

iMates

iMates provide a method of assigning constraints before assembling components. Consider an iMate to be half of a constraint added to one component. You link two iMates to form an assembly constraint. For example, you can assemble a bolt and a part with a threaded hole using predefined insert iMates. Using iMates involves planning to identify correct iMate placement and parameters. Incorrect constraints form if you do not use iMates that correspond to other iMates or do not properly place iMates in reference to other components.

Create iMate Tool

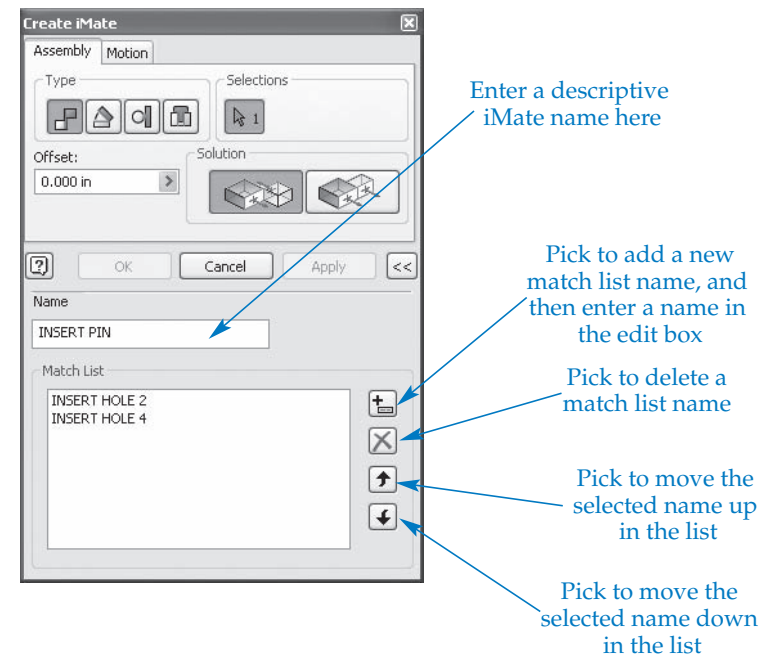


To create iMates, open a part or subassembly file or edit a component in place by right-clicking on the component in the browser or graphics window and selecting **Edit**. Access the **Create iMate** tool to add iMates using the **Create iMate** dialog box. See [Figure 17B-1](#). Select the **Assembly** or **Motion** tab to access options for creating assembly or motion iMates. The process is similar to using the **Place Constraint** dialog box, except that you only specify one selection of the constraint.

When you use iMates, Inventor searches for iMate matches. By default, Inventor searches each possible match based on iMate order in the browser. [Figure 17B-2](#) shows an example of adding a pin to an assembly of two plates, each plate with four insert iMate holes. The pin initially inserts in hole 1 of PLATE:1 because the INSERT HOLE 1 iMate appears first in the browser. If you place additional pins, or search for an alternative location for the pin, hole 2 of PLATE:1 matches next, followed by hole 3 of PLATE:1, and so on. An alternative or addition to the default search pattern is to add a match list when you create an iMate.

Figure 17B-1.

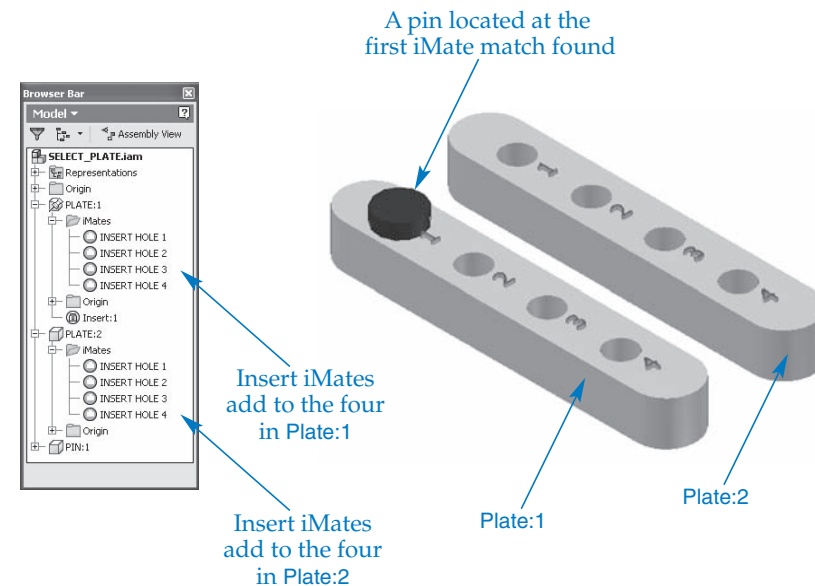
The **Assembly** tab of the **Create iMate** dialog box with the **Mate** constraint button selected.



The match list names you create must correspond to the names of the matching iMates. For example, the match list names for the pin in **Figure 17B-2** correspond to two of the plate iMates shown in **Figure 17B-2**. When you use the match list, the pin initially inserts in hole 2 of PLATE:1. If you place additional pins, or search for an alternative location for the pin, hole 4 of PLATE:1 matches next, followed by hole 2 of PLATE:2, then hole 4 of PLATE:2. Inventor then continues to search other possible iMate matches.

Figure 17B-2.

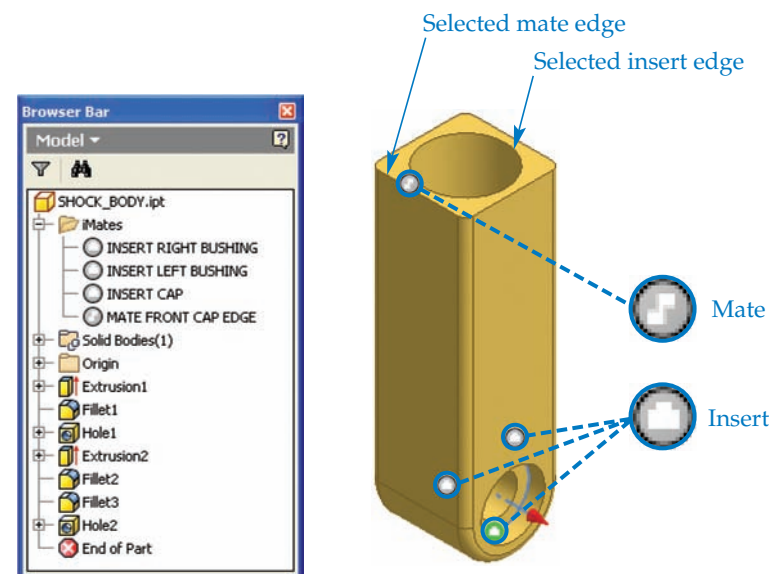
By default, Inventor searches for iMate matches based on the position of assembly iMates in the browser.



Example iMate Creation

The following example identifies a typical approach to creating iMates for three separate parts. The first part, SHOCK_BODY.ipt, contains four iMates, as shown in [Figure 17B-3](#). The iMate symbols, or glyphs, specify the type of iMate and the iMate status. When Inventor identifies a constraint between two iMates, the symbol no longer appears. Name the iMates using the **Name** text box in the **Create iMate** dialog box. Descriptive iMate names are helpful when you are inserting components and referencing iMates.

Figure 17B-3.
Adding multiple iMates to a
single part.

