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## Go Dynamic: How to Create Dynamic Blocks in AutoCAD® 2006

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**GD12-3** Dynamic Blocks is one of the most exciting new features in AutoCAD 2006, but while using them is easy, creating them means that you'll have to master some new skills. This class covers everything you need to know to use the new Block Definition Editor and Block Authoring palette to create dynamic blocks whose size and appearance can vary when used in your drawings.

### **About the Speaker:**

David has more than 20 years of hands-on experience with AutoCAD as a user, developer, author, and consultant. He is the publisher and editor-in-chief of CAD/CAMNet and Engineering Automation Report, the former senior editor of CADalyst magazine, a contributing editor to Desktop Engineering magazine, and the author of more than a dozen books about AutoCAD. A licensed architect, David was also one of the earliest AutoCAD third-party software developers, creating numerous AutoCAD add-on programs. As an industry consultant, David has worked with many companies including Autodesk. He teaches college-level AutoCAD courses and is always a popular presenter at Autodesk University.

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## Introduction

In the past, if you needed several variations of an object—for example, both plan and elevation views of a plumbing fixture or a door with different widths—you would have had to create multiple blocks. *Dynamic blocks* change all that. A dynamic block is an intelligent block. A dynamic block reference can easily be modified in a drawing while you work. When you add a dynamic block to your drawing, you can subsequently manipulate its geometry using custom grips or custom properties. This allows you to adjust the block in-place as needed rather than searching for another block to insert or redefining the existing one.

For example, if you insert a door reference in a drawing, you might need to change the size of the door while you're editing the drawing. If the block is dynamic and defined to have an adjustable size, you can change the size of the door by dragging the custom grip or specifying a different size in the Properties palette. Depending on how the dynamic door block was defined, you might also be able to change the open angle of the door. The door block could also contain custom grips that let you change the hinge point. Or you could create a dynamic conference table and chairs. When you change the length of the table, additional chairs get added automatically.

Dynamic blocks:

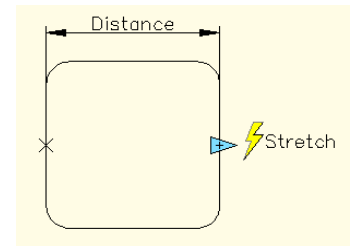
- Can help you streamline block libraries by combining similar blocks into a single dynamic block capable of representing several designs
- Can be edited without having to be exploded
- Can have multiple insertion points that can be cycled through when inserting the block (by pressing the CTRL key)

## Creating Dynamic Blocks

You create dynamic blocks using a new environment in AutoCAD called the *Block Editor*. The Block Editor is a special authoring environment for creating block definitions and adding dynamic behavior. You can use the Block Editor to create a block from scratch, or you can add dynamic behavior to an existing block definition. You can also create geometry, just as you would in AutoCAD's normal drawing area. Most AutoCAD commands can be used in the Block Editor.

To make a block a dynamic block, you add *parameters* and *actions*. For a block to be dynamic, it must have at least one parameter. You then add an action and associate the action with the parameter. Parameters define custom properties for the dynamic block by specifying positions, distances, and angles for the geometry in the block. Actions define how the geometry of a dynamic block will move or change when the block reference is manipulated in the drawing. When you add actions to the block, you must associate them with parameters and usually with geometry.

When you add a parameter to a block definition, custom grips and properties are automatically added to the block. You use these custom grips and properties to manipulate the block reference in the drawing.



### Steps for Creating Dynamic Blocks

To create quality dynamic blocks so that you get the results you expect, you should do the following:

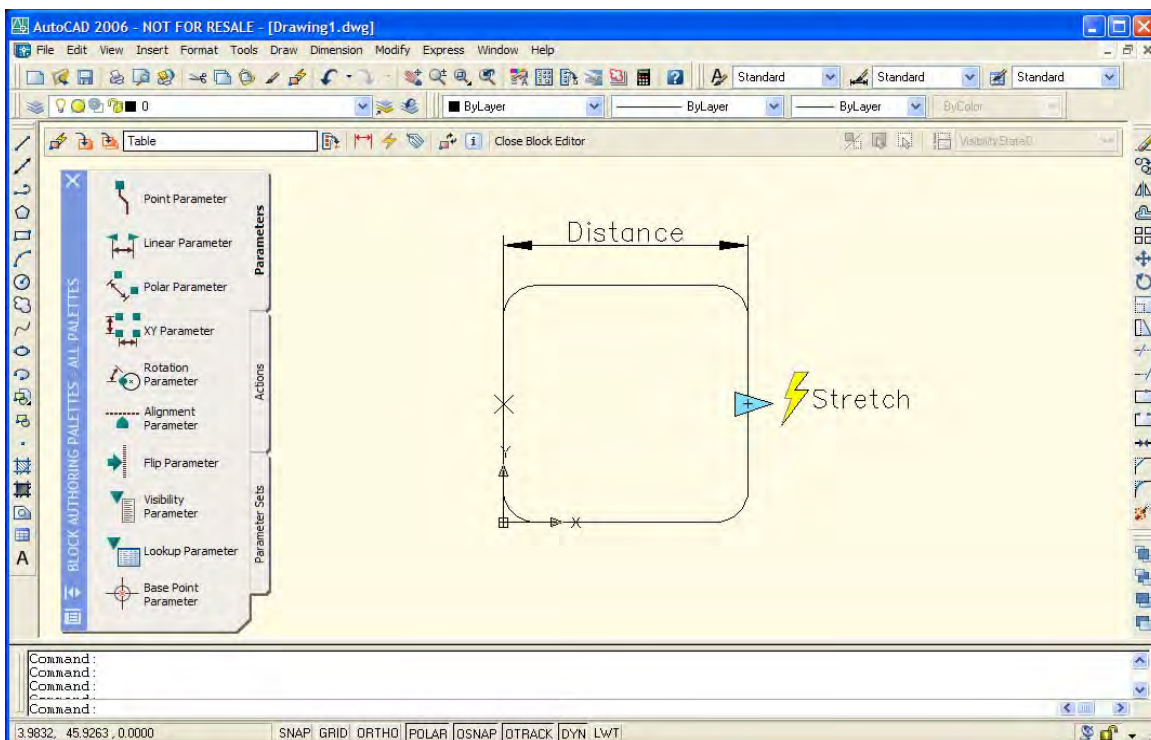
1. **Plan the contents of the block before you create it.** You should know what the block will look like and how it will be used in the drawing. Decide which objects within the block will change or move when the dynamic block is manipulated and how they will change. The order in which you create objects and add actions can make a difference.
2. **Draw the geometry.** You can draw new geometry in the drawing area or the Block Editor. You can also use geometry that already exists in a drawing, or an existing block definition.
3. **Understand how the block elements will work together.** When you add an action to the block definition, you need to associate the action with a parameter and a set of geometry. This creates a dependency. You need to understand how these dependencies affect the geometry within the block.
4. **Add parameters.** Use the tools in the Block Editor to add parameters to the dynamic block definition, following the prompts on the command line.
5. **Add actions.** Use the tools in the Block Editor to add the appropriate actions to the dynamic block definition, following the prompts on the command line.
6. **Define how the dynamic block reference will be manipulated.** You can manipulate a dynamic block reference through custom grips and custom properties. When you define a dynamic block definition, you define what grips are

displayed and how they edit the dynamic block reference. You also specify whether or not custom properties of the block will be displayed in the Properties palette and whether or not these properties can be changed through the palette or through custom grips.

