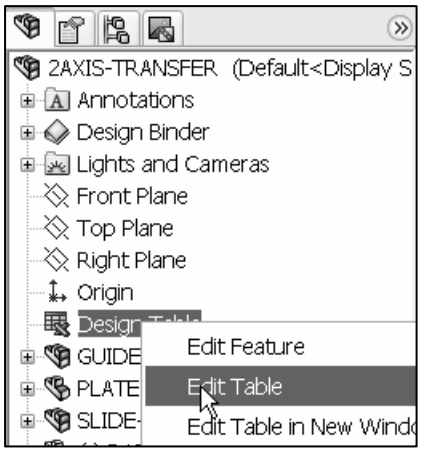
584) Click the **FeatureManager** icon.



Edit the Design Table.

585) Right-click **Design Table** from FeatureManager.

586) Click **Edit Table**. The Add Rows and Columns dialog box is displayed.



587) Click **Cancel**.

Insert the SHCSs $STATE parameters.

588) Hold the **Ctrl** key down.

589) Select the two **$STATE** entries in the parameters box. Note: If the part is suppressed, then the $STATE parameter is displayed.

590) Click **OK**.

591) Release the **Ctrl** key. The $STATE entries are displayed in Cell D2 and E2. The S value in Cells D3 through E7 indicates the Suppressed State.

Insert the Fastener configuration.

592) Enter **Fastener** in Cell A8.

593) Enter **Normal** in Cell B8 and Cell C8.

594) Enter **R** in Cell D8 and E8. The R value indicates the Resolved State in an assembly.

Update the configurations.

595) Click a **position** inside the Graphics window.

596) Click **OK**.

View the configurations.

597) Click the **ConfigurationManager**.

598) Double-click **Fastener** to verify the unsuppressed SHCSs.

Return to the Default Configuration.

599) Double-click **Default**. Click the **FeatureManager**.

Save the 2AXIS-TRANSFER assembly.

600) Click **Save**.

Close all parts and assemblies.

601) Click **Windows**, **Close All** from the Main menu.

Project Summary

In this project you utilized a Top Down design assembly modeling approach with InPlace Mates and features developed in the context of the 2AXIS-TRANSFER assembly. The 2AXIS-TRANSFER assembly consists of following:

- GUIDE-CYLINDER assembly.
- PLATE-B part.
- SLIDE-TABLE assembly.
- SHCSs parts.

You created the PLATE-B part In-Context of the GUIDE-CYLINDER assembly and SLIDE-TABLE assembly. Interference problems were detected and resolved before any parts were manufactured.

You built configurations for the GUIDE-CYLINDER assembly and the SLIDE-TABLE assembly utilizing the ConfigurationManager. The GUIDE-CYLINDER configurations and SLIDE-TABLE configurations were combined in a Design Table to form the 2AXIS-TRANSFER configurations: Normal-Normal, Normal-Extended, Extended-Normal, and Extended-Extended.

Review the assemblies with your project team leader. Ask if the customer has provided any additional input that would constitute a design change. For now, there are no changes. There will be changes in the future. Planning your assembly and configurations determines your success.

How do you control positions of the ROTARY-GRIPPER assembly? Answer: Utilize configurations in Project 4. Review the questions and exercises before moving on to Project 4.

Questions

1. Describe the two design methods utilized in a Top Down design assembly modeling approach.

2. Define an In-context relation.

3. Describe the procedure to rename a feature, sketch or Mate name.

4. Define an InPlace Mate.

5. True or False. An InPlace Mate cannot be deleted from an assembly.

6. Describe the procedure to create a rectangular sketch centered about the part Origin. The rectangular sketch contains only one vertical and one horizontal dimension.

7. True or False. A Concentric SmartMate is created between two cylindrical faces from the same part.

8. True or False. External references cannot be redefined.

9. Identify the two components that determine the geometric and functional requirements for PLATE-B.

10. How do you redefine a component in an assembly?

11. True or False: External references defined In-context become out of context when the corresponding components are not loaded into memory.

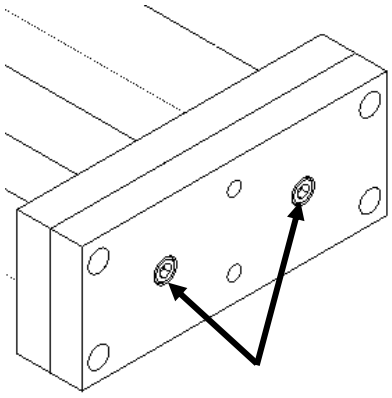
12. Describe the procedure to block updates to a Design Table in the 2AXIS-TRANSFER assembly.

