Autodesk Alias 2010

Learning Alias

Autodesk®

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Learning Alias

Welcome to Alias and the world of three-dimensional modeling, rendering, and animating.

Alias offers a complete solution for the creation of digital content in fields such as industrial design, automotive design, and consumer product design.

How to use this book 1

This chapter shows how to use the tutorials, and presents the graphic and text conventions used in this manual.

About the Learning Alias Tutorials

The tutorials in this book present examples of typical concept design workflows. The tutorials introduce the powerful tools and interactive features of Alias, and demonstrate how to use them to accomplish your concept design tasks.

The first six tutorials introduce modeling tools to build your experience level. We recommend that you start with the first tutorial and proceed sequentially through the modeling tutorials, because they build on each other.

The next two tutorials introduce rendering tools and skills.

These tutorials are densely packed with information and techniques that may be new to you. You may want to re-read the lessons after completion, or even repeat the more difficult lessons.

You can view movies (in Flash format) demonstrating each tutorial in the online documentation. In order to view these movies, you may need to install a Flash player. You can download Flash plug-ins for your browser for free from *www.adobe.com*.

Disclaimer: There may be slight discrepancies in procedures between the movies and the written documentation. If you encounter a discrepancy, use the written documentation version because it will be the most current.

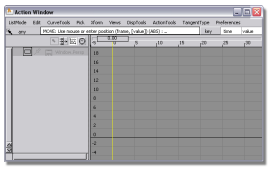
For More Information

These tutorials are an introduction to Alias. They are not intended as an exhaustive guide to the capabilities and options of Alias, and will not teach you everything there is to learn about the products and workflows.

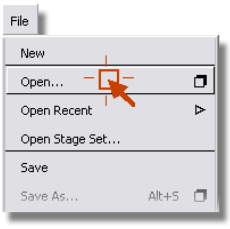
For additional information and more comprehensive explanations of tools and options, refer to the online documentation included with the product, and read Getting help on Alias on page 7.

Graphic Conventions

To call attention to part of a screen shot, we highlight the important area and darken the rest of the image. For example, in the following picture, we have marked the location of the close box on the **Action Window**.



To indicate a click, we use this symbol. For example, in the following picture we have indicated that the **Open** command should be clicked. In the text of the instruction, we will refer to this as **File > Open**. The first word or term is the name of the menu or palette; it is followed by an arrow and the name of the menu item or tool. In the case of a submenu, two arrows are used: **Layouts > All Windows > All Windows** refers to the **All Windows** menu item available from the **All Windows** sub-menu, which is found on the **Layouts** menu.



To indicate that an option box for a tool or menu item should be opened, a box appears after the tool name, like **Surfaces > Skin** ❐.

When we ask you to choose a tool, we show the tool's icon next to the instruction, for example, select **Pick > Object**  .

Terms

Click: Move the mouse pointer over an object and press and release a mouse button once.

Double-click: Move the mouse pointer over an object and press and release a mouse button twice fast.

Drag: Move the mouse pointer over an object and hold down a mouse button, then move the mouse with the button held down. Then release the mouse button.

Click-Drag: Move the mouse pointer over an object, press the mouse button, and move the mouse pointer to a final position before releasing the mouse button.

The Scene: The 3D "world" inside the view windows.

The Model: The curves, surfaces, and points that make up the object you are creating.

Getting help on Alias 2

Autodesk provides you with a number of resources to aid you in becoming a proficient Alias user.

Finding help on Alias features

If:	Try this
You want information about installing Alias	■ Follow the on-screen instructions on the installation DVD. For more detailed instructions, see the InstallingAlias.pdf file on the top level of the DVD.
You are new to Alias	■ Read Getting Started, the booklet included in the kit. ■ Browse through the information on the main documentation page (index.html). ■ Work through these tutorials in Learning Alias. These are basic lessons that will teach you about working in 3D in Alias. They are also the prerequisite for more advanced Alias courses. ■ Use the How To… section of the online documentation to learn how to perform specific operations within Alias, like drawing curves, making four-sided

	surfaces, and using masks while painting. ■ Visit *http://www.autodesk.com/estore* to find out about learning tools.
You are upgrading from a previous version of Alias	■ See the What's New in Alias document, available by selecting **Help** > **What's New**, or available as a PDF file on the Alias Design Community Web site *http://aliasdesign.autodesk.com*. ■ Look at the **What's New** tab in the default shelf provided with the application.
You are looking for detailed information about a tool or feature	■ Look in the "Tool Palettes" and "Menus" sections of the online help. ■ Choose **Help** > **What's This** and then click the tool or menu item. ■ Use the right mouse button on the background of any option window to see help for that tool or operation.
You want to learn new techniques for using Alias	■ See "Learning Alias". ■ See "Learning Technical Surfacing." ■ Go to the Communities section of *http://www.autodesk.com*, and check out the tips and tricks. ■ Visit *http://www.autodesk.com/estore* to find learning tools aimed at intermediate and advanced users.
You want a PDF version of one of the manuals	■ All of the manuals are available in PDF format on the Alias Design Community Web site *http://aliasdesign.autodesk.com*..

You want to know what the keyboard shortcuts are in Alias	■ Choose **Help** > **Modifier Keys** from within Alias, or click Help > Modifier Keys, Marking Menu Keys, and Hotkeys on the main online help page.
You want a Quick Reference card	■ Print the Quick Reference card PDF file provided on the Alias Design Community Web site *http://aliasdesign.autodesk.com*.

Finding Alias training resources

If...	Try this…
You want to obtain in-depth training	■ See the learning materials and training courses available from Autodesk, see *http://www.autodesk.com/training*.
You want to get tips and techniques from the experts at Alias MasterClasses	■ For events near you, see *http://www.autodesk.com/training.*
You want to create plug-ins for Alias	■ Use the Alias Application Programmers' Interface Manual to learn the object-oriented programming required to build plug-ins.
You want information about becoming an Alias-certified instructor	■ See the information at *http://www.autodesk.com/training* or contact us at *learning-tools@autodesk.com*.

Finding support for Alias

If…	Try this
You are a Platinum member and want to access the Knowledgebase or Ask Autodesk	■ Go to the Alias support site at *http://www.autodesk.com/support*
You want to interact with other Alias users	■ Go to the online User-to-User Discussion forum on the Alias support site at *http://www.autodesk.com/support*
You want answers to common troubleshooting questions	■ See the FAQs (frequently asked questions) in the technical support section of the Alias support website at *http://www.autodesk.com/support*.
You want to license your software	■ If you are a Platinum member and need a license, check the executable license file on the top of your installation DVD. If your license isn't there, go to *http://www.autodesk.com/spar* and follow the instructions in the InstallingAlias.pdf file at the top of the Alias DVD. ■ If you are a new customer, go to *http://www.autodesk.com/opa* to obtain a new license.
You want customer or technical support	■ Go to the webpage *http://www.autodesk.com/support*.

Working with Alias

If you create concept designs

- Read about our concept design workflow
- Work through the modeling and rendering tutorials in *Learning Alias*

If you build 3D models based on sketches

- Work through the modeling tutorials in *Learning Alias*

If you build 3D models for manufacture

- Read *About Curves* and *About Modeling*
- Work through the modeling tutorials in *Learning Alias*
- Check the community site for tips and tricks

If you modify 3D models for manufacture

- Read *Alias Fundamentals*
- Work through the *Learning Technical Surfacing* tutorials

If you create rendered images

- Read *About Rendering*
- Work through the rendering tutorials in *Learning Alias*
- Check the community site for tips and tricks and downloadable shaders and backgrounds

If you create animations

- Do the work in the "If you create rendered images" section
- Read *About Animating*
- Work through the animation tutorials in *Learning Alias*

- Check the community site for tips and tricks

Interface Basics

3

Learning objectives

You will learn how to:

- Log into the system and start Alias.
- Arrange windows.
- Use tools and tool options.
- Customize shelves and marking menus.
- Tumble, track, and dolly the view.
- Use the Object Lister window to understand the model.

Introduction

Before you begin working in Alias, you should spend some time learning how Alias represents the scene and the model (both externally and internally), and how you use menus and tools to create and edit model data.

Installing the tutorial courseware files

Each tutorial in this book is based on an Alias wire file, which contains the material you need to learn the tools, skills, and concepts in the tutorial. These files are required to complete the Learning Alias and Technical Surfacing tutorials.

When you install Alias, the courseware files (Alias wire files and other support files) are not automatically installed. You must install them manually.

To install the courseware for use with Alias

The courseware files (Alias wire files and other support files) are not automatically installed when you install the documentation from the Alias Installation DVD.

1. Download the courseware files from the Alias Design Community Web site *http://aliasdesign.autodesk.com.*

   NOTE You need write permissions to the directory in which you plan to install the courseware files.

2. Copy the downloaded `CourseWare` folder into your `user_data` folder.

   On Windows systems, this is typically:

   ```
   C:\Documents and Settings\[userid]\My Documents\Autodesk\Alias\user_data\CourseWare
   ```

   On Mac OS X, this is typically:

   ```
   /Documents/Autodesk/Alias/user_data/CourseWare
   ```

Starting Alias

Logging In

If you have not logged in to your account on your workstation, do so now.

To log in to your account

- Type your user name and password at the prompts.
  If you have an account on this workstation, the operating system user environment appears.

Depending on which product you are using, the Alias icon may have a different name, such as Design or Automotive.

To start Alias on Windows

1. Do one of the following:
   - Double-click the **Alias 2010** shortcut icon on the desktop
   - Select **Programs > Autodesk > Alias 2010 > Alias** from the **Start** menu.

   If you work in an environment where there are several Alias products installed, the first time you run Alias, you may be presented with a choice of products to launch. The product choice depends on the licenses owned by your organization.

2. Choose the product you want to run, and click **Go**.

   If you select **Surface** or **Design**, skip to step 4#.

   If you selected the **Automotive** product, you are presented with a workflow selection.

3. For the purpose of these tutorials, choose the **Default** workflow, which gives you access to all 3D curve and surface creation tools.

   The **Paint** workflow is for working solely within a 2D environment. You can click the **do not show again** check box, so this window will not appear every time you launch Alias. If you have chosen a workflow setting and checked **don't show again**, you can change the default workflow by choosing the workflow you want from **Preferences > Workflows**. Alias launches the application in the same workflow that was active when you last exited the application.

4. Alias shows a splash window as it loads.

   During start-up, Alias may warn you about unusual conditions on your system:

   If you are already running Alias (or if Alias exited abnormally the last time you ran it), the application asks you if you really want to start another copy.

   If you are sure Alias is not running, click **Yes** to continue loading.

5. After Alias has finished loading its resources and plug-ins, the workspace window opens.

To start Alias on Mac OS X

1. Do one of the following:
   - Double-click the **Alias 2010** shortcut icon on the desktop

- Click the **Alias** icon on the Dock.
- From the Apple Finder, select **Go > Applications**, browse to **Autodesk > Alias2010** and double-click **Alias**.

If you work in an environment where there are several Alias products installed, the first time you run Alias, you may be presented with a choice of product to launch. The product choice depends on the licenses owned by your organization.

2 Choose the product you want to run, and click **Go**.

If you select **Surface** or **Design**, skip to step 4#.

If you selected the **Automotive** product, you are presented with a workflow selection.

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4 Alias shows a splash window as it loads.

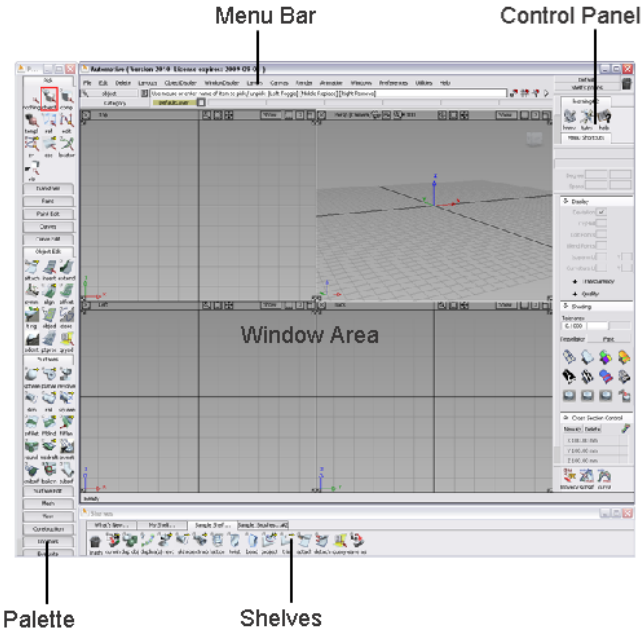
During start-up, Alias may warn you about unusual conditions on your system:

If you are already running Alias (or if Alias exited abnormally the last time you ran it), the application asks you if you really want to start another copy.

If you are sure Alias is not running, click **Yes** to continue loading.

5 After Alias has finished loading its resources and plug-ins, the workspace window opens.

Overview of the Alias Interface



The main parts of the Alias interface are:

- the **Palette** (location can be customized)
- the **Menu Bar**, located at the top
- the **Window Area**, taking up most of the interface and located in the middle (this area may or may not contain view windows when you first start Alias).
- the **Shelves** (location can be customized)
- the **Control Panel**, located on the right

If the **Palette** or **Shelves** are not visible, choose **Windows > Palette...** or **Window > Shelves...** from the **Menu Bar**.

The position of the **Palette** and **Shelves** can be customized from the options in Preferences > Interface > Palette/Shelves Layout ❐. In the following tutorials, we will work with the **Palette** on the **Left** and the **Shelves** on the **Bottom**

of the interface. (To learn how to set options see Set options for a tool or menu item.)

As you continue through this tutorial, you will become more and more familiar with the Alias interface.

Using Help

One of the most important menus is the **Help** menu. The **Help** menu is organized so you can get quick and specific information on just about any tool in Alias.

To get help on a tool or menu item

It is easy to get help on any tool or menu item in the interface using the following steps.

1. Click the **Help** menu, located at the right end of the menu bar.
2. In the **Help** menu, click **What's This?**

   You are prompted to select the tool for which you want help. (This prompt appears in the prompt line, located just below the menu bar.)
3. Click a menu item or a tool icon in the **Palette**.

   A browser window launches and the on-line documentation about that tool icon or menu item displays.
4. When you are finished reading the information, minimize or close the browser window.

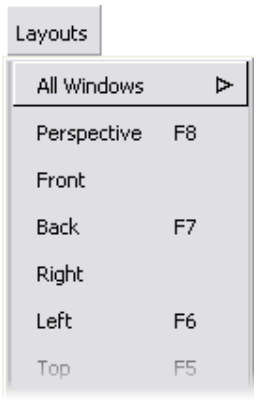
Arranging Windows

Performing Menu Commands

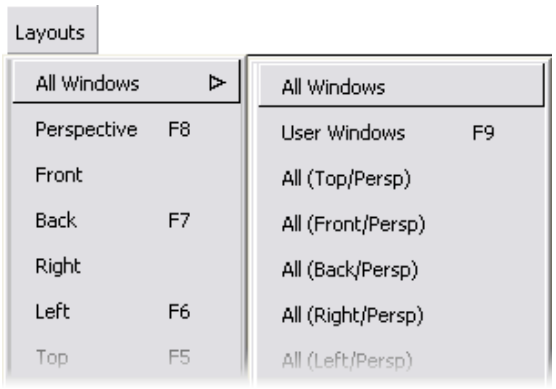
To use the menus to choose a window layout

1. Click the **Layouts** menu to open the menu.

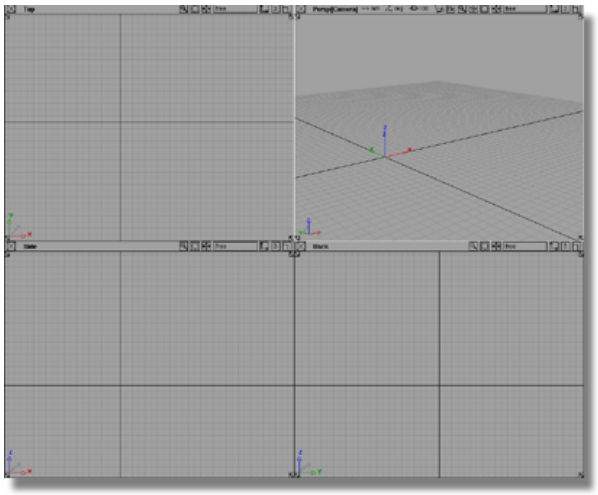
   NOTE Notice the arrow next to the **All Windows** command. This means there are suboptions for this command:



2 Click the **All Windows** command to open the submenu, then click the **All Windows** option.



The **All Windows** command arranges view windows in the following layout: Top, Left, Back, and Perspective.

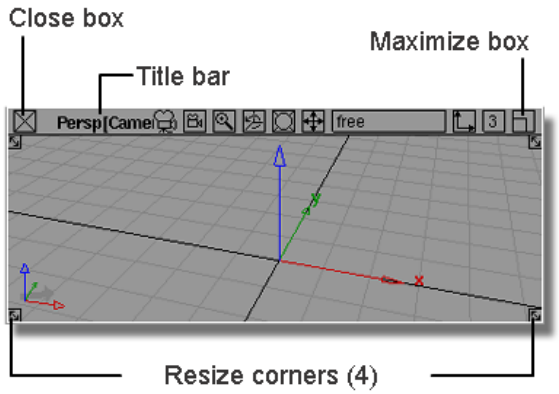


These tutorials sometimes refer to menu options by the path through the menus to the item. So, **All Windows** is: Layouts > All Windows > All Windows .

As an alternative to the single-click method, you can use the pull-down menus by dragging the mouse down the menu and releasing on the option you want.

Window Controls

Use these controls on the borders of view windows to move, close, and resize the window:



The view windows have more controls across the top, but for now, concentrate on the close box, title bar, maximize, and resize corners.

You will discover the functions of the other icons later in the tutorials.

Closing Windows

To close the Top view using the close box

- Find the close box in the upper left corner of the Top view window.



- Click the Top view window close box.



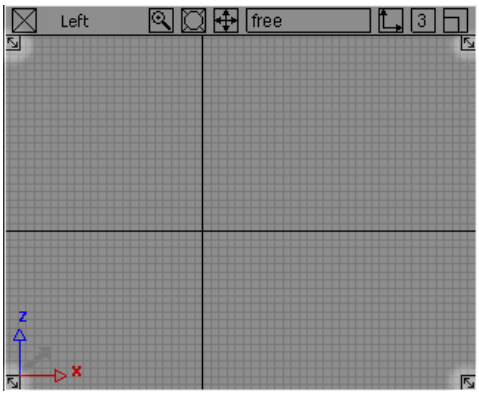
  The Top view window disappears.

Resizing Windows

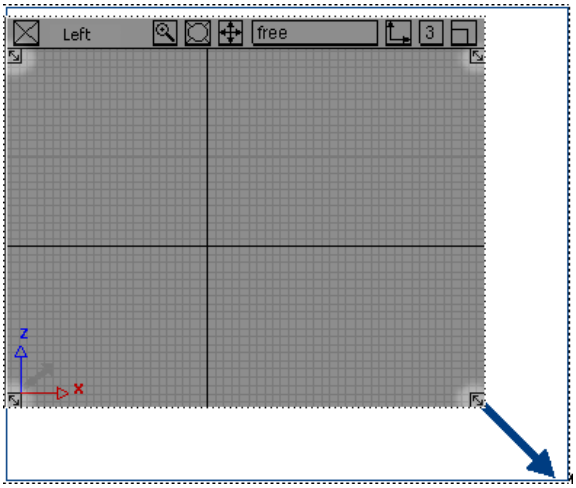
You can change the size of windows using the resize arrows at each corner.

To change the size of a view window using the resize arrows and maximize box

1. Find the resize arrows in the corners of a view window.



2 Drag a resize arrow to change the size of the window. An outline of the view window follows the mouse.



3 Release the mouse button. The corner of the window snaps to the new size.

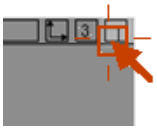
4 Try dragging the resize corners in the other corners to see how they resize the window.

- To work in one large window to see more detail, use the maximize box to temporarily make the view window fill the entire screen.

5 Find the maximize box in the upper right corner of a view window.



6 Click the maximize box of the view window.



The view expands to fill the entire screen.

Notice that the maximize box changes to black to show the window is maximized.

7 Click the maximize box again to return the view window to normal size.



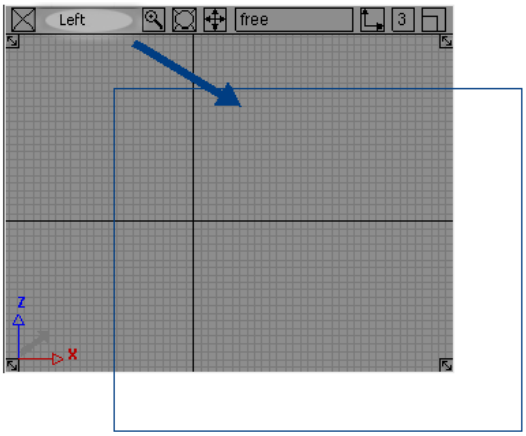
Moving Windows

To move and arrange the remaining windows

1 Find a view window's title bar.

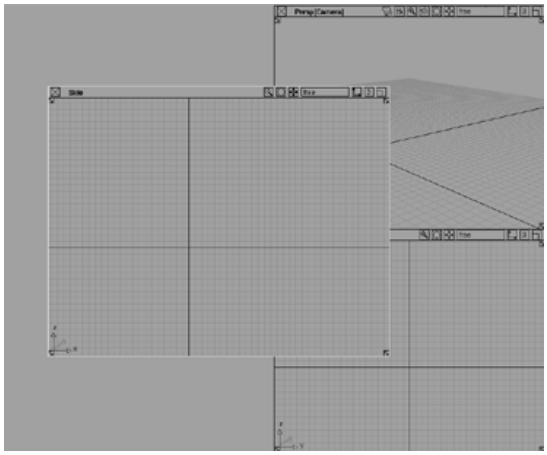
The title bar is the area at the top of the window, between the close box and the other icons on the right.

2 Drag the title bar. An outline of the view window follows the mouse.

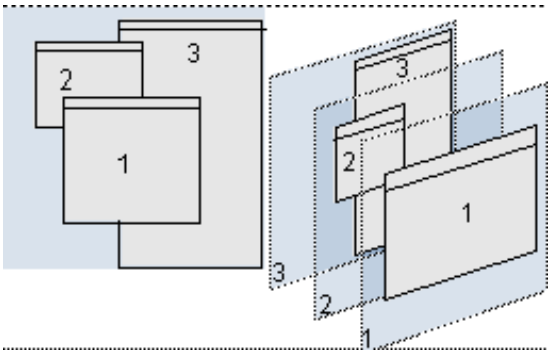


3 Release the mouse button. The window snaps to the new location.

4 By now you probably have some view windows overlapping other windows, similar to this:

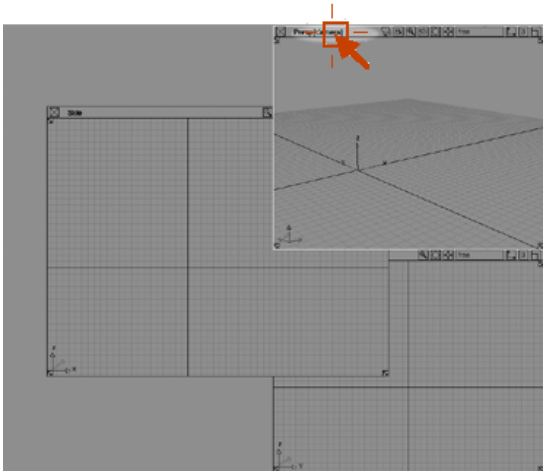


The windows are like a stack of papers on a desk. As you shuffle them, they can overlap.



When windows overlap like this, you can click in a window to move that window to the front of the stack.

5 Click the title bar of the Perspective view window to move it in front of the other windows.



The windows are probably a little disorganized at this point. Quickly reset them to a default layout using the commands in the **Layout** menu again.

6 Choose Layouts > All Windows > All Windows .

The Active Window

Notice one of the view windows has a white border. This is how Alias indicates the active view window (sometimes also called the current view window).

The active view window is always the last view window you clicked in.

Some tools change behavior based on which view is active, but for now you can disregard which view window is active.

Saving an arrangement of windows

If you have a particular choice of windows that you plan to use repeatedly, you can save the set by choosing Layouts > User Windows > Save Current Layout . You are prompted for a file name. To use this layout in the future, choose Layouts > User Windows > Retrieve Layout .

Using Tools

Describes how to use the Alias interface, such as selecting tools and creating shortcuts.

Tool Basics

To orient yourself in the Palette window

1. Find the **Palette** window floating on the left side of the screen.

   If the palette is not visible, go to the **Windows** menu and choose **Palette**.



The **Palette** window is divided into separate palettes of tools, each labeled with a tab at the top.

For example, the **Curves** palette contains tools for creating new curves. The **Curve Edit** palette contains tools for editing and reshaping existing curves.

2 Find the **Surfaces** palette. It is the eighth palette from the top of the window.

NOTE If you cannot see the **Surfaces** palette, use the scroll bar on the left side of the palette window to scroll up or down until it is visible in the window.

---

3 Hold the cursor over a tool.

The name of the tool appears in a small box just below the icon. This small text window is called a tooltip.

This feature can help you to identify tools until you become familiar with the icons in the palette.

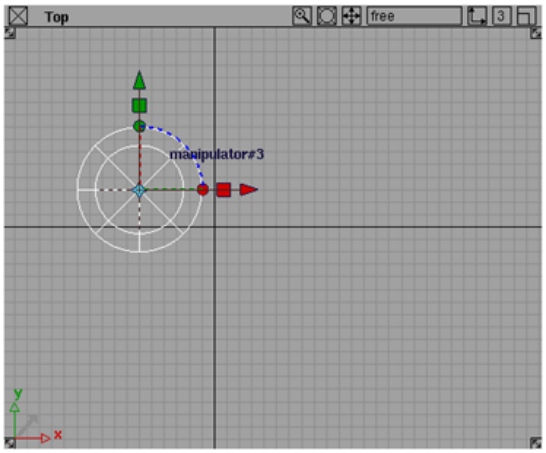
NOTE Once you are familiar with the icons in the palette, you may want to disable tooltips. To do this, select the **Tooltips** option in the **Interface** section of the **General Preferences** window (Preferences > General Preferences ❐).

Now use the geometric primitive tools to add some geometry to the scene. The primitive tools create simple 3D geometric shapes such as cubes, spheres, and cones.

As a technical surfacer, you may not regularly need to add these simple shapes to a model. However, they allow you to practice several Alias interface concepts, including choosing tools, using manipulators, subpalettes, tool option windows, and snapping.

To create a primitive sphere in the scene

1. Click the Surfaces > Primitives > Sphere tool.
2. A red outline appears around the icon to show it is the current tool.
3. Click in the Top view window to place the new sphere.



A new sphere, one grid unit wide, appears where you release the mouse button.

Using a Snap Mode

To use grid snapping to place a primitive cube

You may have noticed that some tools have a small yellow arrow in the top right corner.

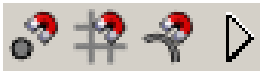


This arrow indicates that more, similar tools are available in a hidden subpalette. To access the extra tools, click and hold the mouse to open the subpalette.

1. In the **Surfaces** palette, click and hold the **Sphere** tool icon.
2. The **Surfaces > Primitives** subpalette appears.
3. Hold the *middle mouse button* on the different tools in the subpalette to see their names.
4. Click the **Cube** tool.

   The subpalette disappears. The **Cube** tool is selected and now occupies the space in the main palette where the **Sphere** tool was.

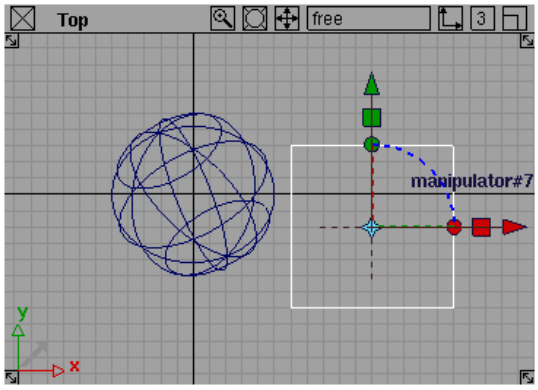
   This time place the new primitive using grid snapping.

5. Find the snap buttons, to the right of the promptline.

6. Click the *Grid*  button to turn on grid snapping.
7. Click and drag in the Top view window.



The cube snaps to the grid intersections as you drag.

8 Place the cube at a grid point by releasing the mouse button.

9 Click the *Grid*  snap button again to turn grid snapping off.

NOTE In addition to using the *Grid* button, you can grid snap by pressing and holding the *Alt* (Windows) or *Command* (Mac) key while you place a primitive.

To use the palette menu to choose the Cone tool

This time use an alternative method for choosing tools from palettes.

1 Click the tab at the top of the **Surfaces** palette.

The palette collapses to just the tab, and the other palettes move up to fill the space.

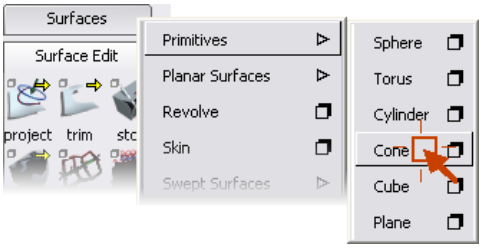
This feature is very useful for saving space in the palette window and in shelves. You can still choose tools from the palette using the palette's menu.

2 Click the *right mouse button* on the **Surfaces** palette's title tab to open the palette's menu.

3 Click the **Primitives** option to open the submenu.

Just like the menus at the top of the screen, arrows indicate that an item in the palette menu has subitems.

4 Click the **Cone** tool option.

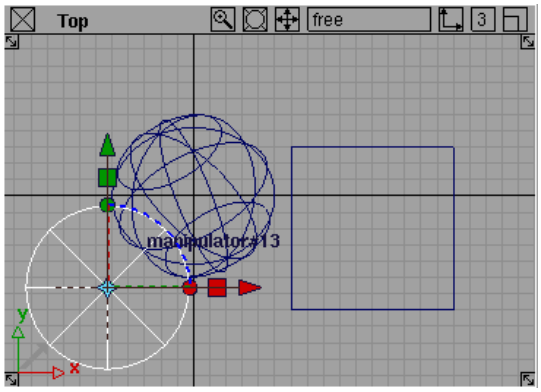


You have now seen two different ways to choose a tool from a palette. From now on, when instructed to choose tools by name, for example:

"On the **Surfaces** palette, choose **Primitives > Cone**."

you can either click the tool icon, or choose the tool from the palette menu.

5 Click in the Top view to place a cone in the scene.



6 Click the **Surfaces** palette's tab again to expand the **Surfaces** palette back to normal.

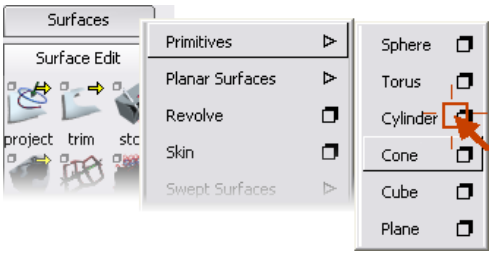
To use tool options to add a half-cylinder

1 With the *right mouse button*, click the title tab of the **Surfaces** palette to open the palette menu, then open the **Primitives** submenu.

Notice that some items have shadowed boxes next to the name of the item.



2 Click the shadowed box next to the **Cylinder** item.

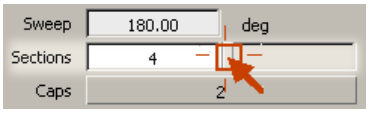


3 The **Cylinder** options window appears.

4 Double-click in the text box labeled **Sweep**, then type `180 and` press *Enter* (Windows) or *Return* (Mac) to set the sweep to 180 degrees.



5 Use the slider next to the **Sections** text box to set the sections to `4`.

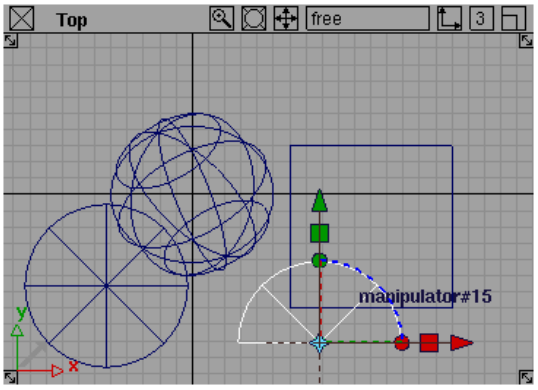


6 Click the **Go** button at the bottom of the window.



This button applies the settings in the window and activates the tool.

7 Click in the Top view window to place the new half-cylinder in the scene.



As you specified in the option window, the cylinder has a 180-degree perimeter and is created from four sections (spans).

8 Look at the **Cylinder** tool icon. It has a small option box symbol in the top left corner.

Like the symbol in the menu, this indicates the tool has options.

9 Double-click the **Cylinder** tool icon.

The **Cylinder Options** window appears.

10 Click **Exit** to close the options window.

Picking and Unpicking Objects

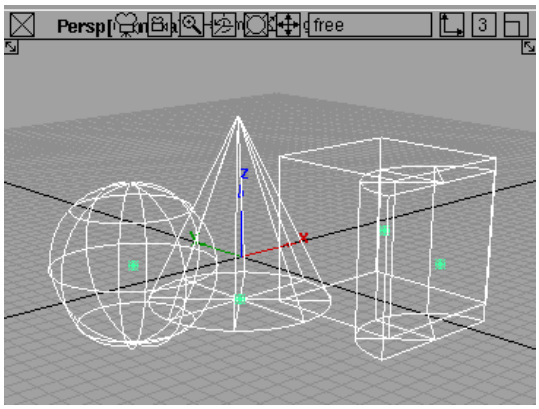
Picking refers to selecting objects in the scene for use with other tools. For example, to move a CV, you must pick the CV, then use the **Move** tool on the picked CV.

Picking objects in the scene is a fundamental part of modeling with Alias. Because it is so important, Alias provides several different tools for picking.

To pick all and pick nothing

1 In the **Pick** palette, choose **Object Types > All Objects/Lights** .

2 All the objects in the scene highlight to show they are picked.

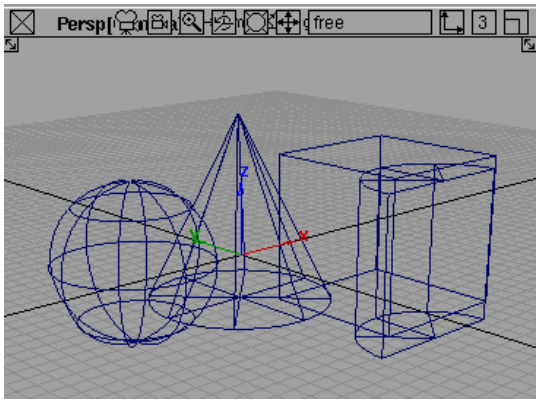


Unlike most selection tools, **Pick > Object Types > All Objects/Lights** does not stay selected, since you never need to use it twice in a row.

When these momentary types of tools finish, the current tool reverts to the last continuous tool you selected.

3 In the **Pick** palette, choose the **Nothing** tool.

4 The Pick > Nothing tool unpicks every object, leaving nothing picked.

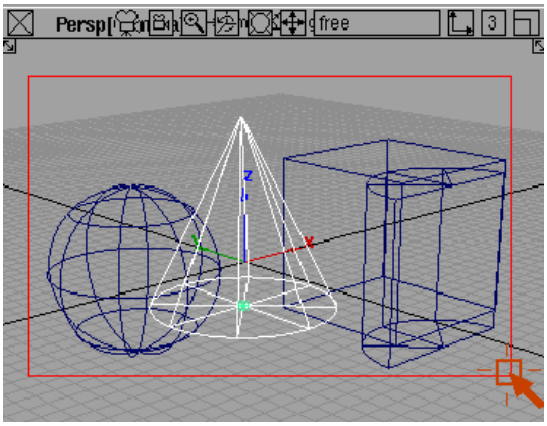


Like the **Pick > Object Types > All Objects/Lights** tool, the Pick > Nothing tool does not stay selected. The current tool reverts to the last tool you used.

To pick and unpick individual objects

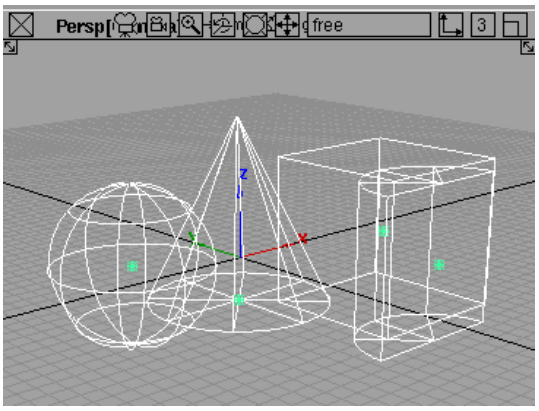
1 Choose the Pick > Object tool.

2 Click the cone primitive in the view windows with the *left mouse button*.

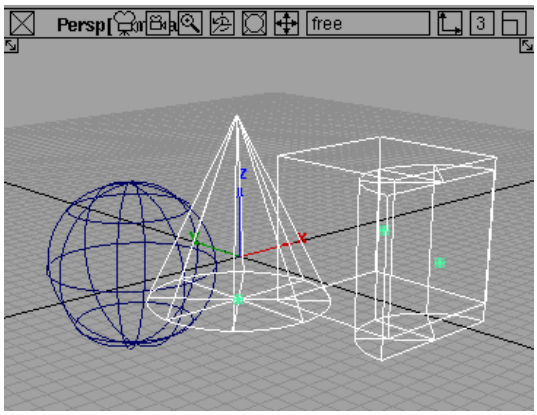


The cone highlights to show it is picked.

3 Click the other objects with the *left mouse button*. They also become picked.



4 With all the objects picked, click one of the picked objects with the *left mouse button*.

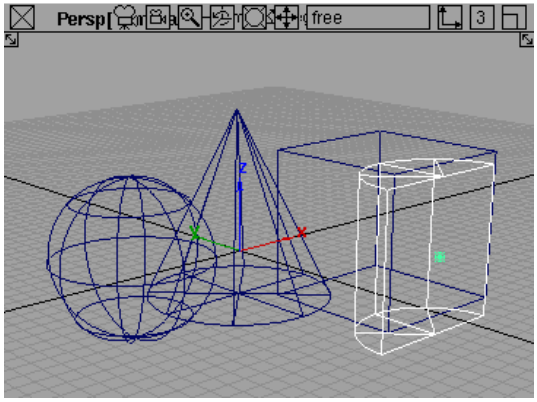


The object you clicked becomes unpicked.

The left mouse button toggles objects between picked and unpicked.

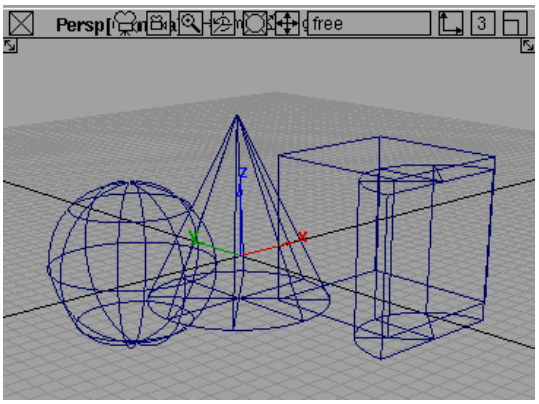
5 Now click one of the primitives with the *middle mouse button*.

The object you clicked is picked and the other objects are unpicked.



The middle mouse button picks only the object you click.

6 Click the picked primitive with the *right mouse button*.

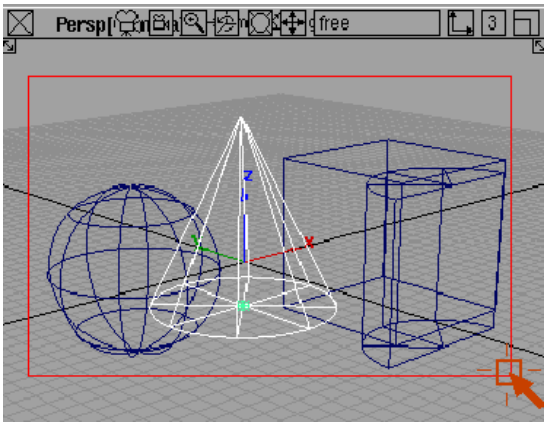


The object is unpicked.

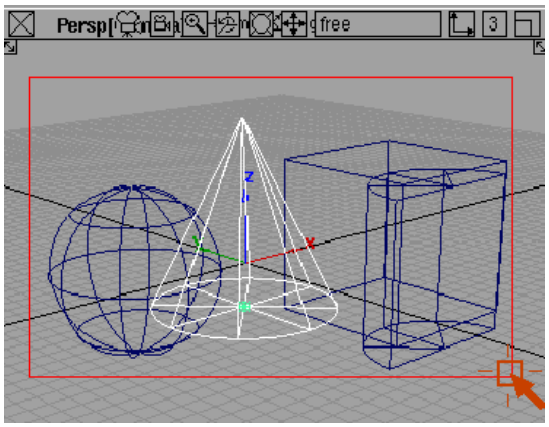
The *right mouse button* unpicks objects. This is most useful with pick boxes, as you will see in the next procedure.

To use pick boxes to pick and unpick several objects at once

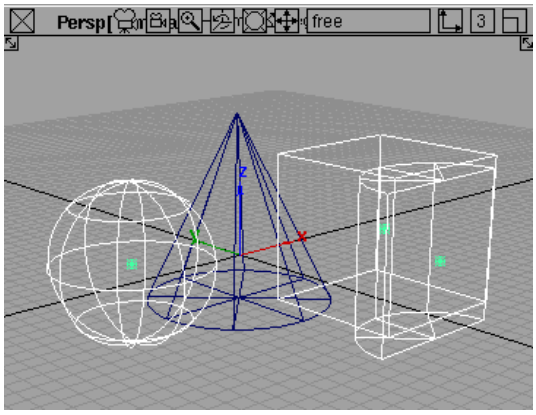
1 With the Pick > Object tool still selected, click one of the primitive objects with the *left mouse button*.



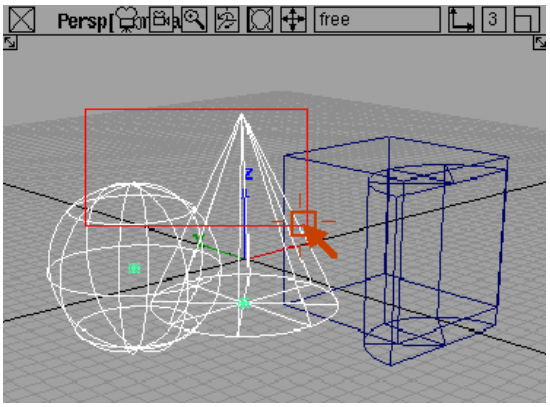
2 Press the *left mouse button* and drag a box around all the primitive objects.



All the objects inside the pick box toggle between picked and unpicked.

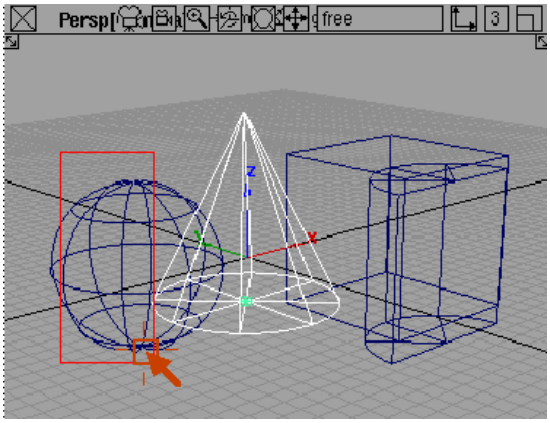


3 Now drag a pick box with the *middle mouse button* around some objects.



Now only the objects inside the box are picked.

4 Now drag a pick box with the *right mouse button* around some of the picked objects.



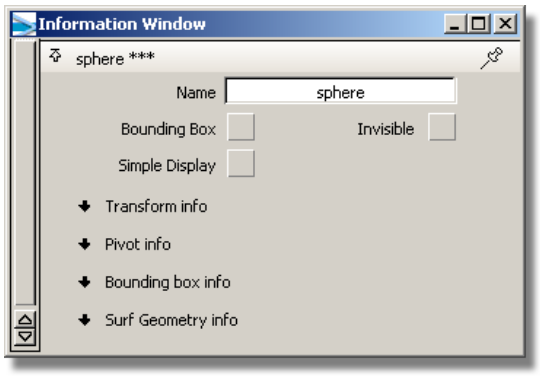
Any objects inside the pick box are unpicked.

To pick by name

1 Use the *middle mouse button* to pick only the sphere.

2 On the **Windows** menu, choose **Information > Information Window**.

The **Information** window appears.



The information window allows you to adjust parameters for objects in the scene.

3 Find the **Name** field. The name of the object should be `sphere` or something similar.

4 Close the **Information** window.

5 Click in empty space with the *middle mouse button*.

All objects in the scene are unpicked.

- Remember, the middle mouse button picks only what you click. If you pick "nothing" (empty space), then the tool acts as if you had chosen Pick > Nothing .

6 Type `sphere`, then press *Enter* (Windows) or *Return* (Mac). The text appears as you type in the promptline at the top of the workspace window.

When you press *Enter* (Windows) or *Return* (Mac), the sphere is picked.

Shortcuts to Tools

The variety of tools available is the source of Alias's power, but finding tools in the palette can become potentially time consuming. You can make commonly used tools available more quickly, and hide rarely used tools until you need them.

Alias provides three solutions: shelves, marking menus, and hotkeys.

Shelves are like the palettes, except you control the tools' options and their position on the shelves. You use shelves to organize all your commonly used tools.

Marking menus appear at the current mouse location. They provide a very fast method to choose the tools you use most often (such as Pick > Object).

Hotkeys are special key combinations that perform common menu or tool commands.

Creating Custom Shelves

To show and hide the shelf window

1 On the **Windows** menu, choose **Shelves**.

The **Shelves** window appears.

- The **Shelves** window provides a floating window in which to keep commonly used tools.
  Alias, however, provides another, even more convenient location for shelves. In these tutorials, you will use the shelf area in the control panel.
- Since you will not be using the **Shelves** window, you can close it.

2 Choose **Windows > Shelves** again to hide the Shelves window, or click the Shelves window's close button.

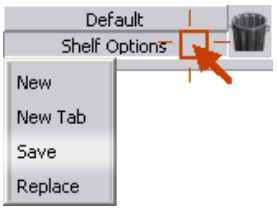
To help demonstrate how to make new shelves, clear the default shelves and make new shelves specific to these tutorials.

Before you clear the default shelves, save them, so you can retrieve them later.

To save the initial shelf set

1 Choose **Windows > Control Panel**. The control panel appears.

2 Hold the *left mouse button* on the **Shelf** menu button at the top of the control panel's shelf area to open the options menu.



3 Drag down to the **Save** option and release the mouse button.

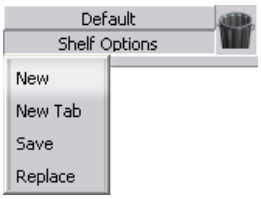
A file requester appears.

4 Click in the **Object name** text field and type `Default`, then click **Save**.

In the next procedure, you will start a new shelf of tools commonly used in curve fitting in preparation for the lesson on fitting curves to scan data.

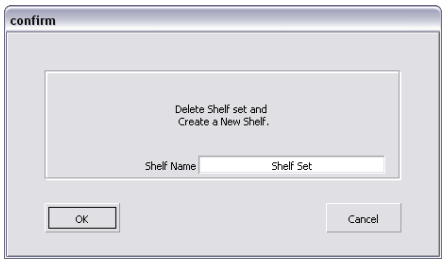
To clear the existing shelf set and create a new one

1 Hold the *left mouse button* on the menu button at the top of the shelf area to open the options menu. Notice how the menu button is now called **Default**, after the name of the current shelf.

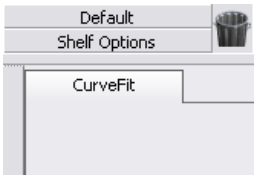


2 Choose **New** from the options menu.

A requester appears asking for the name of the new shelf.



3 Click in the text box, press the *Esc* key to clear the text, and type `CurveFit`. Click *OK* to name the new shelf.



The old Shelf set is deleted and a new, empty shelf appears in the shelf area.

Now you can begin adding tools to the new shelf.

4 In the Palette window, find the **Curve Edit** palette.

5 With the *middle mouse button*, drag the **Fit Curve** tool onto the **CurveFit** shelf in the control panel.

The tool appears in the shelf.

You could move the entire **Curve Edit** palette onto the shelf by dragging its title tab, but you only want a selection of tools from the full palette.

Next, add curve drawing tools to the palette.

Since you will often need to create curves of different degree in technical surfacing, it would be useful to have customized versions of tools with different settings.

The shelf allows you to do this. When you drag a tool onto a shelf, the new copy of the tool keeps the settings it had when it was dropped on the shelf, independent of the original tool in the palette.

Using this technique, create several versions of the two original curve creation tools, New curve (edit pts) and New curve (cvs) .

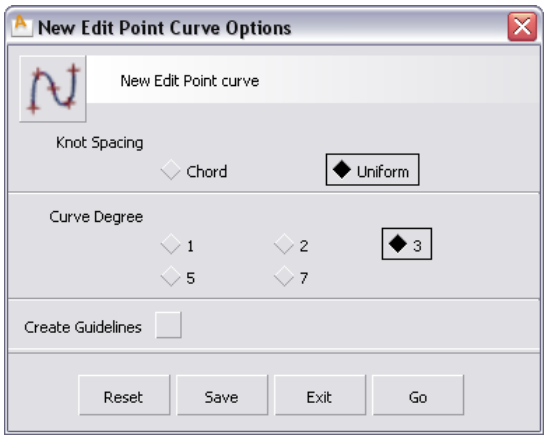
For each version, assign different settings for the **Degree** option.

To add versions of the New curve tools to the shelf with different options

1 In the **Curves** palette, double-click **New Curves > New Edit Point Curve** and open the tool's option window.

2 (Remember that you can also choose **New Edit Point Curve** from the palette menu).

The **New Edit Point Curve** option window appears.



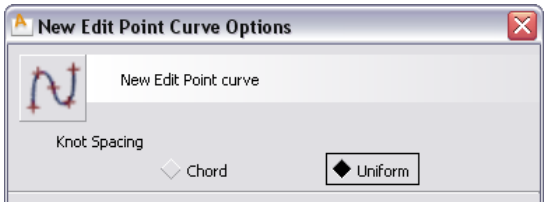
The options let you set the knot spacing (parameterization) and degree of the new curve.

3 Make sure **Knot Spacing** is set to **Uniform** and **Create Guidelines** is off.



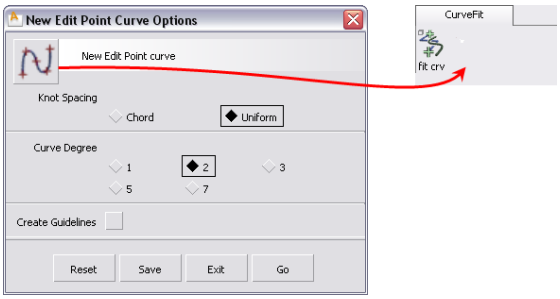
4 Set the **Degree** option to 2.

5 Find the tool icon at the top of the option window.



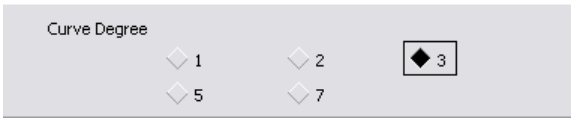
This icon represents the tool as configured with these settings.

6 Press the *middle mouse button* on the tool icon at the top of the option box and drag it to the **CurveFit** shelf.

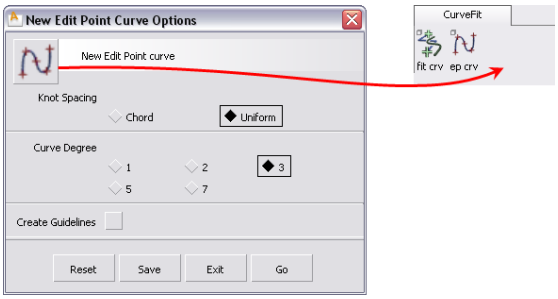


Now when you choose this icon in the shelf, the **New Curve (edit pts)** tool creates degree 2 curves.

7 Back in the option window, set the **Degree** to 3.



8 Use the *middle mouse button* to drag the tool icon at the top of the option window to the shelf.

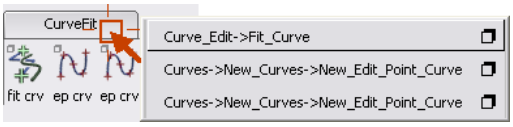


Another copy of the tool is added to the shelf. When you choose this copy of the tool, the **New Curve (edit pts)** tool will create degree 3 curves.

9 Click **Exit** at the bottom of the option window to close the window.

To rename the tools

1 Move the mouse over the **CurveFit** shelf's title tab and press the *right mouse button* to show the shelf's menu.



Note that the two versions of the tool have the exact same name and icon.

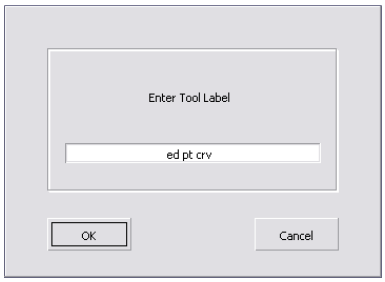
To be able to distinguish between the tools, rename them.

2 Find the first version of **New Curve by Edit Points** you dragged to the shelf.

If you cannot remember which is which, double-click the two icons to see their option windows. You want the version with the **Degree** option set to 2.

3 Hold down the *Ctrl* (Windows) or *Control* (Mac) key and double-click the tool icon.

A name requester appears.



4 Double-click in the text box and type `Edit_pt_Deg_2`, then click *OK* to rename the tool.

5 Hold down the *Ctrl* (Windows) or *Control* (Mac) key and double-click the second copy of the **New Curve by Edit Points** tool.

6 Double-click in the text box and type `Edit_pt_Deg_3`, then click *OK* to rename the tool.

7 Hold down the *right mouse button* on the title tab of the shelf to open the shelf menu.

The two copies of the tool are now distinguishable in the menu, but still have identical icons.

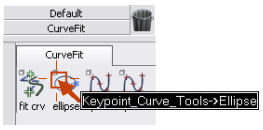
We recommend you keep the shelves collapsed and use the shelf menus to choose tools. This saves space in the shelf.

To remove a tool from the shelf

1 Add another tool to the **CurveFit** shelf.

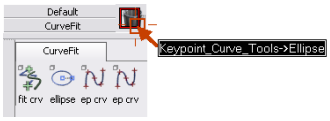
Let's now assume that this was a mistake and you want to remove the tool.

2 Hold the *middle mouse button* over the tool's icon in the shelf.



The name of the tool appears.

3 With the *middle mouse button* held down, drag the label to the upper-right corner of the window and position the cursor over the trash can icon.



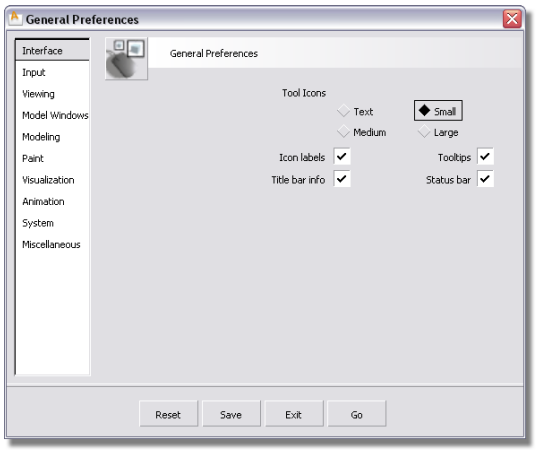
4 Release the mouse button. The tool disappears from the shelf.

You can also delete groups of tools by dragging a tab with the middle mouse button to the trash can.

You may have noticed that icons are a bit crowded on the shelf. The large icons are good when you are learning which icon is which, but now you can switch to the small icon size to save space in the shelf.

To change to the small icon size

1 In the **Preferences** menu, choose **General Preferences** ❐. The **Interface** options appear.



2 Set the **Tool Icons** to **Small**.



If you want, you can also turn on the **icon labels** option to display name labels for all the icons.

3 Click the **Go** button at the bottom of the window to apply the changes.



Alias loads smaller versions of all the tool icons.

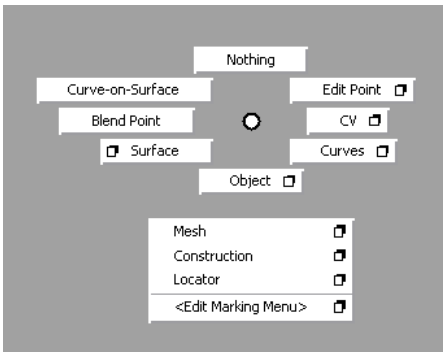
You have seen how to create shelves with customized tools. In later lessons, you will load pre-made shelves containing all the tools you need to complete the tutorials.

Using and Customizing Marking Menus

An even faster method for selecting tools is the marking menus. Marking menus generally hold fewer tools than a shelf, but are much faster since you can use quick gestures to choose tools. With practice, selecting tools with marking menus becomes almost instantaneous.

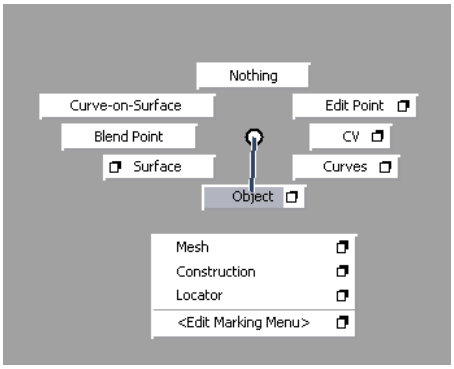
To choose common tools with marking menus

1. Hold down the *Shift* and *Ctrl* (Windows) or *Shift* and *Control* (Mac) keys.
2. With the keys held down, hold the *left mouse button*.



The left mouse button marking menu appears at the location of the mouse pointer.

3. Keep the *left mouse button* held down and drag down until the Pick > Object box is highlighted.



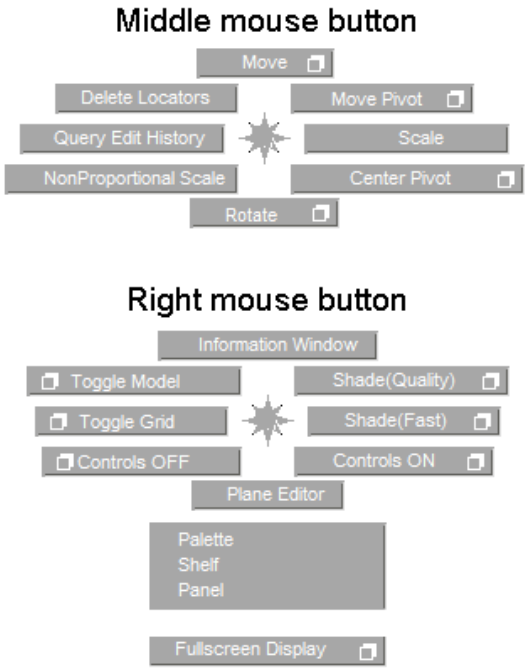
A thick black line shows the direction of the mouse pointer.

4. Release the mouse button to choose the highlighted tool.

   The Pick > Object tool is now the current tool.

5. Hold *Shift* and *Ctrl* (Windows) or *Shift* and *Control* (Mac) with the middle, then with the right mouse buttons to see the other marking menus.

   Each mouse button has a separate marking menu.



Once you have learned which direction corresponds to which tool in a marking menu, you can use a quick gesture to choose the tool.

6 Hold the *Shift* and *Ctrl* (Windows) or *Shift* and *Control* (Mac) keys, then drag up and release the mouse button quickly.

The black line shows the direction, but the menu is not drawn.

When you release the mouse button, the marking menu flashes the name of the selected tool on the screen.

You have just selected Pick > Nothing .

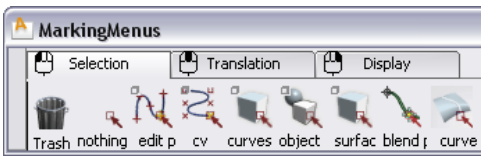
Use this method to choose tools even faster once you have mastered the positions of the tools on the menu.

Learn which tools are on the marking menus, and use the marking menus whenever you need to choose one of those tools. The more you use them, the faster you will become, until you can choose tools with quick gestures.

To customize a marking menu with common tools

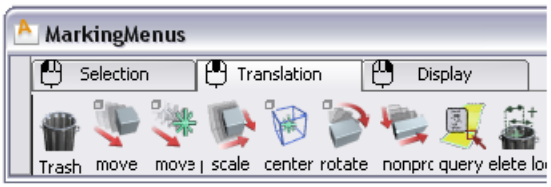
1 On the **Preferences** menu, open the **Interface** submenu and choose **Marking Menus**.

The **MarkingMenus** shelf window appears.

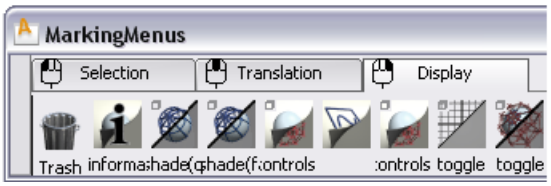


This is a special shelf window. The tools and menu items on the different tabs appear in corresponding marking menus.

Middle



Right

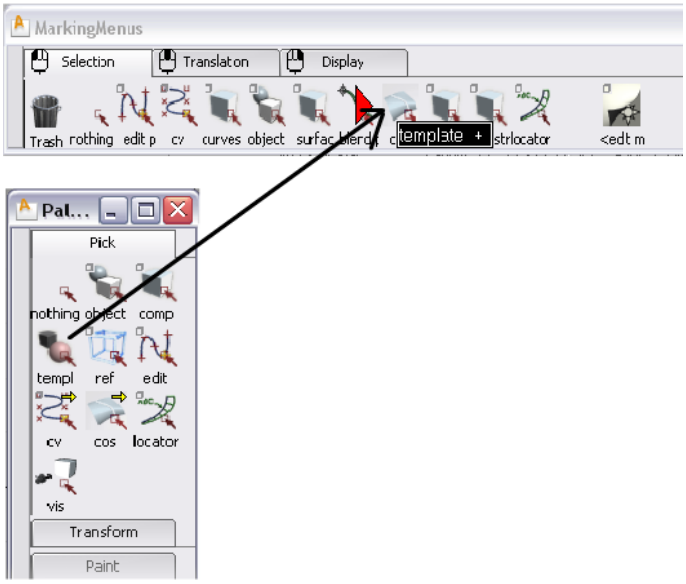


The procedure to modify the content of marking menus is similar to the one for modifying shelves that you learned earlier.

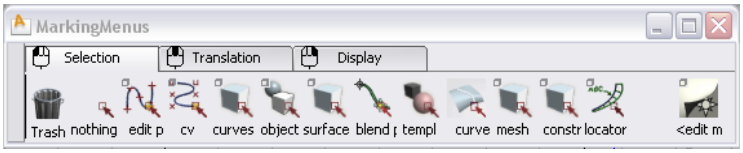
Here you will make a small modification to the **Selection** marking menu shelf.

2 Click the **Pick** tab in the Palette (if it isn't already expanded) and locate the **Pick > Template** tool.

3 Hold down the *middle mouse button* on the icon and drag it to the marking menu shelf, to the location shown in the image below.

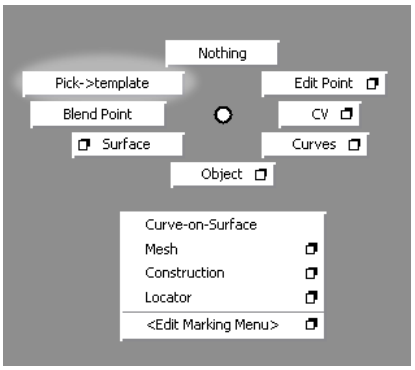


4 Release the mouse button to position the icon at the location indicated by the red arrow.



You now have a tool on the marking menu to pick templated geometry.

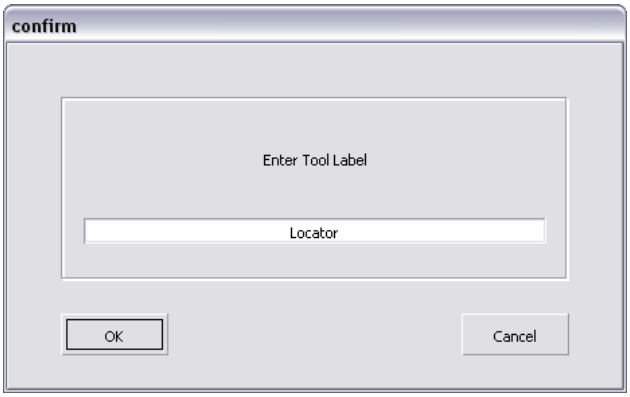
5 Hold down *Shift* and *Ctrl* (Windows) or *Shift* and *Control* (Mac) keys and press the *left mouse button* to show the marking menu again.



The tool you just added is called **Pick > Template** in the marking menu. Change the name to something more concise.

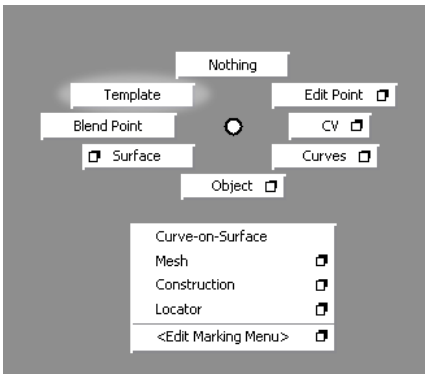
6 In the **MarkingMenu** shelf window, hold down the *Ctrl* (Windows) or *Control* (Mac) key and double-click the **Pick Template** tool in the shelf.

7 A dialog box appears.



8 Type **Template** in the text field and click *OK* to rename the tool in the marking menu.

9 Show the left mouse button marking menu again.



You now know how to customize the marking menus. In later lessons, you will load pre-made marking menus with common surfacing tools.

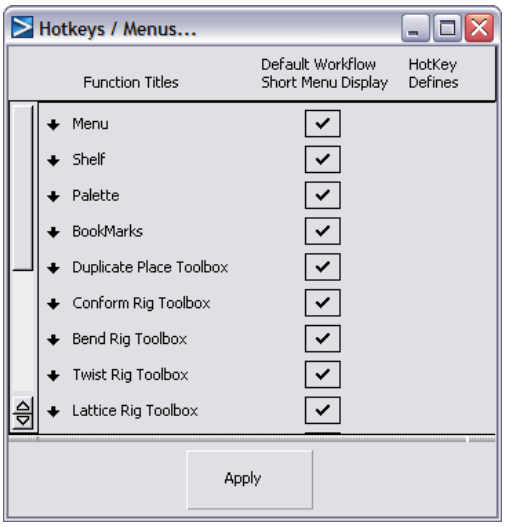
Using hotkeys

Hotkeys are special key combinations that choose tools or perform menu commands. You can get a complete listing of all the hotkeys in the hotkey editor.

To use hotkeys

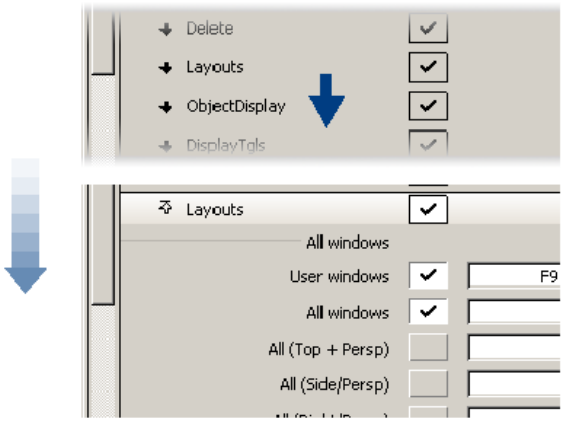
1 On the **Preferences** menu, click **Interface** and choose **Hotkeys/Menu Editor**.

The hotkey editor appears.



- Alias's option windows use a hierarchy similar to that of the File Lister: options are organized into hierarchical sections that can be collapsed and expanded.

2 In the **Menu** section, click the **Layouts** subsection title to expand it.



Click to open a Section Heading.

You can see the hotkey for the **User windows** item, as well as text fields for defining other hotkeys.

You can define your own hotkeys, if you want. For the most part, you will not use hotkeys in these lessons.

If you are new to Autodesk Alias products, we recommend that you spend some time working with the product before you define hotkeys, so you can learn which commands you use frequently enough to need a hotkey.

3 Click the close box to close the hotkey editor.

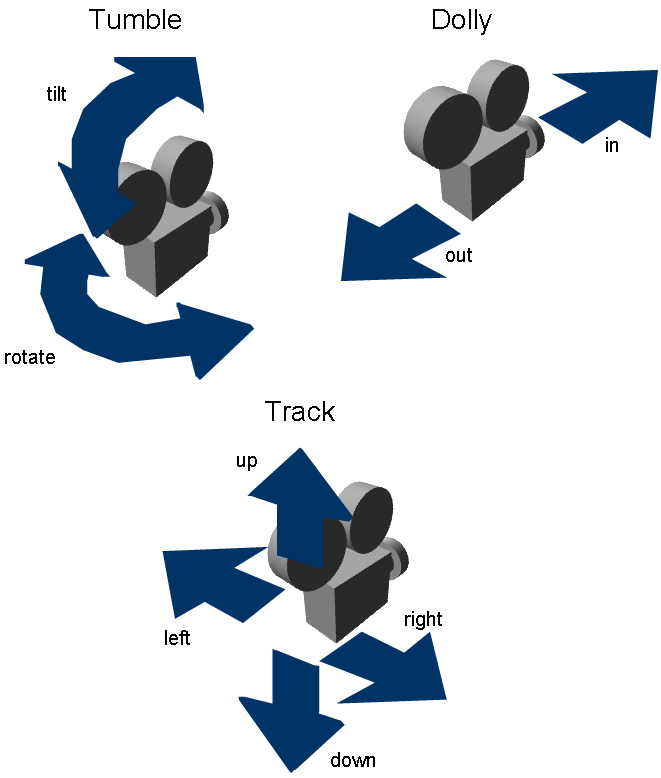
Changing Your View of the Model

Learn how Alias represents the 3D model on your 2D monitor, and how to use the view controls to get the best possible angle on the model for the task at hand.

Tracking, Dollying, and Tumbling the Camera's View

There are many different ways to change the camera's view in Alias.

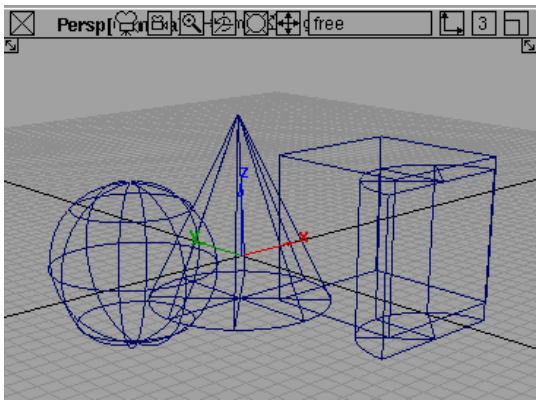
In general, you only need to learn three camera moves to model effectively: tumble, dolly, and track.



Because these camera movements are so common, Alias uses special hotkey/mouse combinations to access these movements quickly.

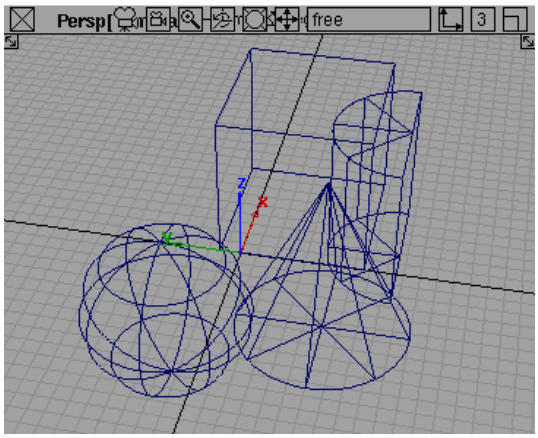
To use the camera move mode to move the camera in a perspective window

1. Hold down the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys. Keep the keys held down during the following steps.
2. Make sure the mouse pointer is over the perspective view window.



3 Drag the *left mouse button* to tumble the camera:

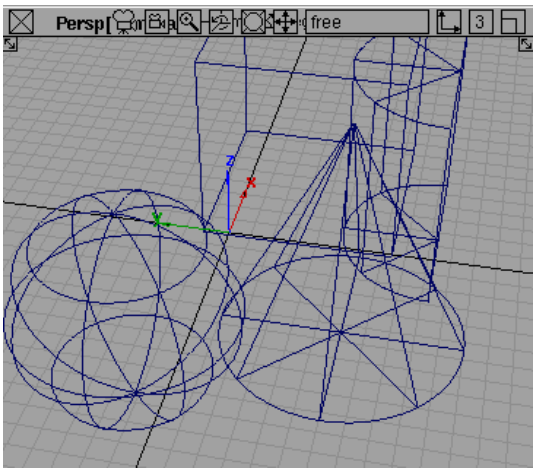
- Drag left and right to rotate the camera.
- Drag up and down to tilt the camera.



Tumbling the camera changes the azimuth and elevation angles of the camera.

4 Release the *left mouse button*, but keep the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys held down.

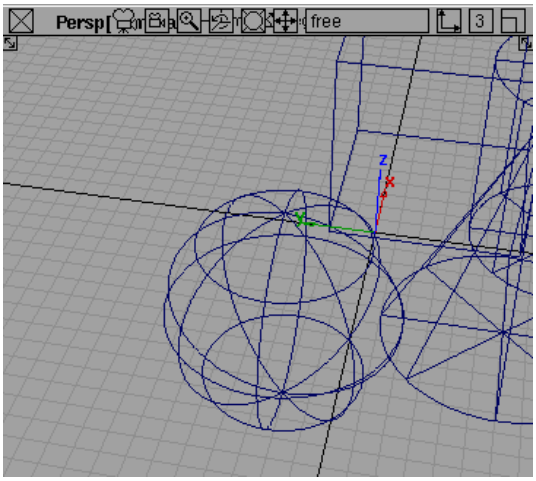
5 Drag the *right mouse button* to dolly the camera in and out.



Dollying moves the camera forward and backward.

6 Again, release the *right mouse button*, but keep the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys held down.

7 Drag the *middle mouse button* to track the camera.



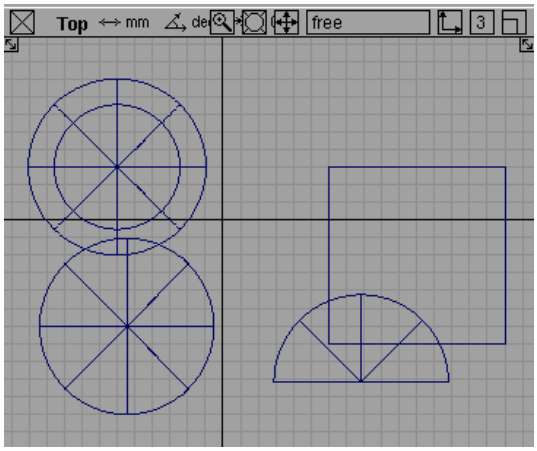
Tracking moves the camera, but does not change the direction in which the camera is pointing.

8 When you are done moving the camera, release the mouse button and the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys to exit camera move mode.

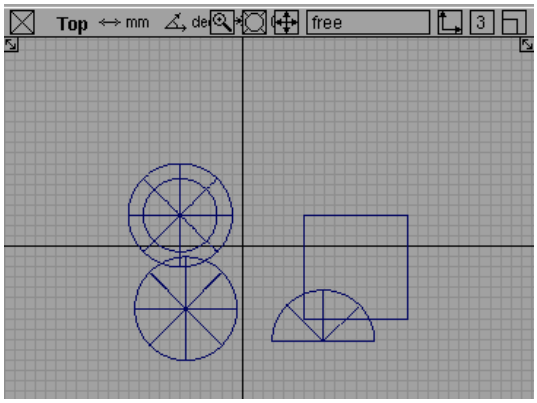
Now, try moving the camera in the orthographic windows.

To use the camera move keys to move the camera in an orthographic window

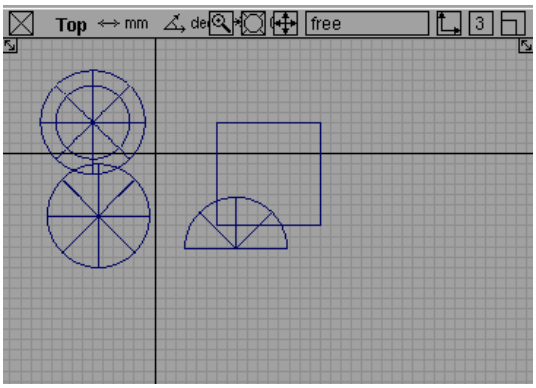
1. Hold the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys to enter camera move mode.
2. Make sure the pointer is over an orthographic window such as Top, Side, or Back.



3. Drag the *right mouse button* to dolly in and out.



4. Drag the *middle mouse button* to track up, down, left and right.



5 Now try dragging the *left mouse button* to tumble the orthographic view.

Nothing happens. You cannot change the view direction of orthographic windows. They always look in the same direction.

Moving the camera is a very important skill in Alias. Throughout these lessons, you need to move the camera to work with geometry.

Using the camera move mode soon becomes second nature. With practice, you will be able to move the camera where you need it without thinking about the keys or the mouse.

Practice tumbling, tracking, and dollying the camera around the model some more before you move on.

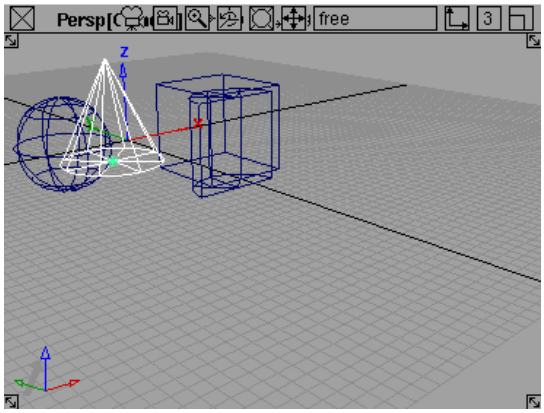
To use Look At to center on an object

1 Use the marking menus to choose the Pick > Nothing tool.

2 Remember that the *left mouse button* marking menu has the pick tools.

3 Now use the marking menus to choose the Pick > Object tool.

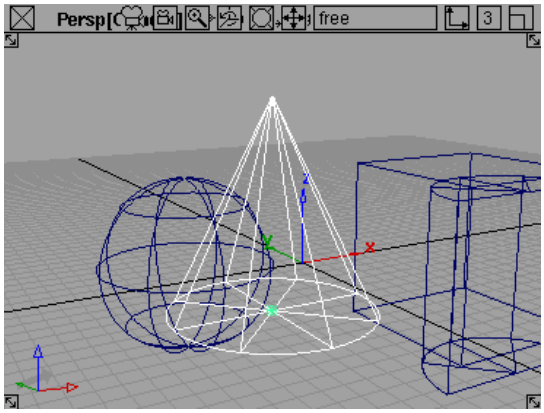
4 Pick one of the geometric objects you created earlier.



5 Find the **View** palette. It is near the bottom of the Palette window.

6 Choose the **Look At** tool.

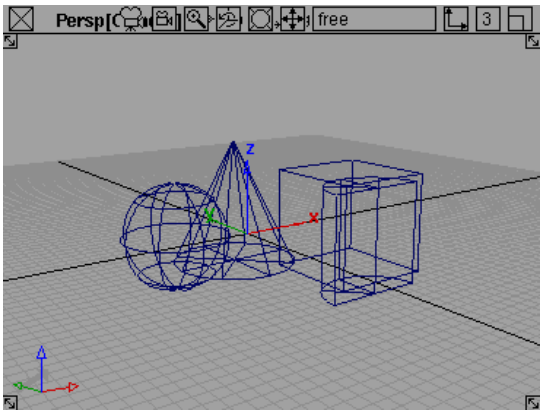
7 The active view window (the window with the white outline) changes to center on the picked object.



8 Pick nothing .

9 Use the **Look At** tool again.

10 The active view changes to center on all the existing geometry.



When you use **Look At** with nothing or everything picked, the view centers on all the geometry in the scene.

Look At is most useful to quickly find geometry that is outside the view of a window or too far to be seen clearly. Alias provides two additional tools to make it easier to move the camera around a model quickly: the "point of interest" and Viewing Panel.

Changing the Point of Interest

Normally, camera move mode (*Shift+Alt* (Windows) or *Shift+Command* (Mac)) is calibrated to best view objects at the origin (the center of world space, coordinate 0,0,0). This can become awkward when you want to move the camera around objects away from the origin.

The point of interest manipulator lets you center the camera movements on a point on the model.

To use the point of interest manipulator

First, make sure the point of interest manipulator is turned on.

1. Choose Preferences > General Preferences ❐.
   The General Preferences window appears.
2. Click **Viewing** on the left-hand side to open the Viewing section.
3. Turn on the **Use point of interest** option.

4 Change the **View Control** setting to **Viewing Panel**.

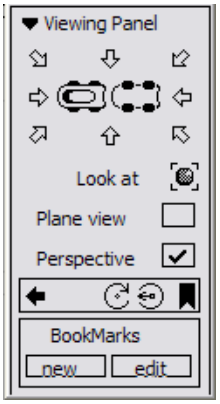
The ViewCube is the default view control, but we will use the Viewing Panel in these tutorials. The ViewCube and NavBar provide the same functionality as the Viewing Panel. For information, see Use the ViewCube tool and NavBar.

NOTE The point of interest manipulator works the same for both the Viewing Panel and the ViewCube and NavBar.

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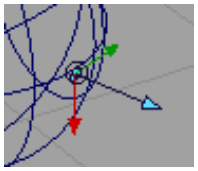
5 Click **Go** to close the window and use the new settings.

6 Hold down the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys to enter camera move mode. Keep the keys held down for the rest of this procedure.



The Viewing Panel appears in the upper left corner of the Perspective window.

7 Position the mouse pointer on the wireframe of one of the primitive objects and double-click with the *left mouse button*.



When you release the mouse button, the point of interest manipulator appears on the model where you clicked.

Drag with the *left mouse button* to tumble. The view tumbles around the point of interest.

8. Click and release on another point on one of the primitive objects.

   The point of interest manipulator jumps to the new point.

9. Drag the circle at the center of the point of interest manipulator.

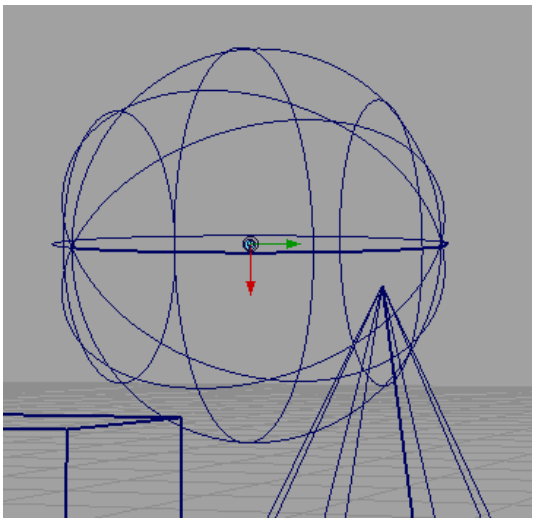
   The manipulator moves across the surface of the object.

10. Notice the light blue or yellow arrow extending from the center of the manipulator. This arrow indicates the normal at this point on the surface.

    The arrow is light blue when it is pointing toward you and yellow when pointing away.

11. Click the light blue or yellow arrow.

    The view changes to look at the point down the normal.

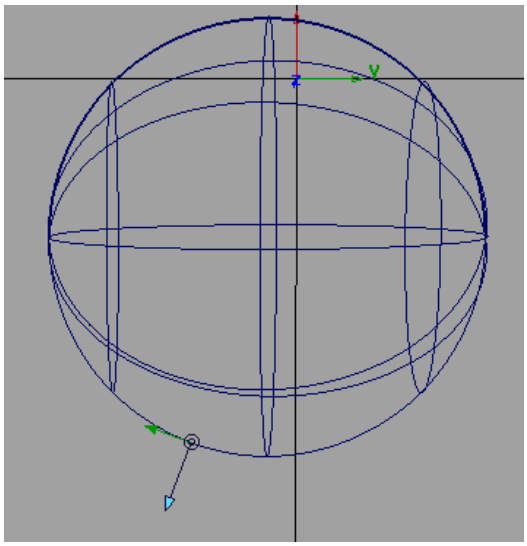


12. Now look for the red and green arrows extending from the center of the manipulator (tumble the view to show the arrows more clearly, if necessary).

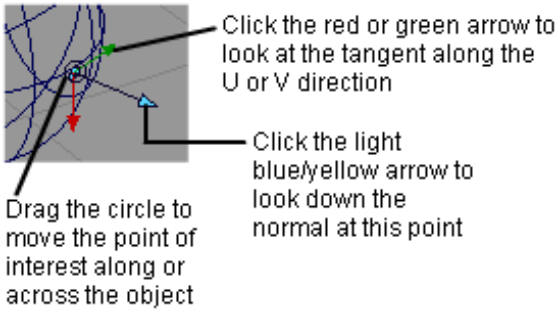
    These arrows represent the tangents along the U and V directions of the object.

13. Click the red arrow.

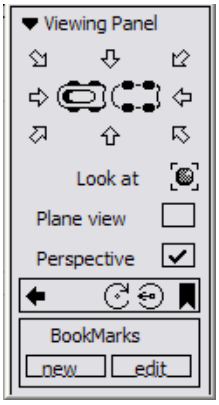
    The view changes to look down the tangent in the U direction.



Use the following overview illustration as a reminder of the different controls on the point of interest manipulator.



Using the Viewing Panel



The **Viewing Panel** appears when you enter camera move mode in the Perspective window.The ViewCube tool and NavBar appear by default, but you changed this setting in the previous section. This window lets you quickly switch the Perspective window to a default or user-defined view of the model.

As you work on the model, you will probably find yourself changing the camera view back and forth between two or more areas of interest. The **Viewing Panel** lets you "bookmark" views of the model and return to those views by clicking the name of the bookmark.

To use the Viewing Panel to move between different views

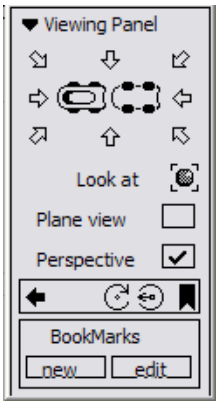
1. Click the maximize box in the upper right corner of the Perspective view window.

   The Perspective view window enlarges to full screen.

2. Open the **General Preferences** window and click **Go**.

3. Hold down the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys to enter camera move mode. Keep the keys held down for the rest of this procedure.

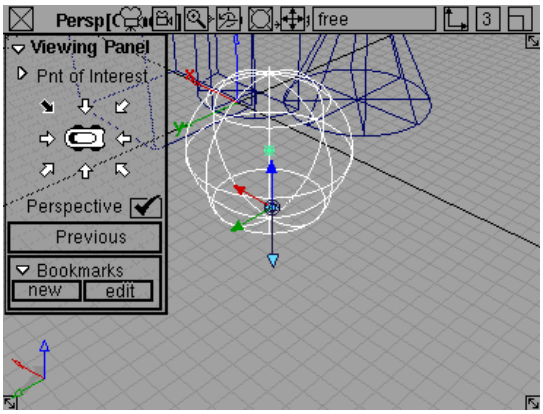


The Viewing Panel appears in the upper left corner of the Perspective window.

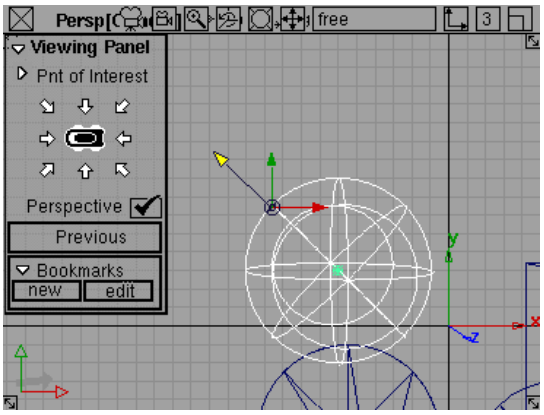
The images at the center of the panel (small icons of the top and bottom of a car) represent the model.

4 Click an arrow to view the model from one of eight different directions.

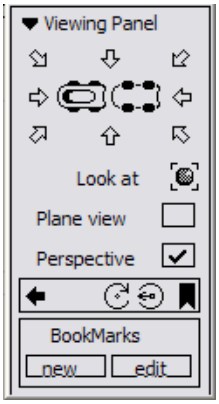
The horizontal and vertical arrows represent front, side, and back views. The diagonal arrows represent three-quarter views.



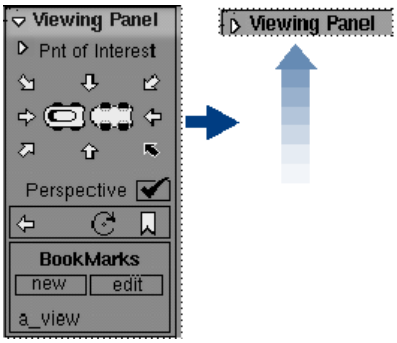
5 Click the left car icon to see a top view, or the right car icon to see a bottom view.



6 Click the white arrow near the bottom of the Viewing Panel to return to the view previous to your last camera move.



7 Click the **Viewing Panel** section heading at the top of the panel to collapse the entire panel into a small heading.

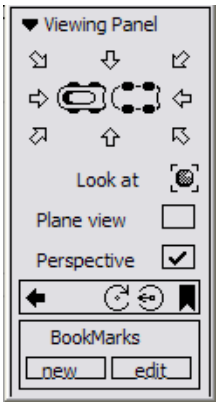


Use this technique to get the Viewing Panel out of the way when you want as much viewing area as possible.

To use the Point of Interest manipulator

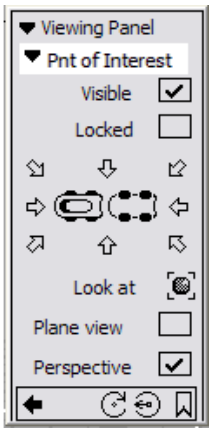
1 Hold down the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys, then press the *left mouse button* to open the Viewing Panel. Keep the keys held down for the rest of this procedure.