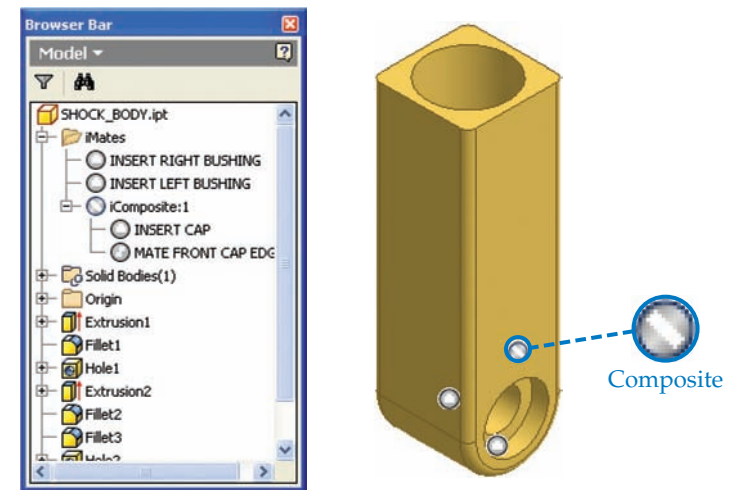


Composite iMates combine two or more iMates so that when you place a component, you do not have to select multiple iMates. You can conduct several constraint operations using a single composite iMate. To create a composite iMate, expand the iMate folder in the browser for the selected component. Pick each iMate to link together in the iMate folder, using [Ctrl] or [Shift] to make multiple selections, and then right-click and select **Create Composite**. See [Figure 17B-4](#).

composite iMates: Two or more iMates linked together and added to a single component and used for the same assembly operation.

Figure 17B-4.

Creating a composite iMate that, in this example, groups the insert and mate iMates needed to position a cap.



Next, close SHOCK_BODY.ipt and open SHOCK_BUSHING.ipt. This model contains a single insert iMate, as shown in [Figure 17B-5](#). Then close SHOCK_BUSHING.ipt and open SHOCK_CAP.ipt, shown in [Figure 17B-6](#). SHOCK_CAP.ipt requires a composite iMate that contains an insert and mate iMate.



NOTE

Notice that only iMates that control constraints between two components are composite. All other iMates remain individual.

Figure 17B-5.
Creating one insert iMate in
a single part.

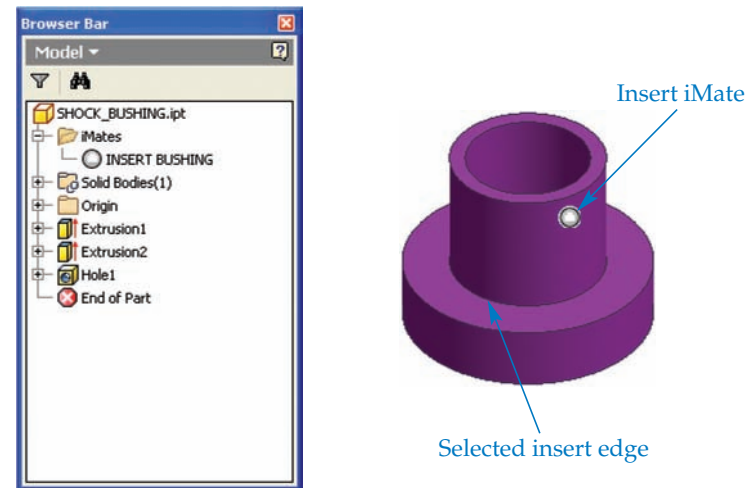


Figure 17B-6.
Creating a composite iMate
that groups the insert and
mate iMates needed to
position the cap.

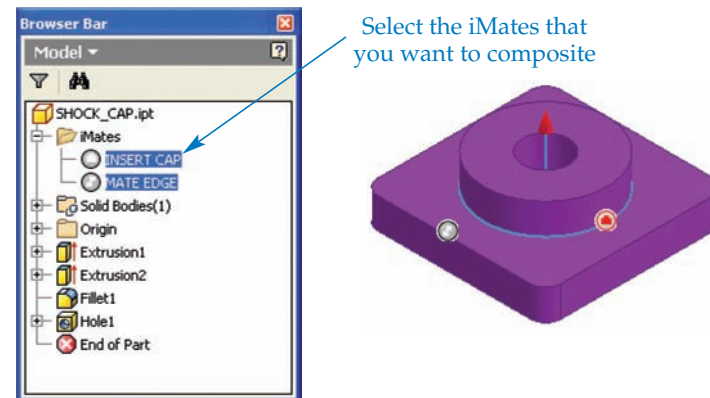
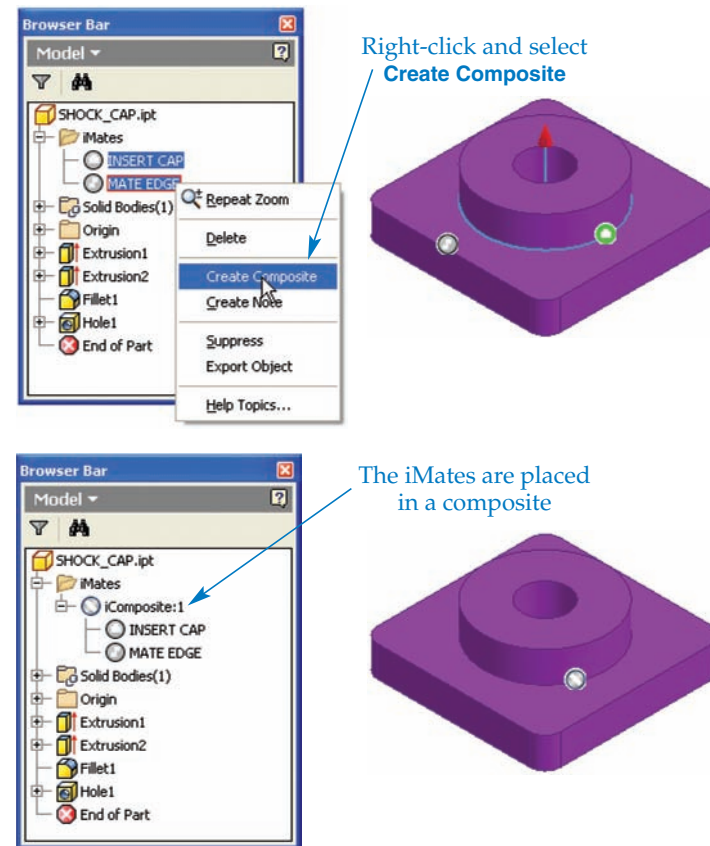


Figure 17B-6. (continued)



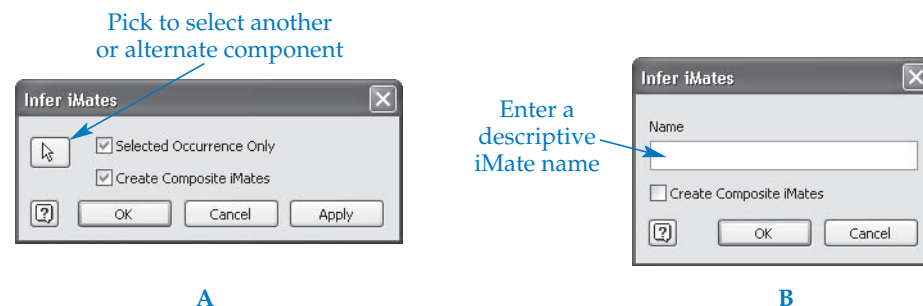
Inferring iMates

You can also infer iMates based on feature geometry or existing constraints placed using conventional techniques. When you infer iMates, existing constraints remain in the assembly file, while iMates are extracted to separate component files. Open an assembly file from which to infer iMates. You can then infer iMates from components or from constraints in the browser.