7. **Save the block and then try it in the drawing.** After saving the block definition and exiting the Block Editor, insert the dynamic block reference in your drawing and test the block's functionality.

### The Block Editor

The Block Editor is a special authoring environment for creating block definitions and adding dynamic behavior. It provides special Authoring palettes for accessing block authoring tools, and a drawing area in which you can draw and edit geometry as you would in AutoCAD's main drawing area. To help you identify when you are working in the Block Editor, it displays with a different background color than AutoCAD's main drawing area, and you can specify this background color. The Block Editor also displays a special toolbar that shows the name of the block definition currently being edited as well as tools to save the block definition, add parameters and actions, define attributes, and manage the visibility states of objects in the block.

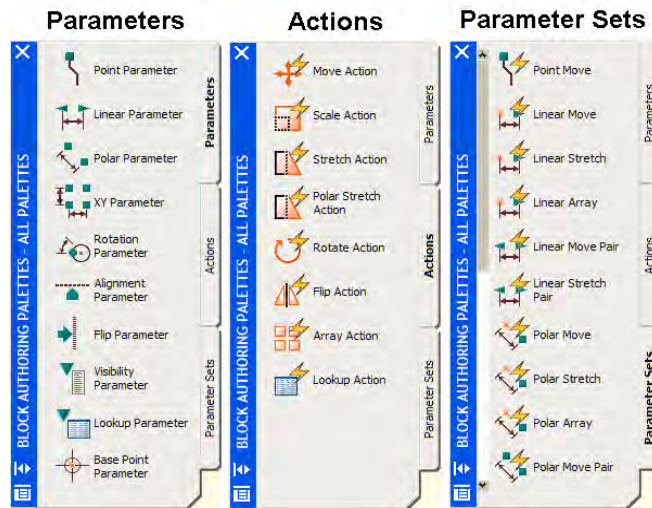


#### Things to remember when working in the Block Editor:

- You can select any parameter, grip, action, or geometric object in the Block Editor to view its properties in the Properties palette.
- When you select an object in the Block Editor, the coordinate values shown in the Properties palette reflect the block definition space.
- When you work in the Block Editor, the command line should be displayed, because it displays prompts for nearly all aspects of creating a block.
- The origin of the UCS icon displayed in the Block Editor defines the base point for the block. The UCS command is disabled in the Block Editor. You can change the base point for the block by moving the geometry relative to the origin of the UCS icon, or by adding a base point parameter.
- You can open an existing 3D block definition in the Block Editor and assign parameters to the block. However, the parameters will ignore any Z coordinate values in the block space. Block references cannot be edited along the Z-axis.
- Although you can create a dynamic block that contains solid objects and add actions to it, you can't perform solid editing commands (such as stretch a solid, move a hole within a solid, and so on) within a dynamic block reference.

## Block Authoring Palettes

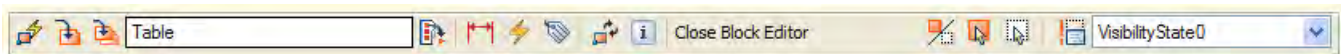
When you work in the Block Editor, AutoCAD displays three Block Authoring palettes. You can use the tools on these palettes to add parameters and actions to your dynamic block definition.



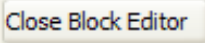




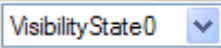
Note that you can also customize these palettes, adding your own custom block authoring tools. However, in order to preserve the default tools, you should create a new palette for your custom tools. You can change the tool description, parameter type, associated actions, key point on the parameter to which the action is tied, and the tool palette image. You cannot drag parameters and actions from the Block Editor onto any other tool palette.

## Block Editor Toolbar

The Block Editor displays a special toolbar that shows the name of the block definition currently being edited as well as tools for creating, modifying, and saving dynamic blocks.



|                                    |                                       |   |
|------------------------------------|---------------------------------------|---|
|                                    | Edit or Create Block Definition       | Opens the Edit Block Definition dialog box, allowing you to select a block definition to be modified.     |
|                                    | Save Block Definition                 | Saves changes made to the current block definition  |
|                                    | Save Block As                         | Saves the block with a new name   |
| <input type="text" value="Table"/> | Block Definition Name                 | Displays the name of the current block  |
|                                    | Authoring Palettes                    | Toggles the Block Authoring Palettes on and off   |
|                                    | Parameter                             | Provides another method for adding a parameter (instead of the Block Authoring palette)                   |
|                                    | Action                                | Provides another method for adding an action (instead of the Block Authoring palette)                     |
|                                    | Define Attribute                      | Opens the Attribute Definition dialog box, allowing you to add attributes to the block definition.        |
|                                    | Update Parameter and Action Text Size | Adjusts the display text size of parameters and actions within the Block Editor so that they are legible. |
|                                    | Learn About Dynamic Blocks            | Opens the New Features Workshop dialog box and displays the Dynamic Blocks topic.                         |

|   |                          |  |
|---|--------------------------|--|
|  | Close Block Editor       | Closes the Block Editor. You will be prompted to save changes if you haven't already done so.  |
|  | Visibility Mode          | Toggles the visibility of geometry (BVMODE).<br>0=only visible geometry in the current visibility state will be seen.<br>1=all geometry in the current visibility state will be seen, but invisible geometry will be gray. |
|  | Make Visible             | Makes selected geometry visible in the current visibility state.   |
|  | Make Invisible           | Makes selected geometry invisible in the current visibility state.   |
|  | Manage Visibility States | Opens the Visibility States dialog box so you can manage visibility states.  |
|  | Visibility States        | Lets you select the current visibility state from a drop-down list.  |

## How Objects are Displayed in the Block Editor

Parameters, actions, and their relationships (dependencies) are displayed in different ways in the Block Editor. You can specify settings for some of these elements.

### Parameters

In the Block Editor, most parameters look like dimensions. If you create a value set (a range of values) for a parameter, tick marks are shown at the locations of those values. You can also specify the parameter color, parameter text and arrow size, parameter font, grip color, and control the display of tick marks for parameters. When you use a visibility parameter in your block definition, you can specify which geometric objects are invisible for a given visibility state.

### Actions

An action displays its name and icon (a lightning bolt) in the Block Editor. You can specify the text size and color for actions in the Block Editor.

### Grips

You can specify the grip size and color for display in the Block Editor. This does not affect the size and color of grips in a block reference in a drawing.

### Dependencies





















When you select a parameter, grip, or action in the Block Editor, its associated objects, or dependencies, are highlighted. This is called *dependency highlighting*. You can turn dependency highlighting on or off.

| Selected object in the Block Editor | Objects that are dependency highlighted                    |
|-------------------------------------|--|
| Parameter                           | Associated grips and actions                               |
| Grip                                | Associated parameter and actions                           |
| Action                              | Associated parameters, grips, and selection set (geometry) |

## The Basics of Defining a Dynamic Block

You add dynamic elements to a block definition in the Block Editor. In addition to geometry, a dynamic block generally includes one or more parameters and one or more actions.