13. The GUIDE-CYLINDER has two configurations. The SLIDE-TABLE has two configurations. Describe the process of combining the GUIDE-CYLINDER configurations and the SLIDE-TABLE configurations to create the 2AXIS-TRANSFER configurations.

14. Identify the following icons in the Assembly toolbar.

a	b	c	d	e	f	g	h	i	j	k	l	m

Exercises



Exercise 3-1: Size and assemble the two SHCSs between PLATE-B and the GUIDE-CYLINDER in the 2AXIS-TRANSFER assembly.

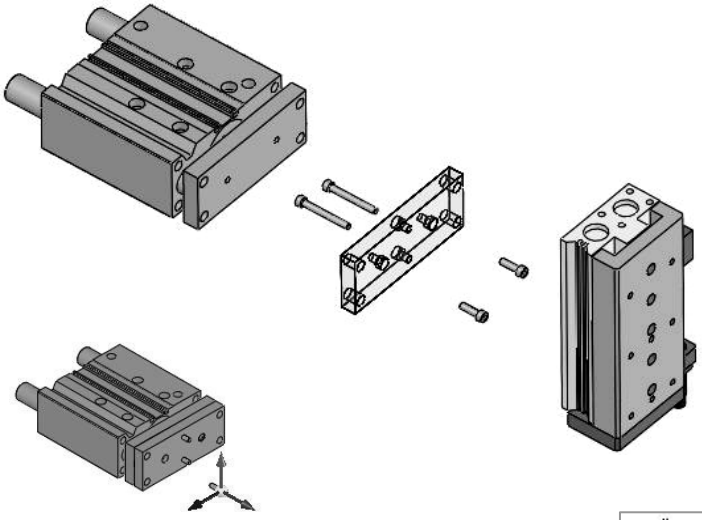
Exercise 3-2: Size and assemble the SHCSs to fasten the PLATE-B part to the SLIDE-TABLE assembly.

Note: You must complete Exercise 3-1 and 3-2 before performing Exercise 3-3.

Exercise 3-3: Modify the Fastener configuration in the 2AXIS-TRANSFER Design Table to include the two SHCSs utilized to assemble PLATE-B to the SLIDE-TABLE assembly.

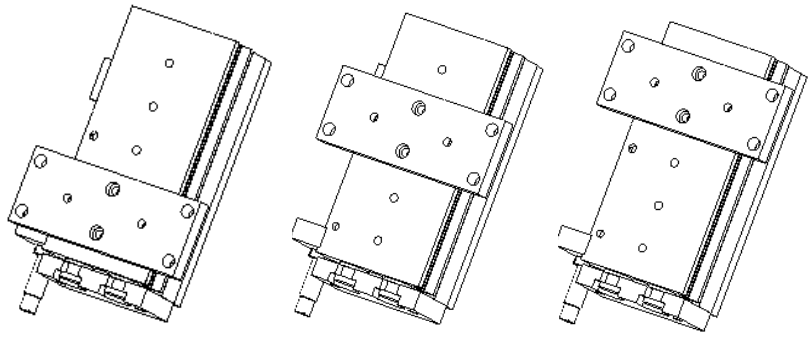
Create an Exploded view for the 2AXIS-TRANSFER assembly. Hint: Right-click the Fastener Configuration, New Exploded View. Click on a component to Explode. Drag the Triad red axis to position components approximately 1in (25mm) in the Graphics window. Modify the distances between the Explode steps to display the individual components.

Right-click ExplView1 from the ConfigurationManager. Click Animate collapse to display the animation. Select Stop from the Animation Controller.



Exercise 3-4: Create two new 2AXIS-TRANSFER Configurations. The first configuration is named MIDDLE. The second configuration is named UPPER.

Redefine the two Concentric Mates between the PLATE-B part and the SLIDE-TABLE assembly. The MIDDLE configuration utilizes BodyThruHole2 and BodyThruHole3. The UPPER configuration utilizes BodyThruHole1 and BodyThruHole2.