To infer iMates from components, right-click on the component in the browser or graphics window, and select **Infer iMates...** from the **Component** cascading submenu to display the **Infer iMates** dialog box. See [Figure 17B-7A](#). You can extract iMates from a different component by picking the **Select Component** button and then choosing a different component from the browser or graphics window. If the assembly includes multiple copies of a component, pick the **Select Occurrence Only** check box to extract iMates to the selected component. Uncheck **Select Occurrence Only** to add iMates to all component occurrences. If the selected component contains two or more iMates required to build the same assembly, select the **Create Composite iMates** check box to link the iMates together and form composite iMates. Pick the **Apply** button to add the iMates, or pick the **OK** button to add the iMates and exit the tool.

Figure 17B-7.

A—The **Infer iMates** dialog box that appears when you infer iMates from a selected component.
B—The **Infer iMates** dialog box that appears when you infer iMates from a selected constraint.



To infer iMates from a constraint, right-click on a constraint in the browser, or use [Ctrl] or [Shift] to select multiple constraints and right-click. Select **Infer iMates...** to display a different **Infer iMates** dialog box. See [Figure 17B-7B](#). Enter a descriptive name for the iMate in the **Name** text box to help you recognize the iMate when placing a component. If you selected two or more constraints, and it is appropriate to form a composite iMate from the constraints, pick the **Create Composite iMate** check box. Pick the **OK** button to add the iMates and exit the tool.



NOTE

You can infer iMates automatically by selecting the **Infer iMates** check box in the dialog box of certain part features, including extrusions, revolutions, and holes. Inventor attempts to infer iMates based on circular feature edges, such as the edge of an extruded circle. The result is typically an insert iMate placed on all possible circular edges, which may or may not be relevant to the assembly.

Using iMates

Often the most effective way of using iMates is with the **Place Component** tool. When you are adding components to an assembly, the **Interactively place with iMates** button in the **iMates** area is active by default. This function allows you to view how the component will be inserted and adjust placement options if necessary. This is an excellent choice when the assembly includes several of the same components, if iMates do not fully control placement, or if multiple solutions are possible.

Figure 17B-8 shows placing a component using the **Interactively place with iMates** option. A preview of the iMate constraint appears. If the preview looks acceptable, pick the location or press [Enter]. You can place additional copies of the component by picking a location in space or pressing [Enter]. If another iMate match is possible, a preview of the next placement appears. Press [Esc] or right-click and select **Done** to exit. Right-click and select an option or press a shortcut key as listed in **Figure 17B-9** to apply another option when placing iMate components, depending on the number of iMates matches.

Figure 17B-8.

A— Using the **Interactively place with iMates** option to add bushings to the body.
B—The assembly with iMate-constrained bushings.

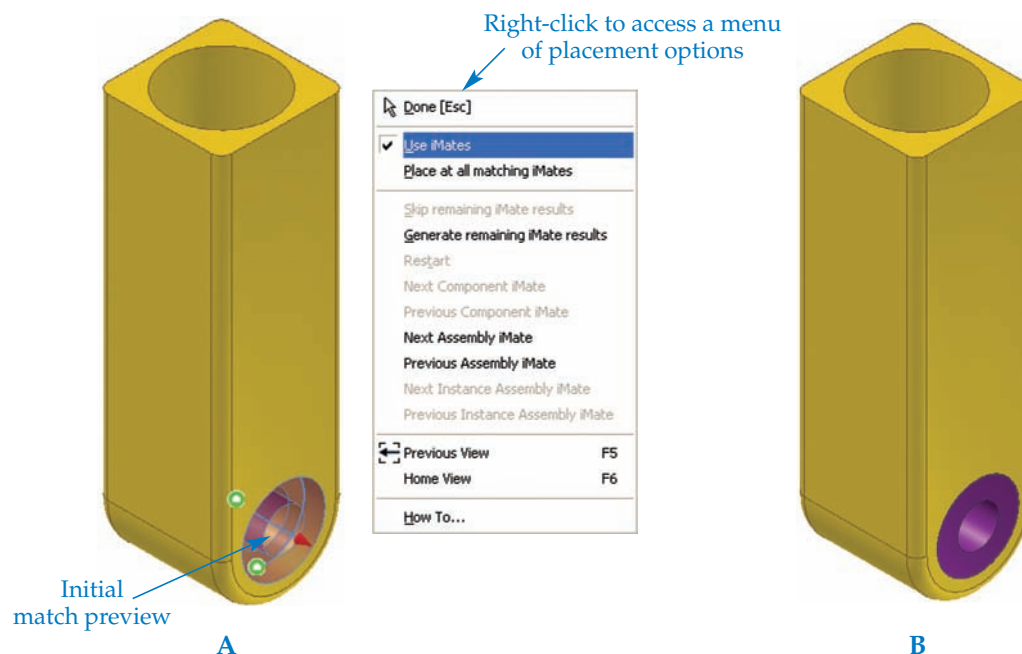


Figure 17B-9.

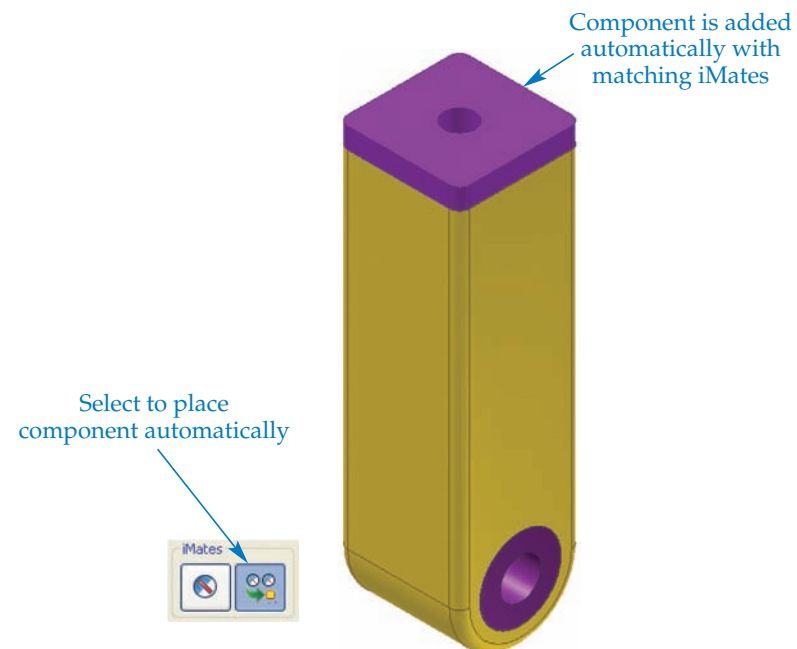
Options available when you right-click while placing components interactively.