Parameters define custom properties for the dynamic block by specifying things like position, distances and angles for geometry in the block. They are identified on screen by a blue grip. When you add a parameter to a dynamic block definition, grips are added to key points of the parameter. Key points are the parts of a parameter that you use to manipulate the block reference. The shape of the grip varies based on the type of parameter, and each type of parameter supports only certain types of actions. Properties of parameters can be set to specify increments as well as minimum and maximum values. A lookup parameter is used to assign multiple sizes to a specific block. A visibility parameter is used to assign multiple appearances to a block, such as font, side, or plan views.









| Parameter Type   | Grip  | Supported Actions   | Description   |
|--|---|---|---|
|  Point        |    | Move, Stretch   | Defines an X and Y location in the drawing. In the Block Editor, looks like an ordinate dimension.  |
|  Linear       |    | Move, Scale, Stretch, Array                                     | Shows the distance between two anchor points. Constrains grip movement along a preset angle. In the Block Editor, looks like an aligned dimension.  |
|  Polar        |    | Move, Scale, Stretch, Polar Stretch, Array                      | Shows the distance between two anchor points and displays an angle value. In the Block Editor, looks like an aligned dimension.   |
|  XY           |    | Move, Scale, Stretch, Array                                     | Shows the X and Y distances from the base point of the parameter. In the Block Editor, displays as a pair of dimensions.  |
|  Rotation     |    | Rotate  | Defines an angle. In the Block Editor, displays as a circle.  |
|  Alignment    |    | None (the action is implied and contained within the parameter) | Defines an X and Y location and an angle. An alignment parameter always applies to the entire block and needs no action associated with it. An alignment parameter allows the block reference to automatically rotate around a point to align with another object in the drawing. An alignment parameter affects the rotation property of the block reference. In the Block Editor, looks like an alignment line. |
|  Flip       |  | Flip  | Flips objects. In the Block Editor, displays as a reflection line. Objects can be flipped about this reflection line. Displays a value that shows if the block reference has been flipped or not.   |
|  Visibility |  | None (the action is implied and contained within the parameter) | Controls the visibility of objects in the block. A visibility parameter always applies to the entire block and needs no action associated with it. In a drawing, you click the grip to display a list of visibility states available for the block reference. In the Block Editor, displays as text with an associated grip.  |
|  Lookup     |  | Lookup  | Defines a custom property that you can specify or set to evaluate a value from a list or table you define. It can be associated with a single lookup grip. In the block reference, you click the grip to display a list of available values. In the Block Editor, displays as text with an associated grip.   |
|  Base Point |  | None  | Defines a base point for the dynamic block reference relative to geometry in the block. Cannot be associated with any actions, but can belong to an action's selection set. In the Block Editor, displays as a circle with crosshairs.  |

Actions define how the geometry of a dynamic block reference will move or change when the custom properties of a block reference are manipulated in a drawing. They are identified on screen by a lightning bolt. A dynamic block usually contains at least one action.

In general, when you add an action to a dynamic block definition, you must associate the action with a parameter, a key point on the parameter, and geometry. A key point is the point on a parameter that drives its associated action when edited. The geometry associated with an action is called the selection set.

You can assign more than one action to the same parameter and geometry, but you should not assign two or more of the same type of actions to the same key point on a parameter if both actions affect the same geometry.

Each type of action can be associated with specific parameters.

| Action Type   | Parameter                |
|---|--------------------------|
|  Move          | Point, linear, polar, XY |
|  Scale         | Linear, polar, XY        |
|  Stretch       | Point, linear, polar, XY |
|  Polar Stretch | Polar                    |
|  Rotate        | Rotation                 |
|  Flip          | Flip                     |
|  Array         | Linear, polar, XY        |
|  Lookup      | Lookup                   |


## Practical Examples

Use what you've learned to add dynamic action to some typical blocks.

### Adding a Point Parameter

You can add point parameters to existing blocks so that they will have multiple insertion points. Then attach a move action to each point parameter. To make this work properly, you should add a basepoint parameter (so that when you move the block, the basepoint moves also).

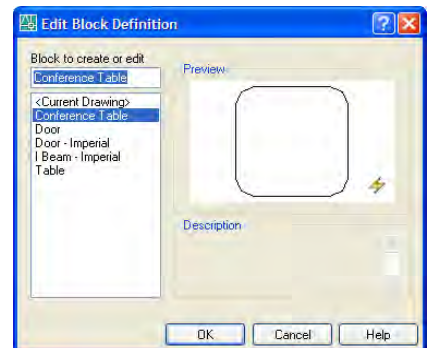
1. Open the block in the Block Editor by doing one of the following:

- In the Standard toolbar, click the Block Editor button 
- In the drawing, double-click on the block
- In the pull-down menu, click Tools > Block Editor
- At the command line, type BEDIT

2. When AutoCAD displays the Edit Block Definition dialog box, select the block you want to modify and then click OK.

Note that you can also select the block you want to edit, right-click, and then choose Block Editor from the shortcut menu.

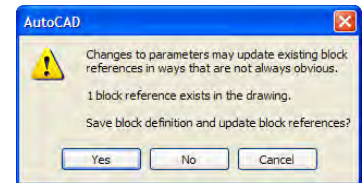
3. On the Parameters tab of the Block Authoring Palette, click the Base Point parameter. When AutoCAD prompts you to Specify parameter location:, select the origin (0,0).



4. On the Parameters tab, click the Point parameter. When AutoCAD prompts you to Specify parameter location or [Name/Label/Chain/Description/Palette]:, locate a new point (in this case, the center of the table).

**NOTE:** Notice that when you place a parameter that requires an action, an exclamation symbol appears adjacent to the parameter. This indicates that the parameter requires an associated action that has not yet been attached. The base point parameter does not require an action, so no exclamation symbol appeared for that parameter.

5. When AutoCAD prompts you to Specify label location:, click to position the label.
6. On the Actions tab, click the Move action. When AutoCAD prompts you to Select parameter:, select the position parameter you just added (by clicking on the label).
7. When AutoCAD prompts you to Select objects:, select all of the objects (be sure to select the position parameter you just added as well as the base point parameter you added in step 3).
8. When AutoCAD prompts you to Specify action location or [Multiplier/Offset]:, click to position the action location.
9. On the Block Editor toolbar, click the Close Block Editor button. When AutoCAD displays an alert box asking if you want to save the block definition and update block references, click Yes.



Now test your block by inserting it into the current drawing. Press the CTRL key to cycle through the possible insertion points. Insert the block and then click on one of the grips and try moving the block.

### Adding a Stretch Parameter

You can add a stretch parameter to the block so that you can change the size of the table. First, add a linear parameter. Then attach a stretch action to the linear parameter.