NOTE If the Viewing Panel does not appear, ensure that you are not clicking the left mouse button before holding down *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) .



2 Double-click an object. This shows the manipulator and adds **Pnt of Interest** to the Viewing Panel.

3 Click the arrow next to **Pnt of Interest** to see the options.



4 Turn off the manipulator by clicking the **Visible** check box to hide the point of interest manipulator.

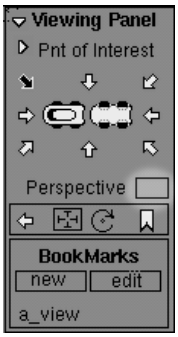
Turn the **Visible** check box on to show the manipulator again.

5 Turn on the **Locked** check box to keep the point of interest manipulator locked at its current position.

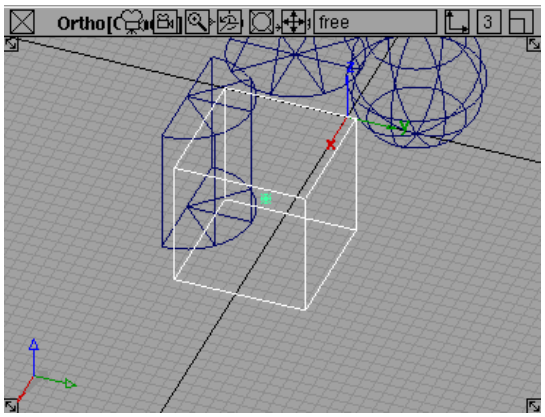
The manipulator does not move when you click at another point or drag its center handle. Use this option if you find you are moving the manipulator unintentionally.

Turn the **Locked** check box off to free the manipulator.

6 Turn off the **Perspective** check box.



The perspective view changes to an isographic projection.

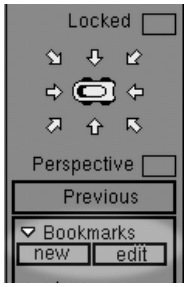


Many people find an isographic view easier for technical modeling, since parallel lines in the model remain parallel in the view window.

For the remainder of the tutorials, the screen shots will show isographic views. However, feel free to turn the **Perspective** checkbox back on if you prefer a perspective view.

To set and show bookmarks

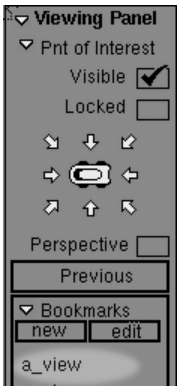
1. Move the mouse pointer over the Perspective view and hold down the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys, keeping them held down, to enter camera move mode.



2. With *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) still held down, find the **Bookmarks** section at the bottom of the **Viewing Panel**.

   If it is not visible, click the tag in the bottom right corner of the **Viewing Panel**. It turns white and the bookmarks section appears.

3. Click the **new** button in the bookmarks section.



A new bookmark appears at the bottom of the section.

4 Move the camera to a new view on the model.

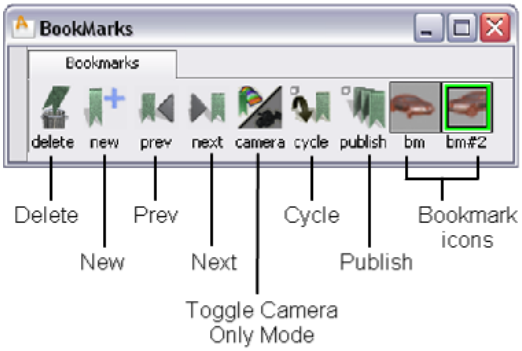
5 Click the **new** button again.
A second bookmark appears in the bookmark list.

6 Click the label for the first bookmark, then the second.
The view switches back and forth between the two bookmarked views.

NOTE To be able to distinguish between bookmarks later, you should rename them now.

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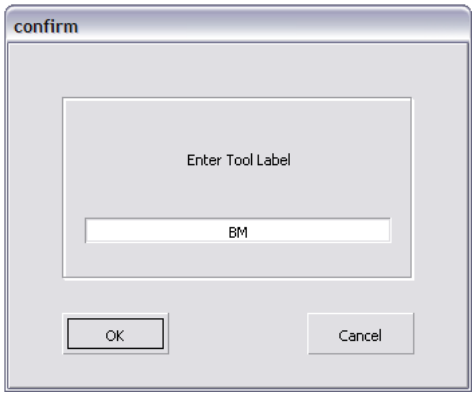
7 Click the **edit** button in the **BookMarks** section.
The **BookMarks Lister** window appears.



8 Release the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys.

9 Hold down the *Ctrl* (Windows) or *Control* (Mac) key and double-click the first bookmark icon in the Bookmark Lister.

A dialog box appears.



10 Type a new name for the bookmark, then click *OK*.

For production work, you should use meaningful names, such as “back panel” or “door handle”.

NOTE By default, bookmarks are named bm, bm#2, bm#3, and so on. Move the cursor over a bookmark icon to see its current name.

---

11 *Ctrl* (Windows) or *Control* (Mac) double-click and rename the other bookmark.

12 Note the buttons in the **Bookmark Lister** window:

- The **Delete** button removes the selected bookmarks (white outline) from the list.
- The **New** button adds a bookmark of the current view. This is the same as clicking **new** in the Viewing Panel.
- The **Prev** and **Next** buttons change the view to the bookmark that precedes or follows the highlighted bookmark (green outline).
- The **Toggle Camera Only Mode** button displays bookmarks either with the camera view only, or with both the view and display attributes (default).
- The **Cycle** button displays the bookmarked views in a slideshow fashion.

- The **Publish** button saves the selected bookmarks, current shelf bookmarks, or all bookmark(s) as image files on your disk.
- Clicking on a bookmark icon changes the view to that bookmark. This is the same as clicking a bookmark in the **Viewing Panel**.
- Clicking the *right mouse button* in an empty part of the **Bookmark Lister**, and choosing **New shelf** from the drop down menu creates a new shelf.

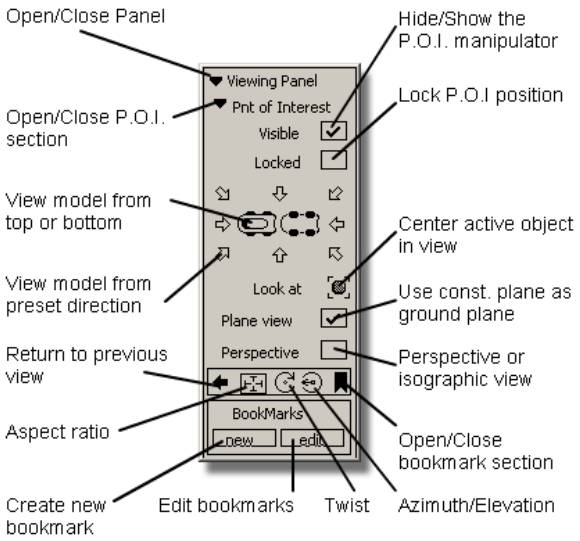
13 Close the **Bookmark Lister**.

14 Hold the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys in the Perspective window to show the **Viewing Panel**.

Notice your new names in the **BookMarks** section.

See also Windows > Bookmark Lister.

Use the following overview illustration as a reminder of the different controls on the Viewing Panel.



NOTE The **Twist** and **Azimuth/Elevation** tools rotate the view around the point of interest.

See also:

- Use the view panel

Understanding the Object Lister

Alias keeps track of every aspect of the scene in a hierarchical data structure. You can view representations of this structure through the SBD (scene block diagram) or through the Object Lister.

Curves, surfaces, groupings, transformations, components, lights, and everything else in the scene is represented by nodes in the hierarchy.

You may want to use the Object Lister in the following circumstances:

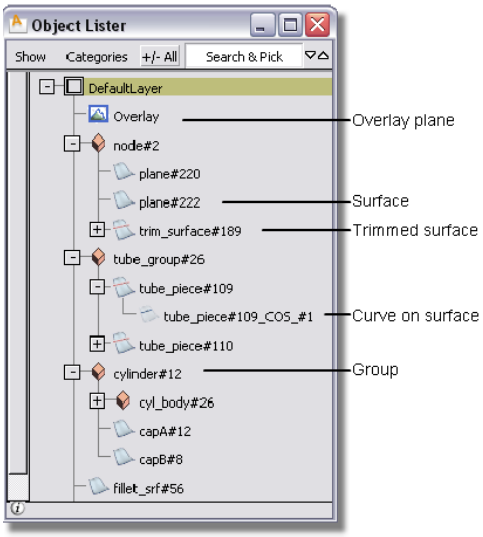
- In complex models, it can be easier to pick objects in the Object Lister than in a view window.
- The Object Lister shows important information that has no visual equivalent in the view windows, such as how the components and objects are grouped, and how they relate to modeling layers.
- The Object Lister lets you confirm the effects of tools and menu items on the internal structure of the scene to help diagnose problems.

Types of Nodes

Information of different types is associated with nodes in the hierarchical data structure. These nodes can represent surfaces of different types, curves, lights, or groups of objects.

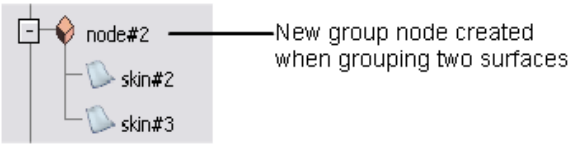
Different types of geometry are indicated by different icons.

For a full list of icons, see Windows > Object Lister .



Node States

- Grouped: you can group several objects. In the Object Lister, this is represented by putting the objects under an orange block.



- Instanced: you can duplicate an object as an “instance”. Instead of a new object, an instance is just a pointer to existing geometry. It is represented in the Object Lister as a white cube. As well, the object that has been instanced gains a node underneath.

- Compressed: as the Object Lister becomes busier, you may want to collapse a part of the graph into a single node. The node with other nodes below it has a plus sign (+) in front of it. Nodes that have been expanded and can be collapsed have a minus sign (-) in front. *Shift* -click a **-** or **+** sign to expand or compress the entire hierarchy.

- Invisible: you can make objects in the scene invisible. Nodes for invisible objects have gray text.

- Templated: you can “template” objects in the scene so they are still visible, but cannot be transformed or picked. Nodes for templated objects do not change their appearance; however, when the object is picked, in the view windows, it will be pink. When inactive, gray.

The Object Lister window

To view and pick using the Object Lister window

1. On the **Windows** menu, choose **Object Lister**.
   The **Object Lister** window appears.

   The graph in the window is the diagram representing the current scene.
2. Use the scroll bar on the left to move through the graph.
   The nodes are labelled with their names and icons showing their types.
3. Click a geometry node in the **Object Lister** window.
   The corresponding object in the scene becomes picked.

Pick > Object and Pick > Component

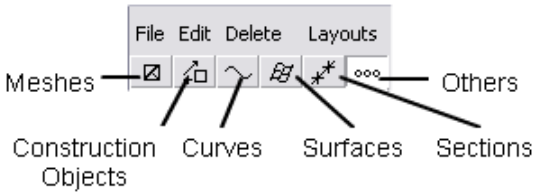
Unlike in the modeling windows, you can use either Pick > Object or Pick > Component to select whole objects or parts of objects in the Object Lister. In this section, you will compare picking in the modeling window with picking in the Object Lister.

To pick using Pick > Object and Pick > Component

1. Choose Pick > Nothing .
2. In the Object Lister window, click the plus (+) sign beside the cube to open its representation.

   You can see that the cube is constructed of six planes that are grouped.
3. Choose Pick > Object and pick the cube in a view window.
4. In the **Object Lister** window, you can see that the grouping node is picked.
5. Choose Pick > Component .

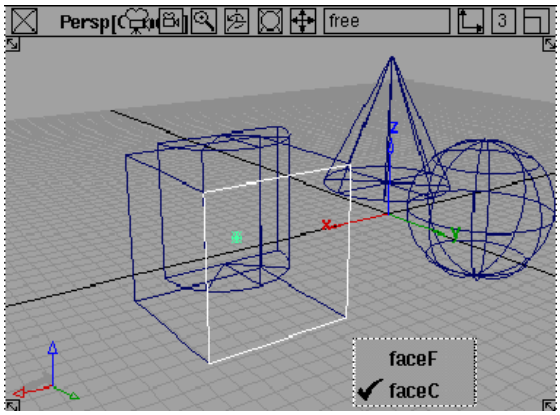
6 Find the component filter buttons to the left of the promptline. These buttons appear when the Pick > Component tool is active.



7 Make sure the **Surfaces** button is pushed in.

8 Click the cube.

- Since you must click an edge, which is shared by two sides, a small box appears under the mouse pointer with the name of both sides. Click the name you want.
- The Pick > Component tool only picks one side of the cube.



In the **Object Lister** window, you can see that instead of picking the entire group, the Pick > Component tool picked one of the subnodes

9 Instead of choosing Pick > Component and having difficulties selecting a surface that can be attached to or overlaid by another surface, you can click the subobject directly in the **Object Lister**.

Conclusion

You now know how to:

- Log into the system and start Alias.
- Get help.
- Arrange windows.
- Use tools and tool options.
- Customize shelves and marking menus.
- Tumble, track, and dolly the view.
- Use the **Object Lister** window to understand the internal representation of the model.

Introduction to 3D

4

Learning Objectives

In this introductory modeling tutorial, you will start working with 3D space.

You will learn how to:

- create primitive objects
- duplicate objects
- move, scale, and rotate objects
- group and organize components
- save files

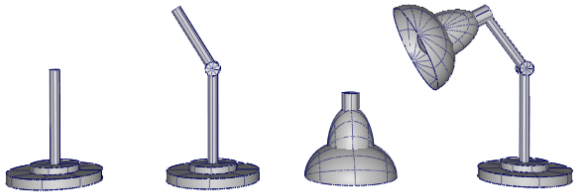
This tutorial introduces you to working in 3D space, using the Autodesk Alias modeling environment. You will build a desk lamp from cylinders and spheres using the Alias Surfaces menu. As you build up the design, you will get used to moving, scaling and rotating objects in 3D space.

You will learn how to group and organize the desk lamp, so that you can rotate the component parts to simulate the operation of a real lamp.

Beginning a Model

Desk lamp modeling strategy

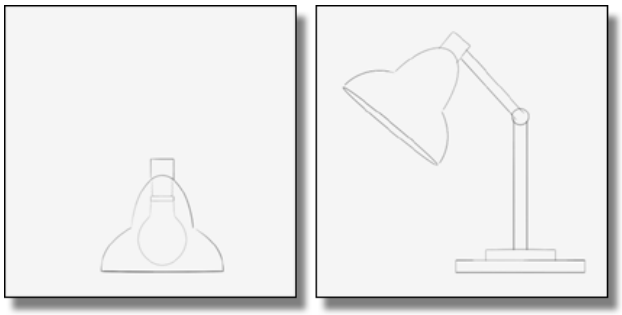
The modeling strategy for building the desk lamp model is shown below.



First, you will create a base from cylinders. Then, you will build a moveable arm at an angle, also using cylinders. Finally, you will build a lampshade using spheres, which will then be assembled onto the arm.

As you gain experience in using Alias, choosing a modeling strategy will become a natural part of your workflow.

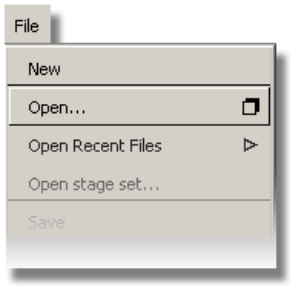
To help you build the desk lamp model, an exercise file has been provided which contains outline sketches of the design.



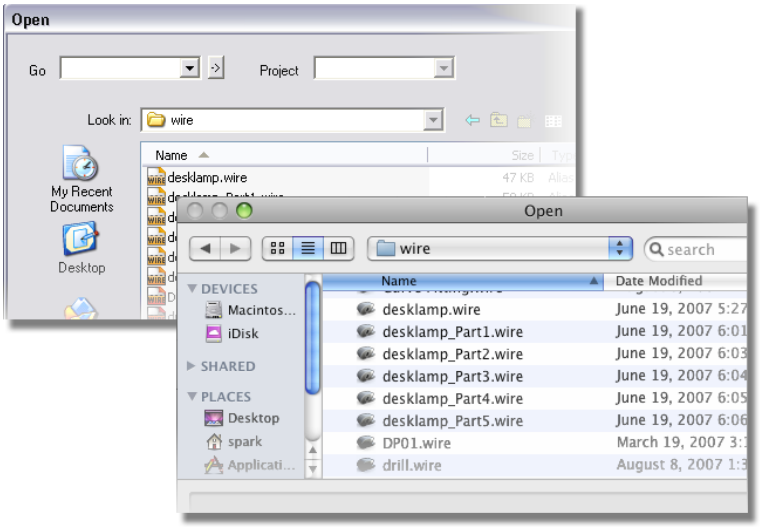
Opening the tutorial file


Watch **how to open files** and set projects.

1 Choose File > Open to open the **File Browser**.

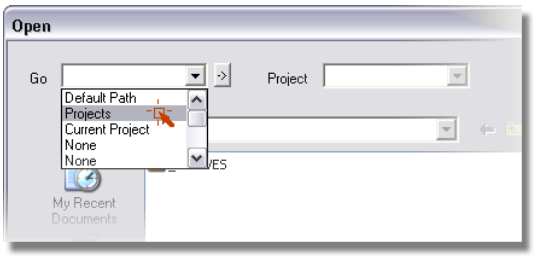


The file browser window appears.

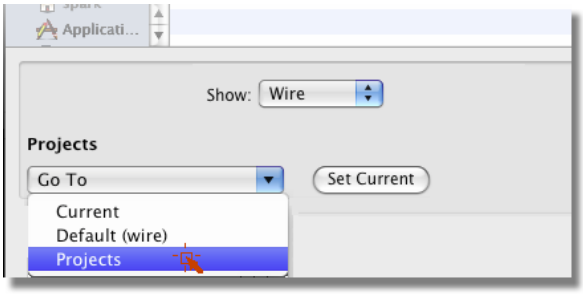


If the `desklamp` file is shown, jump to step 2. If not, follow the next steps to set up the `CourseWare` directory.

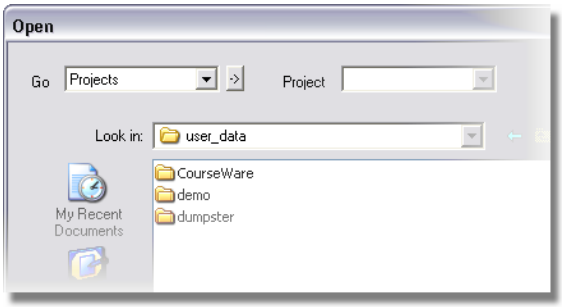
On Windows, click the arrow next to the **Go** field and select **Projects** to open the `user_data` directory.



On Mac OS X, select **Projects** from the **Projects** drop-down list to open the `user_data` directory.

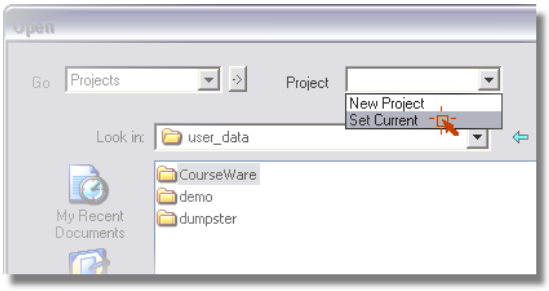


The projects in the `user_data` directory are displayed. If the `CourseWare` project is not shown, refer to To install the courseware for use with Alias on page 14.

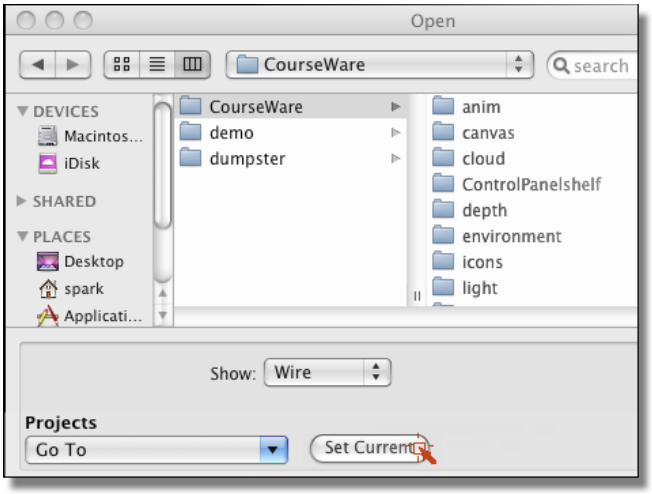


Make the CourseWare directory the current project and open its `wire` subdirectory as follows:

- On Windows, click the `CourseWare` directory and choose **Project > Set Current**.

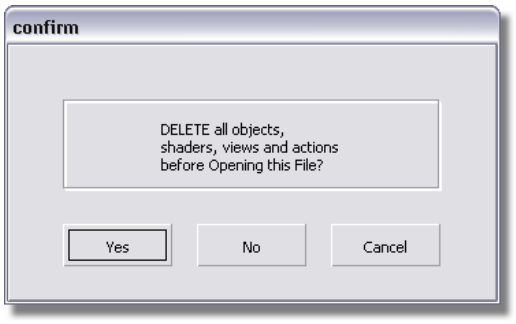


- On Mac OS X, click the `CourseWare` directory, click **Set Current**.

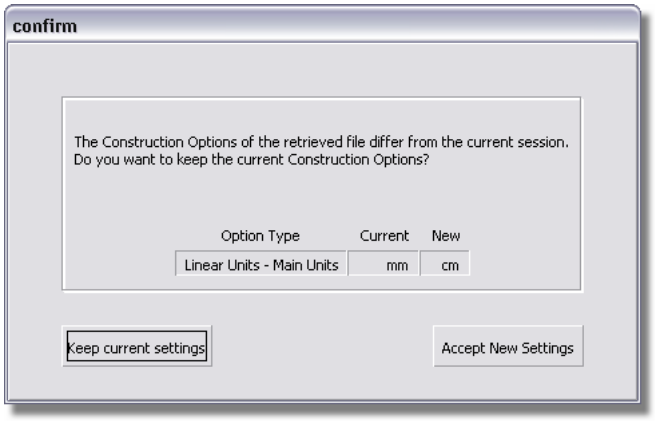


2 In the `wire` directory, choose the file `desklamp` and click **Open**. Alternatively, double-click the file to open it.

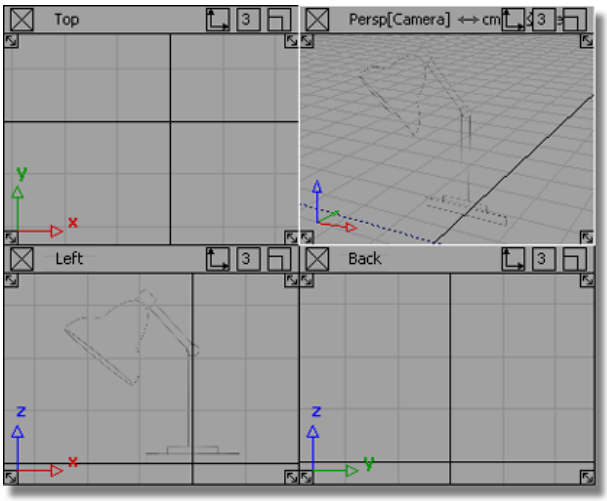
When prompted to delete all objects, click **Yes**.



NOTE If your values for construction settings differ from those in the `desklamp.wire` file, you are presented with a dialog box. Click **Accept New Settings** to use the construction settings in `desklamp.wire`.



The file browser closes and the desk lamp exercise file appears in the Alias window.



A sketch of the desk lamp design displays in the Left view. This sketch is a reference image, known as a canvas plane. You will use it as a guide to model the desk lamp.

If the two sketches do not appear, it is because the canvas plane display has been turned off. To turn on canvas display, choose WindowDisplay > Toggles > Canvas Planes .

TIP If you do not see any views, or the views do not take up the full view window space, choose Layouts > All Windows > All Windows .

Part 1: Creating 3D objects

In this section you will create a primitive object, a cylinder, for the base of the desk lamp.


Watch **Part 1** of the tutorial.

Creating a Primitive Object

What are Primitives?

Primitives are ready-made objects in familiar shapes. The primitives are made from a single surface, or a group of surfaces that form an enclosed volume.

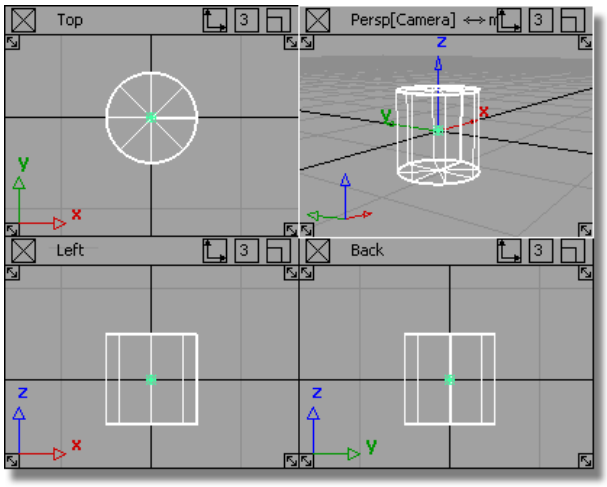
In Alias, you can create the following primitives:

- Sphere
- Torus
- Cylinder
- Cone
- Cube
- Plane

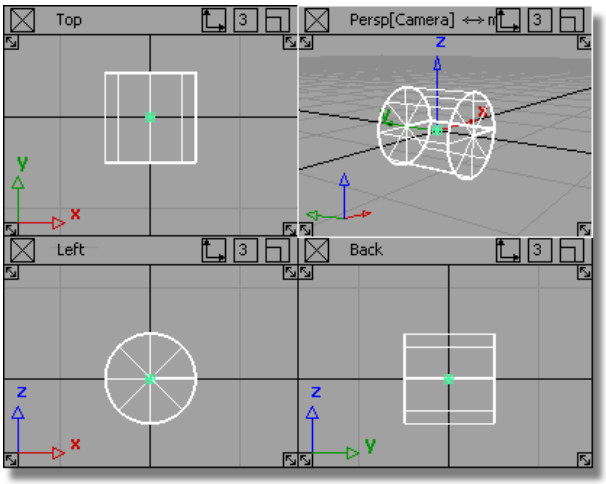
Placing Primitives in views

Use the 2D views (Top, Left, and Back) to place the primitives. Which window you choose affects which way up the primitive is created.

For example, placing a cylinder in the Top view creates a pillar.



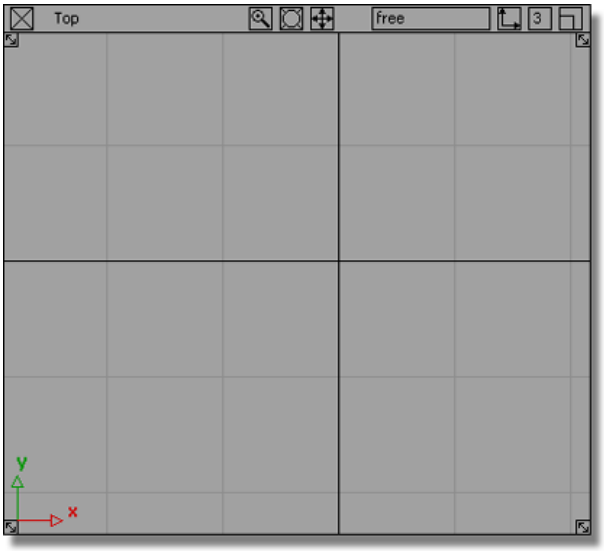
Placing the cylinder in the Left or Back views creates a ‘fallen pillar’, or a ‘log’.



Creating the lamp stand

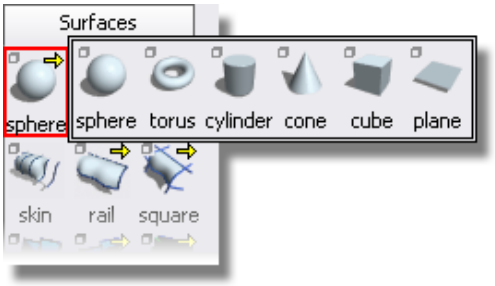
Now create a cylinder for the base of the lamp stand.

1 Create the first cylinder using the Top window.
Maximize the **Top** view.



2 Choose Surfaces > Primitives > Cylinder from the palette. If the palette is not open, choose Windows > Palette from the menu bar.

3 To choose the **Cylinder** tool, press and hold the mouse button, so the cursor is over the **Sphere** icon until the entire **Primitives** drawer appears.



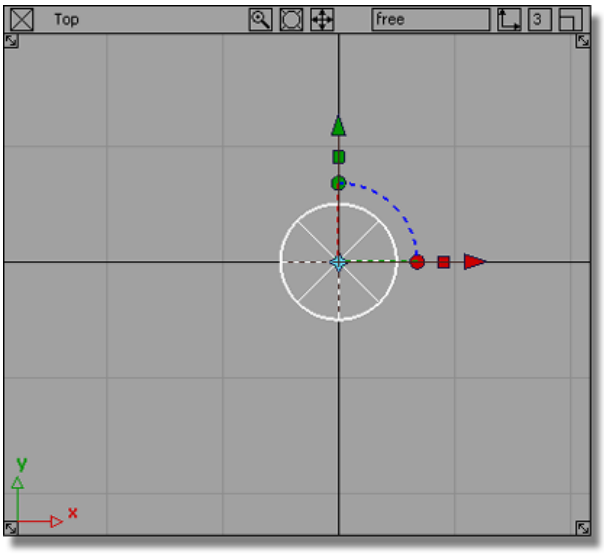
Then, click the **Cylinder** icon to choose the **Cylinder** tool.

The **Cylinder** tool is displayed in the **Surfaces** palette, and is outlined in red to indicate it is the active tool.

4 You can control the exact placing of a primitive using various snapping modes. In this section, use grid snapping to align all the cylinders centrally on the grid origin. The grid origin is where the two dark grid lines cross.

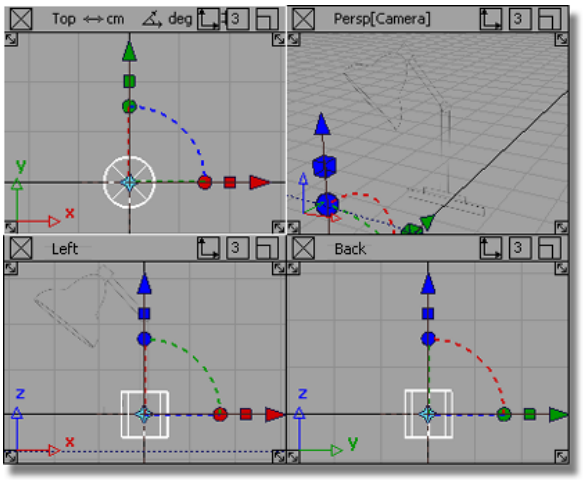
Hold down the *Alt* (Windows) or *Command* (Mac) key to turn on grid snap mode.

Press and hold the *Alt* (Windows) or *Command* (Mac) key near the origin. Keep your finger held down on the *Alt* (Windows) or *Command* (Mac) key and move the mouse until the new cylinder snaps to the correct grid point.



Release the *Alt* (Windows) or *Command* (Mac) key and the mouse button.

5 Choose Layouts > All Windows > All Windows or press the *F9* key to display all four views, and check that the cylinder has been placed correctly, as shown.



The cylinder remains picked, or active. Picked objects are drawn with white lines, and objects that are not picked are drawn with dark blue

lines. Most tools and commands work on picked objects. Since the Cylinder is picked, any tools or commands you choose will be applied to it.

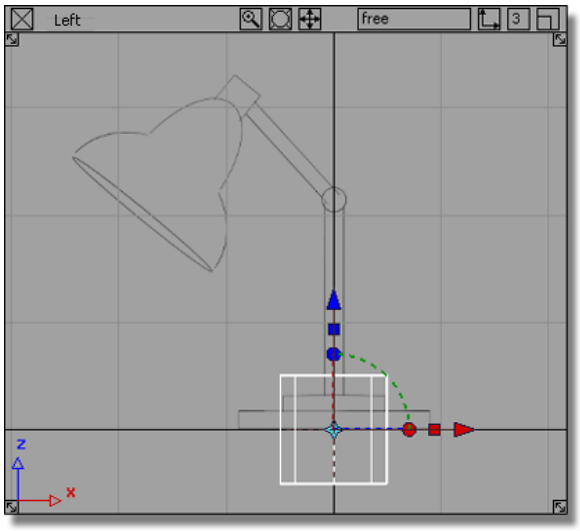
NOTE The cylinder has a manipulator attached to it, as do all primitives when they are first added to the scene. The manipulator can be useful for transforming a primitive, but is not relevant to this tutorial.

TIP To delete the cylinder, press the *Delete* key.

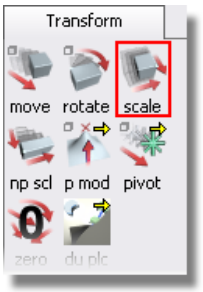
Scaling the lamp base

Next scale the cylinder to the correct size.

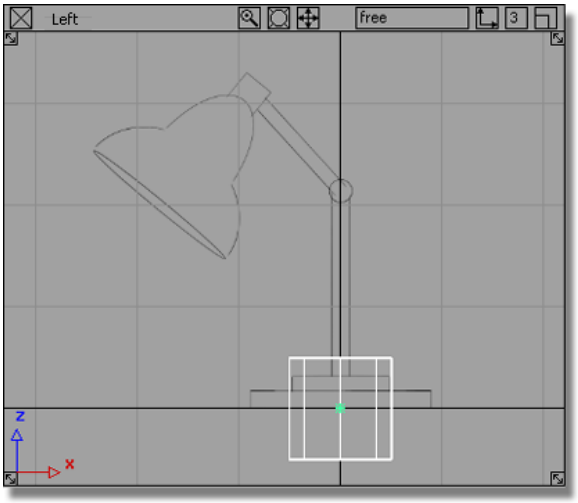
1 Maximize the **Left** view, as this is the view you will continue working in.



2 Choose Transform > Scale .

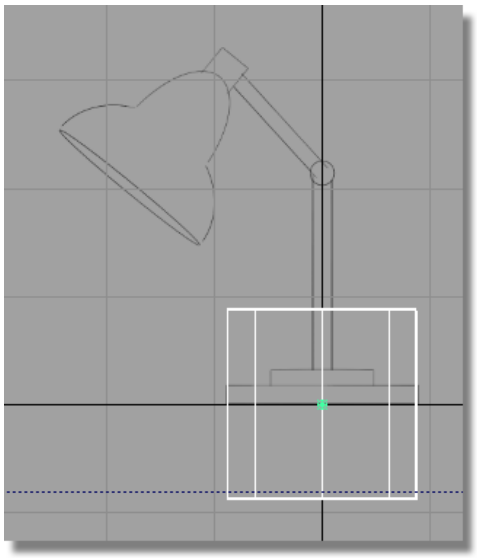


The **Scale** icon is outlined in red to indicate it is the active tool. At the same time, the cylinder's manipulators disappear.

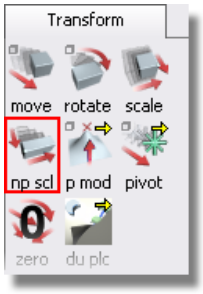


3 Click and drag the *left mouse button* to scale the cylinder equally in all axes.

Scale the cylinder to roughly fit the width of the bottom cylinder shown on the sketch. This forms the base of the lamp.



The Transform > Non-p Scale tool (non-proportional scale) modifies the x, y or z scale of an object separately. This allows an object to be stretched or squashed.



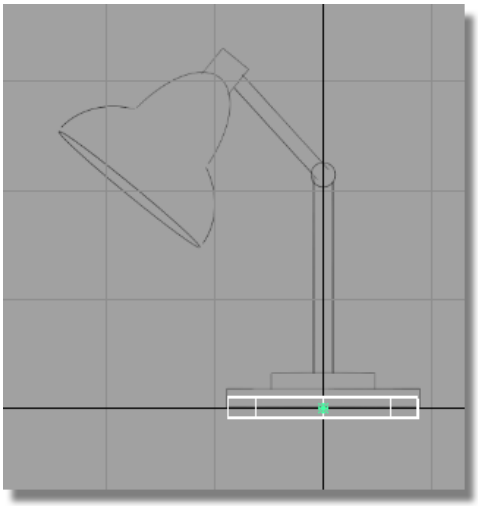
The mouse buttons are used to control the non-proportional scaling. For this section, use the 2D views (Top, Side, and Back) to control the transforms. In these views, the mouse buttons work as follows:

Left mouse button		free transform

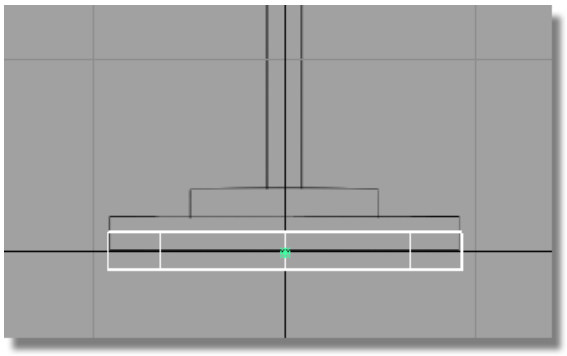
Middle mouse button		horizontal transform
Right mouse button		vertical transform

Next use the *right mouse button* to adjust the vertical height of the base.

1. Choose Transform > Non-p Scale .
2. Click and drag with the *right mouse button* to adjust the height of the cylinder. Make the height approximately the same as shown in the sketch.



NOTE The cylinder is centered on the origin.



Later, you will line up the cylinder to the grid line, to make the lamp base sit on the ground.

Saving your work

Now save the lamp as a new file.

It is always important to save your work at each stage. However, to safeguard the files in the CourseWare project, it is write-protected. You cannot save any new work in the CourseWare project.

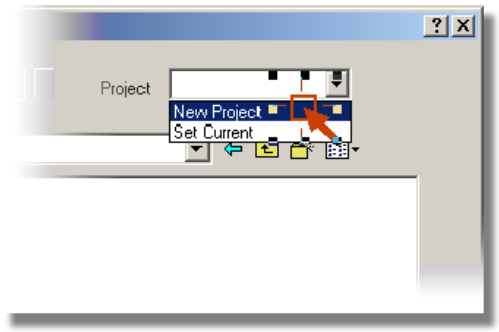
To save your work you must create a project directory. Project directories are special directories created by Alias that allow you to efficiently store all the files related to a specific project together.

Saving your work in a Windows environment

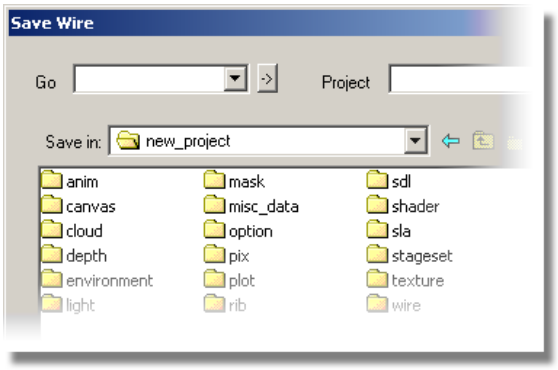
1. Choose File > Save As .

   The File Browser opens.

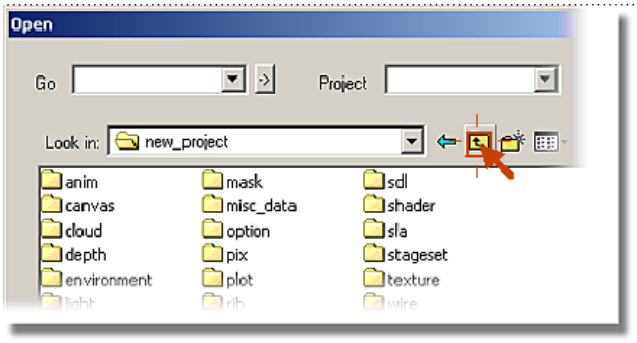
2. Click the arrow next to the **Project** field and choose **New Project** from the menu.



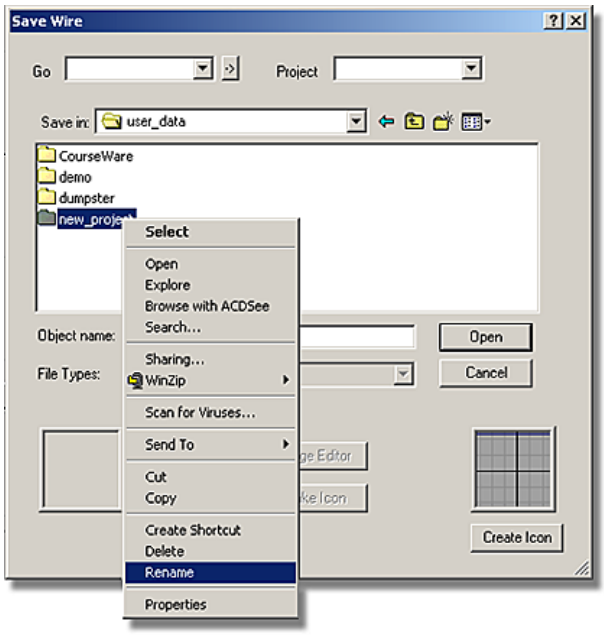
A new project is created which is immediately displayed in the File Browser.



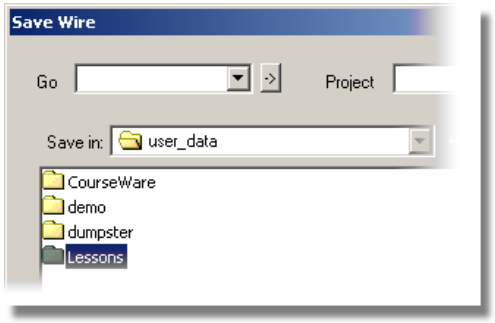
3 Click the **Up 1 level** button to move up one directory. This is the `user_data` directory that contains all the projects, including the `new_project`.



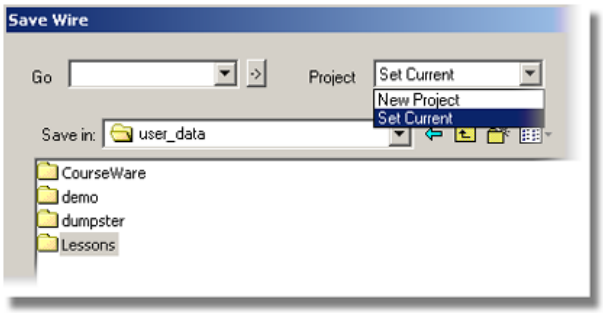
4 Click the *right mouse button* on the `new_project` directory and choose **Rename** from the menu.



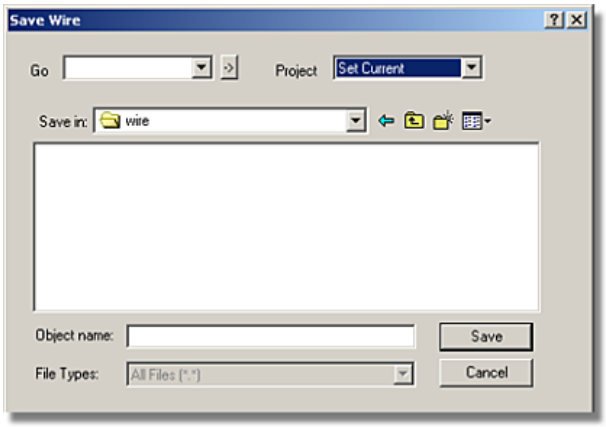
5 Type `Lessons` and press *Enter* (Windows) or *Return* (Mac).



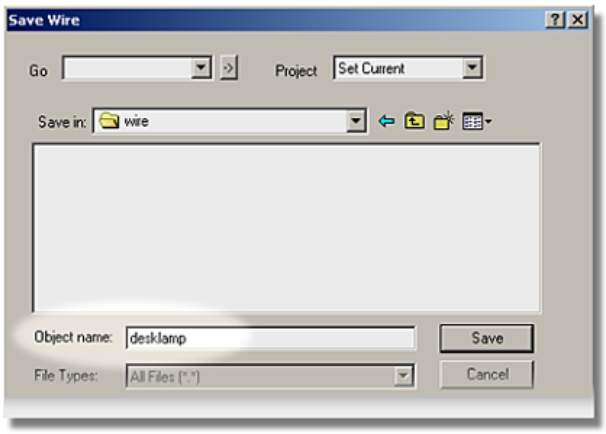
6 Click the arrow next to the **Project** field and choose **Set Current** to make `Lessons` the current project.



The wire directory of the `Lessons` project is now displayed in the File Browser.



7 In the **Object** name field, type `mydesklamp` and press *Enter*.

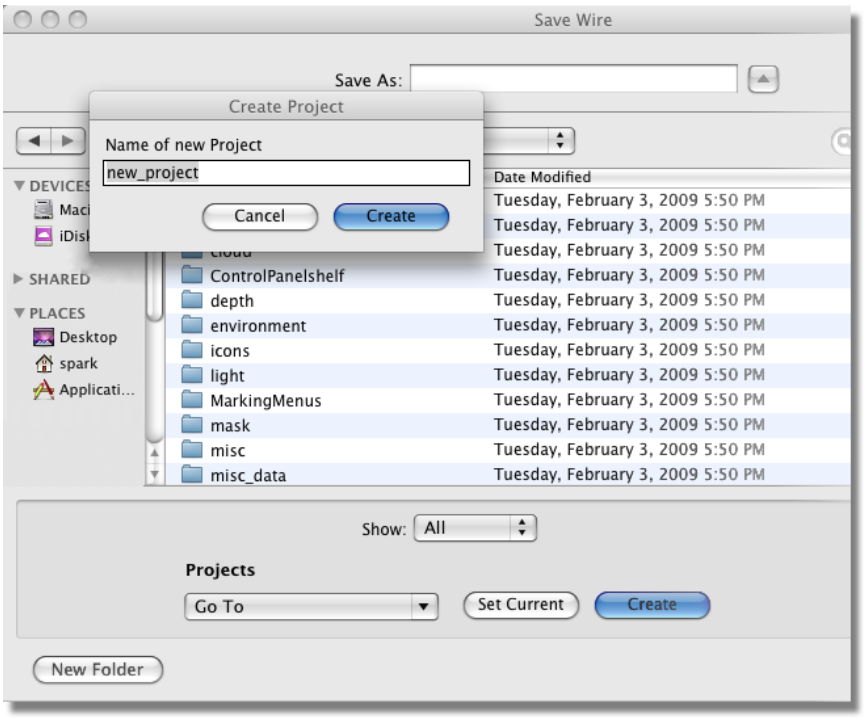


Alias saves the file `mydesklamp.wire` in the `Lessons` project.

TIP It is good modeling practice to save often as insurance against having to start from the very beginning if you make a mistake.

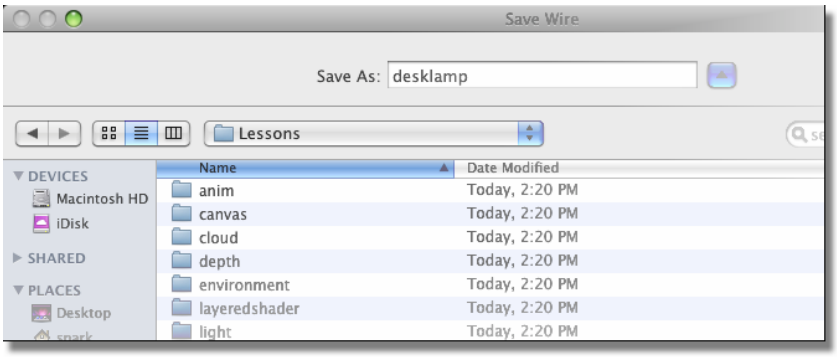
Saving your work in a Mac OS X environment

1. Choose File > Save As .
   The File Browser opens.
2. Click **Create** and in the **Name of new Project** field, type the project name `Lessons`.

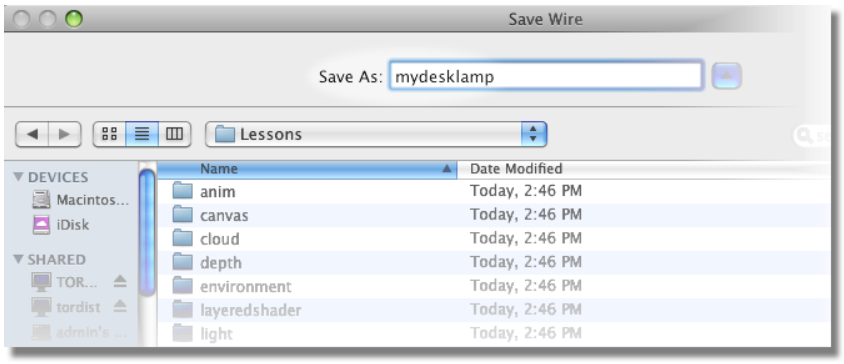


3 Click **Create**.

A new project is created which is immediately displayed in the File Browser.



4 In the **Save As** field, type `mydesklamp` and press *Return* .



Alias saves the file `mydesklamp.wire` in the `Lessons` project.

TIP It is good modeling practice to save often as insurance against having to start from the very beginning if you make a mistake.

Part 2: Building the lampstand

In this section, you will continue to build the lamp stand from cylinders.

 Watch **Part 2** of the tutorial.

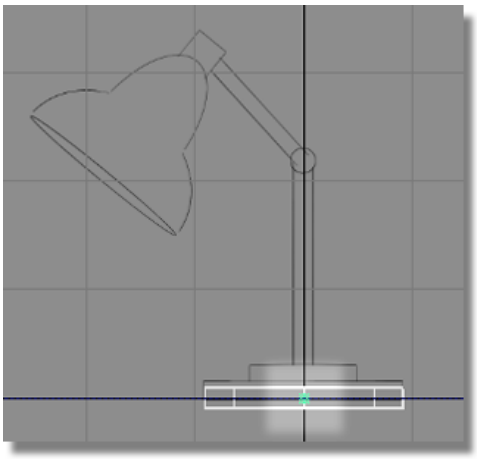
Aligning the base to the grid

Next, align the cylinder to the grid in the Back view, to make the cylinder look like it is sitting on the ground. To do this accurately, you need to set the pivot point of the cylinder.

Pivot points

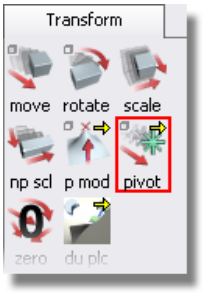
When scaling or rotating an object, the transformation is applied about the object's pivot point. When moving and snapping an object, it is the pivot point that is snapped to the specified position.

The pivot point is indicated by a small green icon. This is displayed only when the object is picked. By default, the pivot is at the center of the primitive.



The position of the pivot is modified using the **Transform > Local > Set Pivot** tool.

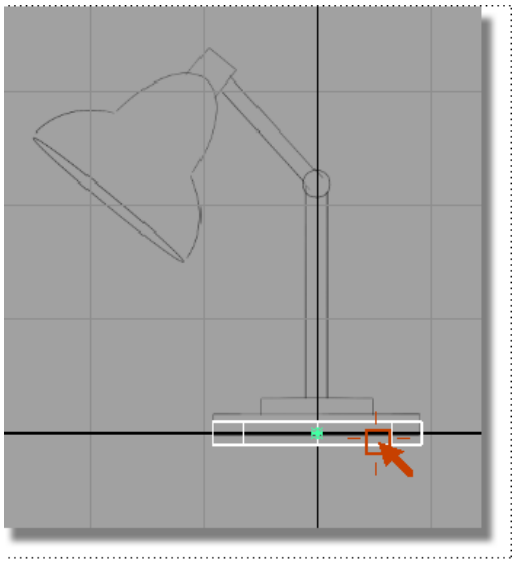
1 Choose Transform > Local > Set Pivot .



2 The pivot needs to be at the base of the cylinder. To move the pivot point to the base use curve snapping and select the bottom line of the cylinder.

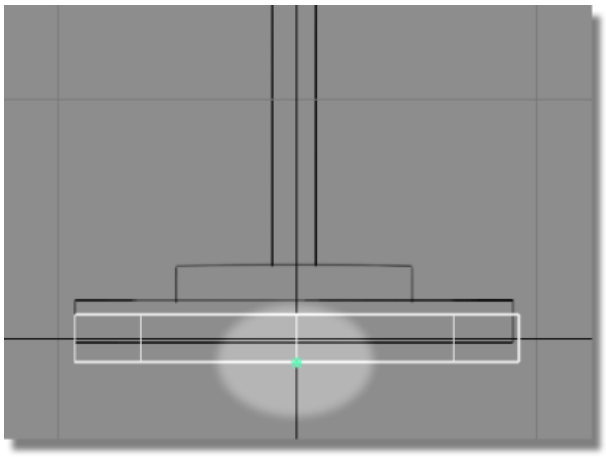
Hold the *Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac) keys down together to turn on curve snapping.

3 Click the bottom edge of the cylinder with the *right mouse button*. Using the right mouse button keeps the pivot point centered as it moves downwards.



The pivot point snaps precisely onto the bottom edge of the cylinder.

Release the *Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac) keys and the mouse button.



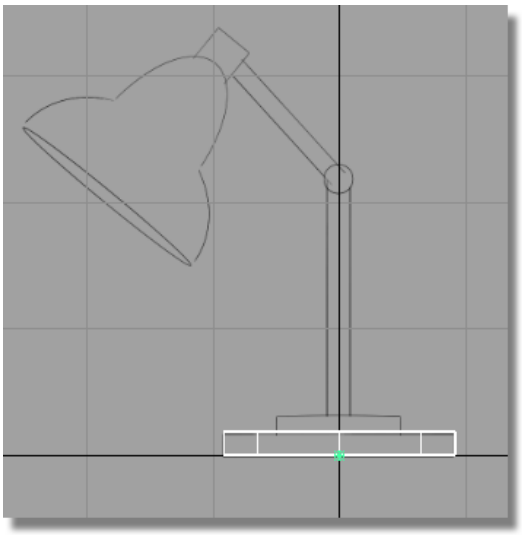
TIP If you make a mistake, choose Edit > Undo to step back.

Next, move the cylinder onto the grid.

4 Choose Transform > Move .

5 Hold down the *Alt* (Windows) or *Command* (Mac) key to turn on grid snap mode, and press and drag with the *left mouse button* in any direction. The cylinder moves so that its pivot point always snaps to a grid intersection.

Drag the cylinder to the origin.



Release the *Alt* (Windows) or *Command* (Mac) key to turn off grid snap mode.

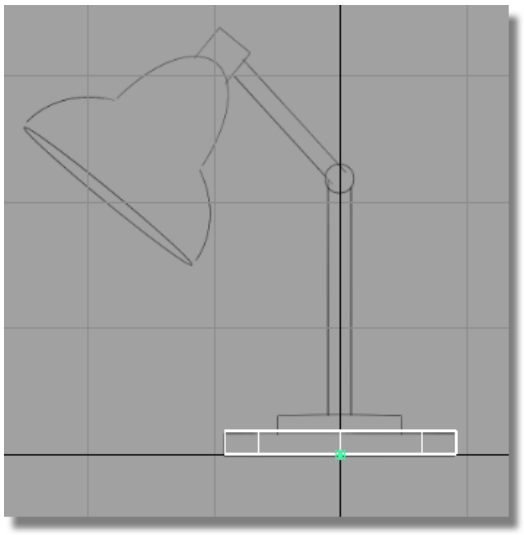
NOTE You can adjust the height of the base again using Transform > Non-p Scale and the *right mouse button*. The location of the pivot point makes the scaling easier to control.

Duplicating the cylinder

The cylinder now has a convenient pivot point location. To save time, copy this cylinder and then move and scale it to create the other components.

1 With the cylinder still picked, choose Edit > Copy .

2 Choose Edit > Paste .



Your screen appears not to have changed. However, a second cylinder has been placed in the same location as the first, and is selected, ready to be moved or scaled.

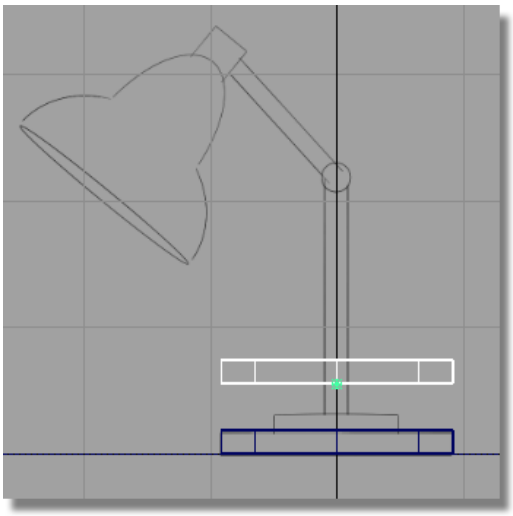
3 Choose Transform > Move .

4 As the cylinder is already selected, you do not need to click the cylinder to move it.

NOTE When there are many objects on the screen, it is preferable to click away from the object when using any of the transform tools.

---

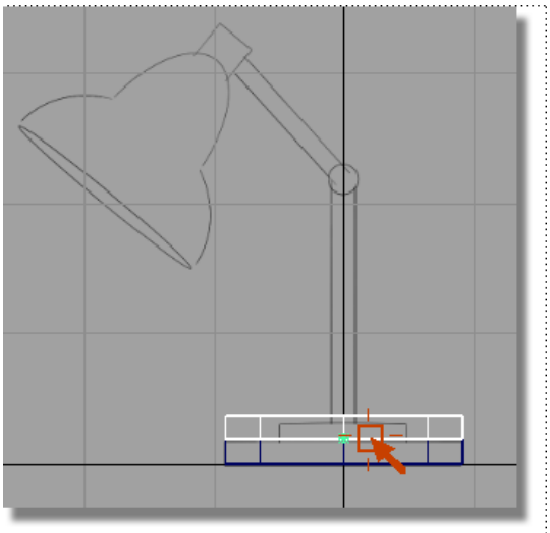
5 Click and drag using the *right mouse button* (away from the objects) to move the new cylinder vertically away from the original.



Next, snap this cylinder to the top of the first cylinder.

6 Check that the **Transform > Move** tool still has the red box outline, so it is active. If it is not active, choose it again.

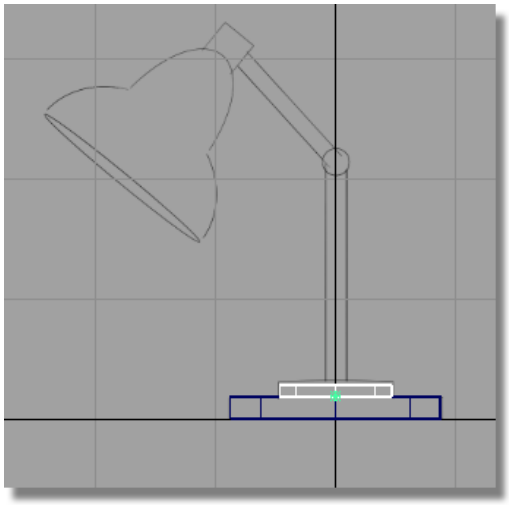
Hold down the *Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac) keys together to turn on curve snapping. Click the top edge of the original cylinder with the *right mouse button*.



The second cylinder moves to the top of the first cylinder.

Release the *Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac) key to turn off curve snap mode.

7 Choose Transform > Scale and use the *left mouse button* to scale the cylinder to match the width shown in the sketch.



8 Choose Transform > Non-p Scale and use the *right mouse button* to adjust the height of the cylinder to match the sketch.

NOTE When clicking and dragging the mouse, click in the background, away from all objects. This ensures that no objects get accidentally picked or scaled.

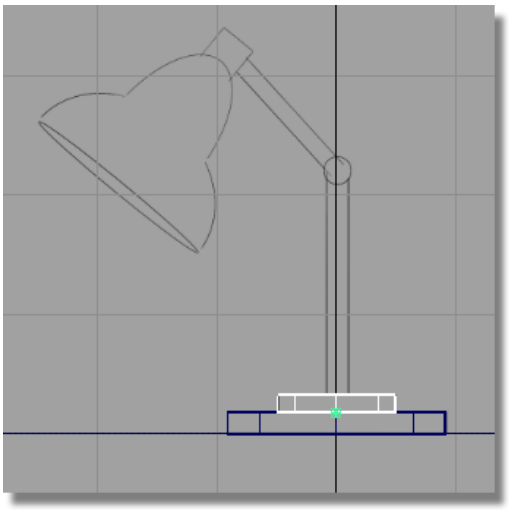
Creating the lamp pillar

The same technique can be used to create the main pillar of the lamp stand.

1 With the second cylinder still selected, use Edit > Copy

followed by Edit > Paste

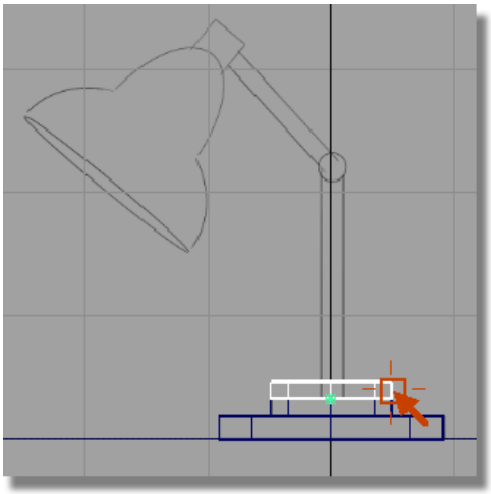
to create a third cylinder.



A third cylinder is created in the same position as the second, and is active, ready to be moved.

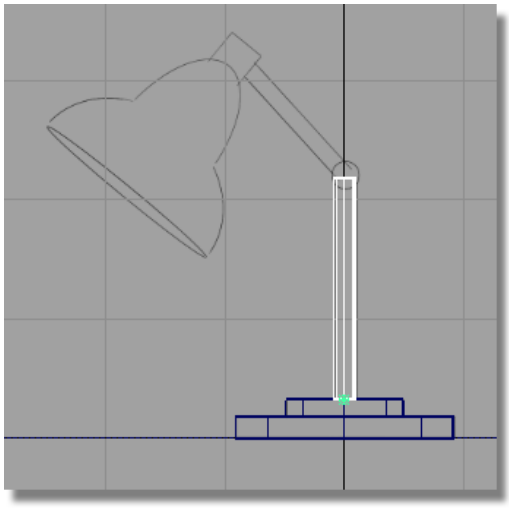
2 Choose Transform > Move . Hold down the *Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac) keys to turn on curve snapping mode.

3 Click the top edge of the second cylinder to move the new cylinder into place.



4 Choose Transform > Scale and use the *left mouse button* to scale the cylinder. Resize the cylinder to match the width of the pillar. Remember to click and drag in the background, away from the objects.

5 Choose Transform > Non-p Scale and use the *right mouse button* to adjust the height of the cylinder to match the sketch.

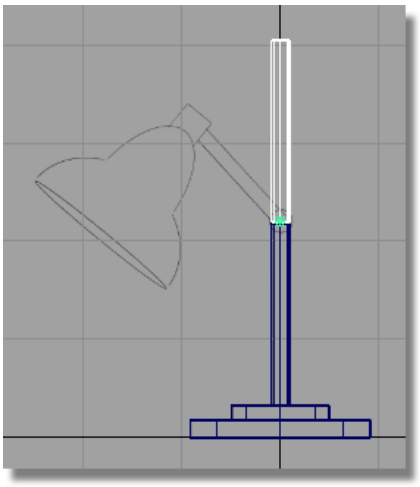


Building the lamp arm

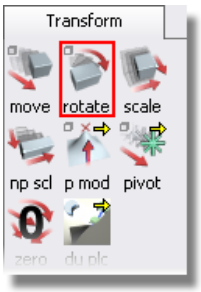
Next, build the angled arm of the lamp.

1 With the third cylinder still selected, choose Edit > Copy followed by Edit > Paste.

2 Choose Transform > Move . Use the *right mouse button* to move the cylinder into place.



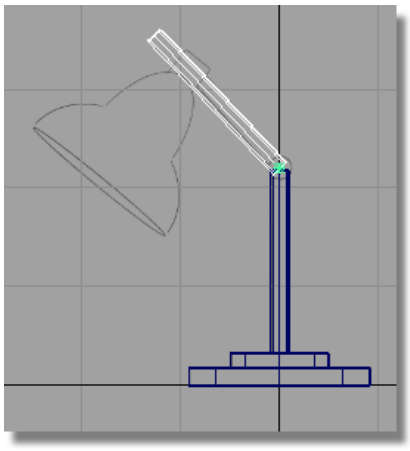
3 Choose Transform > Rotate .



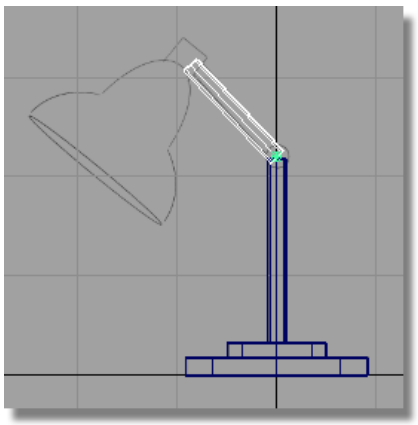
The **Transform > Rotate** tool is used to rotate an object around its pivot point. The axis of rotation is determined by which mouse button you use:

- The *left mouse button* rotates around the x-axis
- The *middle mouse button* rotates around the y-axis
- The *right mouse button* rotates around the z-axis

4 Using the *middle mouse button,* rotate the cylinder about the y-axis until it is approximately in position.



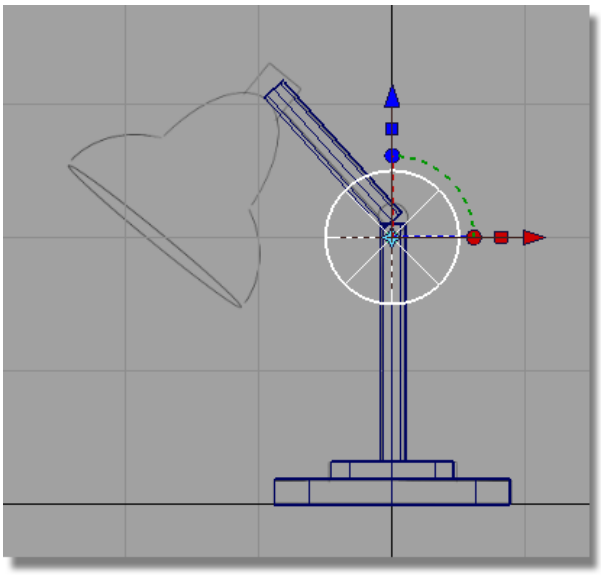
5 Choose Transform > Non-p Scale and use the *right mouse button* to adjust the length of the second pillar.



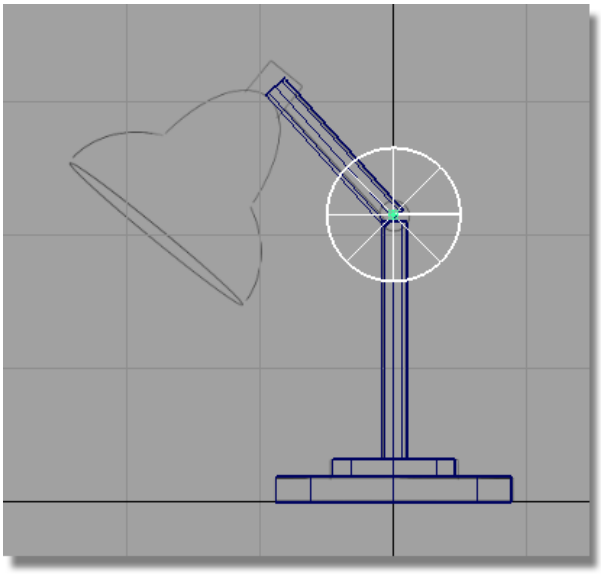
Create the hinge cylinder

Add one more cylinder to complete the design of the arm.

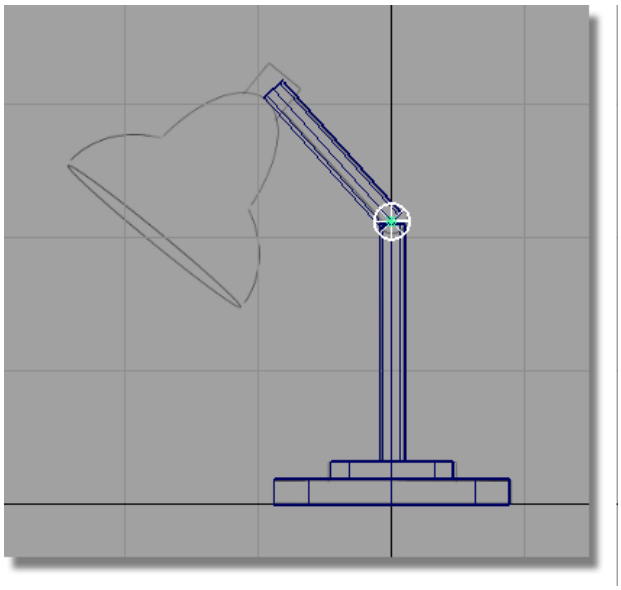
1 Choose Surfaces > Primitives > Cylinder . Hold down the *Alt* (Windows) or *Command* (Mac) key to turn on grid snapping. Click near the grid intersection closest to the hinge.



2 Choose Transform > Move . Click and drag the *right mouse button* to move the cylinder to the hinge position.



3 With the cylinder still selected, choose Transform > Scale . Click and drag the *left mouse button* to resize the cylinder to match the hinge in the sketch.



You have now completed the modeling for the base and the arm.

Saving your work

Choose File > Save As to save the current scene, and call your file `mydesklamp2`.

Part 3: Organizing the model

In this section, you will organize your model by grouping. One group will be the base of the lamp, the other group will be the angled arm and hinge. The groups will be named and managed using the Object Lister. The Object Lister is a schematic view of the objects in your scene. It is very useful for managing the components of a design.

 Watch **Part 3** of the tutorial.

Using the Object Lister to control visibility

Use the Object Lister to turn off the sketch, making the geometry easier to select.

1 Choose Windows > Object Lister from the Alias menu.

2 Choose **Show > By Object** on the **Object Lister** menu.



The objects in your scene are listed.



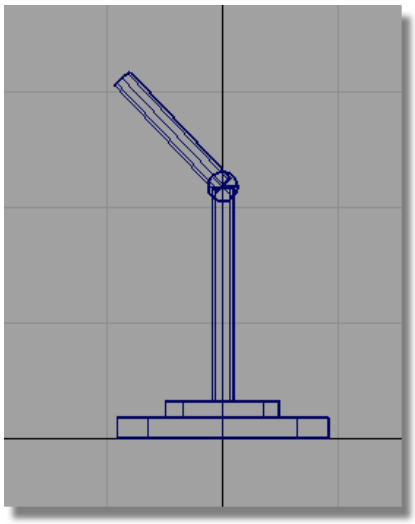
The sketch is shown at the top of the list, followed by the cylinders you created.

NOTE The 'Persp' object is the camera used to show the perspective view. This will not be used in this tutorial and can be ignored.

3 Click the *right mouse button* on the **Sketch_Assembly** name in the Object Lister. A submenu appears. Keep the mouse button held down and move to visible.



Release the mouse button and the sketch disappears from the screen.



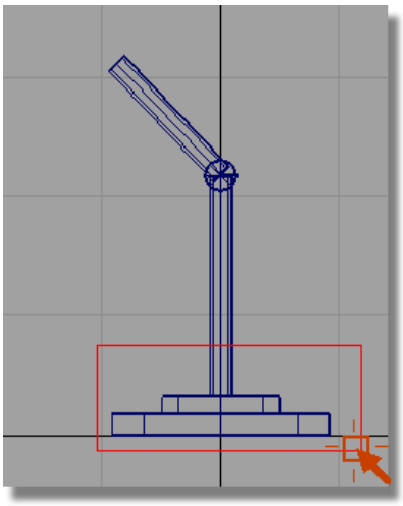
NOTE Make the sketch visible again by selecting the same submenu and choosing **Visible**.

Grouping the base objects

Individual objects can be grouped so they can be selected with a single click. A group has a single pivot point.

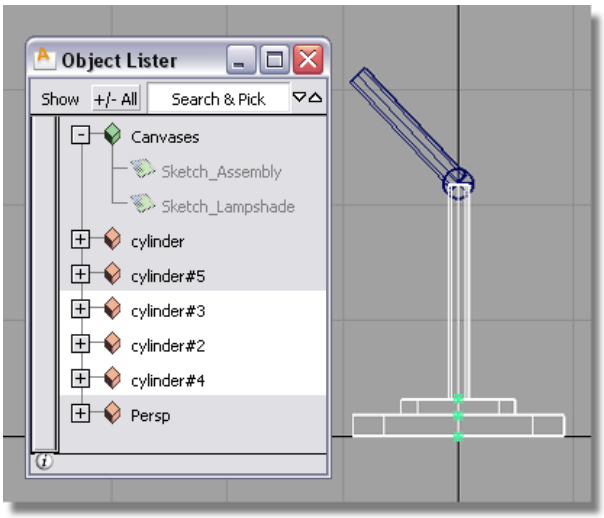
1 Use Pick > Object from the Alias palette.

2 Click and drag in the area shown to select all the base components.



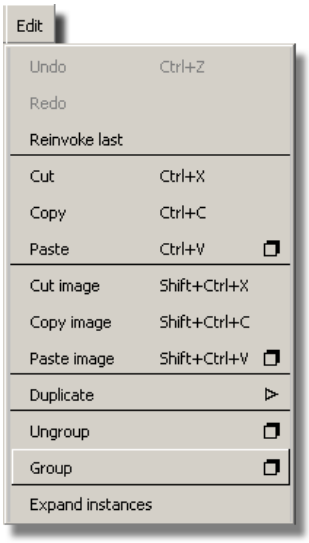
The selected objects are highlighted in white and are also highlighted in the Object Lister.

Note that each cylinder is showing a different pivot point.

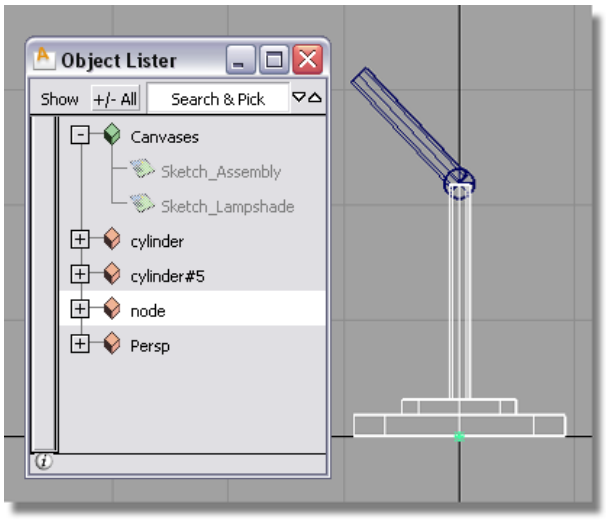


3 Right-click on the selected objects in the **Object Lister** and choose **Group** from the pulldown menu.

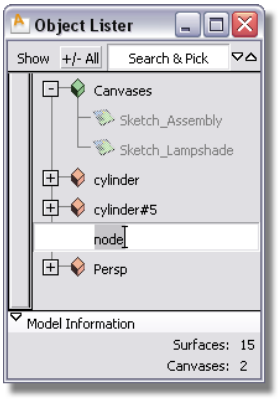
NOTE If you are not using the **Object Lister**, you can group the selected objects by choosing Edit > Group from the main menu.



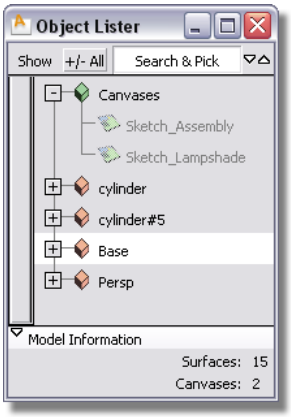
The grouped objects are now shown with a single pivot point at the origin. The separate cylinders in the Object Lister have now been replaced by a single item named **node**.



4 Double-click the word **node** in the Object Lister.



The word **node** is highlighted. Type **Base** to name the group, then press *Enter* (Windows) or *Return* (Mac).

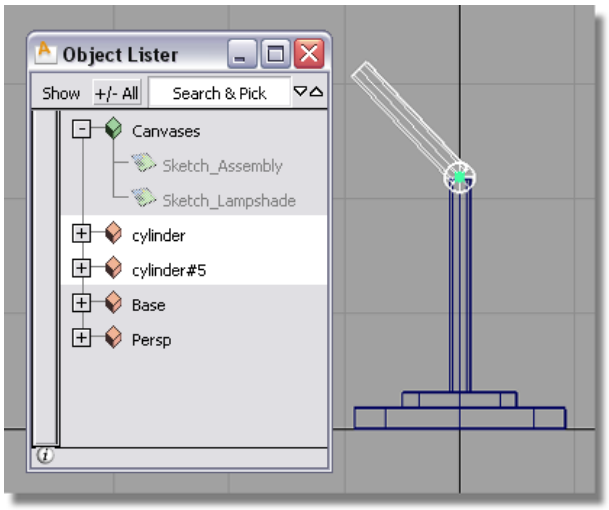


Grouping the arm

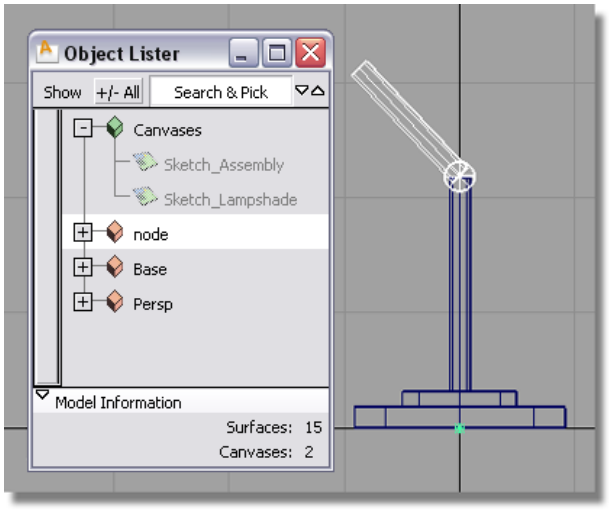
Next, group and name the upper arm of the lamp.

1 Choose Pick > Nothing .

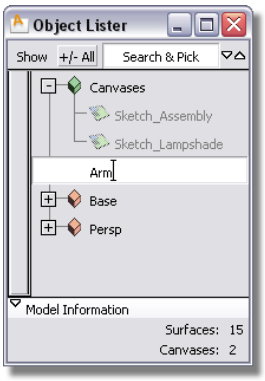
2 Choose Pick > Object and pick the top two cylinders.



3 Right-click on the selected objects in the **Object Lister** and choose **Group** from the pulldown menu (or choose Edit > Group).

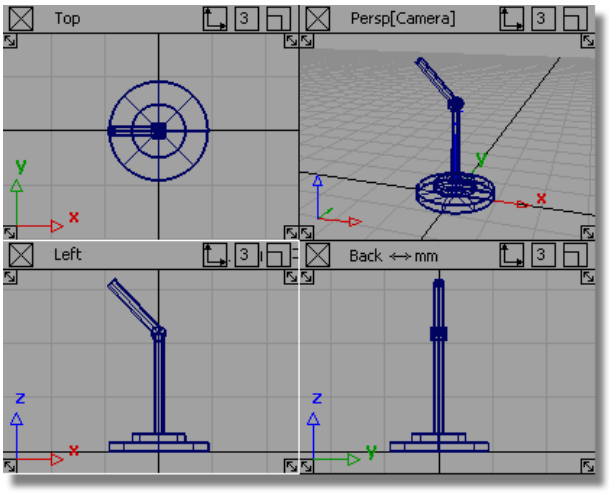


4 Rename the new node to **Arm**.



5 Choose Pick > Nothing to deselect all the objects.

6 Choose Layouts > All Windows > All Windows to display all four views, and check that all the objects are in the right locations.



NOTE If there are any problems, ungroup the models and use **Transform > Move** and **Transform > Scale** to adjust the model. Then, group the components again, as before.

Saving your work

Choose File > Save As to save the current scene, and call your file `mydesklamp3`.

Part 4: Building the lampshade

In this section, you will build the lampshade and a simplified bulb from primitive spheres.

Creating geometry at the origin

Many designed objects are symmetrical and aligned. It is good practice to build models centered on the origin, so grid snapping and mirror tools can be used.

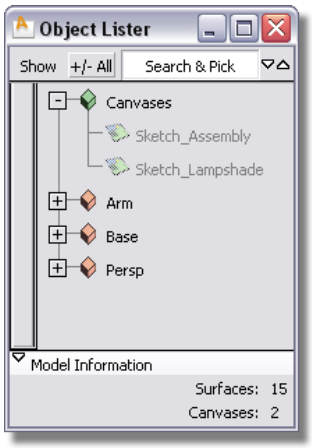
You will model the lamp shade separately at the origin, then move it into position on to the upper arm.

 Watch **Part 4** of the tutorial.

Making the base and arm invisible

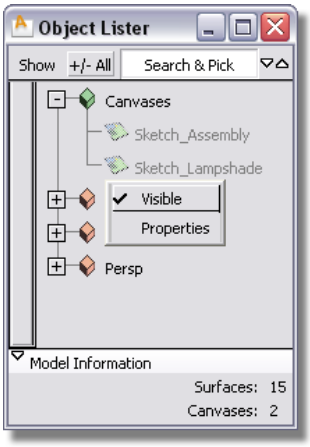
The components you have already built can be made invisible to provide a clear space to build the lamp.

1 Choose Windows > Object Lister to open the Object Lister window.



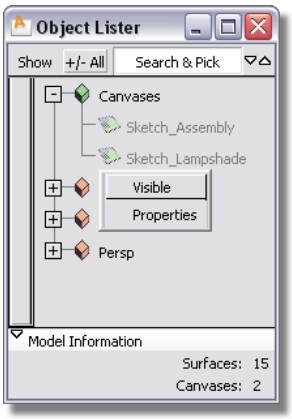
TIP If you cannot see your objects listed, check that **Show** > **By Object** has been selected in the Object Lister submenu.

2 Click the *right mouse button* on the **Arm** text to select the submenu. Choose **Visible** to make the upper arm invisible.

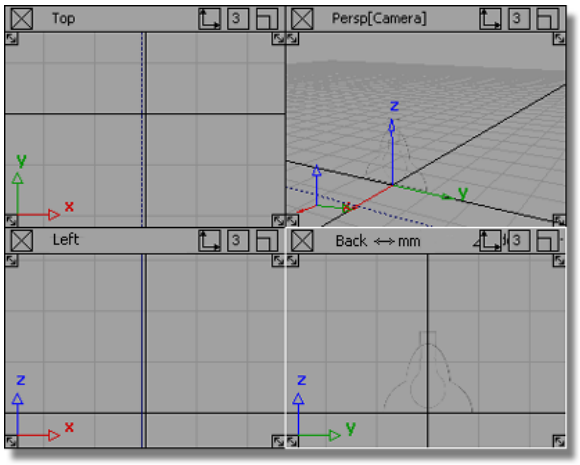


3 Make the Base invisible using the same process.

4 Use the *right mouse button* over the **Sketch_Lampshade** text to select the submenu. Choose **Visible** to make the sketch visible.



A new sketch for the lamp head appears in the Back window, and all geometry should be invisible.

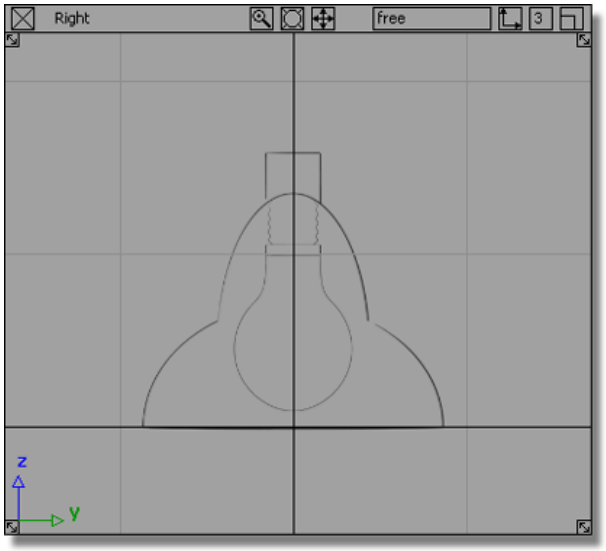


5 Close the Object Lister.

Creating the light bulb

Build a simplified light bulb from a primitive sphere.

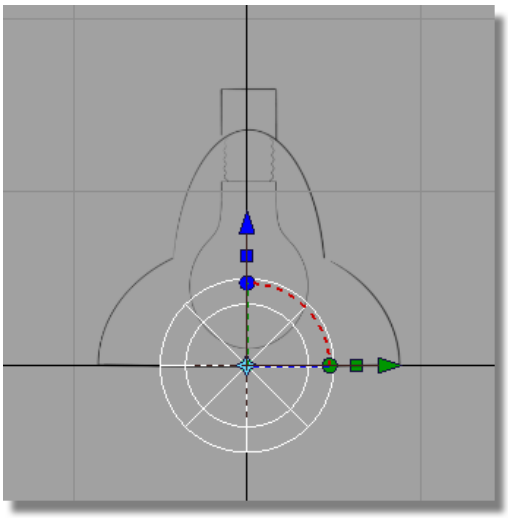
1 Maximize the Back window to start creating the bulb and lampshade.



2 Choose the Surfaces > Primitives > Sphere tool.

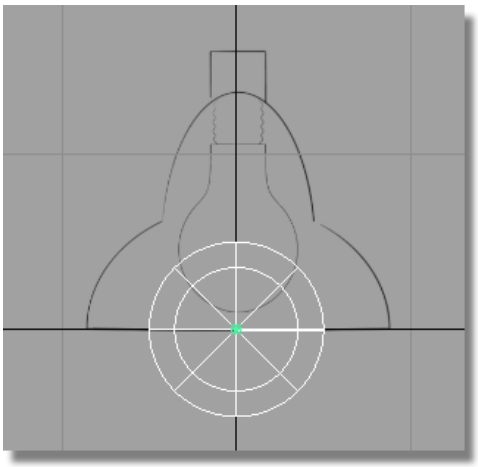
3 Hold the *Alt* (Windows) or *Command* (Mac) key down to turn on grid snapping. Click and hold the *left mouse button*, and move the cursor around. The new sphere jumps to grid points as you near them.

Position the new sphere on the origin.

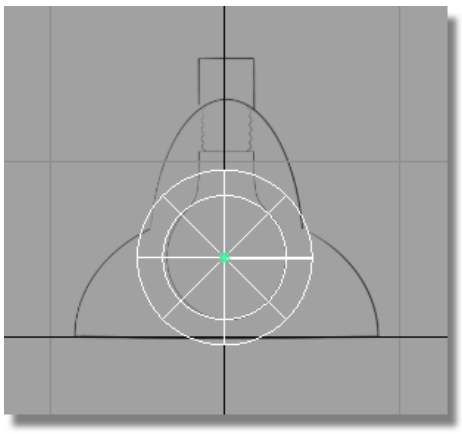


4 Choose Transform > Move .

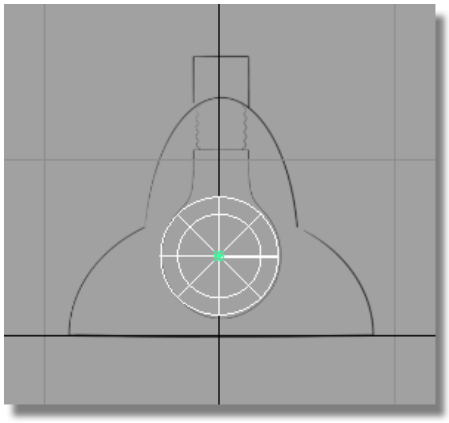
The manipulator disappears.



Use the *right mouse button* to move the bulb approximately on the center of the sketched bulb.



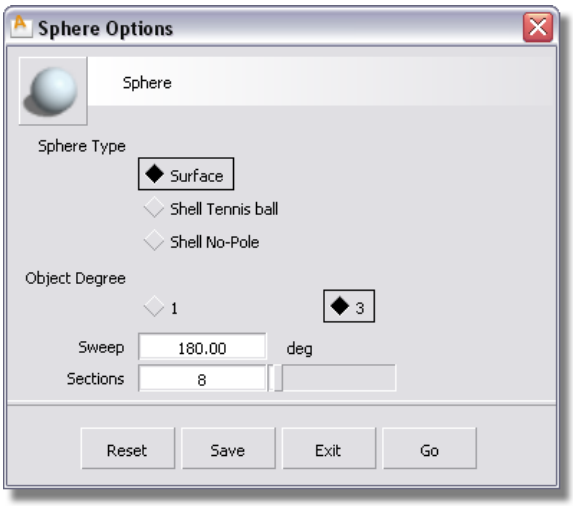
5 Choose Transform > Scale and click and drag the left mouse button to match the size of the sphere to the sketched bulb.



Creating the lampshade

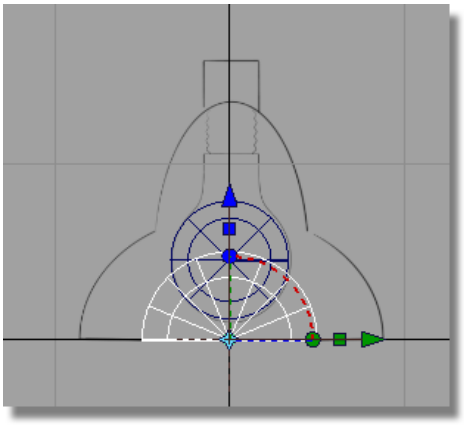
Next, create the lamp shade. The main shape of the lamp shade is created from two half-spheres, one large one and then a smaller one above. A cylinder is then added to join the shade to the arm.

1 Choose the Surfaces > Primitives > Sphere tool. Double-click the sphere icon to open up the option box. Type in `180` for the **Sweep**.



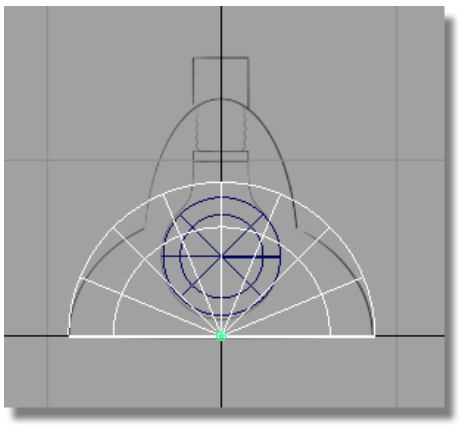
2 Click the **Go** button. Hold the *Alt* (Windows) or *Command* (Mac) key down to turn on grid snapping. Click near the origin to place the half sphere.