Menu Option	Shortcut	Function
Use iMates	[Ctrl]+[I]	Select to constrain the component with iMates, or deselect to place the component without constraining with iMates.
Place at all matching iMates		Pick to place and constrain the component at all possible matching assembly iMate locations; effective when the same component must be inserted and constrained multiple times.
Skip remaining iMate results	Space bar	Select if you do not want to apply additional iMate constraints, usually when more iMates are available than are needed.
Generate remaining iMate results	[Ctrl]+[Enter]	Choose to apply all additional iMate constraints without individually selecting each iMate; saves time when it is apparent that all other iMates can be solved automatically.
Restart		Pick to undo an iMate selection.
Next Component iMate	[→]	Choose to cycle the selection to the next iMate located on the component you are inserting.
Previous Component iMate	[←]	Pick to cycle the selection to the previous iMate located on the component you are inserting.
Next Assembly iMate	[]	Select to cycle the selection to the next iMate found on the assembly.
Previous Assembly iMate	[↓]	Choose to cycle the selection to the previous iMate found on the assembly.
Next Instance Assembly iMate	[Ctrl]+[→]	Available if the assembly contains two or more of the same components, and can be used to select the same iMate, but on the next component.
Previous Instance Assembly iMate	[Ctrl]+[←]	Available if the assembly contains two or more of the same components, and can be used to select the same iMate, but on the previous component.

Select the **Automatically generate iMates on place** button in the **iMates** area when it is not necessary to place components with iMates interactively. For example, you can place the cap shown in **Figure 17B-10** using the **Automatically generate iMates on place** function because the iMates fully describe the constraint, and there are no other copies of the component in the assembly.

Figure 17B-10.

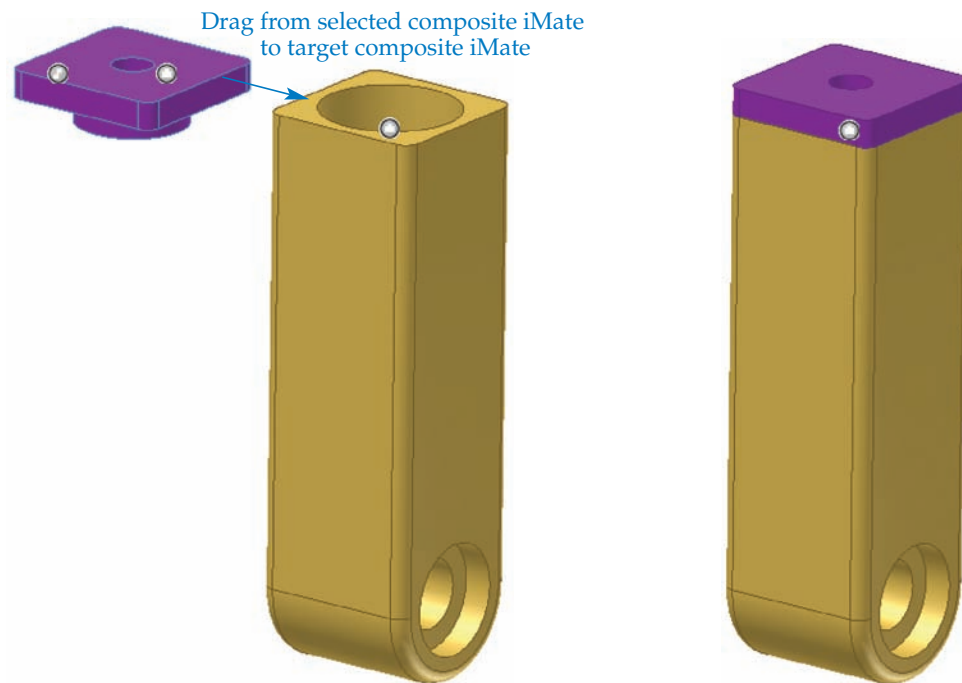
Using the **Automatically generate iMates on place** option to place a component with iMates. No options are available; the component inserts and constrains automatically.



The **Place Component** tool does not allow you to constrain components that are already in the assembly using iMates. Alt-drag is one option for using iMates in this situation. Hold down [Alt] and hold down the left mouse button on the iMate symbol on the component to constrain, and drag the component to the corresponding iMate symbol on the other component. You can only select iMates appropriate for the selected constraint. When you are satisfied with the intended constraint, release the mouse button to apply the constraint. See [Figure 17B-11](#).

Figure 17B-11.

An example of a drag-mate iMate constraint.



The **Place Constraint** tool provides another option for constraining components that are already in the assembly using iMates. The process is similar to using the **Place Constraint** tool to constrain assembly components without iMates, except that instead of selecting faces, edges, axes, or points, you select iMates. You must select the constraint type that corresponds to the specified iMate.



NOTE

You cannot select composite iMate symbols when using the **Place Constraint** tool. However, you can expand a composite iMate in the browser and select individual iMates in the browser.

Activity

1. Launch Inventor, if it is not already open.
2. Begin a new part file using the Part-IN.ipt template from the **New File** dialog box. Do not open the actual template file.
3. Sketch a 1" × 4" rectangle on the XY plane, using the projected center point to fix the sketch in space. Extrude the sketched rectangle .25" in the positive direction.
4. Open a sketch on the extruded face and sketch the .25" × .5" rectangle shown in **Figure 17B-12A**. Extrude the sketch to the opposite face.
5. Pattern the second extrusion as shown in **Figure 17B-12B**. Use a count of 4 and a spacing of 1".
6. Establish the iMates shown using the selections shown in **Figure 17B-12C** and **Figure 17B-12D** and the following specifications.
 - A. iMate: Assembly
Type: Mate
Offset: 0
Solution: Mate
 - B. iMate: Assembly
Type: Mate
Offset: 0
Solution: Flush

Figure 17B-12.
Construction of the
ACT17B-1a.ipt file.