Default MIDDLE UPPER

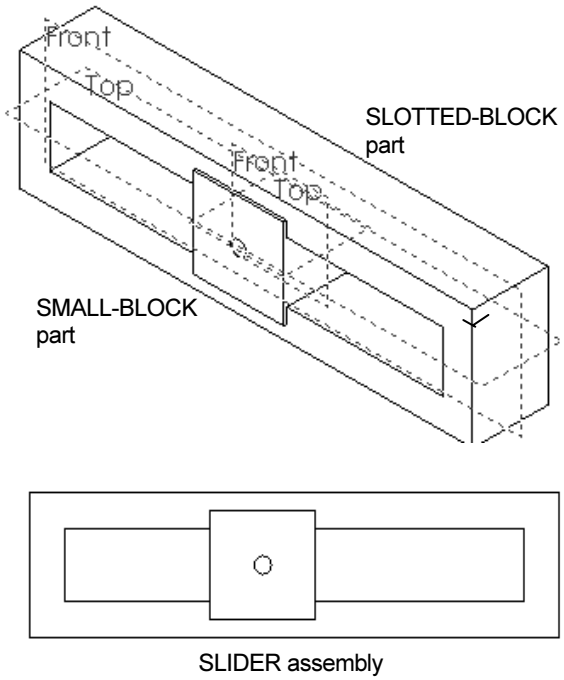
2AXIS TRANSFER Configurations

Exercise 3-4A:

Note: Exercise 3-4A and Exercise 3-4B require your own dimensions. Manually sketch your ideas on paper. Add dimensions. Label each part and each assembly.

The SMALL-BLOCK part translates freely along the SLOTTED-BLOCK part in the SLIDER assembly. The SMALL-BLOCK and SLOTTED-BLOCK are symmetric about the Front Plane. The SLOTTED-BLOCK is fixed to the SLIDER assembly Origin. The SMALL-BLOCK contains a Thru Hole.

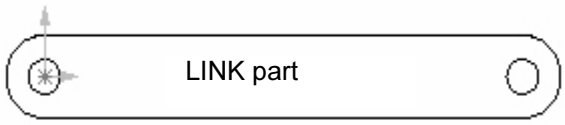
Determine the two positions where the SMALL-BLOCK collides with the SLOTTED-BLOCK.



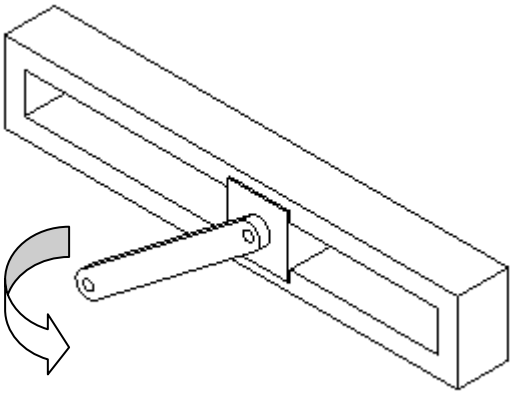
SLIDER assembly

Exercise 3-4B:

Create the MECHANISM assembly. The SLIDER assembly is the first component in the MECHANISM assembly.



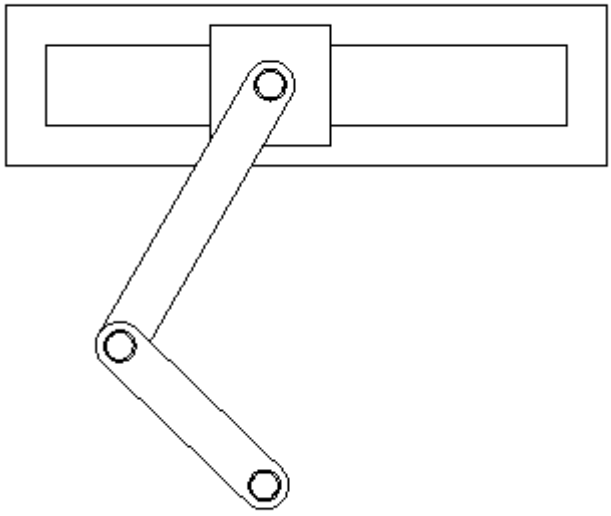
Create the first LINK part. Assemble the LINK part to the SMALL-BLOCK part. The LINK part is free to rotate in the MECHANISM assembly.