3 Choose Transform > Rotate . Type 90,0,0 on the prompt line to rotate the sphere 90 degrees around the X axis.



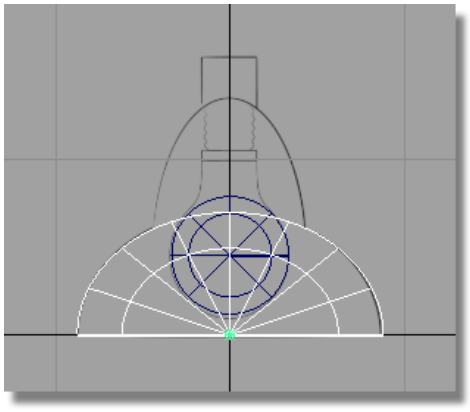
4 Choose Transform > Scale . Click and drag the *left mouse button* to scale the half-sphere.

Scale the half-sphere to match the width of the large outer curves on the sketch.



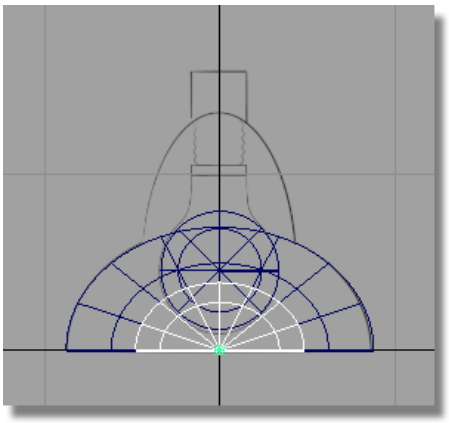
5 Choose Transform > Non-p Scale . Use the *middle mouse button* to adjust the height of the half sphere to match the sketch.

NOTE The reason we use the middle instead of the right mouse button is because the scaling occurs with respect to the *local axes* of the half sphere, not the world axes. To see the local axes of a selected object, choose Transform > Local > Set Local Axes.

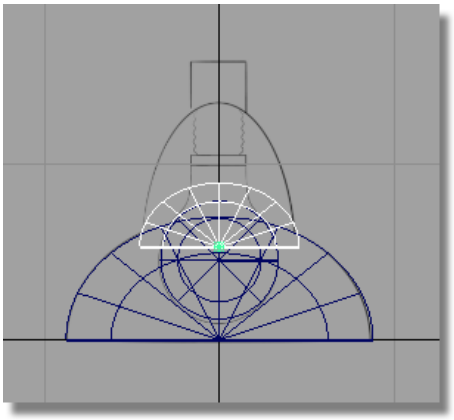


6 Choose Edit > Copy and Edit > Paste to create a second half sphere. Scale and move it to create the top section of the lamp.

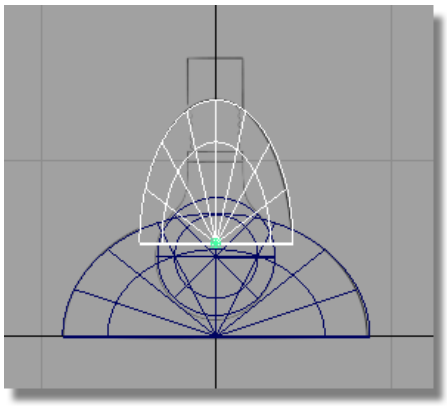
7 Choose Transform > Scale and use the *left mouse button* to scale it to approximately half its original size. Remember to click and drag in an area of the screen that will not accidentally select any of the objects.



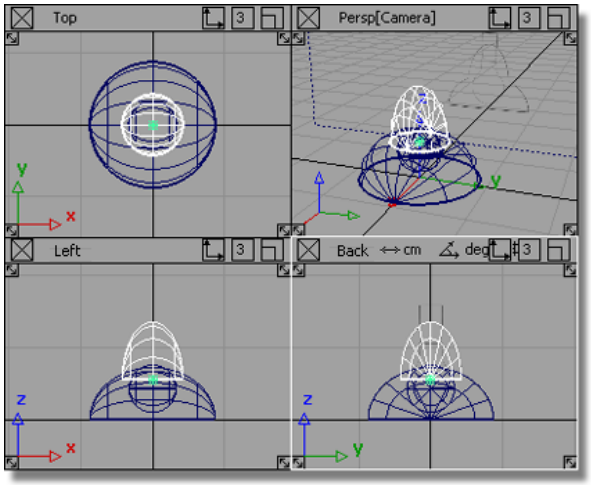
8 Choose Transform > Move and use the *right mouse button* to move the half sphere into position based on the sketch.



9 Choose Transform > Non-p Scale and use the *middle mouse button* to adjust the height of the half-sphere.



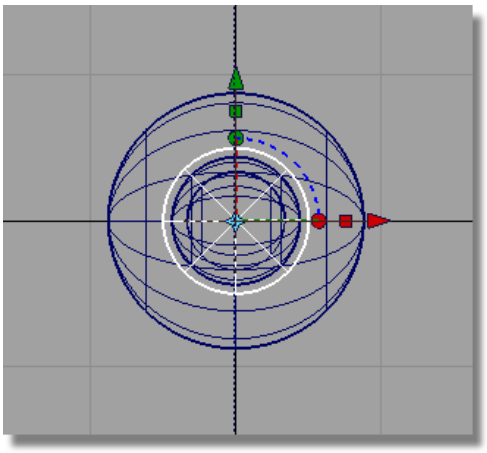
10 Choose Layouts > All Windows > All Windows to display all four views.



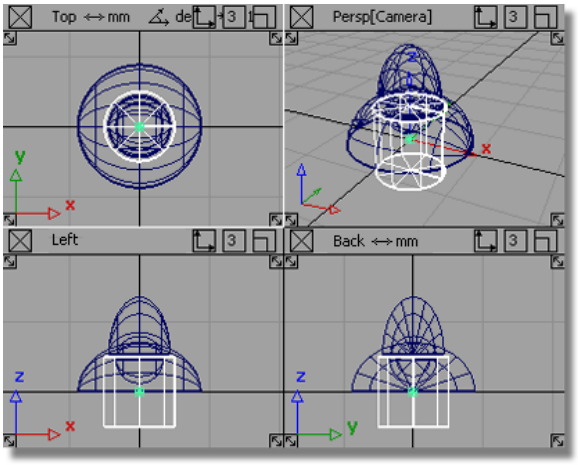
11 Maximize the Top view.

Now create a cylinder to connect the lampshade to the arm.

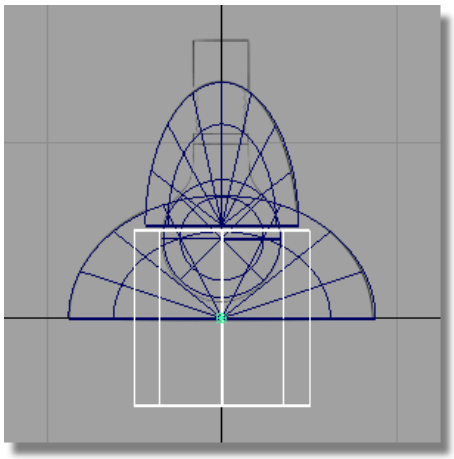
12 Choose Surfaces > Primitives > Cylinder . Hold down the *Alt* (Windows) or *Command* (Mac) key to turn on grid snapping and place the new cylinder at the origin in the Top view.



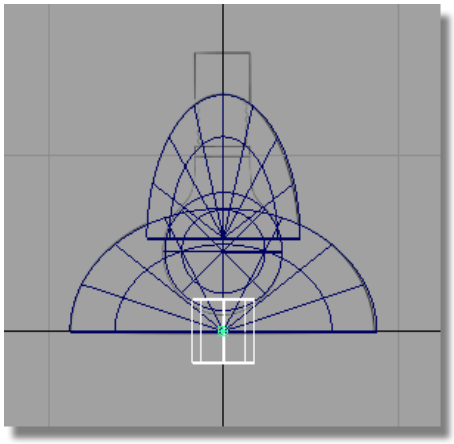
13 Choose Layouts > All Windows > All Windows to display all four views. Choosing to place the cylinder using the Top view has placed it in the correct orientation.



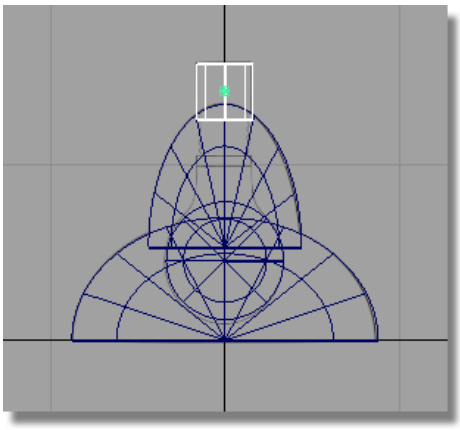
14 Maximize the Back window to reposition and scale the cylinder.



15 Choose Transform > Scale to reduce the cylinder to a size suitable for the end of the lampshade.



16 Choose Transform > Move and use the *right mouse button* to position the cylinder to match the sketch.

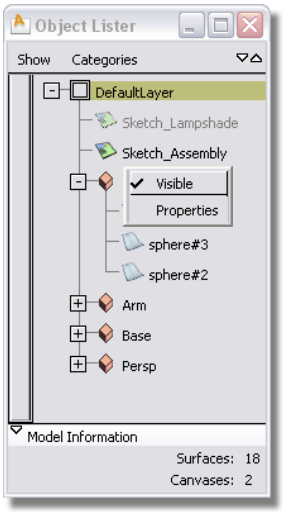


Grouping the lampshade

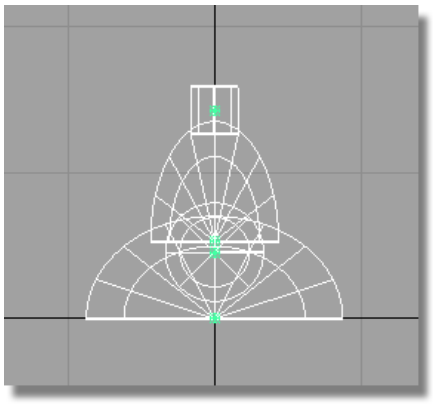
1 Choose Windows > Object Lister to open the Object Lister.

Use the *right mouse button* on the **Sketch_Lampshade** item to bring up the submenu.

Choose **Visible** to turn off the sketch.

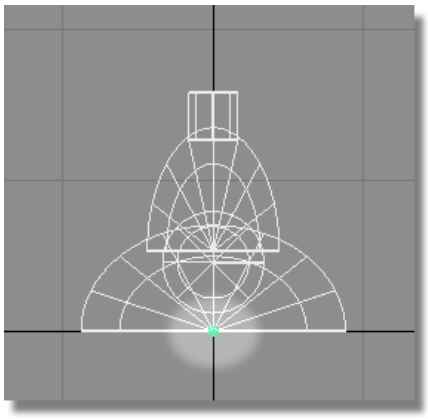


2 Use Pick > Object and pick all the objects.



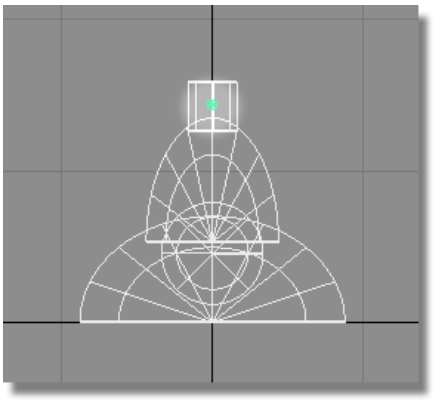
3 Right-click on the selected objects in the **Object Lister** and choose **Group** from the pulldown menu (or choose Edit > Group).

The objects are still selected, but notice they now have a single pivot point at the origin. The default location for a new pivot point is the origin.

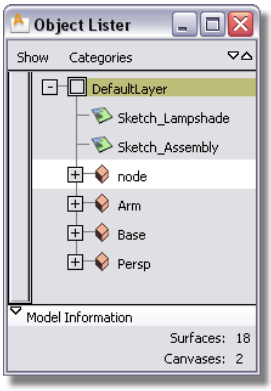


The lampshade is designed to rotate where it connects to the lamp arm. So next, you will adjust the pivot point to be in the center of the cylinder.

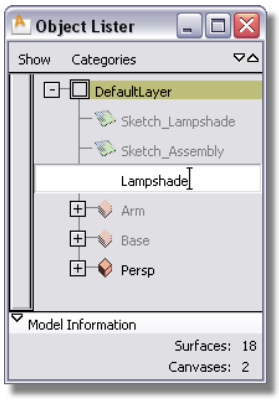
4 Choose Transform > Local > Set Pivot . Use the *right mouse button* to move the pivot upwards, to approximately the center of the cylinder.



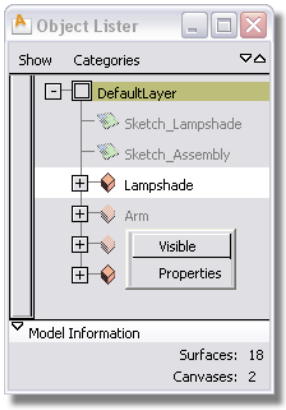
In the Object Lister, the new group is shown as **node**.



5 Double-click node to rename it to **Lampshade**.

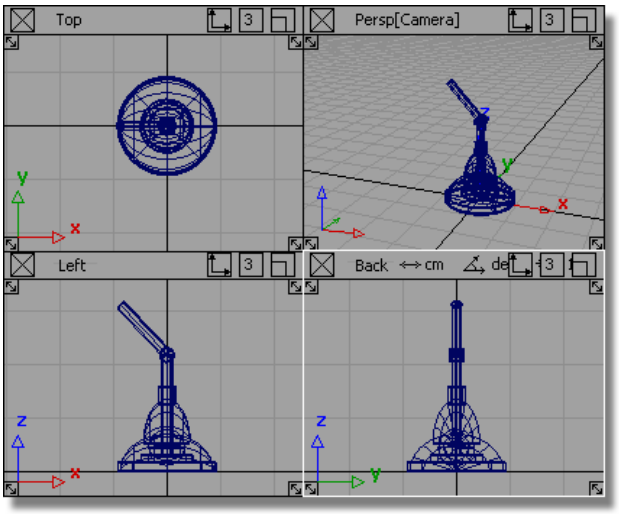


6 Make the Base and Arm components visible using the *right mouse button* and the submenu.



7 Choose Pick > Nothing . All the objects are deselected.

8 Choose Layouts > All Windows > All Windows to display all four views.



You have now built all the components of the lamp, and it is ready to be assembled.

9 Choose File > Save to save the current scene, and call your file `mydesklamp4`.

Part 5: Assembling the desk lamp

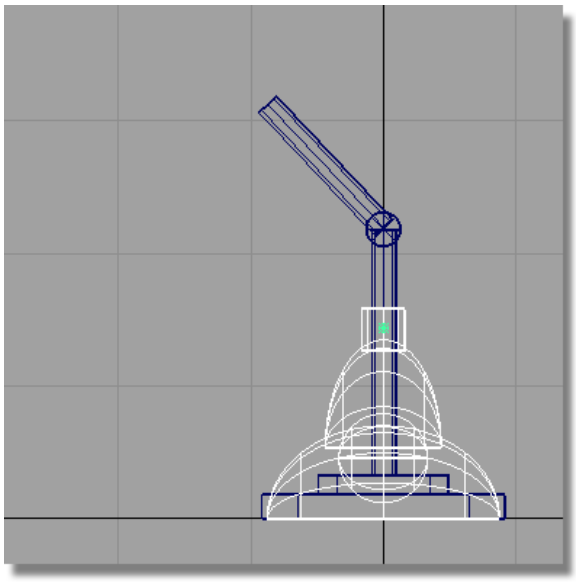
In this section, you will assemble the finished desk lamp by moving the lampshade into the correct position and grouping it with the upper arm.

 Watch **Part 5** of the tutorial.

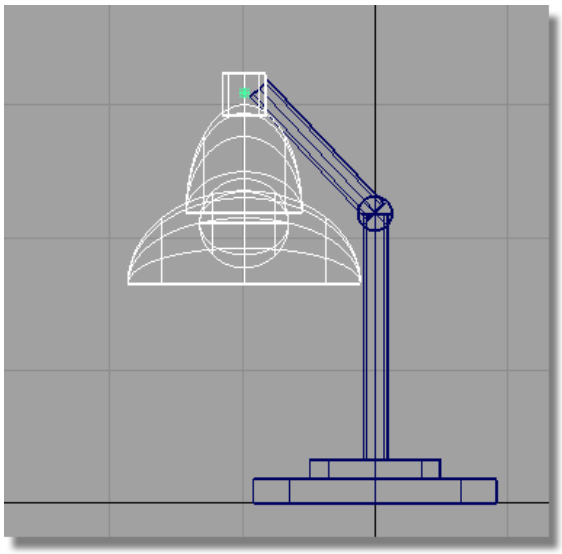
Positioning the lampshade

1 Maximize the Left window.

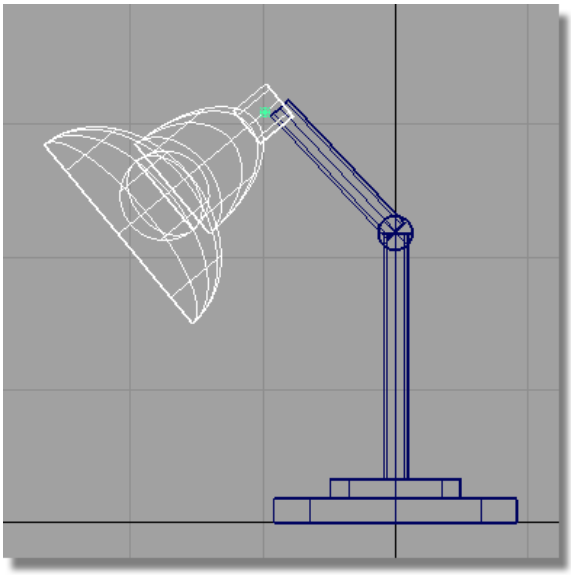
2 Choose Pick > Object and select the lampshade group.



3 Choose Transform > Move . Click and drag (away from the objects) to move the lampshade to the end of the upper arm.



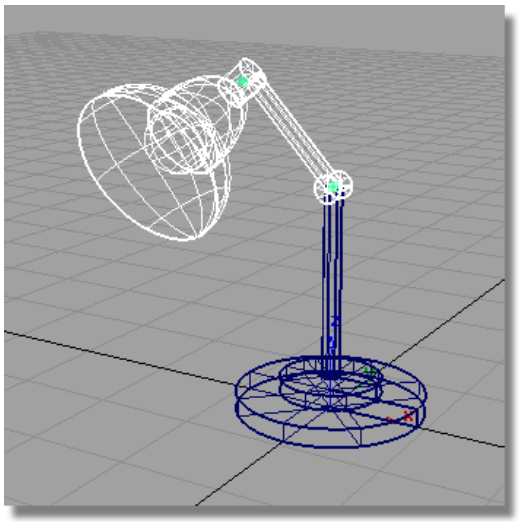
4 Choose Transform > Rotate . Use the *middle mouse button* to rotate the lampshade about the y-axis.



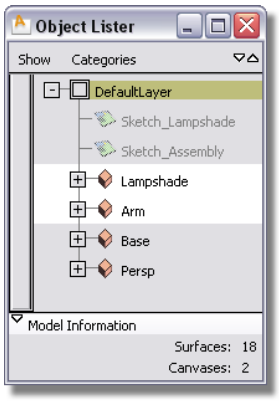
Grouping the lampshade and arm

Next, group the lampshade to the arm, so the lamp can be moved and arranged.

1 Use Pick > Object and select the lampshade and the upper arm.

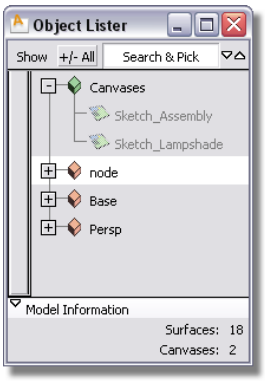


The two groups are highlighted in the Object Lister.

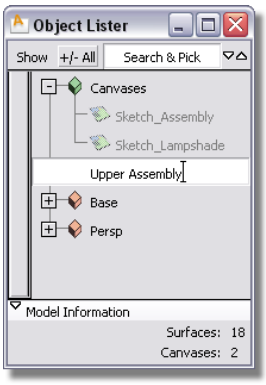


2 Right-click on the selected objects in the **Object Lister** and choose **Group** from the pulldown menu (or Choose Edit > Group).

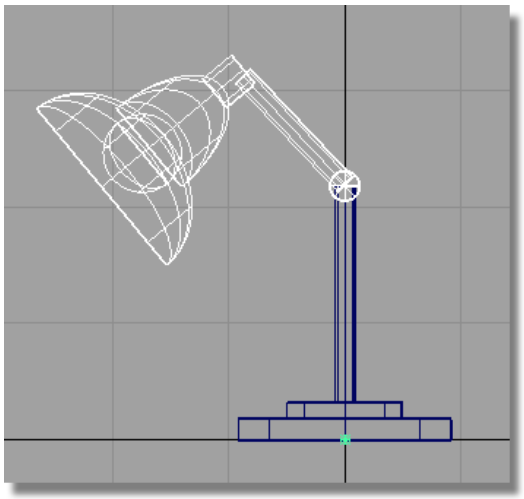
A new node is created and displayed in the Object Lister.



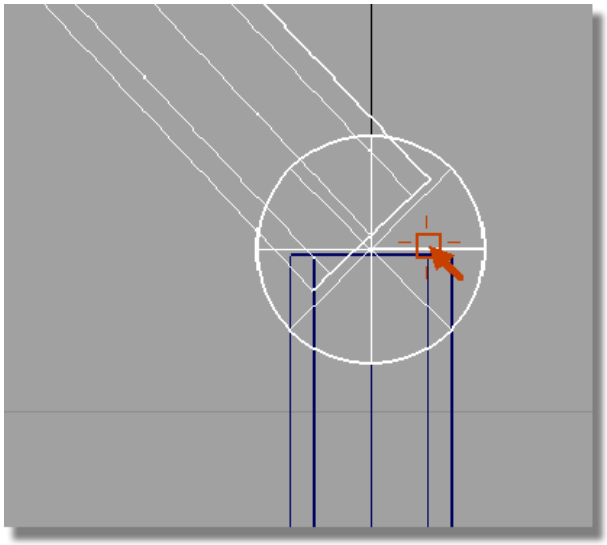
3 Rename the node **Upper Assembly**.



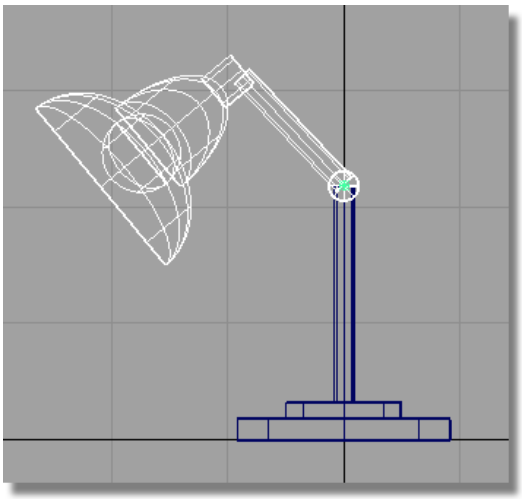
The group is created with the pivot point in the default location, at the origin. To ensure the upper assembly rotates correctly, you will now move the pivot point to the center of the hinge.



4 With **Upper Assembly** selected, choose Transform > Local > Set Pivot . Hold the *Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac) keys down and use the *right mouse button* to click the center-line of the hinge cylinder.



The pivot point moves to the center of the hinge.



Saving your work

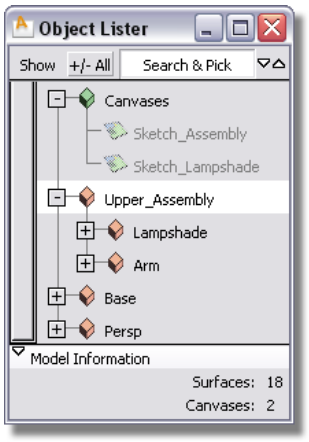
Choose File > Save As to save the current scene, and call your file `mydesklamp5`.

Part 6: Posing the Lamp Model

 Watch **Part 6** of the tutorial.

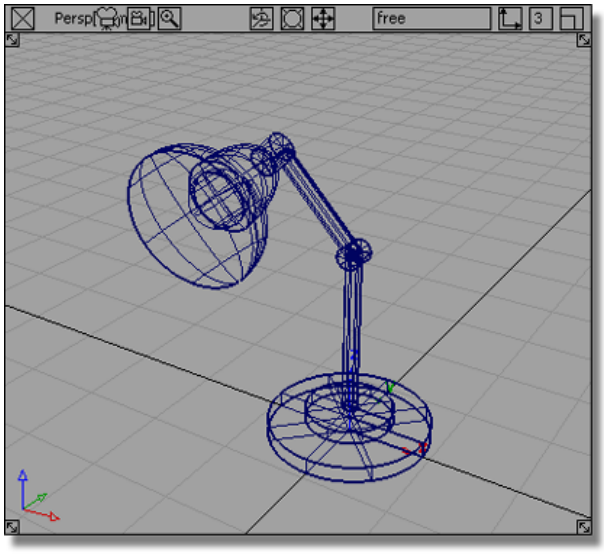
The groups you created previously are still in the model.

1 In the Object Lister click the '**+**' sign to the left of **Upper Assembly**. The **Lampshade** and **Arm** subgroups are shown.



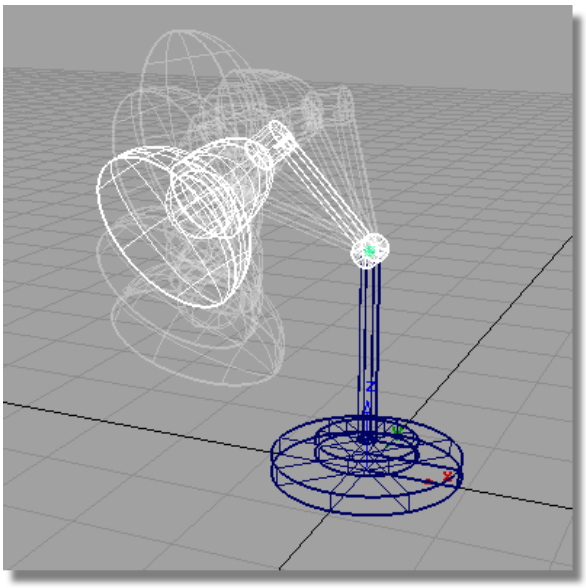
These groups and subgroups allow you to move and rotate different components of the lamp.

2 Maximize the perspective view.

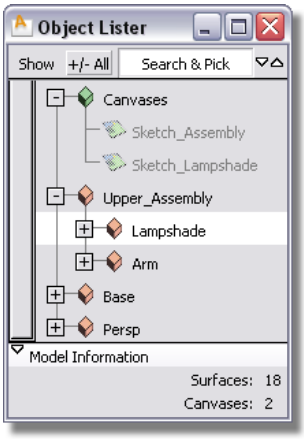


3 Click the **Upper Assembly** in the Object Lister to select the group.

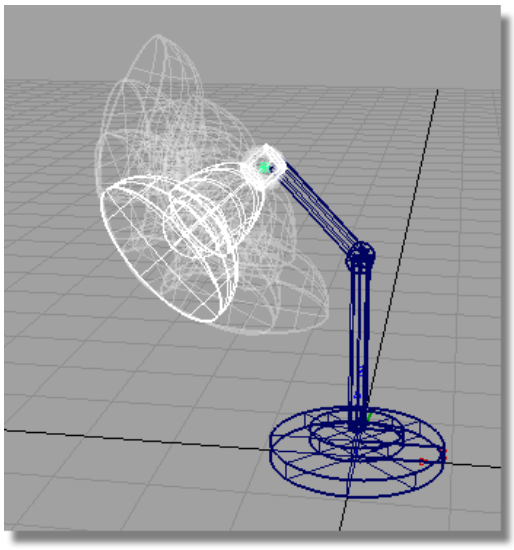
4 Choose Transform > Rotate . Use the *middle mouse button* to rotate the upper assembly about the y-axis.



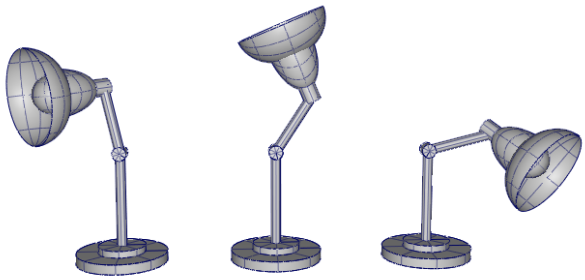
5 In the Object Lister, click the **Lampshade**.



6 With the **Transform > Rotate** tool still active, use the *middle mouse button* to rotate just the lampshade about the y-axis.



You can position the lamp in many different poses, by picking and rotating individual groups around the x, y and z axes.



Using Diagnostic Shading

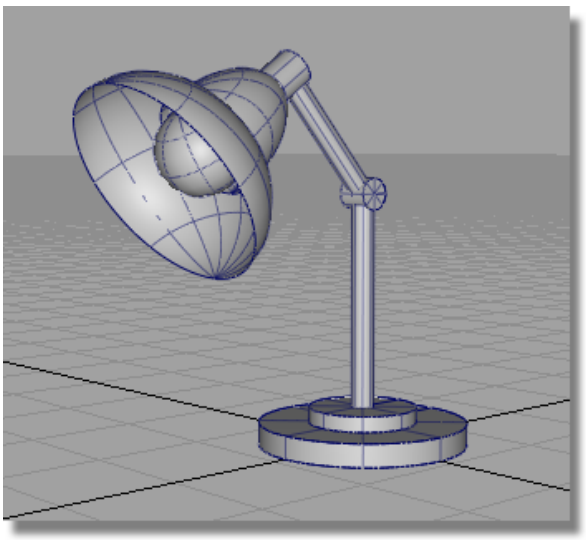
The wire model can be shaded to give a more realistic view of the geometry. Diagnostic shading can be accessed in the Control Panel to the right of the Alias interface.

NOTE If the panel is not shown, choose Windows > Control Panel to make it visible.



1 Choose Pick > Nothing .

2 Choose the **Multi Color** shade icon  to color all objects in the scene.



To return to the wireframe view, choose the wireframe icon  .

Conclusion

Congratulations! You have just completed the desk lamp model.

Most of your design work will involve more complex shapes than you have used here, but you have gained useful experience in controlling the Alias interface, which you will apply as you learn the more complex modeling techniques later in this book.

Important concepts that you should take through to future modeling tasks:

- Using snapping to accurately position geometry.
- Using the left, middle and right mouse button s to control transforms such as Move, Scale and Rotate.
- Building geometry around the origin to align and center the model.
- Organizing your model using the Object Lister.
- Regularly saving your work.

Quiz

Now that you have completed this modeling tutorial, do this quick quiz to help you remember what you have learned.

1 How do you place an object exactly at the origin?

(a) Hold the *Ctrl* (Windows) or *Control* (Mac) key down before you click

(b) Hold the *Alt* (Windows) or *Command* (Mac) key down and click close to the origin

(c) Zoom in really close to the origin and move your mouse as close as possible to the grid intersection, then click

(d) Click with the middle mouse button

(e) Open the object option box and select the 'origin' option

2 How can you tell when an object in the scene is selected (active)?

(a) It is shown in blue

(b) It is shown in white

(c) It blinks

(d) It is outlined in red

(e) All the other objects go gray

3 When using Transform > Scale, if the object is already selected where is the best place to click and drag to specify the scaling?

(a) Away from all geometry, in the gray background

(b) Touching the object

(c) On the transform palette

(d) On another, unselected, object

(e) In the control panel

4 What action does holding the *Shift* and *Alt* (Windows) or *Option* (Mac) keys together, and using the right mouse button do?

(a) Move an object vertically

(b) Delete an object

(c) Zoom in an out of the view

(d) Scroll the Palette up and down

(e) Save the file

5 Which button or key is used to specify movement or scaling in the horizontal direction in the Top, Left and Side views?

(a) Left mouse button

(b) Middle mouse button

(c) Right mouse button

(d) The *Alt* (Windows) or *Option* (Mac) key

(e) The *Ctrl* (Windows) or *Control* (Mac) key

6 Which location is the best one to save your data into?

(a) In the `user_data` directory.

(b) In My Documents

(c) In the wire directory of the demo project, in the `user_data` directory

(d) In the `wire` directory of a project created and renamed for your task, in the `user_data` directory

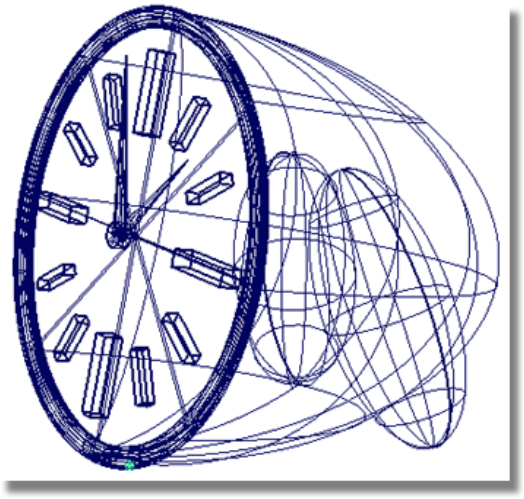
(e) In the `pix` directory of the named project

On your own

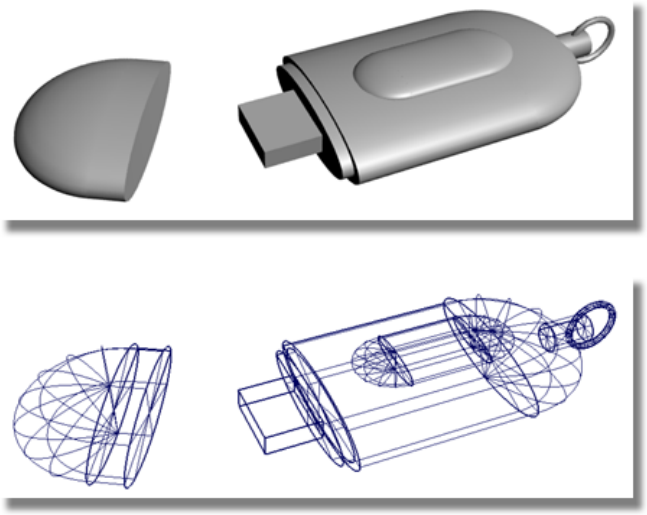
Now that you have created a complex object from simple primitive objects, see what else you can build. Here are some ideas to get you started.

The alarm clock shown below is made from a half-sphere, with a torus for the rim and cubes for the hands. The clock is assembled first, and then grouped and rotated so that the face is angled upwards. Finally, two scaled spheres are used for feet. Have a look at the help documentation on the Edit > Duplicate > Object tool, as this is useful to help build the 12 hour markers on the clock face.





This USB memory stick was made from a cylinder with a half-sphere. They were created and aligned at the default size, and then grouped and non-proportionally scaled to create the flattened oval shape.



A fun exercise that will give you the opportunity to use all the primitive tools is to build a snowman. The model shown is just one variation; use your imagination to create your own character. To save time, use the Edit > Duplicate > Mirror tool to create a left arm as a copy of the right arm. You

need to open the option box to make sure that you mirror the objects in the right direction. Using Edit > Group on the head, or the arm objects for example lets you rotate them into realistic positions.





Quiz Answers

Answers to the Desk lamp Tutorial quiz

1. (b) Hold the *Alt* (Windows) or *Command* (Mac) key down and click close to the origin. The *Alt* (Windows) or *Command* (Mac) key turns on grid snap mode, so the object will always be placed on the grid intersection nearest to where you click.
2. (b) It is shown in white. The selected object(s) will be affected by whatever tool you choose, for example Transform > Move. To make sure that nothing is affected, choose the Pick > Nothing tool.
3. (a) Away from the geometry. Because the object is already selected, the only input required is a click and a drag to specify the transform. If you accidentally pick on a second object, the transform will be applied to that object instead. Try to find an area in the view that has no geometry in it, and then click and drag.
4. (c) Zoom in and out of the view.
5. (b) Middle mouse button.

6 (d) In the wire directory of a project created and renamed for your task, in the `user_data` directory. It takes a few steps to set up a new Alias project, but doing so will make your data much easier to manage and to find.

Modeling a Joystick

5

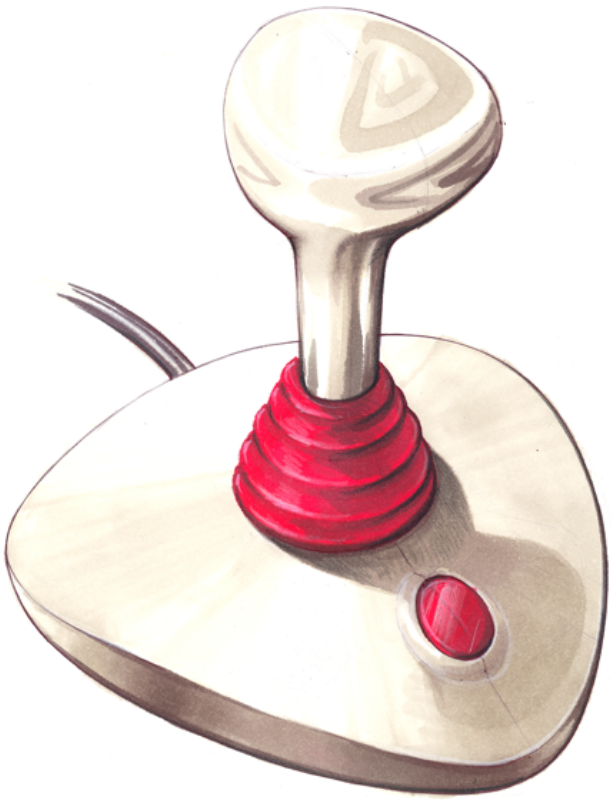
Learning Objectives

This tutorial introduces you to modeling. You will learn how to:

- Create curves using CVs and edit points
- Use curves to create different types of surfaces (skinned, revolved, extruded, and planar)
- View a model in hardware shaded mode
- Edit CVs

Introduction

In this tutorial, you will model a computer joystick like the one below. You will be introduced to tools that enable you to build surfaces from curves. As well, you will start to use layers to organize your work. Finally, you will learn a way to view and evaluate your work.



New tools used in this tutorial

- Curves > Primitives > Circle
- Pick > Point Types > CV
- Pick > Point Types > Hull
- Curves > New Curves > New Edit Point Curve
- Curves > New Curves > New CV Curve
- Surfaces > Skin
- Surfaces > Planar Surfaces > Set Planar
- Surfaces > Swept Surfaces > Extrude

New menu items used in this tutorial

- Layers > New
- Layers > Visibility > Invisible/Visible
- WindowDisplay > Hardware Shade

New Control Panel tools you will use in this tutorial

- Display CV/Hull

Part 1: Creating the Joystick Handle

In this section, you will create the joystick handle by revolving a profile curve.

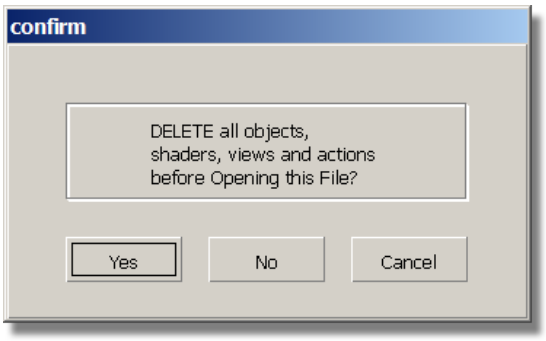
 Watch **Part 1** of the tutorial.

Opening the tutorial file

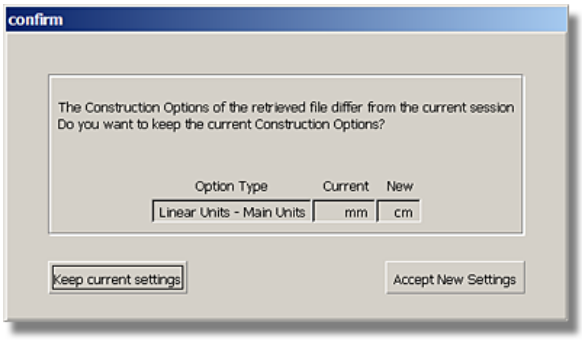
1. Choose File > Open to open the File Browser.
2. In the File Browser, locate the CourseWare directory and set it as the **Current Project**.
3. Open the file called `joystick.wire`, located in the wire directory in the `CourseWare` project.

   For information on how to open a file, see Opening the tutorial file on page 82.

   A dialog box appears, asking if you want to delete all objects, shaders views, and actions. Click **Yes**.

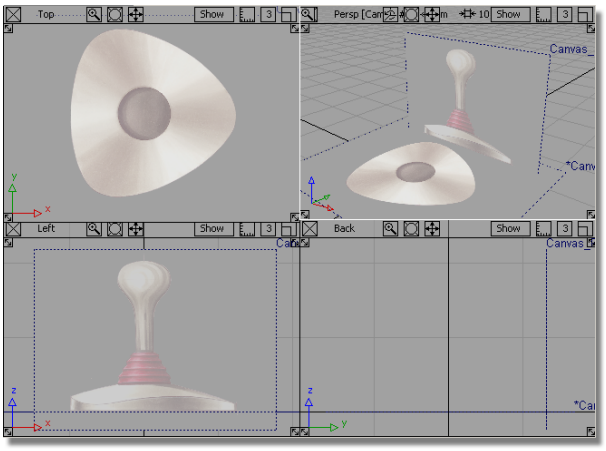


If your values for construction tolerances differ from those in the `joystick.wire` file, you will be presented with a dialog:



Click **Accept New Settings** to use the construction tolerances in `joystick.wire`.

The file is opened.



NOTE The scene contains two reference images on canvas planes. You will use these as a guide to model the joystick.

If you do not see any images, choose WindowDisplay > Toggles > Canvas Planes to turn on the display of canvas planes.

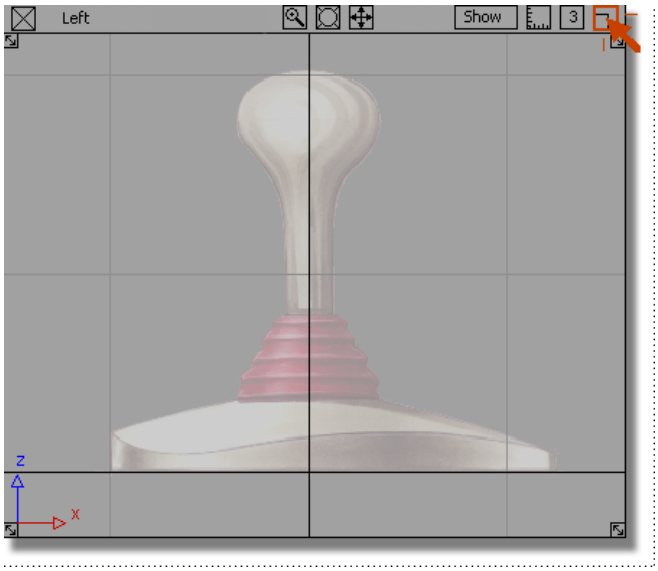
To turn off the borders for canvas planes, choose WindowDisplay > Toggles > Construction Objects .

If the modeling views do not occupy the full size of the Alias window, choose Layouts > All Windows > All Windows .

Creating the Joystick Handle

You will start by creating a curve that follows the profile of the joystick handle, which will later be used to revolve a surface for the handle.

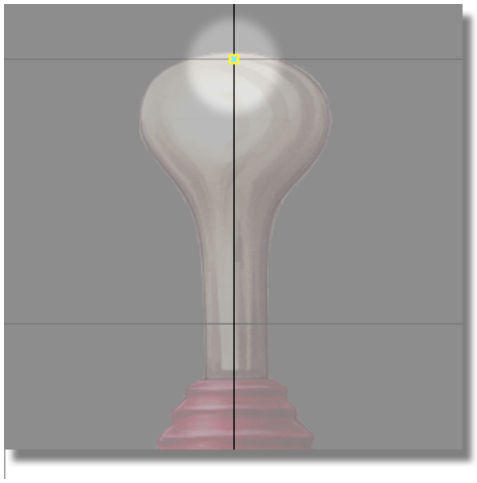
1 Maximize the Left view by clicking on the square icon on the top right of the Left view window.



2 Choose Curves > New Curves > New CV Curve.

3 This tool allows you to create a curve by placing control vertices (CVs, for short). CVs control the shape of a curve.

4 Hold down the *Alt* (Windows) or *Command* (Mac) key to turn on grid snap mode, and click the *left mouse button* on the grid intersection at the top of the handle.

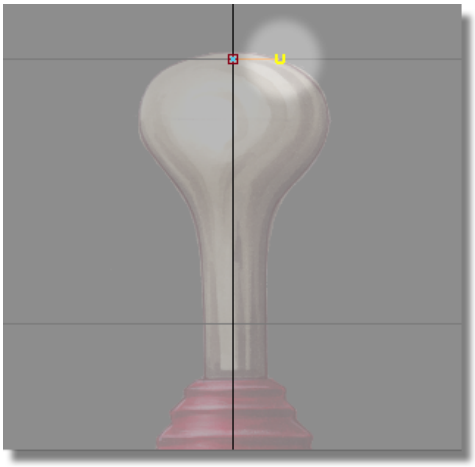


A control vertex appears.

This is the first CV of the curve and is displayed as a small box.

5 Release the *Alt* (Windows) or *Command* (Mac) key to turn off grid snap mode.

6 Press and hold the *middle mouse button* to the right of the first CV to create the second CV. Move the mouse button to position the CV, then release the middle mouse button.

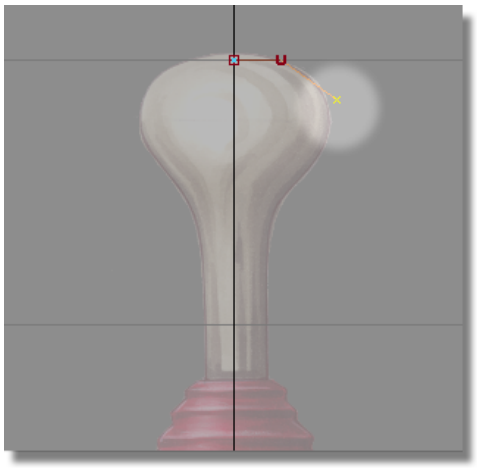


The second CV is displayed as a small U.

By using the middle mouse button, the second CV is horizontally aligned with the first CV. Having these two CVs aligned horizontally helps to avoid a bump or dimple in the top when you revolve the surface.

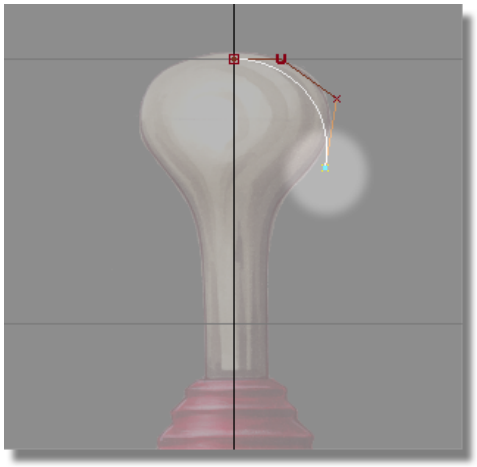
NOTE The straight red line joining the first and second CVs is not the curve. It is the hull. Hulls connect all the CVs on a curve.

7 Press and hold the *left mouse button* along the edge of the joystick handle outline to create the third CV. Move the mouse to position the CV and then release the left mouse button.



The third CV appears. This and all further CVs on the curve are displayed as small crosses. The hull now consists of two red straight line segments between the first, second and third CV.

8 Press and hold the *left mouse button* again to position the fourth CV along the edge of the handle outline.

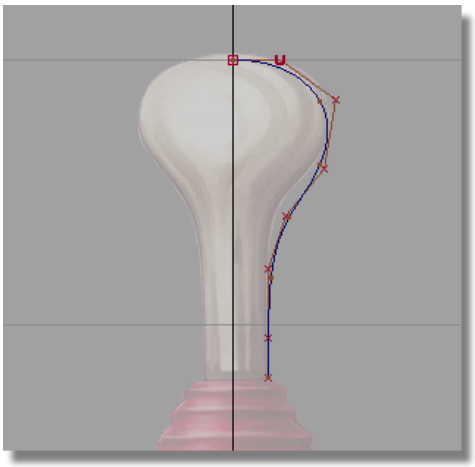


The fourth CV appears.

A white curve now connects the first CV and the fourth CV. The hull now consists of three red straight line segments that connect all the CVs together.

At this point, don't worry about the shape of the curve. Later, you will adjust the position of each CV to change the shape of the curve.

9 Continue to place four more CVs in the following positions to complete the curve.



10 Choose Pick > Nothing to complete the curve and unpick it.

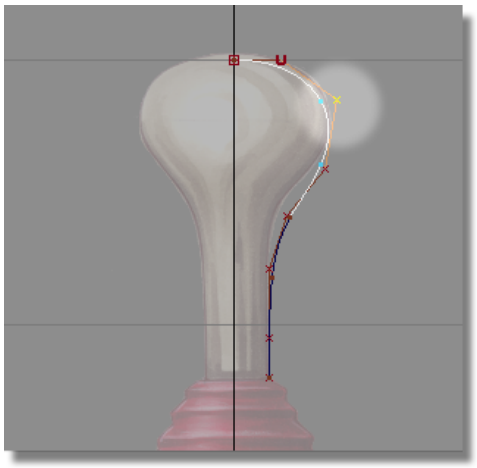
Editing the handle profile curve

Now, you will move CVs to edit the shape of the profile curve to match the reference image.

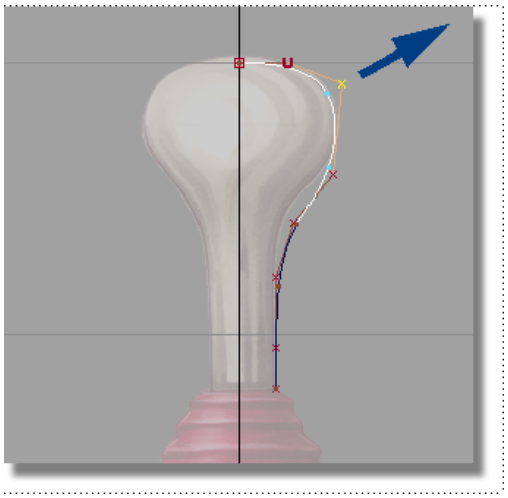
1 Choose Pick > Point Types > CV .

2 Use the *left mouse button* to click the third CV or drag a pick box around it.

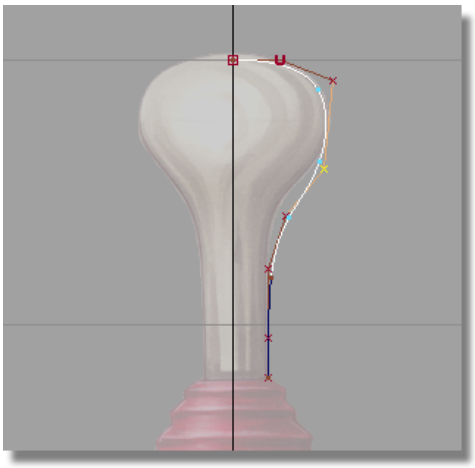
Remember, CVs do not lie on the curve; they are located on the hull.



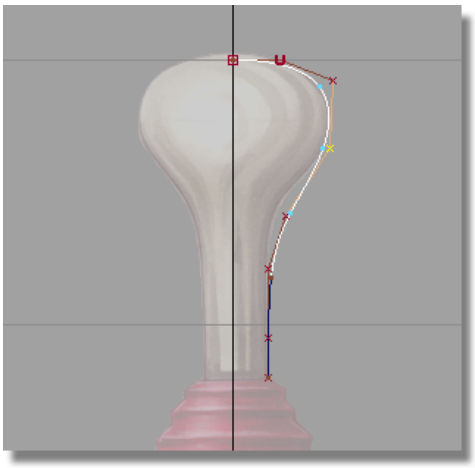
3 Choose Transform > Move and drag the mouse to move the CV so that the curve lies directly on the edge of the handle sketch.



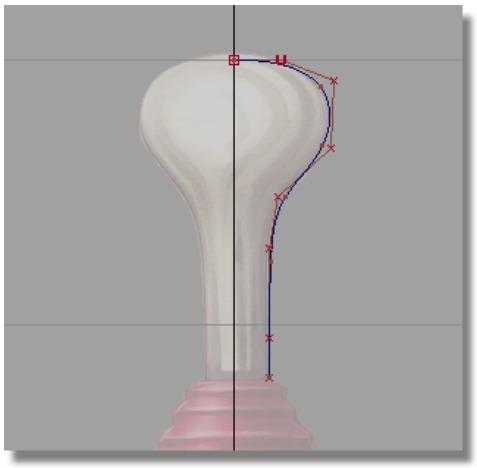
4 Click the fourth CV to pick it.



5 With the **Move** tool still active, drag the mouse to move the CV so the curve lies on the edge of the handle sketch.



6 Continue picking and moving CVs until the curve matches the sketch.



Revolving the handle profile curve

Next, you will revolve the profile curve to create a surface for the joystick handle.

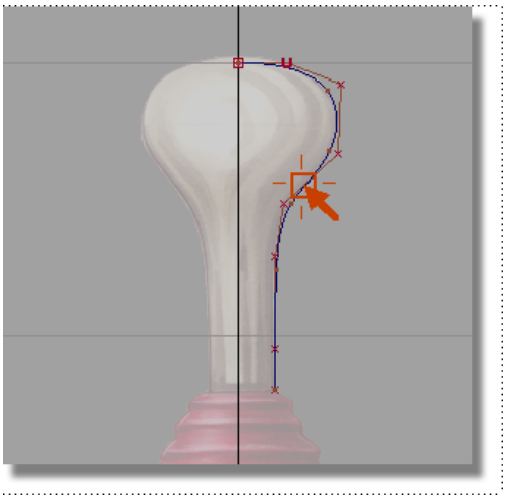
1 Choose Surfaces > Revolve .



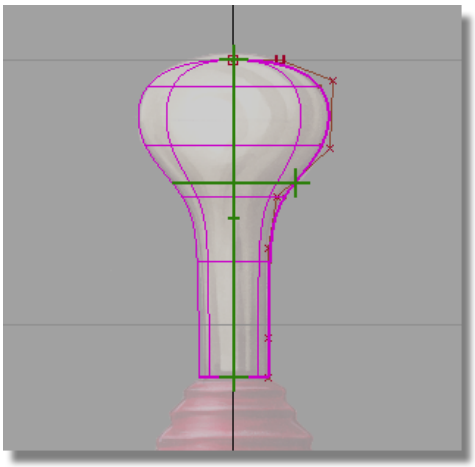
In the prompt window, which is just below the menu bar, you are prompted to select a curve to revolve.



2 Click on the profile curve to select it.

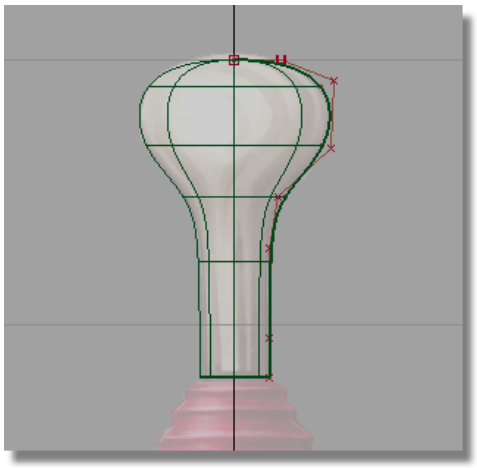


The curve is revolved and a surface is created.



When you initially create a surface of revolution, it has two green manipulators. These manipulators enable you to easily change the sweep of the profile curve and the angle of the revolution axis. The surface you have created is correct, and so you won't adjust the manipulators.

3 Choose Pick > Nothing to unpick the surface.



The manipulators disappear.

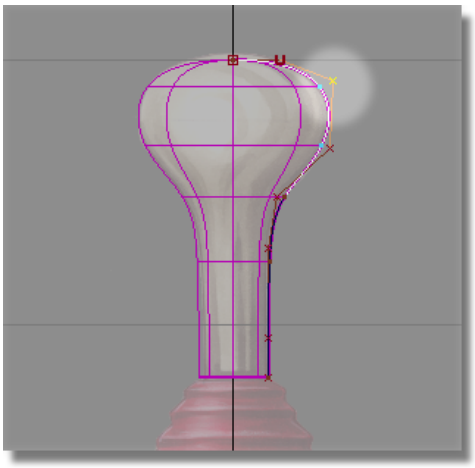
Modifying the handle curve and surface

Most surfaces you create in Alias have what's known as construction history. Construction history allows you to easily change a surface after you have created it.

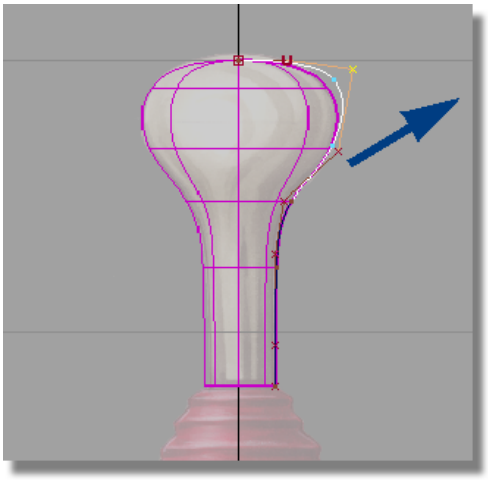
For example, if you move a CV on the original profile curve, the revolved surface will automatically update.

Next, you will move a CV to see the effect of construction history.

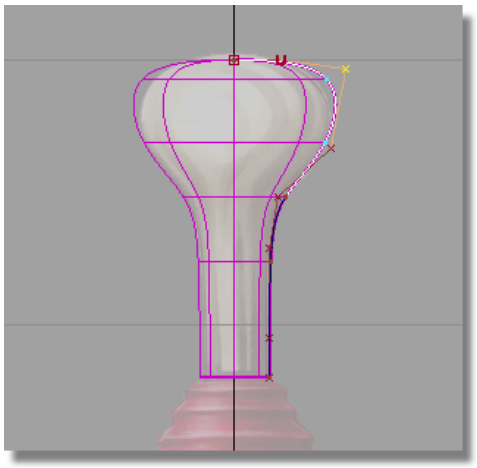
1 Choose Pick > Point Types > CV and click the third CV to pick it.



2 Choose Transform > Move and drag the mouse to move the CV slightly.



When you release the mouse button the revolved surface automatically updates.

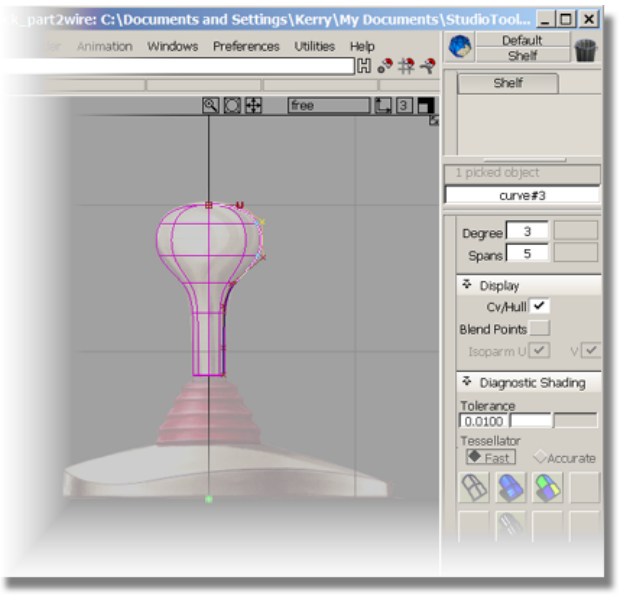


3 Choose the Edit > Undo tool, or the hotkey *Ctrl* + *Z* (Windows) or *Command* + *Z* (Mac) to undo the move.

The surface is now complete, so next, you will turn off the CV display for the curve.

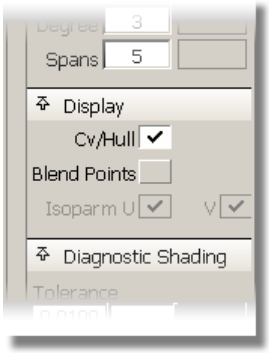
TIP It is good practice to turn off the CVs for curves and surfaces, if you don't need to use them. This helps to reduce clutter on your screen and makes your model easier to view. It is easy to turn the CVs back on if you need to work with them.

On the **Control Panel** on the right of your screen is a **Display** section.

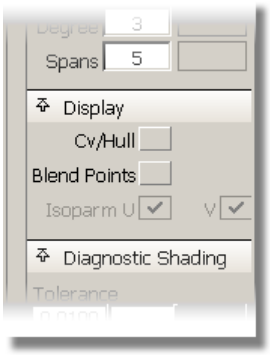


TIP If the **Control Panel** is not displayed, choose Windows > Control Panel to make it visible.

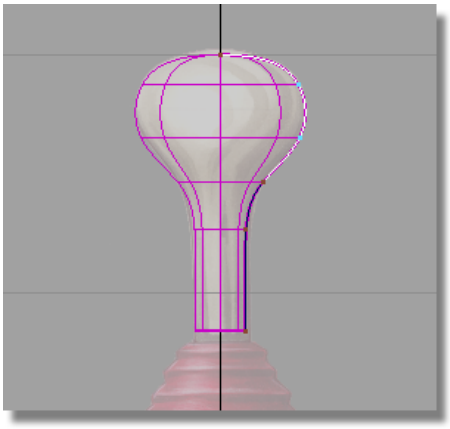
In the **Display** section, the **CV/Hull** check box indicates that the CVs and hulls are currently visible.



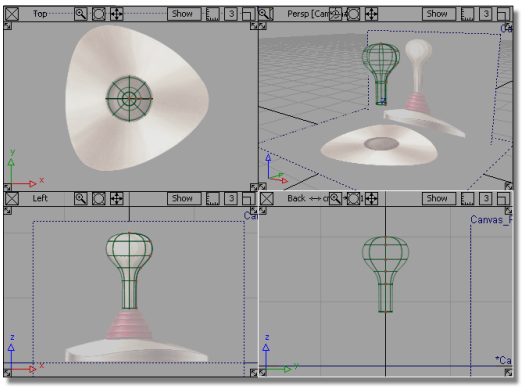
4 With the CV still selected, click the **CV/Hull** check box to remove CVs from the curve display.



The CVs and hulls are no longer displayed in the view.



5 Choose Layouts > All Windows > All Windows to return to the four views.



TIP The hotkey for Layouts > All Windows > All Windows is the **F9** function key. Use this to set the screen to show all four views at any time.

Saving your work

Now, you will save the scene as a new file.

1. Choose File > Save As to open the File Browser.
2. In the File Browser, locate the `Lessons` directory. Set the `Lessons` directory as the **Current Project**.
3. Save your work in the wire directory of the `Lessons` project.
4. Name your file `myjoystick.wire`.

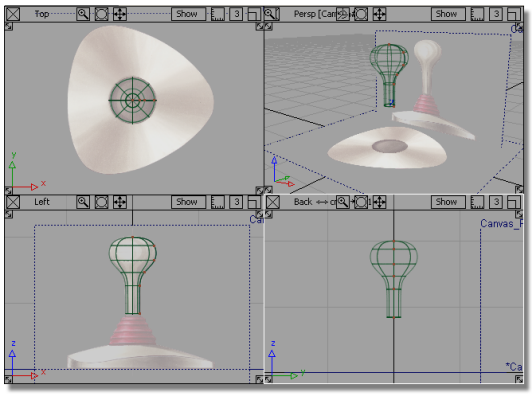
For information on creating the `Lessons` project, or saving your work, see Saving your work on page 96.

Part 2: Creating the Joystick Base

In this section, you will create the joystick base with skin and planar surfaces.

Opening the tutorial file (optional)

If you successfully completed Part 1, you can proceed directly to the next step, **Creating the Base Outline Curve.**



If you were not successful in part 1, open the file called `joystick_part2.wire`, located in the wire directory of the `CourseWare` project. This file contains the completed model from Part 1.

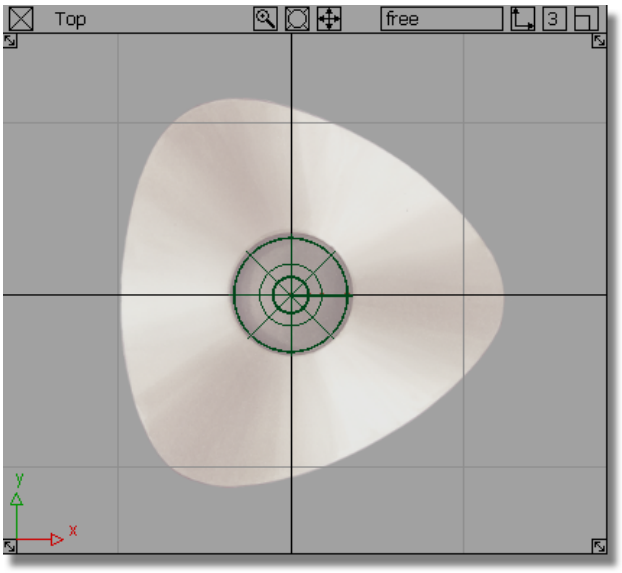
 Watch **Part 2** of the tutorial.

Creating the Base Outline Curve

First, you will create a rounded triangle shape from a primitive circle.

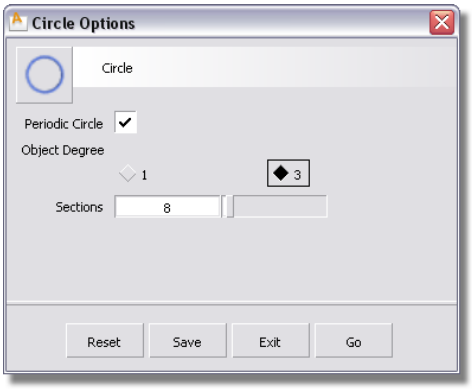
1 Choose Layouts > Top to maximize the Top view.

TIP The hotkey for Layouts > Top is *F5*.



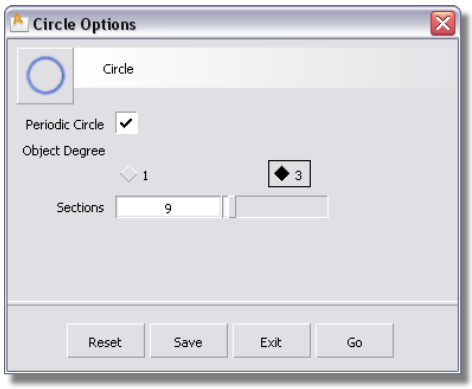
2 Choose Curves > Primitives > Circle .

3 Double-click the icon to open the option box for the circle.

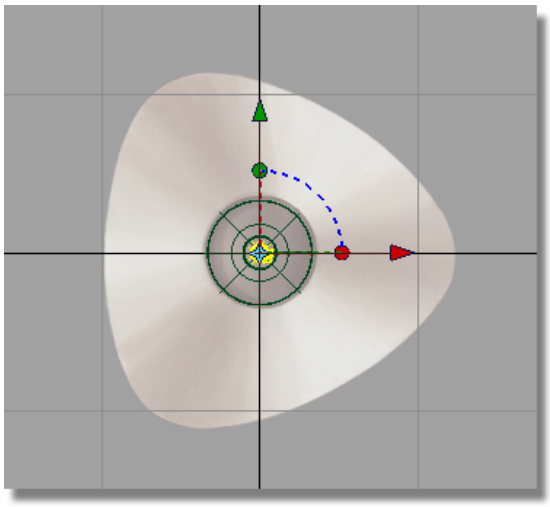


In the **Sections** box, the default number of sections is set at **8**. As you will be creating a triangular shaped base, **9** sections will provide a better arrangement of CVs.

Type in **9** in the **Sections** box. Click the **Go** button in the circle option box.



4 Press and hold the *Alt* (Windows) or *Command* (Mac) key to turn on grid snapping. Click near the origin (where the two dark grid lines intersect) to place the circle at the center of the base.



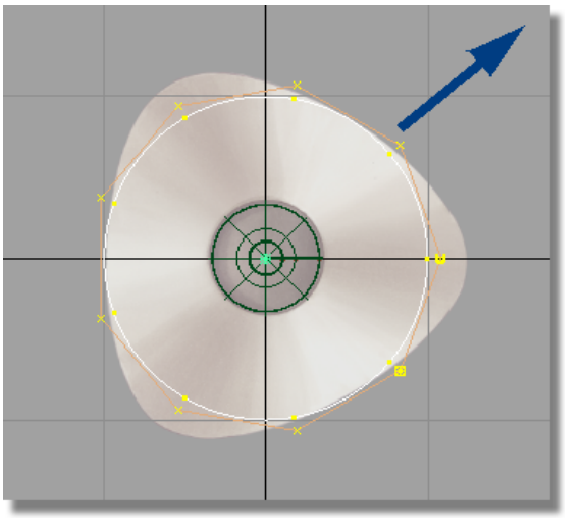
A small circle is placed at the origin. The manipulators are shown, but you won't use them for this part of the tutorial.

Next, you will scale and reshape the circle to form the base outline.

5 Choose Transform > Scale .

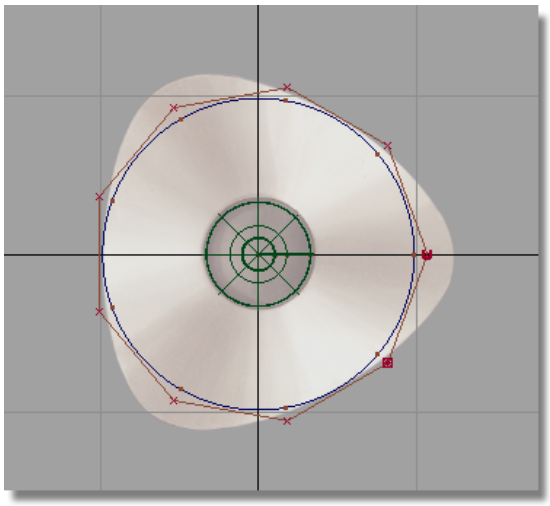
6 The manipulators disappear.

Click and drag with the *left mouse button* towards the top right corner of the screen, to make the circle larger. Match the size of the circle to the inside of the base outline, as shown below.



TIP Use the screen diagonal direction for an increase or decrease in scale. Drag towards the **bottom left** corner to **decrease** the scale. Drag towards the **top right** corner to **increase** the scale.

7 Choose Pick > Nothing to deselect the circle.

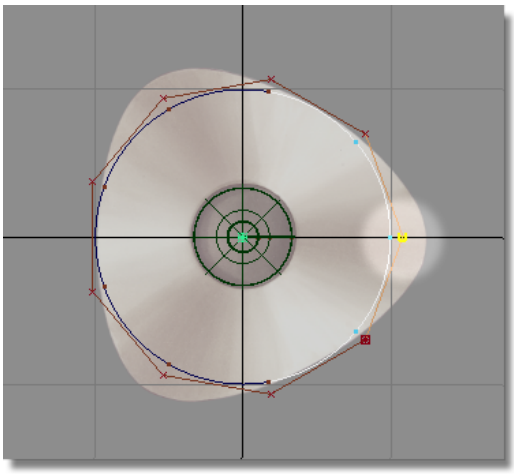


TIP Check that the CV shown as a U is at the right side of the circle. If the U CV is at the left, it means that you have inverted the circle while scaling. Scale the circle again, being sure to click and drag towards the top right of the screen.

You will now select the three CVs which will form the apexes of the triangular base.

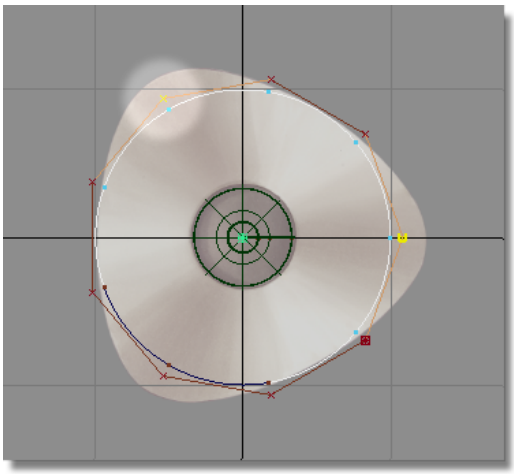
8 Choose Pick > Point Types > CV and click the CV nearest the right side of the sketch. This CV is drawn as a small U.

9 **TIP** As the CVs are small, it is sometimes easier to select them by dragging a pick box around each one.



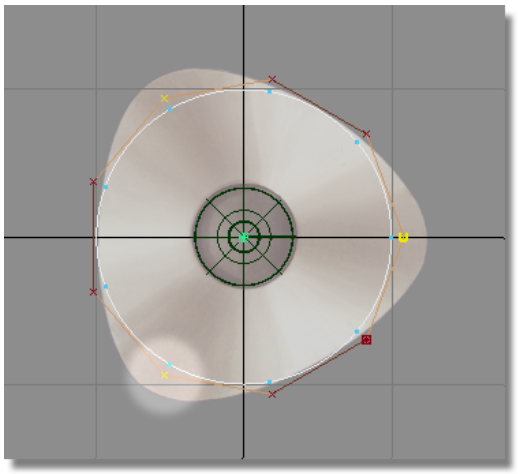
The CV is selected and highlighted in yellow.

10 With the Pick > Point Types > CV tool still active, choose the CV at the top left hand corner of the sketch by clicking and dragging a pick box around it.

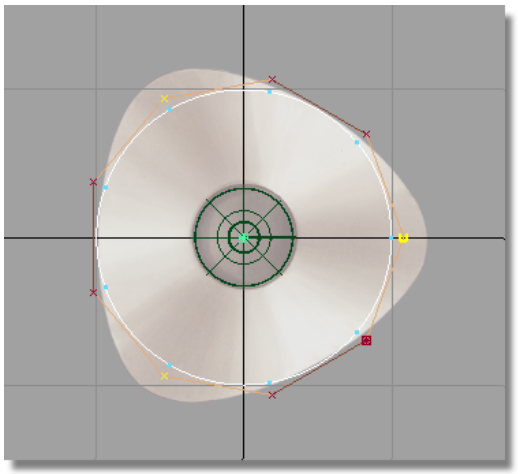


The second CV is selected and highlighted.

11 With the Pick > Point Types > CV tool still active, click and drag a pick box around the CV at the bottom left hand corner of the sketch.

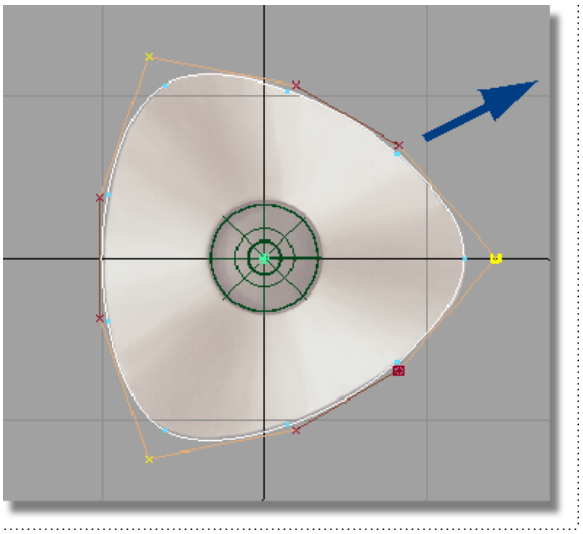


Check that the three CVs are selected and shown in yellow, and that there are two unselected (red) CVs between each corner CV.



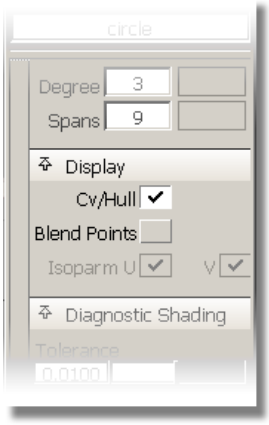
12 Choose Transform > Scale .

13 Click and drag the *left mouse button* until the outline shape is matched.

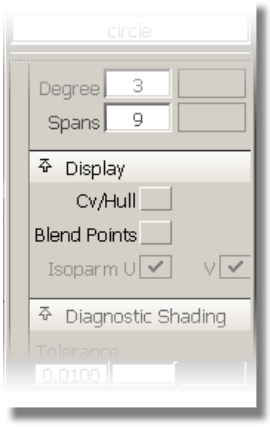


Next, you will make the CVs and hulls invisible for the curve.

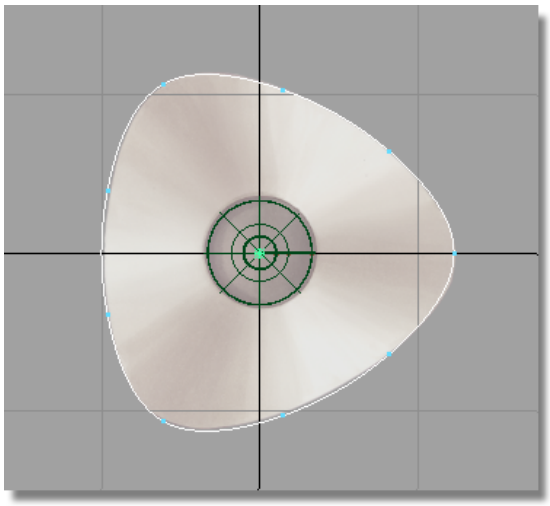
14 On the **Control Panel**, go to the **Display** section.



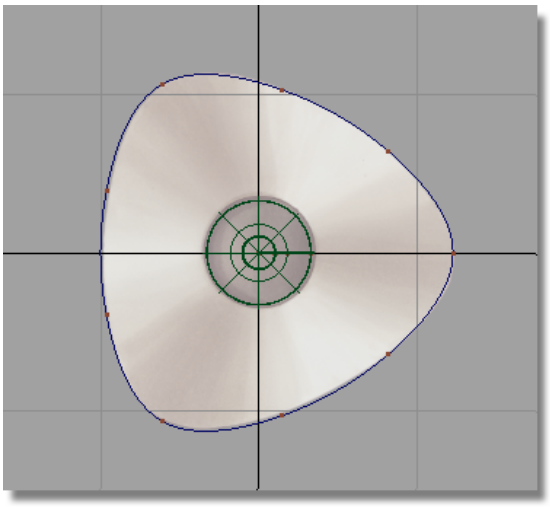
Click on the **CV/Hull** check to remove it.



The CVs and Hulls for the curve are no longer visible.



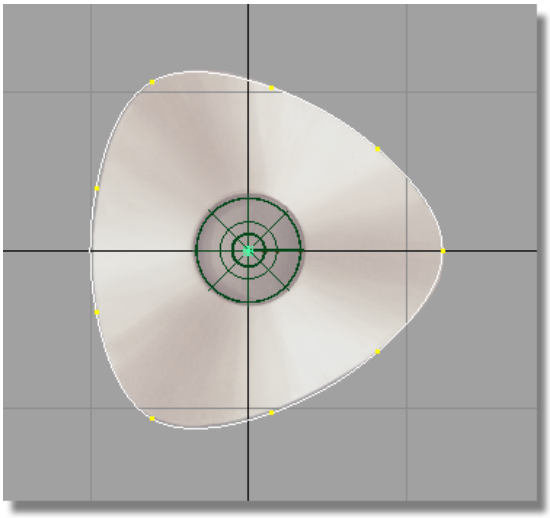
15 Choose Pick > Nothing to unpick the curve.



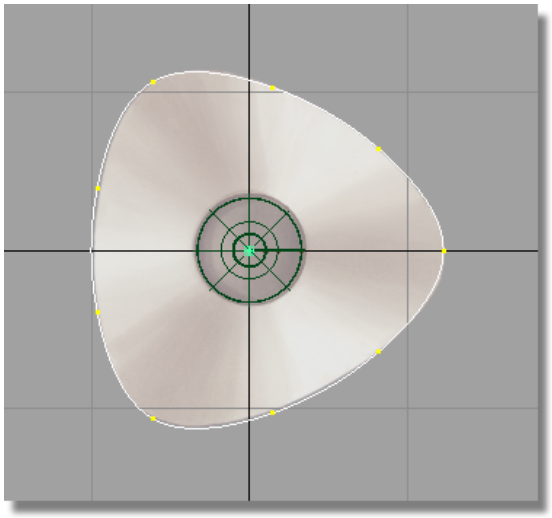
Creating the Upper Curve for the Base

Next, you will create the upper edge of the side wall, by copying and moving the first curve.

1 Choose Pick > Object and select the base outline curve that you just created.

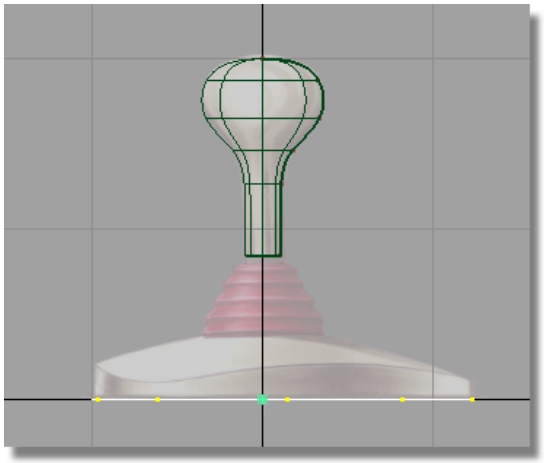


2 Choose Edit > Copy followed by Edit > Paste .



The screen appears unchanged, but a second curve is created and placed at the same location as the first. This curve is selected (shown in white) and ready to move.

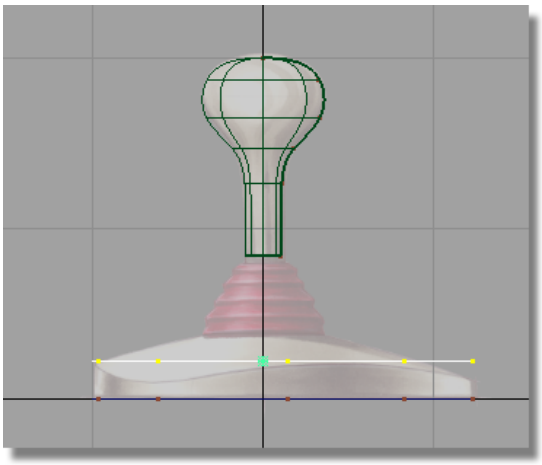
3 Choose Layouts > Left or press the *F6* hotkey to maximize the Left view.



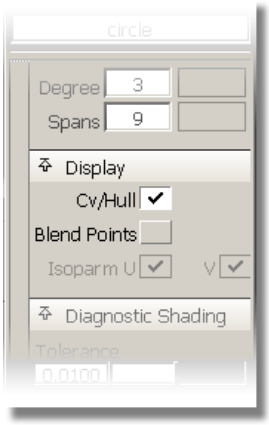
4 Choose Transform > Move .

5 Click and drag the *right mouse button* upwards to move the curve upwards. Click and drag away from the selected curve to avoid picking the original curve.

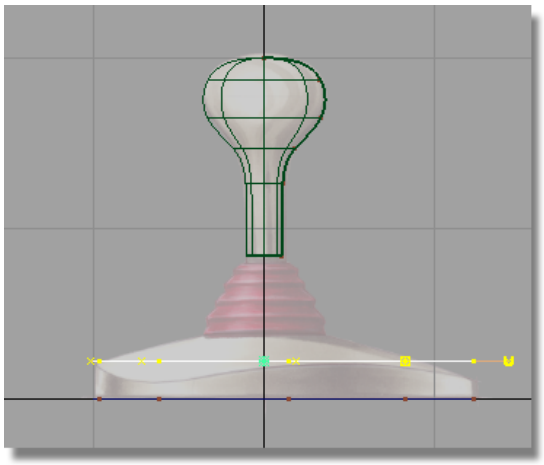
Move the curve so it is aligned with the top of the wavy edge of the joystick base sketch.



6 With the curve still selected, click the **CV/Hull** check box in the **Control Panel Display** section to turn the CVs and Hulls on.

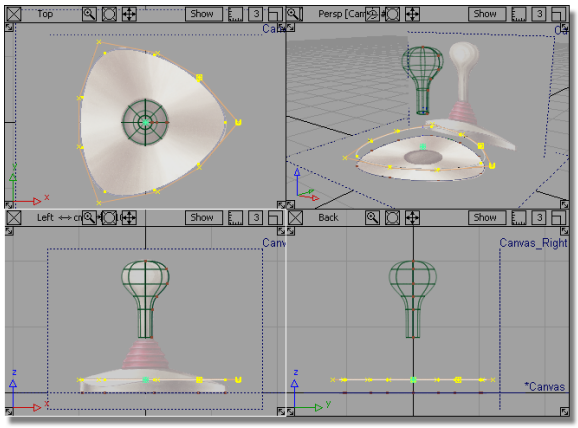


The CVs and hulls appear.



Next, you will shape the curve in 3D. To be able to see the shape develop, you will work with all four views on the screen.

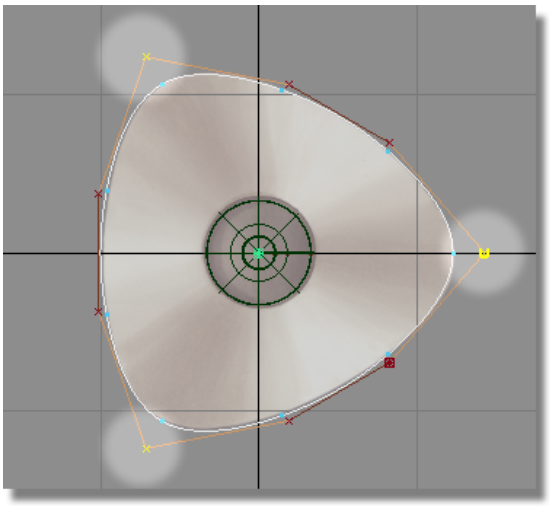
7 Use Layouts > All Windows > All Windows or the *F9* hotkey to return to the four views.



8 Choose Pick > Nothing to deselect the curve.

9 Looking in the Top view, choose Pick > Point Types > CV and select the three corner CVs.

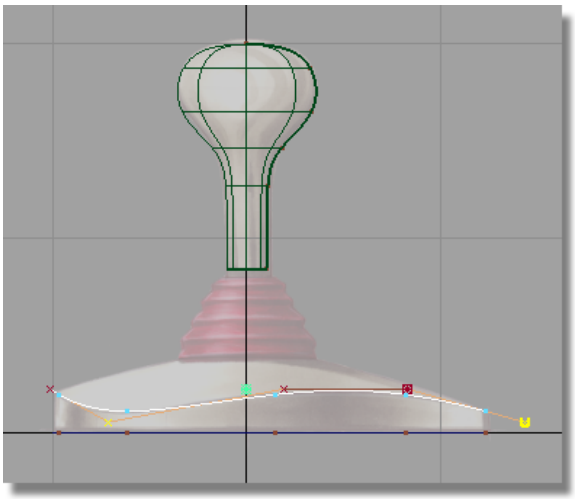
10 Click on each CV or drag a pick box over each of them.



Next, you will move these CV points downwards in the Left view.

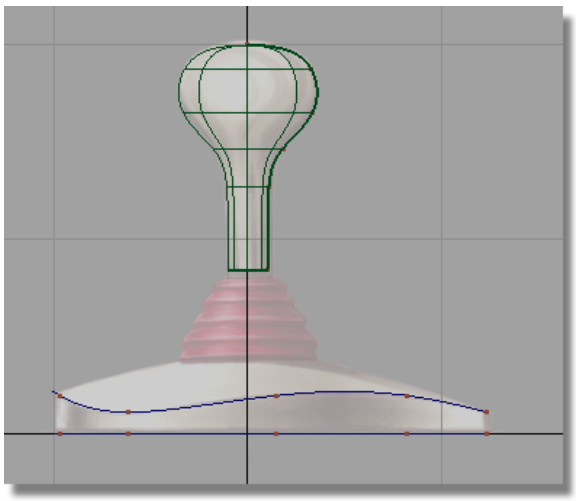
11 Choose Transform > Move .

12 In the **Left** view, use the *right mouse button* to move the selected CVs downwards, until the curve matches the shape of the top edge drawn in the sketch.



13 Choose Pick > Nothing to deselect the CVs.

14 In the **Control Panel**, click on the **CV/Hull** check box to turn the CVs off.

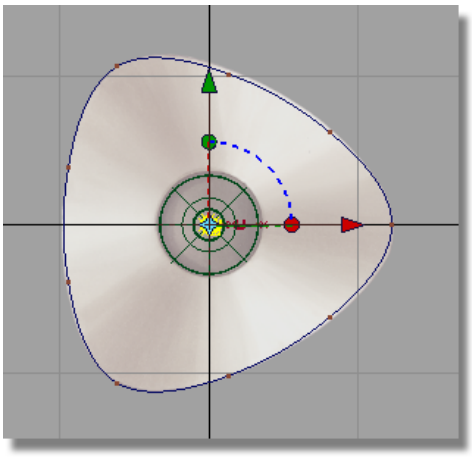


Creating the Top Curve for the Base

You will continue working in the four views to create the small circle at the top of the base, where the joystick handle is connected.

1 Choose Curves > Primitives > Circle .

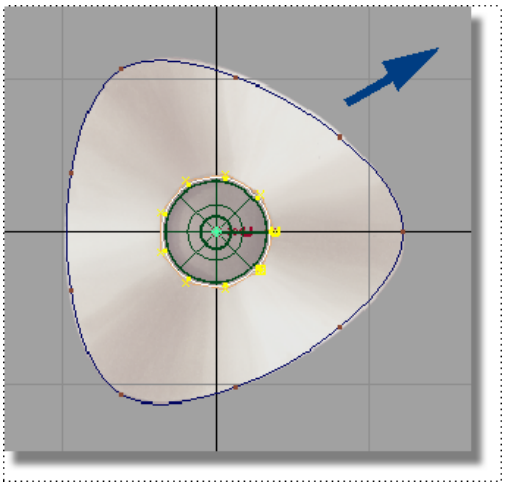
2 Hold down the *Alt* (Windows) or *Command* (Mac) key to turn on grid snapping. In the Top view, click near the origin to place the circle exactly on the center grid point.



A small circle is placed at the origin, with the manipulator shown.