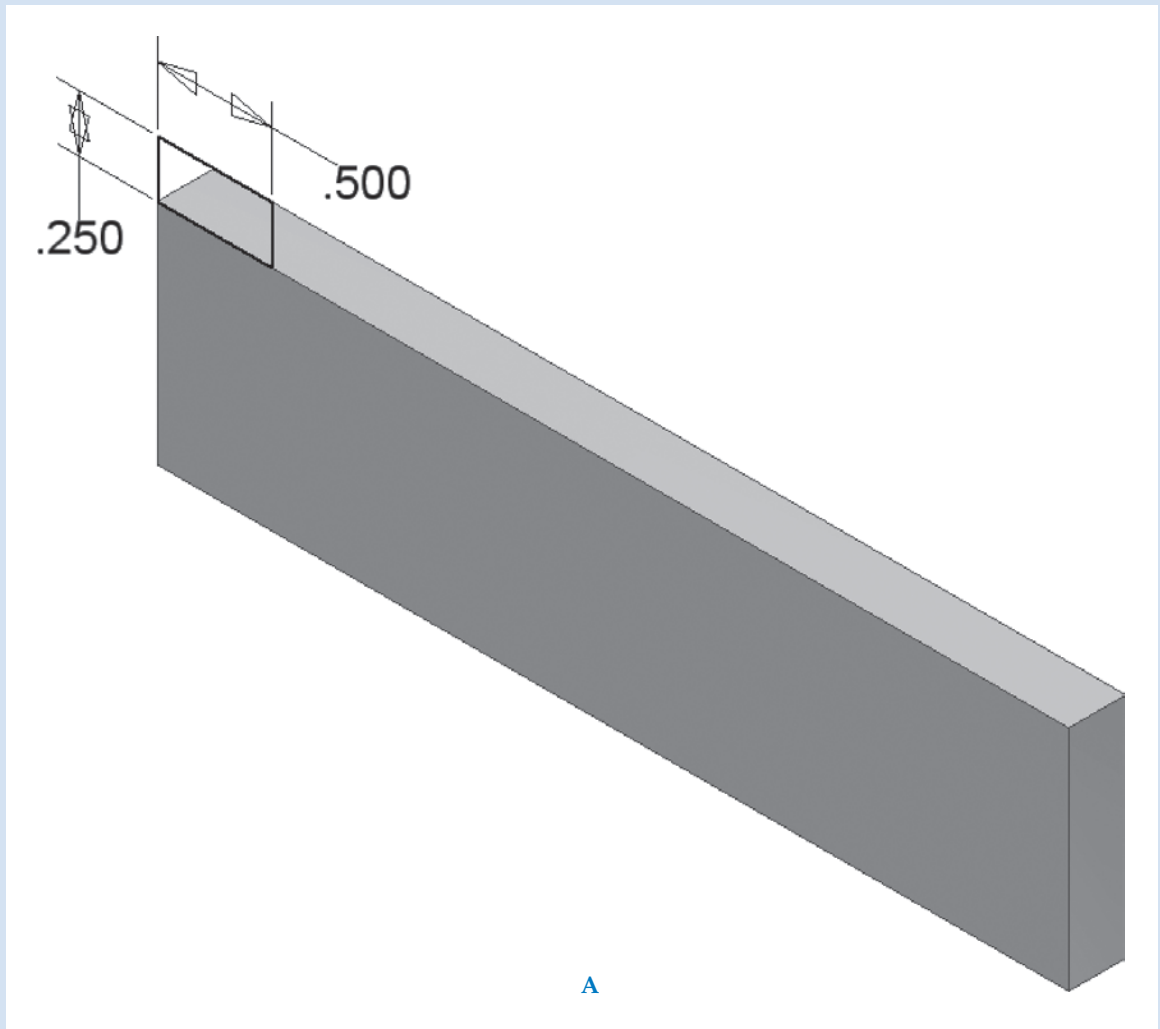
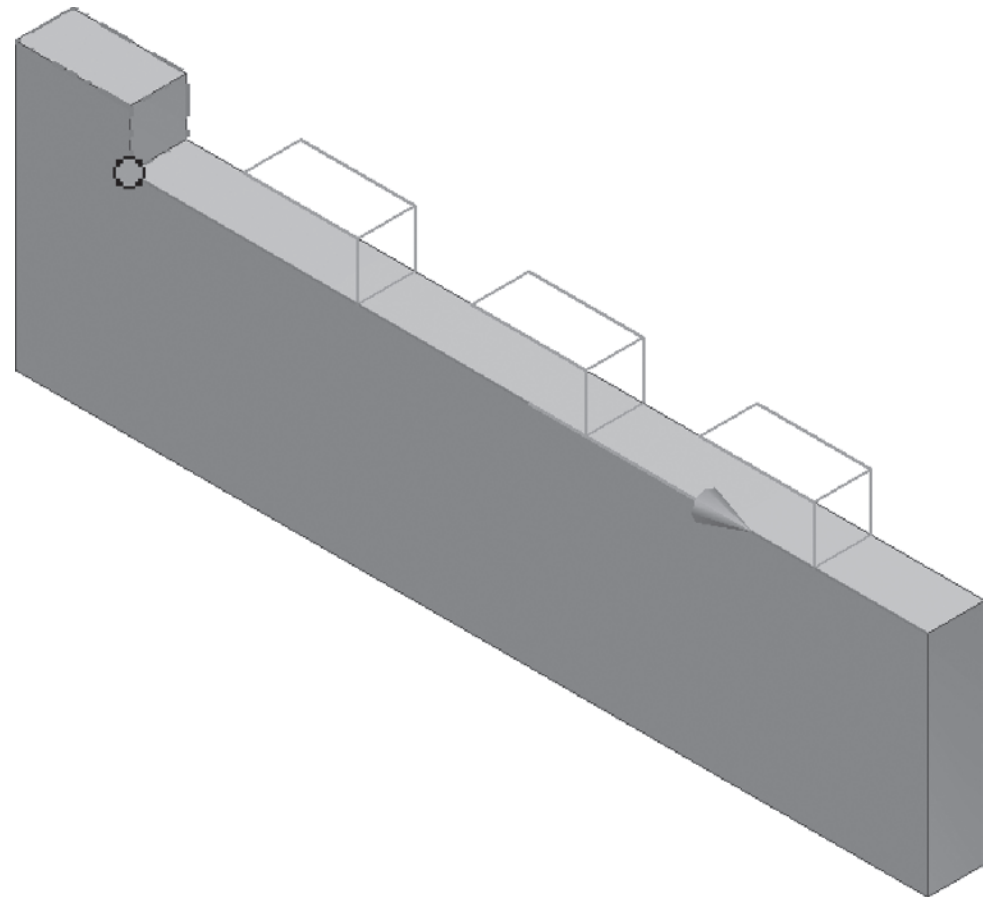


Figure 17B-12. (continued)



B

Figure 17B-12. (continued)