1. Open the Block Editor to edit the block from the previous example.
2. On the parameters tab, click the Linear parameter. When AutoCAD prompts you to Specify start point or [Name/Chain/Description/Base/Palette/Value set]:, select the left side of the table.
3. When AutoCAD prompts you to Specify endpoint:, select the right side of the table.
4. When AutoCAD prompts you to Specify label location:, click to place the parameter.
5. On the Actions tab, click the Stretch action. When AutoCAD prompts you to Select parameter:, select the linear parameter you just added.
6. When AutoCAD prompts you to Specify parameter point to associate with action or enter [sTart point/Second point] <Second>:, press ENTER.
7. When AutoCAD prompts you to Specify first corner of stretch frame or [CPolygon]:, select the opposite corners of a crossing window so that the entire right side, top, and bottom edges of the table are selected.
8. When AutoCAD prompts you to Select objects:, use a crossing window to select the right, top, and bottom edges of the table.
9. When AutoCAD prompts you to Specify action location or [Multiplier/Offset]:, click to position the action location.
10. Repeat steps 5 through 9 to add a stretch action attached to the grip at the other end of the linear parameter. Then close the Block Editor and save the changes you made to the block.

Now test your block again. When you select the block, notice the new stretch grips. Click on one of the new grips and try stretching the length of the table.

## Set Incremental Distance Values for the Table Size

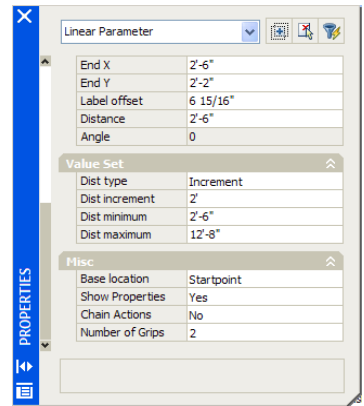
When you stretch the length of the table, notice that the table can take on any length. In reality, the table is probably sold only in specific incremental lengths, so you need to revise the block to constrain the stretch operation so that the table can only be stretched to specific lengths.

1. Open the Block Editor to edit the block from the previous example.
2. Select the linear parameter (labeled “Distance”), right-click, and select Properties from the shortcut menu.
3. In the Properties palette, set the following properties:

Dist type: Increment  
 Dist increment: 2'-0"  
 Dist minimum: 2'-6"  
 Dist maximum: 12'-6"

4. Close the Block Editor and save the changes you made to the block.

Now test your block again. When you stretch the block now, notice that the table can only be stretched to a length that varies between 2'-6" and 12'-6", in 2-foot increments.

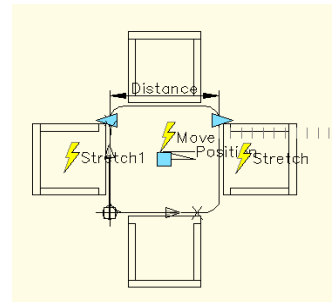


## Adding an Array Parameter

In a dynamic block reference, an array action causes the associated objects to copy and array in a rectangular pattern when the associated parameter is edited through a grip or the Properties palette. In the case of the table block, if you included chairs as part of the table block definition, you could then use an array action to add more chairs when the table is stretched.

In the Block Editor, four instances of a chair block have been added to the conference table. Before adding the array action, you should modify the move and stretch actions to include the chair as part of the selection set for those actions.

1. In the Block Editor, double-click on the move action. When AutoCAD prompts you to `Select object to add to action set or [Remove]:`, select the four chairs, and then press ENTER.
2. Double-click one of the stretch actions. When AutoCAD prompts you to `Specify first corner of stretch frame or [CPolygon]:`, select the opposite corners the stretch frame so that the chair added at that end is now within the frame.
3. When AutoCAD prompts you to `Select object to add to action set or [Remove]:`, select the chair at that end of the table, and then press ENTER.
4. Repeat steps 1 through 3 for the other stretch action.
5. Then close the Block Editor and save the changes you made to the block.

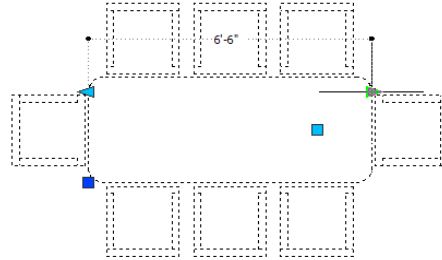


Now test your block. Notice that when you move the block, the chairs move with the table, but if you stretch the length of the table, the chairs may not behave properly. You'll solve that by adding an array parameter.

6. In the Block Editor, on the Actions tab, click the Array action. When AutoCAD prompts you to `Select parameter:`, select the linear parameter.
7. When AutoCAD prompts you to `Select objects:`, select the two chairs on either side of the table (but not the ones on the ends), and then press ENTER.
8. When AutoCAD prompts `Enter the distance between columns (| | |):`, specify a distance of 24-inches.

9. When AutoCAD prompts you to Specify action location:, click to position the action location.
10. Close the Block Editor and save the changes you made back to the block.

Now test your block again. Notice now when you stretch the block, additional chairs are automatically added or removed as needed.



## A Dynamic Door

For our next example, we'll create a dynamic door block similar to the one included as a sample dynamic block in the Architectural tool palette. Although it looks fairly simple at first glance, it's a bit more complex to create.

The object is to create a block that can be any width from 2'-0" to 4'-0", can fit into a wall of any thickness, can have different hinge points, can swing either into or out from a room, and can appear with the door either open at a 45° or 90° angle. Start by drawing a 3'-0" door showing both the 45° and 90° swing angle conditions. Door jambs have also been created. You can either save this as a new block and then edit it using the Block Editor, or create this geometry within the Block Editor.

Start by adding all of the necessary parameters:

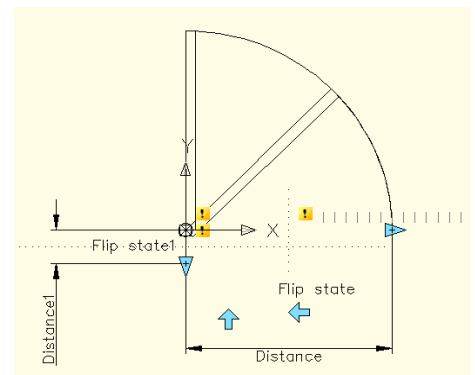
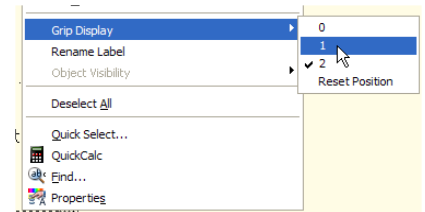
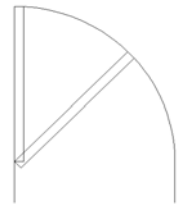
1. In the Block Editor, add a base point parameter at the hinge location.
2. Add a flip parameter at the midpoint of the door opening. (Tip: Move the grip to a different location.)
3. Add a flip parameter at the midpoint of the door jamb. (Tip: Move the grip to a different location.)
4. Add a linear parameter to the width of the door.
5. Select the linear parameter you just added, right-click, choose Grip Display from the shortcut menu, and change the number of grips so that only one grip is displayed. Also set the following properties:

Dist type: Increment  
 Dist increment: 2"  
 Dist minimum: 2'-0"  
 Dist maximum: 4'-0"

6. Add a linear parameter to the thickness of the wall and change the grip display to show only one grip.

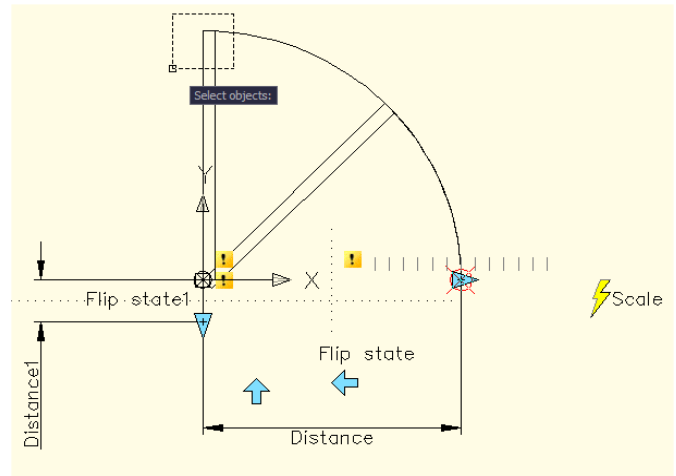
Now start adding the necessary actions. Start with the scale action to change the radius of the door swing arcs:

1. On the Actions tab, select the Scale action. When prompted, select the linear parameter defining the width of the door.
2. When prompted to select objects, select the two door swing arcs (both the 45° and 90° swings) and the flip state at the midpoint of the door width. Then specify a location for the action.



Next, add a stretch action for the 90° opening.

1. On the Actions tab, select the Stretch action. When prompted, select the same linear parameter as before.
2. When prompted to specify a parameter point to associate with the action, press ENTER.
3. When prompted to specify the stretch frame, indicate a small window around the end of the door away from the hinge.
4. When prompted to select objects, select the door. Then specify a location for the action.
5. Select the stretch action you just added. In the Properties palette, change the Angle Offset value to 90°. Change the Action Name to Stretch 90.



Repeat the previous 5 steps for the 45° angle door. When you change the properties for this stretch action, change the Angle Offset value to 45° and change the Action Name to Stretch 45.

Next, add a stretch action for the width of the door opening:

1. On the Actions tab, select the Stretch action. When prompted, select the same linear parameter as before.
2. When prompted to specify a parameter point to associate with the action, press ENTER.
3. When prompted to specify the stretch frame, indicate a small window around the jamb at the swing side of the door.
4. When prompted to select objects, select just the jamb at the swing side of the door. Then specify a location for the action.

Add a flip action to swap the hinge and latch sides of the door:

1. On the Actions tab, select the Flip action. When prompted, select the flip parameter (flip state) at the midpoint of the door opening.
2. When prompted to select objects, select everything. Then specify a location for the action.

Next, add a stretch action to adjust the thickness of the wall:

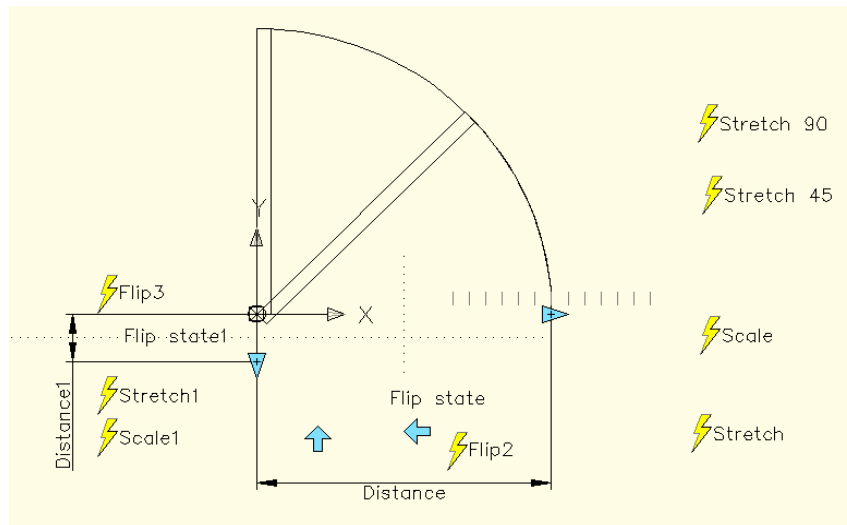
1. On the Actions tab, select the Stretch action. When prompted, select the linear parameter for the wall thickness.
2. When prompted to specify a parameter point to associate with the action, press ENTER.
3. When prompted to specify the stretch frame, indicate a window crossing the door jambs, with the ends of the jambs away from the hinge point inside the crossing window.
4. When prompted to select objects, select just the two door jambs. Then specify a location for the action.

Next, add a scale action to adjust the flip axis so that it remains at the midpoint of the thickness of the wall regardless of how thick the wall becomes:

1. On the Actions tab, select the Scale action. When prompted, select the same linear parameter for the wall thickness.
2. When prompted to select objects, select just the flip action that will flip the door swing about the midpoint of the wall thickness. Then specify a location for the action.

Finally, add a flip action to reverse the direction of the door swing:

1. On the Actions tab, select the Flip action. When prompted, select the flip parameter at the midpoint of the wall thickness.
2. When prompted to select objects, select everything. Then specify a location for the action.
3. Close the Block Editor and save your changes.



Now you're ready to test out your dynamic door block. Insert the door into a wall opening in your drawing. Try adjusting the width of the door and the thickness of the wall to match those in your drawing. Click on the flip grips to change the hinge position and reverse the swing of the door. When you are satisfied that everything works correctly, you're ready to modify the dynamic block so that you can select whether you want to view the door opened at a 45° or 90° angle.

### Adding Visibility States

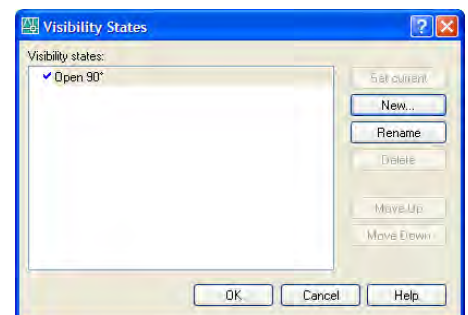
You can use visibility states to make geometry visible or invisible in a dynamic block. One block can have any number of visibility states.

Using visibility is a powerful way to create a block that has many different graphical representations. You can easily change a block reference that has different visibility states without having to find a different one to insert in your drawing.

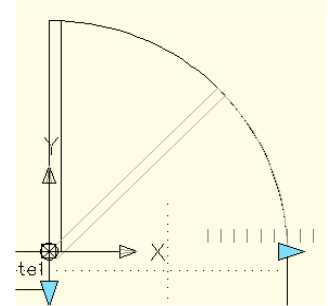
In the case of the dynamic door block you just created, you can add visibility states to show the door open at either a 45° or 90° angle.