3 Choose Transform > Scale .

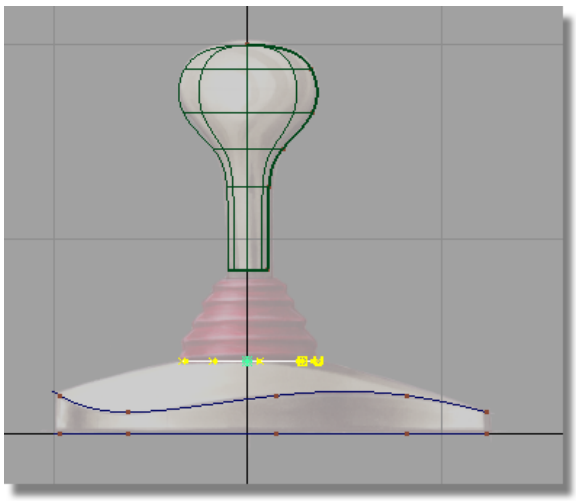
4 Be careful not to click on any of the curves, and click and drag with the *left mouse button*. Drag towards the top right of the screen to scale the circle to match the smaller inner circle on the sketch.



Now, you will move the circle upwards in the Left view.

5 With the circle still selected, choose Transform > Move .

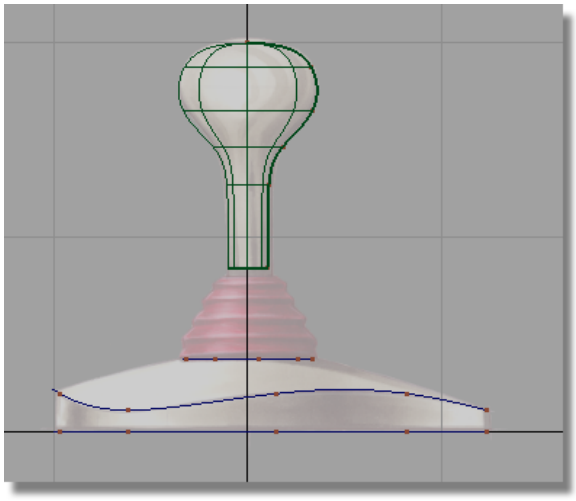
6 In the Left view, click and drag the *right mouse button* to move the circle upwards to match the top of the base in the sketch.



The circle is now in position at the top of the base.

7 On the **Control Panel Display** section, click on the **CV/Hull** check to turn the CVs and hulls off for the circle.

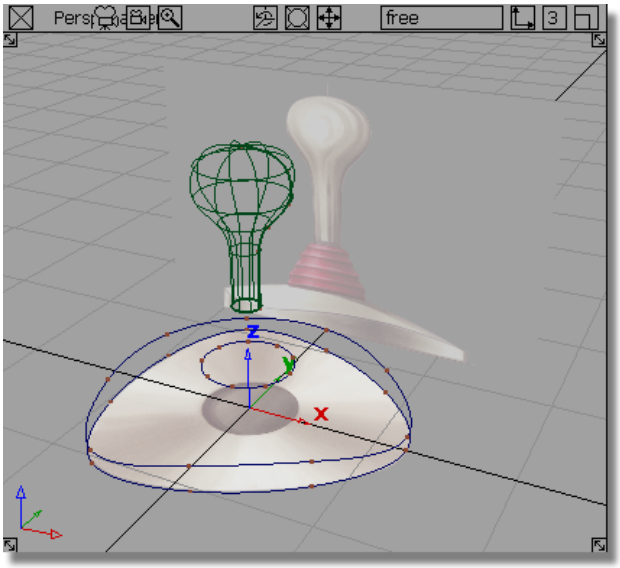
8 Choose Pick > Nothing to deselect the circle.



Creating the base surfaces

Next, you will create the surfaces for the base using the **Skin** and **Planar surfaces** surface tools. First, you will create the side wall of the base using a skin surface.

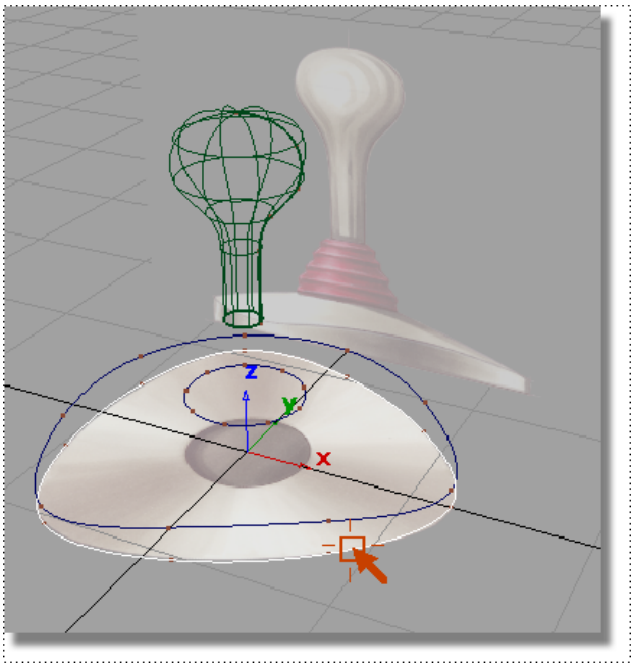
1 Choose Layouts > Perspective or *F8* to maximize the perspective view.



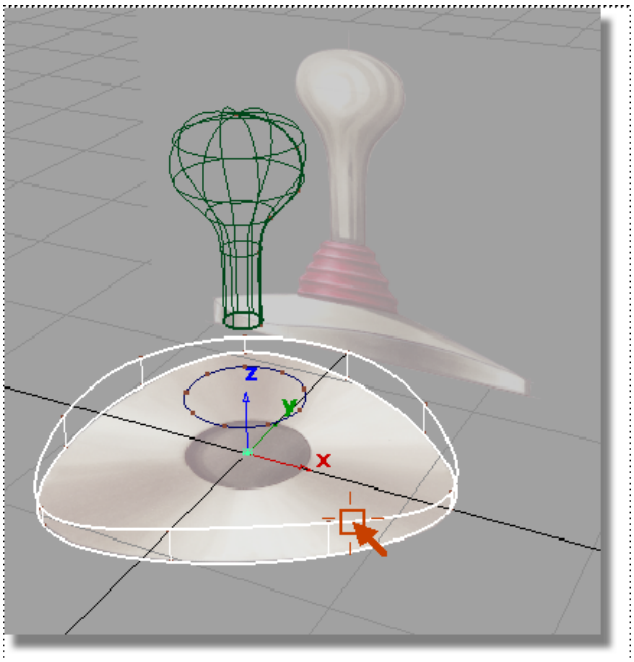
2 Choose Surfaces > Revolve .

3 You are prompted to select the first curve.

4 Select the first triangular curve you created at the bottom of the base.



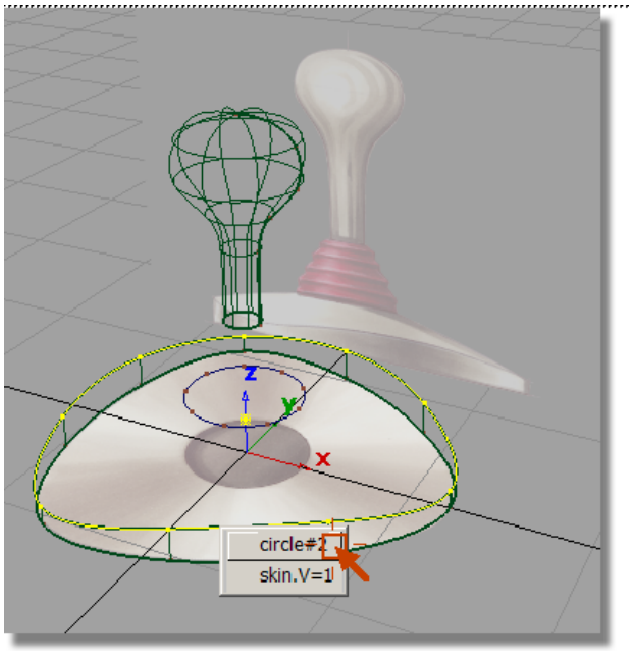
5 Select the second triangular curve as the top edge of the side wall.



A skin surface is created between the two curves.

Next, you will create the surface across the top of the base component.

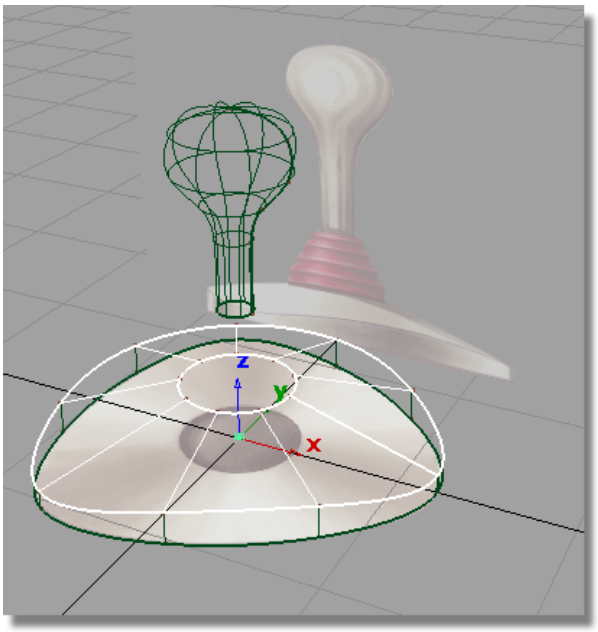
6 With the **Skin** tool still active, select the second triangular curve again. The pick chooser offers a choice between the curve and the surface you just created.



Keep the mouse button held down and move the mouse over the circle curve in the pick chooser.

Release the mouse button to select the circle.

7 Now, you are prompted to select the next curve. Click the smaller circle at the top of the base.

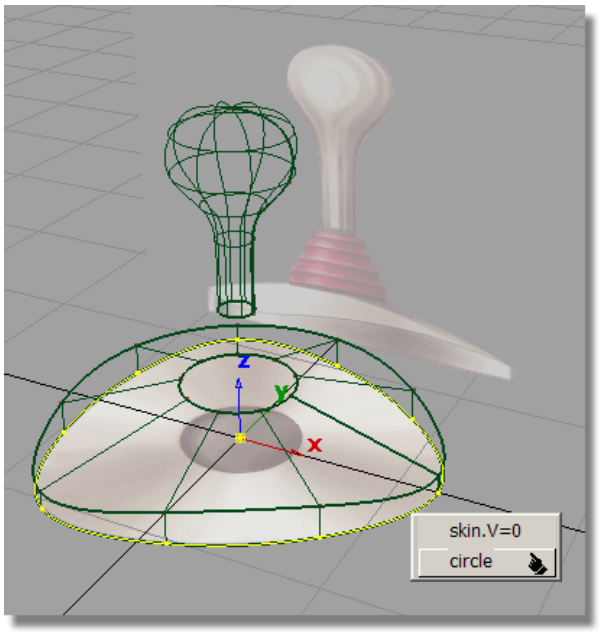


The top skin surface is created between the two curves.

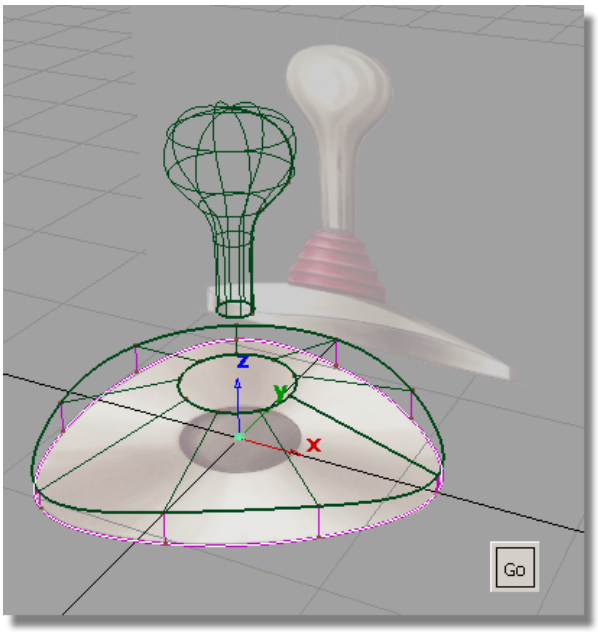
Next, you will create the surface underneath the base.

8 Choose the Surfaces > Planar Surfaces > Set Planar tool.

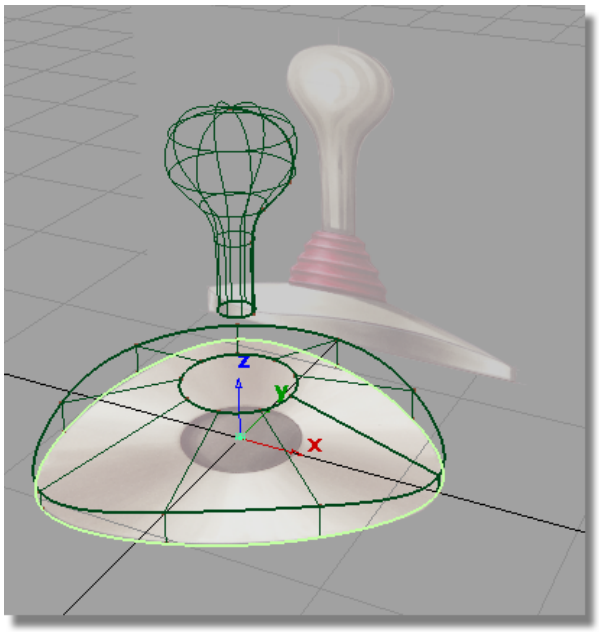
9 Select the first triangular curve at the bottom of the base. The pick chooser appears.



Select the circle curve.

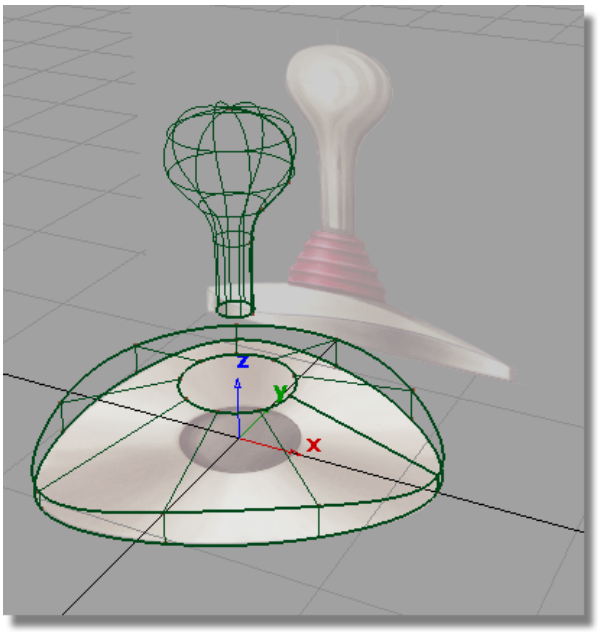


Click on the **Go** button that appears in the bottom right of the screen.



A planar surface is created across the bottom of the base.

10 Choose Pick > Nothing to unpick the planar surface.



Save your work

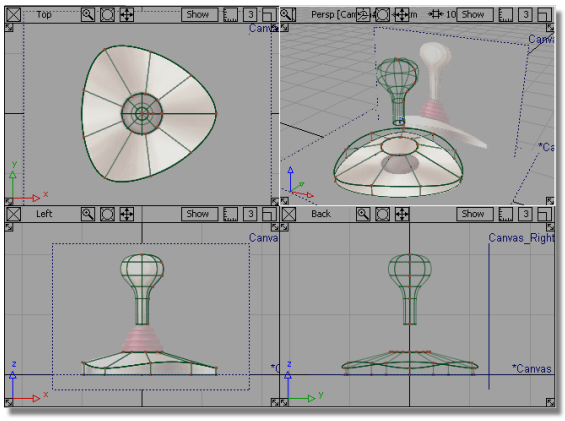
1. Choose File > Save As to save the current scene.
2. Save your work in the `wire` directory of the `Lessons` project.
3. Name your file `myjoystick2.wire`.

Part 3: Creating the Flexible Sleeve

In this section, you will create the flexible component that connects the base to the joystick handle.

Opening the tutorial file (optional)

If you successfully completed Part 2, you can proceed directly to the next step, **Creating the zig-zag curve.**



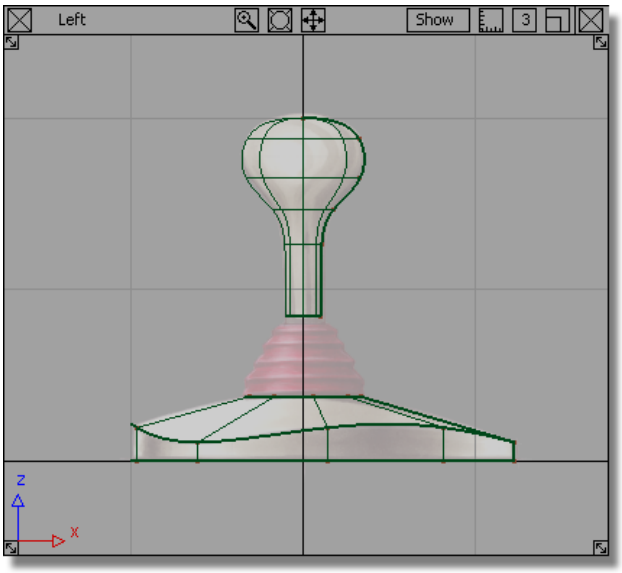
If you were not successful in part 2, open the file called joystick_part3.wire, located in the wire directory of the CourseWare project. This file contains the completed model from Part 2.

 Watch **Part 3** of the tutorial.

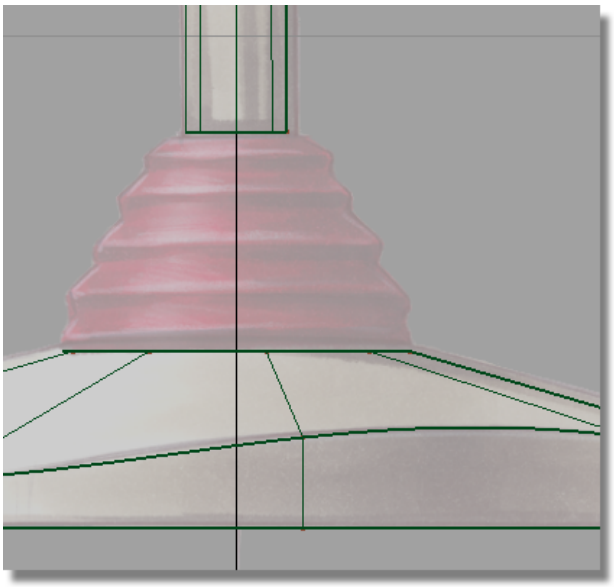
Creating the zig-zag curve

To create the profile for the sleeve, you will first create a simple curve across the gap between the handle and the base. Then, you will increase the number of CVs in the curve so a detailed zig-zag shape can be created.

1 Choose Layouts > Left or *F6* to maximize the Left view.



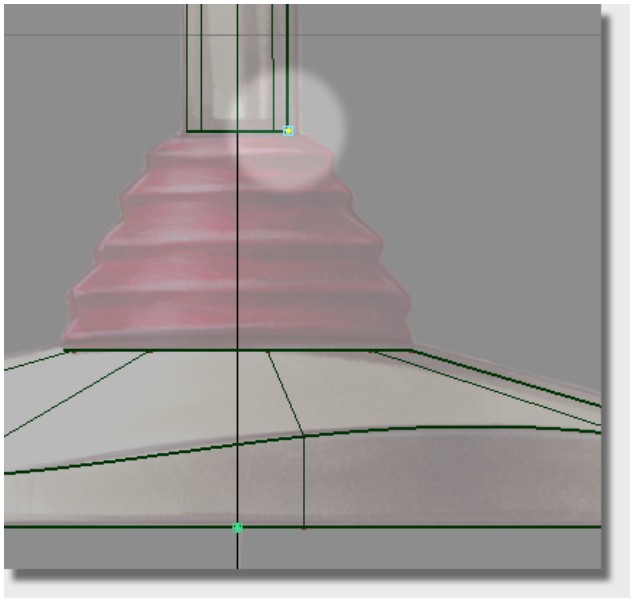
2 Zoom in to the sleeve area. Hold the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys down together and click-drag with the *right mouse button*.



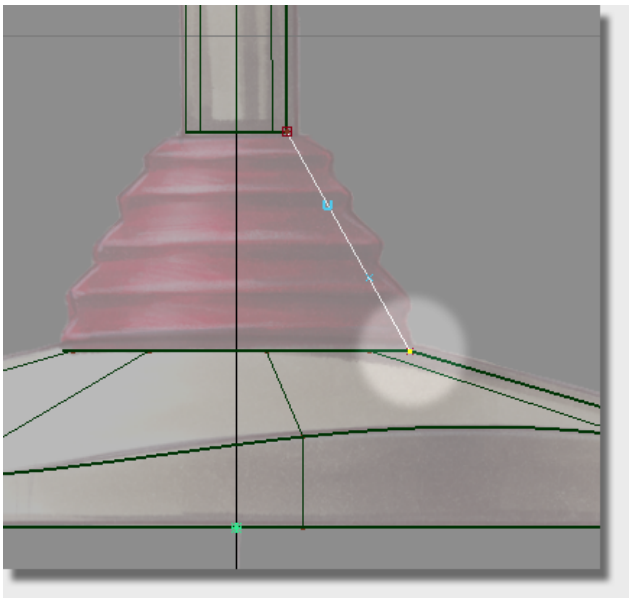
You will start with a single span curve stretched across the gap between the bottom of the handle and the top of the base. You will use curve snapping to accurately place the sleeve curve between the end of the handle and the base curves.

3 Choose Curves > New Curves > New Edit Point Curve.

4 Hold down the *Alt* + *Ctrl* (Windows) or *Command* + *Control* (Mac) and keys to turn on curve snapping. Click on the base of the handle to place the first edit point. Without releasing the mouse button, drag the edit point until it snaps to the corner.



Keep the *Alt* + *Ctrl* (Windows) or *Command* + *Control* (Mac) keys held down and click near the top of the base to place the second edit point. Without releasing the mouse button, drag the edit point until it snaps to the corner.

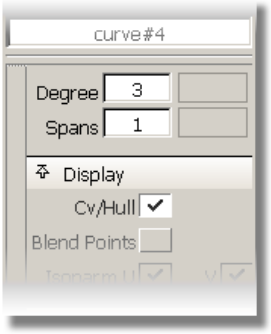


A single span curve is created that has two Edit Points (one at either end) and 4 CVs.

NOTE The part of a curve between two edit points is called a span. If a more complex curve is created with many edit points, there will be many spans, one between each pair of edit points. When a curve has more spans, it also has more CVs. These extra CVs can be used to create a more complex shape.

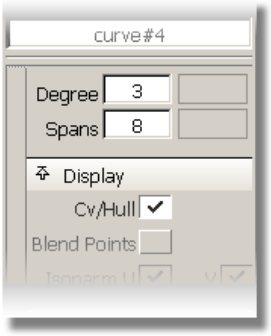
You will now increase the number of CVs in this curve so you can create the zig-zag profile of the sleeve.

5 In the **Control Panel**, the number of spans that make up the curve is displayed.

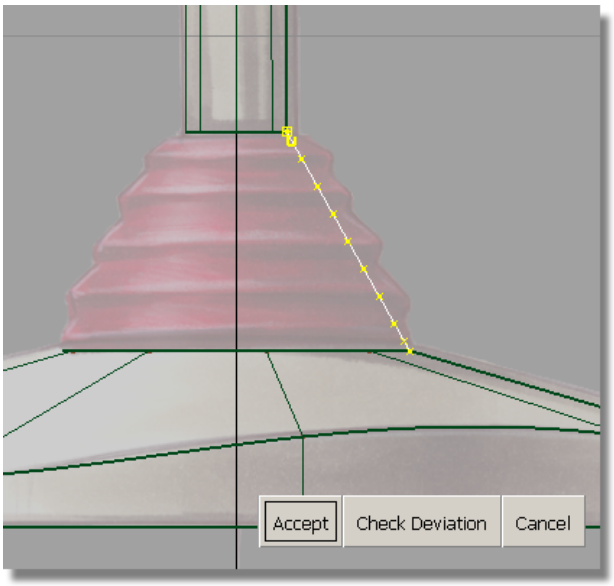


The curve currently has only 1 span.

6 In the Spans section of the control panel, type in **8** and press *Enter* (Windows) or *Return* (Mac).



The curve is rebuilt with 8 spans, and now has 11 CVs. A preview of the rebuilt curve is shown in the view.



Choose **Accept** to confirm the rebuild.

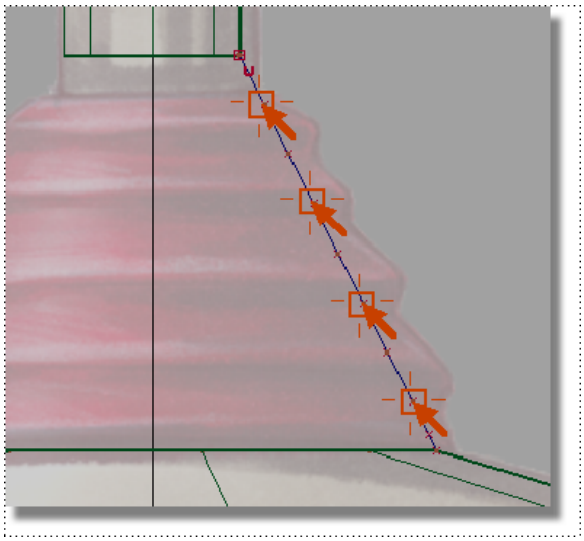
7 Choose Pick > Nothing to deselect the curve.

Next, you will select some of the CVs to be moved to shape the curve.

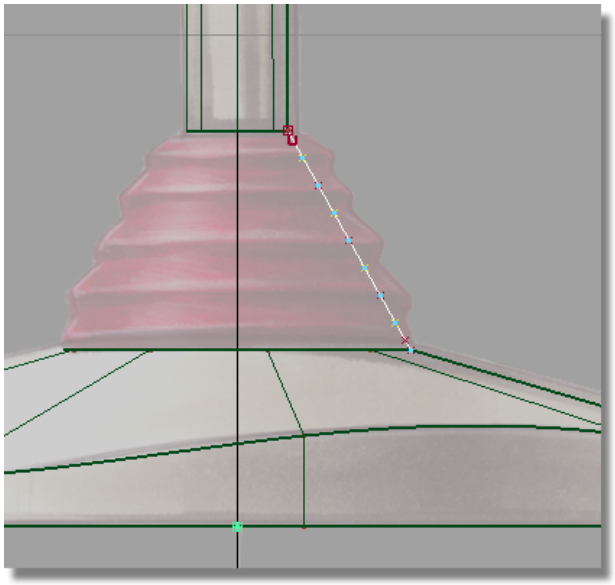
Looking at the top of the curve, the first CV is shown as a small square, and the second CV is shown as a U. You will leave these two CVs unselected, so the sleeve profile stays connected to the handle, and the direction of the end tangent is not modified.

8 Choose Pick > Point Types > CV .

9 Continue counting from the top and select the third, fifth, seventh and ninth CVs.

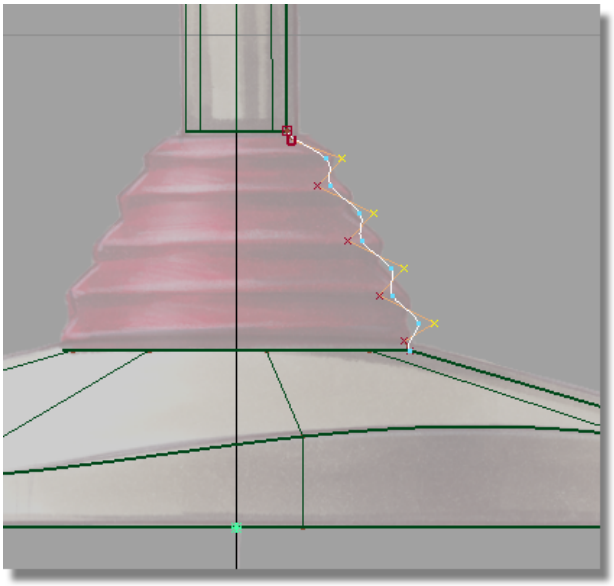


Leave the last two CVs unselected so the sleeve curve remains connected to the base profile, and the direction of the end tangent is not modified.



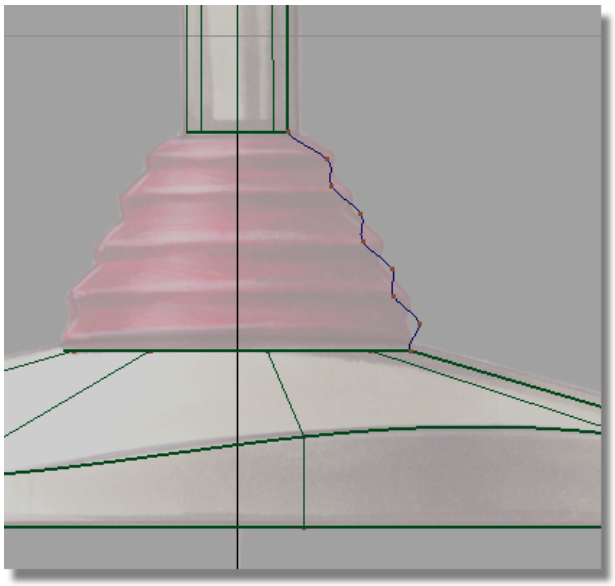
10 Choose Transform > Move .

11 Click and drag the *middle mouse button* to the right until a gentle zig-zag shape is created, as shown.



12 With the CVs still selected, click on the **CV/Hull** check box to turn off the CVs and hulls for the curve.

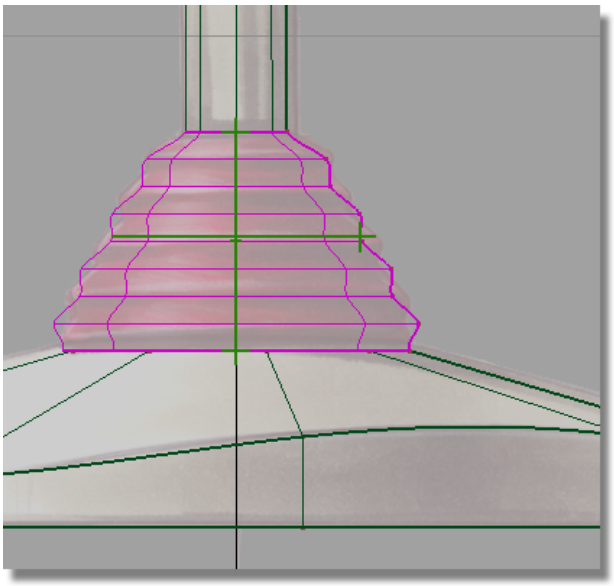
13 Choose Pick > Nothing to deselect the CVs.



Next, you will create the sleeve surface.

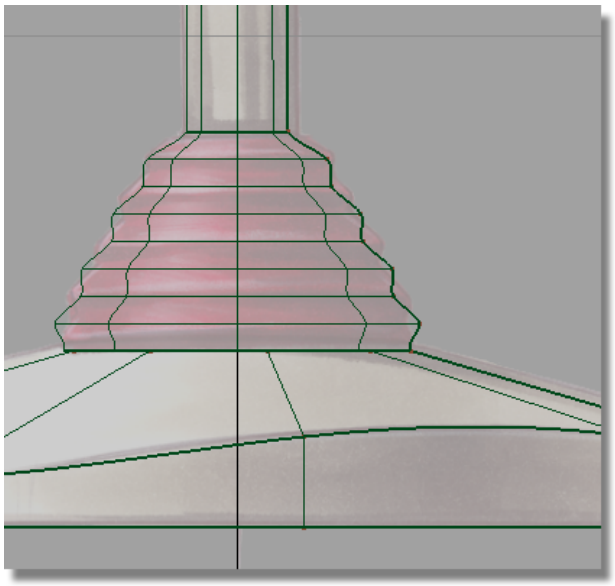
14 Choose Surfaces > Revolve .
You are prompted to select a curve to revolve.

15 Click on the zig-zag curve to select it.

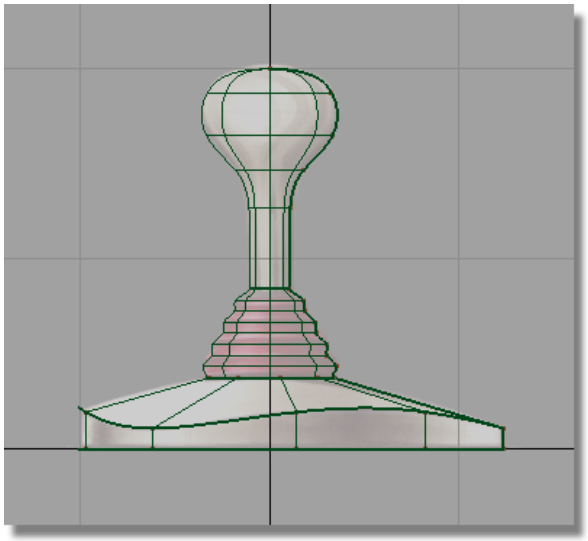


The surface is created and the green handles displayed.

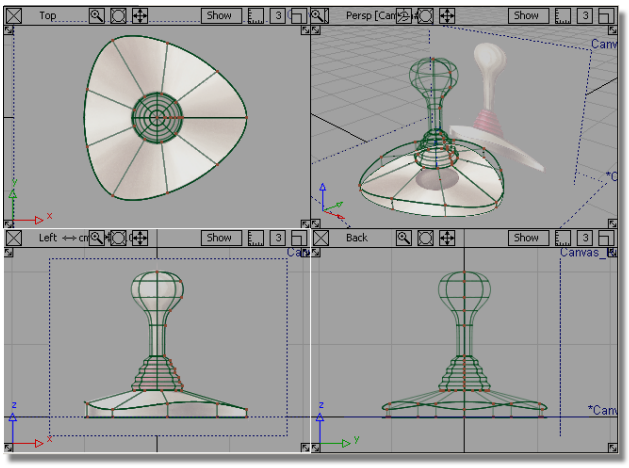
16 Choose Pick > Nothing to deselect the surface.
The green handles disappear.



17 Zoom out to view the whole joystick design.



18 Choose the **F9** key to return to the four windows.



Save your work

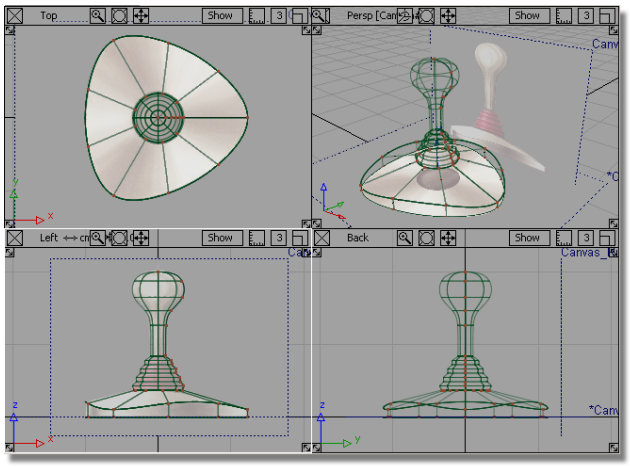
1. Choose File > Save As to save the current scene.
2. Save your work in the `wire` directory of the `Lessons` project.
3. Name your file `myjoystick3.wire`.

Part 4: Creating the connecting cable

In this section, you will create part of the cable that connects the joystick to the computer.

Opening the tutorial file (optional)

If you successfully completed Part 3, you can proceed directly to the next step, **Create the cable path curve**.

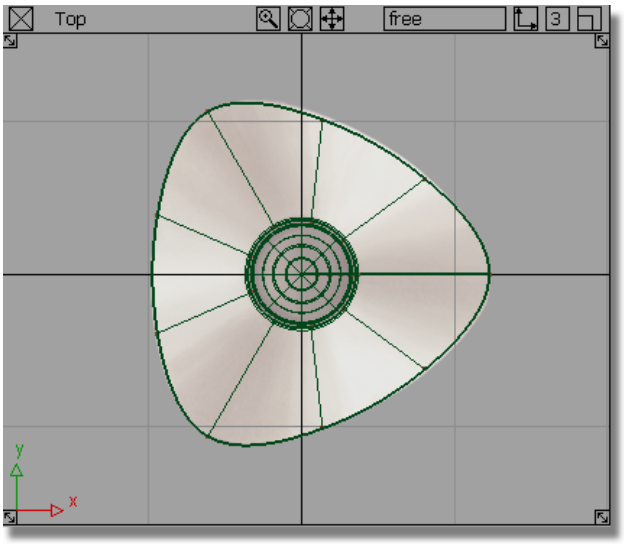


If you were not successful in part 3, open the file called joystick_part4.wire, located in the wire directory of the CourseWare project. This file contains the completed model from Part 3.

 Watch **Part 4** of the tutorial.

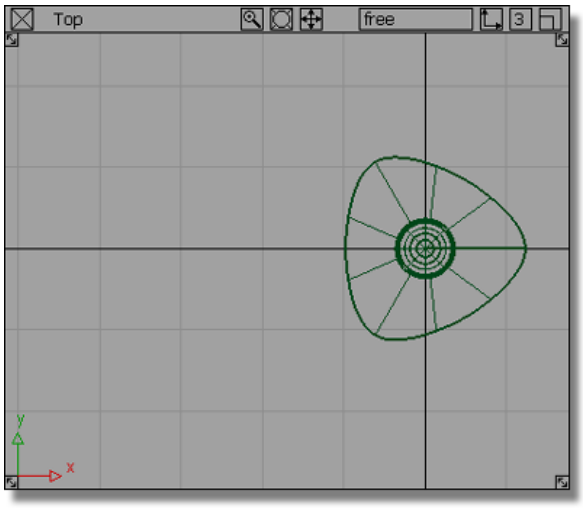
Create the cable path curve

1 Choose Layouts > Left or *F5* to maximize the Top view.



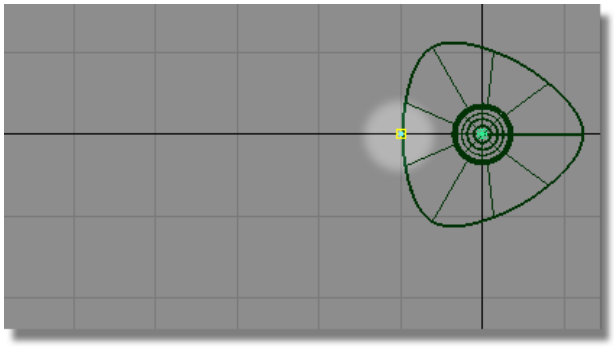
You will create the cable on the left of the joystick, so you will modify the view to give you more space.

2 Hold the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys down and use the *right mouse button* to zoom out of the view. With the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys still held down, use the *middle mouse button* to pan the view, so there is some free space to the left of the joystick.



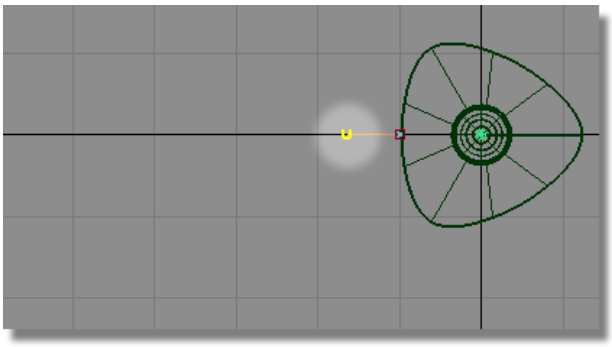
3 Choose Curves > New Curves > New Edit Point Curve.

4 Hold the *Alt* (Windows) or *Command* (Mac) key down to turn grid snapping on, and click on the grid intersection at the left side of the base.



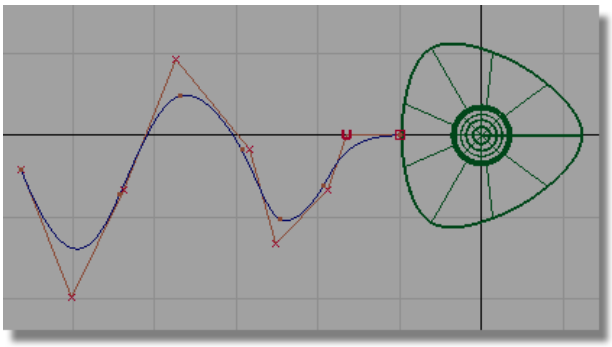
The first CV of the curve is created.

5 Click and drag the *middle mouse button* to position the second CV to the left of the first.



Release the mouse button. The second CV is placed horizontally away from the first.

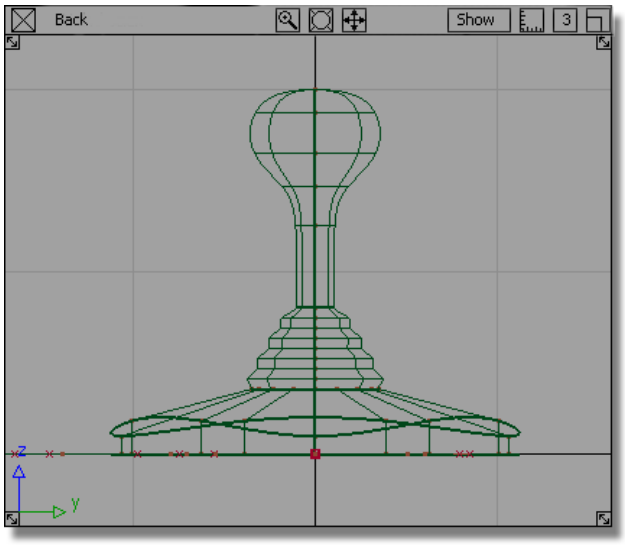
6 Continue to place CVs, creating a wavy path for the cable.



Create the cable profile curve

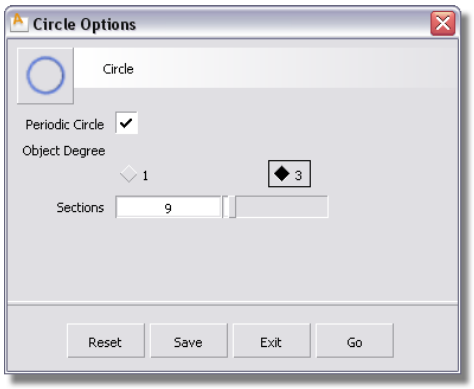
Next, you will create a small circle for the cross-section profile of the cable.

1 Choose Layouts > Left or *F7* to maximize the Back view.



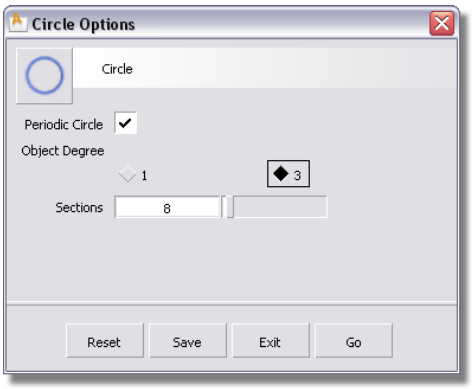
2 Choose Curves > Primitives > Circle .

3 Double-click the icon to open the option box.

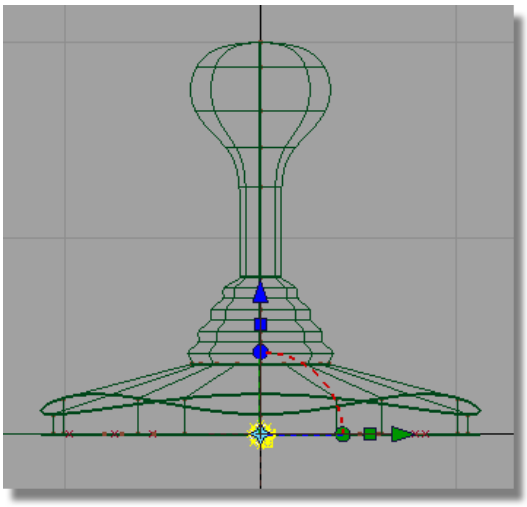


The current options have **9** sections which was set previously for the triangular shape. The default number of sections is 8 which creates a good general purpose circular shape.

Click the Reset button at the bottom of the Circle Options box to reset the options to the default values. Press **Go** to create the circle.

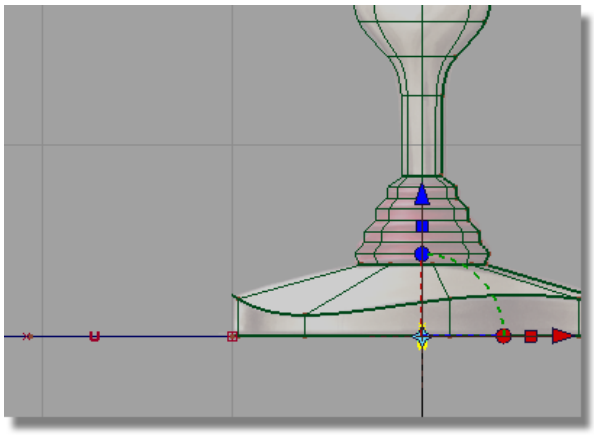


4 Hold down the *Alt* (Windows) or *Command* (Mac) key to turn grid snapping on. Click near the origin in the Back window to place the circle at the center of the base.



A small circle is placed at the origin. The CVs are highlighted in yellow and the manipulator is showing, but it won't be used.

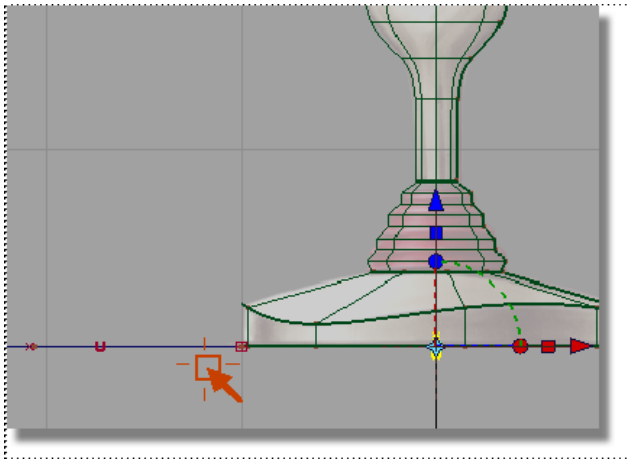
5 Choose Layouts > Left or *F6* to switch to the Left view.



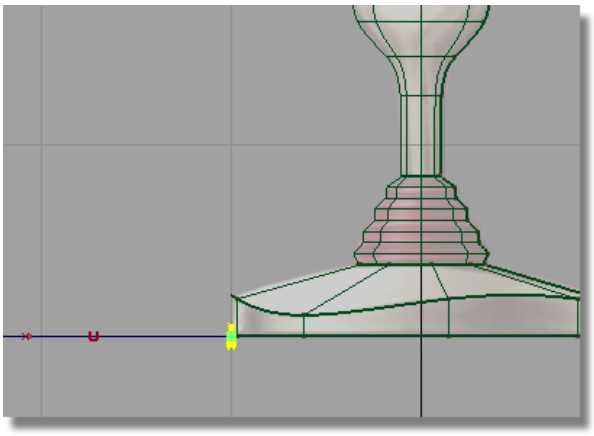
The circle is at the origin. Next, you will move the circle to the left edge of the joystick base, where the path curve begins.

6 With the circle still selected, choose Transform > Move .

7 Hold down the *Alt* (Windows) or *Command* (Mac) key to turn on grid snapping. Click near the grid point where the path curve starts, being careful not to select any other geometry.



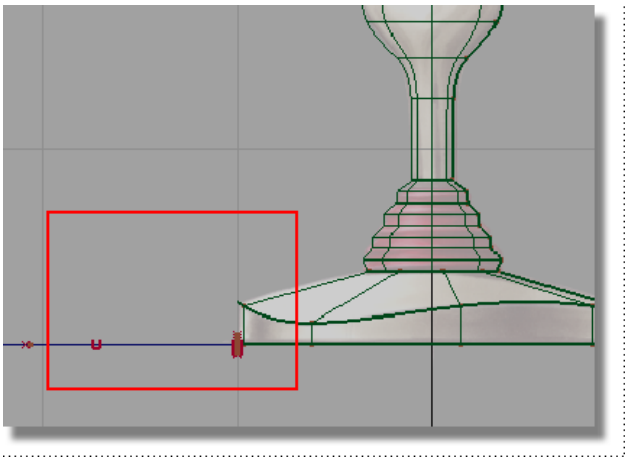
The circle moves to the start of the path.



8 Choose Pick > Nothing to deselect the circle.

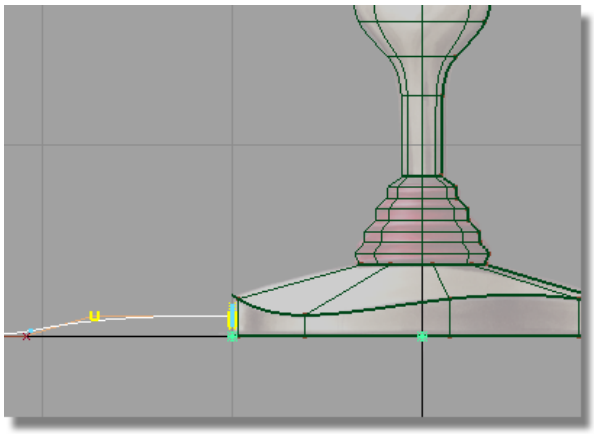
9 The circle and the start of the path curve need to move upwards, so the cable emerges from the middle of the base side wall.

10 Choose Pick > Point Types > CV and drag a box around the circle CVs and the first two CVs on the path curve.



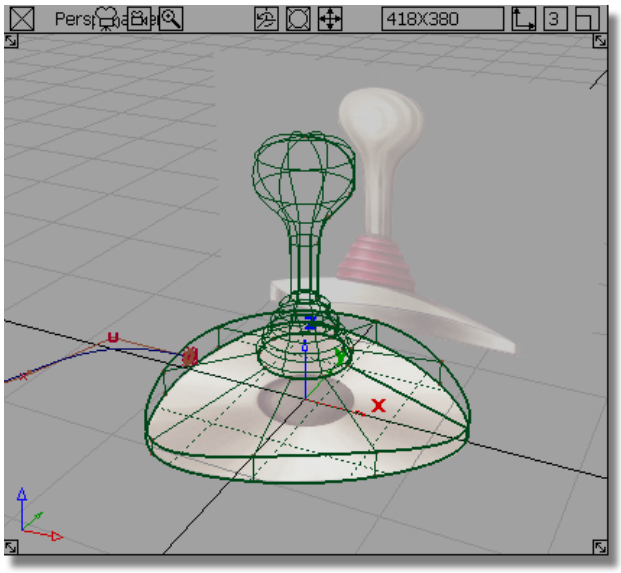
11 Choose Transform > Move .

12 Click and drag the *right mouse button* to move the selected CVs upwards, so the circle sits in the middle of the sidewall of the base.



13 Choose Pick > Nothing to deselect the CVs.

14 Choose Layouts > Perspective or the *F8* hotkey to switch to the perspective view.

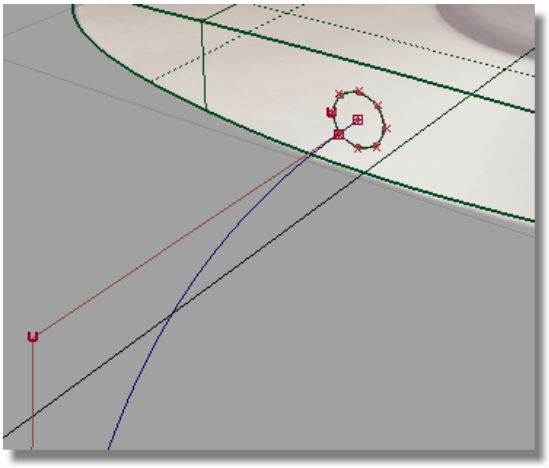


The small circle is at the start of the path curve, centered on the side wall of the base.

Create the cable surface

Next, you will create the extruded surface for the cable.

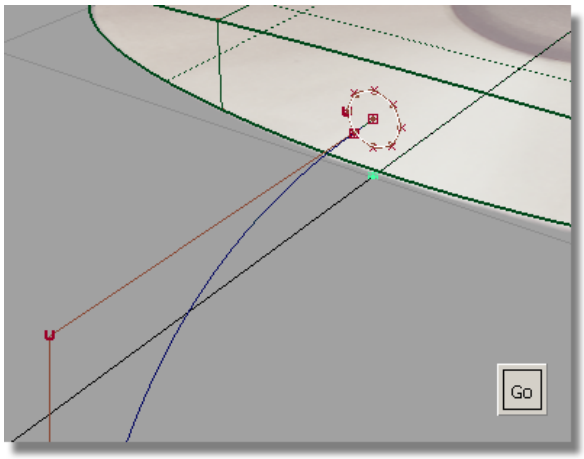
1. Tumble the perspective view and zoom in to the area at the start of the cable. Hold down the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys and use the *left mouse button* to tumble the view, and the *right mouse button* to zoom in.



   To create the cable surface, you will extrude the small circle along the path curve.

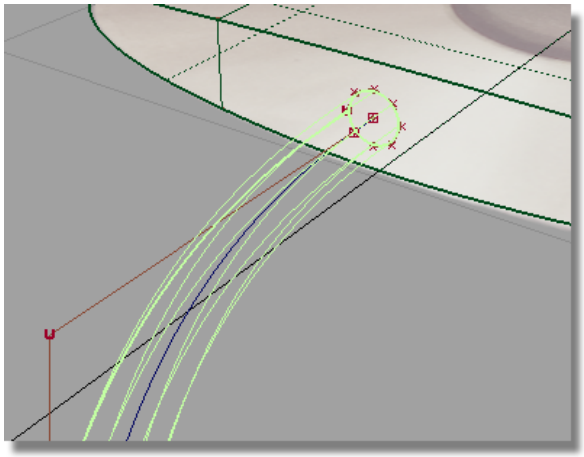
2. Choose the Surfaces > Swept Surfaces > Extrude tool.

3. You are prompted to select the curves to extrude. Click the circle to select it to be extruded.



Select the **Go** button to choose the circle as the generation curve.

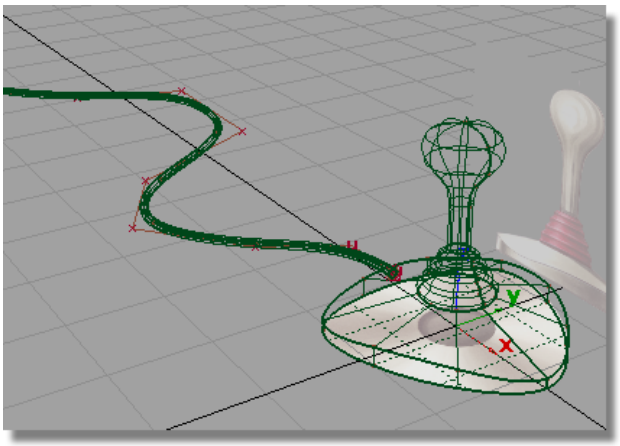
4 You are prompted to select the extrude path. Click on the long wavy curve to select it as the path curve.



The extruded surface is created.

5 Choose Pick > Nothing to deselect the surface.

6 Tumble and zoom out to view the cable surface.



Save your work

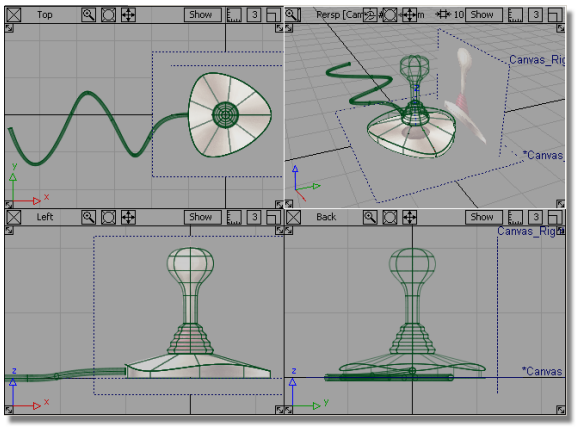
1. Choose File > Save As to save the current scene.
2. Save your work in the `wire` directory of the `Lessons` project.
3. Name your file `myjoystick4.wire`.

Part 5: Assigning objects to layers

In this section, you will assign the curves and surfaces you have created to new layers.

Opening the tutorial file (optional)

If you successfully completed Part 4, you can proceed directly to the next step, **Assigning curves to a layer.**



If you were not successful in part 4, open the file called `joystick_part5.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 4.


Watch **Part 5** of the tutorial.

Assigning curves to a layer

Layers are a way of grouping related objects and organizing a scene. By default, all objects you create are assigned to the **Default Layer**.

First, create a layer.

1. Choose Layers > New to create a layer.

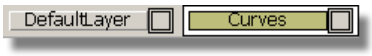


   A new layer button called **L1** appears in the Layer Bar. (The Layer Bar is located just below the prompt line and just above the view window area.)

2. To rename the layer, in the Layer Bar, double-click the **L1** layer.



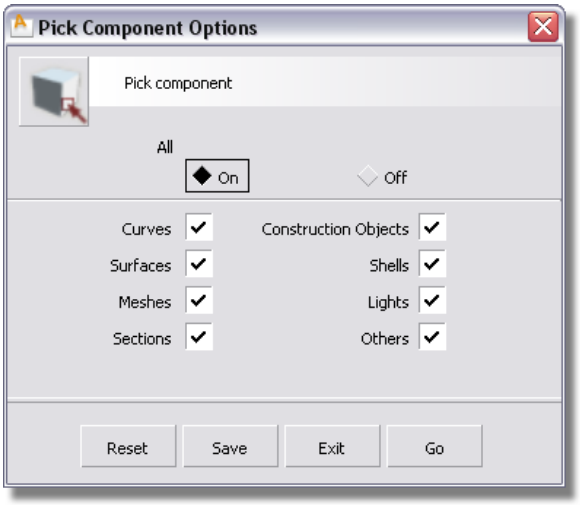
   Type the word **Curves**, and press *Enter* (Windows) or *Return* (Mac).



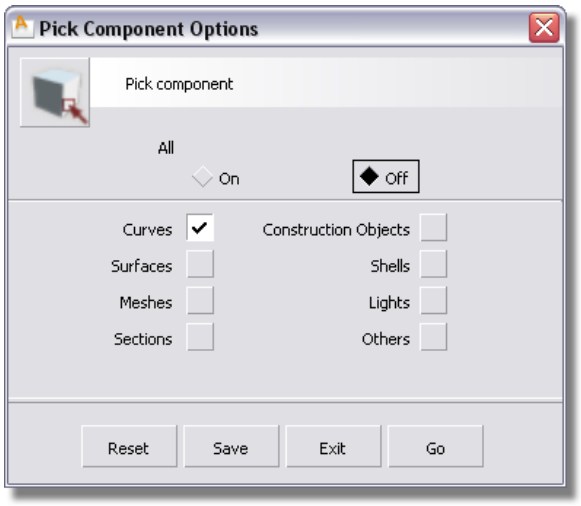
Next, you will select all the curves to be assigned to the layer. You will use the Pick > Component tool which allows you to specify the type of object you want to select. In this case, you will set it to select curves only, so that all the curves can be easily selected using a drag box.

3 Choose Pick > Component .

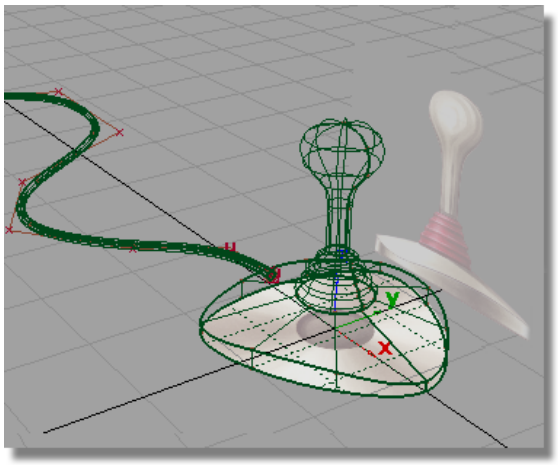
4 Double-click the icon to open the option box.



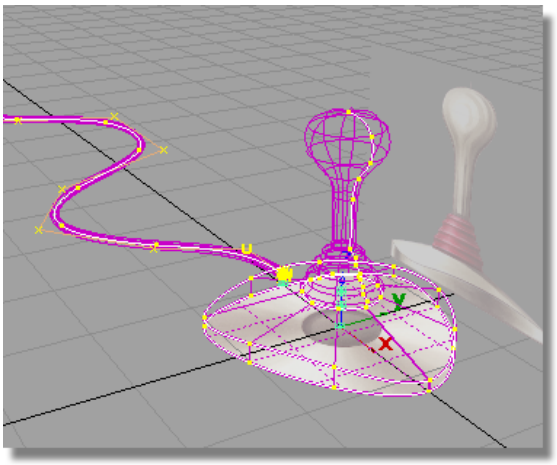
Deselect all the options except **Curves**. Select the **Go** button at the bottom of the option box.



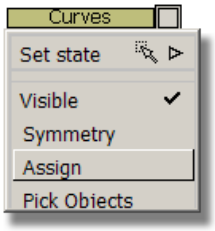
5 Drag a pick box around all of the objects to choose all the curves.



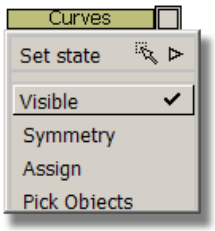
Only the curves are selected.



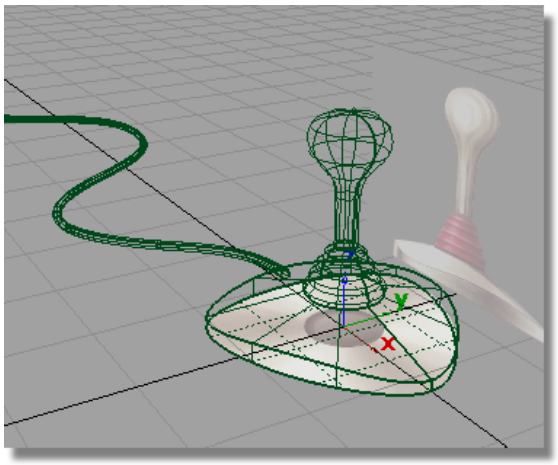
6 In the **Layer Bar**, press and hold the *left mouse button* on the **Curves** layer to display the pull-down menu. Then, choose **Assign** from the menu to assign all the picked curves to the **Curves** layer.



7 Press and hold the *left mouse button* on the **Curves** layer, and choose **Visible** to turn off the visibility of the layer.



The curves are no longer displayed in the scene.



Assigning the surfaces to layers

1 Choose Layers > New to create another layer.



A new layer button called **L2** appears in the Layer Bar.

2 To rename the layer, in the Layer Bar, double-click the **L2** layer.

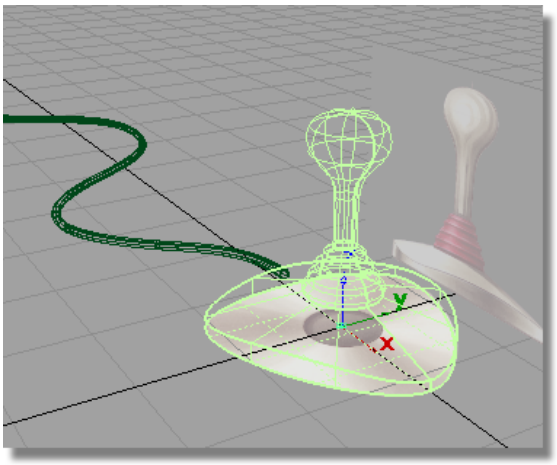


Type the word **Joystick**, and press *Enter* (Windows) or *Return* (Mac).

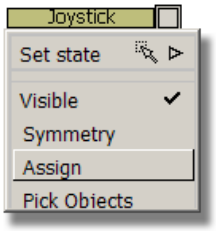


3 Choose Pick > Object .

4 Select the joystick base, sleeve, and handle.



5 In the Layer Bar, press and hold the *left mouse button* on the **Joystick** layer to display the pull-down menu. Then, choose **Assign** from the menu to assign all the picked surfaces to the **Joystick** layer.



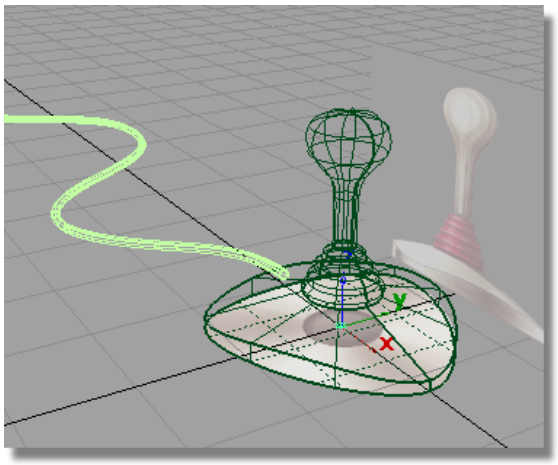
These surfaces are left visible, so you can continue working on them in the next section.

6 Create another layer using Layers > New. Rename the layer **Cable**.

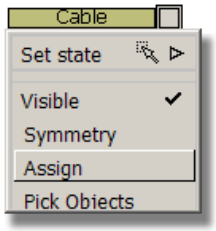


7 Choose Pick > Nothing to deselect the joystick objects.

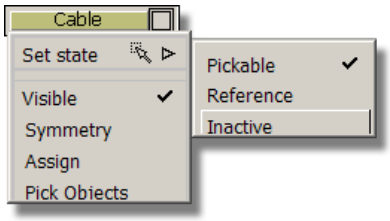
8 Choose Pick > Object and select the cable surface.



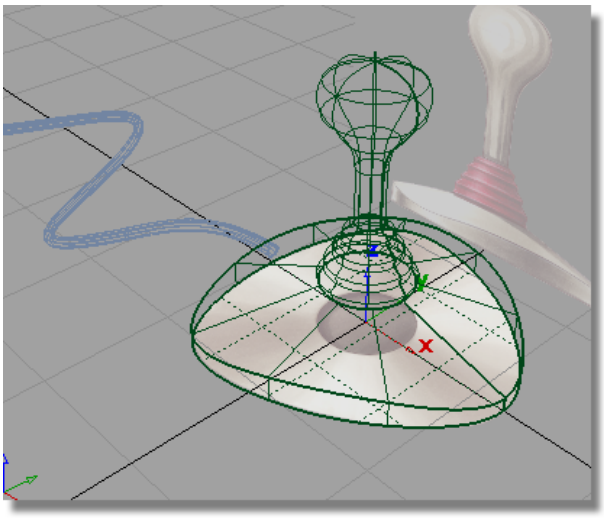
9 **Assign** the cable surface to the cable layer.



10 Press and hold the *left mouse button* on the **Cable** layer, choose **Set State**, then **Inactive** to make the cable surface inactive.

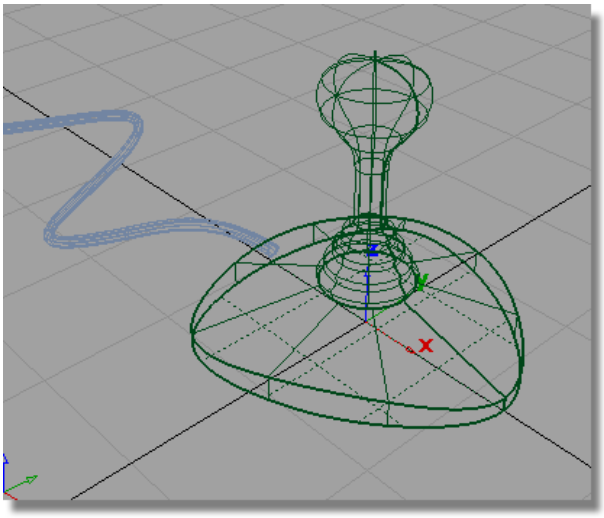


The cable surface is still visible, but is shown in pale blue and cannot be selected.



Finally, as you have finished using the sketches as guides, you will turn them off.

11 Choose WindowDisplay > Toggles > Construction Objects to turn off the sketches.



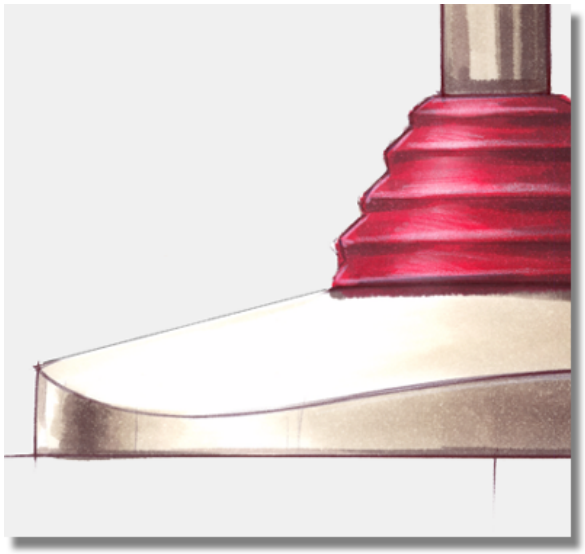
Save your work

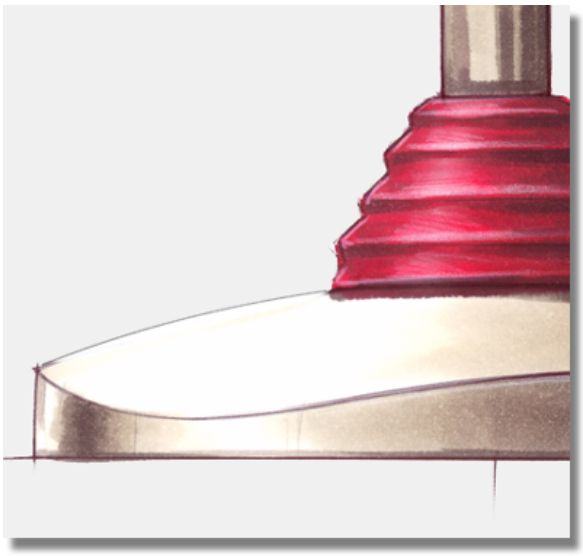
1. Choose File > Save As to save the current scene.
2. Save your work in the `wire` directory of the `Lessons` project. Name your file `myjoystick5.wire`.

Part 6: Directly modifying surfaces

In this section, you will refine the design by directly moving the CVs of the handle and base surfaces. The sketches shown below show the design changes:

The top of the base has changed from being a straight surface, to a gently rounded surface.

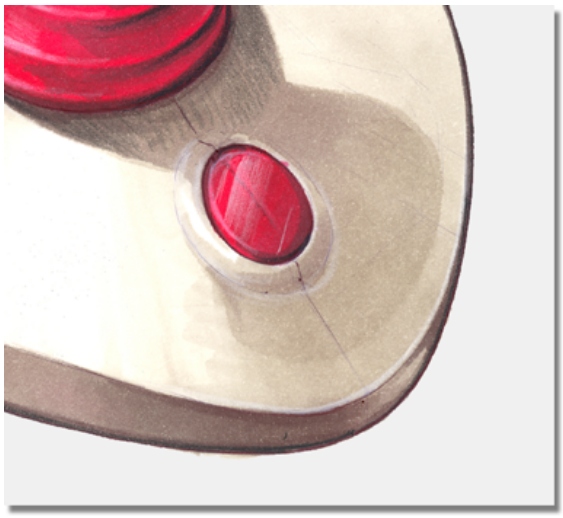




The top of the handle has a triangular, angled shape.

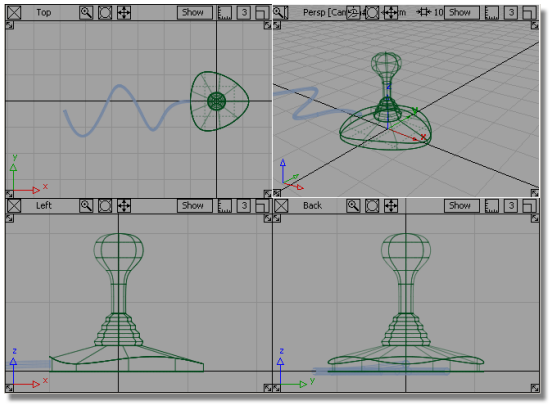


A button has been added to the base.



Opening the tutorial file (optional)

If you successfully completed Part 5, you can proceed directly to the next step, Deleting Construction History.



If you were not successful in part 5, open the file called `joystick_part6.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 5.

 Watch **Part 6** of the tutorial.

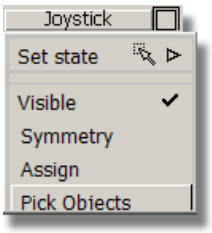
Deleting Construction History

All the surfaces are currently shown in dark green. This indicates that they have construction history, which means that when the curves are modified the surfaces will update.

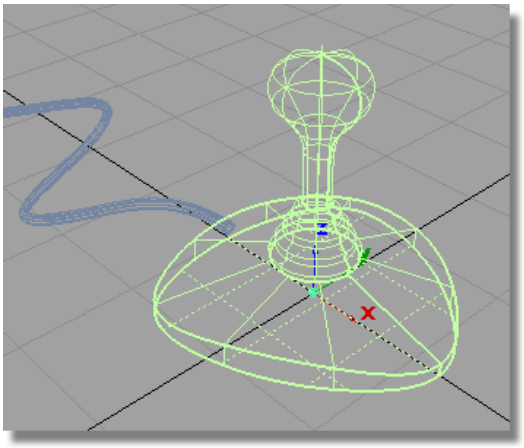
In this section of the tutorial, instead of using the curves to modify the surfaces, you will be modifying the surfaces directly.

To do this, you will first delete the construction history for the surfaces.

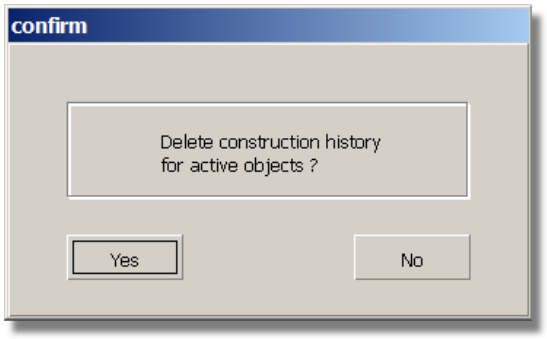
1 On the **Layer Bar**, use the *left mouse button* to click the **Joystick** layer, and select **Pick Objects** from the pull-down menu.



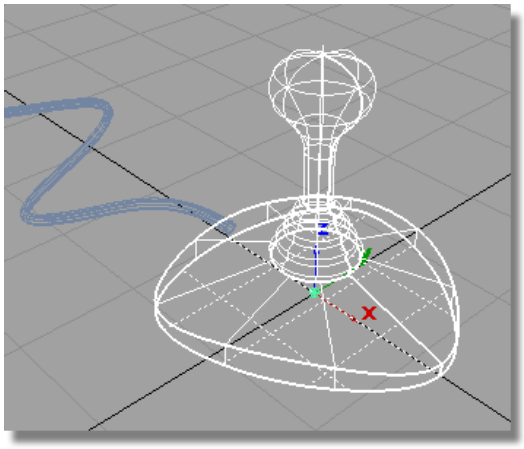
All the joystick surfaces are selected.



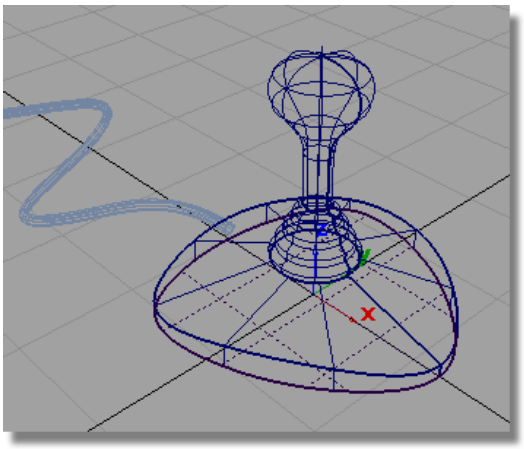
2 Choose Delete > Delete Construction History . A dialog box appears asking if you want to delete the construction history for the objects.



Click **Yes** to delete the history.



3 Choose Pick > Nothing to unpick all the surfaces.



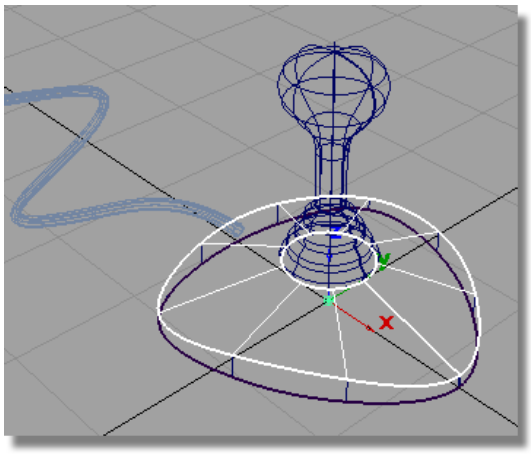
NOTE The surfaces are now shown with dark blue lines, which indicate they have no construction history.

Sculpting the Base

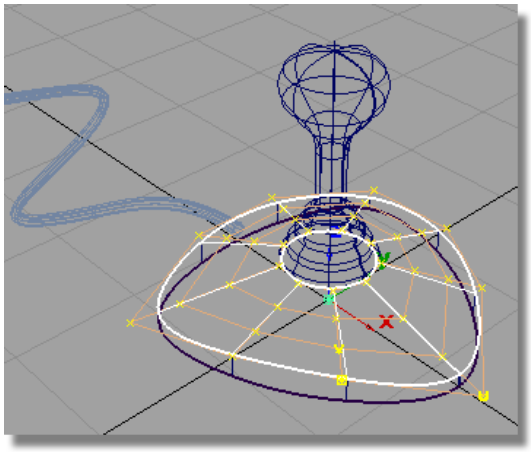
You have already used CVs to create and shape curves. Surfaces also have CVs which can be used in the same way to directly modify the surface shape.

By default, the CVs for a surface aren't displayed, so next, you will turn on the CVs for the top of the base.

1 Choose Pick > Object and select the top surface on the base.

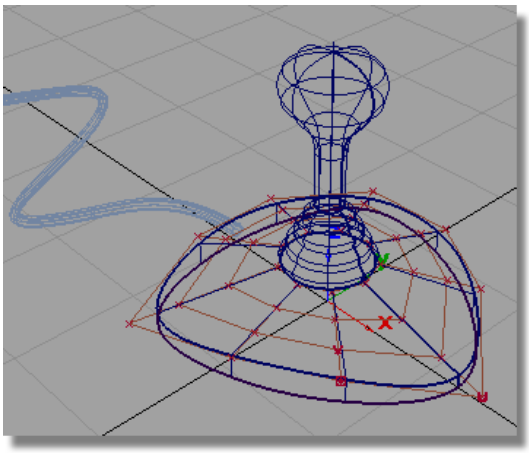


2 In the Control Panel, click the **CV/Hull** check box to turn on the CVs and Hulls for the surface.

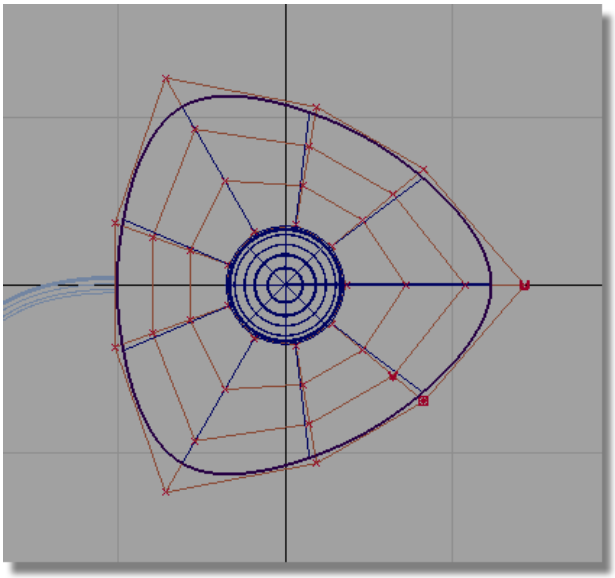


The CVs and Hulls are displayed.

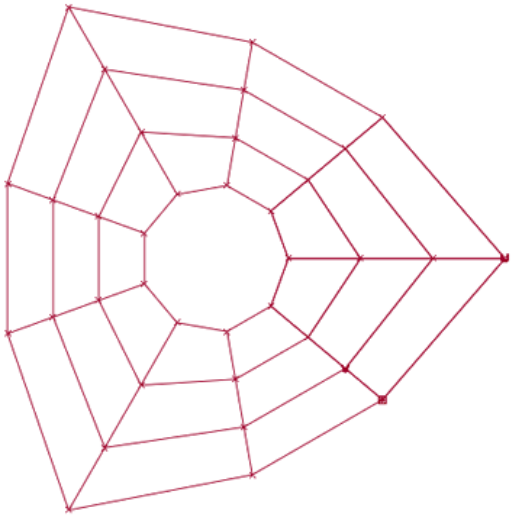
3 Choose Pick > Nothing to deselect the surface.



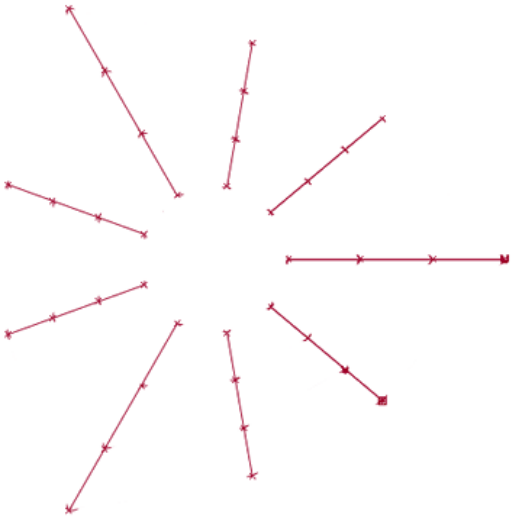
4 Choose Layouts > Top or *F5* to switch to the Top view.



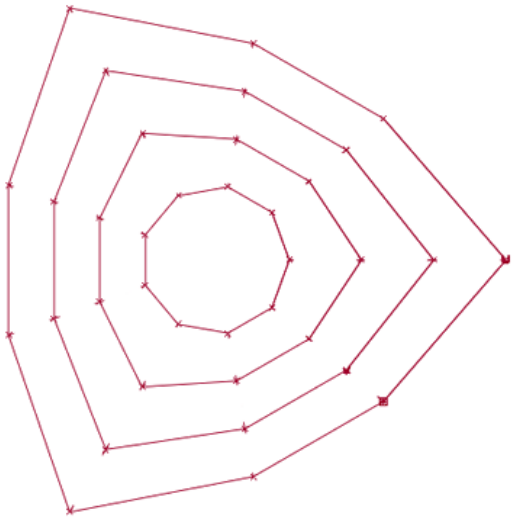
The CVs on the surface are arranged in rows, connected by hull lines. The arrangement of hulls on this surface is shown below.



The hulls go in two directions. One set of hulls radiates out from the middle of the surface.

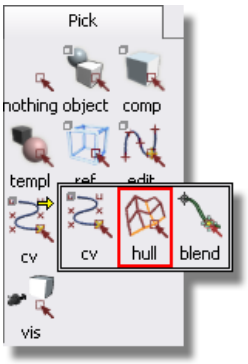


The other set of hulls goes around the surface.

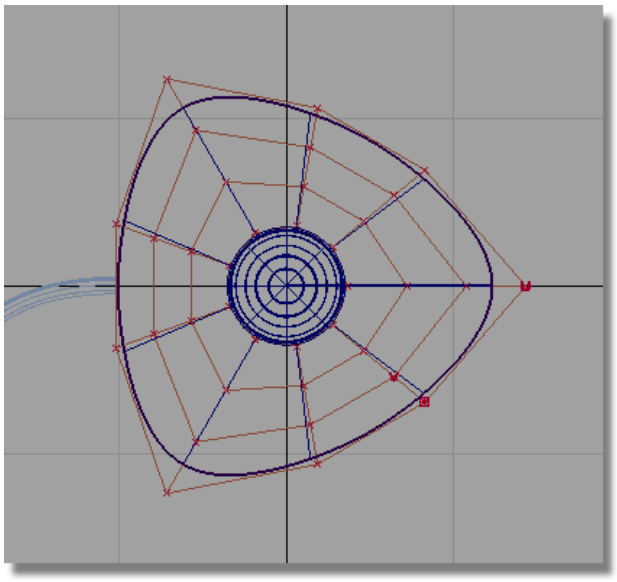


You will select the two center hulls from this set to sculpt a gentle curve into the top surface of the joystick base.

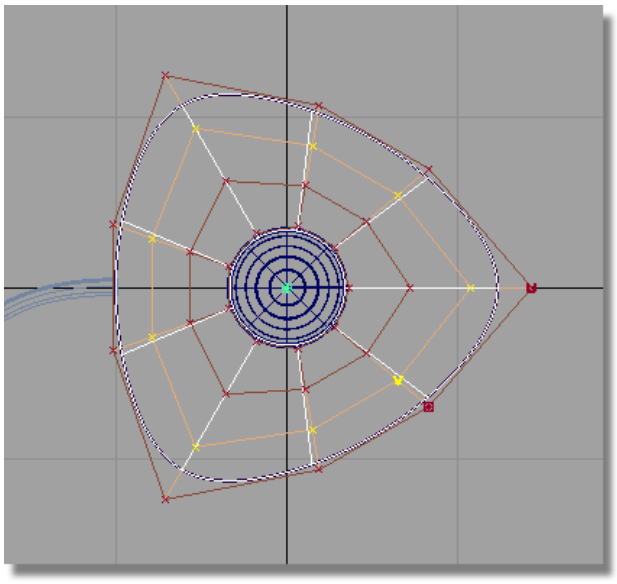
5 Choose Pick > Point Types > CV .



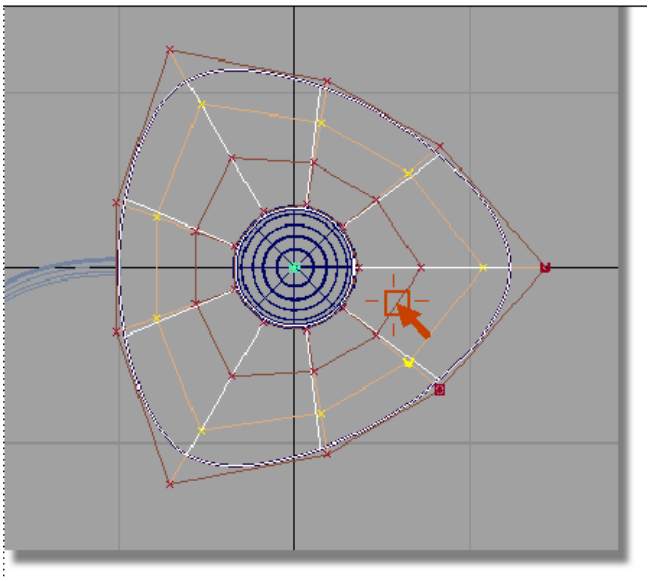
Click the red hull line connecting the second row of CVs in from the outer edge.



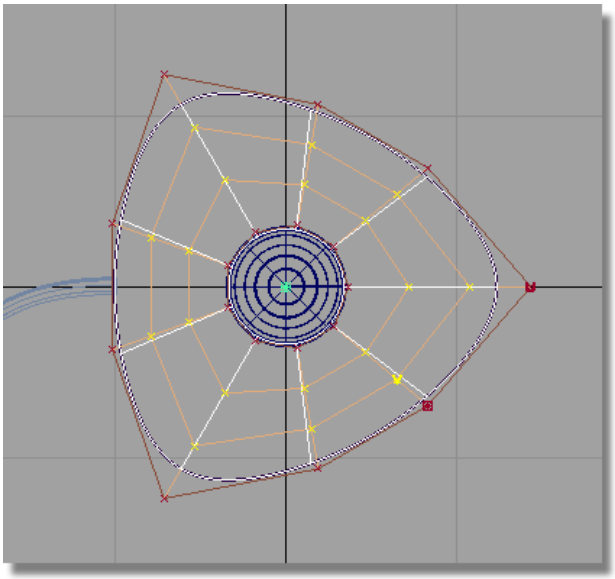
The row of CVs is selected and highlighted in yellow.



6 Click the red hull line connecting the third row of CVs in from the outer edge.

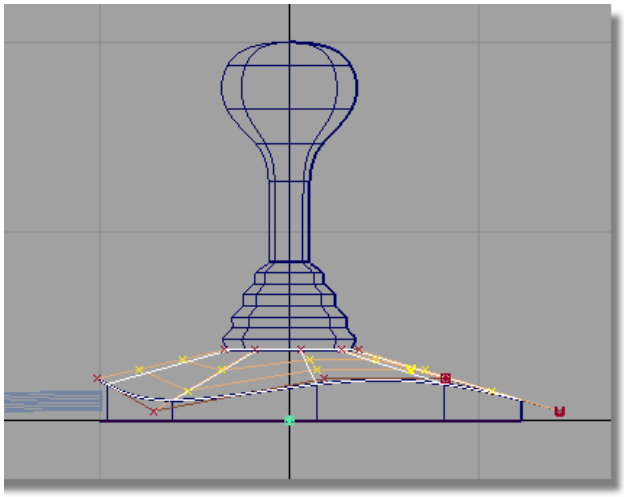


Both rows of CVs are now selected.



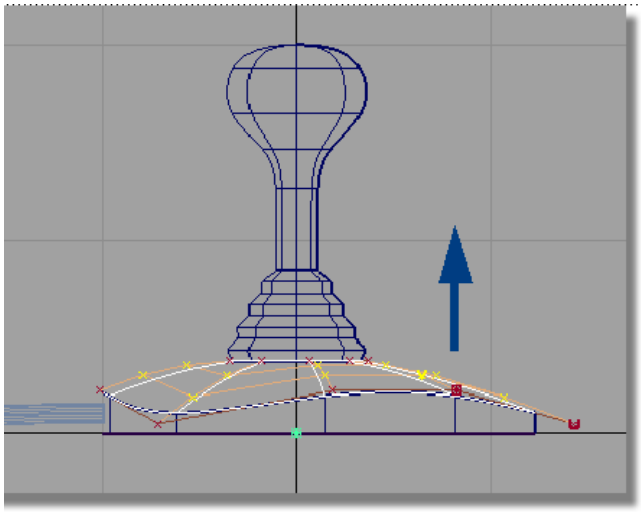
You will now move these hulls, and the associated CVs, upwards in the Left view, to sculpt the surface.