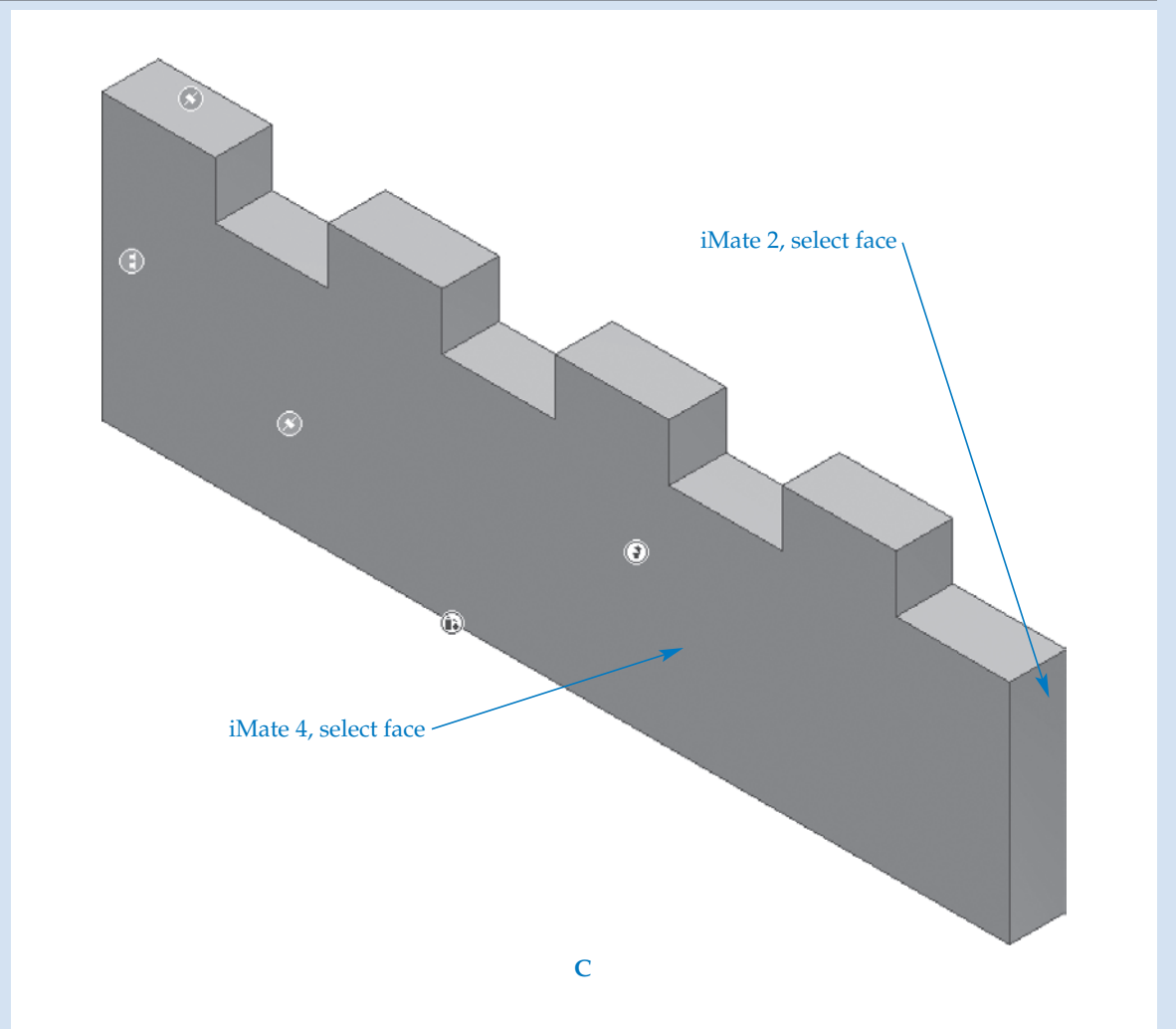
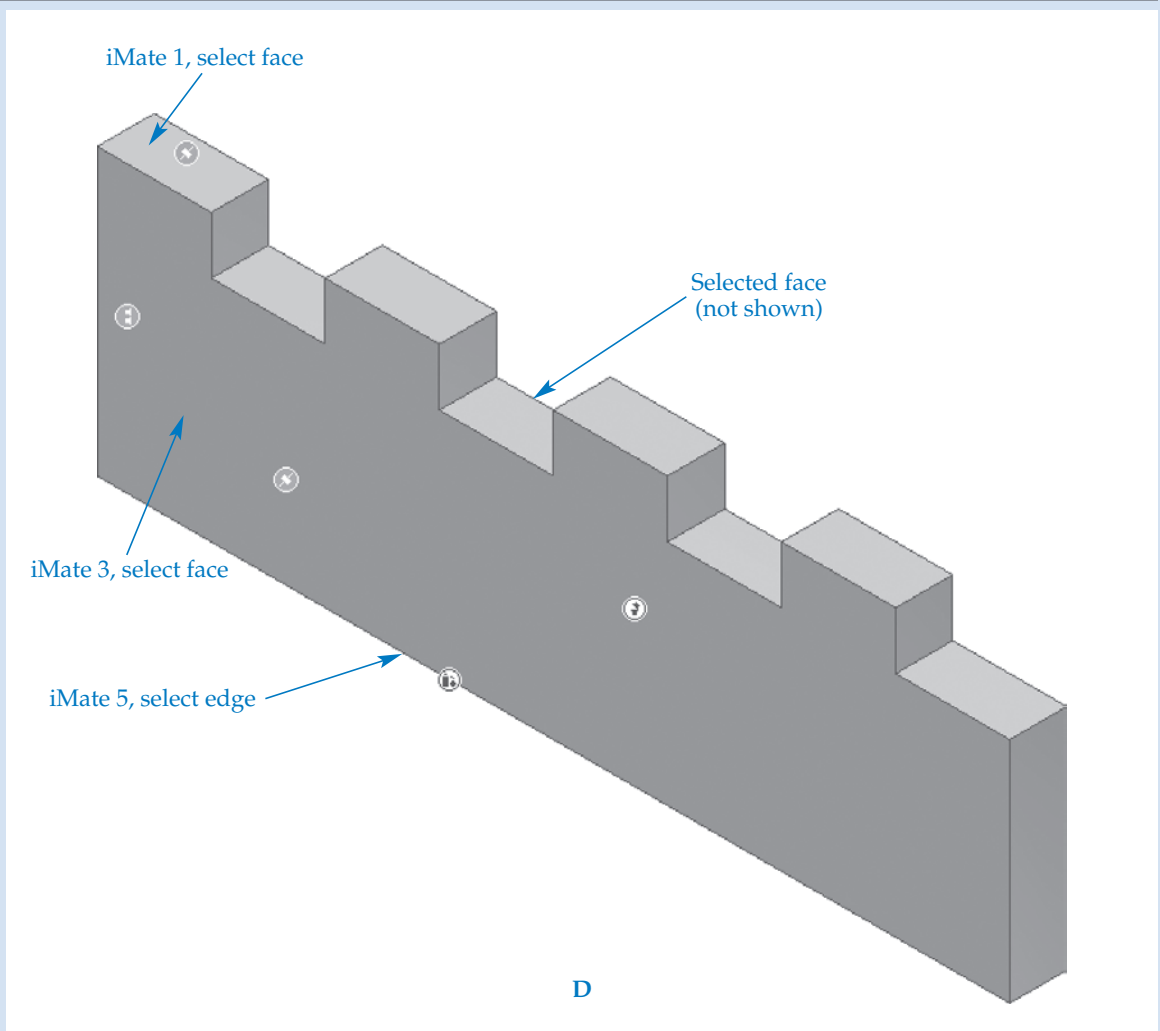
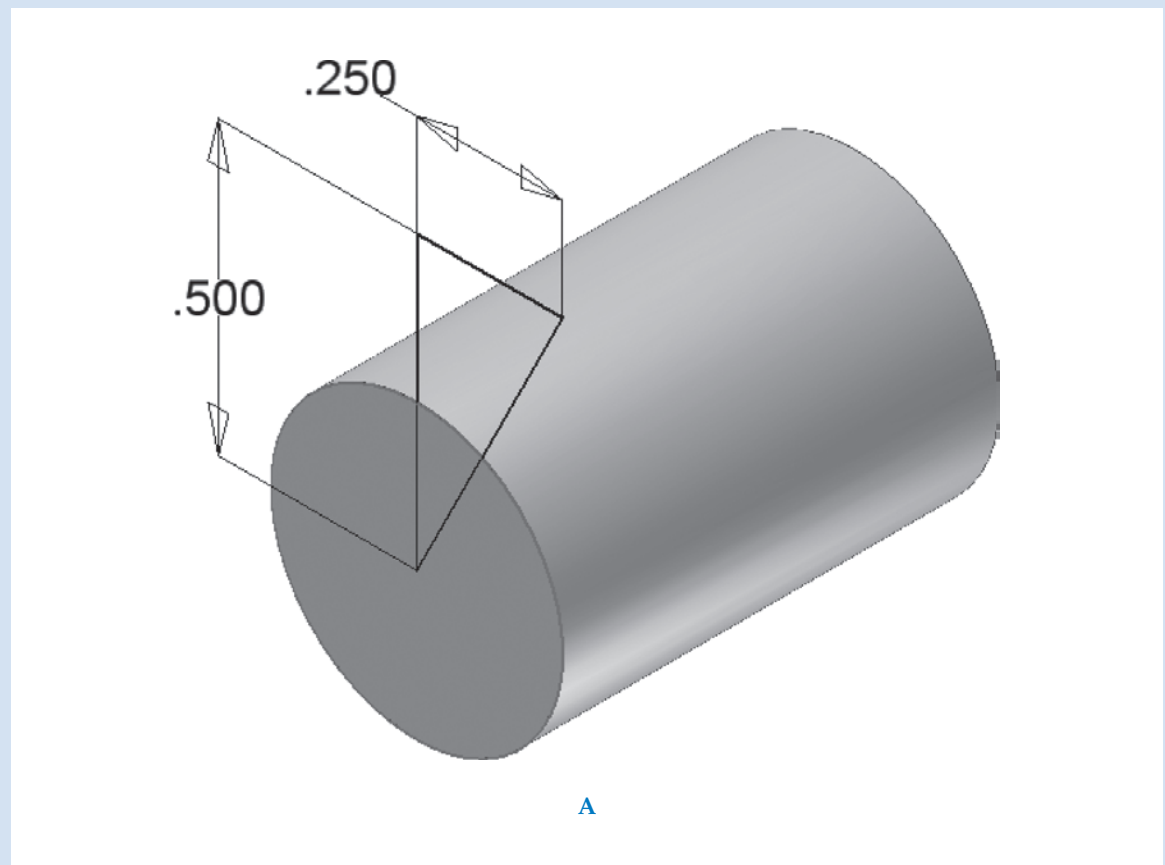