To add visibility states to control the appearance of the block:

1. Open the dynamic door block in the Block Editor.
2. On the parameters tab of the Block Authoring palette, click the Visibility parameter. When AutoCAD prompts you to Specify parameter location or [Name/Label/Description/Palette]:, click to place the parameter.
3. On the Block Editor toolbar, click the Manage Visibility States button. AutoCAD displays the Visibility States dialog box.
4. In the Visibility States dialog box, click Rename and change the name of the default visibility state to Open 90°.
5. In the Visibility States dialog box, click New and create a new visibility state called Open 45°. Then click OK to close the Visibility States dialog box. Open 45° should be the current visibility state (shown in the Visibility States pull-down on the Block Editor toolbar).



6. On the Block Editor toolbar, click the Make Invisible button. When AutoCAD prompts you to *Select objects:*, select the version of the door that is open at a 90° angle as well as its associated door swing. Notice that the objects you selected appear grayed out.
7. On the Block Editor toolbar, select Open 90° from the Visibility States pull-down.
8. On the Block Editor toolbar, click the Make Invisible button. When AutoCAD prompts you to *Select objects:*, select the version of the door that is open at a 45° angle as well as its associated door swing.
9. Close the Block Editor and save your changes.



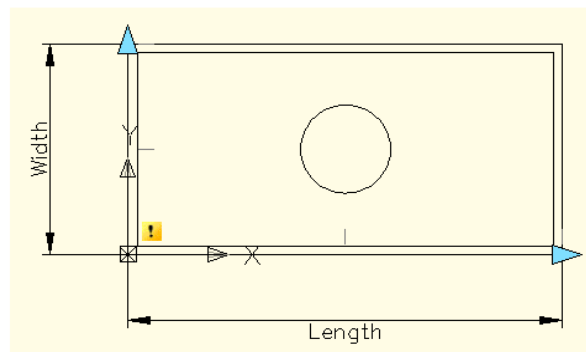
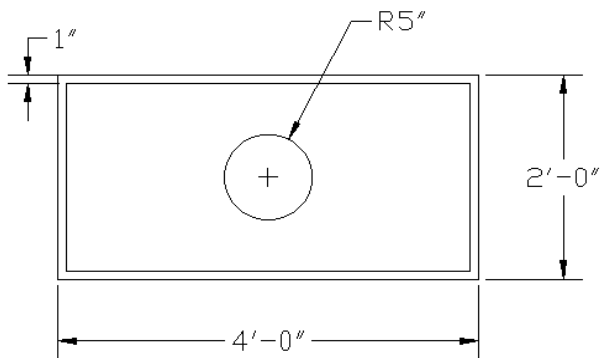
Test your dynamic block again. Notice the new grip that enables you to control the visibility of the door. You can easily switch between a 45° door swing and a 90° door swing.

### Using Lookup Tables to Assign Data to Dynamic Blocks

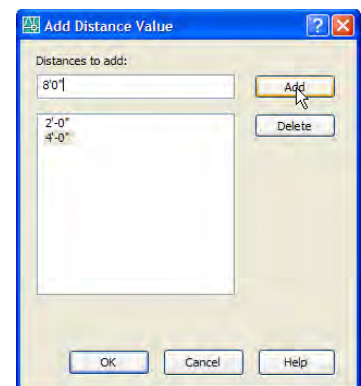
You can use a lookup table to define properties for and assign property values to a dynamic block. Using lookup tables is a powerful way to associate parameter values for the dynamic block reference with other data that you specify (for example, a part number). You can subsequently extract this data from block references in a drawing just as you would extract block attribute data.

When completed, the lookup table assigns property values to the dynamic block reference based on how it is manipulated in the drawing. Or, you can change how the block reference is displayed in the drawing by changing the value of a lookup property of the block reference through a lookup grip or the Properties palette, a process referred to as *reverse lookup*.

For this example, you will create a fluorescent light fixture. Open the Block Editor and create a 2'-0" x 4'-0" fixture similar to the one shown below.



1. Add a linear parameter for the length and a second linear parameter for the width.
2. Change the number of grips displayed to 1 for both of the linear parameters.
3. Select the linear parameter for the length of the fixture. In the Properties palette, under Property Labels, change the Distance label to Length.
4. Under Value Set, change the Dist Type to List. Then in the Dist Value List, click the button. In the Add Distance Value dialog box, type each possible length distance value (2'-0", 4'-0", and 8'-0"), clicking the Add button after you enter each value, to add them to the list. When finished, click OK.
5. Repeat steps 3 and 4 for the width of the fixture, changing the label to Width and entering width values of 1'-0", 2'-0", and 4'-0".



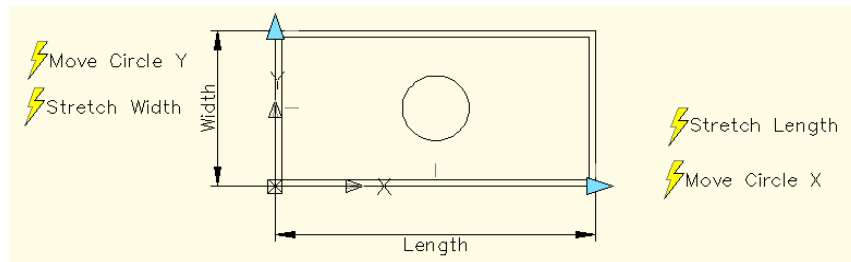
**NOTE:** You can also enter the length and width values in the Properties palette. Simply use a comma to separate each value in the list.

Now you're ready to add the necessary actions.

1. Add a Stretch action to the length parameter. (Tip: After you create it, in the Properties palette, change its Action Name to Stretch Length.)
2. Add a Stretch action to the width parameter. (Tip: Change its Action Name to Stretch Width.)

You need to add Move actions to the circle so that when you stretch the length or width of the fixture, the circle moves half the distance of the stretch action so that it remains centered. To do this, you'll use a multiplier.

3. On the Actions tab, click Move. When prompted, select the Length parameter.
4. When prompted to specify the parameter point, press ENTER (to select the second point).
5. When prompted to select objects, select the circle.
6. When AutoCAD prompts you to Specify action location or [Multiplier/Offset]:, type **M** and press ENTER.
7. When AutoCAD prompts you to Enter distance multiplier <1.0000>:, type **.5** and press ENTER. This will move the circle half the distance of the stretch action.
8. Specify the action location. After you place the action, use the Properties palette to change the Action Name to Move Circle X.
9. Repeat steps 3 through 8 to add another Move action to adjust the location of the circle when you change the width of the fixture. Then change its Action Name to Move Circle Y.



At this point, it's a good idea to test your dynamic block to make sure it behaves as expected before you add the Lookup capabilities.

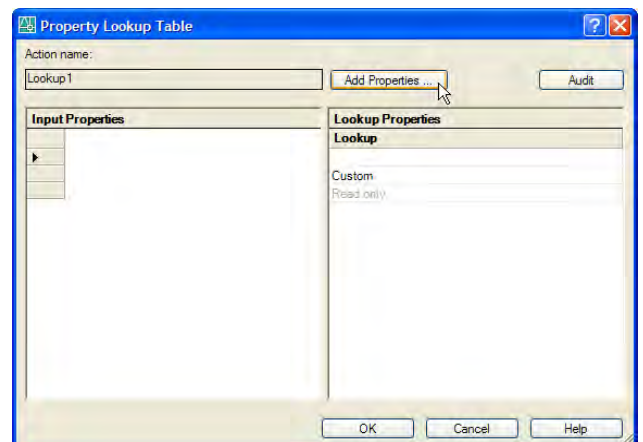
## Adding the Lookup Table

After you've drawn the geometry and added the appropriate parameters and actions required for the dynamic block's functionality, you are ready to add the lookup table to the block definition.