7 Choose Layouts > Left or *F6* to switch to the Left view.



8 Choose Transform > Move .

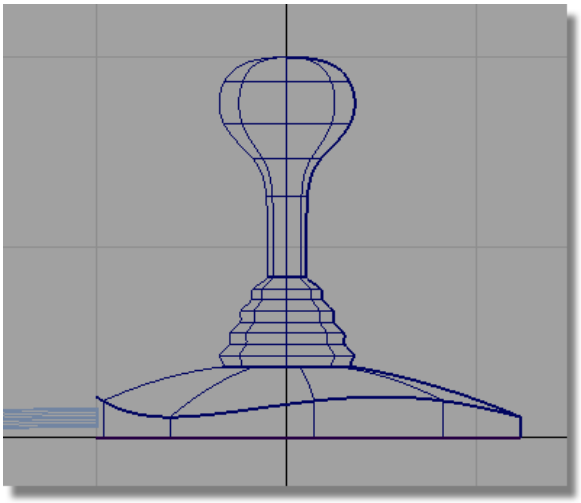
9 Click and drag the *right mouse button* to move the hulls upwards. Move them enough to create a gentle curve on the top edge of the surface.



The surface bends to give a rounded shape to the top of the joystick base.

10 On the Control Panel, click the **CV/Hull** check box to turn off the CVs and Hulls for the surface.

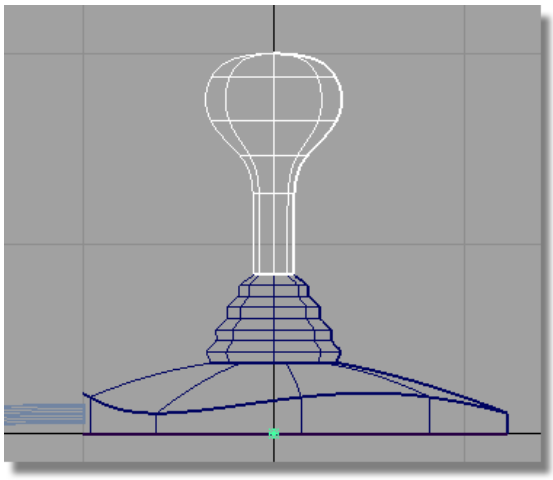
11 Choose Pick > Nothing to unpick the surface.



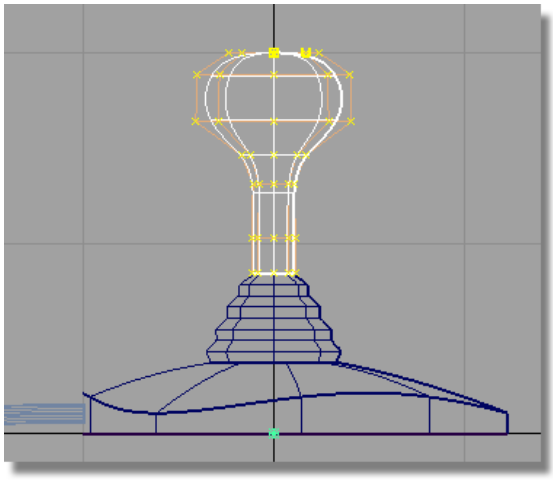
Sculpting the Top of the Handle

Next, you will refine the shape of the top of the joystick handle.

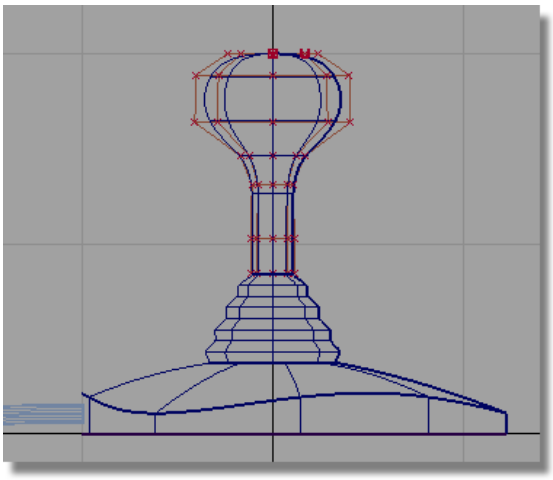
1 Choose Pick > Object and select the handle surface.



2 On the Control Panel, choose the **CV/Hull** check to turn on the CVs and Hulls for the handle surface.

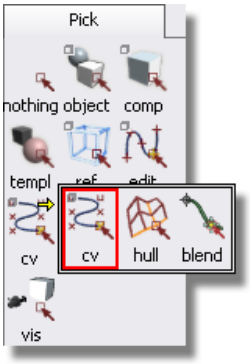


3 Choose Pick > Nothing to unpick the surface.

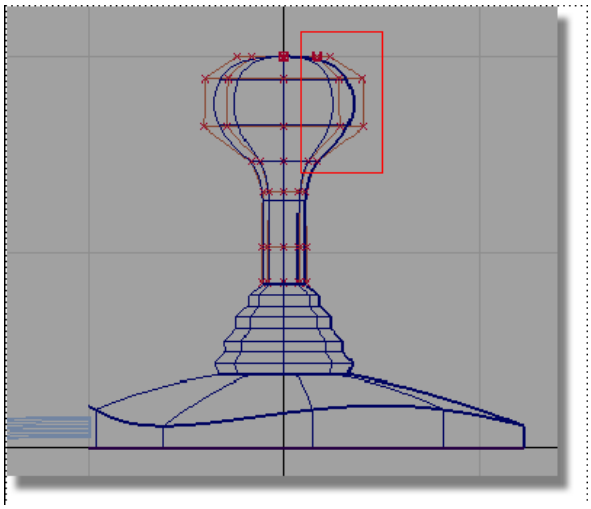


Next, you will select the CVs that shape the top of the handle.

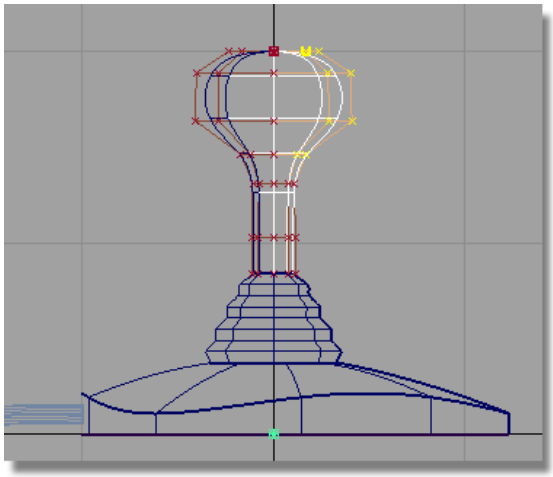
NOTE The pick palette has the **Pick** > **Hull** tool showing. Click and hold the *left mouse button* on the **Pick** > **Hull** icon to open the tool drawer. Move the mouse to the **CV** icon and release to select the **Pick Point Types** > **CV** tool.



4 Choose Pick > Point Types > CV . Drag a pick box around the top right set of CVs shown below.

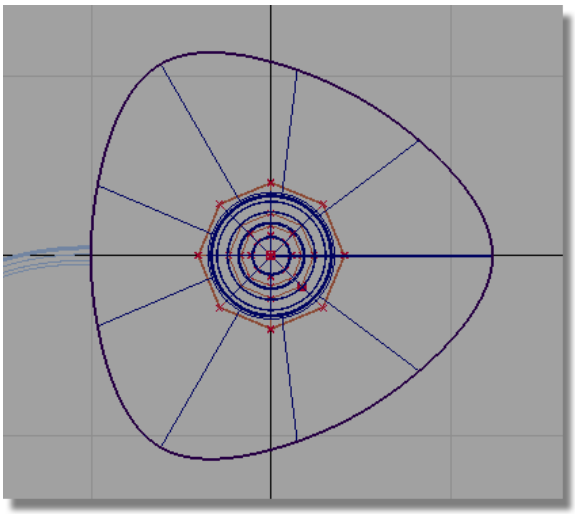


The CVs are selected and highlighted in yellow.

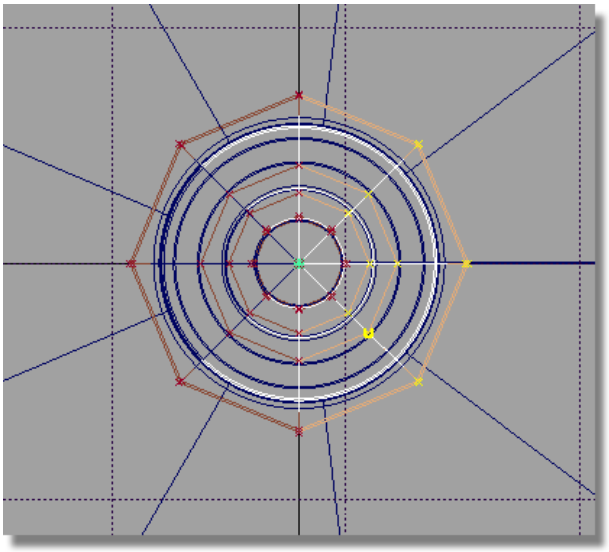


The first modification will be to the plan shape of the handle, so the transforms will be made in the Top view.

5 Choose Layouts > Top or the *F5* hotkey to switch to the Top view.



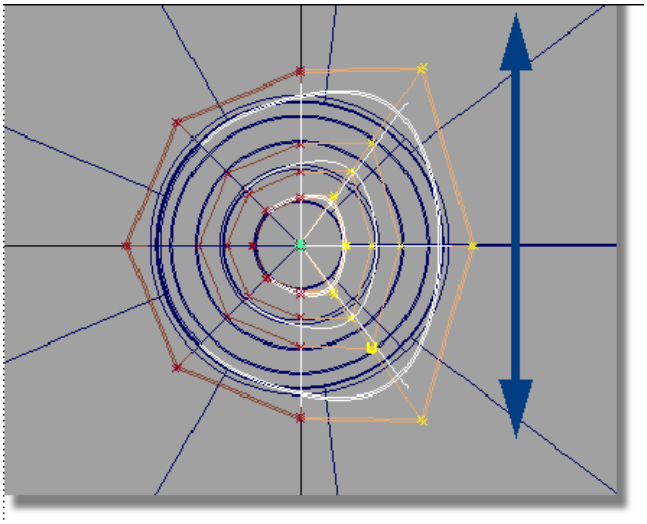
6 Zoom in to see the handle CVs clearly. Hold down the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys together and click and drag the *right mouse button* to zoom.



7 Choose Transform > Non-p Scale .

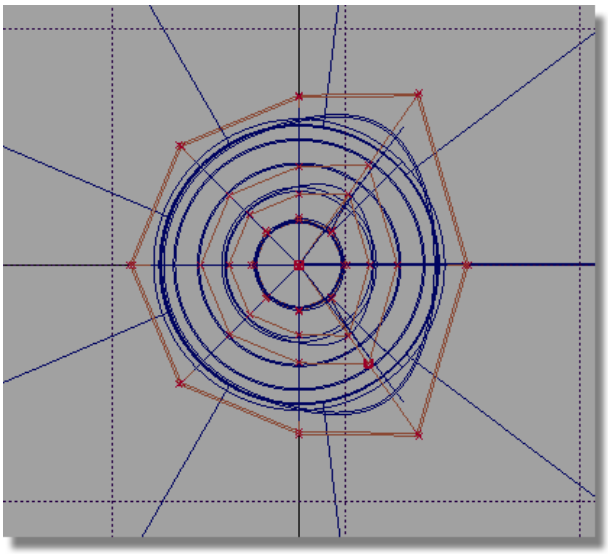
8 Click and drag the *right mouse button* to reshape the handle.

TIP Click and drag away from any of the geometry to avoid selecting different geometry.



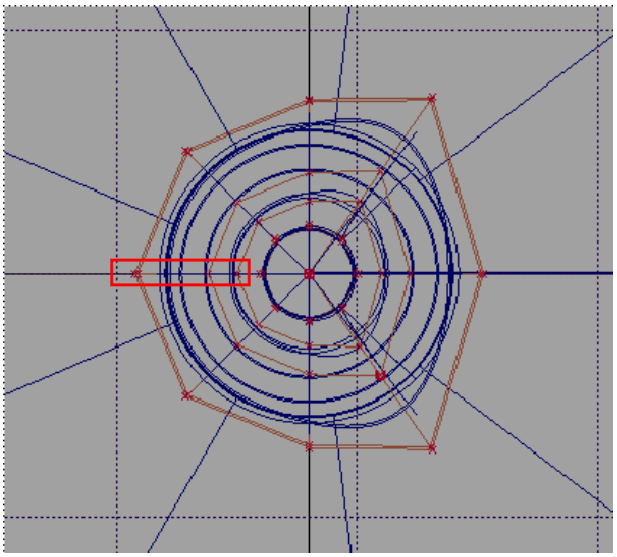
The selected area of the handle surface is stretched.

9 Choose Pick > Nothing to unpick the CVs.

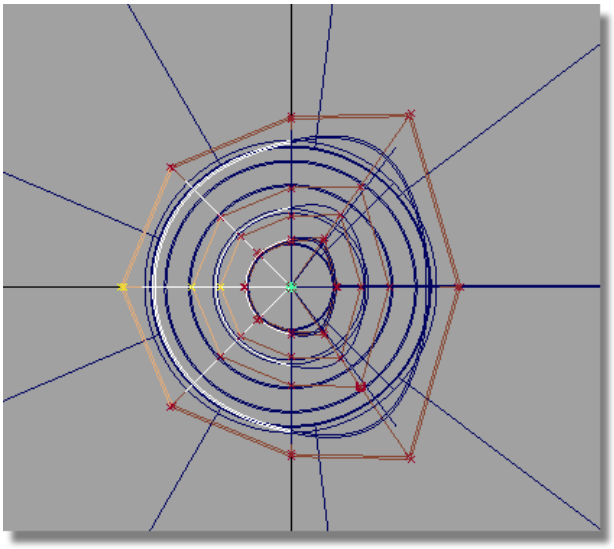


Next, you will select the CVs to the left of the handle, so you can create a soft pointed shape.

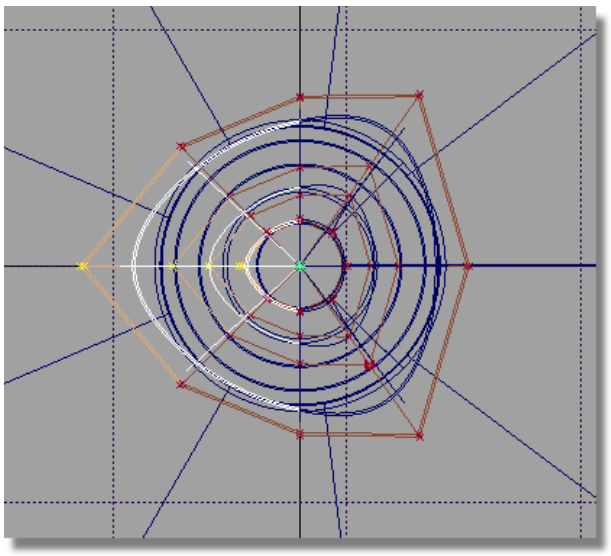
10 Choose Pick > Point Types > CV and drag a pick box over the central CVs on the left of the handle.



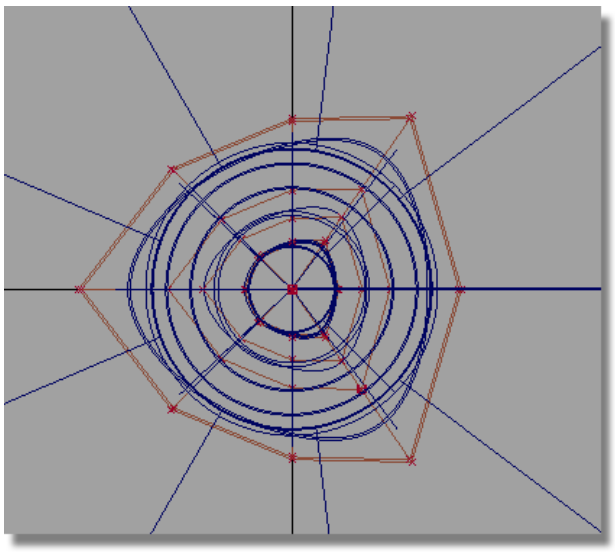
The center-line CVs are selected and highlighted in yellow.



11 Choose Transform > Non-p Scale and click and drag the *middle mouse button* the stretch the handle surface outwards to the side.



12 Choose Pick > Nothing to unpick the CVs.

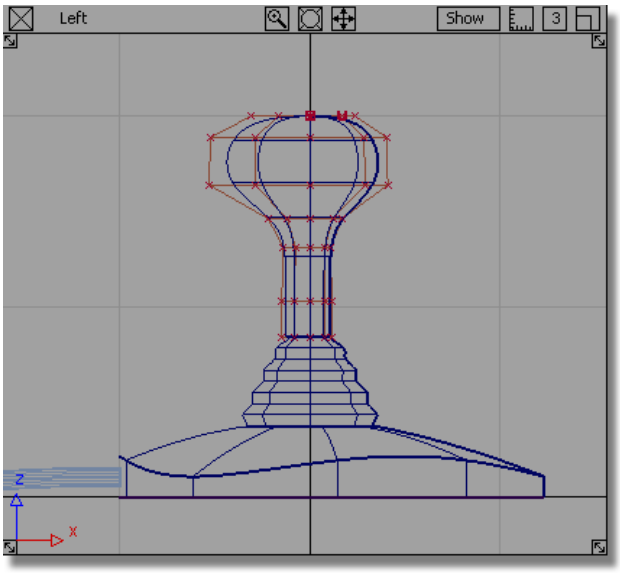


The top of the handle now has a smooth triangular shape.

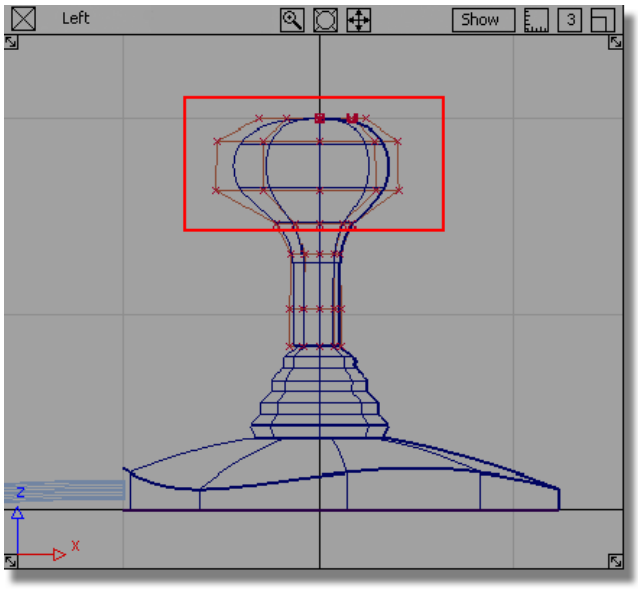
Sculpting the Handle Angle

Next, you will adjust the angle of the top of the handle, to make it more ergonomic.

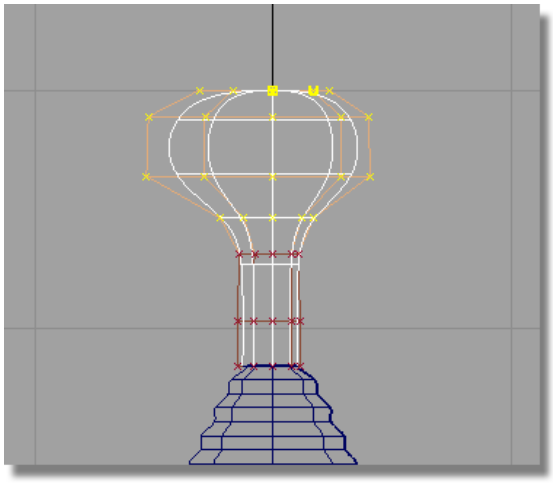
1 Choose Layouts > Left or *F6* to switch to the Left view.



2 Choose Pick > Point Types > CV and click and drag a box around all the CVs at the top of the handle.



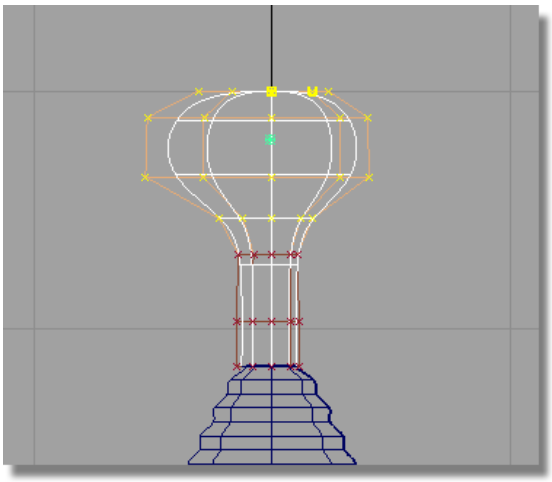
The CVs for the handle grip are selected.



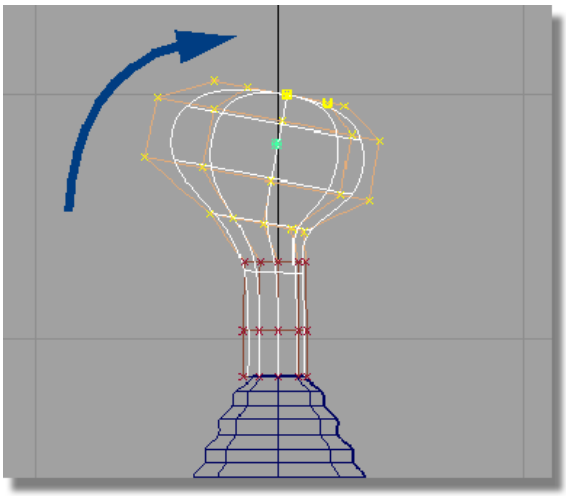
Rotation always works around the object's pivot point. The pivot point for the CVs defaults to the origin. To rotate the CVs correctly, you will position the pivot point at the center of the selected CVs, using the **Center pivot** tool.

3 Choose Transform > Local > Center Pivot .

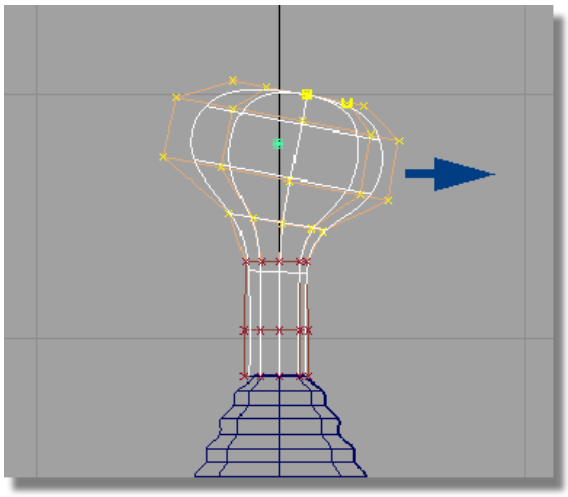
The pivot point for the CVs is placed in the center of the CVs.



4 Choose Transform > Rotate and click and drag with the *middle mouse button* to rotate the CVs about the y-axis.

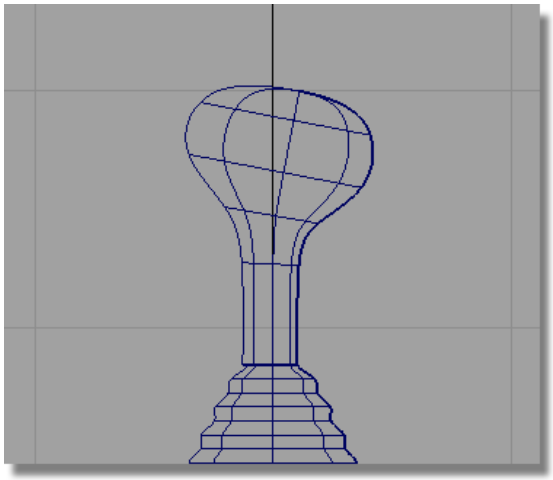


5 Choose Transform > Move and click and drag with the *middle mouse button* to move the CVs slightly to the right to create a smooth transition from shaft of the handle.

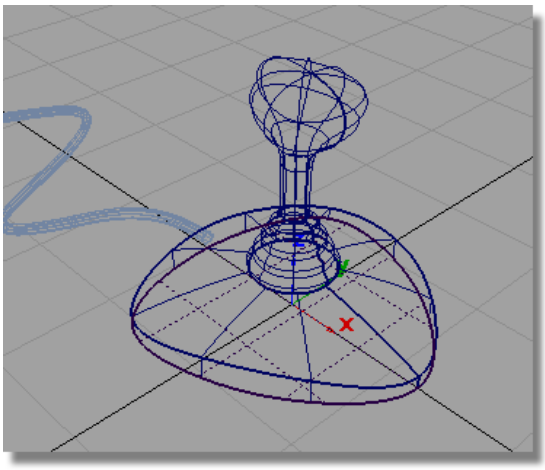


6 On the Control Panel, click the **CVs/Hulls** check to turn the CVs and hulls off.

7 Choose Pick > Nothing to deselect the object.



8 Choose Layouts > Perspective or *F8* to evaluate the design



Save your work

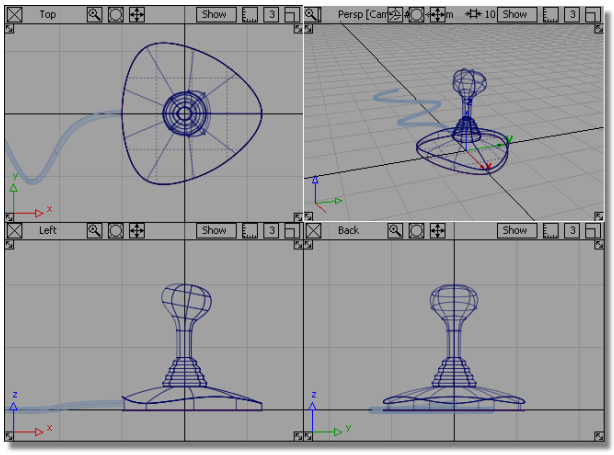
1. Choose File > Save As to save the current scene.
2. Save your work in the `wire` directory of the `Lessons` project.
3. Name your file `myjoystick6.wire`.

Part 7: Creating the button

In this section, you will create a button from a modified sphere.

Opening the tutorial file (optional)

If you successfully completed Part 6, you can proceed directly to the next step, **Creating a primitive sphere.**



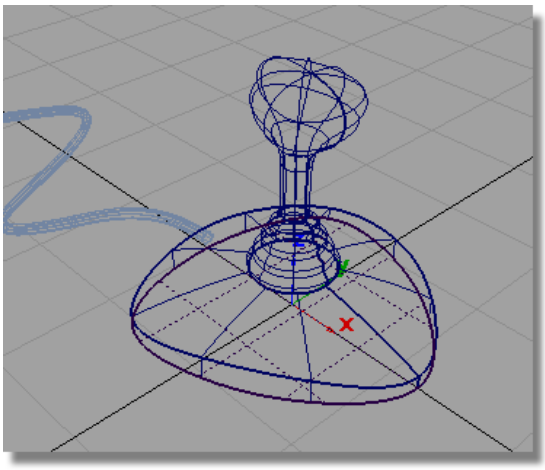
If you were not successful in part 6, open the file called `joystick_part7.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 6.


Watch **Part 7** of the tutorial.

Creating a primitive sphere

You will now create the button for the joystick, by placing and transforming a primitive sphere.

1 Choose Layouts > Top or *F5* to switch to the top view.



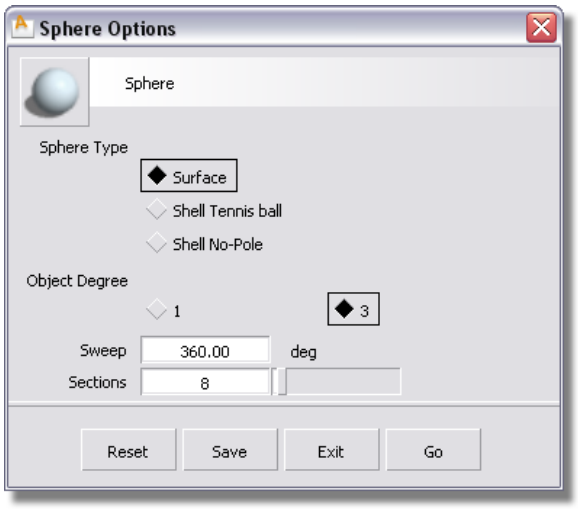
2 In the Layer Bar, click the **Joystick** layer to select it.



The layer is shown in yellow. This means that it is the active layer, and any new curves or surfaces are placed on it.

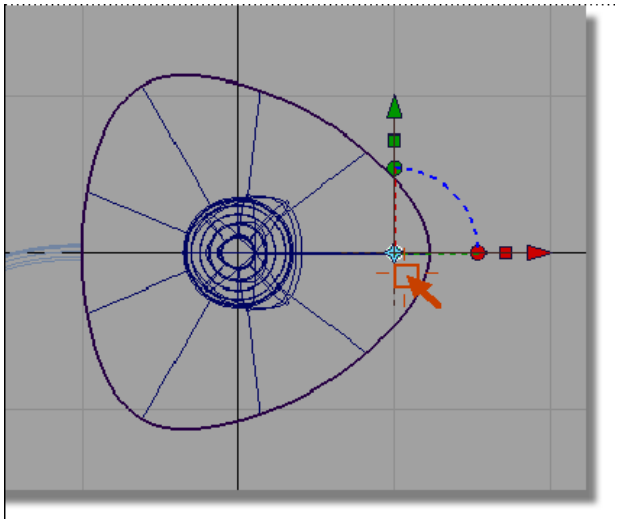
3 Choose Surfaces > Primitives > Sphere .

4 Double click the icon to open the option box. You need to create a whole sphere, so check that the **sweep** is set to **360** degrees.



Click the **Go** button at the bottom of the sphere option box.

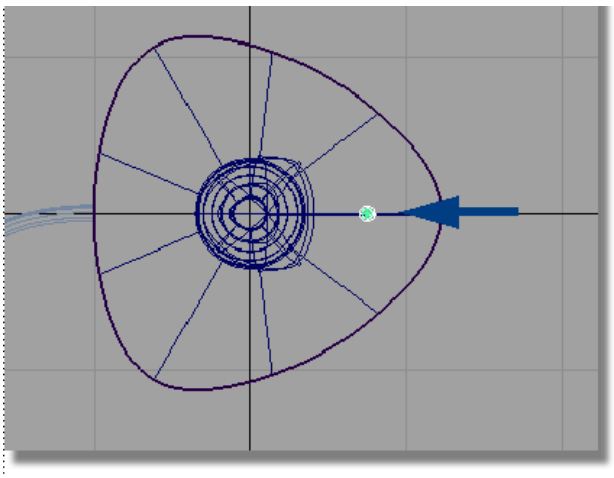
5 Hold down the *Alt* (Windows) or *Command* (Mac) key to turn on grid snapping. Click near the grid intersection just inside the right-hand edge of the base.



A small sphere is placed on the grid intersection.

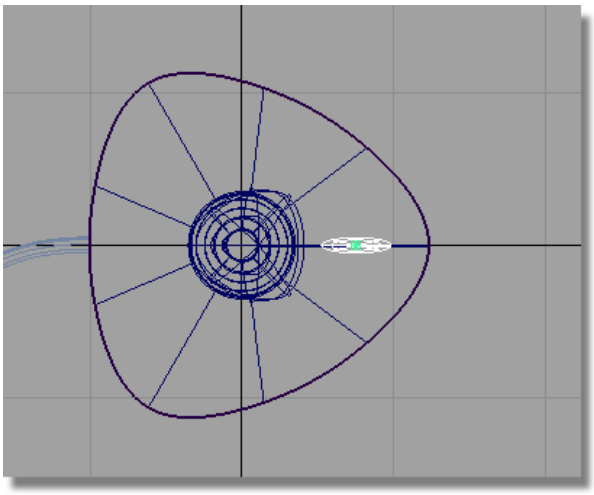
6 Choose Transform > Move .

7 Click and drag the *middle mouse button* to move the sphere to half way between the handle and the edge of the base.

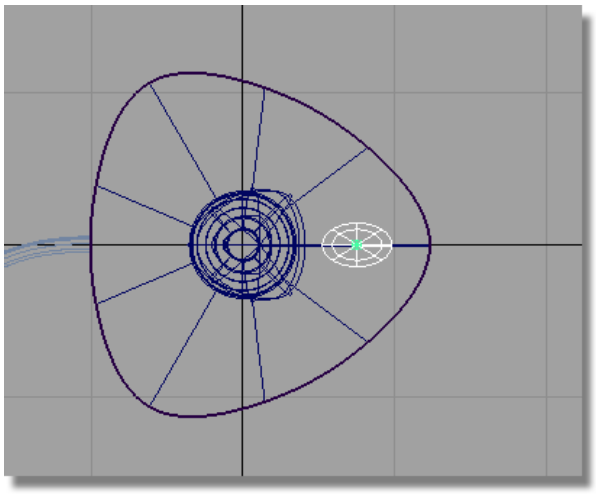


8 Choose Transform > Non-p Scale .

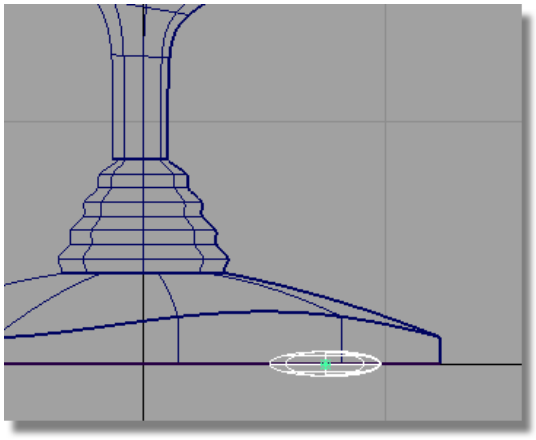
9 Click and drag the *middle mouse button* to stretch the sphere sideways.



10 With **Transform > Non-p Scale** still selected, click and drag the *right mouse button* to stretch the sphere upwards, making an oval shape for the button.

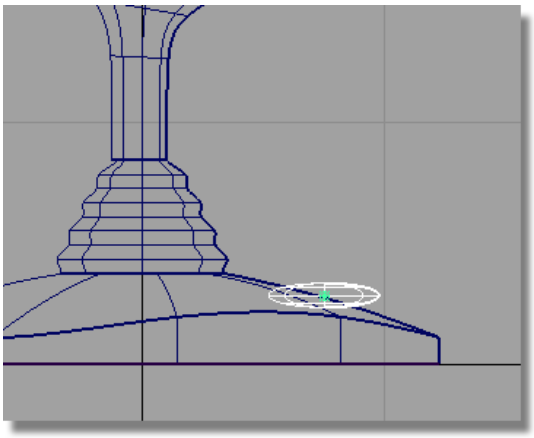


11 Choose Layouts > Left (*F6*) to switch to the Left view.



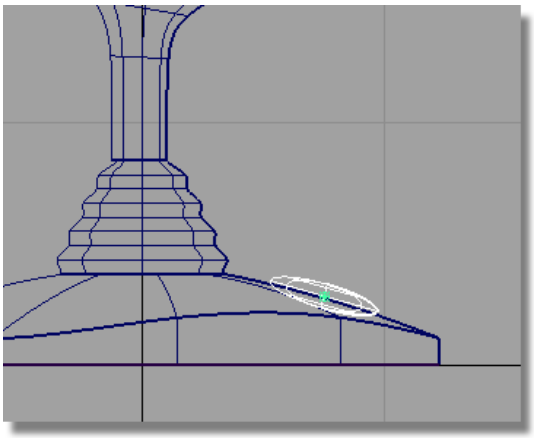
12 Choose Transform > Move .

13 Click and drag the *right mouse button* to move the sphere vertically until the center of the sphere is approximately aligned to the top edge of the base.



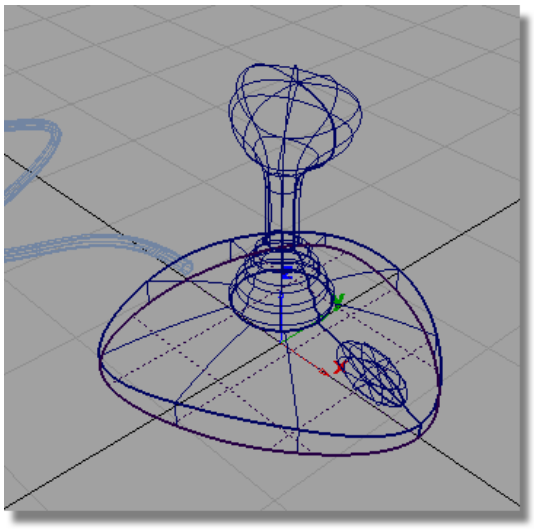
14 Choose Transform > Rotate .

15 Click and drag the *middle mouse button* to rotate the sphere to approximately match the angle of the base.



16 Choose Pick > Nothing to unpick the sphere.

17 Choose Layouts > Perspective to switch to the Perspective view.



Save your work

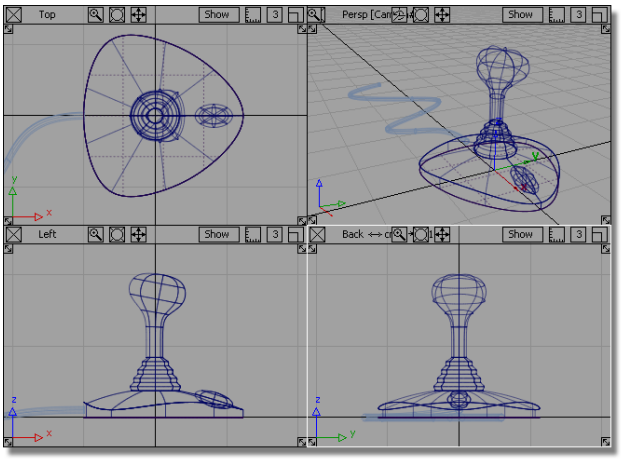
1. Choose File > Save As to save the current scene.
2. Save your work in the `wire` directory of the `Lessons` project.
3. Name your file `myjoystick7.wire`.

Part 8: Visualizing the Model

In this section, you will view the model using Hardware Shading.

Opening the tutorial file (optional)

If you successfully completed Part 7, you can proceed directly to the next step, **Shading the view.**



If you were not successful in part 7, open the file called `joystick_part8.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 7.

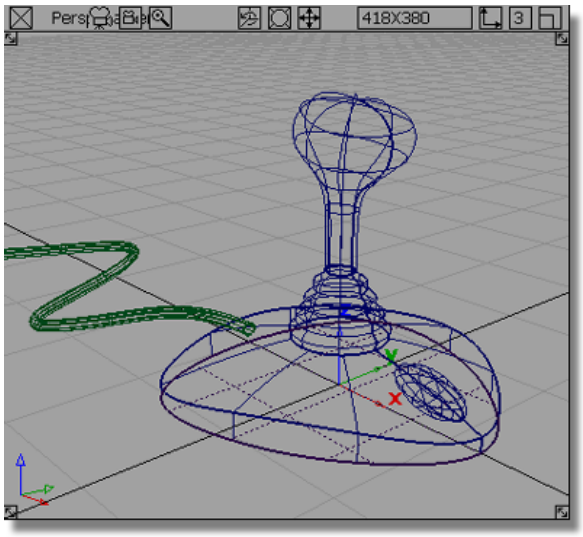

Watch **Part 8** of the tutorial.

Shading the view

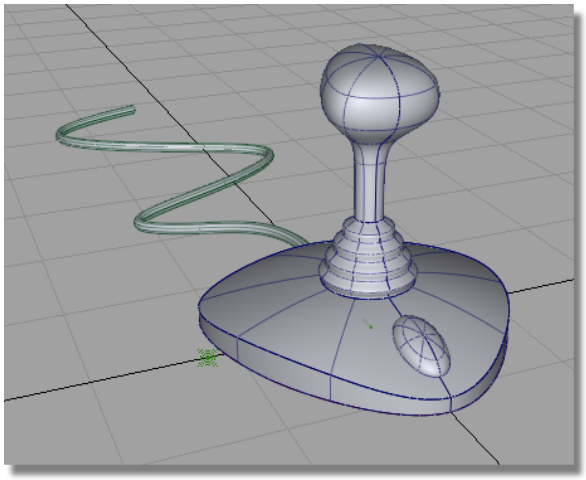
In the previous desk lamp tutorial, Diagnostic Shading was used to visualize the model. In this tutorial, you will use Hardware Shade. Hardware shading allows for more visual effects and introduces you to the techniques you will use for rendering in later tutorials.

You will start by making the cable surface pickable, so it can be shaded.

1. On the **Layer Bar**, press and hold the *left mouse button* on the **Cable** layer, choose **Set State**, then **Pickable** to make cable surface active.
2. Tumble the view until you get a good view of the joystick and cable. Hold down the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys and use the *left mouse button* to tumble the view.

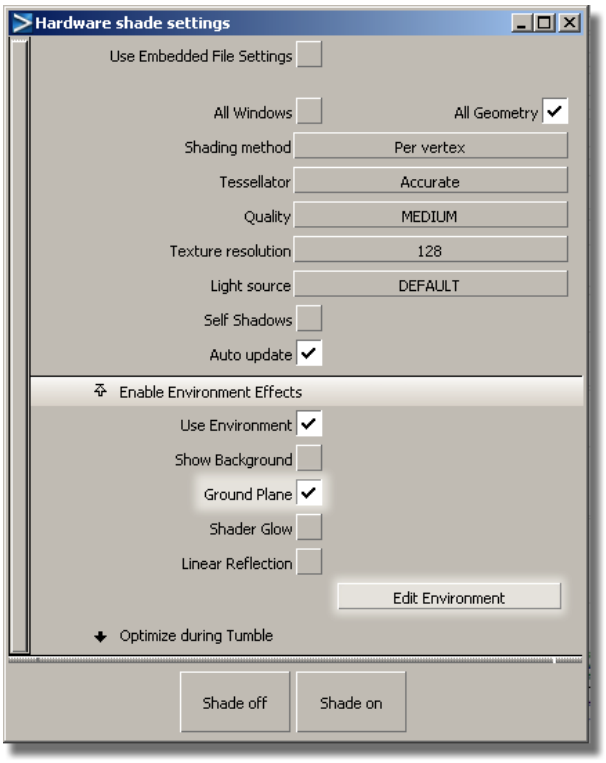


3 Choose WindowDisplay > Hardware Shade .



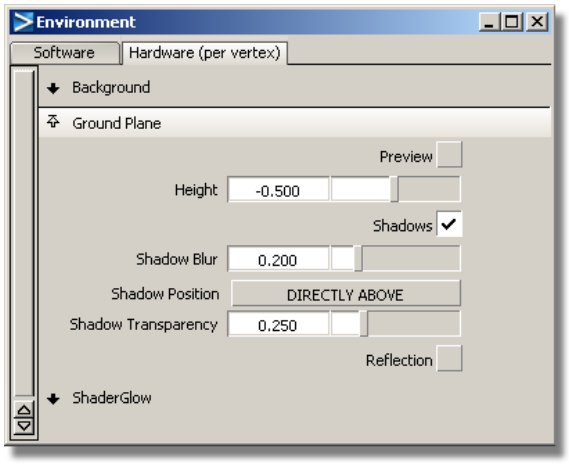
The model is shaded in the default colour.

4 Choose WindowDisplay > Hardware Shade ❒ to open the option box.



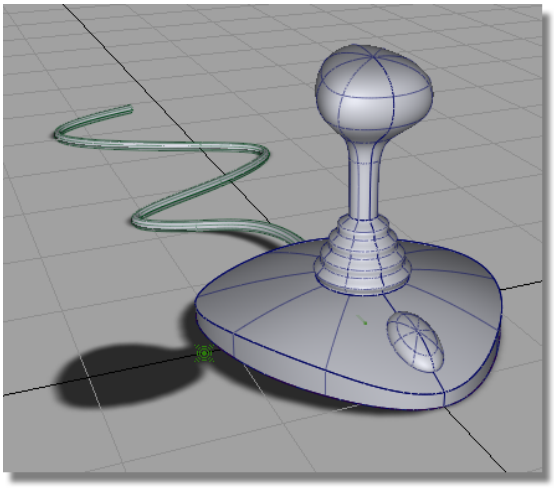
5 In the **Enable Environment Effects** section:

- Click the **Ground plane** check box to turn on the ground plane effects.
- Click the **Edit Environment** button to open the Environment window.



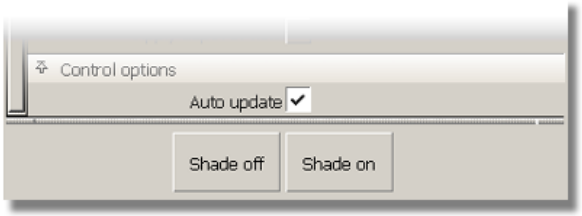
6 In the **Environment** window, set the following options:

- Open the **Ground Plane** section by clicking the small arrow next to it.
- Set the plane **Height**. Type in **-0.5** and press *Enter* (Windows) or *Return* (Mac) to drop the shadow slightly below the base.
- Ensure the **Shadows** box has a check mark so that shadows are turned on.
  A shadow appears underneath the joystick and cable.
- Change the **Shadow Position**. Click and hold the *left mouse button* on the **Shadow Position** menu, which is set to **DIRECTLY ABOVE** by default. Choose **45 DEGREES RIGHT** and release the mouse button.



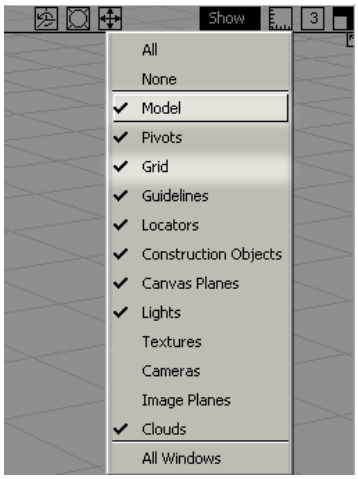
- Change the **Shadow Blur**. Type in **0.2** and press *Enter* (Windows) or *Return* (Mac) to soften the shadows.

TIP If your screen shows the wireframe view, choose the **Shade On** button at the bottom of the **Hardware Shade Settings** box.



To view the design more clearly, you will now turn off the wireframe, grid, and lights.

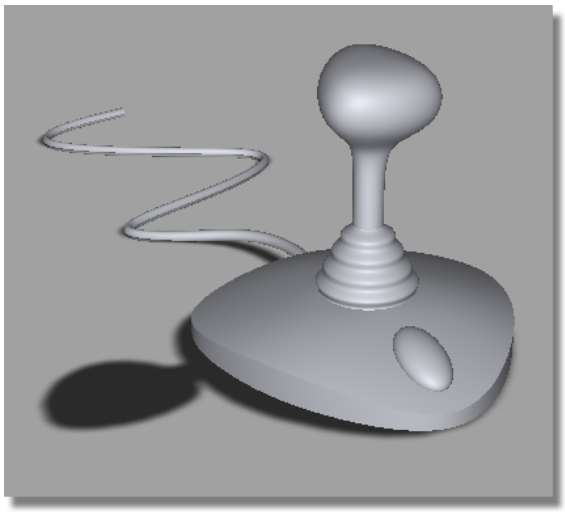
7 In the title bar of the modeling window, click the **Show** button to open up the menu and select **Model** (to remove the check mark). The wireframe lines are turned off.



8 In the title bar of the modeling window, click the **Show** button to open up the menu and select **Grid** (to remove the check mark). The grid lines are turned off.

9 In the title bar of the modeling window, click the **Show** button to open up the menu and select **Lights** (to remove the check mark). The light icons disppear.

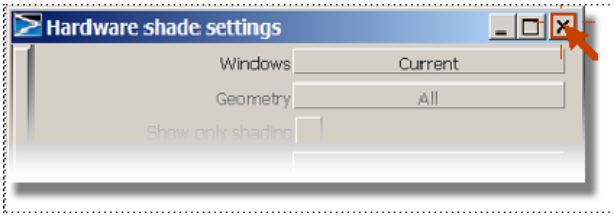
The joystick design is displayed in shaded mode, with no model lines, grid lines, or lights showing.

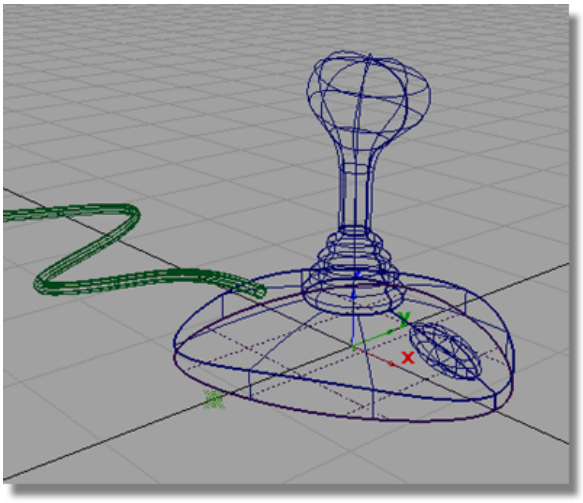


10 Select **Show > Model**, **Show > Grid** and **Show > Lights** once more from the window's title bar to bring back the check marks.

The scene returns to a wireframe view with grid and lights.

11 Close the **Hardware shade settings** option box by clicking the cross in the top right corner.





Now that the Hardware Shade is set up, you don't need to go into the option box the next time you want to shade the model. Just choose WindowDisplay > Hardware Shade to toggle the shading on or off.

Save your work

1 Choose File > Save As to save the current scene.

2 Save your work in the wire directory of the `Lessons` project.

3 Name your file `myjoystick8.wire`.

Conclusion

Congratulations! You have completed the joystick model and have gained experience in using curves and then surface tools to build freeform shapes.

Important concepts to take forward to future modeling projects are:

- On a curve, a minimum of 4 CVs are needed to create the curve. Adding more CVs means that the curve can have a more complex shape.
- Construction history means that you can modify the shape of a surface by changing the curves it was built from.
- Alternatively, you can turn on the CV display for the surface and modify the surface CVs directly to change the surface shape.
- The **Control Panel** can be used to display or hide the CVs of a curve or surface.
- It is good practice to turn off the CVs on objects that aren't being modified, to reduce the complexity of the view on the screen.
- Regularly save your work!

Quiz

Now that you have completed this joystick modeling tutorial, do this quick quiz to help you remember the tools and techniques you have learned.

1. When you created a curve, how many CVs did you need to place before the curve was created? If you aren't sure, try it out now in Alias!
   (a) One CV
   (b) Two CVs
   (c) Three CVs
   (d) Four CVs
   (e) Five CVs
2. To build a skin surface, how many curves do you need?
   (a) Only one
   (b) Only two
   (c) Two or more

(d) A minimum of three

(e) A minimum of four

3 To select a whole row of CVs on a surface with a single mouse click, which tool would you use?

(a) Pick > Object

(b) Pick > Component

(c) Pick > Hull

(d) Pick > CV

(e) Pick > Edit Point

4 The **Hardware Shade** tool can be used to display which of the following?

(a) different colors on objects

(b) shadows falling on a ground plane

(c) reflections in shiny materials

(d) only shaded geometry with no wireframe, CVs, or edit points showing

(e) all of the above

5 To position the pivot point at the center of a group of selected CVs, which tool would you use?

(a) **Transform > Local > Set Pivot** and the *Ctrl* (Windows) or *Control* (Mac) key to snap to a CV point

(b) **Transform > Move** and move the mouse to the center of the CVs

(c) **Pick > Hull** and **Transform > Local > Set Pivot**

(d) **Transform > Local > Center Pivot**

(e) The *F9* hotkey

6 Match the Hotkeys *F5* to *F9* to the window views.

(a) Back

(b) Top

(c) All four views

(d) Left

(e) Perspective

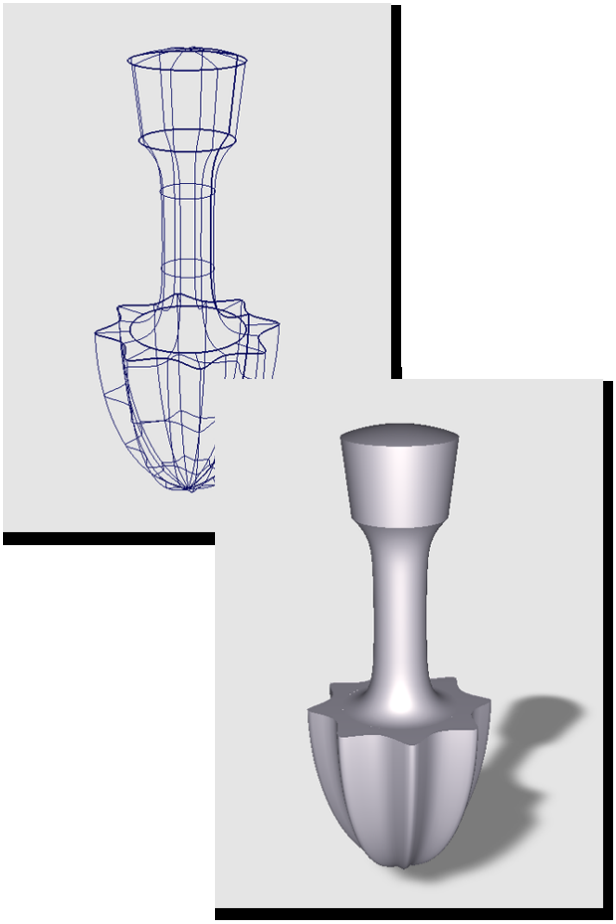
On Your Own

The tools and techniques that you have learned are the basis of all complex modeling with Alias. Use curves and surfaces, controlling their shape with CVs, to create the following designs.

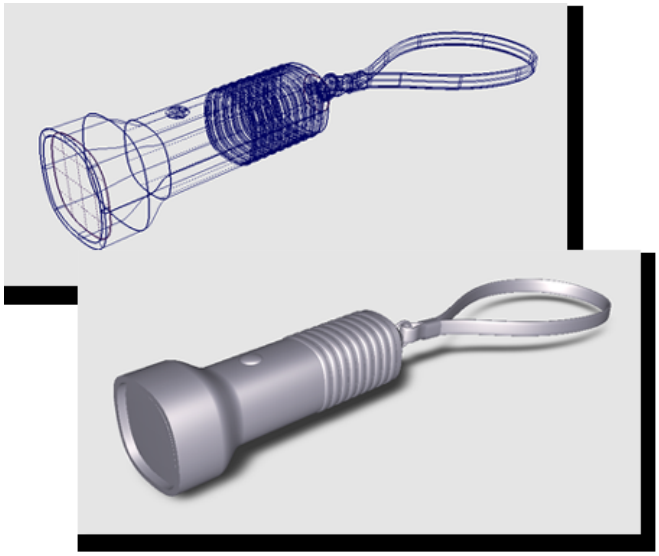
The main body and lid of the coffee pot shown below are created using a revolved surface. The handle is an extrusion and the spout is a skin surface. You will notice that the components are intersecting and have not been fully detailed. This is acceptable for a concept model and you will learn the detailing techniques in the following tutorials.



Continuing the kitchen theme, the lemon squeezer handle is built from revolved surfaces. The squeezer was sculpted from a simple revolved shape. The number of spans was increased, to allow for the number of grooves, and alternate rows of CVs were scaled inwards.



The flashlight below is based on a circle which has been shaped to a smooth square shape. Skin surfaces have been used for the main shape, with extrude surfaces used for the grip detail and the lanyard.



Quiz Answers

Answers to the Joystick Tutorial quiz

1. (d) Four CVs. You created a default degree 3 curve, which requires a minimum of 4 CVs before it is created. To learn more about CVs and curve degree, see Mathematical representations of curves.
2. c) Two or more curves can be used to build a skin surface. If only two curves are used, a ruled, straight, surface is created between them. If more curves are used, use the shift key to select the third and subsequent curves. The surface is blended smoothly through all the curves.
3. c) The **Pick > Hull** tool. A whole row of CVs can also be selected using **Pick > CV** and carefully dragging a pick box around the required CVs. The **Pick > Hull** tool is often easier to use, and it is often good practice to modify a whole row of CVs together, to have more control over the final shape of a surface.
4. e) All of the options listed can be displayed using the **Hardware Shade** tool. This tool has been significantly enhanced in Alias and can be used very effectively to present and visualize your designs.

5 d) The **Transform > Local > Center Pivot** tool. This tool can be used with all objects, curves, surfaces, and groups of CVs.

6 Match the Hotkeys to the window views.

Window	Hotkey
Back	F7
Top	F5
All four views	F9
Left	F6
Perspective	F8

Modeling a Vacuum Cleaner

6

Learning Objectives

In this lesson, you will build a hand-held car vacuum cleaner. This lesson introduces you to more surface building techniques. You will learn how to:

- Create swept surfaces
- Trim off the excess areas of surfaces
- Create rounded edges
- Use Layers to organize complex models

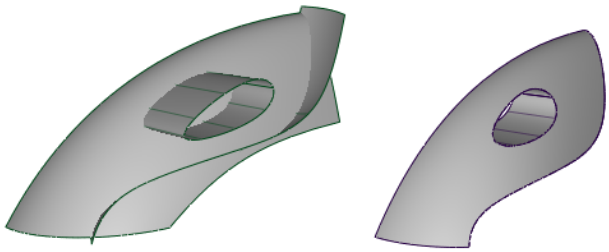


Modeling Workflow

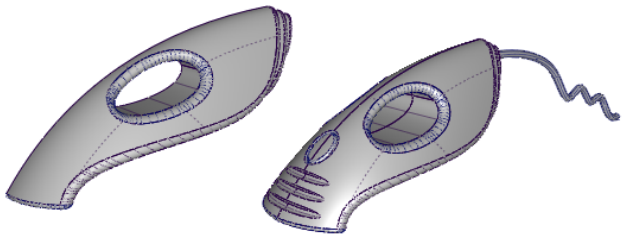
In this tutorial, you will use a modeling technique called overbuilding and trimming. With this technique, you will create simple swept surfaces to define the main shape of the design. You will then combine these surfaces using intersecting and trimming.

As the vacuum cleaner design is symmetrical, you will save time by only building and detailing one half of the model. When the design is complete, you will copy and mirror the surfaces to create the full model.

The workflow you will use to create the vacuum cleaner model is shown below.



First, you will create the main surfaces, and then intersect and trim them to create the body shape. Throughout the tutorial, you will build one half of the vacuum cleaner, and at the end, you will mirror the surfaces to create the completed model.



Then, you will fillet the surfaces and add design details, further trimming the main shape.

New tools used in this tutorial

- Pick > Object Types > Curve on Surface

- Pick > Template
- Object Edit > Patch Precision
- Surfaces > Swept Surfaces > Rail surface
- Surfaces > Surface Fillet
- Surface Edit > Create CurvesOnSurface > Intersect
- Surface Edit > Trim > Trim Surface

New menu items used in this tutorial

- Object Display > Template

Part 1: Creating Primary Surfaces

In this section, you will use the **mono-rail** tool to create the two surfaces that define the vacuum cleaner body.

In the tutorial, file the main curves have already been created and are supplied on a layer called curves. As you don't have to create the curves for this model, you will be able to focus on the techniques of intersecting and trimming surfaces introduced in this tutorial.

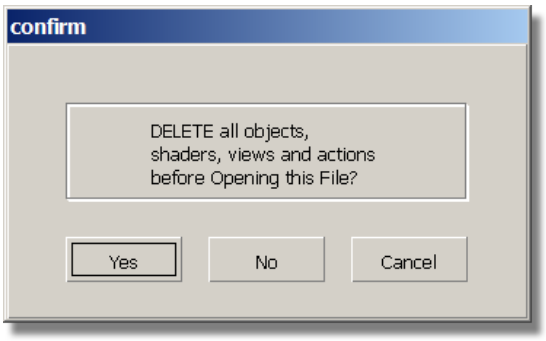
The curves have been created using the same techniques you learned in Tutorial 2. If you want to see how the curves are constructed, use the **Control Panel CV/Hull display** to display the CVs.

If you prefer to create your own curves, you can make the curves layer inactive, and create your own curves using these as a guide.

Opening the tutorial file

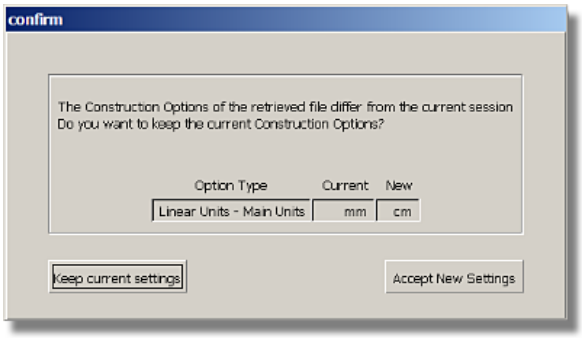
1. Choose File > Open to open the File Browser.
2. In the File Browser, locate the `CourseWare` directory and set it as the **Current Project**.
3. Open the file called `vacuum.wire`, located in the wire directory in the `CourseWare` project.

   For information on how to open a file, see Opening the tutorial file on page 82.



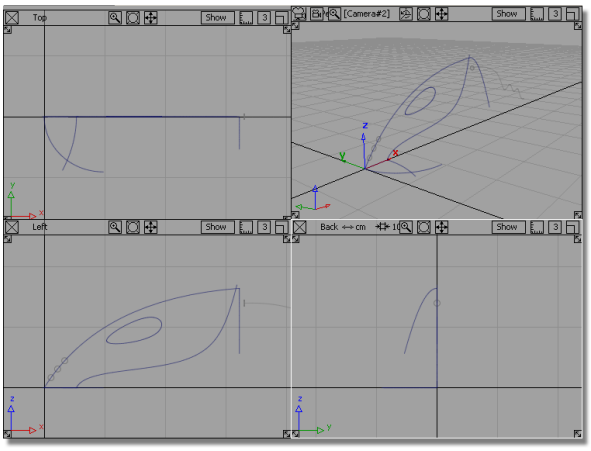
A dialog box appears, asking if you want to delete all objects, shaders views, and actions. Click **Yes**.

If your values for construction tolerances differ from those in the `vacuum.wire` file, you will be presented with a dialog:



Click **Accept New Settings** to use the construction tolerances in `vacuum.wire`.

The file is opened.



If the modeling views do not occupy the full size of the Alias window, choose Layouts > All Windows > All Windows .

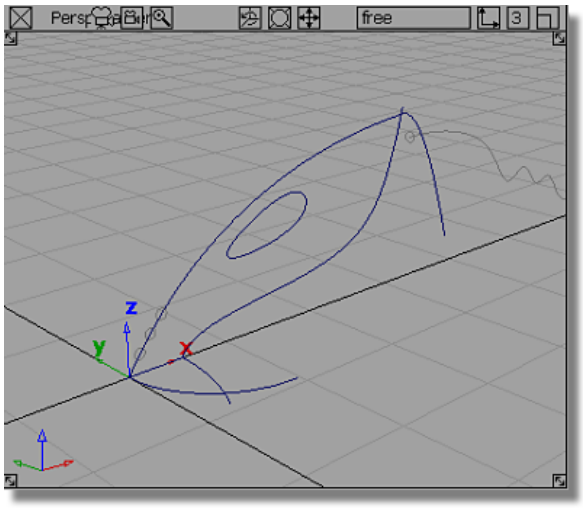


Watch **Part 1** of the tutorial.

Creating the lower surface

You will start by creating the lower body shape using a **mono-rail** surface.

1 Maximize the Perspective view.

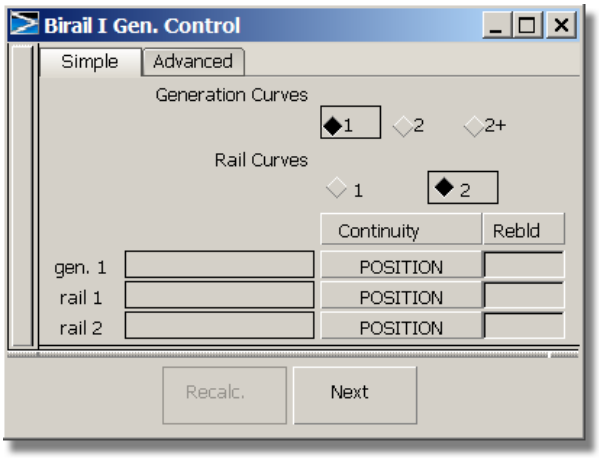


2 Choose Surfaces > Swept Surfaces > Rail Surface.

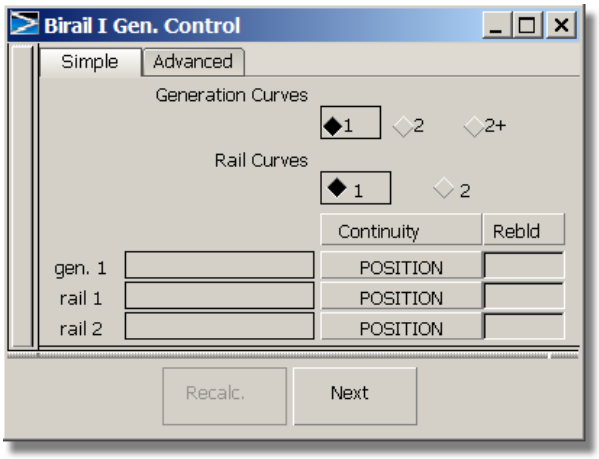


The **Rail** surface defaults to a **birail**, which has two path curves. You will now change this to a **mono-rail**, with only one path curve.

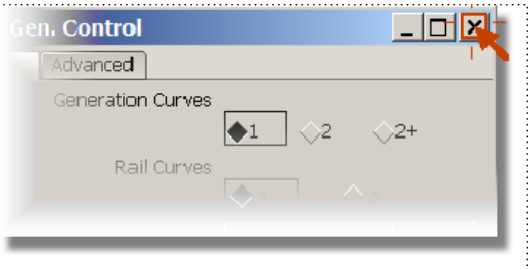
3 Double-click the **Rail** surface icon to open the option window.



4 In the **Rail Surface** option window, click **1** in the **Rail curves** section. Check that the **Generation curves** section is also set to **1**.

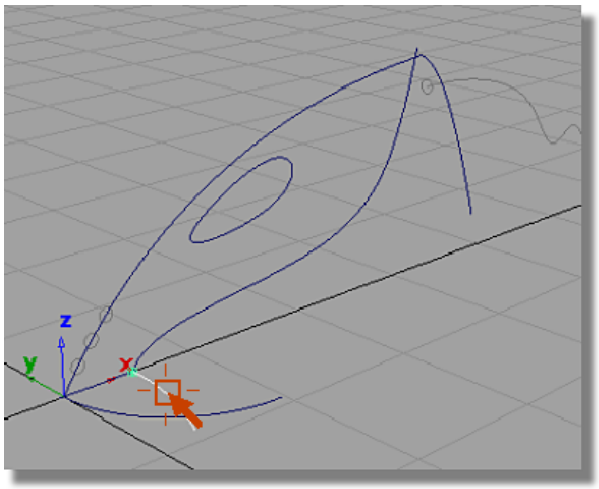


5 Close the **Rail Surface** option window by clicking the X in the top right corner.



You are now prompted to select the generation curve.

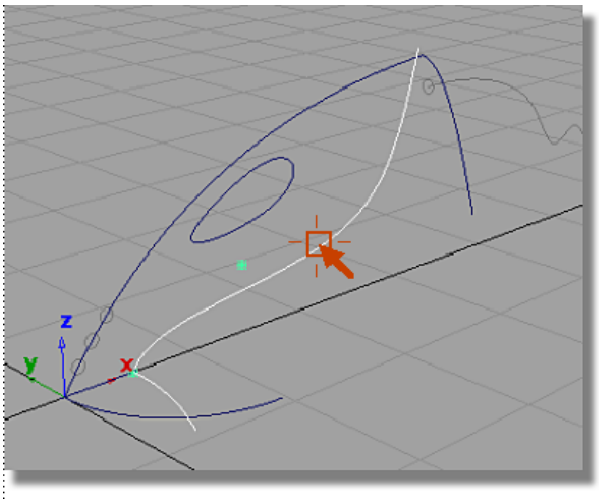
6 Use the *left mouse button* and click the curve shown to select it as the generation curve.



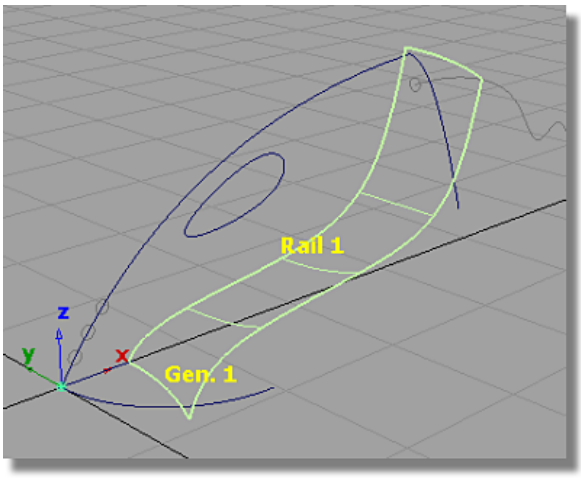
The curve is highlighted.

You are prompted to select the primary rail curve.

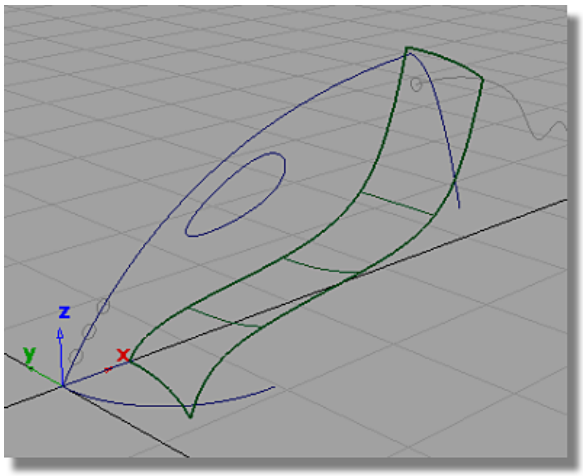
7 Click the lower profile of the vacuum to select it as the path curve.



A mono-rail surface is created.



8 Choose Pick > Nothing to deselect the surface.



To see the shape of the surface more clearly, you will use diagnostic **Shading** on the **Control Panel** to shade the surface.

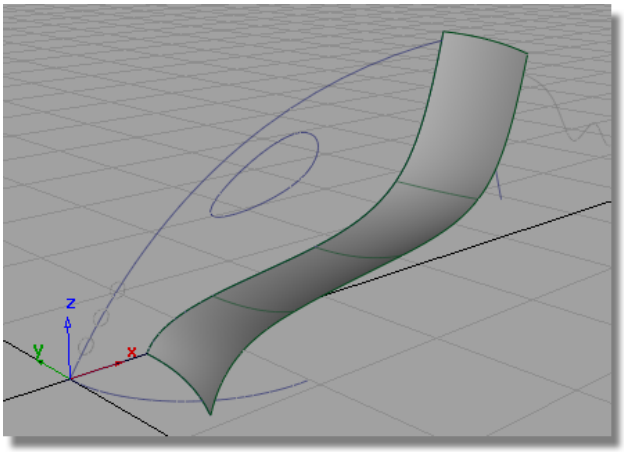


TIP If the **Control Panel** is not displayed on your screen, choose Windows > Control Panel to make it visible.

9 Select the **Multi Color** shade icon to turn on the shading .



The surface is shaded in a default blue color.



10 Select the diagnostic **Shading Off** wireframe icon on the **Control Panel** to turn off the shading.



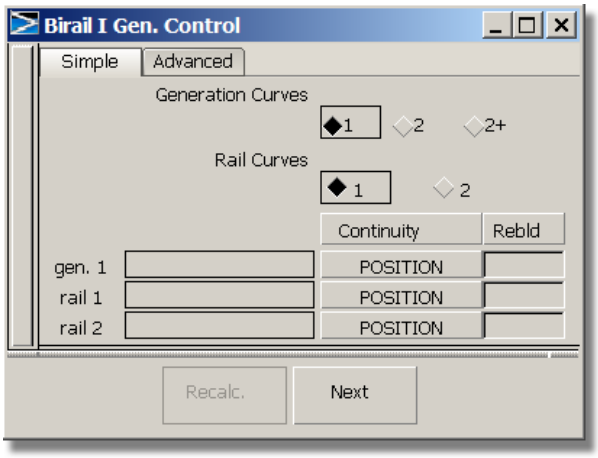
Use the diagnostic shading throughout this tutorial to visualize the geometry.

Creating the Upper Surface

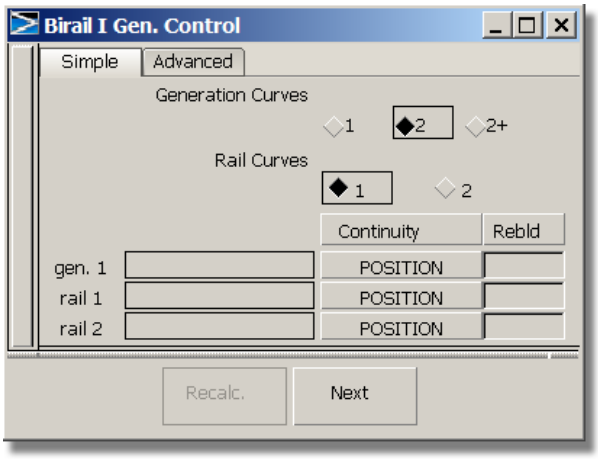
Next, you will create the upper surface of the vacuum cleaner using a Mono-rail surface with two generation curves. When two generation curves are used, the surface blends between the two shapes, as it sweeps along the path curve. This will create a smooth surface blended between the wide nozzle and the narrower handle section.

1 Choose Surfaces > Swept Surfaces > Rail Surface. Double-click the icon to open the option window.

The **Rail** tool is set for 1 generation curve and 1 rail curve.



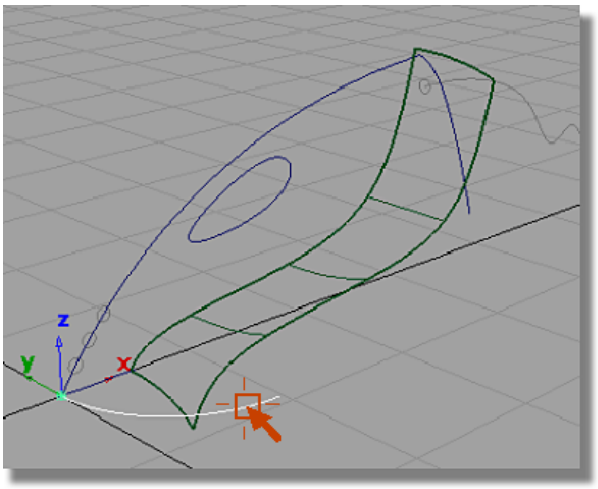
2 In the **Rail** surface option window, click **2** in the **Generation curves** section.



3 Close the option window.

You are prompted to select the generation curve.

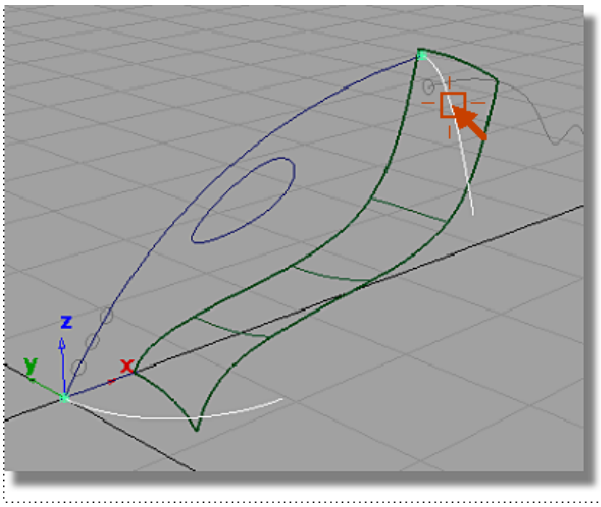
4 Click the curve located at the front of the vacuum nozzle to select it as the first-generation curve.



The curve is highlighted.

You are then prompted to select the next generation curve.

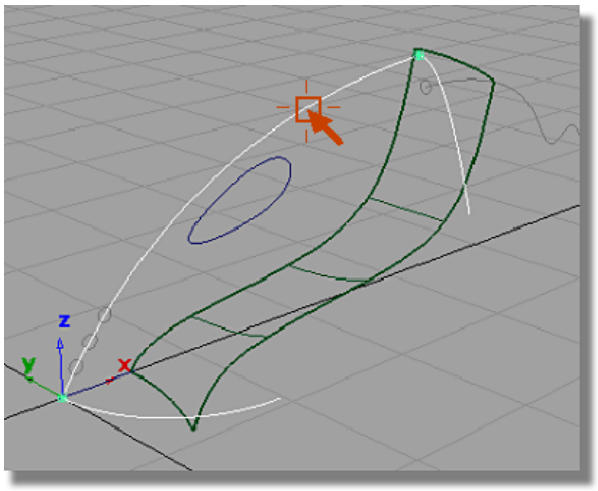
5 Click the curve located at the rear of the vacuum cleaner body to select it as the second-generation curve.



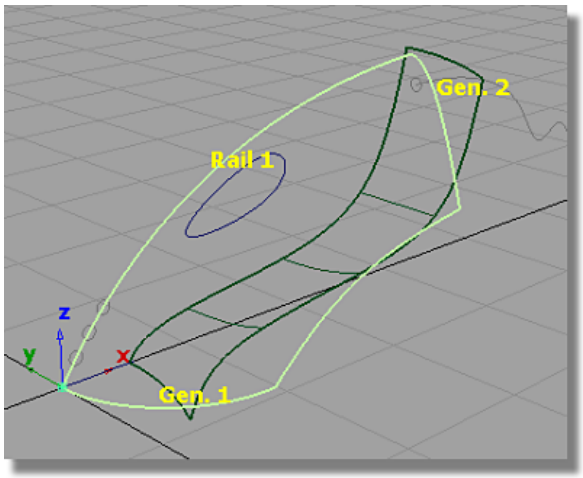
The curve is highlighted.

Next, you are prompted to select the primary rail curve.

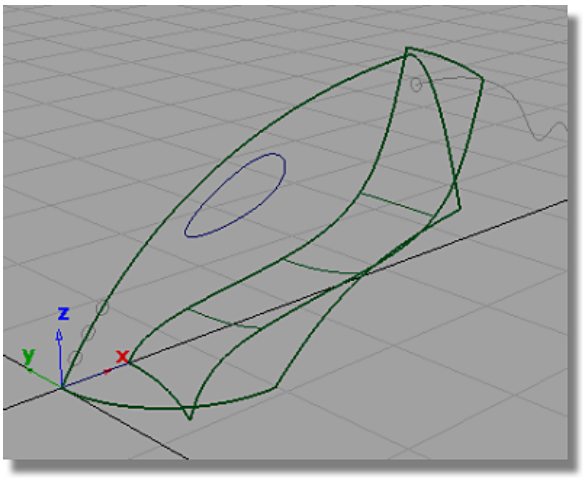
6 Click the upper profile curve of the vacuum cleaner body.



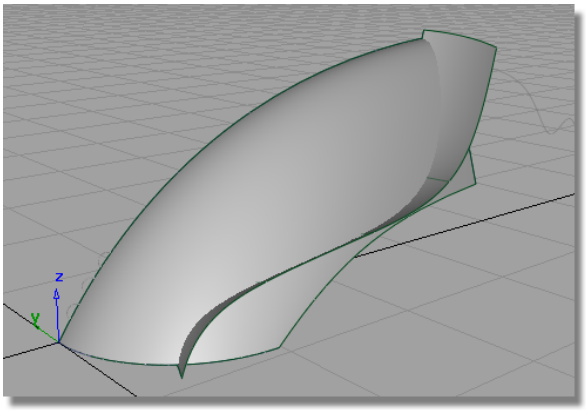
A mono-rail surface is created that blends smoothly between the two generation curves.



7 Choose Pick > Nothing to deselect the surface.



8 Use diagnostic **Shading** on the **Control Panel** to view the relationship between the two overlapping surfaces.



You have now created the two main shapes that will be used to create the vacuum cleaner body.

Saving your work

Now, you will save the scene as a new file.

1 Choose File > Save As to open the File Browser.

2 In the File Browser, locate the `Lessons` directory. Set the `Lessons` directory as the **Current Project**.

3 Save your work in the `wire` directory of the `Lessons` project.

4 Name your file `myvacuum.wire`.

For information on creating the `Lessons` project, or saving your work, see Saving your work on page 96.

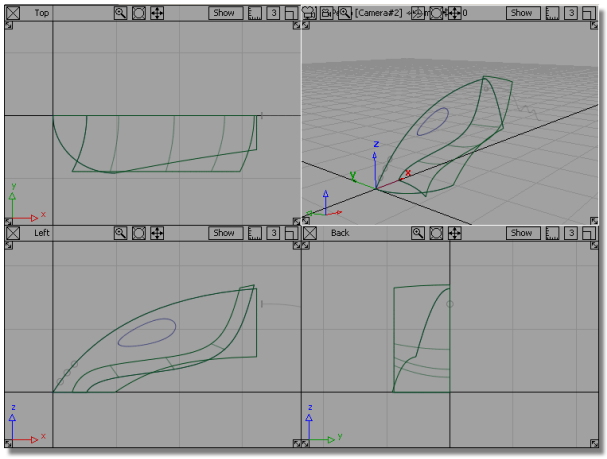
Part 2: Intersecting and Trimming

A common way to combine NURBS surfaces is to intersect the surfaces, then trim them where the two surfaces cross each other. This is the approach you will take with the upper and lower surfaces of the vacuum cleaner.

First, you will intersect the surfaces. When you intersect surfaces, you create curves-on-surface, which are lines that are created on the surfaces where the surfaces intersect. You will then trim the intersecting surfaces along the curves-on-surface, so the unnecessary surface areas are discarded, and only the necessary surface areas remain.

Opening the tutorial file (optional)

If you successfully completed Part 1, you can proceed directly to the next step, Intersecting the upper and lower surfaces.



If you were not successful in part 1, open the file called `vacuum_part2.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 1.

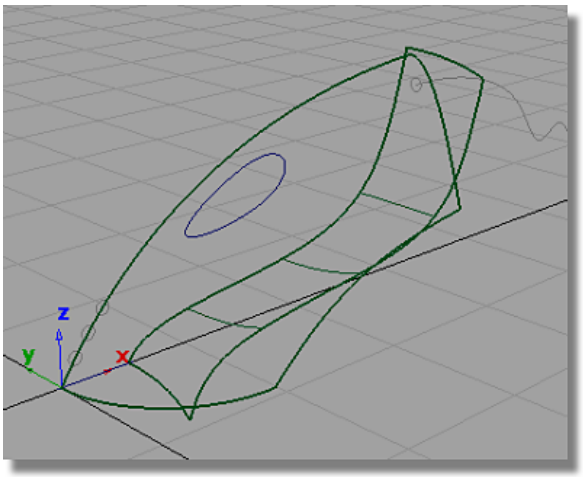


Watch **Part 2** of the tutorial.

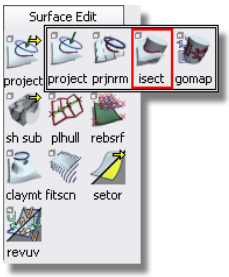
Intersecting the upper and lower surfaces

Now, you will intersect the upper and lower surfaces to create the body shape.

1 Click the **wireframe** icon in the diagnostic **Shading** area of the **Control Panel** to remove the shading.

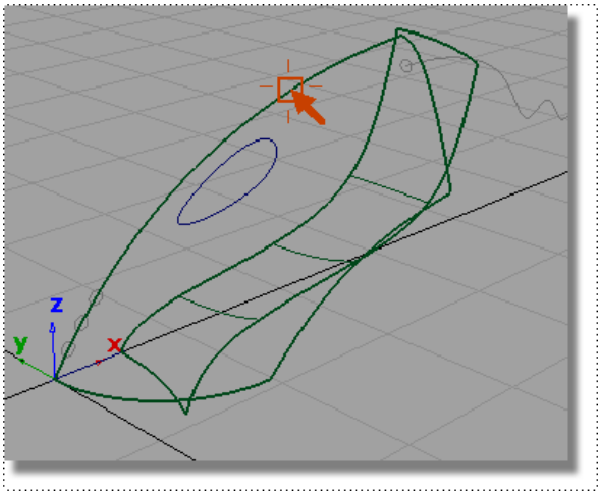


2 Choose Surface Edit > Create CurvesOnSurface > Intersect . This tool creates the curves-on-surface that are used to trim the surfaces.

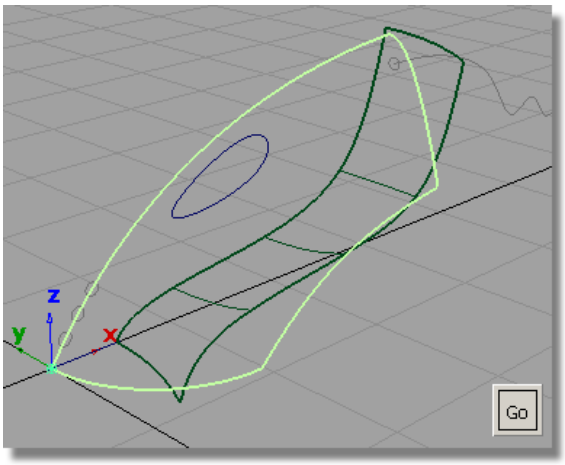


3 You are prompted to select the surface(s) to intersect.

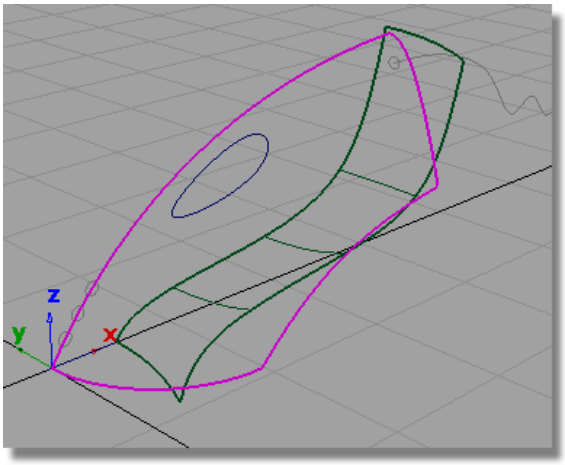
Use the *left mouse button* to click the upper surface to select it.



The surface is highlighted and a **Go** box appears in the lower right corner of the view.

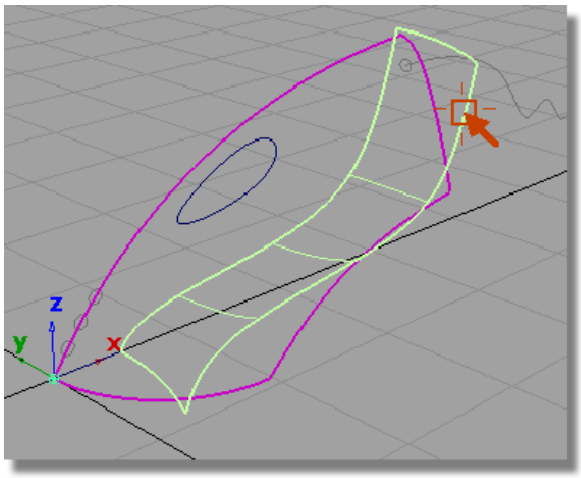


Click the **Go** box to select the first surface to be intersected.

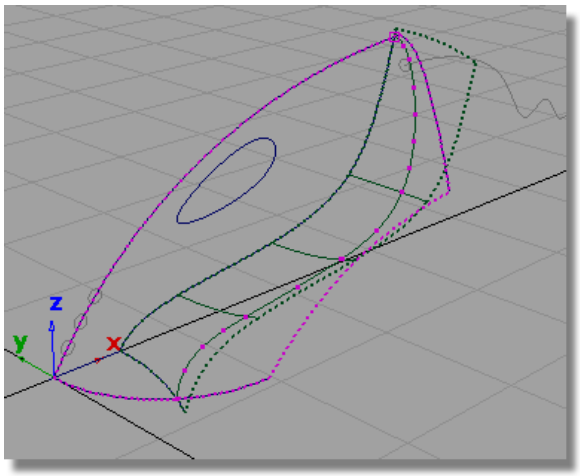


The surface is highlighted in pink.

4 You are prompted to select the intersecting surface.
Click the lower surface to intersect it with the upper surface.



The surfaces are intersected. Two curves-on-surface are created, one on each surface.

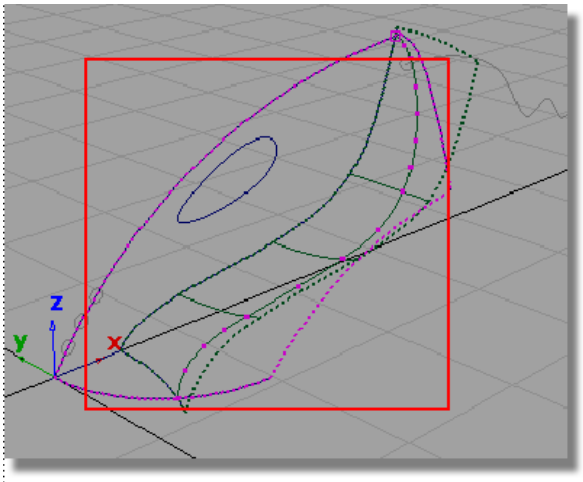


By default, the **Intersect** tool creates a curve-on-surface on each surface so each surface can be trimmed.

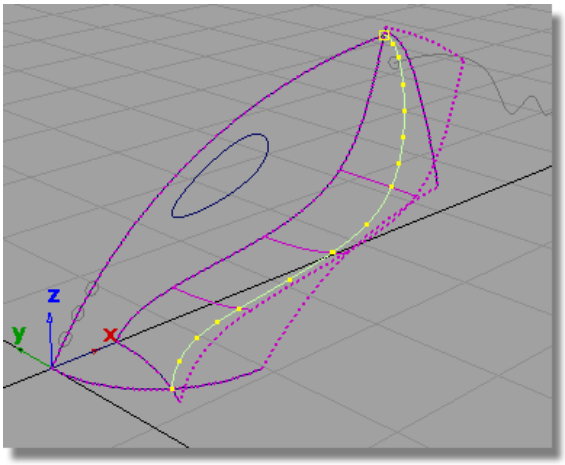
Both surfaces are now drawn with a dotted outline to indicate that each has a curve-on-surface.

5 Choose Pick > Object Types > Curve on Surface .

6 Drag a pick box around the intersected surfaces to pick the curves-on-surface.



The highlighted curves that appear are the two curves-on-surface. It looks as though there is only one curve-on-surface, but in fact there are two in the same location, one on the upper surface, and one on the lower surface.