Figure 17B-12. (continued)



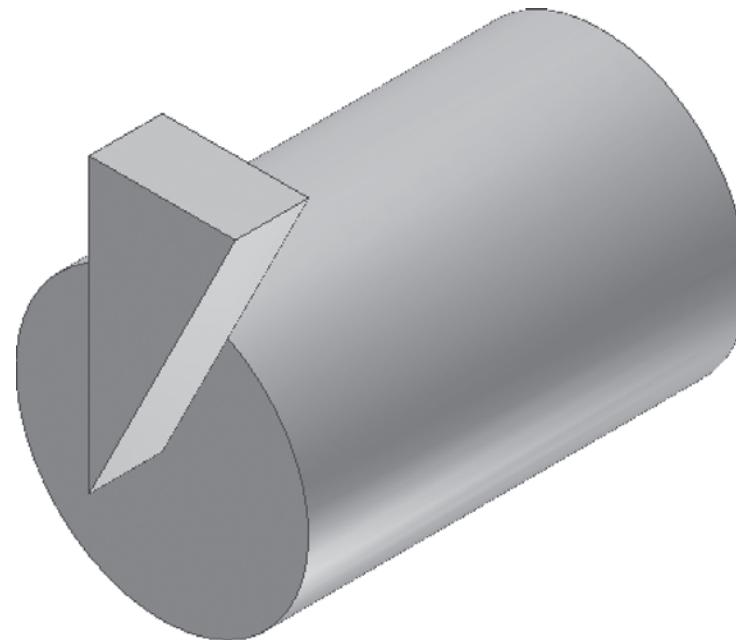
- C. iMate: Assembly
 - Type: Tangent
 - Offset: 0
 - Solution: Outside
 - D. iMate: Assembly
 - Type: Angle
 - Offset: 0
 - Solution: Undirected Angle
 - E. iMate: Motion
 - Type: Rotation-Translation
 - Ratio: 1
 - Solution: Forward
7. Create a composite iMate of iTangent:1 and iRotateTranslate:1.
 8. Create a composite iMate of iMate:1 and iAngle:2.
 9. Save the part as ACT17B-1a.ipt.
 10. Begin a new part file using the Part-IN.ipt template from the **New File** dialog box. Do not open the actual template file.
 11. Sketch a .5" circle on the XY plane, using the projected center point to fix the sketch in space, as shown in **Figure 17B-13A**. Extrude the sketched circle .75" in the negative direction.

Figure 17B-13.
Construction of the
ACT17B-1b.ipt file.



12. Open a sketch on the extruded face and sketch the $.25'' \times .5''$ triangle shown in **Figure 17B-13B**, fully constraining the sketch at the cylinder center. Extrude the sketch $.125''$ in the positive direction.

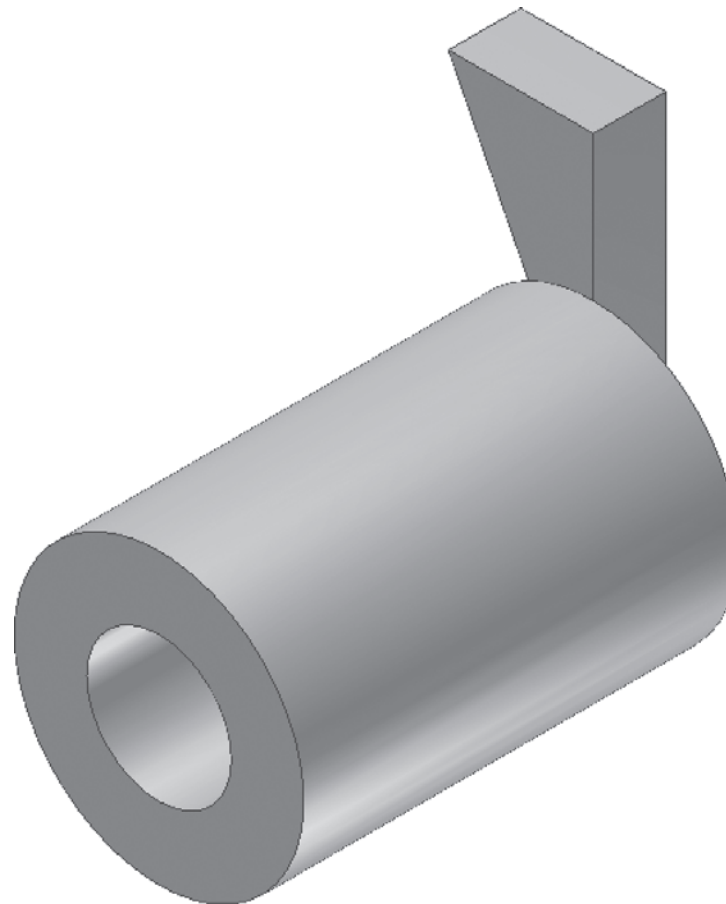
Figure 17B-13. (continued)



B

13. Open a sketch on the opposite cylinder face and place a hole. Then place a $\varnothing.25''$ hole with a depth of $.5''$ and a flat drill point, as shown in **Figure 17B-13C**.