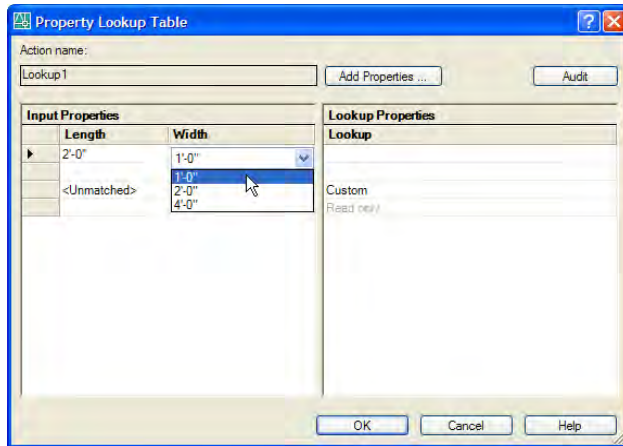
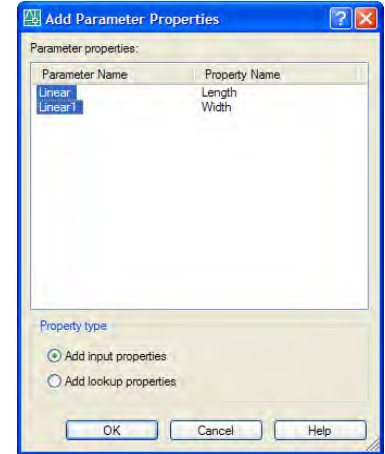
A blank lookup table is created when you add a lookup parameter to a dynamic block definition and then add a lookup action and associate it with the lookup parameter. The lookup table is displayed in the lookup table dialog box.

1. Open the light fixture block in the Block Editor.
2. On the Parameters tab, click the Lookup parameter and specify the parameter location.
3. On the Actions tab, click the Lookup action. When AutoCAD prompts you to Select parameter:, click on the Lookup parameter you just added, and then specify the action location.

As soon as you specify the action location, AutoCAD displays the Property Lookup Table dialog box.



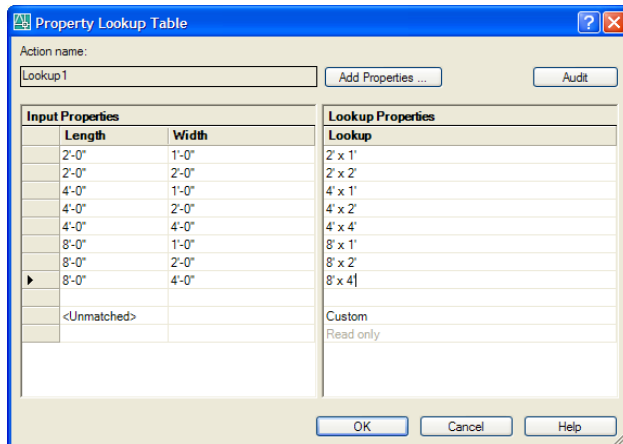
4. Click the Add Properties button to display the Add Parameter Properties dialog box.
5. Under Property Type, make sure the Add Input Properties radio button is selected. Then select both of the parameters and click OK. The Length and Width properties are both added to the Property Lookup Table.
6. Under Input Properties, click in the first field in the Length column. Notice that the drop-down list displays the length values you previously entered when you set up the list values for the Length parameter. Select 2'-0".
7. In the Width column, click in the cell. This drop-down list displays the width values you previously defined. Select 1'-0".



8. Each time you add a pair of length and width values, AutoCAD adds another line to the lookup table. Repeat steps 6 and 7 to define the following eight possible fixture sizes:

|         |         |         |
|---------|---------|---------|
| 2' x 1' | 4' x 1' | 8' x 1' |
| 2' x 2' | 4' x 2' | 8' x 2' |
|         | 4' x 4' | 8' x 4' |

9. After you add all eight possible fixture sizes to the lookup table, add names to the Lookup Properties column on the right side of the dialog box. Then click OK.



10. Select the Lookup parameter. In the Properties palette, change its Lookup Label to Size.

At this point, save your changes, close the Block Editor, and test your block. The block doesn't behave any differently than it did than before you added the lookup table. To complete the process, you need to enable reverse lookup.

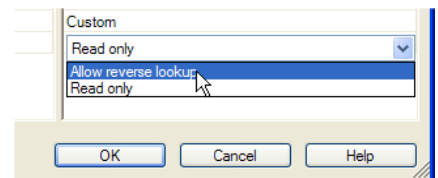
## Enabling Reverse Lookup

When you enable reverse lookup, AutoCAD adds a lookup grip to the dynamic block reference. When you click this grip, a drop-down list of the lookup values for that lookup property (in this case, the size) is displayed. When you select a value from the list, the corresponding input property values are assigned to the block reference.

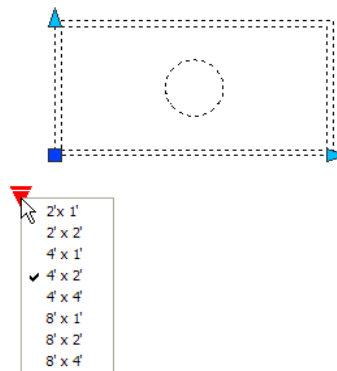
**NOTE:** To enable reverse lookup for a lookup property, each row in the lookup table must be unique. After you add properties and values to the table, you can check for errors and empty cells by clicking the Audit button in the Property Lookup Table dialog box. You can also use the shortcut menu options to insert, delete, or reorder rows. If you leave a cell empty in the lookup properties column and the cell has an associated input property in the same row, the lookup property will not allow for reverse lookup.

To enable reverse lookup:

1. Open the light fixture in the Block Editor.
2. Open the lookup table. (Tip: You can double-click on the lookup action or select it and then click in the Lookup Table cell in the Properties palette.)
3. In the Properties Lookup Table dialog box, at the bottom of the Lookup Properties column, change the table from Read Only to Allow Reverse Lookup. Then click OK.



Close the Block Editor, saving your changes, and test your dynamic block. Notice that now, when you select an instance of the block in your drawing, AutoCAD displays a lookup grip.