MECHANISM assembly

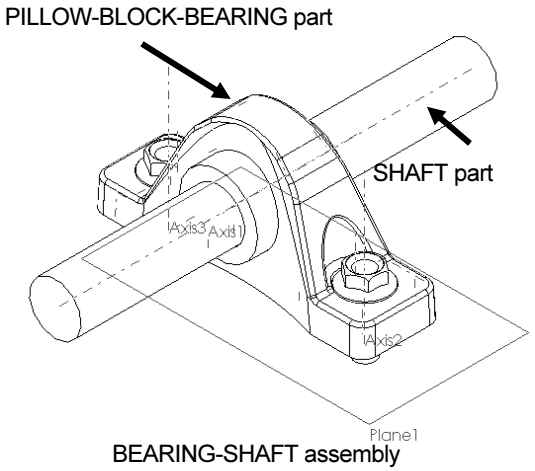
Create the second LINK as a configuration. Assemble the second LINK configuration to the first LINK part.

Create a PIN part. Assemble a PIN at each LINK Thru Hole.



Exercise 3-5: Industry Collaborative exercise.

In Exercise 2-5 you developed the BEARING-SHAFT assembly utilizing a Bottom Up assembly modeling approach. The SHAFT now requires additional BEARINGs for support.

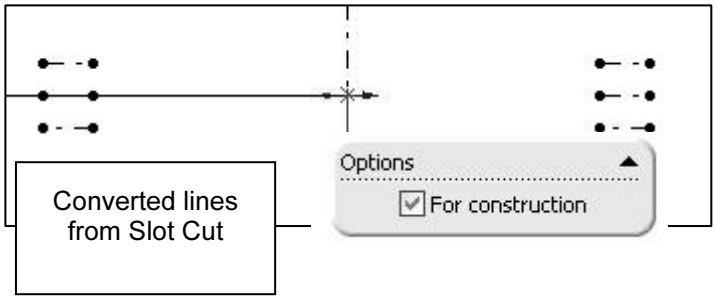


BEARING-SHAFT assembly

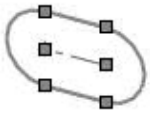
Utilize a Top Down assembly modeling approach to develop the PLATE-BG in context of the BEARING-SHAFT assembly.

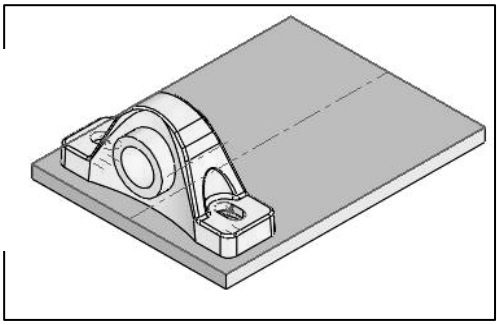
With some imported geometry, Top Down design requires a few additional steps. You cannot select faces for a Sketch Plane. Utilize Plane2 for the PLATE-BG Sketch Plane. Sketch a rectangle centered on the Right plane. The overall size supports three BEARINGs.

Utilize the BEARING Slot Cut edges and Convert Entities. Select the Slot Cut lines and check For Construction.



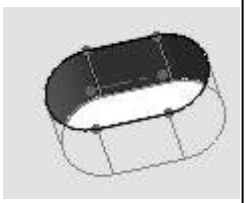
Open the PLATE-BG part. Utilize the Slot Cut construction lines to complete the profile. Extrude the sketch.

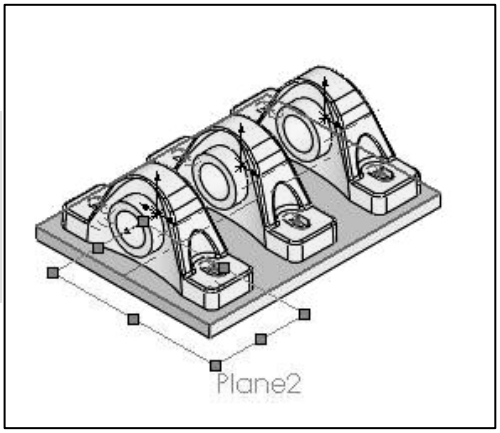




Create a Linear Pattern of Slot Cuts in PLATE-BG. Utilize a derived Component Pattern to complete the assembly.

Note: You can also create the Slot Cut and the Rectangle in the same profile. Utilize the Faces to Pattern option in the PLATE-BG Linear Pattern to create additional Slot Cuts. Select the four inside faces.