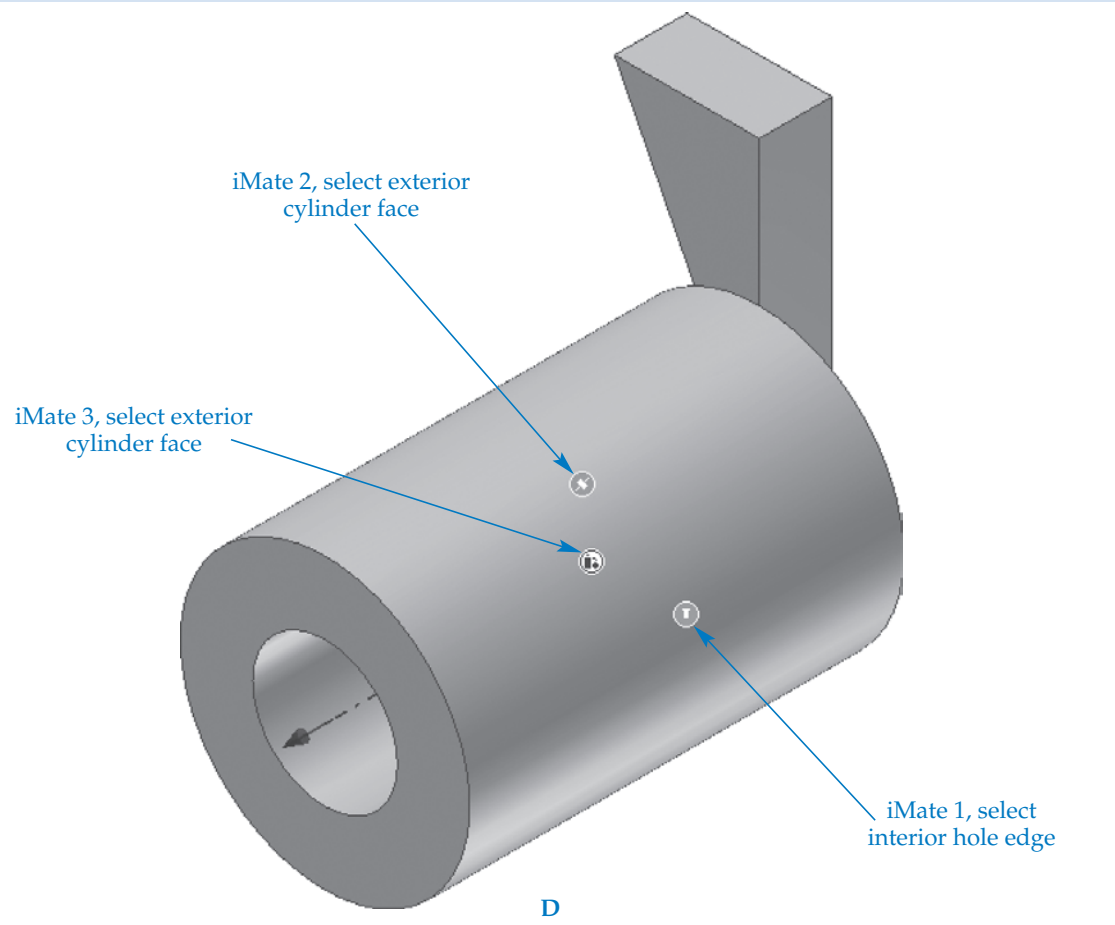
Figure 17B-13. (continued)



C

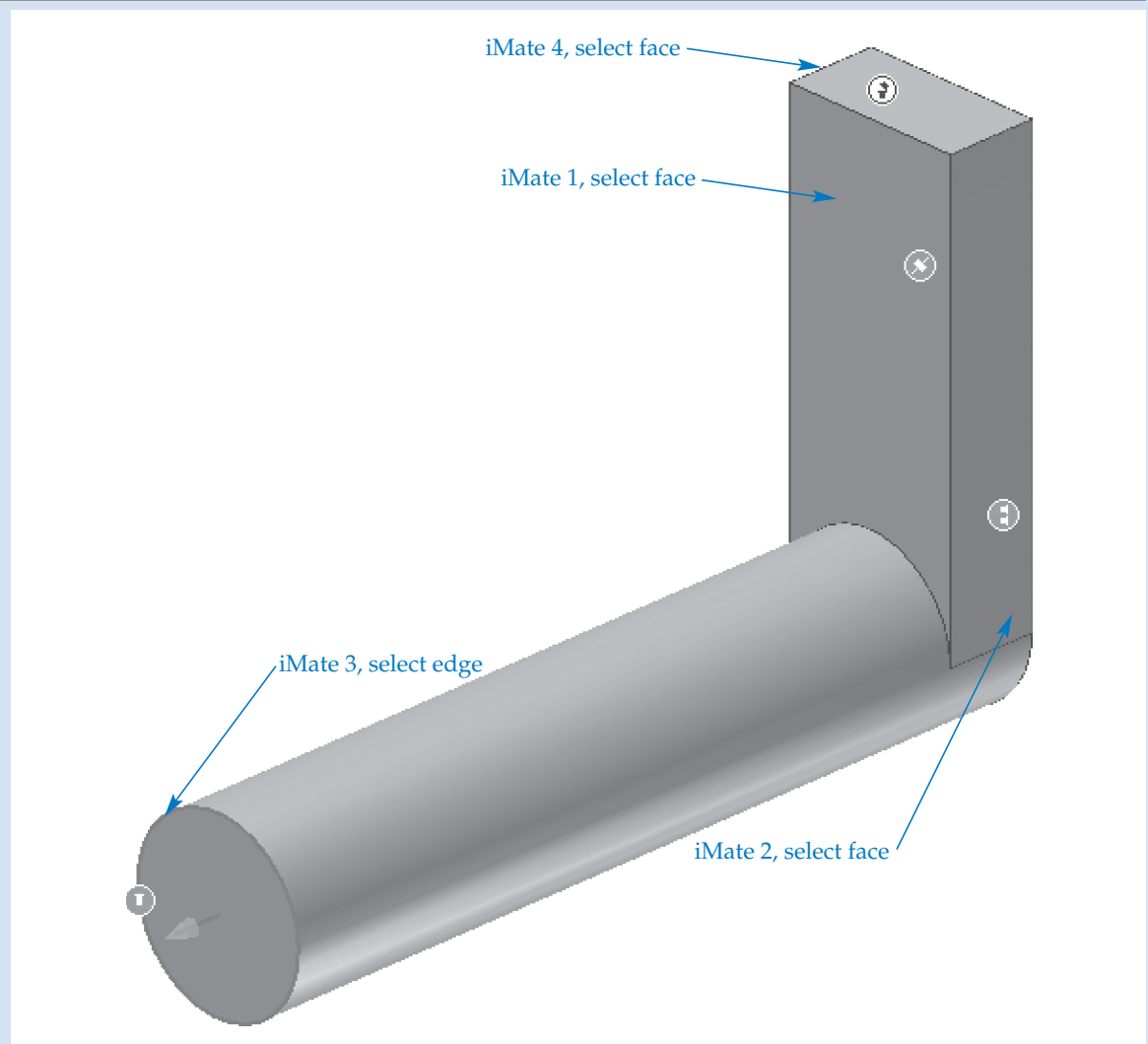
14. Establish the iMates using the selections shown in **Figure 17B-13D** using the following specifications.

Figure 17B-13. (continued)



- A. iMate: Assembly
Type: Insert
Offset: 0
Solution: Opposed
 - B. iMate: Assembly
Type: Tangent
Offset: 0
Solution: Outside
 - C. iMate: Motion
Type: Rotation-Translation
Ratio: 1
Solution: Forward
15. Create a composite iMate of iTangent:1 and iRotateTranslate:1.
 16. Save the part as ACT17B-1b.ipt.
 17. Begin a new part file using the Part-IN.ipt template in the **New File** dialog box. Do not open the actual template file.
 18. Sketch a .25" circle on the XY plane, using the projected center point to fix the sketch in space. Extrude the sketched circle 1" in the positive direction.
 19. Open a sketch on the extruded face and sketch the geometry shown in **Figure 17B-14**. Extrude the sketch (two profiles) .125" in the positive direction.

Figure 17B-14.
Construction of the
ACT17B-1c.ipt file.



20. Establish the iMates using the selections shown and the following specifications.
 - A. iMate: Assembly
Type: Mate
Offset: 0
Solution: Mate
 - B. iMate: Assembly
Type: Mate
Offset: 0
Solution: Flush
 - C. iMate: Assembly
Type: Insert
Offset: 0
Solution: Opposed
 - D. iMate: Assembly
Type: Angle
Offset: 0
Solution: Unselected
21. Create a composite iMate of iMate:1 and iAngle:1.
22. Save the part as ACT17B-1c.ipt.
23. Begin a new assembly file using the Assembly-IN.iam template from the **New File** dialog box. Do not open the actual template file.