## Adding Additional Parameters

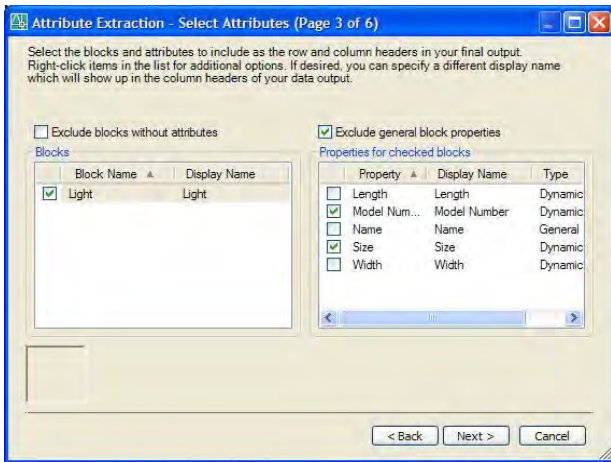
You can add additional parameters and include them as part of the lookup properties for your block. The parameters in dynamic blocks can be included when you extract attributes. For example, you might want to include a model number or cost for each possible light fixture size.

1. Open the light fixture in the Block Editor.
2. On the Parameters tab, add another Lookup parameter. In the Properties palette, change its Lookup Label and Parameter Name to Model Number.
3. Open the lookup table. Click the Add Properties button.
4. In the Add Parameter Properties dialog box, under Property Type, select the Add Lookup Properties radio button.
5. In the Parameter Properties list, select the Model Number parameter and then click OK. The Model Number is added to the lookup table.

- In the Property Lookup Table dialog box, in the new Model Number column, specify a model number for each of the eight light fixtures. Leave the lookup property in the final row set to Read Only. Click OK.

Note that if you had enabled reverse lookup for the model number, AutoCAD would have added a second lookup grip. You could then select the size of the light fixture either by selecting its size from the size lookup or by selecting its model number from the model number lookup. By leaving the model number set to Read Only, AutoCAD displays only the size lookup grip. But when you select a particular size, the model number associated with that light fixture is assigned to that instance of the block as well.

As a final exercise, insert several instances of the light fixture block. Use the new lookup grip to change the size of some of the light fixtures so that you have several instances of fixtures in a variety of sizes. Then use AutoCAD's Attribute Extraction wizard to create a table containing the Model Number, Size, and quantities of each fixture.



| Size    | Model Number | Quantity |
|---------|--------------|----------|
| 2' x 1' | 0201         | 1        |
| 2' x 2' | 0202         | 2        |
| 4' x 2' | 0402         | 5        |
| 8' x 4' | 0804         | 1        |

## Final Notes

By default, when you double-click on a block, AutoCAD opens the block in the Block Editor. If you don't want the block editor to open, you can lock it. To do so, change the value for the new BLOCKEDITLOCK system variable. By default, BLOCKEDITLOCK has a value of 0 (open the Block Editor). If you change the BLOCKEDITLOCK value to 1, when you double-click on a block, AutoCAD will open it using the REFEDIT command, to simply edit the block definition in-place. (Note that if the block contains attributes, double-clicking the block reference opens the Enhanced Attribute Editor.)

**TIP:** CAD Managers may want to lock the Block Editor so that users who shouldn't or don't have authority to modify or update blocks don't have access to the Block Editor. Of course, if they know about the BLOCKEDITLOCK system variable, they could unlock the Block Editor.

Dynamic blocks offer a lot of flexibility to the way you can use blocks, but they are definitely more difficult to define than the blocks you're accustomed to using. You may not want or need to use dynamic blocks for every block, but they will help you simplify your block libraries because they give you the option of creating a single block to represent many usage scenarios.

Remember that when you start to create your own dynamic blocks, take things one step at a time. Plan out what you need the block to do—how you want it to respond. After placing parameters and actions, test the behavior of the block. Remember that multiple actions can be applied to the same parameter and that you can control the way actions behave (such as constraining their angle or size increments). Keep in mind that the order in which you do things can make a difference. With practice, you'll soon be creating dynamic blocks with the best of them.

**Go dynamic!**

## Reference Materials

Like any new functionality in AutoCAD, dynamic blocks add a host of new commands and system variables, which are summarized in the following tables.

| <b>Commands Associated with Dynamic Blocks</b> |  |
|--|--|
| <b>Command</b>                                 | <b>Purpose</b>   |
| <b>BACTION</b>                                 | Adds an action to a dynamic block definition   |
| <b>BACTIONSET</b>                              | Specifies the selection set of objects associated with an action in a dynamic block definition                 |
| <b>BACTIONTOOL</b>                             | Adds an action to a dynamic block definition   |
| <b>BASSOCIATE</b>                              | Associates an action with a parameter in a dynamic block definition  |
| <b>BAUTHORPALETTE</b>                          | Opens the Block Authoring Palettes window in the Block Editor  |
| <b>BAUTHORPALETTECLOSE</b>                     | Closes the Block Authoring Palettes window in the Block Editor   |
| <b>BCLOSE</b>                                  | Closes the Block Editor  |
| <b>BCYCLEORDER</b>                             | Changes the cycling order of grips for a dynamic block reference   |
| <b>BEDIT</b>                                   | Opens the Edit Block Definition dialog box and then the Block Editor   |
| <b>BLOOKUPTABLE</b>                            | Displays or creates a lookup table for a dynamic block definition  |
| <b>BPARAMETER</b>                              | Adds a parameter with grips to a dynamic block definition  |
| <b>BSAVE</b>                                   | Saves the current block definition   |
| <b>BSAVEAS</b>                                 | Saves a copy of the current block definition under a new name  |
| <b>BVHIDE</b>                                  | Makes objects invisible in the current visibility state or all visibility states in a dynamic block definition |
| <b>BVSHOW</b>                                  | Makes objects visible in the current visibility state or all visibility states in a dynamic block definition   |
| <b>BVSTATE</b>                                 | Creates, sets, or deletes a visibility state in a dynamic bloc   |
| <b>RESETBLOCK</b>                              | Resets one or more dynamic block references to the default values of the block definition                      |

| <b>System Variables Associated with Dynamic Blocks</b> |  |
|--|--|
| <b>System Variable</b>                                 | <b>Purpose</b>   |
| <b>BACTIONCOLOR</b>                                    | Sets the text color of actions in the Block Editor   |
| <b>DEPENDENCYHIGHLIGHT</b>                             | Controls whether or not dependent objects are dependency highlighted when a parameter, action, or grip is selected in the Block Editor |
| <b>BGRIPOBJCOLOR</b>                                   | Sets the color of grips in the Block Editor  |
| <b>BGRIPOBJSIZE</b>                                    | Sets the display size of custom grips in the Block Editor relative to the screen display   |
| <b>BLOCKEDITLOCK</b>                                   | Disallows opening of the Block Editor and editing of dynamic block definitions   |
| <b>BLOCKEDITO</b>                                      | Reflects whether or not the Block Editor is open   |
| <b>BPARAMETERCOLOR</b>                                 | Sets the color of parameters in the Block Editor   |
| <b>BPARAMETERFONT</b>                                  | Sets the font used for parameters and actions in the Block Editor  |
| <b>BPARAMETERSIZE</b>                                  | Sets the size of parameter text and features in the Block Editor relative to the screen display  |
| <b>BVMODE</b>  | Controls how objects that are made invisible for the current visibility state are displayed in the Block Edito                         |
| <b>GRIPDYNCOLOR</b>                                    | Controls the color of custom grips for dynamic blocks  |