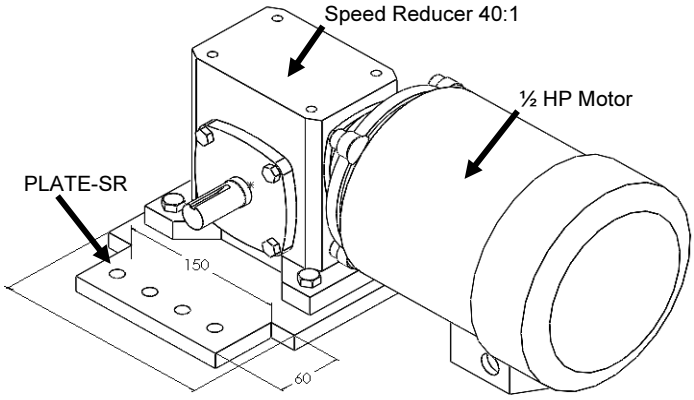




Exercise 3-6: Industry Collaborative exercise.

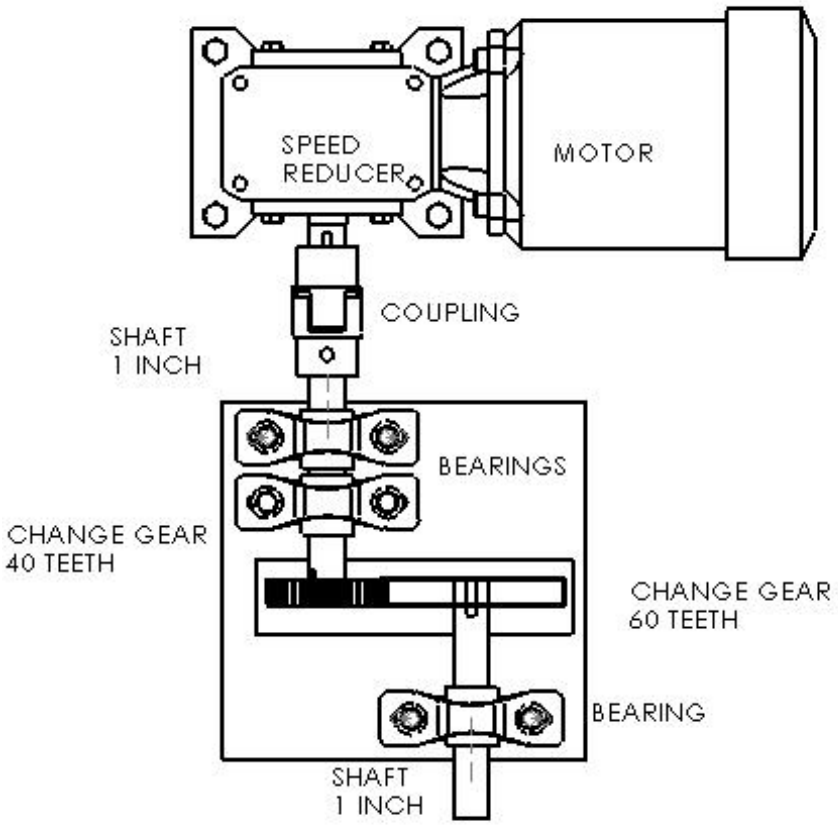
Read the entire project before you begin.

In Exercise 2-6 you sized and downloaded components from Boston Gear based on the Senior engineer's specifications. You created the SPEED-REDUCER assembly. The SPEED-REDUCER assembly consisted of a 1/2HP MOTOR part, SPEED REDUCER 40:1 assembly and the PLATE-SR part.



SPEED REDUCER assembly
Models and Images
Courtesy of Boston Gear

The Senior engineer provides a drawing for a new project. You are responsible to create the final MOTOR-GEAR-BOX assembly. The MOTOR-GEAR-BOX assembly consists of purchased components from Boston Gear. The Boston Gear components are available in the ASSEMBLY-SW-FILES-2006/EXERICISE/ PROJECT3 file folder. CHANGE GEAR 40 and CHANGE GEAR 60 tooth profiles are simplified.