7 Choose Pick > Nothing to unpick the curves-on-surface.

Trimming the surfaces

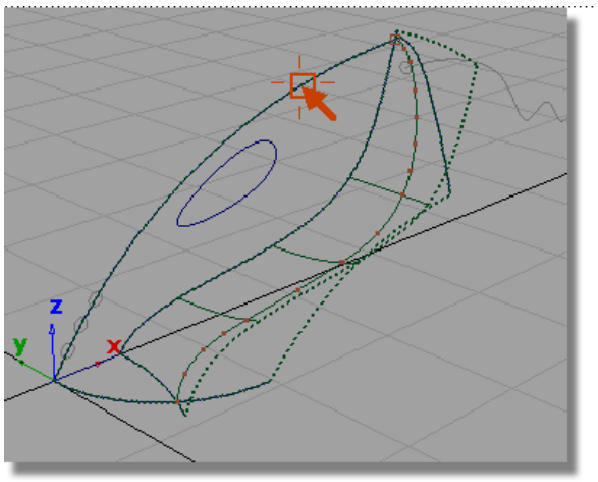
Now, you will trim off the excess from the upper and lower surfaces.

NOTE A trimmed surface is not actually cut; it exists in a hidden form that does not render or affect modeling. While performing a trim, you can easily discard part of a trimmed surface by selecting the unwanted portion of the geometry and clicking the Divide 

button that appears at the bottom right corner of the screen.

1. Choose Surface Edit > Trim > Trim Surface .
2. You are prompted to select a surface to trim.

   Pick the upper surface.

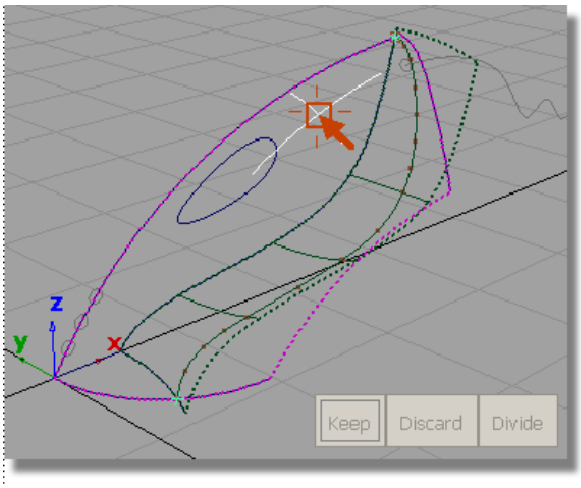


3. You are then prompted to select one of the following:

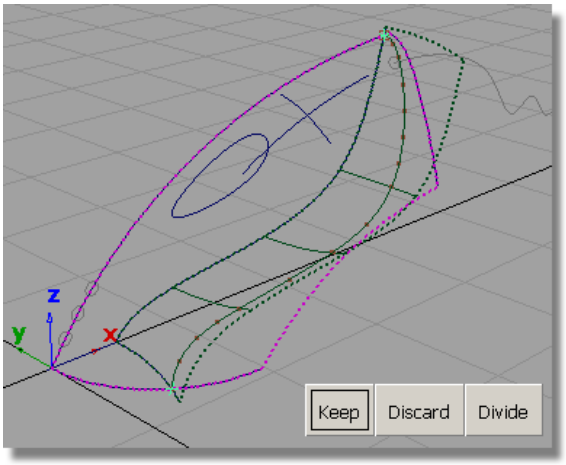
   `Shift select to select surfaces or click to select REGIONS.`

   The last option allows you to trim away the excess parts of the surface, so this is the prompt you will respond to.

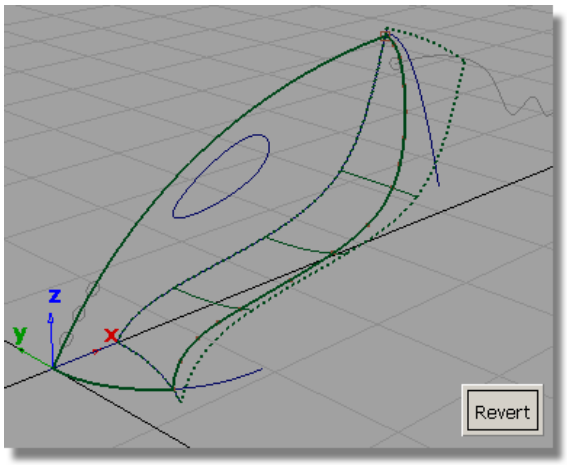
   Click any part of the upper surface on the inside part that you want to keep.



The **Trim** tool places an indicator where you clicked and an option box appears in the bottom right corner of the view.

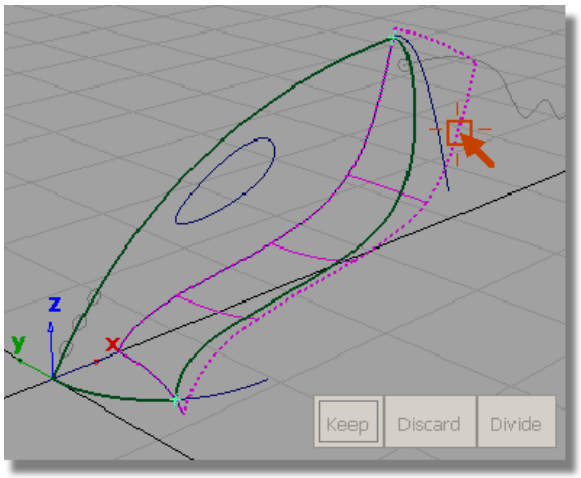


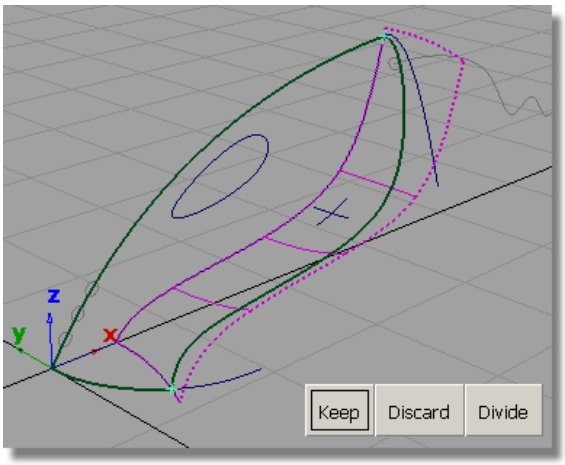
4 Click the **Keep** button.

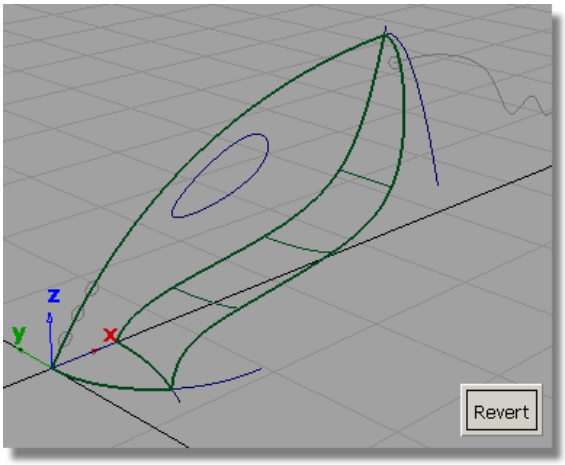


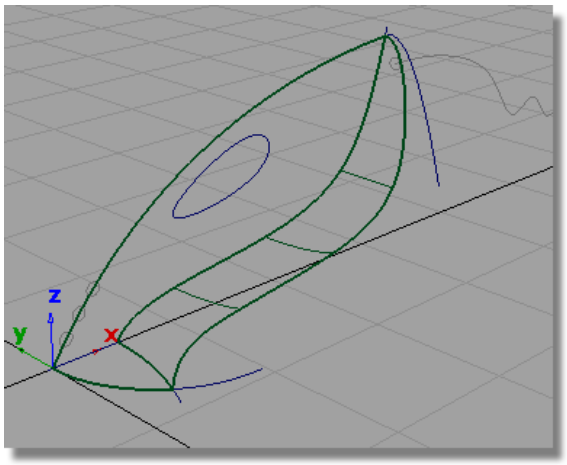
The upper surface is trimmed.

5 Repeat steps 1 – 4 to trim the lower surface.




z
y
x
Keep
Discard
Divide

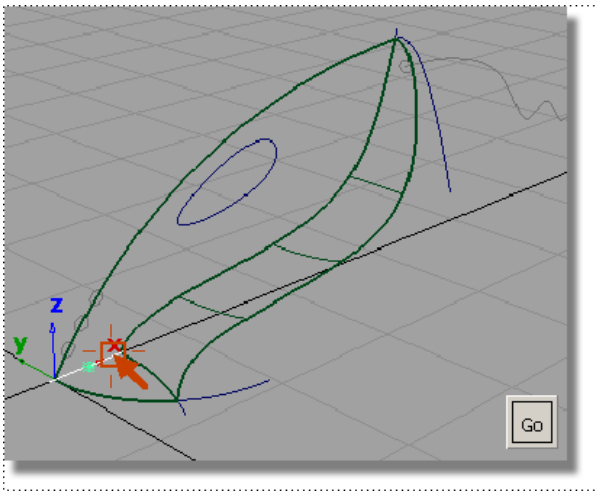

z
y
x
Revert



Creating the nozzle surface

Next, you will create a planar surface across the mouth of the nozzle, to complete the exterior shape of the vacuum body.

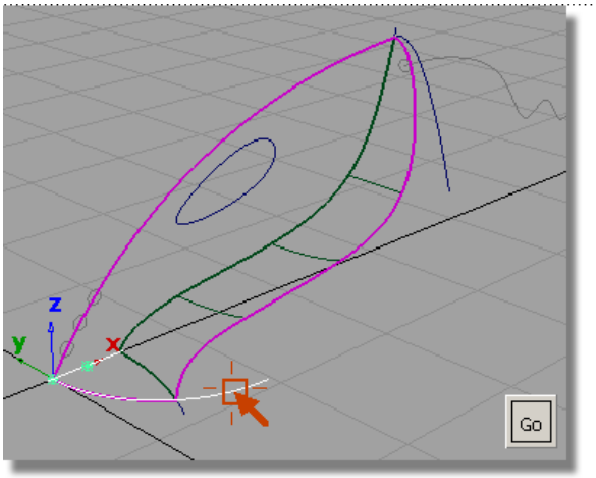
1. 1 Choose the Surfaces > Planar Surfaces > Set Planar tool.
2. You are prompted to select a curve.
3. Click the straight-line curve along the center grid line to select it as the first curve for the planar surface.



The curve is selected and a **Go** button appears in the bottom right corner of the view.

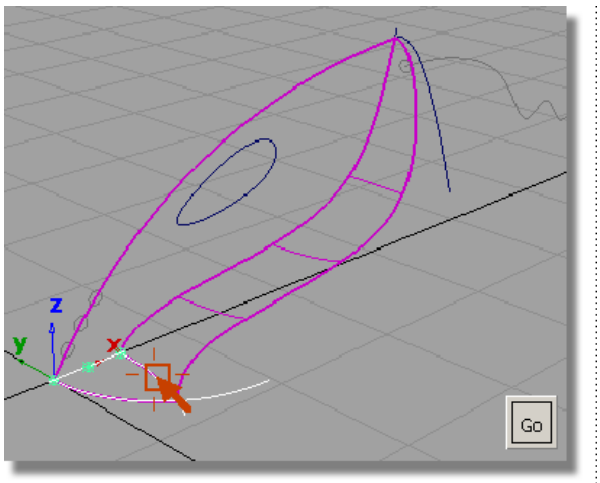
You are prompted to select another curve.

4 Click the front nozzle curve to select it as the second curve for the planar surface. If the pick chooser appears, make sure that you pick the curve, not the surface edge.



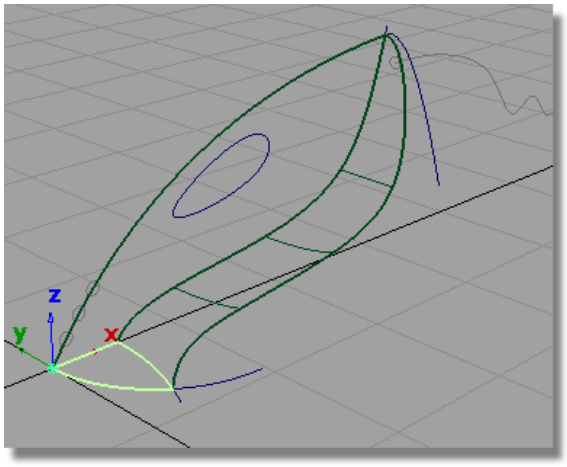
The curve is selected, and you are prompted to select another curve.

5 Click the rear nozzle curve to select it as the third curve for the planar surface.



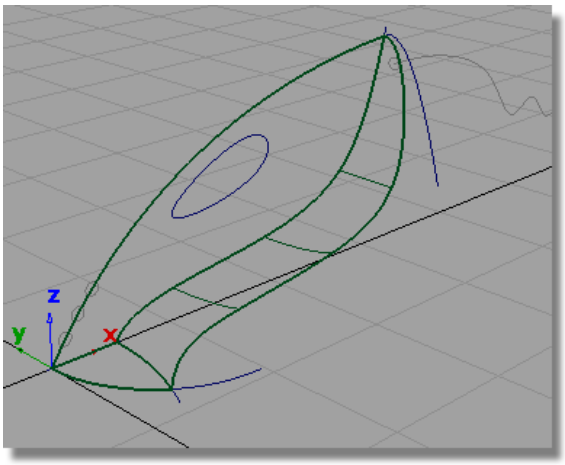
The curve is selected. The three curves form a closed region within which the planar surface will be created.

6 Click **Go** to create the planar surface.

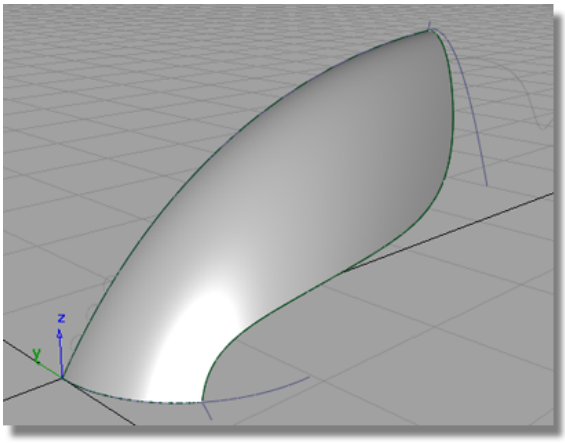


The surface is created and highlighted in pale yellow.

7 Choose Pick > Nothing to deselect the planar surface.



8 Use diagnostic **Shading** in the **Control Panel** to view the model.



Save your work

1 Choose File > Save As to save the current scene.

2 Save your work in the `wire` directory of the `Lessons` project.

3 Name your file `myvacuum2.wire`.

Part 3: Surface Fillet

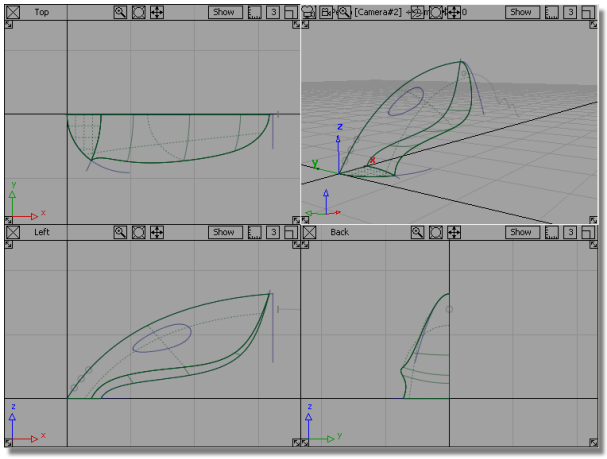
Now that you have intersected and trimmed the upper and lower surfaces, there is a sharp edge where the two surfaces meet.

To create a rounded transition between the two surfaces, you will create a fillet surface using the Surfaces > Surface Fillet tool.

The surface fillet tool will create a rounded surface that blends smoothly between two surfaces, or two sets of surfaces. As well as creating the rounded surface, the Surface Fillet tool can also trim back the original surfaces to create a finished continuous form. This trimming is achieved using curves-on-surface, which are automatically created by the **Surface Fillet** tool.

Opening the tutorial file (optional)

If you successfully completed Part 2, you can proceed directly to the next step, Creating the body fillet.



If you were not successful in part 2, open the file called `vacuum_part3.wire`, located in the wire directory of the `CourseWare` project. This file contains the completed model from Part 2.



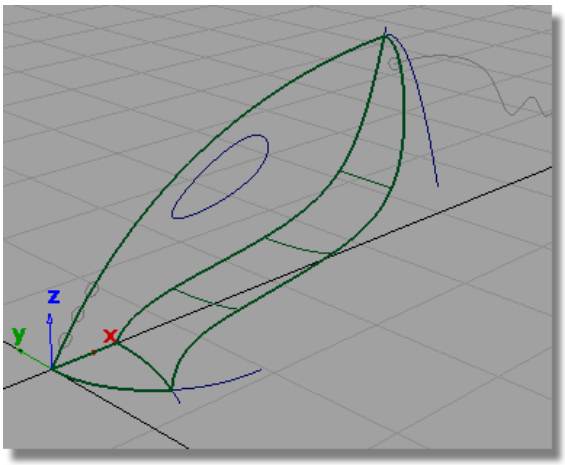
Watch **Part 3** of the tutorial.

Creating the body fillet

Next, you will create a fillet surface along the intersected edge of the vacuum cleaner body.

The **Surface Fillet** tool uses surface indicators to choose which side of a surface to create the fillet. These indicators are easier to see in a wireframe view. So you will first turn off the shaded view.

1 Return to a wireframe view by clicking the wireframe icon in the diagnostic **Shading** section of the **Control Panel**.

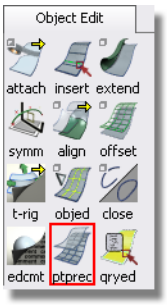


The upper surface only has lines showing on its edges. To improve the visualization of the surface, and to make it easier to select, you can increase the number of lines across the surface using the **patch precision** tool.

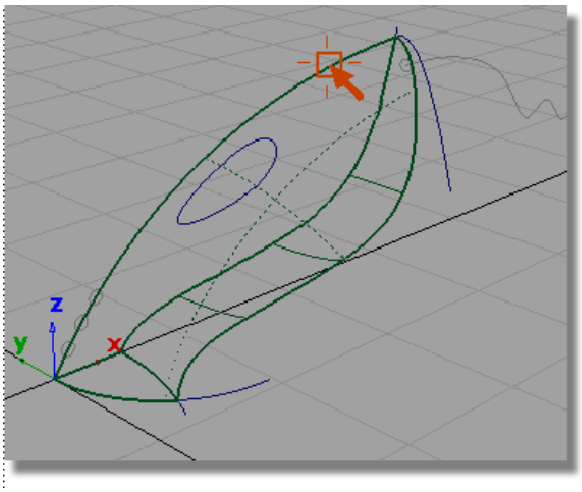
Next, you will increase the patch precision for the upper surface.

2 Choose Pick > Object and select the upper surface.

3 Choose Object Edit > Patch Precision .



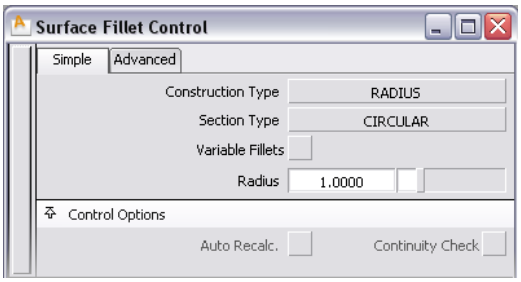
You are prompted to enter the number of curves per patch. Type in **3** and press *Enter* (Windows) or *Return* (Mac).



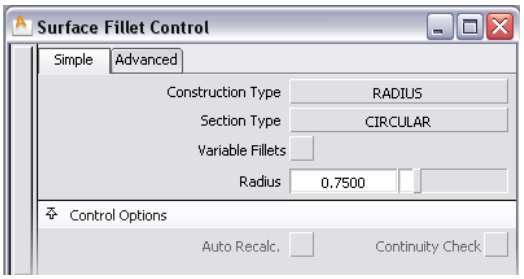
The surface is now displayed with some dotted lines across its interior. These dotted lines make the surface easier to visualize in wireframe, and can be used to select the surface.

Next, you will create the surface fillet along the trimmed edge where the two main surfaces meet.

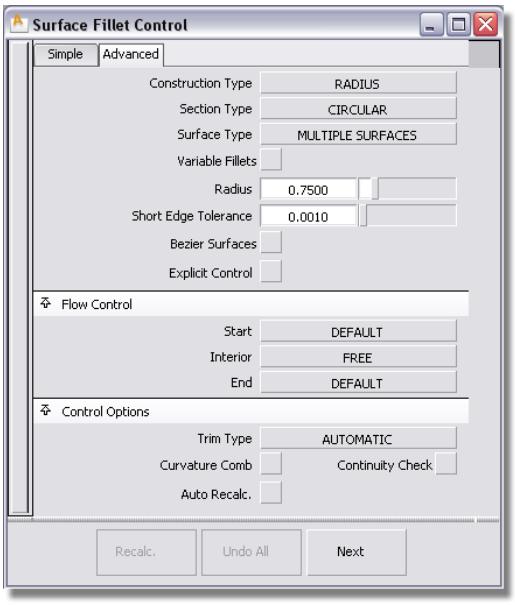
4 Choose Surfaces > Surface Fillet . Double-click the icon to open the option box.



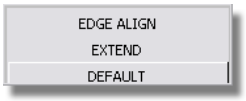
5 In the **Radius** section, type in a radius value of 0.75.



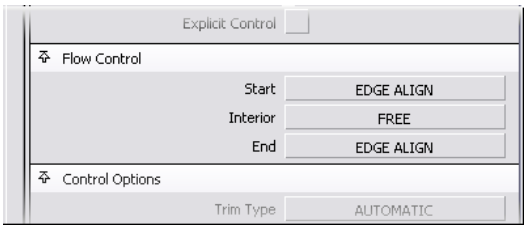
6 Click the **Advanced** tab to open the advanced options for the surface fillet tool.



In the **Flow Control** section, there are pull-down menus for the Start, Interior, and End of the fillet surface.



The **Start** and **End** options are set to DEFAULT. For the **Start** and **End**, select **EDGE ALIGN**.

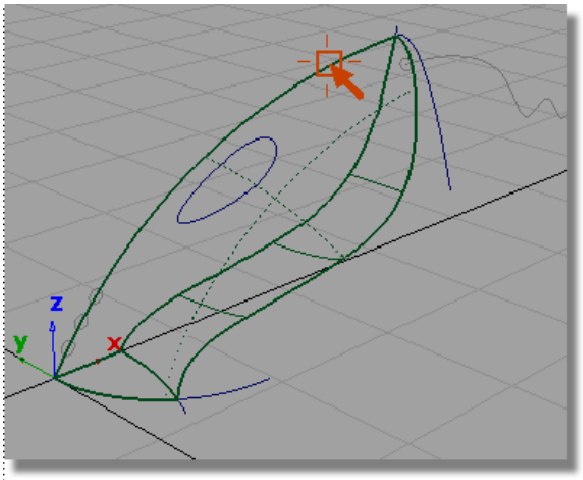


This choice ensures that the fillet surface is built to the full length of the edge, and the upper and lower surfaces are correctly trimmed.

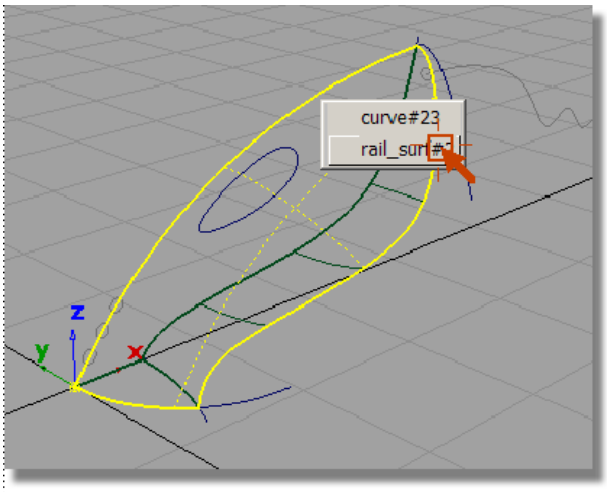
7 Close the **Surface Fillet** option box.

You are prompted to select the first set of surfaces.

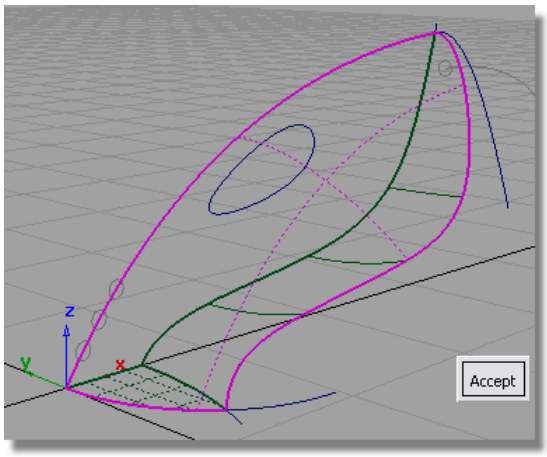
8 Pick the upper surface.



If the pick chooser appears, select the mono-rail surface.



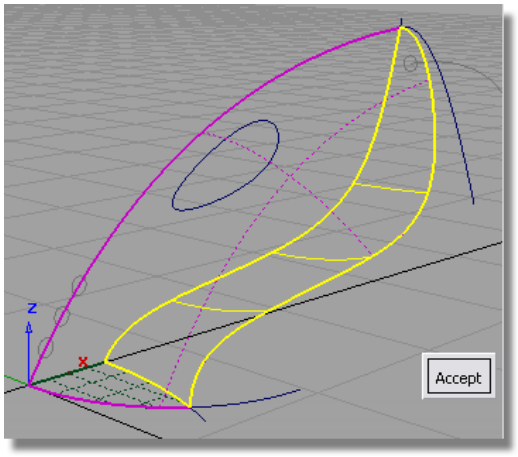
The surface is selected and highlighted in pink, an **Accept** button appears in the bottom right corner of the view.



9 Click **Accept** to select the first surface for filleting.

You are prompted to select the second set of surfaces.

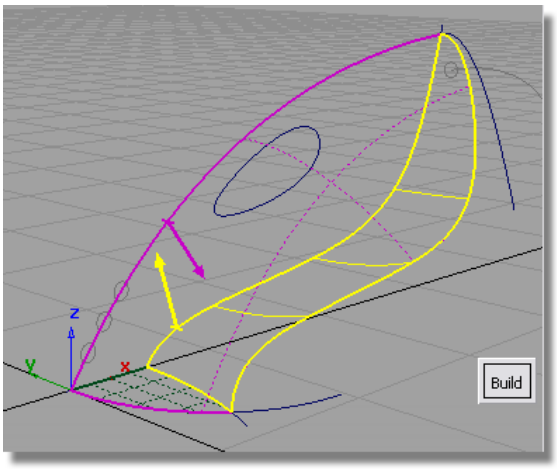
10 Click the lower surface to select it.



The surface is selected and highlighted in yellow, and an **Accept** button appears in the bottom right corner of the view.

11 Click **Accept** to select the second surface for filleting.

Arrows appear on both surfaces, indicating on which side of the surfaces the fillet will be built. If necessary, tumble the view to see which direction the arrows are pointing.

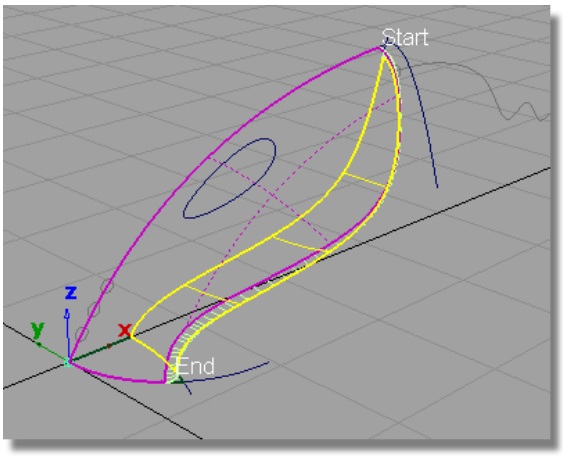


For the upper surface, the pink arrow needs to point inwards towards the inside of the vacuum cleaner body. If it is pointing out from the surface, then click it to reverse it.

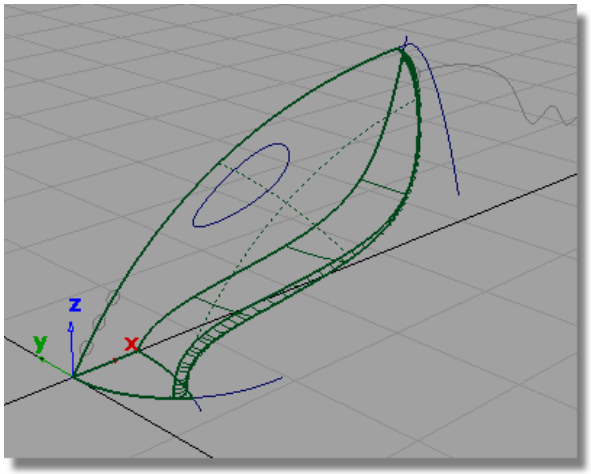
The yellow arrow for the lower surface also needs to point inwards toward the inside of the vaccum cleaner body. If it isn't, click it to reverse its direction.

12 Click **Build**.

The fillet surface is created, and the upper and lower surfaces are trimmed.



13 Choose Pick > Nothing or press *Enter* (Windows) or *Return* (Mac) to deselect all the surfaces.

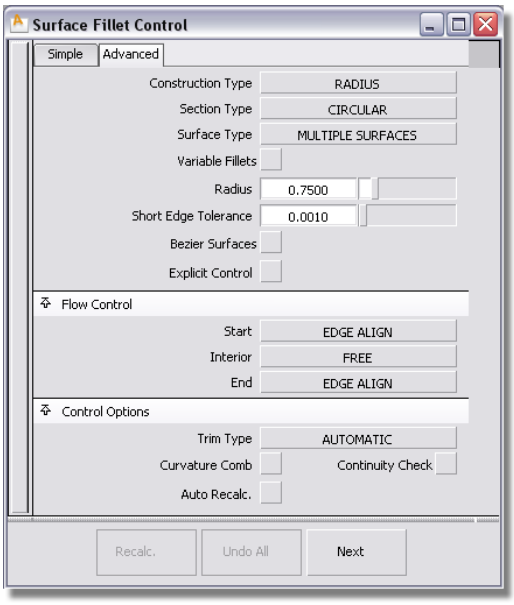


Creating the nozzle fillet

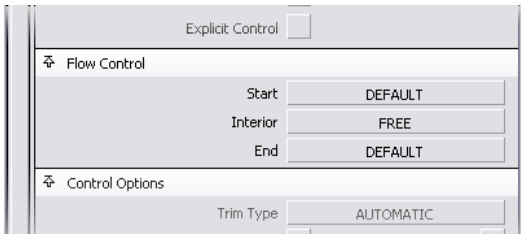
The Surface Fillet tool can be used in different modes. The default mode, which you used for the body fillet, is to create a circular fillet. This creates a constant radius surface along the length of the fillet surface.

For the nozzle, you will create a chordal fillet. A chordal fillet maintains a constant width of surface, instead of a constant radius. This will produce a more regular surface when the angle between the two main surfaces varies along their edge.

1 Choose Surfaces > Surface Fillet . Double-click the icon to open the surface fillet option box. In the **Advanced** tab, the flow control settings are currently set to **Edge Align** for the start and end.

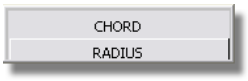


2 The **Flow Control** settings can be returned to the default settings. On the pull-down menu for the **Start** and **End** settings, choose **DEFAULT**.



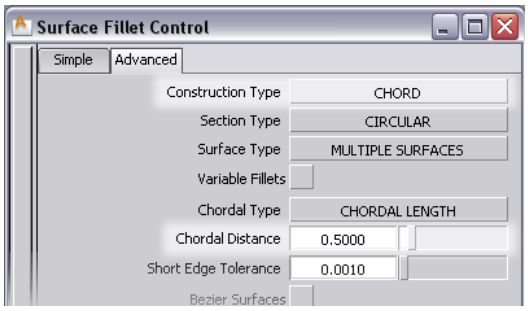
NOTE The ends of the fillet fall on the center-line of the vacuum design. As the edges of the main surfaces are already aligned to the center-line, the Surface fillet EDGE ALIGN adjustment isn't required.

3 In the **Construction Type** setting, there are two choices on the pull-down menu.



Choose **CHORD** from the pull-down menu to select a constant width fillet.

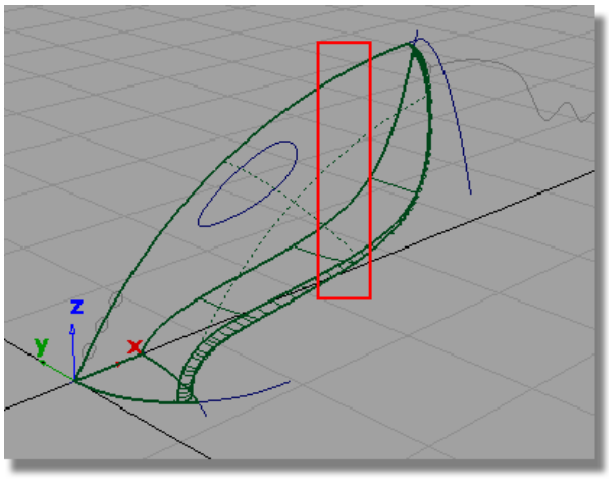
4 Only a small fillet is required around the nozzle, so set **Chordal Distance** to **0.5**.



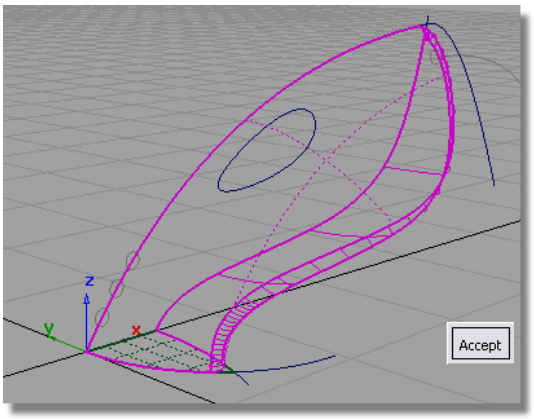
Close the **Surface Fillet** option box.

You are prompted to select the first set of surfaces.

5 Drag a pick box around the upper, lower and fillet surfaces, avoiding the planar surface.

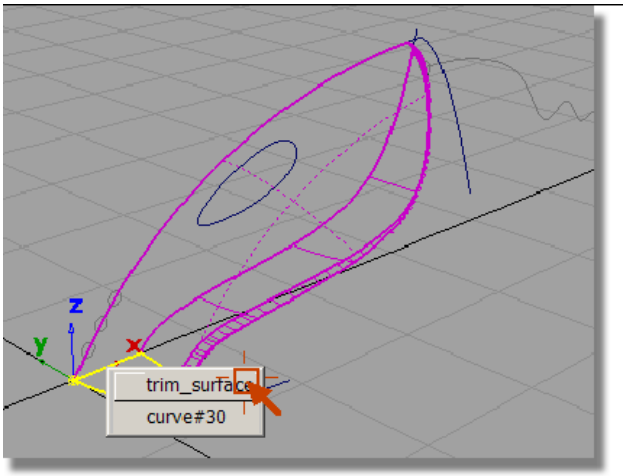


All three surfaces are selected and highlighted in pink, and an **Accept** button appears in the bottom right corner of the view.

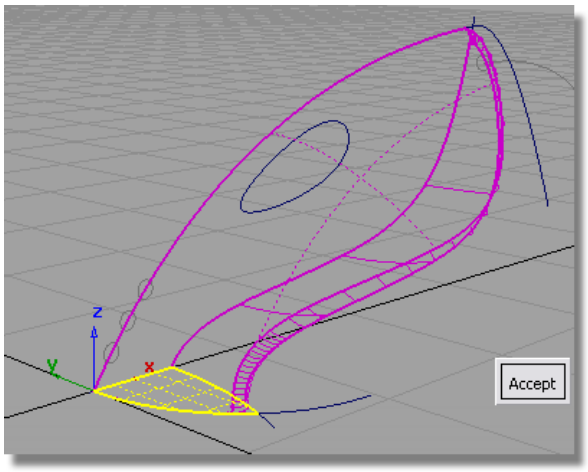


6 Click **Accept** to select the first set of surfaces for filleting.
You are prompted to select the second set of surfaces.

7 Click the planar surface to select it.



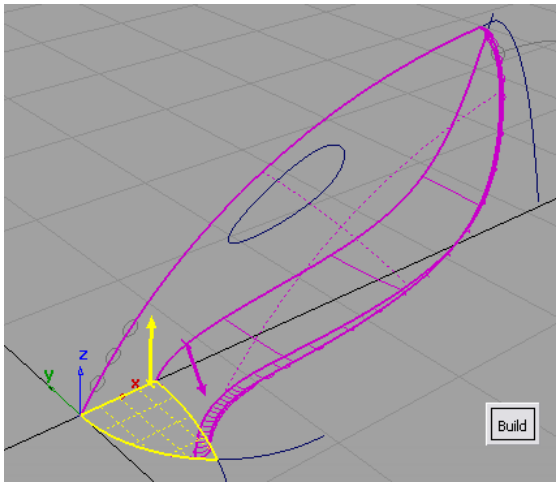
If the pick chooser appears, pick the **trim_surface**.



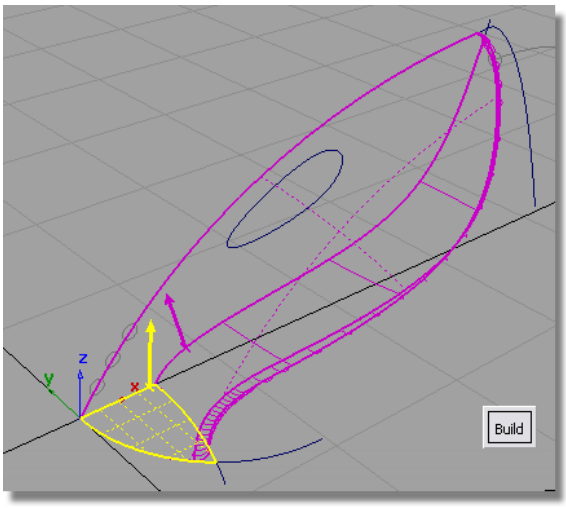
The surface is selected and highlighted in yellow, and an **Accept** button appears in the bottom right corner of the view.

8 Click **Accept** to select the second surface for filleting.

Arrows appear on both sets of surfaces, indicating on which side of the surfaces the fillet will be built.

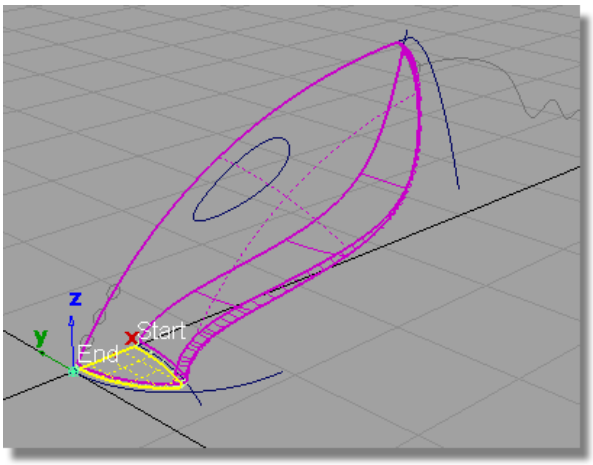


The pink arrow needs to point in towards the inside of the vacuum body. If it is pointing out of the surface, click the arrow to reverse it.



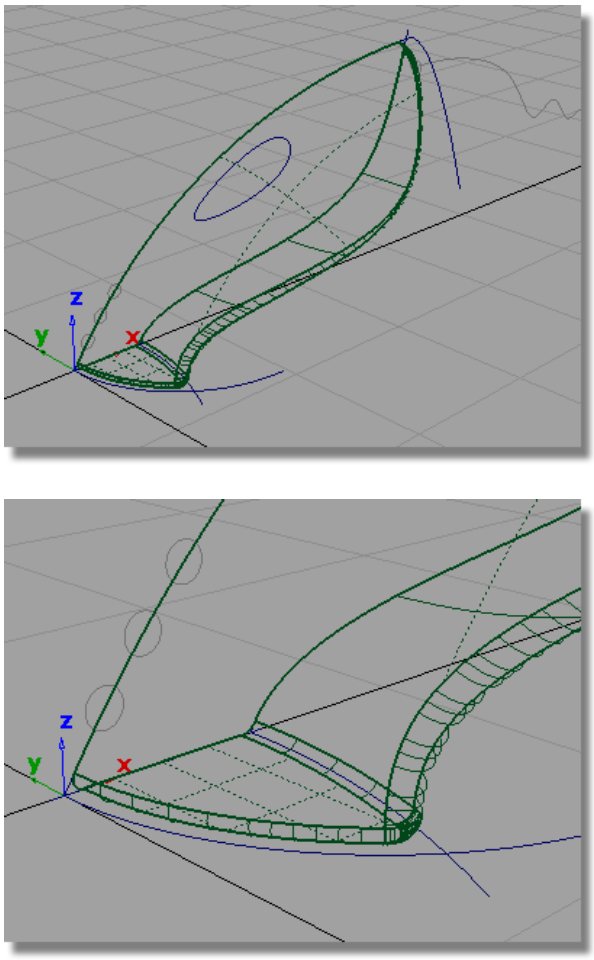
The yellow arrow needs to point upwards towards the inside of the vacuum body. If it is pointing downwards, out of the surface, click the arrow to reverse it.

9 Click **Build**.



The chordal fillet surface is created, and the surfaces trimmed to create a smooth, continuous exterior.

10 Choose Pick > Nothing to deselect all the surfaces.



Save your work

1. Choose File > Save As to save the current scene.
2. Save your work in the wire directory of the `Lessons` project.
3. Name your file `myvacuum3.wire`.

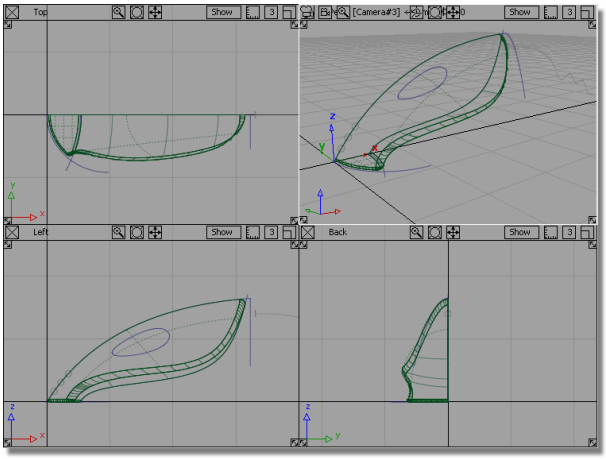
Part 4: Creating the Handle

In this section, you will create a hole through the vacuum cleaner body to create a handle. As before, when you built the main body shape, you will overbuild surfaces to create an intersection.

This time, however, you will not use the intersection and trim tools to create a sharp-edged shape. Instead, you will use the Surface Fillet tool to create a rounded edge and trim at the same time.

Opening the tutorial file (optional)

If you successfully completed Part 3, you can proceed directly to the next step: Creating the handle surface below.



If you were not successful in part 3, open the file called `vacuum_part4.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 3.



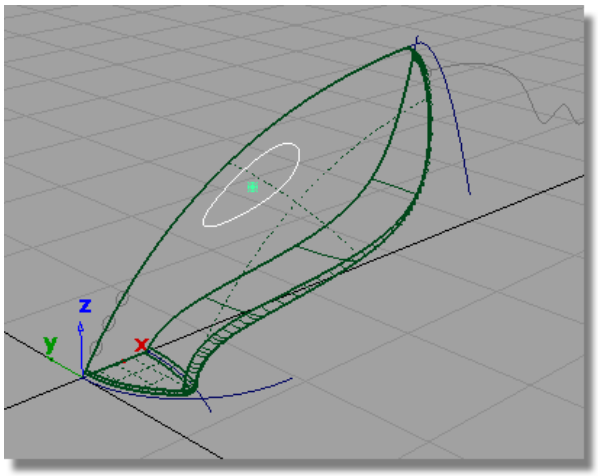
Watch **Part 4** of the tutorial.

Creating the handle surface

You will create the handle using a skin surface, built from the handle curve provided in the tutorial file.

First, you will make a copy of the handle curve and move it to the side of the vacuum, to create the two curves needed for the skin.

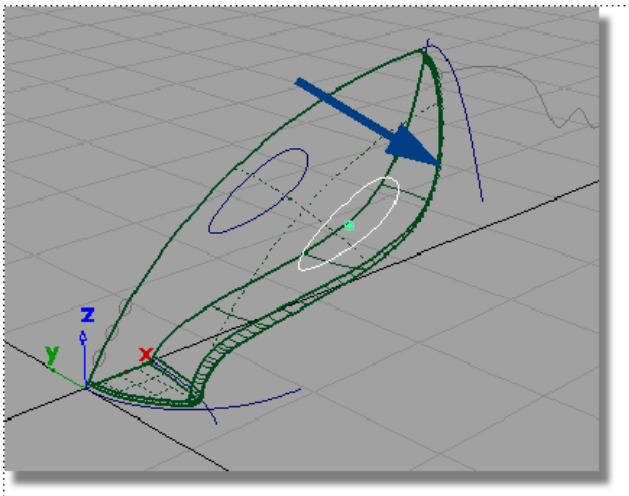
1 Choose Pick > Object and select the oval shaped handle curve.



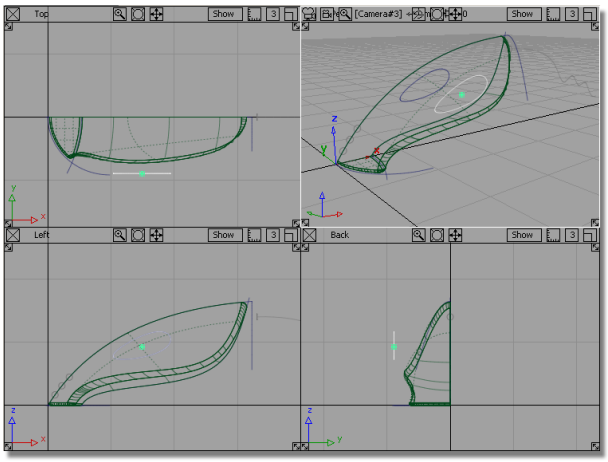
2 Choose Edit > Copy followed by Edit > Paste . The screen appears the same, but a second curve has been created and placed on top of the original, and is selected, ready to be moved.

3 Choose Transform > Move . Since you are working in the perspective view, the mouse buttons can be used to specify a move in the x, y, or z direction.

Click and hold the *middle mouse button* and move the second curve in the negative y-direction. Move the curve so it is well outside the vacuum body surfaces.



4 Use the **F9** hotkey to display all four views, to check that the copied curve is outside the main body.

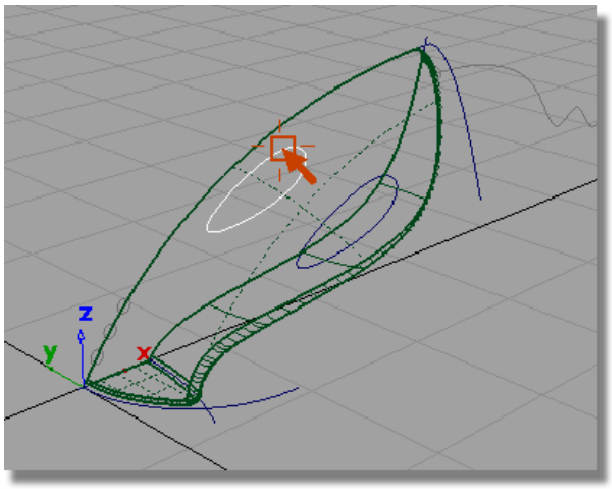


5 Use the **F8** hotkey to return to the perspective view.

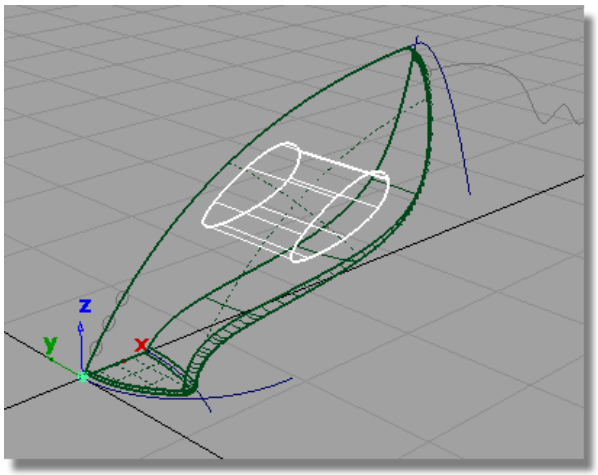
Next, you will create a **skin** surface between the two handle curves.

6 Choose the Surfaces > Skin tool.

7 You are prompted to select the first curve. Click the first handle curve to select it for the skin surface.

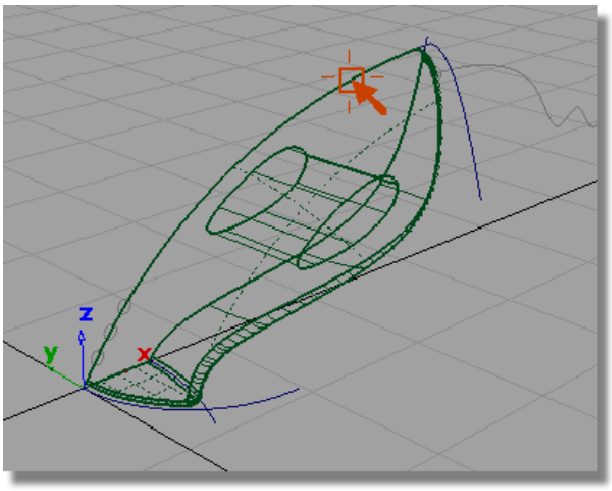


The curve is highlighted, and you are prompted to select the next curve. Click the second handle curve to select it.

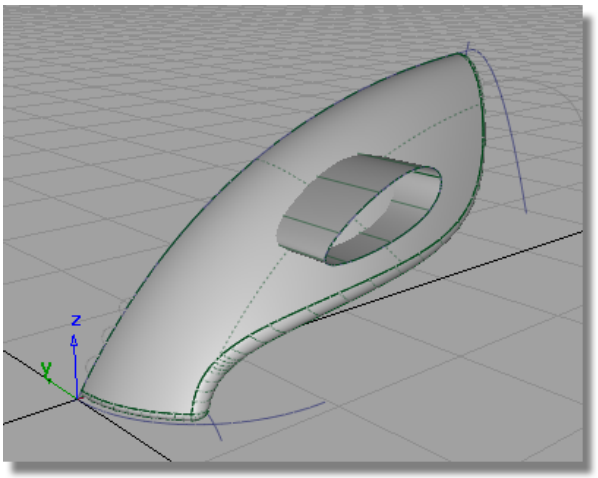


The skin surface is created and highlighted in white.

8 Choose Pick > Nothing to deselect the skin surface.

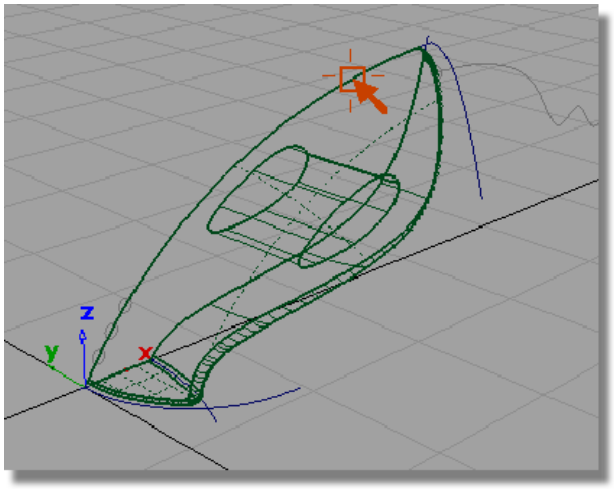


9 Use diagnostic **Shading** to check that the handle surface passes through the body surfaces.



TIP If the handle surface falls short of the body surfaces, use Pick > Object to select the second handle curve. Then, use Transform > Move with the *middle mouse button* to adjust the position of the curve. Because the skin surface has construction history, it will be rebuilt to the new curve position when the mouse button is released.

10 Return to a wireframe view by selecting the wireframe icon in diagnostic **Shading**.



Creating the handle fillet

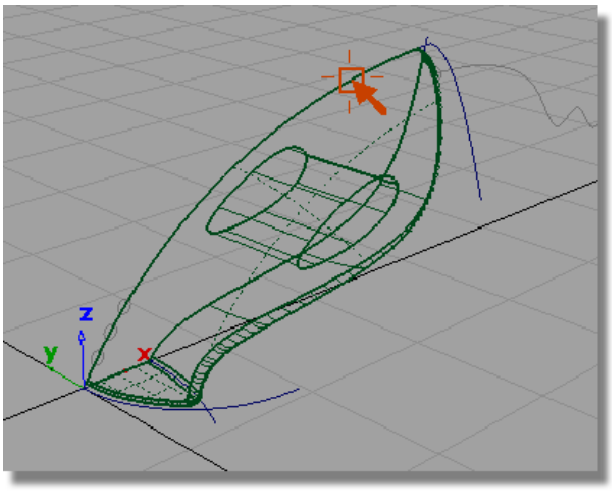
Next, you will use the **Surface Fillet** tool to trim the handle and upper body surfaces, and to create a rounded edge.

1 Choose Surfaces > Surface Fillet . The settings you used before will be used for this fillet surface, so you don't need to open the option box.

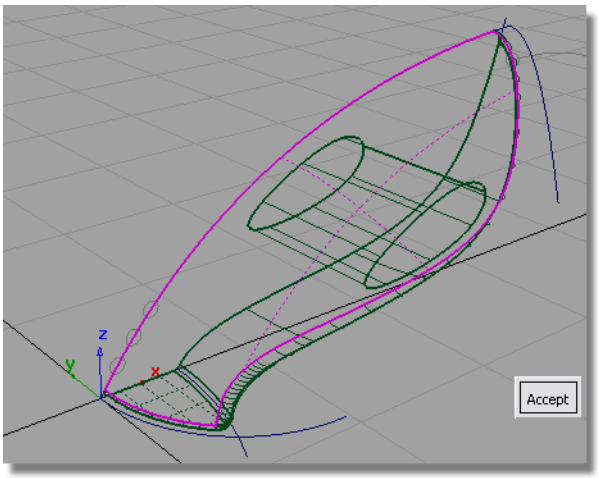
NOTE If you have exited Alias since building the last fillet, see Creating the nozzle fillet on page 316 for the correct **Surface Fillet** options to use.

You are prompted to select the first set of surfaces.

2 Click the upper surface to select it.

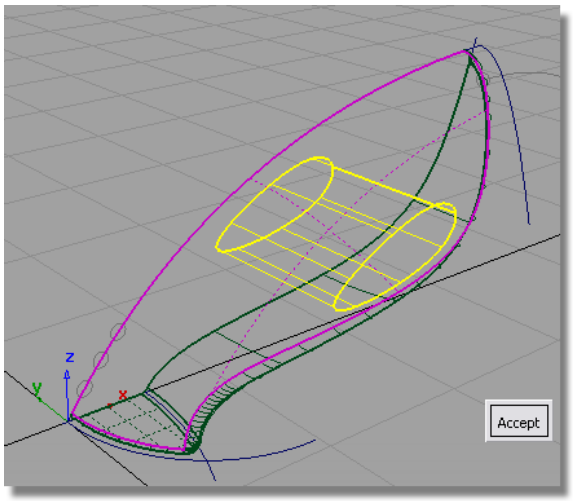


The surface is selected and highlighted in pink, and an **Accept** button appears in the lower right corner of the view.



3 Click the **Accept** box to select the first surface for filleting.
You are then prompted to select the second set of surfaces.

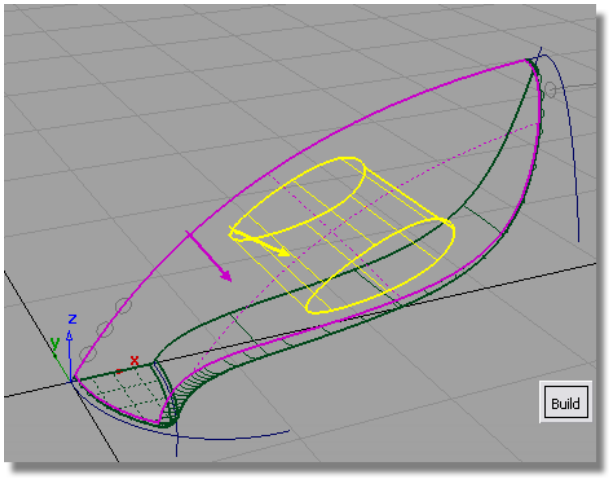
4 Click the handle surface to select it.



The surface is selected and highlighted in yellow, and an **Accept** box appears in the bottom right corner of the view.

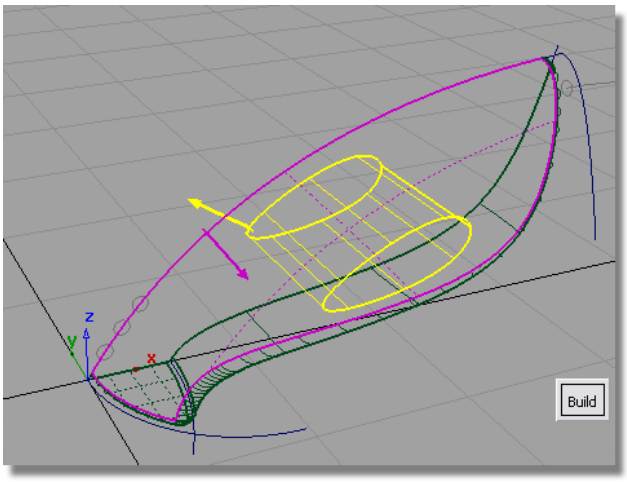
5 Click **Accept** to select the second surface for filleting.

Arrows appear on both surfaces, indicating on which side of the surfaces the fillet will be built.



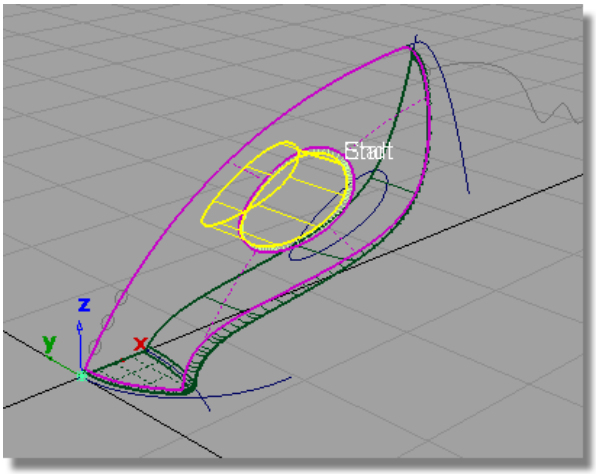
The pink arrow needs to point in towards the inside of the vacuum surfaces. If it is pointing out from the surfaces, click the arrow to reverse it.

The yellow arrow needs to point outwards from the handle surface. If it is pointing in towards the center of the handle, click the arrow to reverse it.



6 Click **Build**.

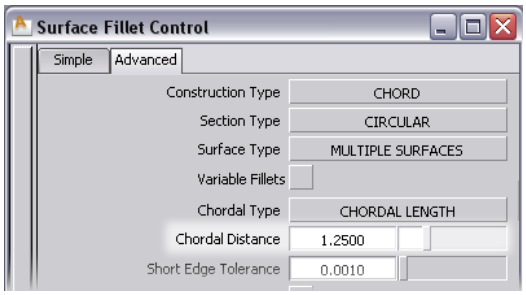
A small fillet surface is created, and the upper and handle surfaces are trimmed.



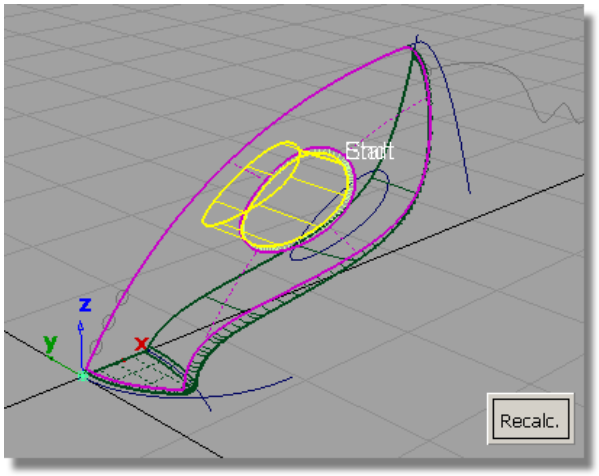
To create a comfortable handle, a larger fillet is required.

7 Choose Surfaces > Surface Fillet .p to open the option window.

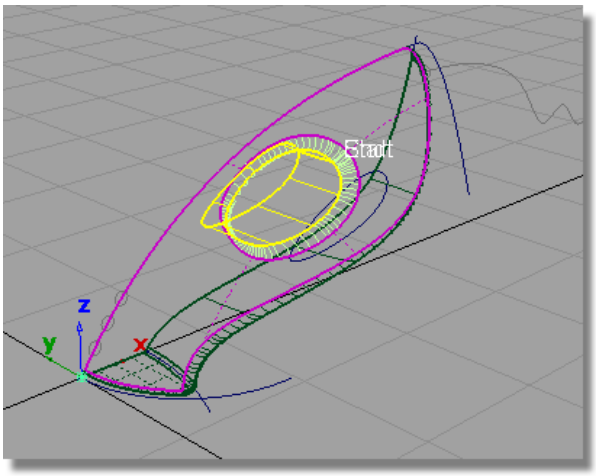
8 Type `1.25` in the **Chordal Distance** field and press *Enter* (Windows) or *Return* (Mac) to adjust the fillet size.



A **Recalc** button appears at the bottom right corner of the view.

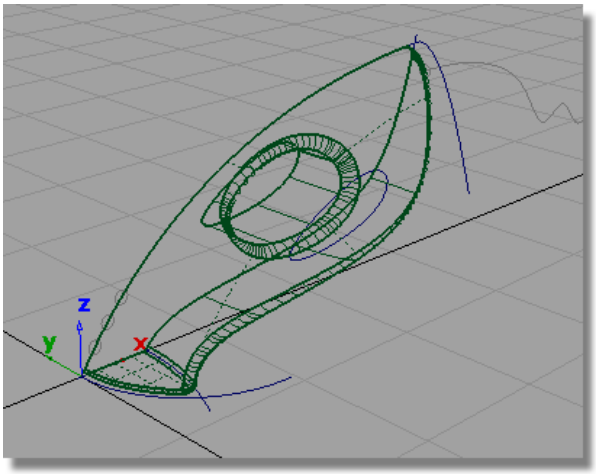


9 Click **Recalc** to rebuild the fillet.



The fillet is rebuilt to the larger size, providing a more comfortable handle design.

10 Choose Pick > Nothing to deselect all the surfaces.



11 You have now completed the main body shape for the vacuum cleaner design.

Save your work

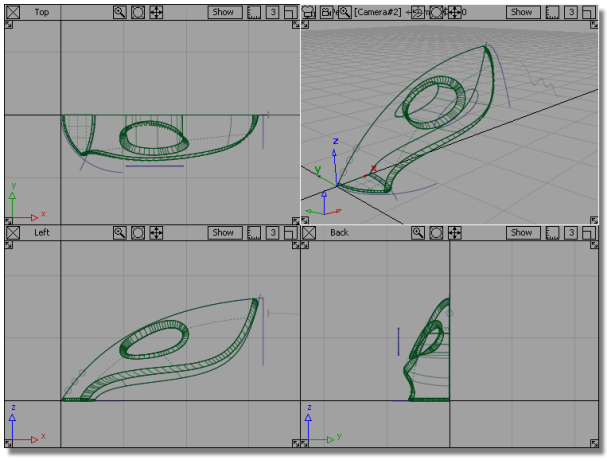
1. Choose File > Save As to save the current scene.
2. Save your work in the `wire` directory of the `Lessons` project.
3. Name your file `myvacuum4.wire`.

Part 5: Air Vents

In this section, you will create grooves to represent styled air intakes.

Opening the tutorial file (optional)

If you successfully completed Part 4, you can proceed directly to the next step, Creating the groove surfaces.



If you were not successful in part 4, open the file called `vacuum_part5.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 4.



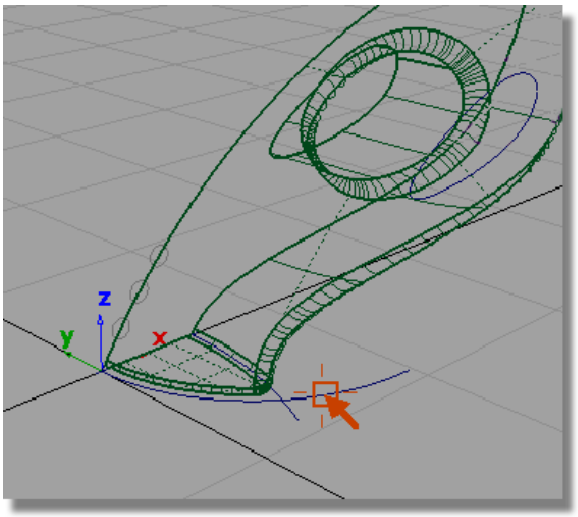
Watch **Part 5** of the tutorial.

Creating the groove surfaces

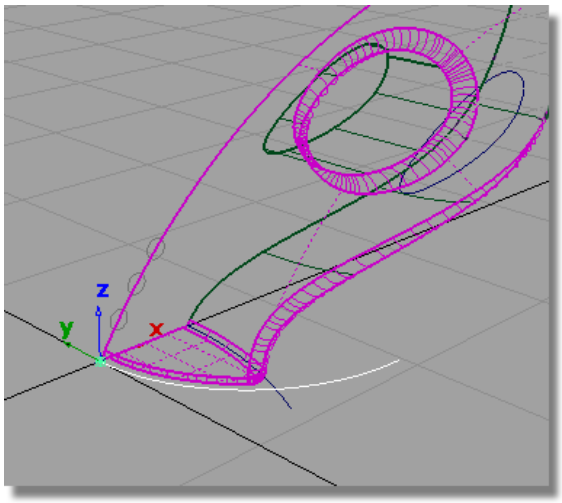
The groove surfaces will be created from three extruded tube shapes. The profile of the tubes will be circular, and the path will follow the general shape of the main body. To create an interesting intersection line, the path curve will pull away from the body shape so the grooves fade out at the outer edge.

To match the character of the main body shape, you will use the original nozzle curve as a path to extrude the three groove surfaces.

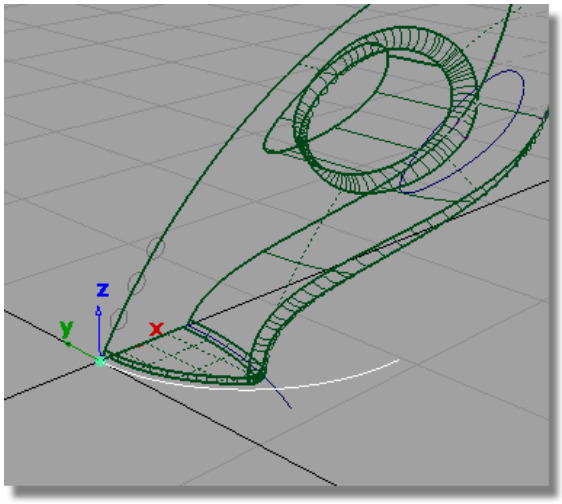
1 Choose Pick > Object and select the front nozzle curve.



NOTE The surfaces are highlighted in pink. This indicates the surfaces have construction history. If the curve is modified, the surfaces will update. You will not be modifying the curve; instead, you will take a copy so the shape can be changed without affecting the surfaces.

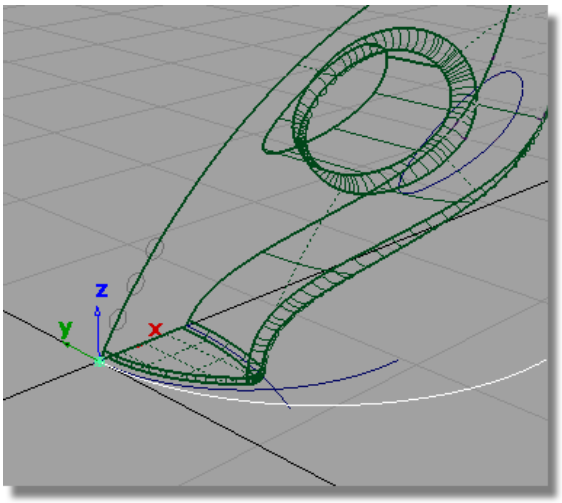


2 Choose Edit > Copy followed by Edit > Paste to create a copy of the curve.

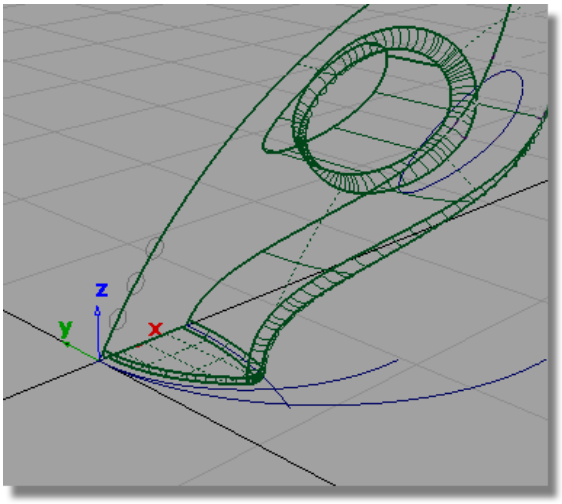


NOTE The surfaces are no longer highlighted in pink, as the new curve is a new copy with no relationship to the surfaces.

3 Choose Transform > Scale and type in `1.5` to increase the size of the curve.



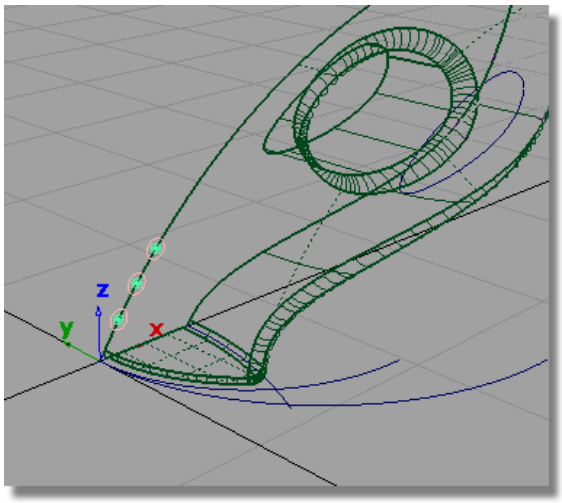
4 Choose Pick > Nothing to deselect the curve.



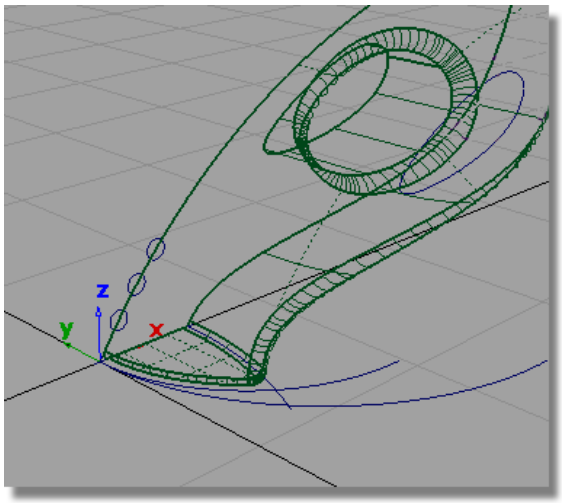
This scaled curve will be used as a path curve for the extruded surfaces.

The three gray circles at the front of the vacuum cleaner have been templated. You will now untemplate these so you can use them as the generation curves for the extrude surfaces.

5 Choose Pick > Template and drag a pick box around the three circles.



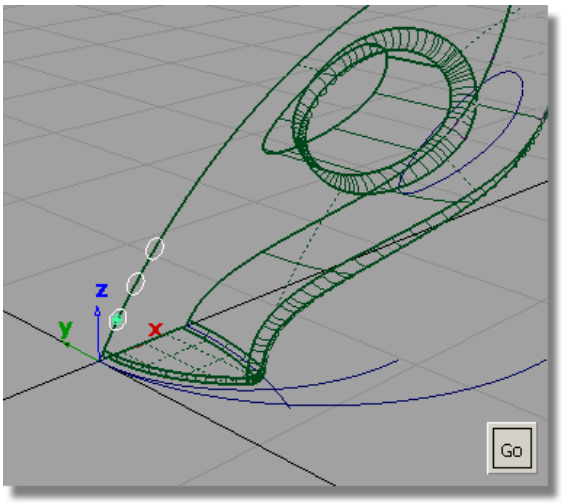
6 Choose ObjectDisplay > Template to return the curves to pickable geometry.



You will now extrude the circles along the path curve.

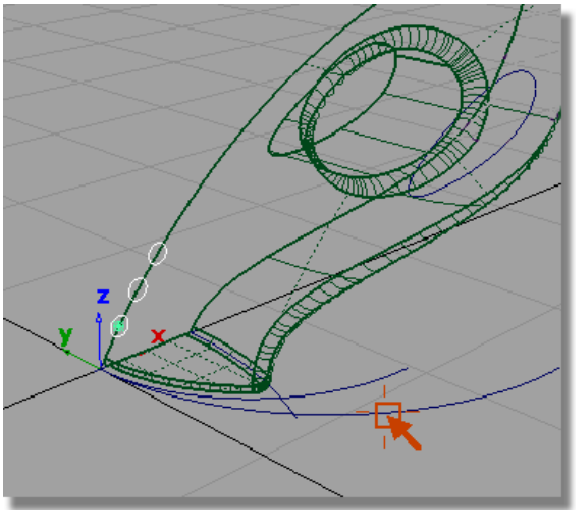
7 Choose Surfaces > Swept Surfaces > Extrude . You are prompted to select curve(s) to extrude.

8 Pick all three circles.

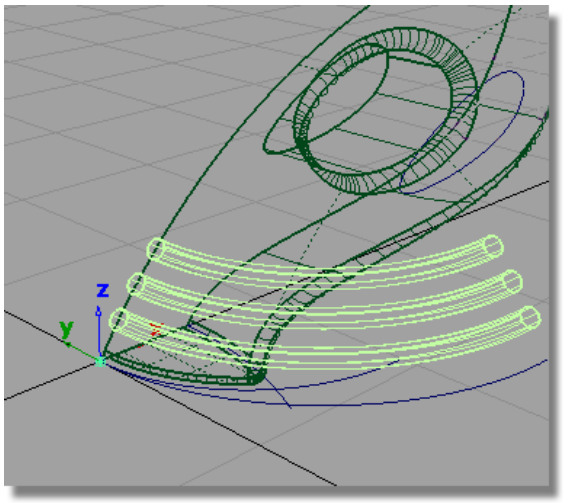


Click **Go** to select the circles for extrusion.

9 You are prompted to select the extrude path. Click the larger curve you have just scaled to select it as the path curve.



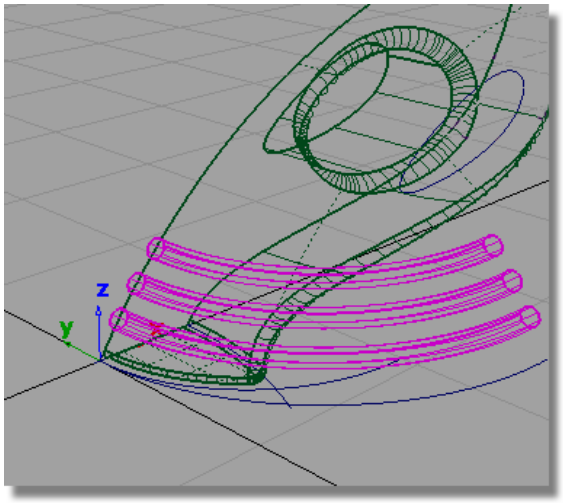
Three surfaces are created, following the shape of the upper surface.



Intersecting and Trimming the air vents

You will now intersect and trim the three extruded surfaces with the upper surface of the vacuum body.

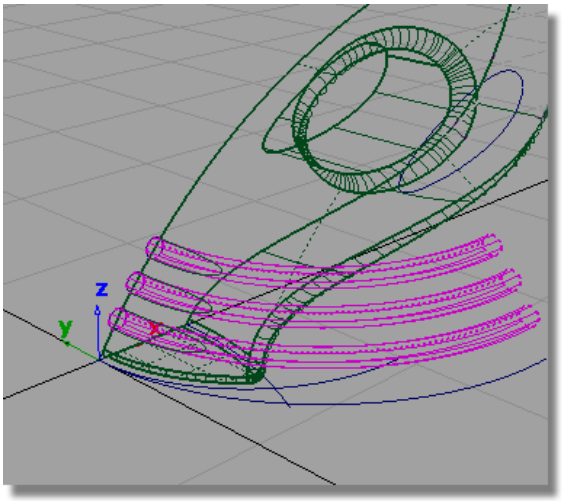
1 With the three surfaces still selected, choose Surface Edit > Create CurvesOnSurface > Intersect .



The three extruded surfaces are highlighted in pink, indicating they are selected for intersecting.

2 Because the three extruded surfaces are already selected, you are prompted to select the surface to be intersected.

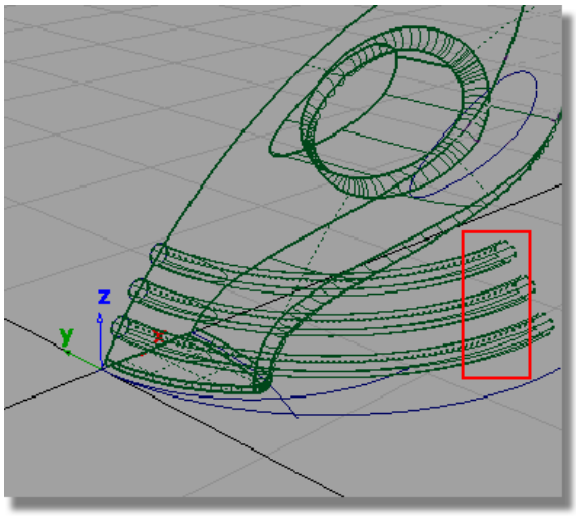
Pick the upper surface of the vacuum.



The surfaces are intersected and the curves-on-surface created.

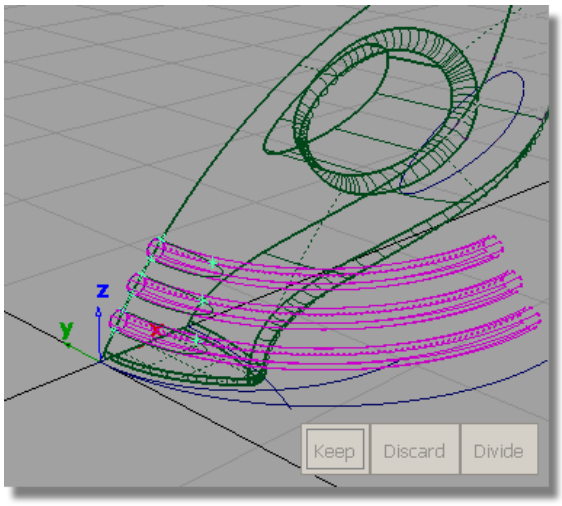
Now, you will trim the excess from the surfaces, starting with the extruded surfaces. In this trimming operation, it is easier to select the part of the surfaces you want to discard, so you will use the **Discard** option in the trim tool, instead of the **Keep** option.

3 Choose Pick > Object and drag a pick box to select the three extruded surfaces.



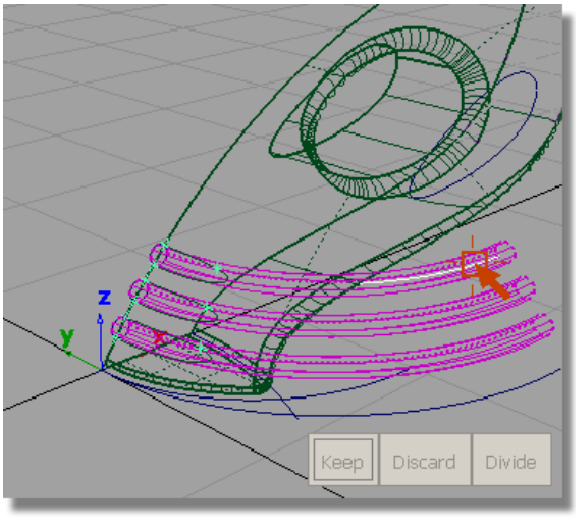
TIP If you have many surfaces to trim, you can select them all using a pick box before choosing the trim tool.

4 Choose Surface Edit > Trim > Trim Surface .

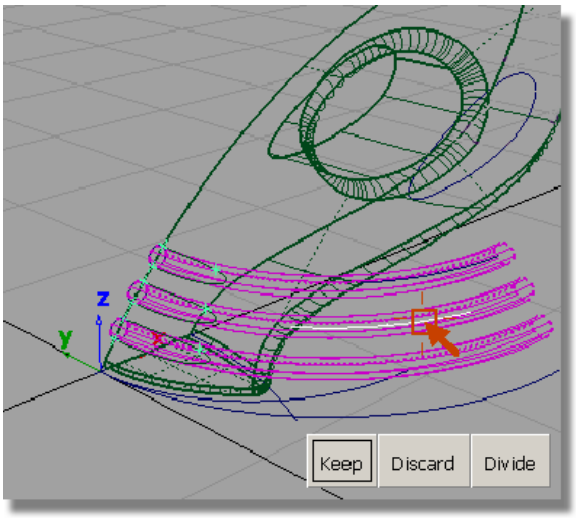


The surfaces are highlighted in pink, and you are prompted to select the regions to trim.

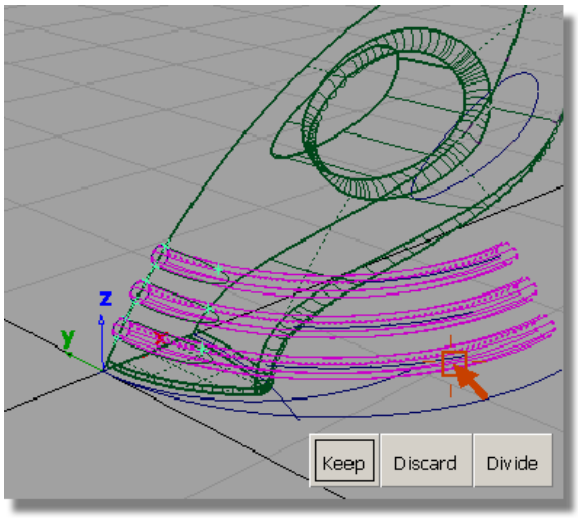
5 Click the first extruded surface, in the region to discard



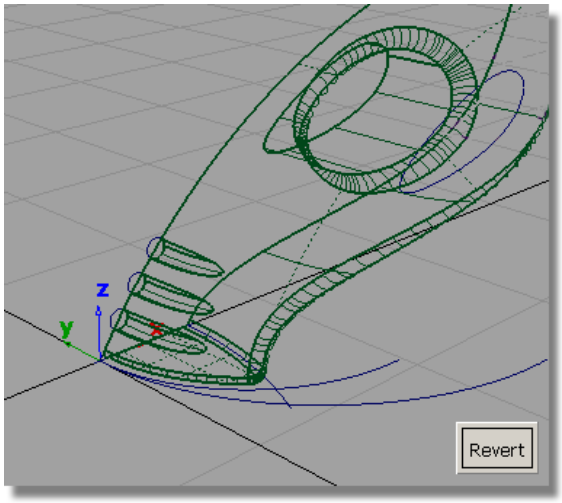
6 Pick the second extruded surface, also in the regions that need to be discarded.



7 Pick the third extruded surface, also in the regions that need to be discarded.



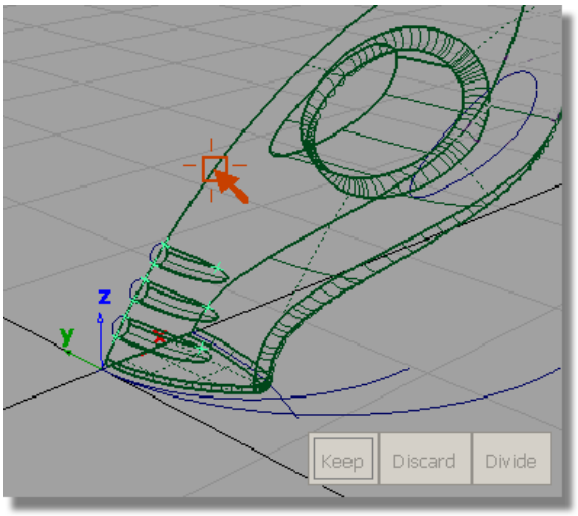
8 Click **Discard** at the lower right corner of the view.



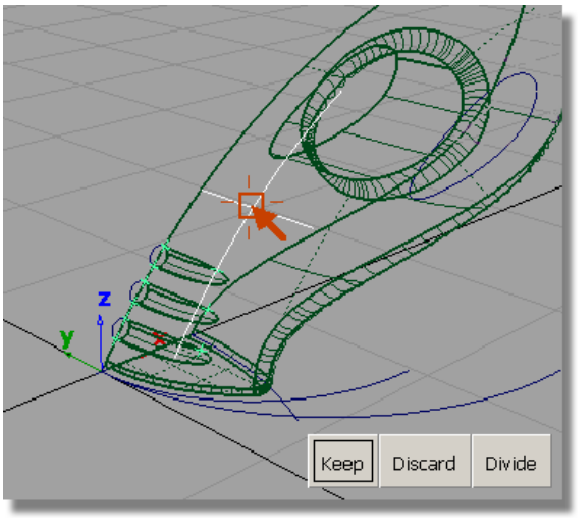
The excess surfaces are discarded.

Next, you will trim the upper surface.

9 Still in the **Trim** tool, pick on the upper surface to select it for trimming.

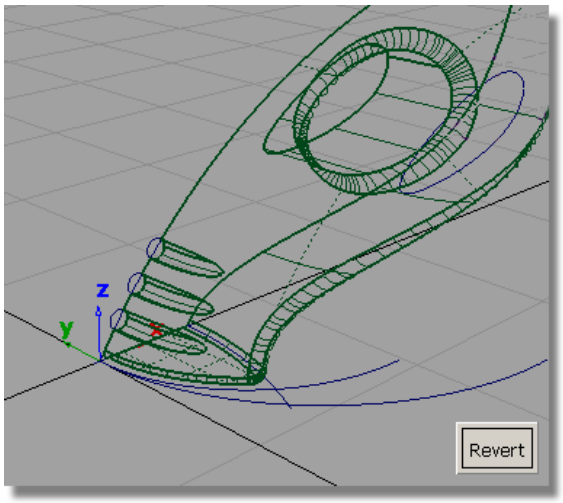


10 Click the main region of the upper surface to select it as the part of the surface to keep.



An indicator is placed where you clicked and three buttons appear in the bottom right corner of the view.

11 Click **Keep** to trim the surface.

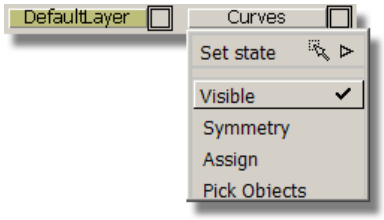


The upper surface is trimmed.

12 Choose Pick > Nothing to complete the trimming operation.

Now that you have created all the main surfaces, you will make the curves layer invisible, so the surfaces can be viewed more clearly.

13 On the **Layer Bar**, click and hold on the curves layer to view the pull-down menu. Select **Visible** to turn off the visibility of the layer.

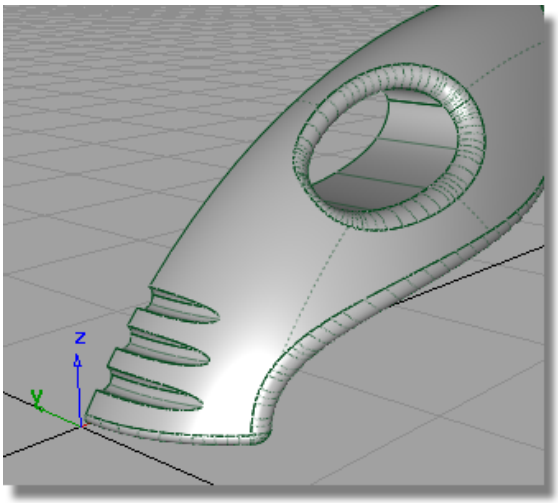


In the **Layer Bar**, the curves layer is displayed with a dotted outline to indicate it is turned off.



The curves are no longer displayed on the screen.

14 Use **diagnostic shading** to evaluate the results.



Save your work

1. Choose File > Save As to save the current scene.
2. Save your work in the `wire` directory of the `Lessons` project.
3. Name your file `myvacuum5.wire`.

Part 6: Power Button

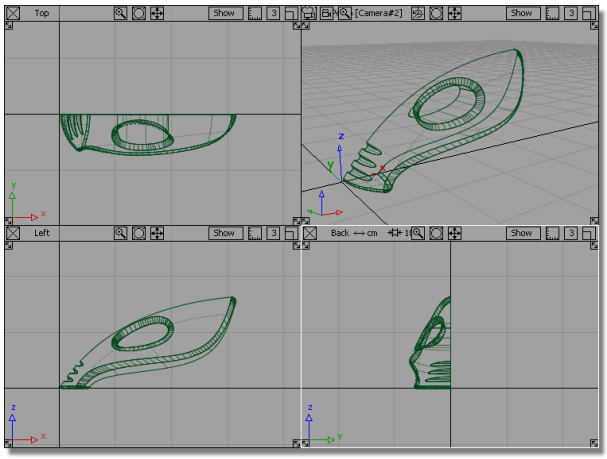
In this section, you will create the on/off button for the vacuum cleaner.

You will create the button detail in two stages. First, you will create a recess in the body surface where the button will sit. Then, you will create the button so it sits flush with the body surface.

Because one set of surfaces will fit into another, you will use layers to organize the geometry.

Opening the tutorial file (optional)

If you successfully completed Part 5, you can proceed directly to the next step, Creating a cylinder for the power button.



If you were not successful in part 5, open the file called `vacuum_part6.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 5.