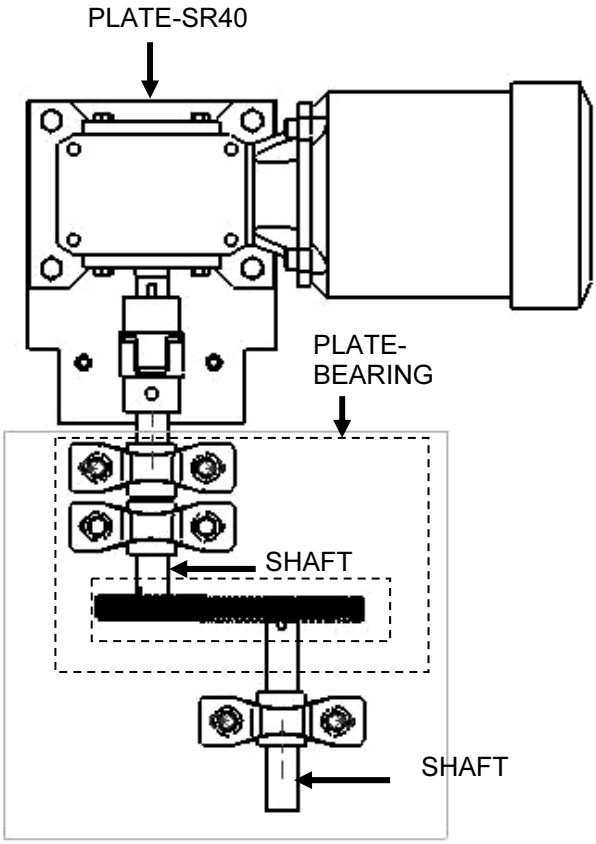
MOTOR-GEAR-BOX assembly
Models and Images Courtesy of Boston Gear

The purchased components are:

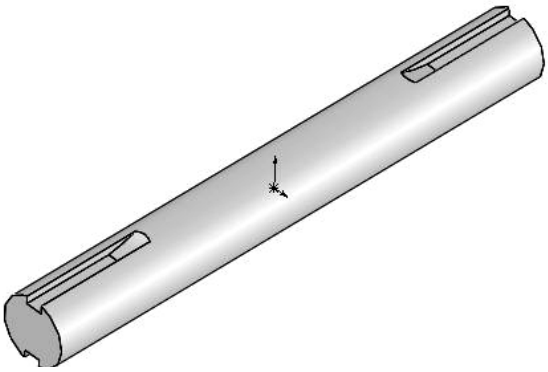
QTY:	DESCRIPTION:	FILE NAME:	Boston Gear Part No.:
1	½ HP MOTOR	futf-default-11950.sldprt	FUTF
1	SPEED-REDUCER 40:1	f721-40b5-g-2.sldasm	F721B-40-B5-G
1	COUPLING	fc20_1-default-37402.sldprt	FC20-1
1	CHANGE GEAR 40 Teeth	gd40b-simpletooth.sldprt	GD40B
1	CHANGE GEAR 60 Teeth	gd60b-simpletooth.sldprt	GD60b
2	PILLOW BLOCK BEARING	bg-1in-pillow-block.sldprt	SRP16

You are required to create the following parts:

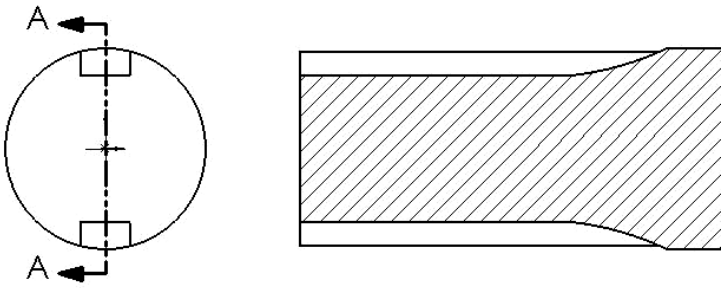
- SHAFT part (Qty2).
- PLATE-SR40 part.
- PLATE-BEARING part.



Create the SHAFT part. The SHAFT dimensions are 1″, (25.4mm) diameter by 8″, (203.2mm) length. The SHAFT contains grooves, called keyseats. Approximate the size of the keyseats that correspond to the CHANGE GEAR and COUPLING keyways.



Note: Exact dimensions and tolerance for standard keys, keyways and keyseats for gears and shafts are available in ASME B17.1, ASME B17.2 and the Machinery's Handbook.

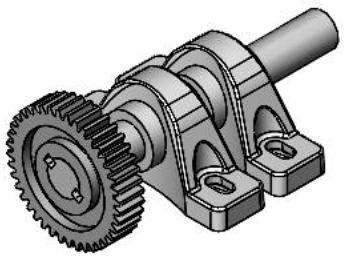


Create the PLATE-SR40 part. Utilize an In-context feature to determine the hole locations from the SPEED-REDUCER.

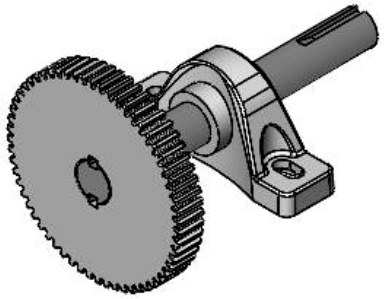
Create the BEARING-PLATE part. The BEARING-PLATE part contains the Thru Hole locations to fasten the PILLOW BLOCK BEARINGs. Create an Extruded Cut feature in the BEARING-PLATE. Note: Design for CHANGE GEAR clearance.

Simplify the MOTOR-GEAR-BOX assembly. Create three sub-assemblies:

- SPEED-REDUCER40 assembly.
- GEAR40-BEARING assembly.
- GEAR60-BEARING assembly.

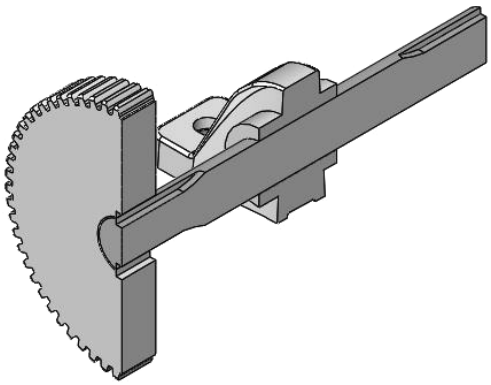


GEAR40-BEARING assembly

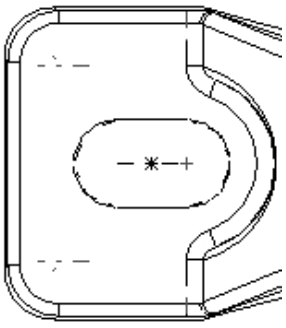


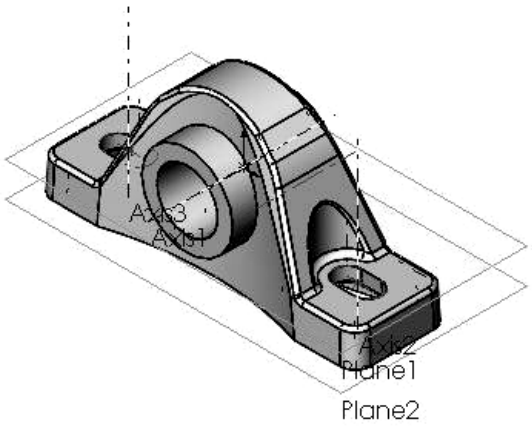
GEAR60-BEARING assembly

View the Axis and Temporary Axis. The SHAFT part is free to rotate. The GEAR part is fixed to the SHAFT part. Utilize edges and or vertices to align the GEAR keyway to the SHAFT keyway.

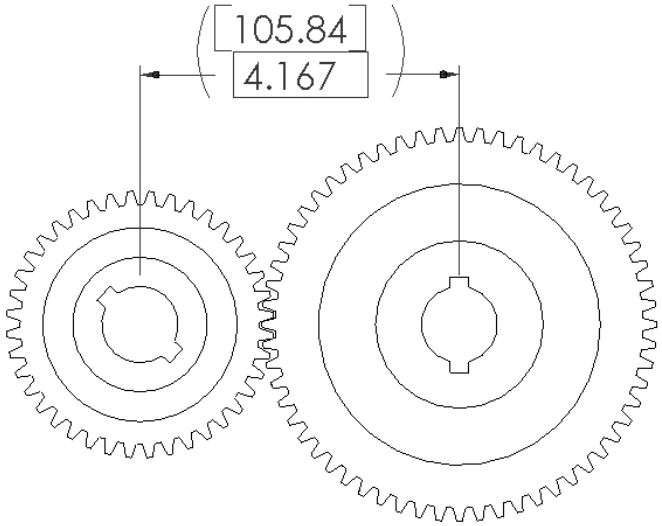


The PILLOW BLOCK BEARING part was imported as an IGES file. Reference Planes, Axes and Sketches were added. Utilize the sketched point and axis in the middle of the Slot Cut to locate the fasteners.