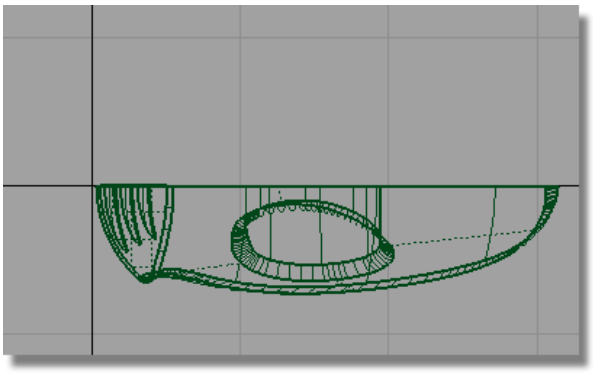


Watch **Part 6** of the tutorial.

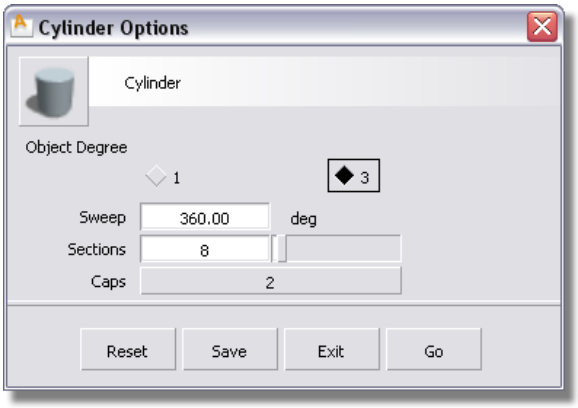
Creating a cylinder for the power button

First, you will create a cylinder surface for the outline of the power button.

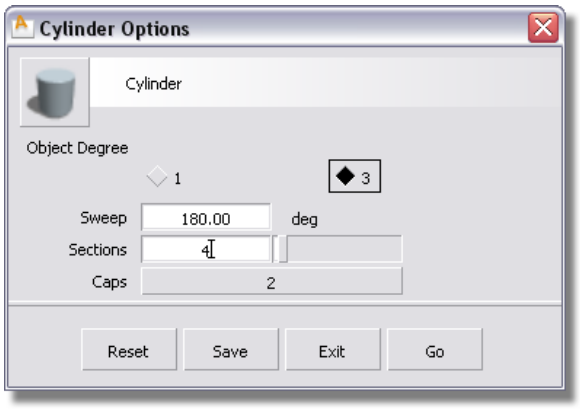
1. Return to the wireframe view using the diagnostic **Shading** in the **Control Panel**
2. Choose Layouts > Top or the **F5** hotkey to switch to the Top view.



3 Choose Surfaces > Primitives > Cylinder . Double-click the icon to open the cylinder options.

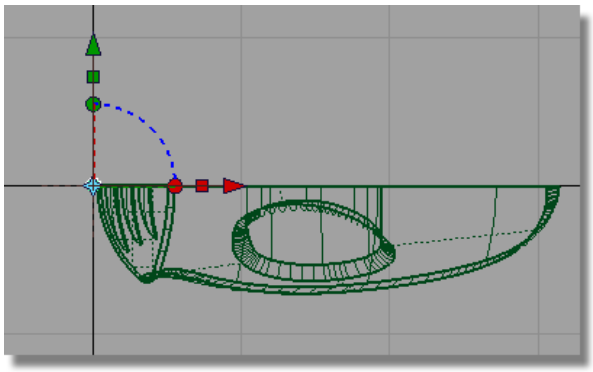


4 Set the **Sweep** to **180** and the **Sections** to **4** to create a half cylinder. Set the **Caps** to **0** from the pull-down menu, to only create the side wall of the cylinder.

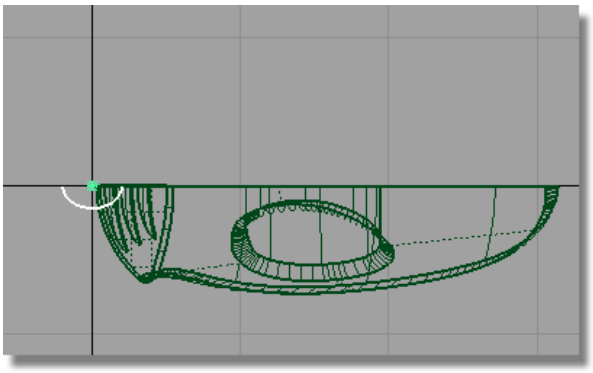


Click the **Go** button to create the half cylinder.

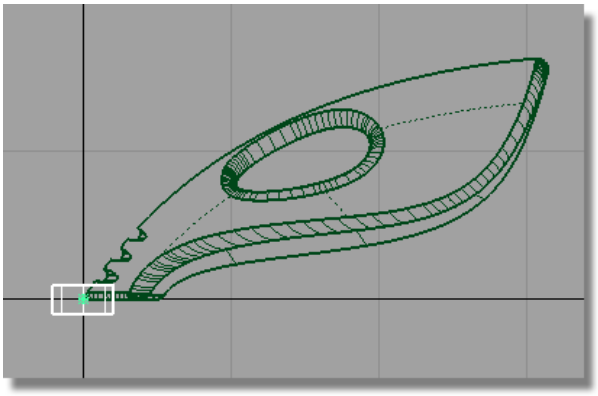
5 In the Top view, hold down the *Alt* (Windows) or *Command* (Mac) key to turn on grid snapping, and click near the origin. Snapping the cylinder on the origin ensures that it is centered.



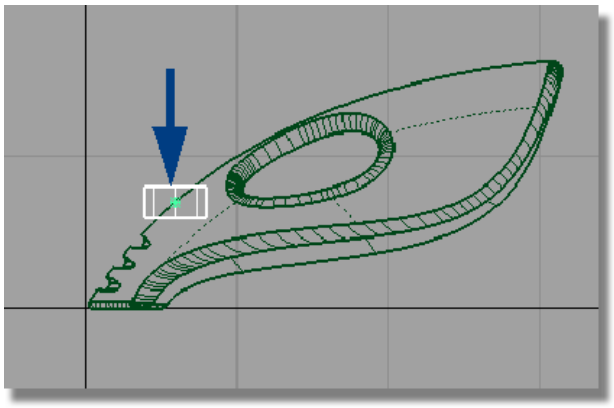
6 With the cylinder still selected, choose Transform > Non-p Scale . Type in **4,-3,2** to scale the half cylinder to an oval shape, and to invert it so it is on the right side of the grid.



7 Choose Layouts > Left to switch to the Left view.

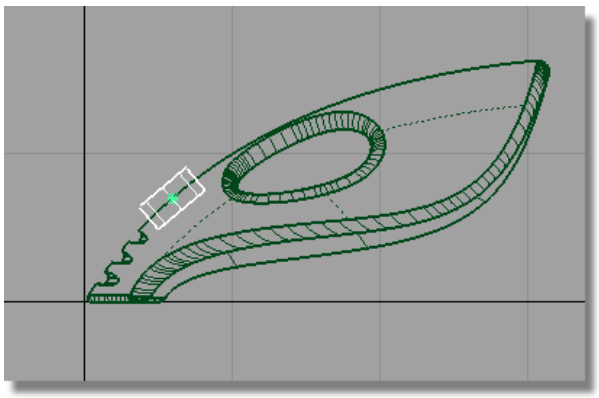


8 Choose Transform > Move . Hold down the *Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac) keys to turn on curve snapping. Point the cursor at the top edge of the upper surface and click and hold down the *left mouse button*. With the mouse button still pressed, move the cylinder until it is roughly half way between the handle and the air vents.

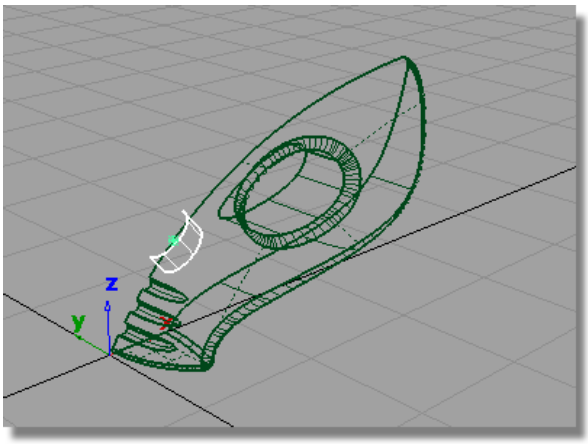


The cylinder moves along the edge.

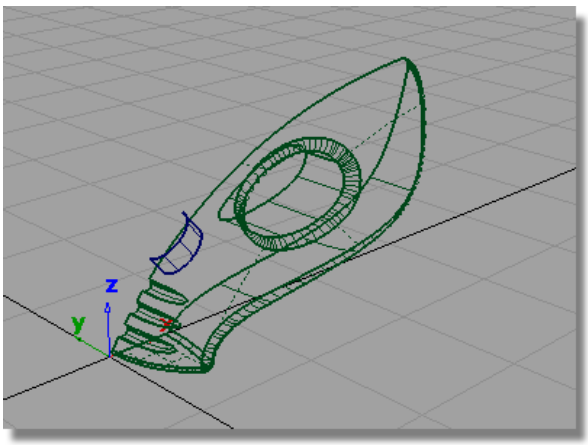
9 Choose Transform > Rotate and type in **0,-40,0** to rotate the cylinder around the y-axis. Check that the cylinder is entering the upper surface at a good angle. If you need to adjust the angle further, click and drag the middle mouse button to adjust the y-rotation.



10 Choose Layouts > Perspective , or the **F8** hotkey to return to the perspective view.



11 Choose Pick > Nothing to deselect the cylinder.



Creating two surfaces for the button and the recess

The cylinder you have just created will be used twice. First, you will use it as the sidewall of the power button, then a second copy will be used to create the sidewall of the recess in the main body.

The upper surface will also be used twice. A copy will be used to create the top of the power button. Most of the surface will be trimmed away, but the part that is left will be flush with the vacuum body.

The original upper surface will be trimmed to create the recess for the button.

To avoid confusion with these copied surfaces, you will first create layers for the body surfaces, and for the power button surfaces.

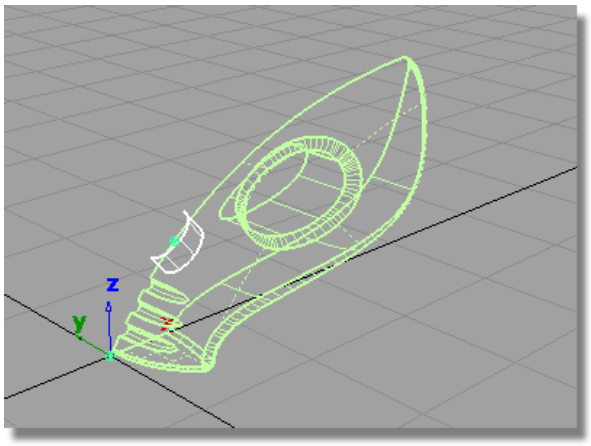
1 Choose Layers > New to create a layer.



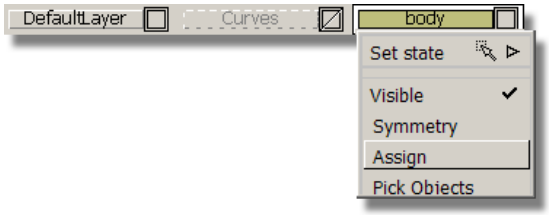
2 Rename the layer body.



3 Choose Pick > Object . Click-drag a pick box over all the geometry to select all the surfaces.



4 On the **Layer Bar**, click and hold on the body layer to see the pull-down menu. Choose **Assign** to assign all the surfaces onto the layer.



5 Choose Pick > Nothing to deselect all the surfaces.

6 Now, you will create a second layer for the power button.

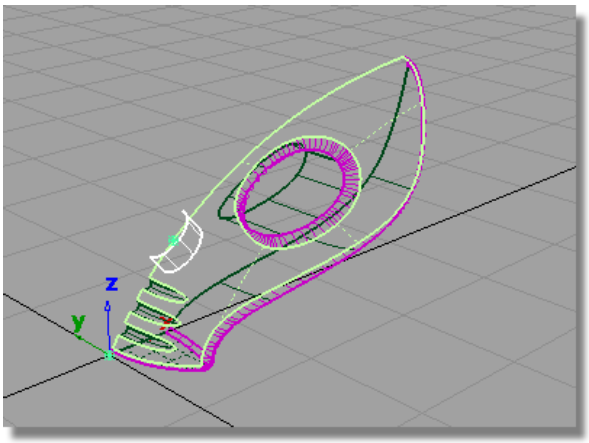
Choose Layers > New to create a layer.



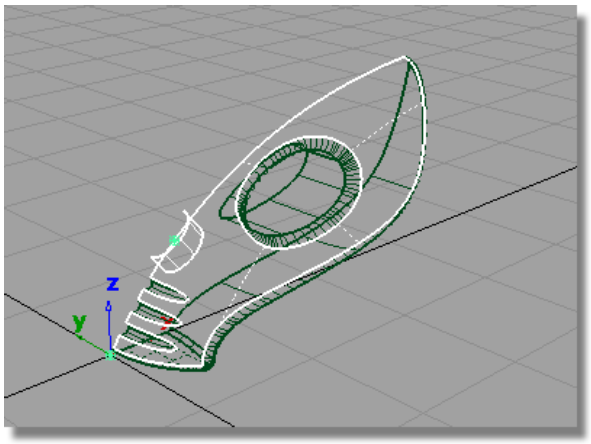
7 Rename the layer power_button.



8 Choose Pick > Object . Pick the half cylinder and the upper surface of the vacuum body.



9 Choose Edit > Copy followed by Edit > Paste . The two surfaces are copied and left selected.



10 On the **Layer Bar**, click and hold on the **power_button layer** to view the pull-down menu. Choose **Assign** to assign the two copied surfaces onto the layer.



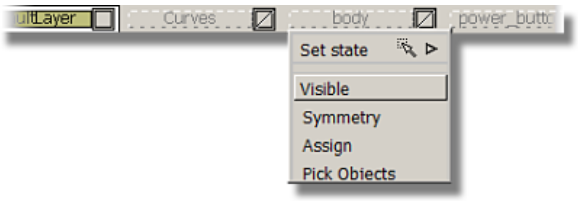
You now have two copies of the cylinder and top surface, one on the body layer, and one on the power_button layer.

11 Choose Pick > Nothing to deselect the surfaces.

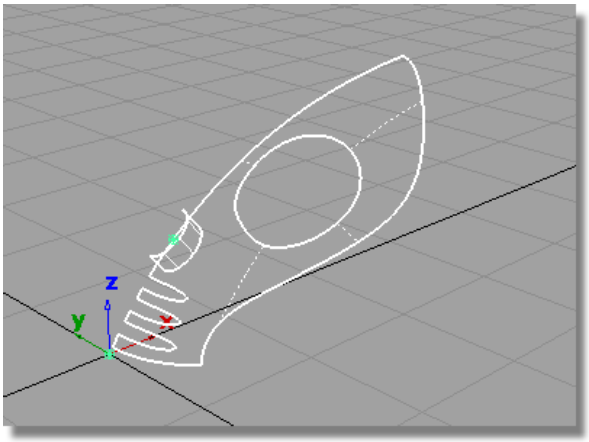
Creating the power button

Next, you will use the copied surfaces to create the power button. You will use the **Surface fillet** tool to trim and round the edge of the power button.

1 On the **Layer Bar**, click and hold **on the body** layer to see the pull-down menu. Choose **Visible** to make the body surfaces invisible.

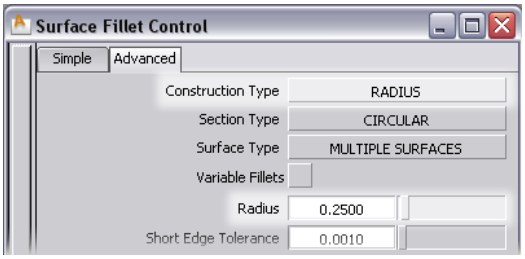


Only the two surfaces you copied are visible.



2 Choose Surfaces > Surface Fillet . Double-click the icon to open the option box.

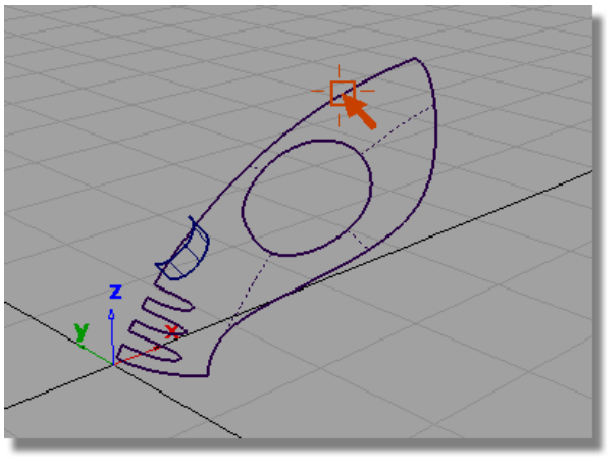
Change the settings to **Construction Type RADIUS** and **Radius 0.25**.



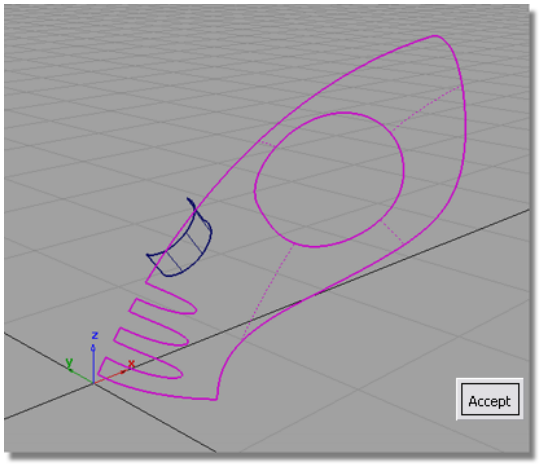
Close the **Surface Fillet** option window.

You are prompted to select the first set of surfaces.

3 Click the upper surface to select it.

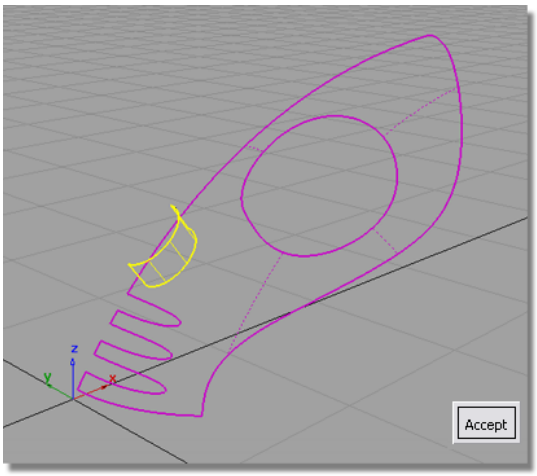


The surface is selected and highlighted in pink, and an **Accept** button appears in the bottom right corner of the view.



4 Click **Accept** to select the first surface for filleting.
You are then prompted to select the second set of surfaces.

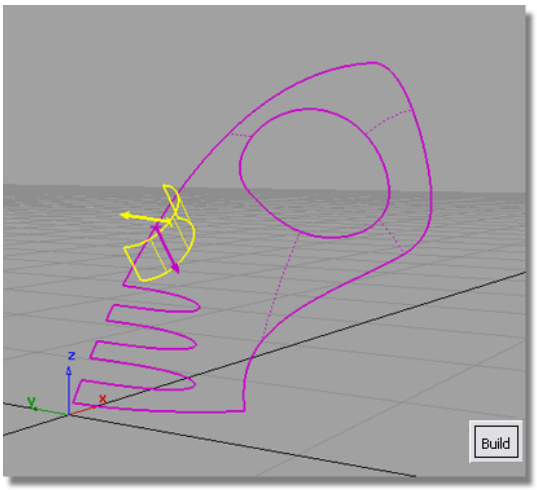
5 Click the half cylinder surface to select it.



The surface is selected and highlighted in yellow, and an **Accept** button appears in the bottom right corner of the view.

6 Click **Accept** to select the second surface for filleting.

Arrows appear on both surfaces, indicating on which side of the surfaces the fillet will be built.

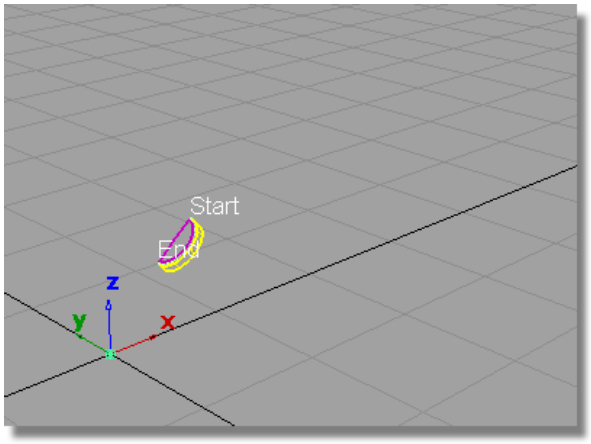


The pink arrow needs to point in towards the inside of the vacuum surfaces. If it is pointing out from the surfaces, click the arrow to reverse it.

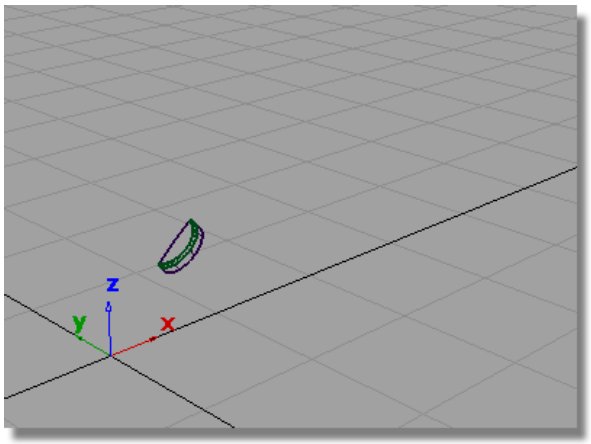
The yellow arrow needs to point inwards on the cylinder surface. If it is pointing outwards, click the arrow to reverse it.

7 Click **Build**.

The fillet surface is created, and the upper and cylinder surfaces are trimmed to create the power button.



8 Choose Pick > Nothing to deselect all the surfaces.



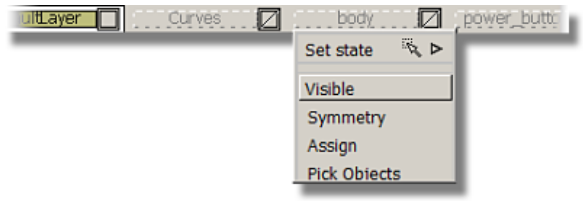
Creating the power button hole

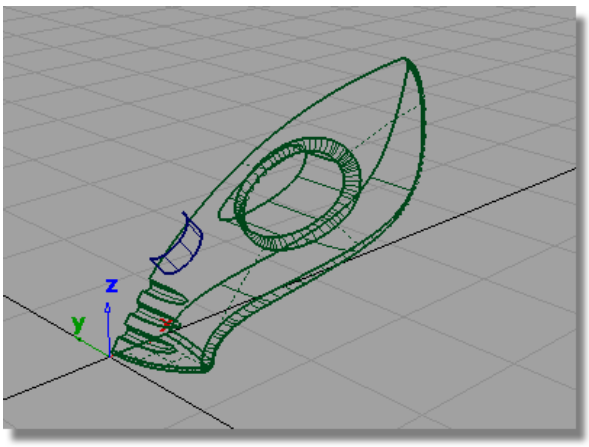
Next, you will use the **Surface Fillet** tool to trim and round the edge of the power button recess.

1 On the **Layer Bar**, click and hold on the **power_button** layer to see the pull-down menu. Choose **Visible** to make the power_button surfaces invisible.



2 Make the body layer visible by choosing **Visible** from the pull-down menu.





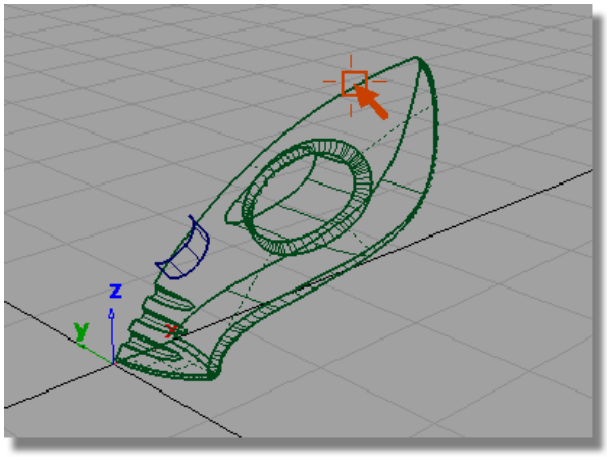
3 Make the body active by clicking the layer tab to make it yellow. This means all new surfaces will be assigned to this layer.



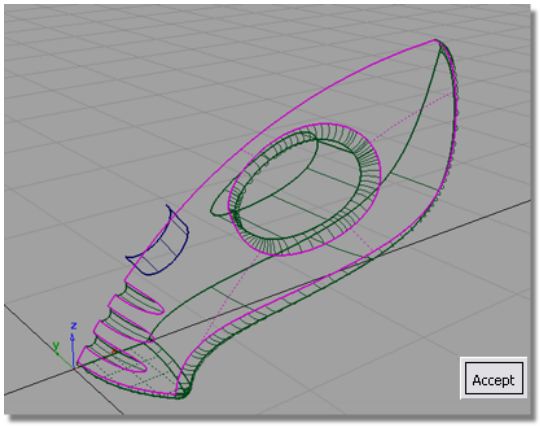
4 Choose Surfaces > Surface Fillet . The settings you used before are used for this fillet surface, and so you don't need to open the option box.

You are prompted to select the first set of surfaces.

5 Click the upper surface to select it.



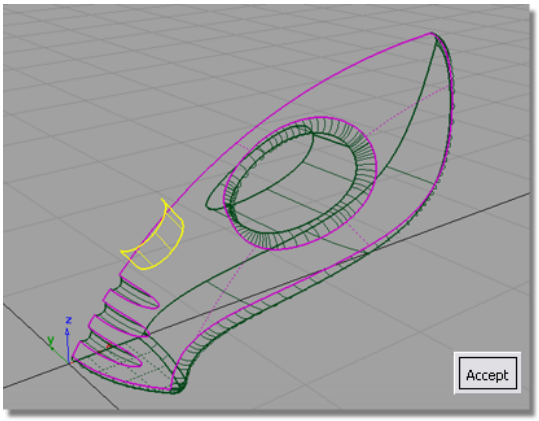
The surface is selected and highlighted in pink, and an **Accept** button appears in the bottom right corner of the view.



6 Click **Accept** to select the first surface for filleting.

You are prompted to select the second set of surfaces.

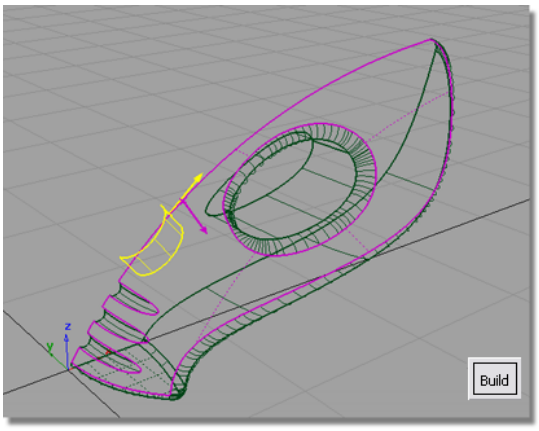
7 Click the cylinder surface to select it.



The surface is selected and highlighted in yellow, and an **Accept** button appears in the bottom right corner of the view.

8 Click **Accept** to select the second surface for filleting.

Arrows appear on both surfaces, indicating on which side of the surfaces the fillet will be built.

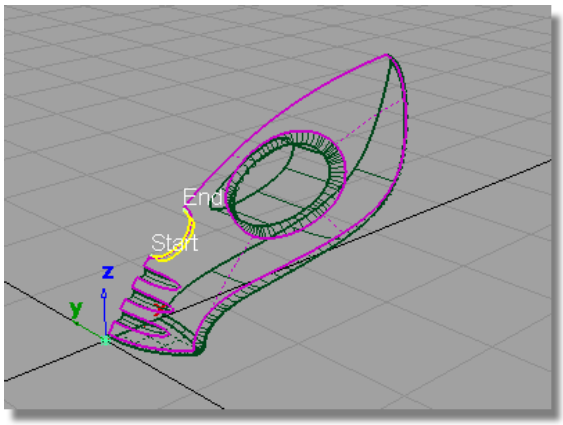


The pink arrow needs to point in towards the inside of the vacuum surfaces. If it is pointing out from the surfaces, click the arrow to reverse it.

For the recess, the fillet needs to be created on the other side of the cylinder, so the yellow arrow needs to point outwards on the cylinder surface. If it is pointing inwards, click the arrow to reverse it.

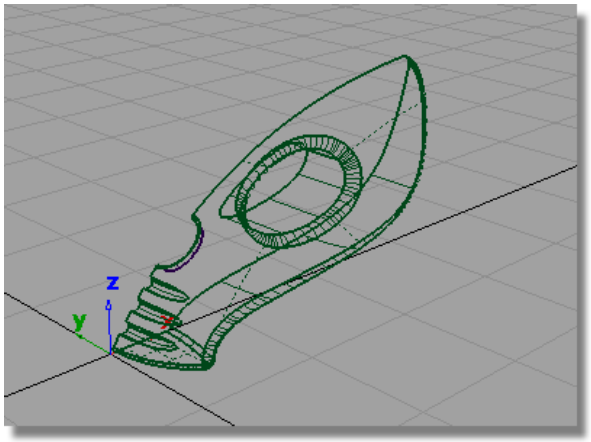
9 Click **Build**.

The fillet surface is created, and the upper and cylinder surfaces are trimmed to create a recess for the power button.

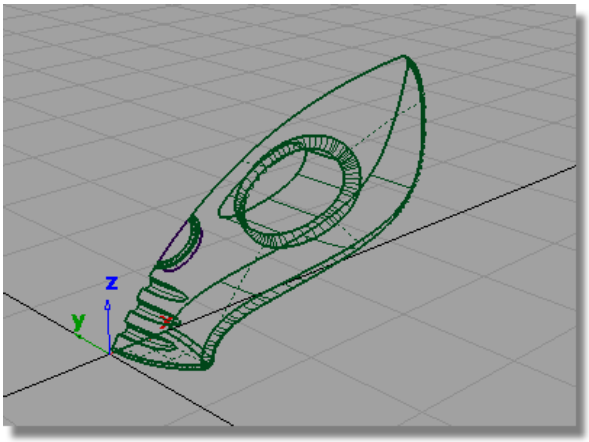


NOTE Because you changed the direction of the yellow arrow for this second fillet, the result is different from the filleting of the power button.

10 Choose Pick > Nothing to deselect the fillet surface.



11 Make the power_button layer visible by choosing **Visible** from the pull-down menu.



You have now completed the main vacuum cleaner body surfaces.

Save your work

1 Choose File > Save As to save the current scene.

2 Save your work in the `wire` directory of the `Lessons` project.

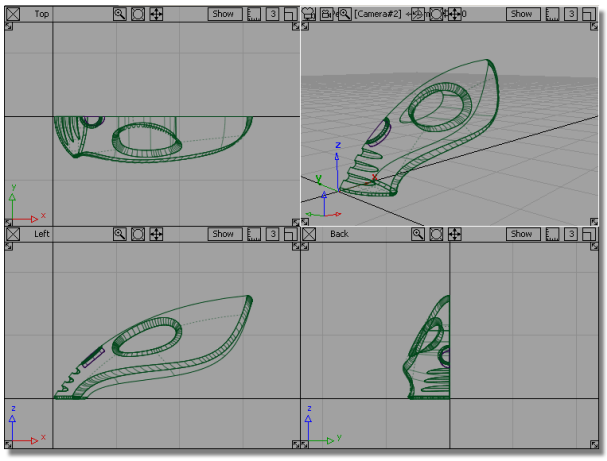
3 Name your file `myvacuum6.wire`.

Part 7: Dust Bag and Cable Connector

In this section, you will create the dust bag and cable connector surfaces at the rear of the vacuum cleaner.

Opening the tutorial file (optional)

If you successfully completed Part 6, you can proceed directly to the next step, Extracting the body shape.



If you were not successful in part 6, open the file called `vacuum_part7.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 6.



Watch **Part 7** of the tutorial.

Extracting the body shape

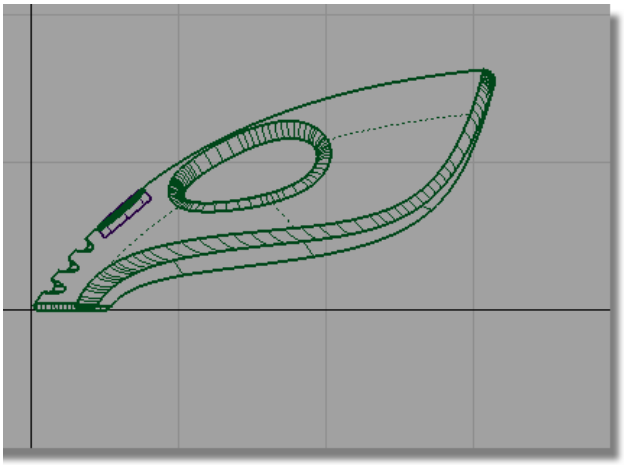
At the back end of the vacuum cleaner there are two additional components, a dust bag and a cable connector, shown on the sketch below.



You will create these components as scaled copies of the rear surfaces of the main vacuum cleaner body. By using the same shape, you will create a rhythm of similar shapes, which gives the design its character.

You will start by creating copies of the body surfaces and placing them onto a new layer.

1 Choose Layouts > Left to maximize the Left window.



2 Choose Layers > New to create a layer.

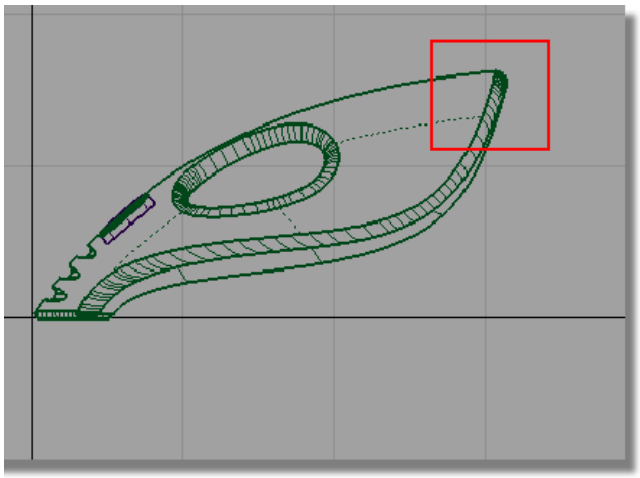


3 In the **Layer Bar**, rename the new layer dustbag.

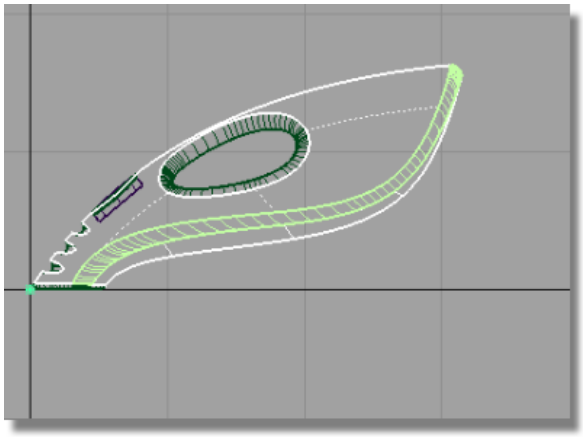


Now, you will make a copy of the surfaces and assign them to the dustbag layer.

4 Choose Pick > Object and drag a pick box around the end surfaces of the vacuum body. Make sure you don't select the handle or handle fillet surfaces.



5 Choose Edit > Copy followed by Edit > Paste . A copy of the surfaces is made, placed on top of the originals, and highlighted.

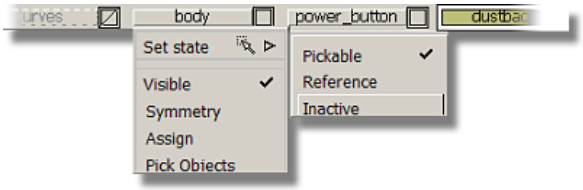


6 In the **Layer Bar**, click and hold on the dustbag layer to see the pull-down menu. Choose **Assign** to assign the copied surfaces to the dustbag layer.



7 Choose Pick > Nothing to deselect the surfaces.

8 On the **Layer Bar**, click and hold on the body layer and choose **Set state > Inactive** to make the body surfaces inactive.

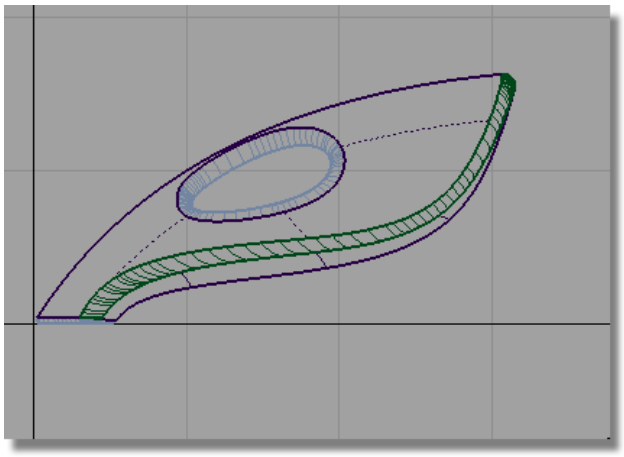


The layer tab is displayed in pale blue to indicate that it is inactive.



9 Do the same for the power_button layer to make the power button surfaces inactive.

Now, only the copied surfaces on the dustbag layer are displayed and pickable.



Trimming the dust bag surfaces

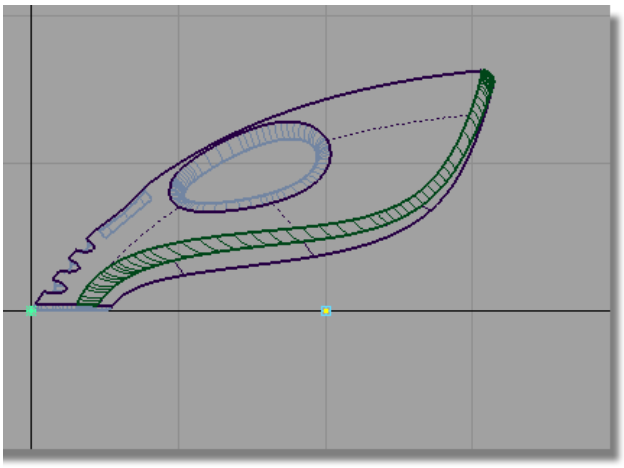
Only the ends of the body surfaces are required for the dust bag and cable connector.

Next, you will trim the surfaces so only the rear part of the shape is left. This will make the surfaces easier to work with and easier to visualize.

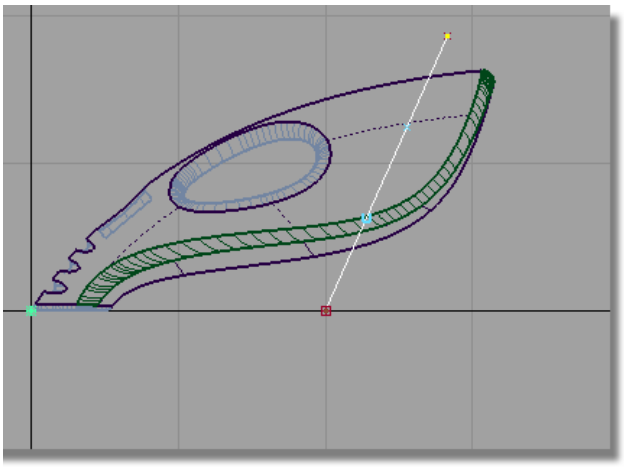
You will trim the surfaces by using a curve to define the cutting line.

1 Choose Curves > New Curves > New Edit Point Curve.

You are prompted to enter the new edit point position. Hold down the *Alt* (Windows) or *Command* (Mac) key and click near the grid intersection shown below to position the first edit point of the curve.

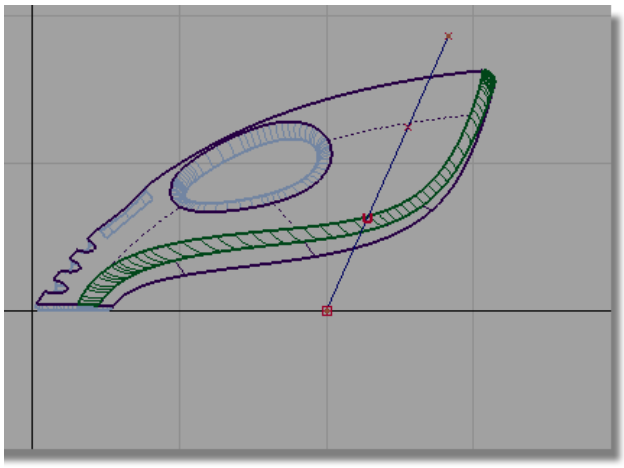


Place the second edit point by clicking and holding the *left mouse button*. Keep the mouse button held down and move the edit point until the curve is roughly at the same angle as the back of the vacuum.



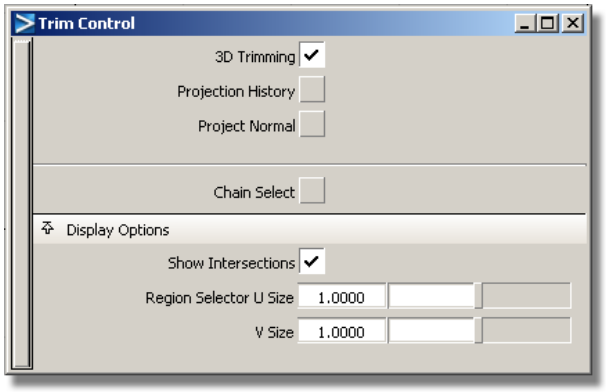
Make sure your curve is long enough to extend beyond the body surfaces.

2 Choose Pick > Nothing to deselect the curve.

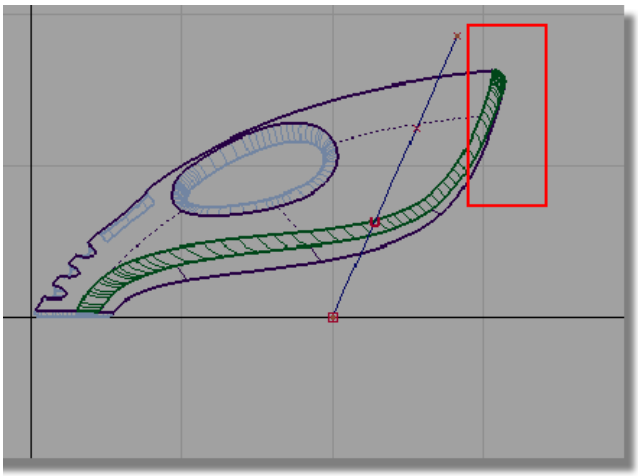


The **Trim** tool can be used to create a curve-on-surface directly from a projected curve before trimming the surface. You will now use the curve you have just drawn to cut away the front end of the surfaces.

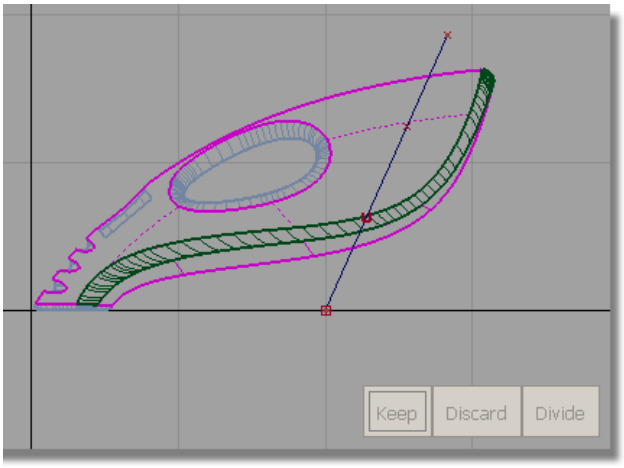
3 Choose Surface Edit > Trim > Trim Surface and double-click the icon to open the option box. Click the **3D Trimming** check box to turn on the projection option in the trim tool.



4 You are prompted to select the surfaces to trim. Click and drag a pick box around all the surfaces.



The surfaces are selected and highlighted in pink.

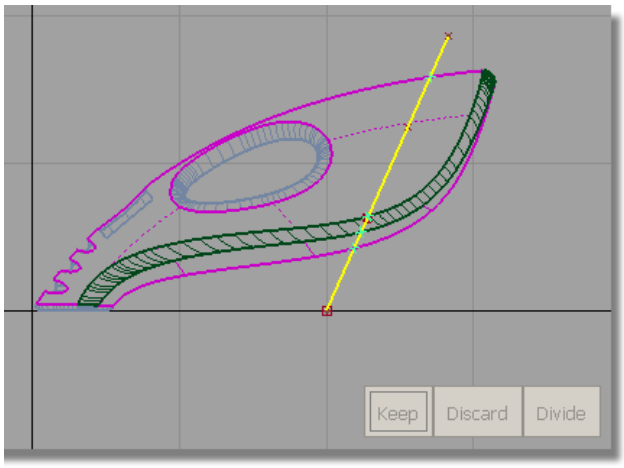


You are then prompted to select one of the following:

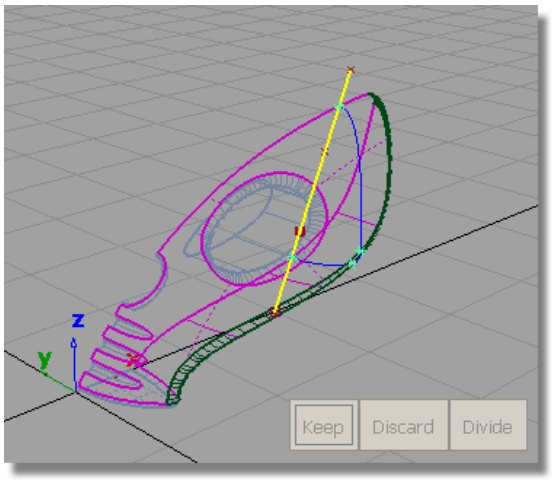
```
Shift select to select additional surfaces or Select curves to
PROJECT or click to select REGIONS.
```

This time, you will use the **Trim** tool to project the curve onto the surfaces, and so you will respond to the second prompt.

5 Click the curve you just created to select it as a curve to project.



6 To see the effect of the projection, press the **F8** hotkey to switch to the perspective view.

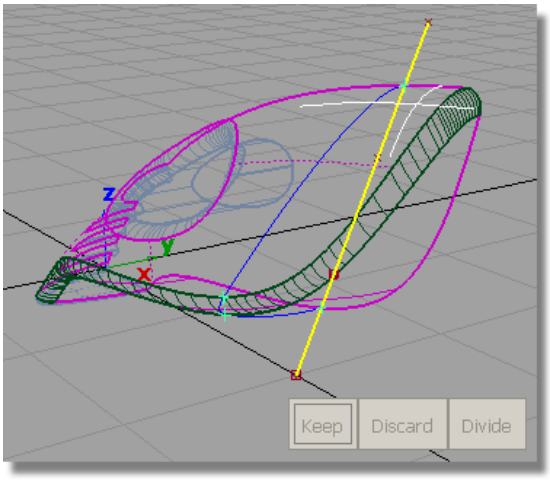


You can see that a curve-on-surface has been created across the surfaces and is shown in bright blue.

Still in the trim tool, you are now prompted with the three options. This time you want to select a REGION of each surface to keep.

7 Zoom and tumble the view to get a close-up view of the rear of the vacuum.

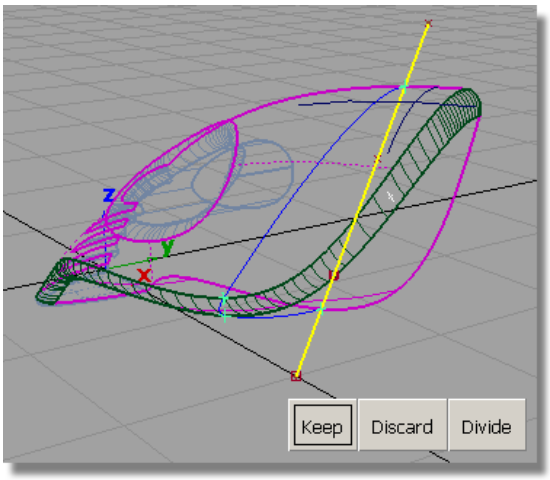
8 Click in the rear part of the upper surface to select it as the part to keep.



An indicator appears on the surface to show it is selected for trimming.

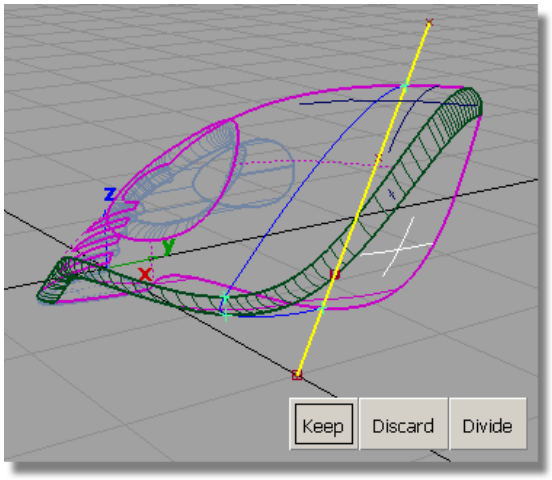
9 Click the rear part of the fillet. Avoid clicking any of the lines on the fillet surface, as these will be mistaken for projection lines.

TIP Zoom in to make it easier to select a part of the fillet surface with no lines.



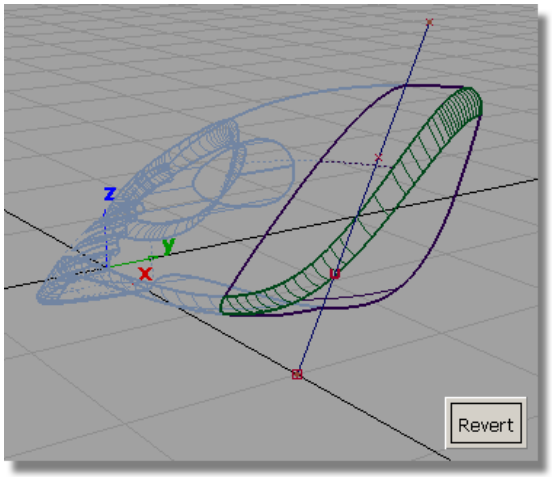
An indicator appears on the surface to show that it is selected for trimming.

10 Click the rear part of the lower surface.



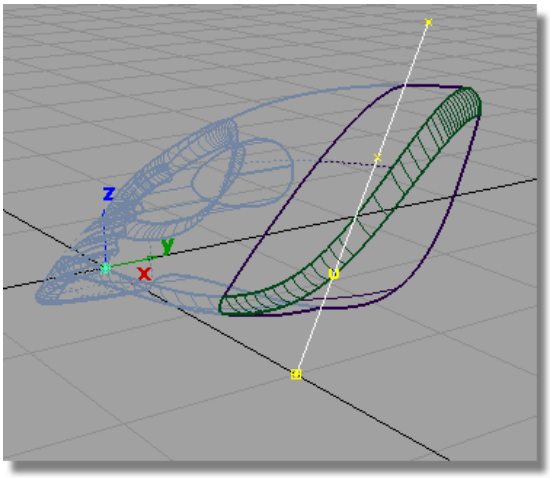
An indicator appears on the surface to show that it is selected for trimming.

11 Click **Keep** in the bottom right corner of the view to keep the ends of the surfaces.

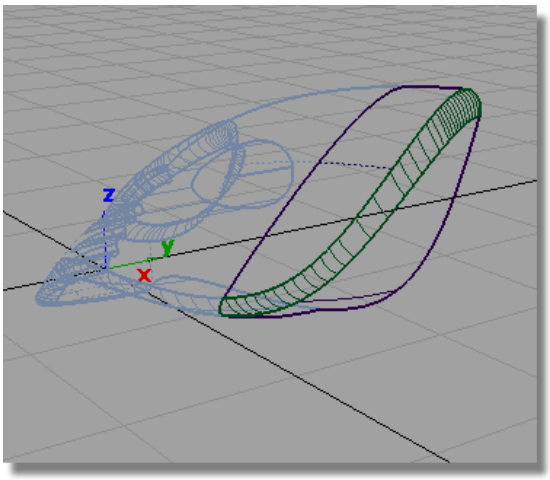


The surfaces are trimmed.

12 Choose Pick > Object and select the curve.



13 Choose Delete > Delete Active , or press the *Delete* key on the keyboard to delete the curve.



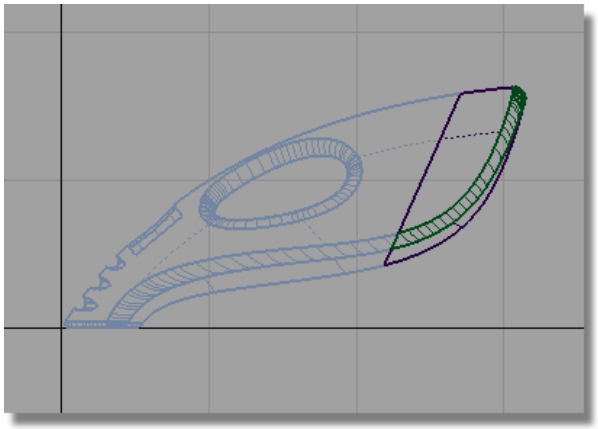
You have trimmed out a part of the vacuum design that can now be used to create the dust bag and cable connector.

NOTE The original body surfaces are unchanged, and are shown on the invisible (pale blue) layer.

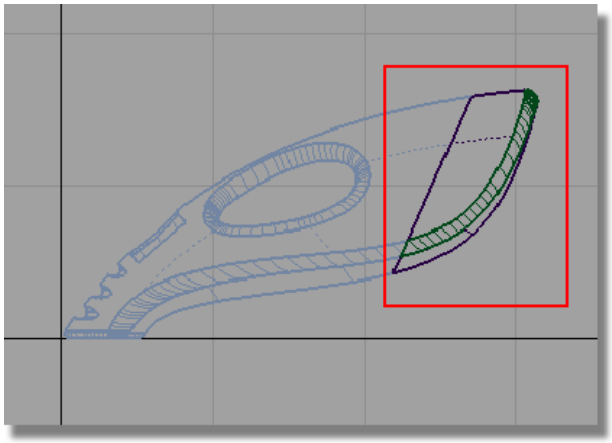
Scaling the dust bag and connector

Next, you will group the surfaces together so that they can be scaled and positioned to complete the design of the dustbag.

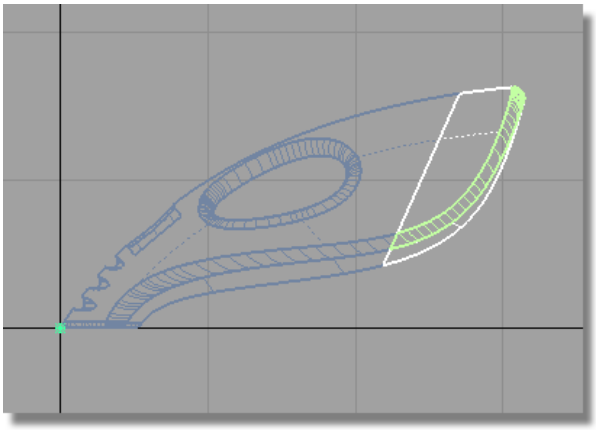
1 Choose Layouts > Left to switch to the Left view.



2 Choose Pick > Object and drag a pick box around all the surfaces.

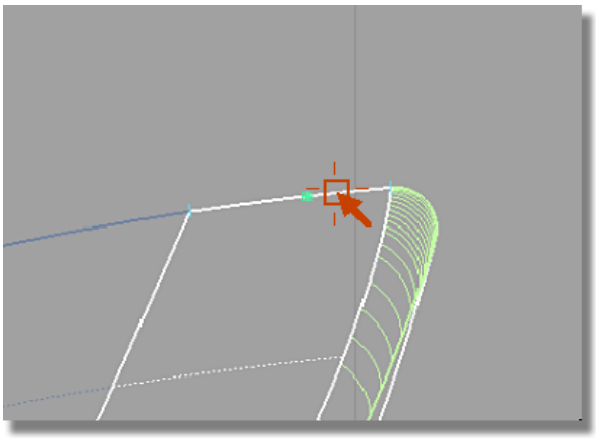


3 Choose Edit > Group . The surfaces are now grouped with a single pivot point, placed at the origin.

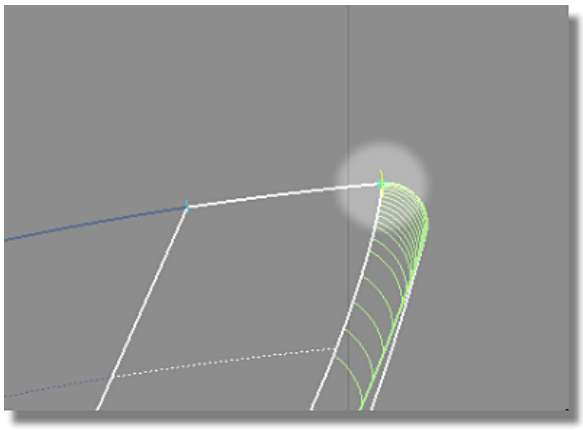


Next, you will move the pivot point to the end of the surfaces using curve snapping. The pivot point will be used to control the scaling of the surfaces.

4 With the group still selected, choose Transform > Local > Set Pivot . Hold down the *Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac) keys to turn on curve snapping. Point the cursor exactly on the top edge of the upper surface. (You may need to zoom in to view the area in more detail.)

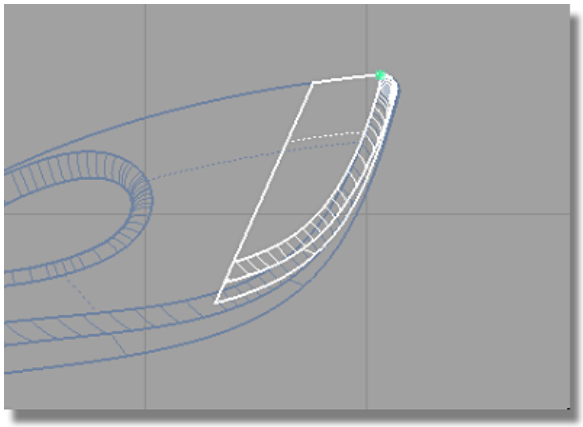


Click and hold the *left mouse button* and drag it to the pale blue cross at the right end of the surface to position the pivot point.



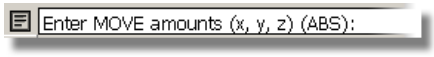
The pivot point jumps to the end of the surface edge.

5 Choose Transform > Scale and type in a value of **0.85** to shrink the surfaces. A dialog box appears asking whether you want to delete the construction history for the surfaces. Click **Yes**.



The surfaces are scaled smaller to form the dustbag.

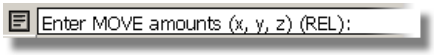
6 Choose Transform > Move . You are prompted to enter the move amounts.



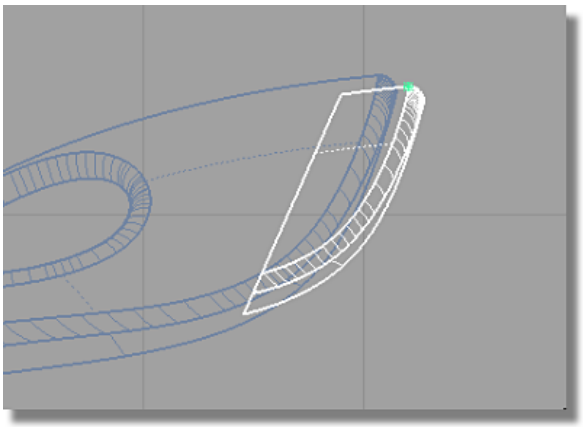
The prompt line displays (ABS) to indicate absolute mode. In absolute mode, coordinates that are typed in will be measured from the origin.

As the dustbag only needs to be moved slightly from its current position, you will switch to relative dimensioning, so the coordinate values will move the surfaces relative to their current position.

7 Type **r** and press *Enter* (Windows) or *Return* (Mac).



8 Type **1.25,0,-0.5** and press *Enter* (Windows) or *Return* (Mac) to move the dust bag 1.25 cm in x and -0.5 cm in z.



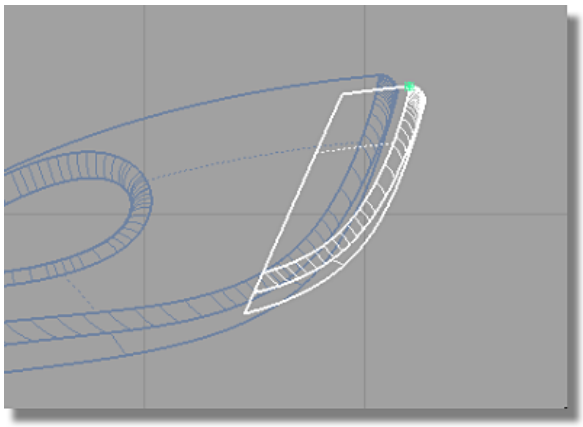
NOTE The x,y,z values can be typed in with either a space or a comma separating the numbers.

The dustbag is now in position.

Creating the cable connector

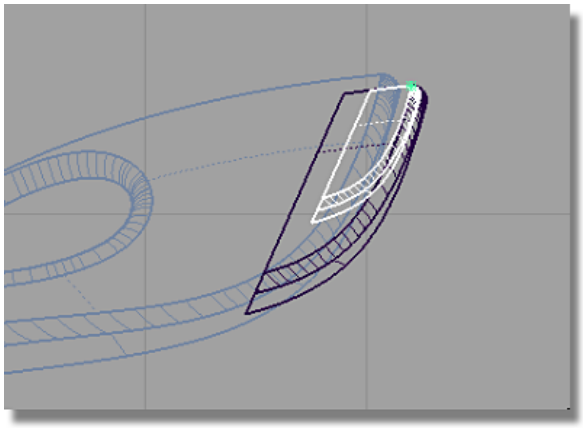
The cable connector component is created in the same way.

1 With the dustbag still selected, choose Edit > Copy followed by Edit > Paste .

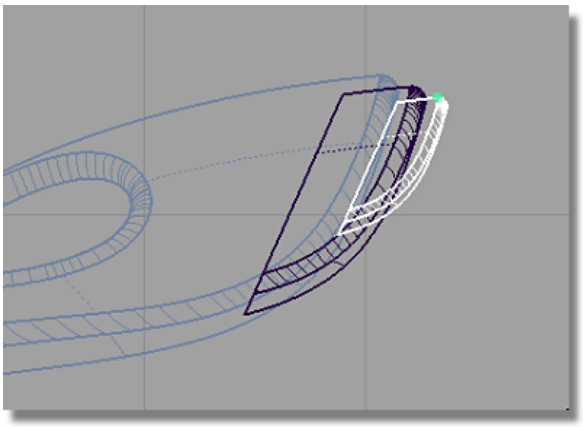


A copy of the dustbag is created and is selected, ready to transform.

2 Choose Transform > Scale . Type in **0.6** to reduce the size of the group of surfaces.

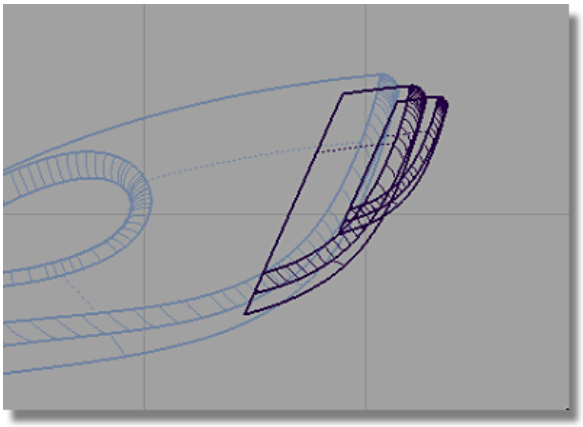


3 Choose Transform > Move . Type in , and press *Enter* (Windows) or *Return* (Mac) to move the cable connector 1.25 cm in x and -0.5 cm in z.

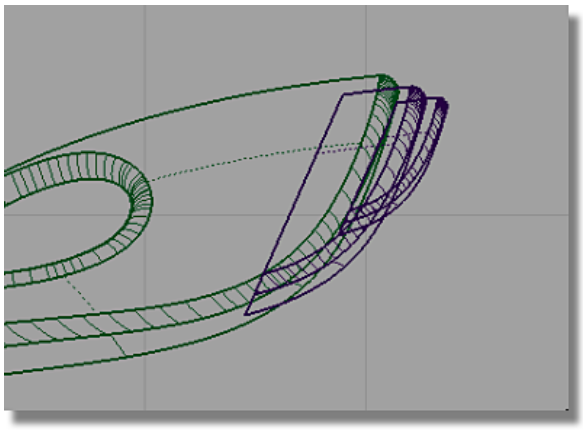


NOTE You can move the surfaces freely using the mouse buttons if you want to adjust the design.

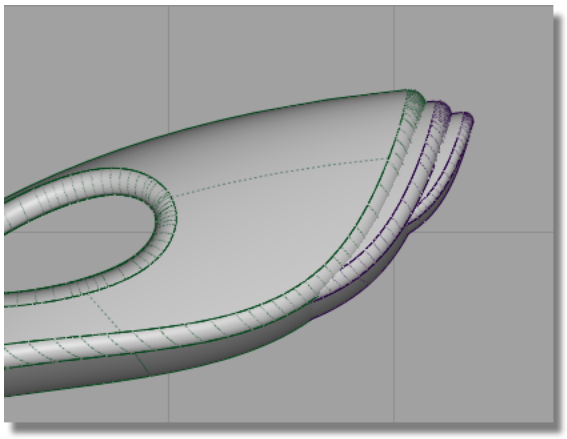
4 Choose Pick > Nothing to deselect the surfaces.



5 On the **Layer Bar**, click and hold on the body layer to see the pull-down menu. Choose S**et state > Pickable** to view the main body. Do the same for the power_button layer.



6 Use diagnostic **Shading** to view the completed dustbag design.



For a concept design, it is typical for changes to be made regularly to the model. During this phase, it is acceptable to leave the dust bag and connector surfaces overlapping with the main body shape. This allows you to quickly experiment with scaling and moving the components to explore the design.

When the design is resolved, you would trim away the parts of the surfaces that are intersecting the body, to create a continuous outer surface. This is covered in Part 8, an optional extra stage in this tutorial.

Save your work

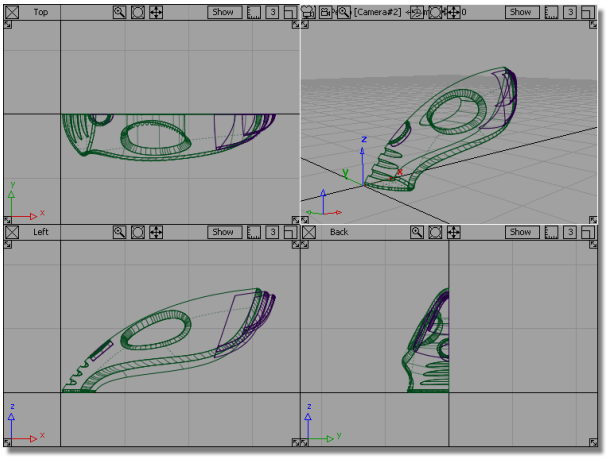
1. Choose File > Save As to save the current scene.
2. Save your work in the `wire` directory of the `Lessons` project.
3. Name your file `myvacuum7.wire`.

Part 8: Completing the Model

In this section, you will complete the model by mirroring the surfaces. You also have the option of creating the power cable to finish off the presentation of the design.

Opening the tutorial file (optional)

If you successfully completed Part 7, you can proceed directly to the next step, Mirroring the surfaces.



If you were not successful in part 7, open the file called `vacuum_part8.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 7.

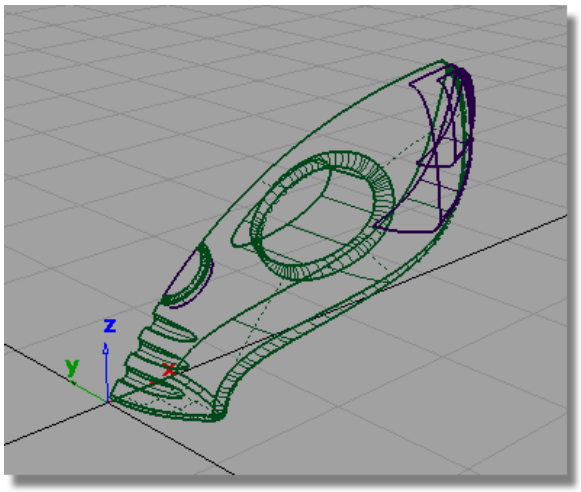


Watch **Part 8** of the tutorial.

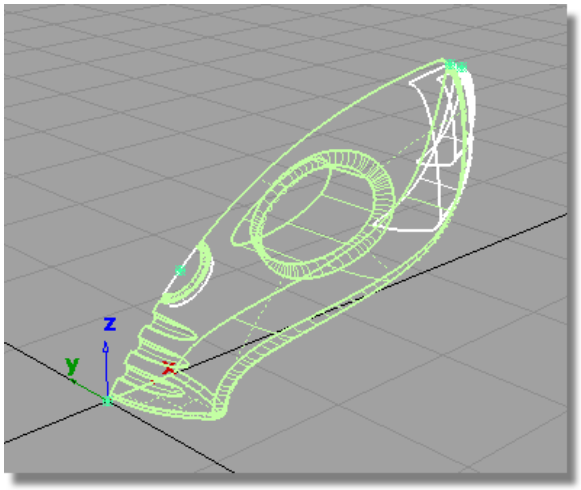
Mirroring the surfaces

Finally, you will mirror all the surfaces to create the final design.

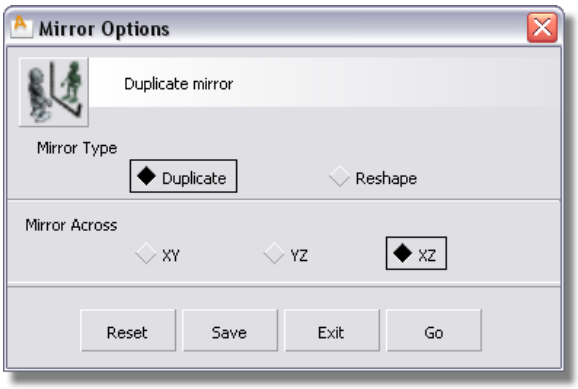
1 Choose Layouts > Left or the **F8** hotkey to switch to the perspective view.



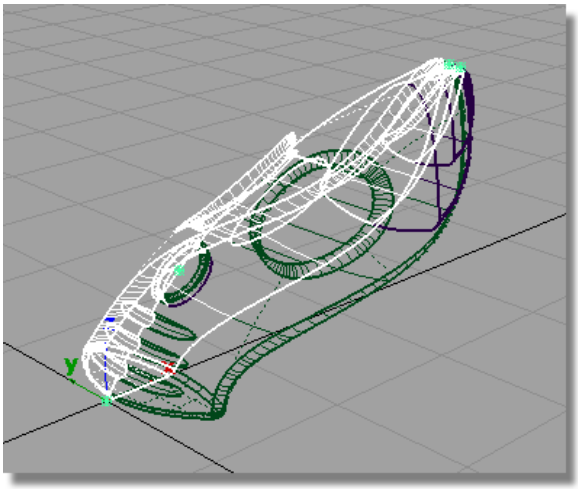
2 Choose Pick > Object and drag a pick box around all of the surfaces to select them.



3 Choose Edit > Duplicate > Mirror ❒ to open the mirror tool option box.

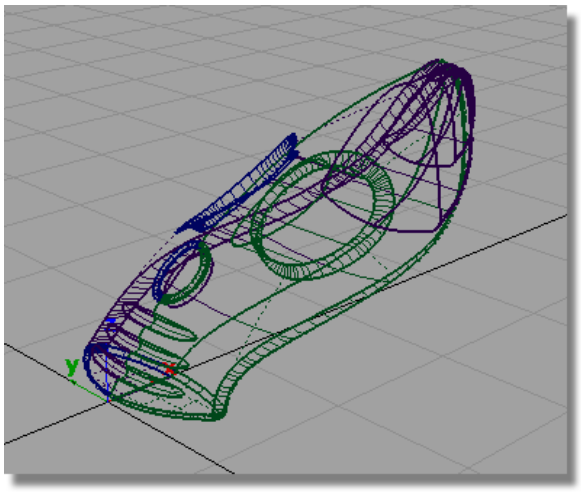


4 Choose **XZ** as the **Mirror Across** plane, and click **Go**.

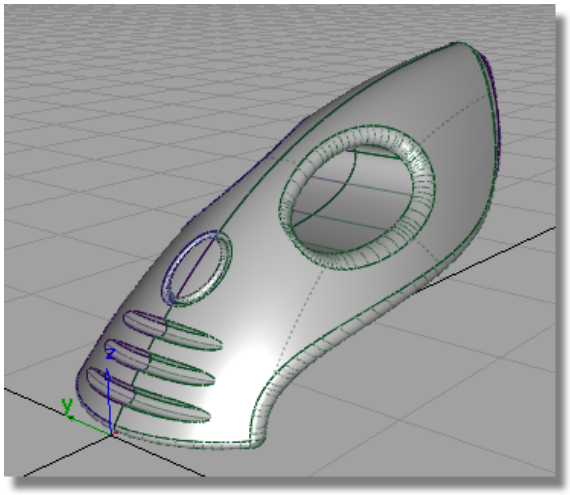


The vacuum cleaner surfaces are mirrored, and the whole design can now be viewed.

5 Choose Pick > Nothing to deselect the mirrored surfaces.

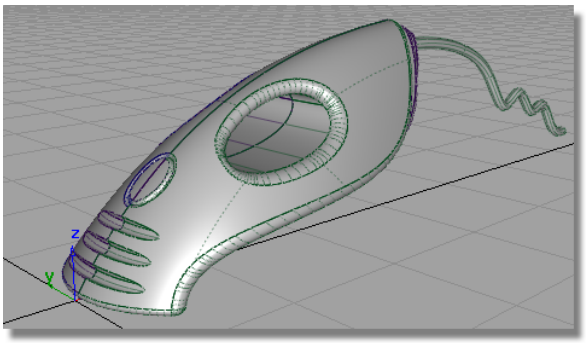


6 Use **diagnostic shading** to view the completed model.



Optional: Create the power cable

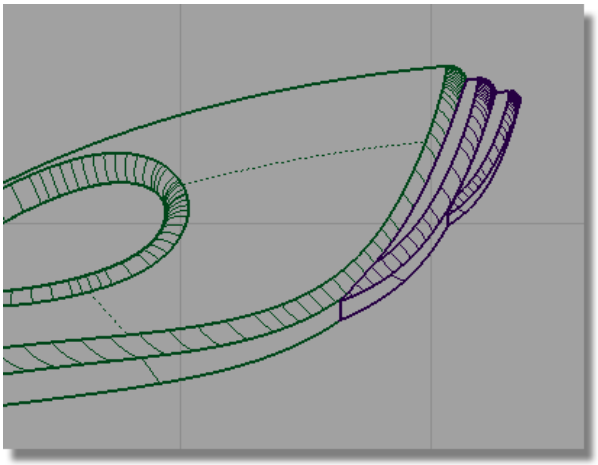
If you have time, you can create the power cable using an extruded surface, as you did in the joystick tutorial. The curves are supplied as templates on the curves layer of the tutorial file.



Optional: Trimming the dust bag and connector

If you are feeling confident using the intersecting and trimming tools, you may want to tidy up the rear of the vacuum cleaner by intersecting and trimming the dust bag and cable connector.

Remember to intersect all dust bag surfaces with the body surfaces, and the connector surfaces with the dust bag surfaces.



TIP Delete the mirrored surfaces, then do the intersecting and trimming. When the trimming is complete, mirror the surfaces to create the completed model.

Save your work

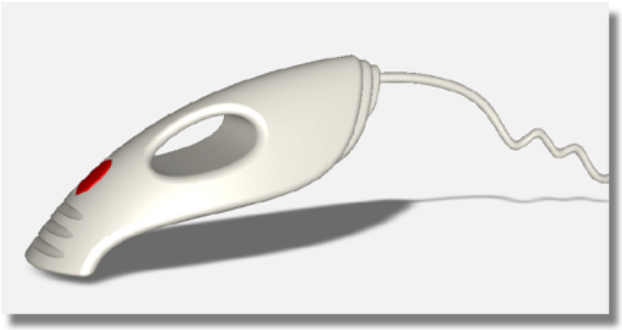
1 Choose File > Save As to save the current scene.

2 Save your work in the `wire` directory of the `Lessons` project.

3 Name your file `myvacuum8.wire`.

Conclusion

Congratulations! You have completed the vacuum cleaner model and have used intersecting and trimming to create a detailed, complex model.



Important concepts to take forward to future modeling projects are:

- The technique of overbuilding surfaces, and then intersecting and trimming them can be used to create detailed designs.
- For more complex models, use layers to organize the geometry and control how the objects display on the screen.
- For a concept model, it is common to leave the surfaces overlapping as the design goes through revisions and changes. The overlapping surfaces will not be seen when the model is shaded and viewed.
- For a detailed, finished model, all the surfaces should be intersected and trimmed, to create a single, enclosed outline. This can be used to create rapid prototyping models and be exported to engineering CAD systems.

Quiz

Now that you have completed this vacuum modeling tutorial, do this quick quiz to help you remember the tools and techniques you have learned.

1 Curve snapping helps you place or transform an object so that it snaps to a curve or an edge. How do you turn curve snapping on?

- (a) Hold down the *Ctrl* (Windows) or *Control* (Mac) key
- (b) Hold down the *Alt* (Windows) or *Option* (Mac) key
- (c) Hold down the *Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac) keys
- (d) Hold down the *Shift* and *Alt* (Windows) or *Shift* and *Command* (Mac) keys
- (e) Hold down the *Shift* and *Ctrl* (Windows) or *Shift* and *Control* (Mac) keys

2 Only one layer is active at any one time. How is the active layer displayed?

- (a) The layer tab blinks
- (b) All the geometry on the layer is shown in pale blue
- (c) All the other layer tabs are hidden
- (d) The layer tab is shown in yellow
- (e) The layer tab is shown in red

3 When typing in x,y,z, dimensions, how do you switch from absolute to relative mode?

- (a) Choose **Relative** from the Control Panel
- (b) Choose **Relative** from the Transform palette
- (c) Type **r** after you have typed the dimension
- (d) Type in **r** and enter, or just type an **r** before you type the dimension
- (e) Alias automatically knows that you need relative mode

4 What is the minimum number of Edit Points needed to create a curve using the **Curves > New Curves > New Edit Point Curve** tool?

- (a) one
- (b) two
- (c) three
- (d) four

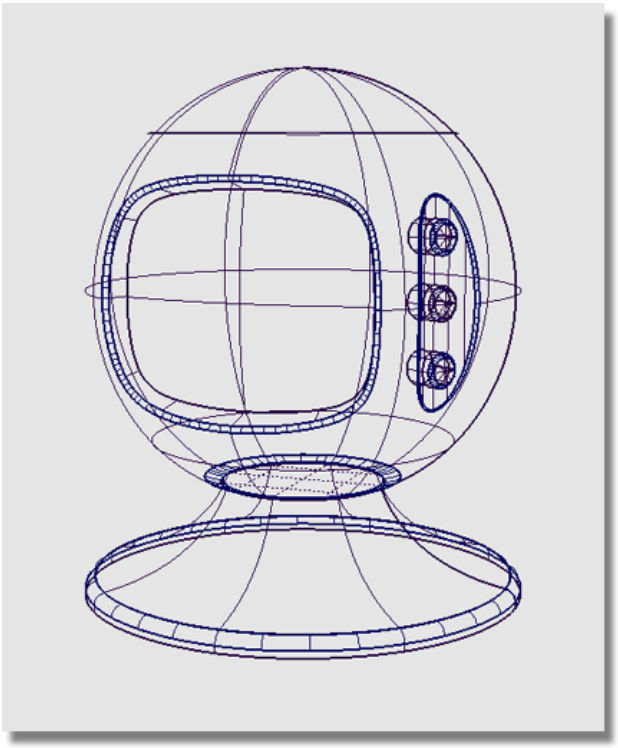
- (e) five

5 The **Surface Edit > Trim > Trim Surface** tool can be used for which of the following functions?
   - (a) To discard an area of a surface defined by a curve-on-surface
   - (b) To keep an area of a surface defined by a curve-on-surface
   - (c) To divide a surface into two areas defined by a curve-on-surface
   - (d) To project a line onto a surface to create a curve on surface
   - (e) All of the above

On Your Own

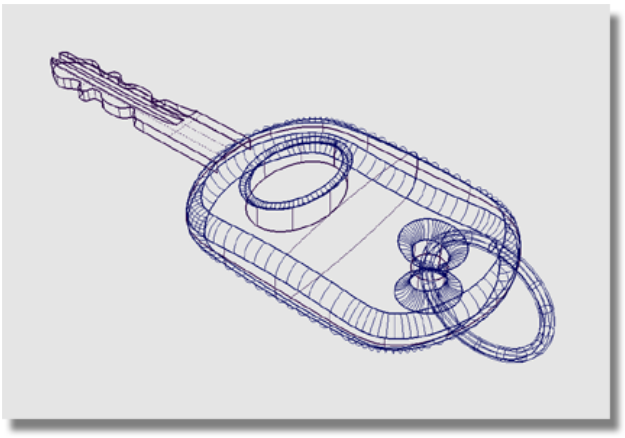
The modeling technique of overbuilding and trimming can be used to create more detailed and intricate models. Use the following examples as inspiration for practicing the skills you have just learned.

The 1970's-style TV shown below is based on a simple sphere. The screen and the controls are cut into the sphere using intersecting and trimming. The base is a revolved surface. All the sharp edges have been finished with the Round or Fillet tool.



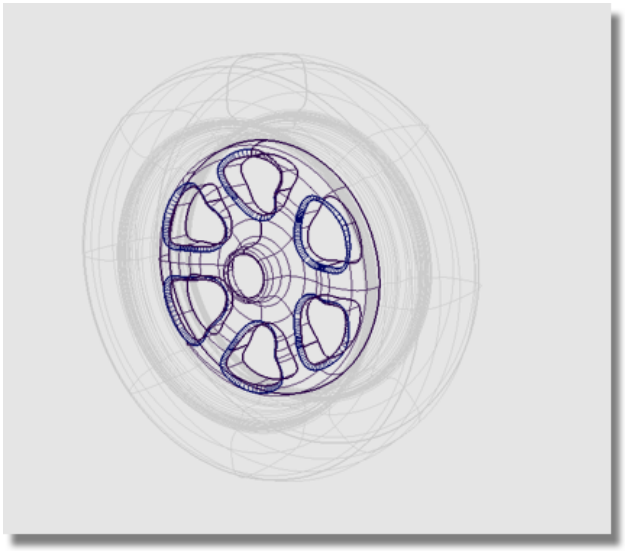


The car key model is typical of many electronic devices with function buttons. You can use the same technique that you used with the vacuum cleaner power button to create the key fob function key.



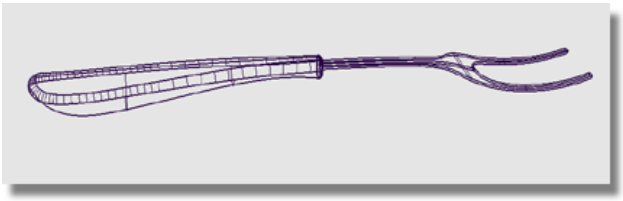


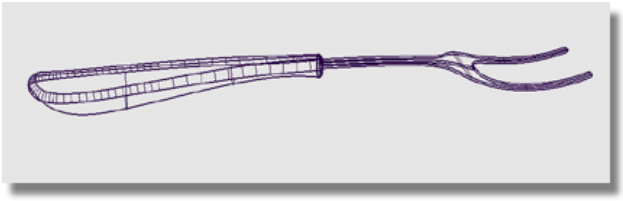
The wheel shown below is created from one revolved surface and six skin surfaces. Intersecting and trimming is used to cut the holes out of the revolved surface.





The barbecue fork is modeled in much the same way as the shapes would be made in a workshop. Imagine the fork prongs as a sheet of steel, bent to give the gentle curve along their length. The prong shape is then cut out. The handle is made from two large mono-rail surfaces, intersected, trimmed and then filleted.





Quiz Answers

Answers to the Vacuum Cleaner Tutorial quiz

1 (c) Hold down the *Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac) keys.

2 (d) The layer tab is shown in yellow.

3 (d) type **r** before you enter the values, either on the same line, or press *Enter* (Windows) or *Return* (Mac) between the r and the values.

4 (b) Two

5 (e) All of the functions.

Modeling an MP3 Player

7

Learning Objectives

In this lesson, you will build an accurate model of an MP3 player. You will learn how to:

- Use Keypoint curves to create accurate geometric shapes.
- Create surfaces with a draft angle.
- Set up Construction Options for accurate modeling.
- Create edges with a radius using the Fillet and Round tools.
- Create symmetrical and duplicated geometry.



New tools used in this tutorial

- Object Edit > Offset
- Edit > Duplicate > Object
- Curves > Arcs
- Curve Edit > Create > Fillet Curve
- Surfaces > Draft/Flange
- Surfaces > Round
- Object Display > Template
- Object Display > Invisible

Introduction

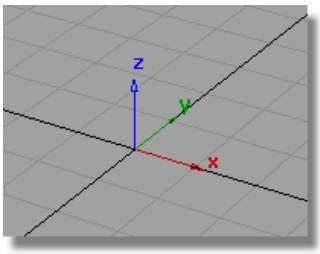
Modeling to Dimensions

In the previous exercises you have focused on building complex forms, using freeform shapes.

In this exercise, you will focus on geometric shapes and working to accurate dimensions.

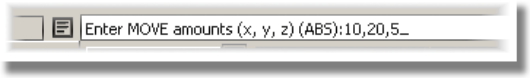
X,Y,Z Coordinates

To specify dimensions and locations in Alias, you will refer to the X, Y, Z grid directions.



An X, Y, Z location is called a coordinate.

To enter a coordinate, type the X, Y, and Z values into the prompt line. They must always be in the X, Y, Z order, and the three numbers can be separated by either a space or a comma: for example:



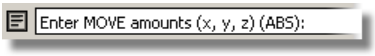
Absolute and Relative Coordinates

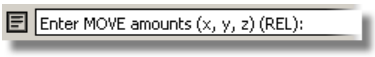
Coordinates can be specified in two ways: absolute or relative.

Absolute coordinates are always measured from the origin.

Relative coordinates are measured from the last coordinate used.

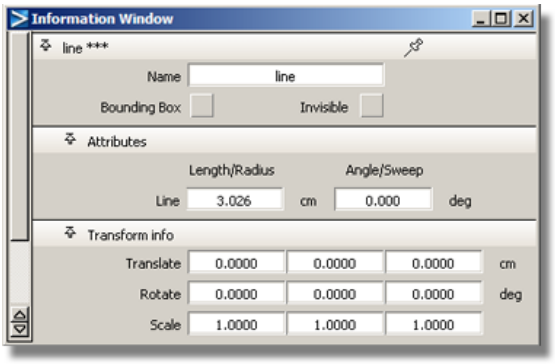
In the prompt line, (ABS) or (REL) is shown, depending which mode you are in. To switch modes, type the letter ‘r’ or the letter ‘a’ either on its own or before typing the coordinate.





The Information Window

As well as entering coordinates in the prompt line, the **Information Window** can be used to check or modify the dimensions of lines, curves and objects.

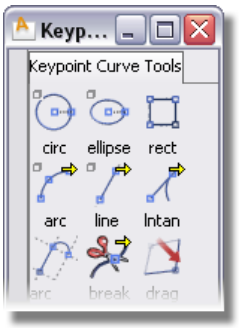


You will use the Information Window to specify the radius of arcs.

Keypoint Curves

In the previous tutorials, you created freeform curves using CVs and Edit Points.

In this tutorial, you will use keypoint curves to create geometrically accurate lines and arcs.



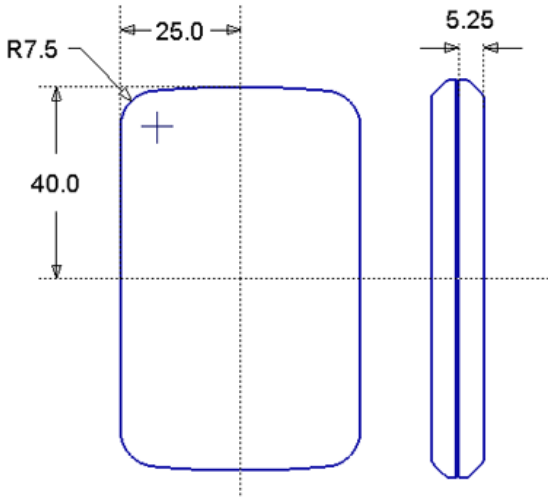
Part 1: Creating the Casing Curves

In this section, you will use Keypoint curves to create the outline of the MP3 player casing.

You will choose millimeters as the units for measurement and building, and use X, Y, Z coordinates to accurately position the curves.

To save time, you will build only one quarter of the geometry, and use symmetry to create the full model.

The dimensions of the casing are shown below:



Creating a New File

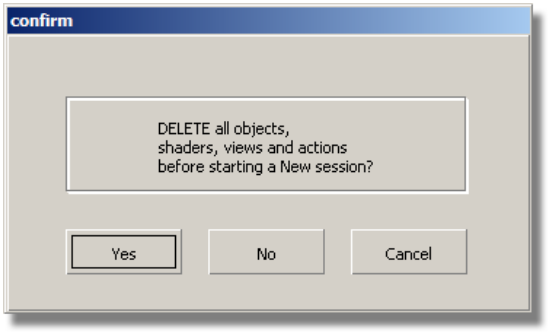
For this tutorial, you will create a file and work from the dimensioned drawing to create your model.



Watch **Part 1** of the tutorial.