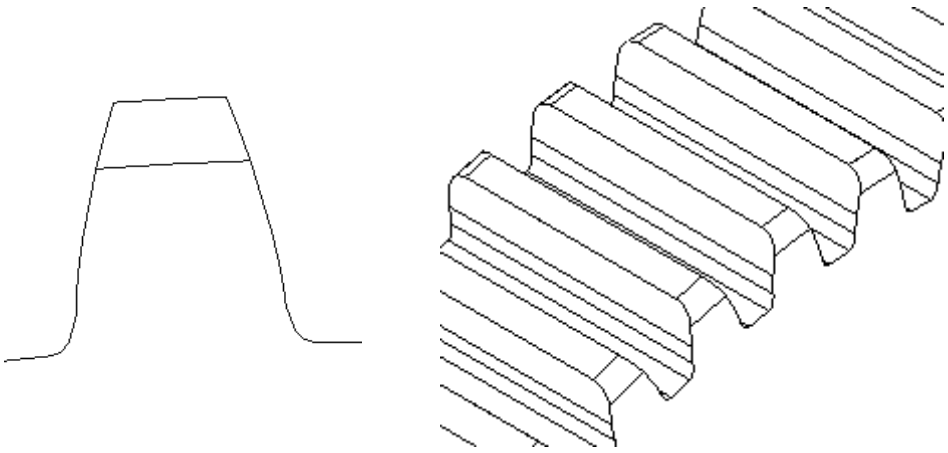




The Pitch Diameter of the CHANGE-GEAR determines the horizontal distance between the SHAFTs. The CHANGE-GEAR40 Pitch Diameter is 3.333 inch. The CHANGE-GEAR60 Pitch Diameter is 5.000 inch. The horizontal distance between the two SHAFTs is (3.333+5.000)/2 = 4.167 inch [105.84mm].



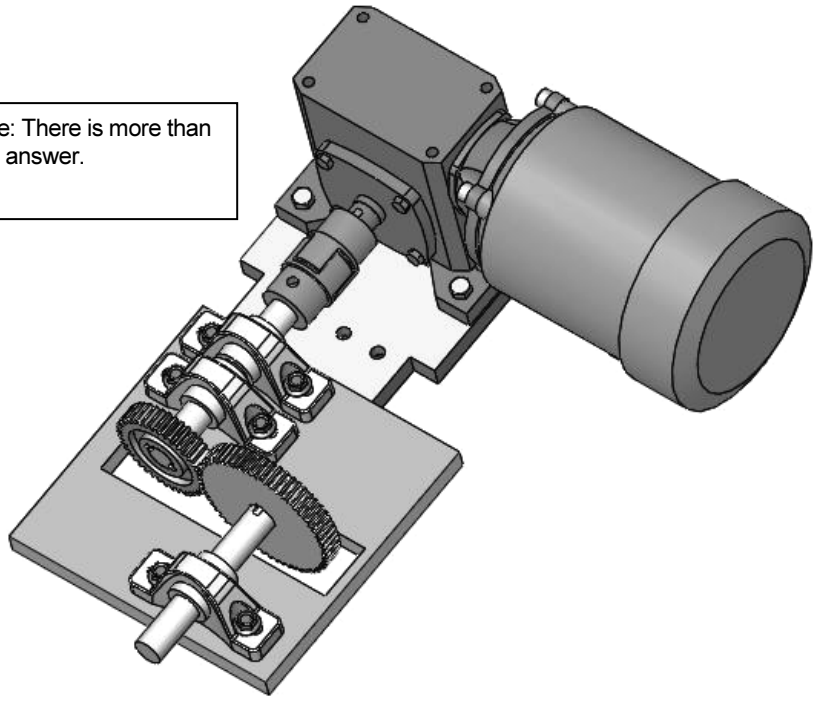
The CHANGE GEAR Tooth profile has been simplified to save file size and rebuild time. The actual tooth profile consists of a series of curves and fillets.



Return to the Boston Gear web site www.bostongear.com. See Exercise 2.6. Utilize the Boston Gear Part No. from the table in Exercise 2.6. Determine the material, pressure angle and maximum Torque Rating for each CHANGE GEAR.

Determine the inside Bore Diameter for the COUPLING. Determine the dimensions of the output key on the SPEED-REDUCER from the F72B1B-B5 Outline drawing.

Note: There is more than one answer.



MOTOR-GEAR-BOX Assembly
Models and Images Courtesy of Boston Gear
www.bostongear.com