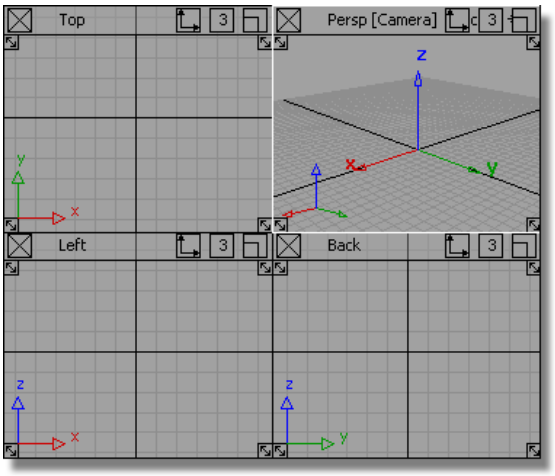
➤ Choose File > New to open the File Browser.

If you already have a file open, you will be asked if it is OK to delete the current file.



Answer **Yes**.

An empty file is created.



Setting Up Modeling Units

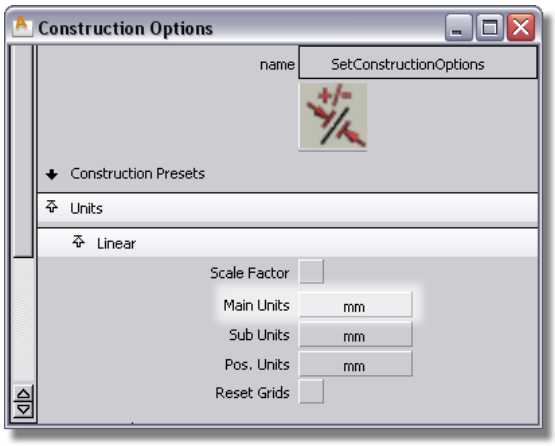
When you are using dimensions to specify a model in Alias, you first need to select which units to use.

All the commonly used units are available:



For this tutorial, you will be working in millimeters, so first you will ensure that the modelling units are set to **mm**.

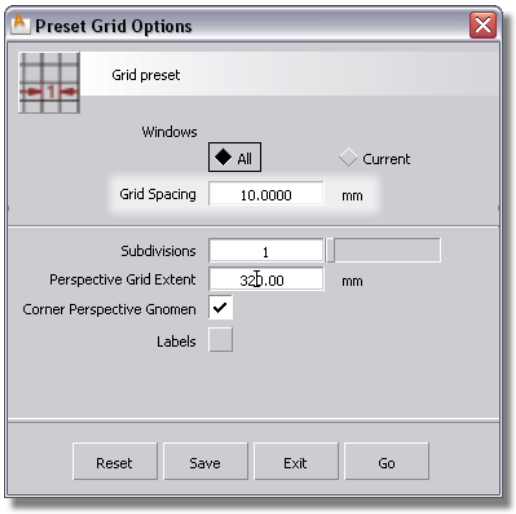
1 Choose Preferences > Construction Options . In the **Units** section, open **Linear** and check that the **Main Units** are set to **mm**. Close the window.



To help you visualize the scale of the new model, you will change the grid spacing.

2 Choose Construction > Grid Preset and double-click the icon to open the option window.

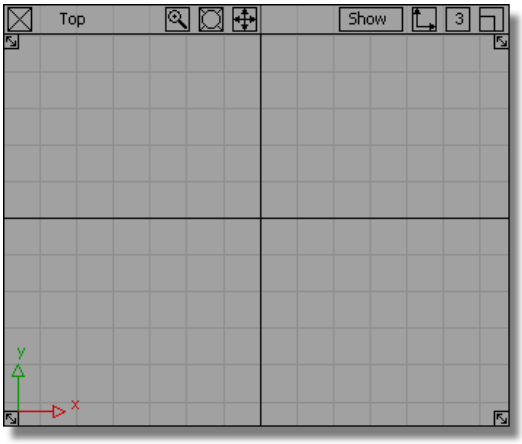
3 Set the **Grid Spacing** to 10.0 mm in the Preset Grid Options window.



4 Click **Go** to change the grid.

5 Maximize the **Top** window.

6 Zoom into approximately 10 grid squares vertically; this will give you a good view for the size of the MP3 player.

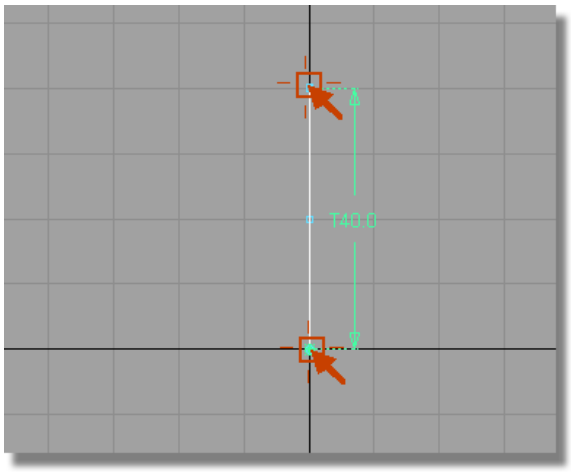


Creating the Casing Curves

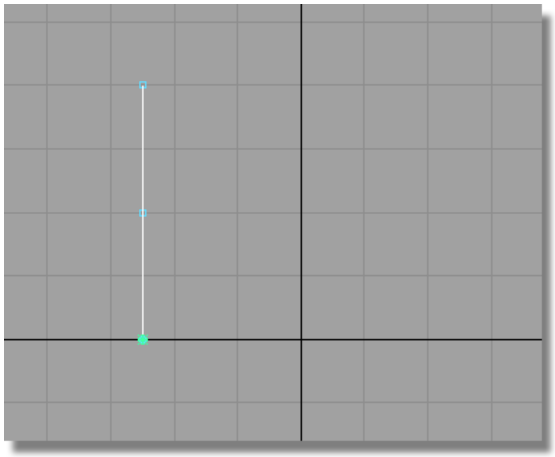
First, you will create the side and top curves of the MP3 player casing.

1 Choose Curves > Keypoint Curve Toolbox, then Keypoint Curve Tools > Lines > Line and use the *Alt* (Windows) or *Command* (Mac) key to *Grid Snap* the start of the line to the origin.

2 Grid Snap the end of the line to the grid point 4 grid squares up to create a vertical line 40 mm long.



3 With the curve still selected, choose Transform > Move and type in -25,0,0 at the prompt window to move the curve 25 mm to the left in the x-direction.



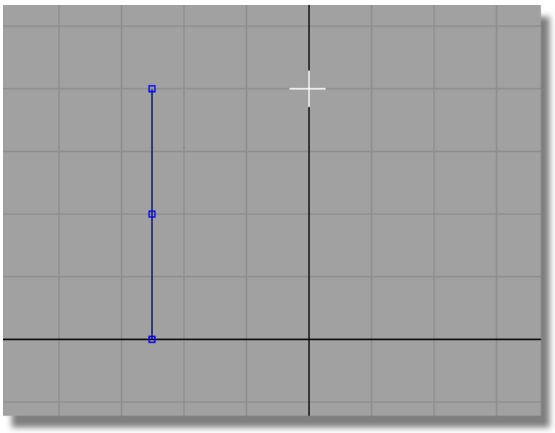
TIP If the last coordinate numbers are zero, then you can omit them. For example, 25,0,0 can be entered as 25 only. However, a coordinate of 0,0,25 needs to be entered in full.

Next, you will create the arc for the top of the MP3 player.

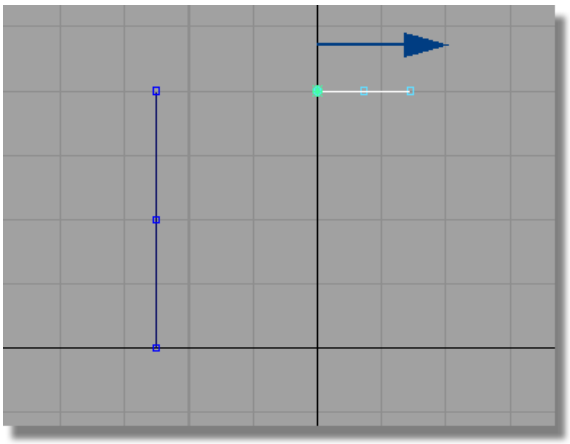
The arc will define one half of the design, which will later be mirrored. It is therefore important that the arc is tangent to the center line, so that it will create a smooth result when it is mirrored.

So first, you will create a horizontal construction line to help create a tangent arc.

4 Choose Curves > Keypoint Curve Toolbox, then Keypoint Curve Tools > Lines > Line and use the *Alt* (Windows) or *Command* (Mac) key to *Grid Snap* to the grid point at 0,40,0.



5 Using the *middle mouse button*, click to the right of the grid to create a horizontal line.



NOTE The length of the line isn't important; it just needs to be snapped to the center grid line, and be horizontal.

Now you will create the arc at the top of the MP3 player.

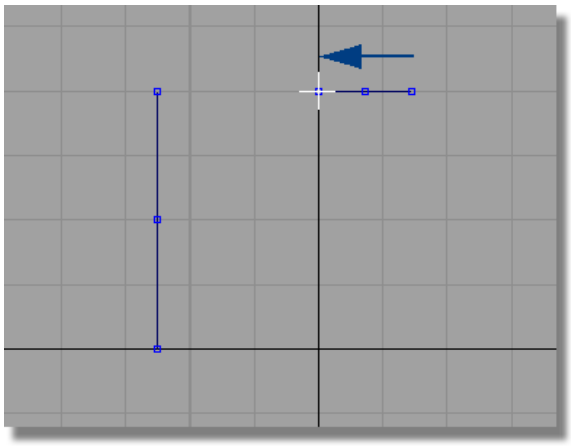
6 Choose Curves > Keypoint Curve Toolbox, then Keypoint Curve Tools > Arcs > Arc Tangent to Curve .

7 You are prompted to

```
Select the curve at location to make arc tangent to.
```

Click the horizontal line and, without releasing the mouse button, drag the start point to the left end of the line, where it meets the grid.

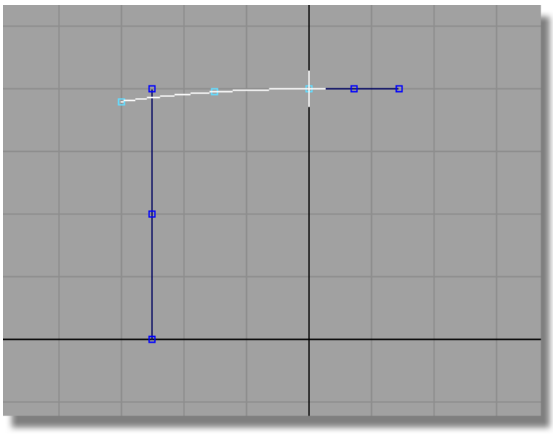
NOTE The arc start point automatically snaps to the line, so you don't need to use the curve snap (*Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac)).



8 You are prompted to

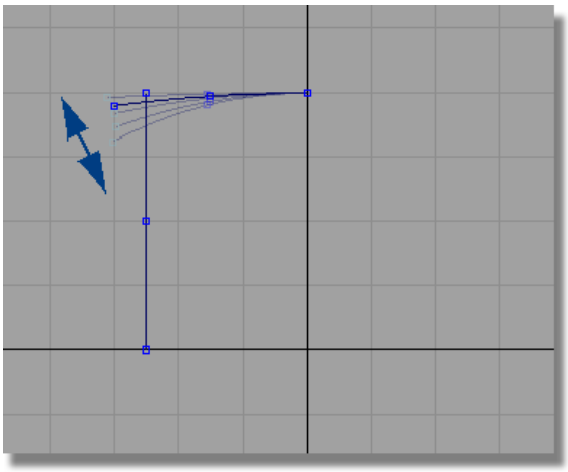
```
Enter end point of tangent arc.
```

Type -30,38,0 to position the end point.

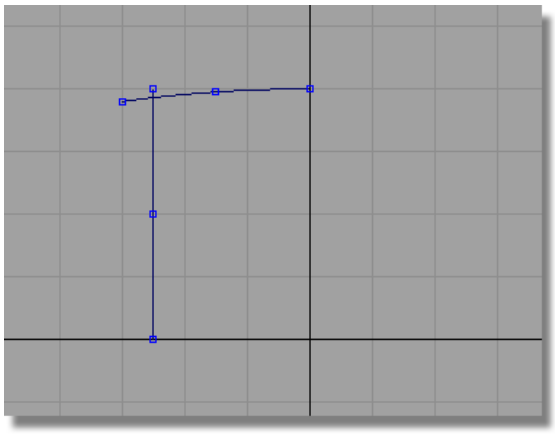


TIP The coordinate given for the end point gives you an arc similar to the design shown at the start of this tutorial.

TIP If you want to modify the arc, and design your own shape, choose Curves > Keypoint Curve Toolbox, then Keypoint Curve Tools > Drag Keypoints and click and drag the end of the arc until you achieve the desired curve. The curve remains tangent to the center line.



9 You no longer need the horizontal line, so choose Pick > Object to select it, and press the *Delete* key to delete it.



Now you will use the Curve Fillet tool to create a smooth corner.

10 Choose Curve Edit > Create > Fillet Curves .

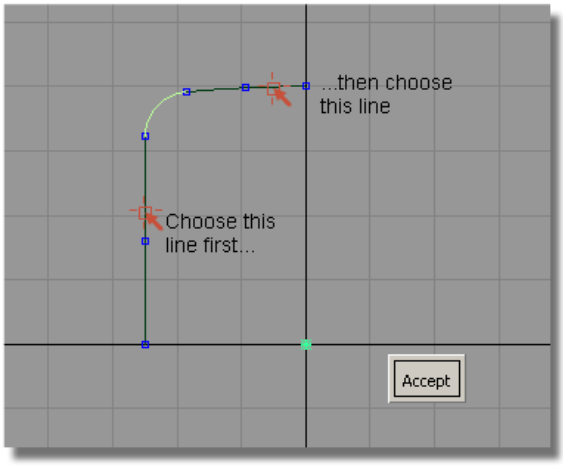
11 You are prompted to choose a curve.



12 Pick the vertical line.

Then you are prompted to choose a second curve.



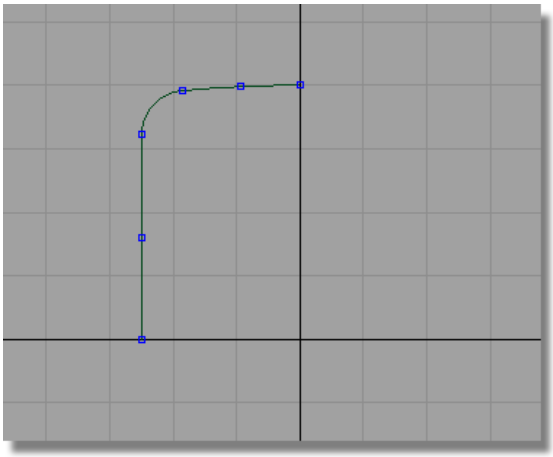


13 Pick the arc.

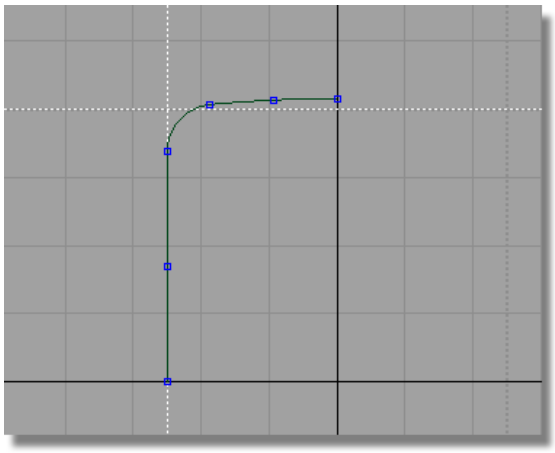
14 When prompted to adjust the fillet radius, type in a value of **7.5**.



15 Click **Accept** to create the fillet curve.



TIP Guidelines may be created when you use keypoint curves. They appear as dotted lines which highlight when the cursor is near. They can be useful when laying out a design, but you don't need them for this tutorial.



To delete the guidelines, choose Delete > Delete Guidelines from the menu.

Save your work

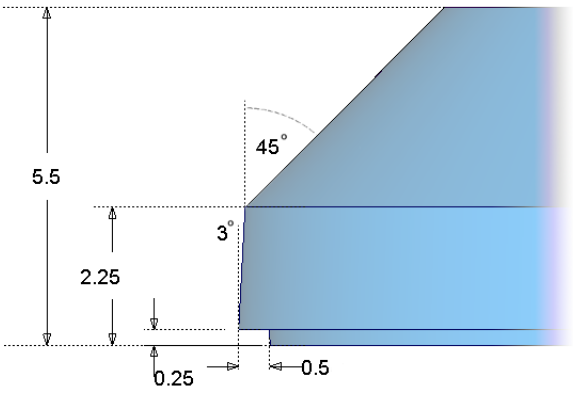
1. Choose File > Save As to save the current scene.
2. Save your work in the wire directory of the Lessons project.
3. Name your file `myMP3Player.wire`.

For information on creating the Lessons project, or saving your work, see Saving your work in a Windows environment on page 96or Saving your work in a Mac OS X environment on page 100.

Part 2: Creating the Side Surfaces

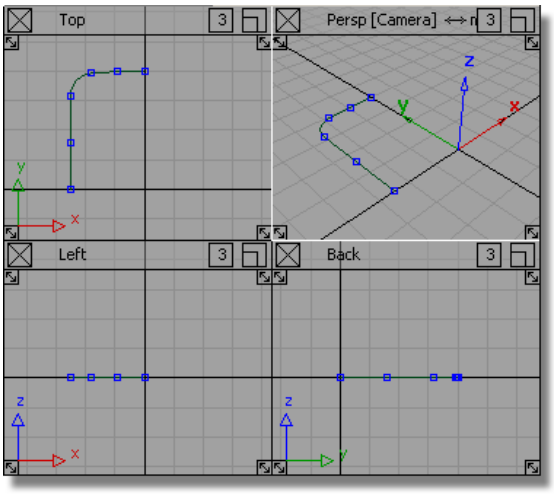
The design of the MP3 player features chamfered sides. You will now use the **Draft** and **Flange** tools to create the side surfaces and a split-line feature.

The dimensions for the casing are shown below.



Opening the tutorial file (optional)

If you successfully completed Part 1, proceed to the next step: Creating the Side Surfaces, below.



If you were not successful in part 1, open the file called `MP3Player_part2.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 1.

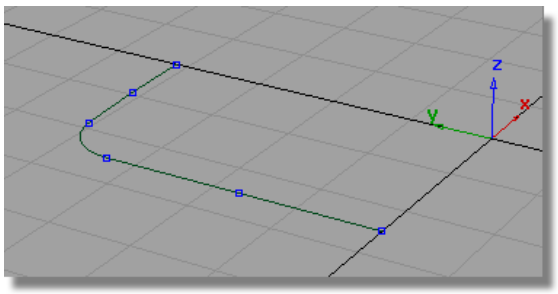


Watch **Part 2** of the tutorial.

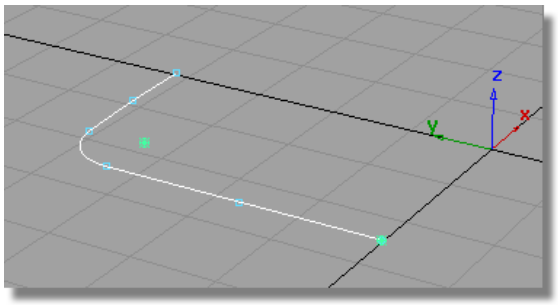
Creating the Side Surfaces

First, you will move your curves away from the center line in the z-direction. This will leave some space for a split-line feature you will create later in the tutorial.

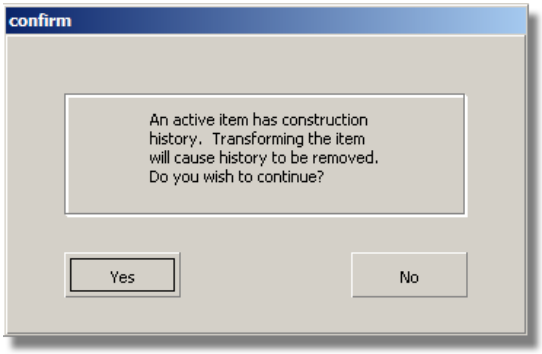
1. Maximize the **Perspective** Window.



2. Choose Pick > Object and drag a pick box over all the curves to select them

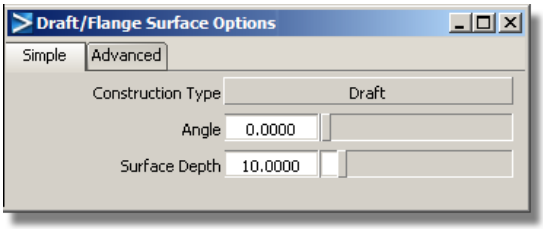


3. Choose Transform > Move and type r0,0,0.25 in the prompt window to move the curves up by 0.25 mm in the z-direction.
4. You will be asked about losing construction history, which relates to the fillet curve. Answer **Yes**.

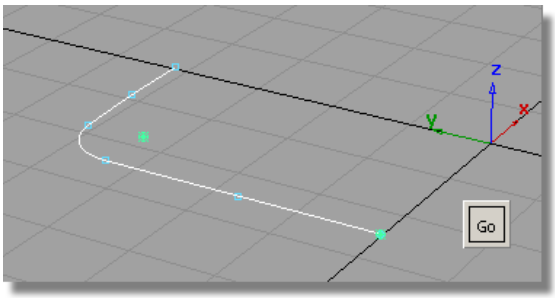


Now you will create the side wall using the **Draft** surface.

5 Choose Surfaces > Draft Surfaces > Draft/Flange . Double-click the icon to open the option window. You will start with the default Draft settings, and then modify them after the surface is created.

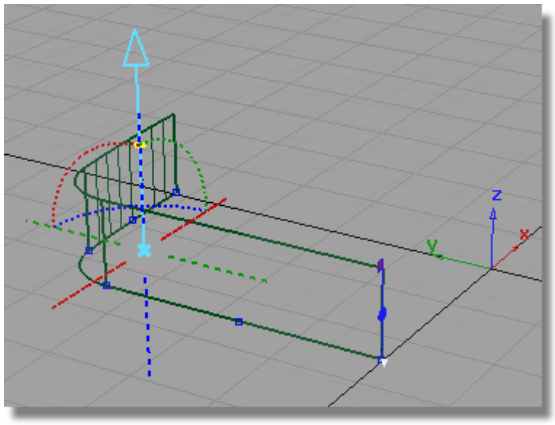


6 As the curves are already selected, click **Go** to create the surface.



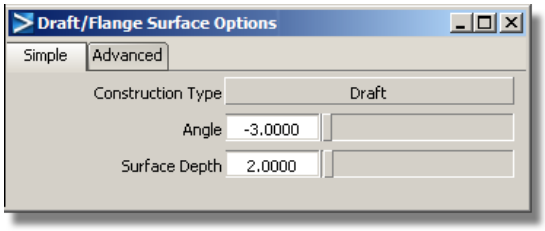
The default Draft surface is built. The default draft direction is in the positive z-axis, which is correct for your design.

TIP To change the draft pull direction for future designs, click the dotted lines and arcs representing the axes.

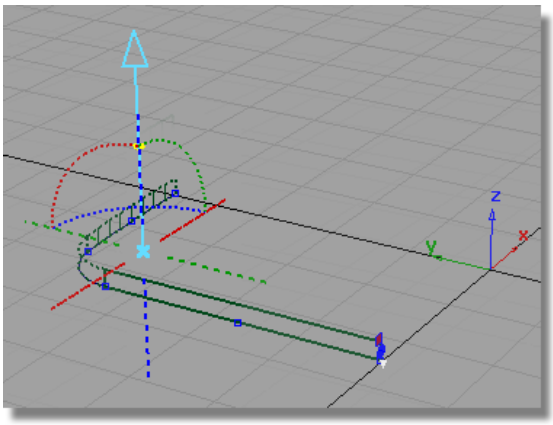


Now you will modify the Draft Angle and the Surface Depth to match the required dimensions.

7 In the Draft option window, change the settings to an **Angle** of **-3** degrees, and a **Surface Depth** of **2**.



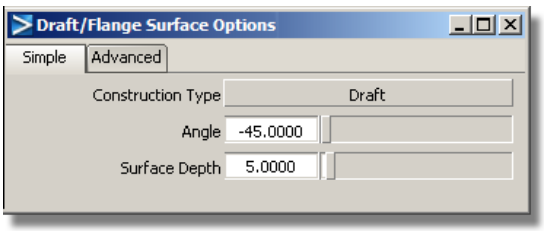
The Draft surface is rebuilt to the new settings.



8 Choose Pick > Nothing to complete the surface creation.

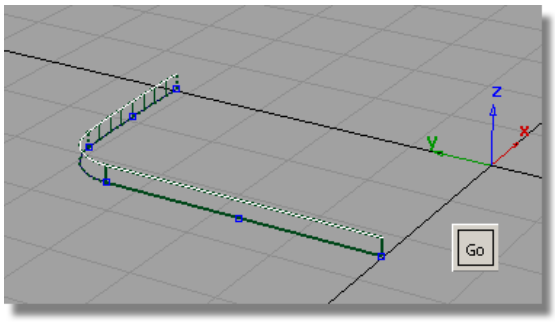
9 Now you will build the chamfered surfaces.

10 Double-click the Draft icon to open the option window again. Change the settings to an **Angle** of **-45** degrees, and a **Surface Depth** of **5**.

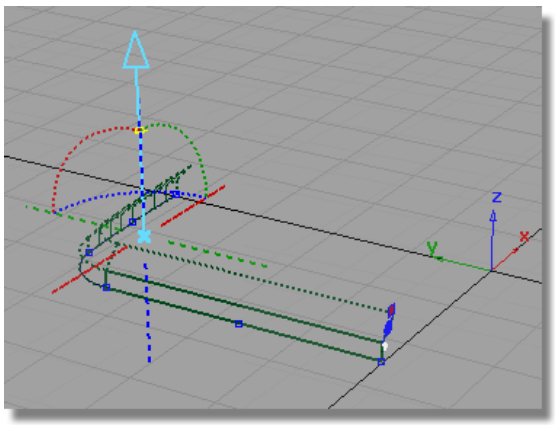


NOTE You will build the chamfered surface to an approximate length. The front face of the MP3 player will later be used to trim the side walls to the correct height.

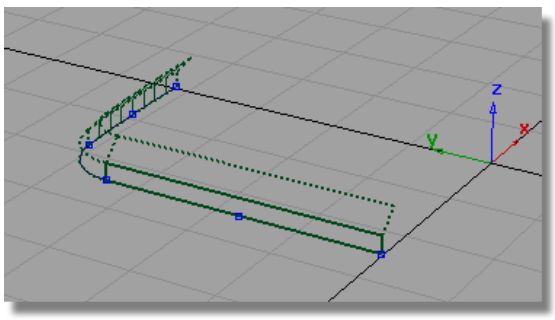
11 Pick the three top edges of the draft surfaces as the input curves for the new draft surfaces.



Click **Go** to create the chamfered surfaces.



12 Choose Pick > Nothing to complete the Draft surfaces.



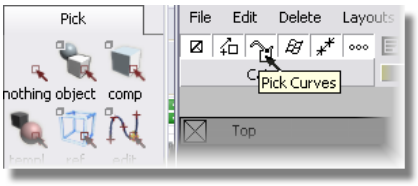
Creating the Split-Line

Next you will use the Flange surface to create the small split-line feature at the center line.

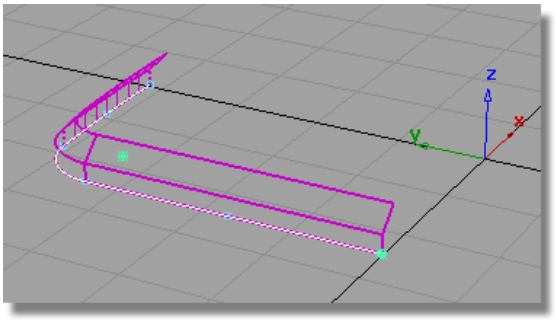
The Flange surface can only be built from a surface edge, not a curve. This is because it measures its angle from the surface edge, not from a draft direction. So first, you will template your curves to make it easier to select the surface edges.

1 Choose Pick > Component and modify the options so that only curves will be selected.

2 **TIP** You can either double-click the **Pick > Component** icon to set up the options in the option window, or you can use the small icons in the menu bar, as shown below.



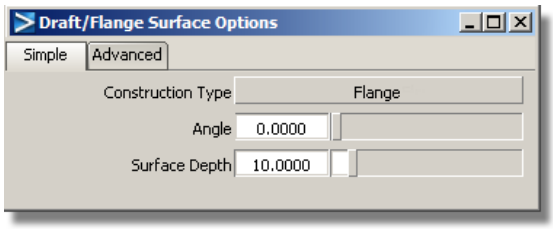
3 Drag a pick box across the model. Only the curves are selected.



4 Choose ObjectDisplay > Template to turn the curves into a template that will not be selected by the **Pick > Object** tool.

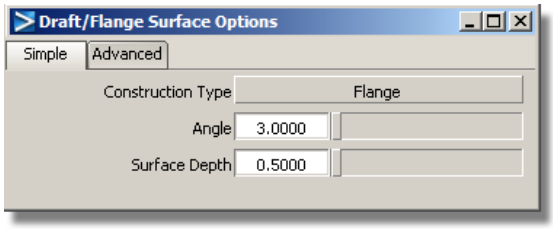
Now you will create some small Flange surfaces to represent the split-line detail.

5 Choose Surfaces > Draft Surfaces > Draft/Flange . Double-click the icon to open the option window. Change the **Construction Type** from **Draft** to **Flange**.

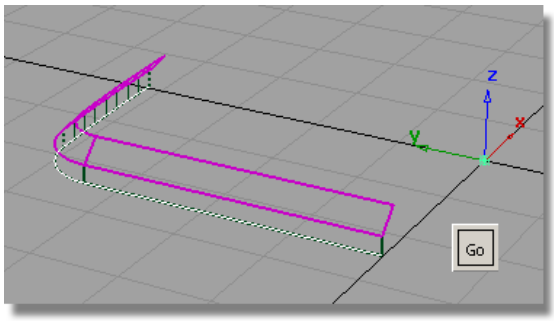


6 Change the **Surface Depth** to **0.5**, and change the **Angle** to **3**.

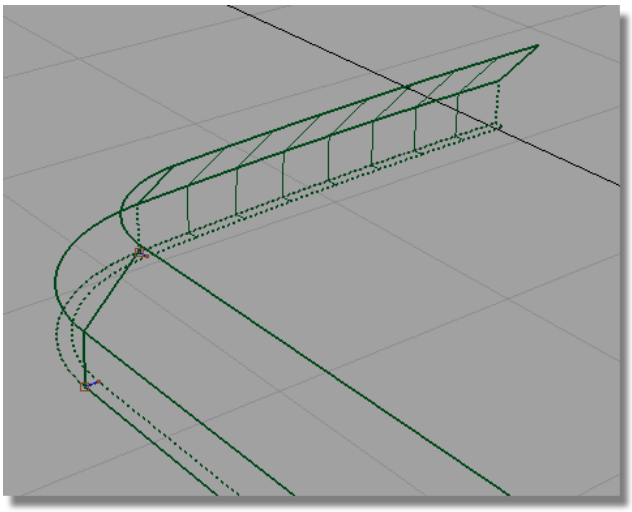
NOTE The angle of 3 degrees compensates for the draft angle of 3 degrees on the sidewalls. So the flange surfaces will be built parallel to the ground plane.



7 Click the lower edges of the side walls and click **Go**.



The small flange surfaces are created.

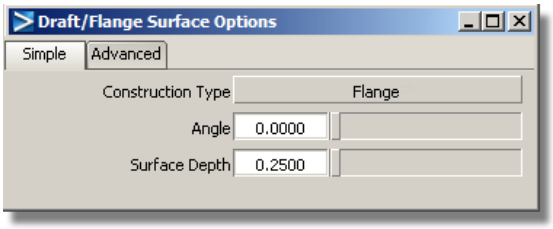


8 Choose Pick > Nothing to complete the Flange surface.

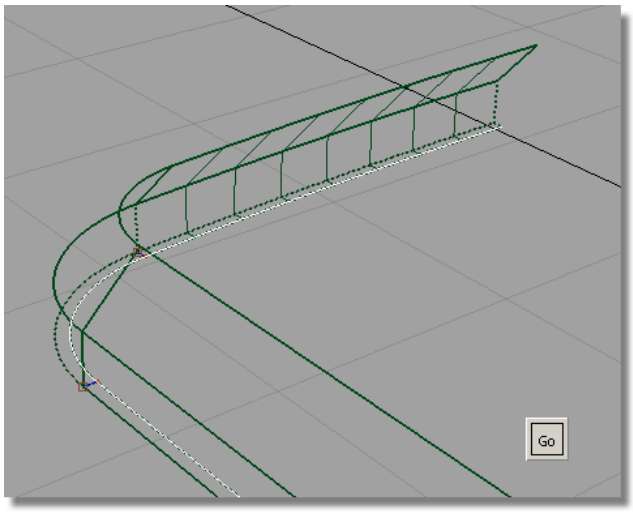
To finish off the sidewalls, you will now create another set of flange surfaces to meet the center-line.

9 Choose Surfaces > Draft Surfaces > Draft/Flange again, double-click the icon to open the option window.

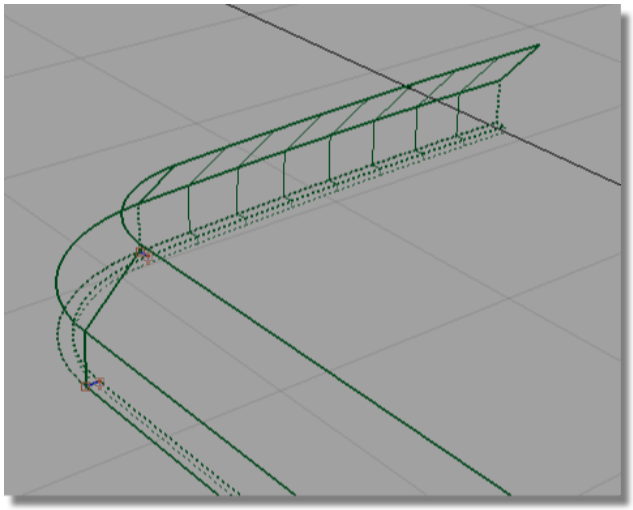
10 Change the **Angle** to **0** and the **Surface Depth** to **0.25**.



11 Choose the three edges of the flange surface you just created and click **Go**.

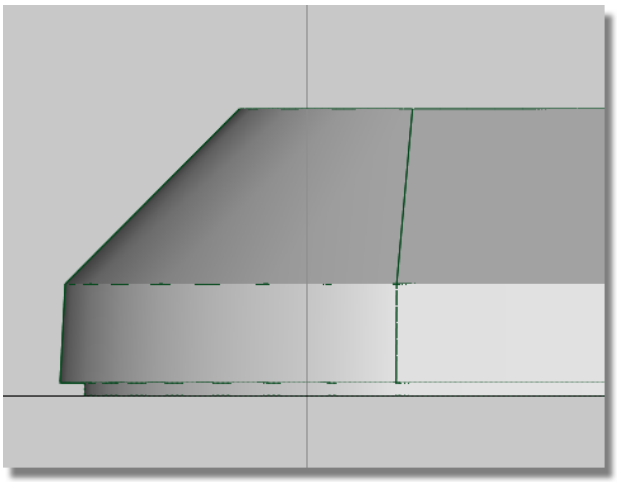


12 Choose Pick > Nothing to complete the Flange surface.



13

The side profile of the surfaces shows how the draft angles and split-line detail have been accurately created.



TIP The Draft and Flange tools may create some extra curves-on-surface. Use Pick > Object Types > Curve on Surface and drag a box over all the surfaces to select them. You can delete these, as they aren't needed.

Saving your work

1. Choose File > Save As to save the current scene.
2. Save your work in the `wire` directory of the `Lessons` project.
3. Name your file `myMP3Player2.wire`.

For information on creating the Lessons project, or saving your work, see Saving your work in a Windows environment on page 96 or Saving your work in a Mac OS X environment on page 100.

Part 3: Completing the Casing

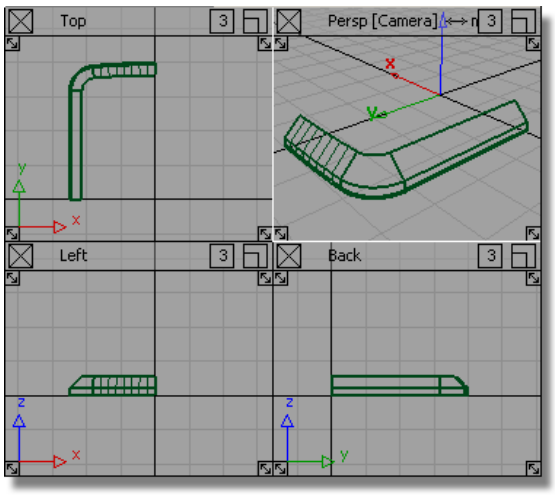
To complete the design, you will use a Plane surface to create the front of the casing, and a Surface Fillet to trim and fillet it to the chamfered surfaces.

You will use Layer Symmetry and Mirror to create all the surfaces for the front casing.

Finally, you will duplicate the front casing to create the rear casing, and organize all the geometry onto layers.

Opening the tutorial file (optional)

If you successfully completed Part 2, proceed to the next step: Creating the Front Surface, below.



If you were not successful in part 2, open the file called `MP3Player_Part3.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 2.

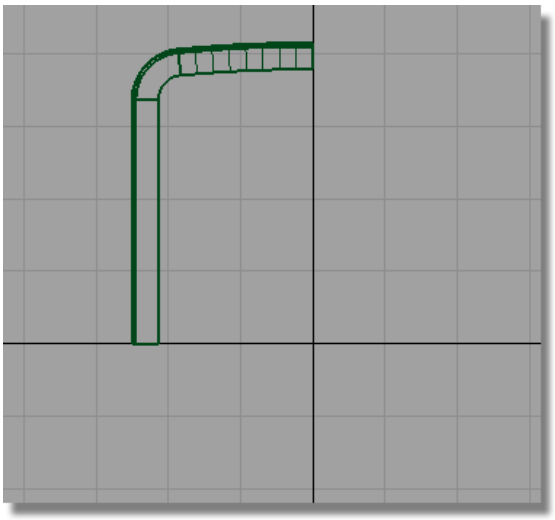


Watch **Part 3** of the tutorial.

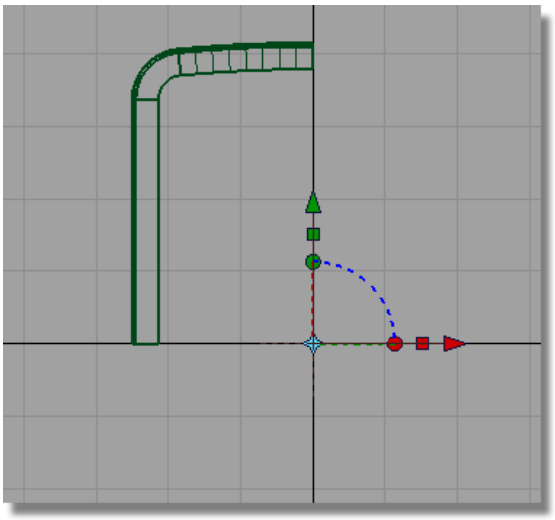
Creating the Front Surface

First you will create the front face of the casing, and position it at the correct height for the MP3 Player dimensions.

1 Maximize the Top window.

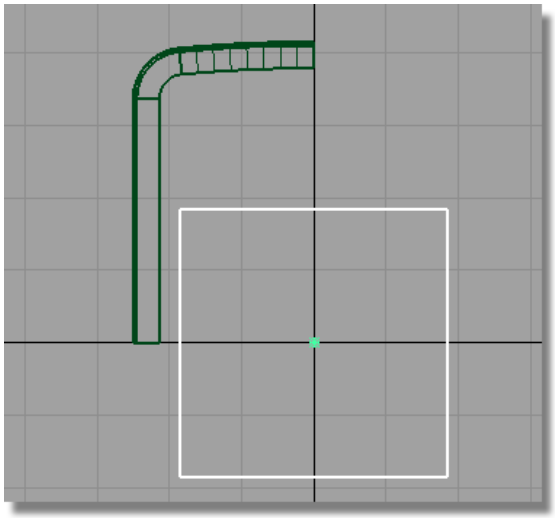


2 Choose Surfaces > Primitives > Plane . You are prompted to enter the new plane position. Use the *Alt* (Windows) or *Command* (Mac) key and grid snap the plane to the origin.



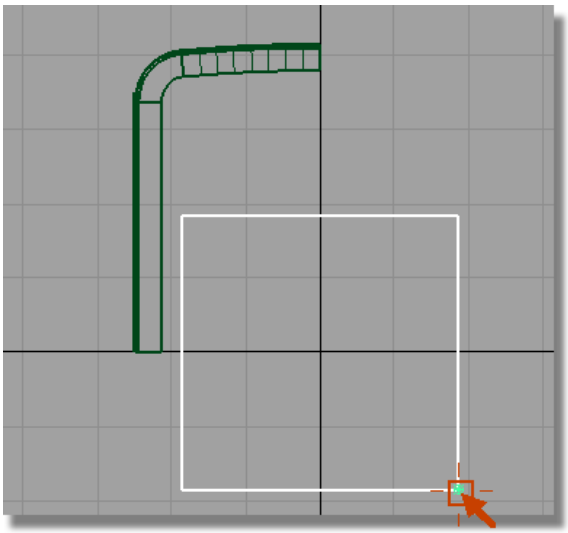
The Plane surface is created 1mm square in size. It is already selected, so you will now scale and move the plane to form the front face of the casing.

3 Choose Transform > Scale and click and drag the left mouse button to make the plane large enough to see clearly.

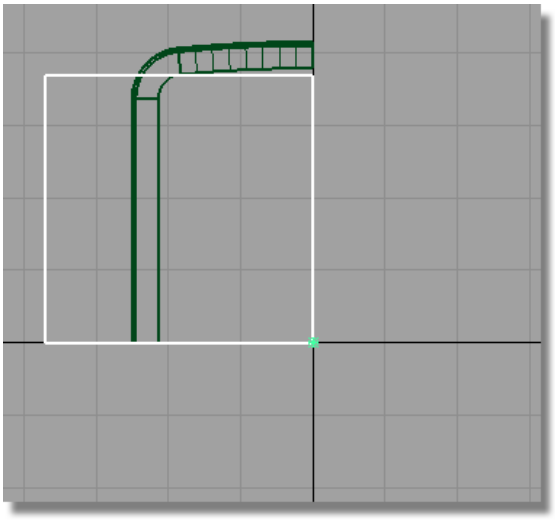


Now you will set the pivot point for the Plane to the lower right-hand corner.

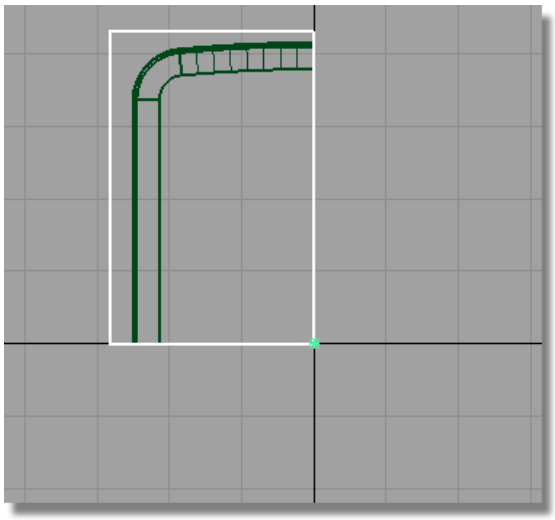
4 Choose Transform > Local > Set Pivot . Use the curve snap (*Ctrl* + *Alt* (Windows) or *Control* + *Command* (Mac)) to snap the pivot accurately to the bottom right corner of the plane.



5 Now choose Transform > Move . Use grid snap (*Alt* (Windows) or *Command* (Mac) key) to position the plane exactly at the origin.

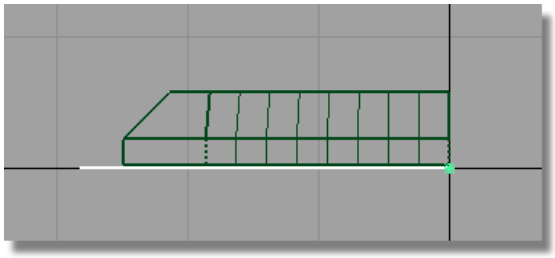


6 Use Transform > Non-p Scale to size the plane to approximately fit the design. Make sure that the plane overlaps the chamfered edges.

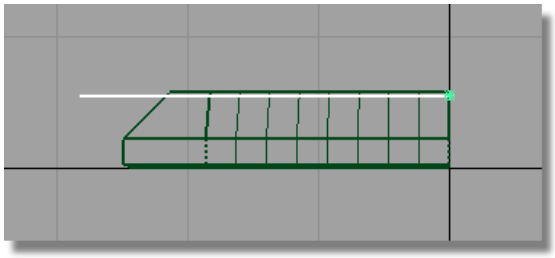


Next, you will move the plane up in the z-axis.

7 Maximize the **Left** window



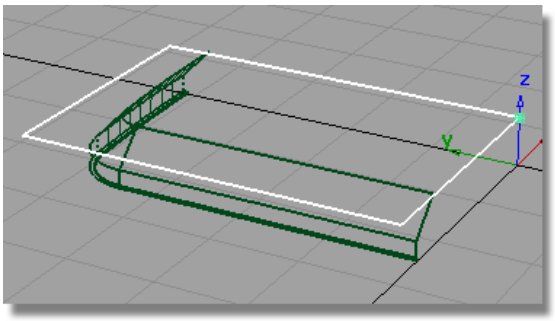
8 Choose Transform > Move and type 0,0,5.5 in the prompt window to move the plane up 5.5 mm in the z-axis.



Filleting the Plane Surface

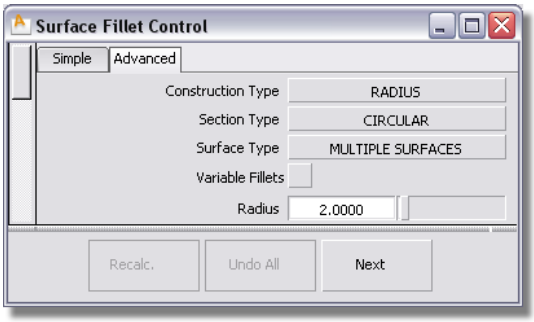
Now you will use the Surface Fillet tool to trim the front face and create an edge with a radius in one operation.

1 Maximize the **Perspective** window.

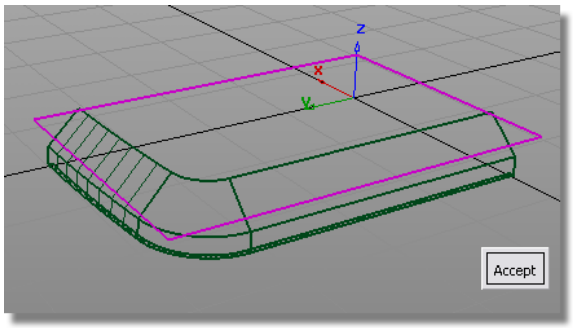


2 Choose Surfaces > Surface Fillet and double-click the icon to open the option window.

3 Change the Radius to **2**.

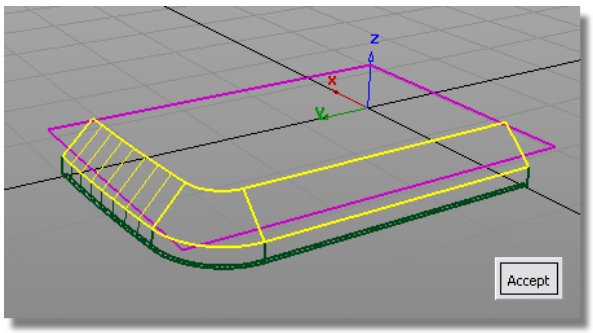


4 You are prompted to select the first set of surfaces. Select the plane.



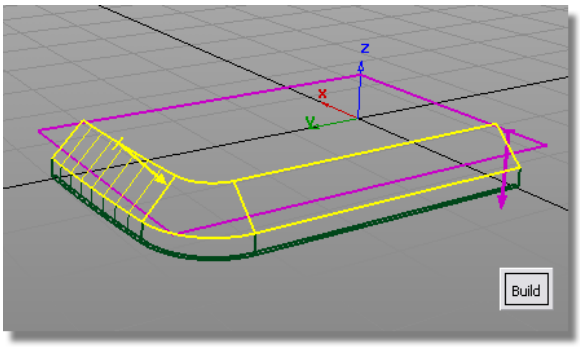
5 Click **Accept**.

6 Next you are prompted to select the second set of surfaces. Click the three chamfered surfaces.



7 Click **Accept**.

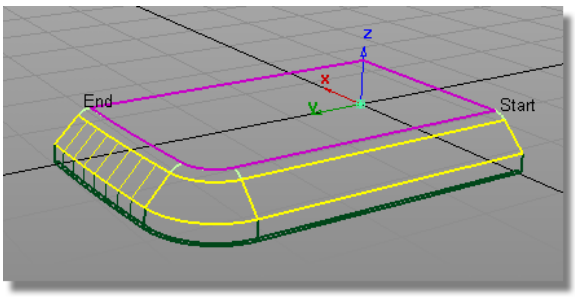
Arrows appear on both surfaces indicating on which side the fillet will be built. In this case, we want the pink arrow to point down, and the yellow arrow to point inwards.



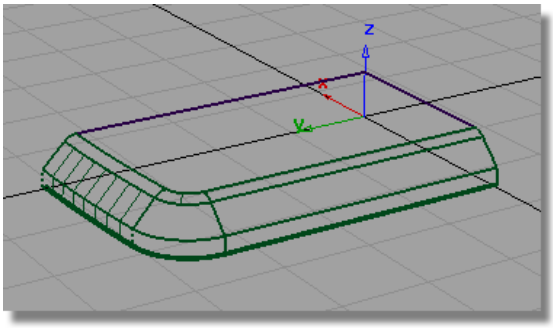
8 If necessary, click an arrow to reverse its direction.

9 Click **Build**.

The edge with the specified radius is created and all the surfaces are trimmed.



10 Choose Pick > Nothing to complete the fillet.

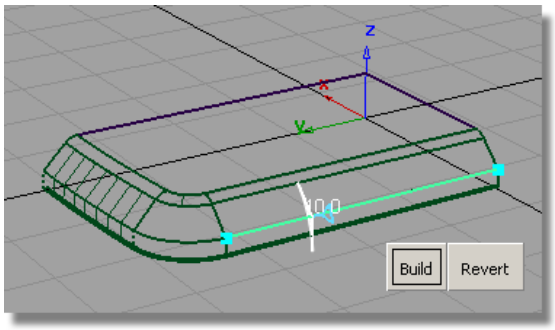


Using Round for the Remaining Edges

Next you will create a radius on the remaining edges using the Round tool.

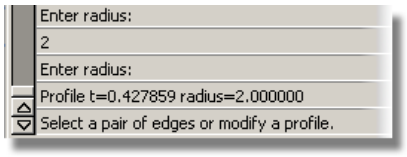
You could use either the **Round** or the **Surface Fillet** to create the softened edge. As the surfaces already meet at a sharp edge, the **Round** tool will be quicker to use.

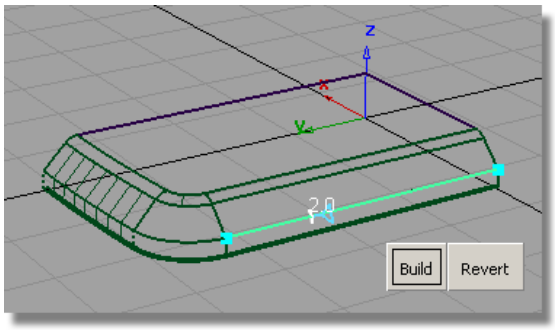
1 Choose Surfaces > Round . You are prompted to select a pair of edges. Click one of the edges between the chamfer and the side surfaces.



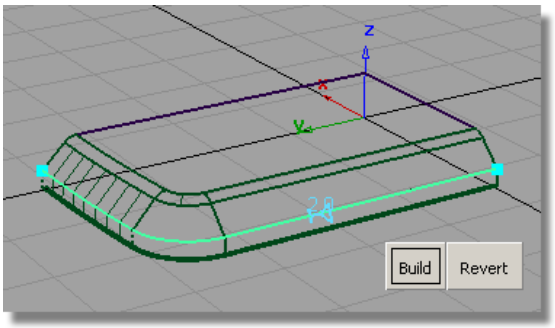
A radius indicator appears and is highlighted in white.

2 Type in **2** at the prompt line to adjust the radius value to 2 mm.

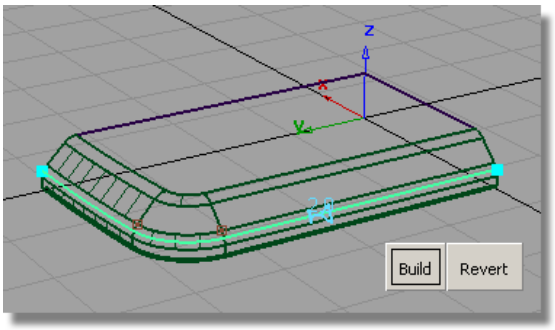




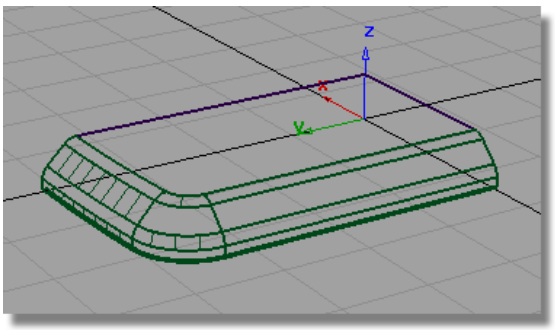
3 Click the other edges to complete the round.



4 Click **Build** to create the round surfaces and trim back the draft surfaces.



5 Choose Pick > Nothing to complete the round.

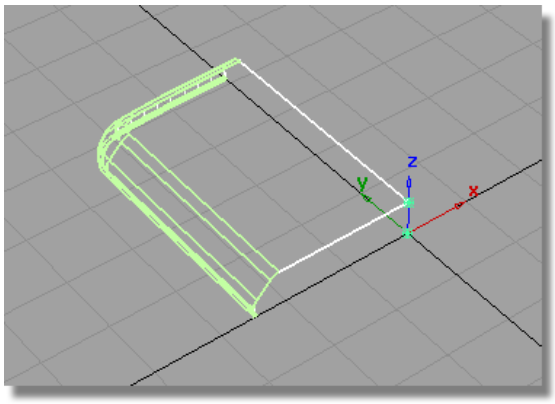


Completing the Front Casing

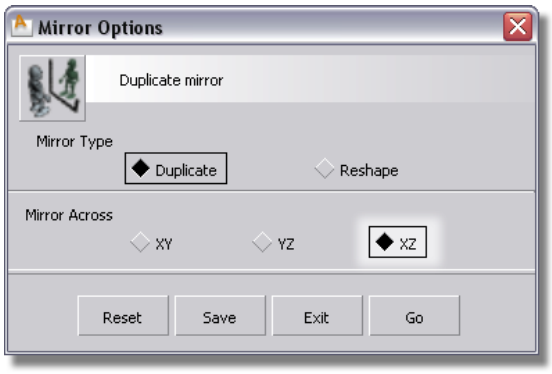
The MP3 Player casing is made from two similar components, the front and the back casing. You will complete the front and rear casings using the mirror tool and Layer symmetry.

First you will create the lower quarter of the front casing.

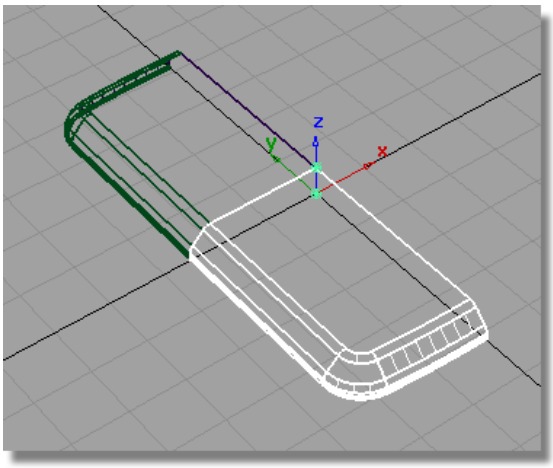
1 Choose Pick > Object and drag a selection box over all the surfaces to select them.



2 Choose Edit > Duplicate > Mirror ❒ to open the mirror option window.



3 Choose the **XZ** plane and click **Go**.



4 Choose Pick > Nothing to deselect the surfaces.

Layer Symmetry

You used mirror to create the lower surfaces, so that the top surfaces can be modified, by adding a screen, and the lower surfaces can be modified by adding buttons.

For the left and right sides of the design however, you want the geometry to be the same on both sides. So for the left and right sides, you will use Layer Symmetry to view a mirror image of the geometry, which will update as you continue to build surfaces.

1 Choose Layers > New to create a layer for the front casing.

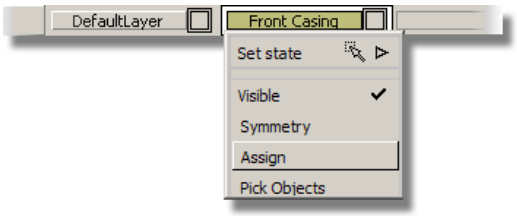


2 Double-click in the layer tab and rename the layer **Front Casing**.



3 Choose Pick > Object and drag a pick box over all the surfaces to select them.

4 Choose Assign from the Front Casing layer tab sub-menu.

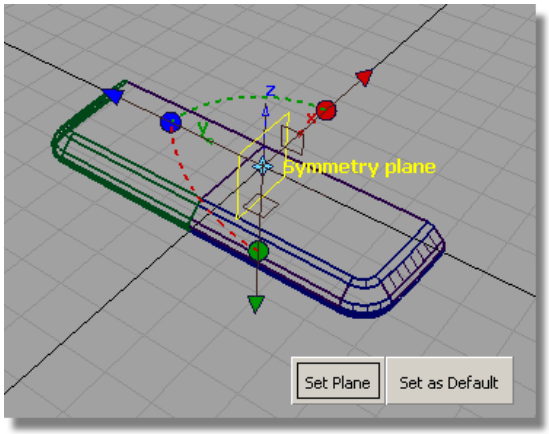


The symmetry on layers is typically used in one of the three axis directions. Now you will set the **Symmetry Plane** so that your geometry is mirrored left to right.

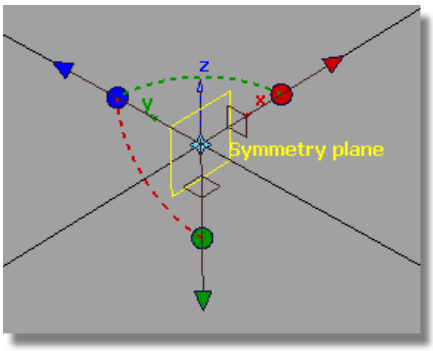
The new layer is selected and shown in yellow. (If the layer isn't selected, you need to click the layer tab to select it).

5 Choose Layers > Symmetry > Set Plane .

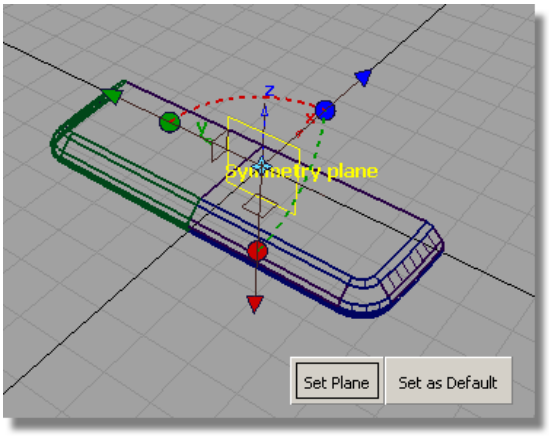
The current symmetry plane is highlighted in yellow. You need to change this so that the geometry will be mirrored left and right.



6 Click the small brown square that represents the YZ plane.



The large yellow plane changes to the right axis for your model.



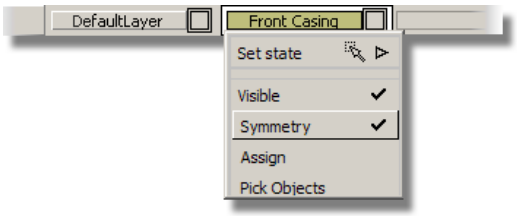
7 Click **Set as Default** to set this axis for all future layers.



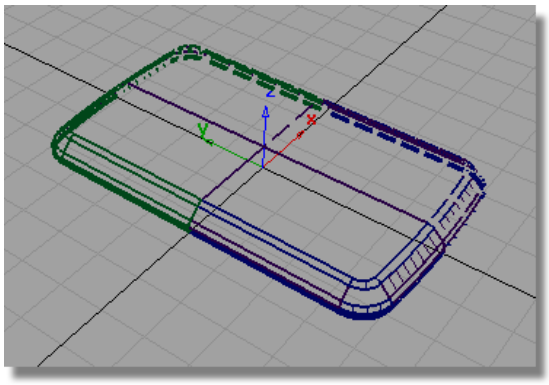
8 Click **Set Plane** to set the plane for this layer.



On the **Front Casing** layer, choose the symmetry option from the layer sub-menu.



The geometry on the layer is mirrored and shown as dotted lines to indicate that it is only a visualization of the mirrored geometry, not real geometry.



Creating the Rear Casing

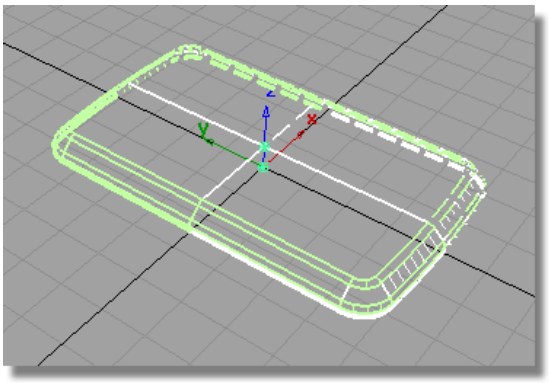
Now is a good time to copy the surfaces for the rear casing, before you start to detail the front.

First you will create a layer for the rear.

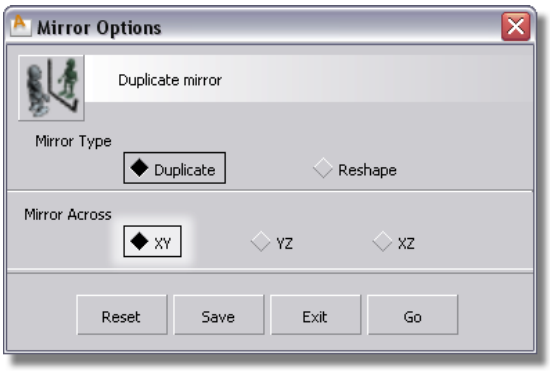
1 Choose Layers > New and rename the layer Rear Casing.



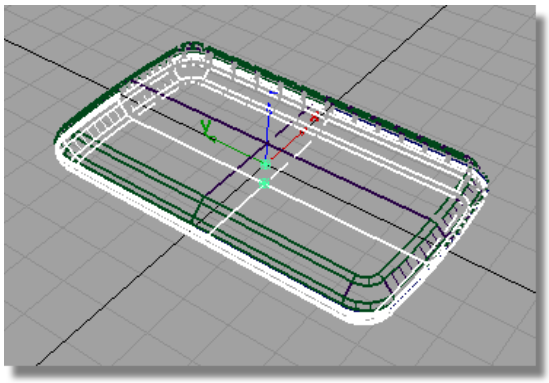
2 Choose Pick > Object and drag a pick box over all the geometry to select it.



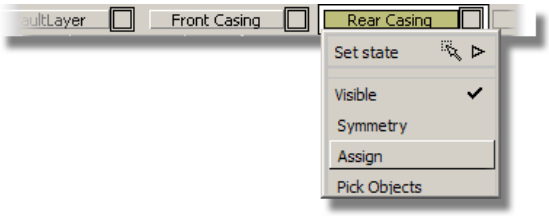
3 Choose Edit > Duplicate > Mirror ❒ to open the option window. Choose the **XY** plane and click Go.



The surfaces are mirrored.



4 With the surfaces still selected, **Assign** them to the **Rear Casing** layer.



5 Turn on **Symmetry** on the Rear Casing layer.

6 Turn off **Visible** on the Rear Casing layer to make it invisible.

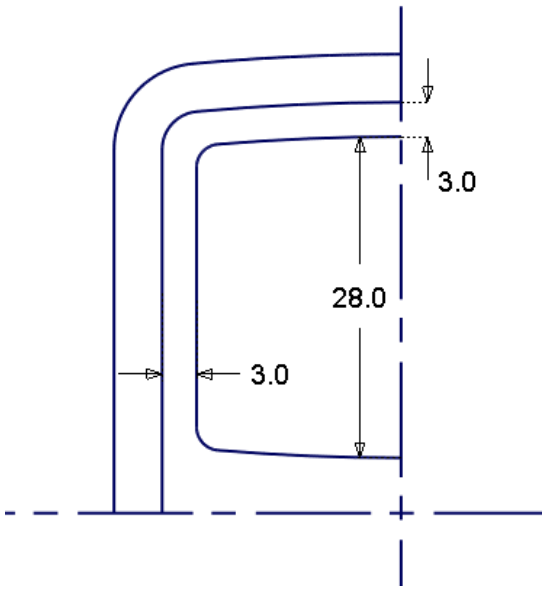
Saving your work

Save your work in the `wire` directory of the `Lessons` project. Name your file `myMP3Player3.wire`.

Part 4: Creating the Screen Recess

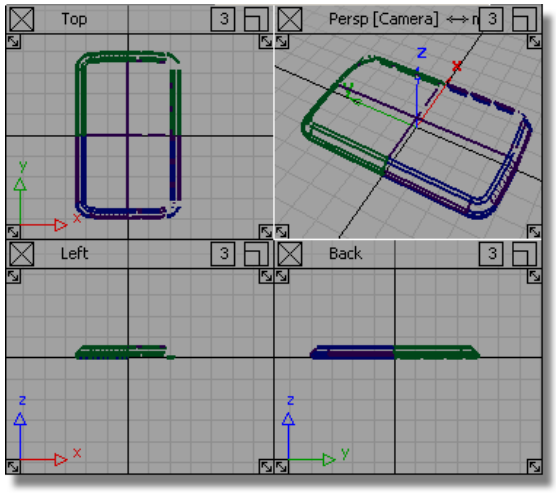
The screen is cut out of the front face of the MP3 player.

You will Offset the outline of the casing to create the screen curves. You will then Project them onto the front face to create Curves-on-Surface. These can then be used to Trim out the aperture for the display screen.



Opening the tutorial file (optional)

If you successfully completed Part 3, proceed to the next step: Creating Offset Curves below.



If you were not successful in part 3, open the file called `MP3Player_part4.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 3.



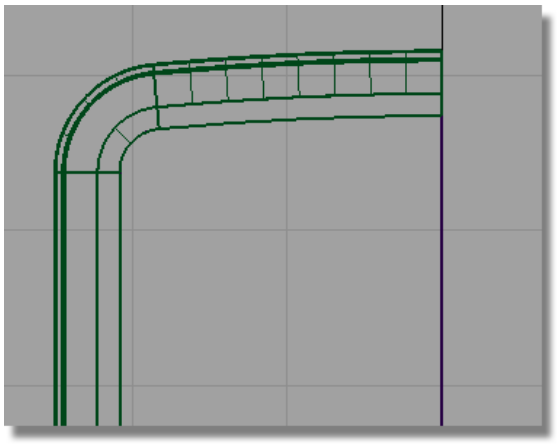
Watch **Part 4** of the tutorial.

Creating Offset Curves

To keep the structured style of the design, the shape of the screen will echo the curve at the top of the MP3 player.

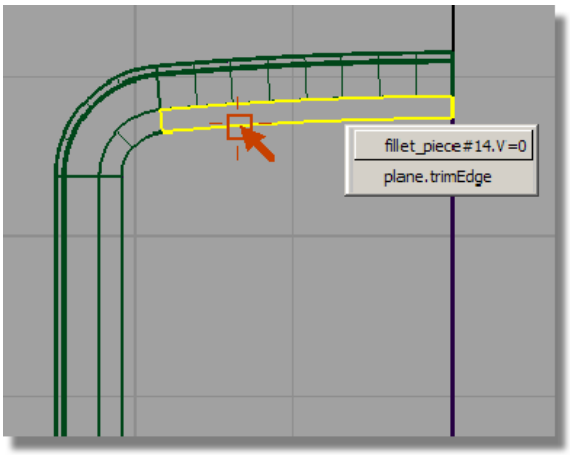
Start by duplicating the edge of the top surface to create a reference curve.

1. Maximize the **Top** window.
2. Turn off the Symmetry on the **Front Casing** layer, and zoom into the top half of the casing.

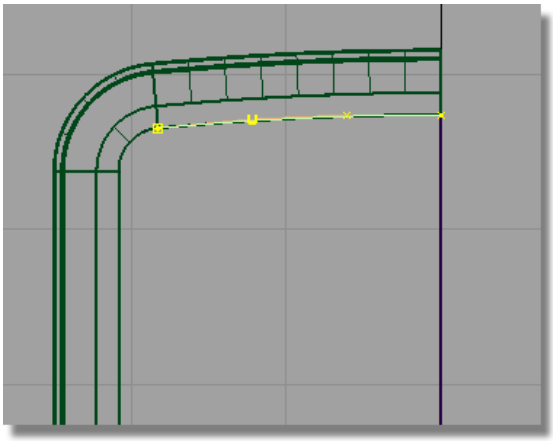


3. Choose Curve Edit > Create > Duplicate Curve and select the lower edge of the fillet surface at the top of the casing.
4. You will get a choice of picking the edge of the fillet surface or the edge of the plane.

   Select the edge of the fillet. This will give you a good quality curve.

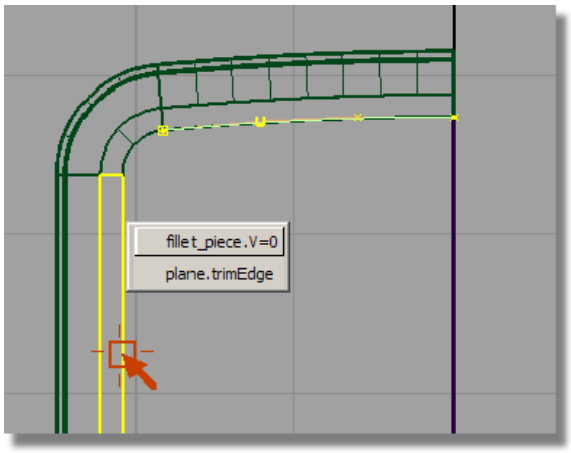


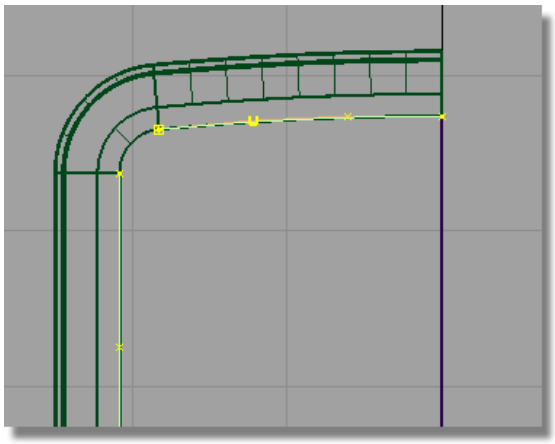
A curve is created that is a duplicate of the surface edge.



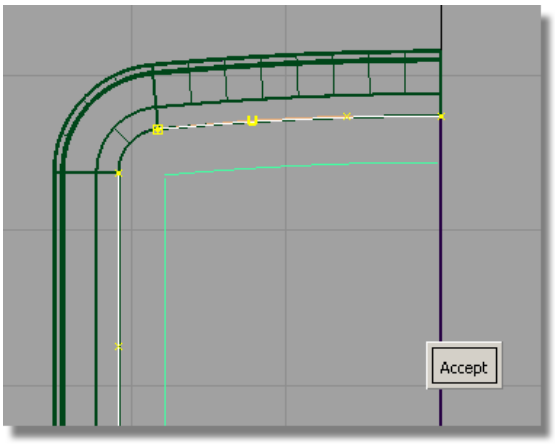
5 With the Curve Edit > Create > Duplicate Curve tool already active, select the fillet surface at the left side.

6 Again, choose the fillet edge, not the edge of the plane.

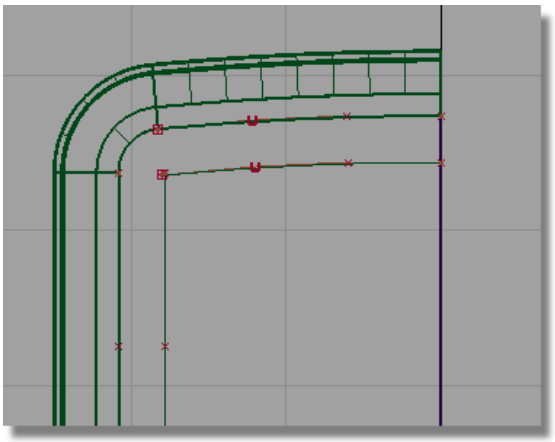




7 With the curves still highlighted, choose Object Edit > Offset and type in **-3** to create the top and side curves for the screen.



8 Click **Accept** to create the offset curve.

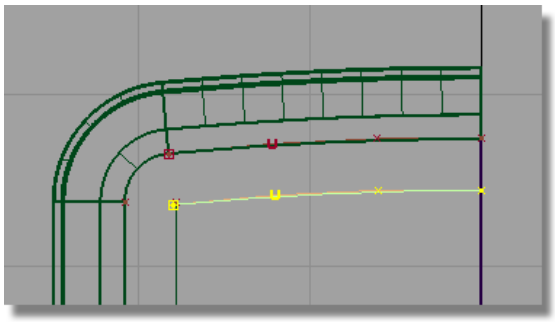


Now you will duplicate and mirror the top curve to create the lower curve.

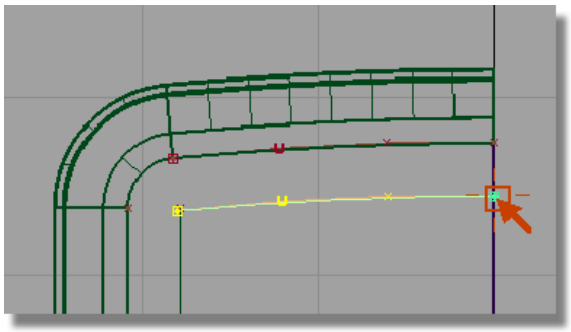
This time you will use a different technique for mirroring. The **Edit > Duplicate > Mirror** tool always mirrors across a grid axis. You will use the **Edit > Duplicate > Object** tool to mirror across an object's pivot point.

So first, set the pivot for the curve.

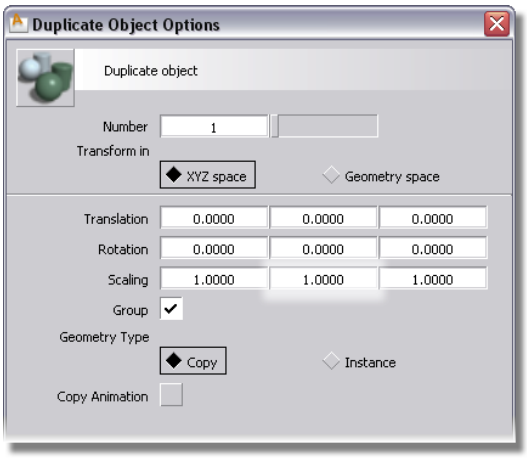
9 Choose Pick > Object and select the upper curve.



10 Choose Transform > Local > Set Pivot and use the *Ctrl* (Windows) or *Control* (Mac) key to snap the pivot point to the end of the curve.

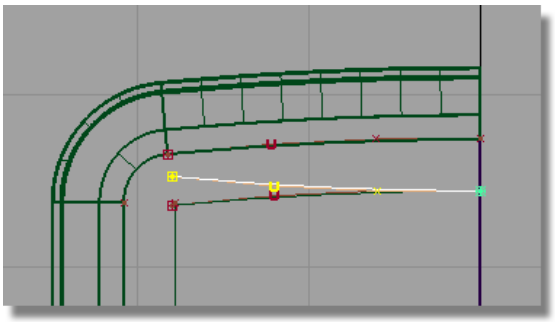


11 Choose Edit > Duplicate > Object ❐ to open the option window. Change the **Scaling** in the **y-direction** to **-1**.

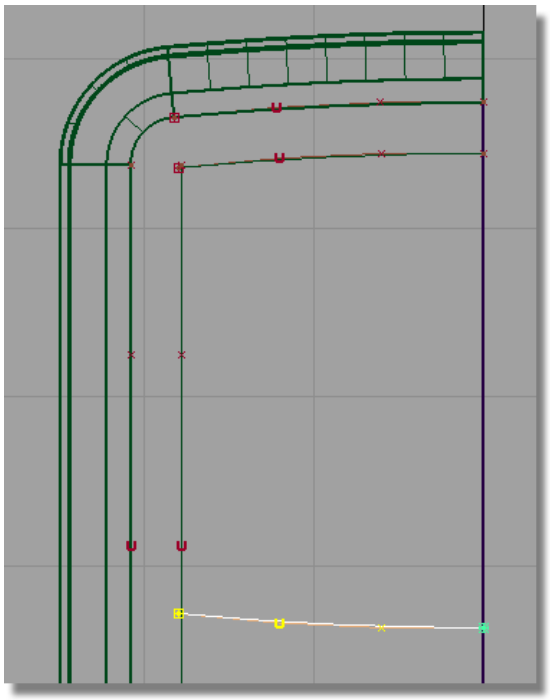


TIP **The Duplicate Object** tool is used to duplicate and transform objects in one operation. It is useful for creating patterns of many duplicates, and you will use it later in the tutorial to create the pattern of control buttons.

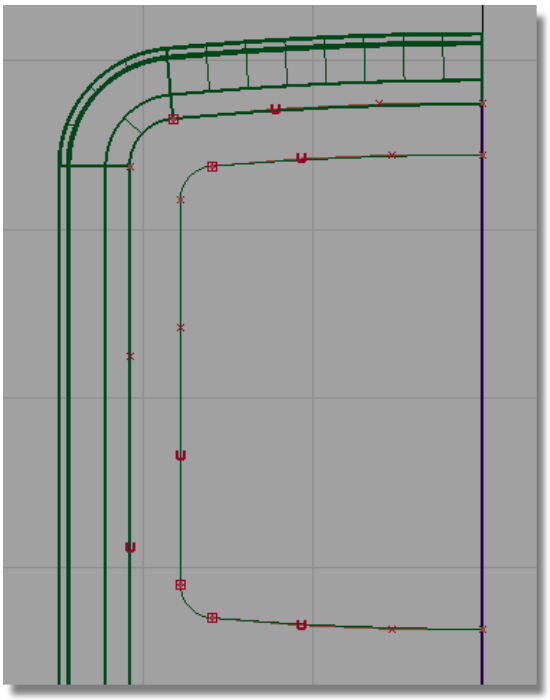
Click **Go** to create a duplicated curve, scaled in the Y-direction to create a mirrored copy.



12 Choose Transform > Move and type in **0, -28** to move the curve downward.



13 Choose Curve Edit > Create > Fillet Curves and follow the prompts to create fillets between the curves. Set the fillets radii to 2.0 by typing the value on the prompt line.



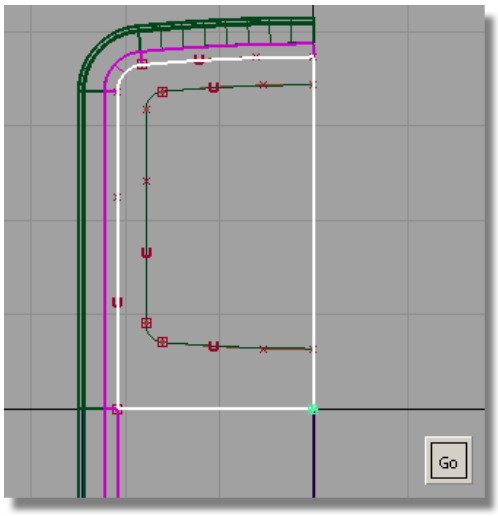
Projecting the Screen Curves

Next, you will **Project** the curves onto the front surface to cut out the screen shape.

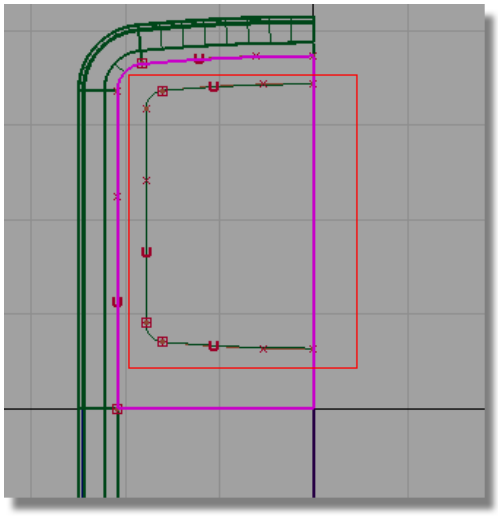
The direction of projection is determined by the active window: the curves will be projected perpendicular to the active window.

By continuing to work in the **Top** window, you will be setting the direction of projection correctly.

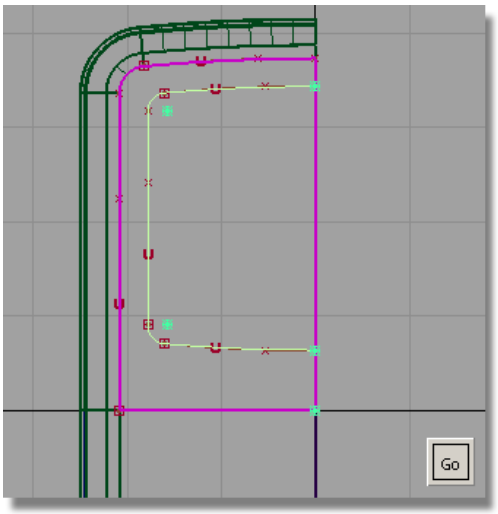
1. Choose Surface Edit > Create CurvesOnSurface > Project .
2. You are prompted to select a surface. Pick the plane surface, and click **Go**.



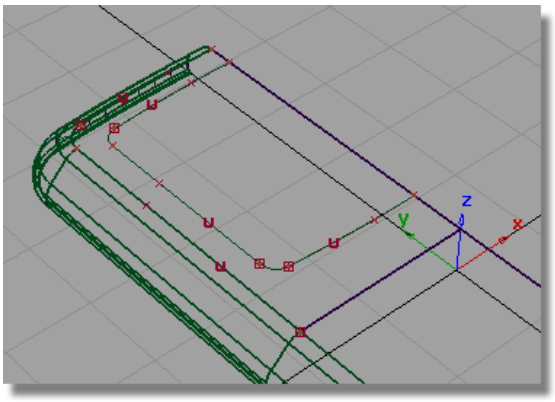
3 You are then prompted to select the curves to project. Drag a pick box over the screen outline curves you created.



4 Click **Go** to project the curves.



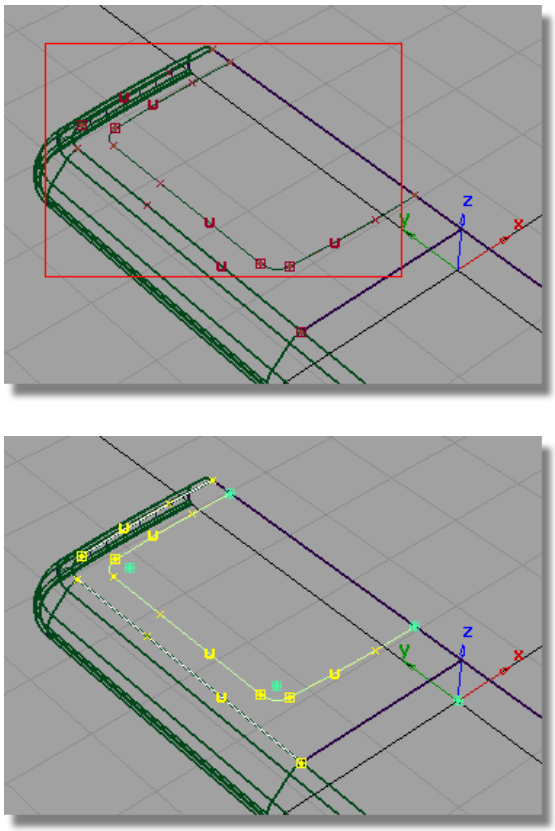
5 Maximize the **Perspective** window.



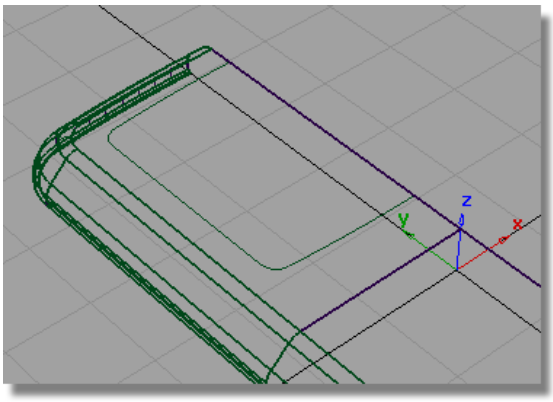
You will now template the curves, so that you can see the curves-on-surface more easily.

6 Choose Pick > Component and choose the curves-only option.

7 Drag a pick box over all the curves to select them.



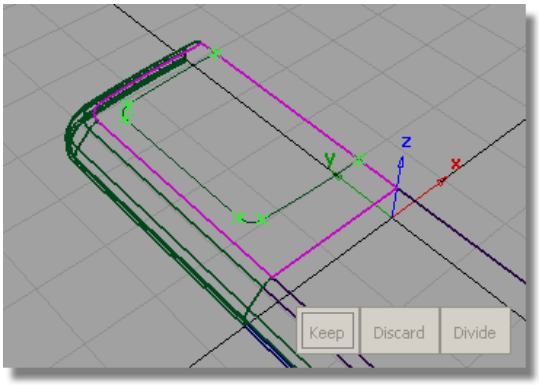
8 Choose ObjectDisplay > Template to template the curves.
Now you can see the curves-on-surface created by projecting.



Next, you will trim the front face of the casing to create the opening for the screen.

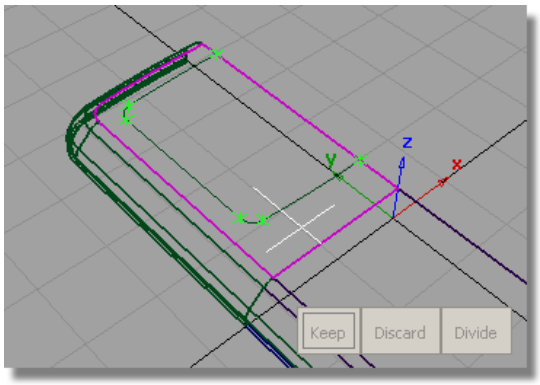
9 Choose Surface Edit > Trim > Trim Surface . You are prompted to select a surface to trim.

Pick the plane surface.

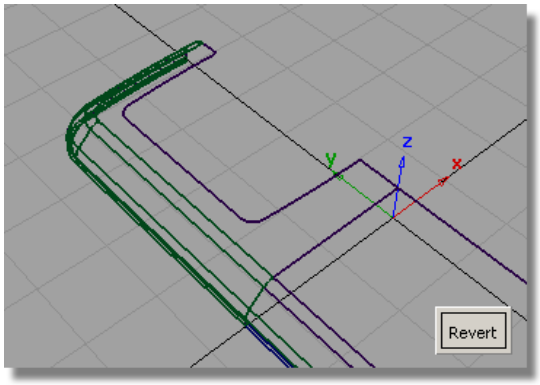


10 You are then prompted to select a region.

Click the plane surface, outside the screen area.



11 Click **Keep** to trim the surface.



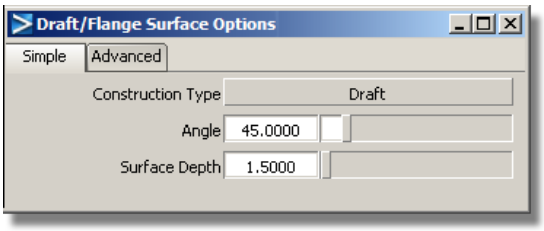
Creating the Screen Surfaces

Now you will create a chamfered edge for the screen, and a screen surface.

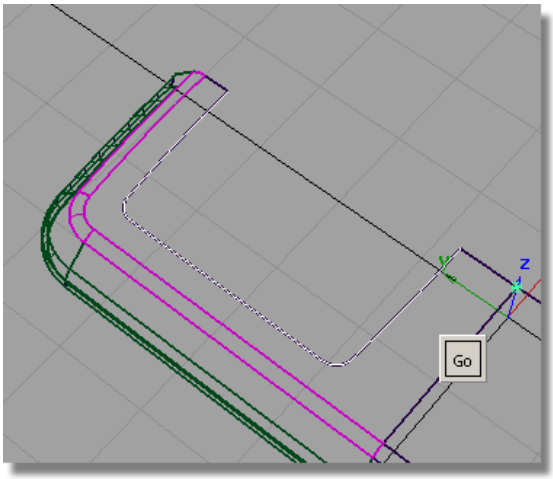
1 Choose Surfaces > Draft Surfaces > Draft/Flange. Double-click the icon to open the option window.

Reset the **Construction Type** to **Draft**.

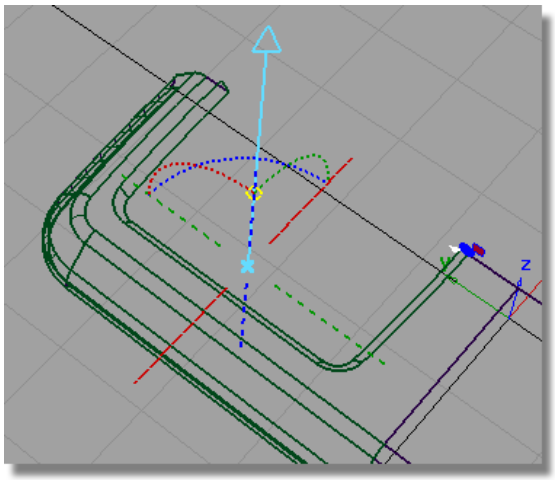
Set the **Angle** to **45** degrees and the **Surface Depth** to **1.5**.



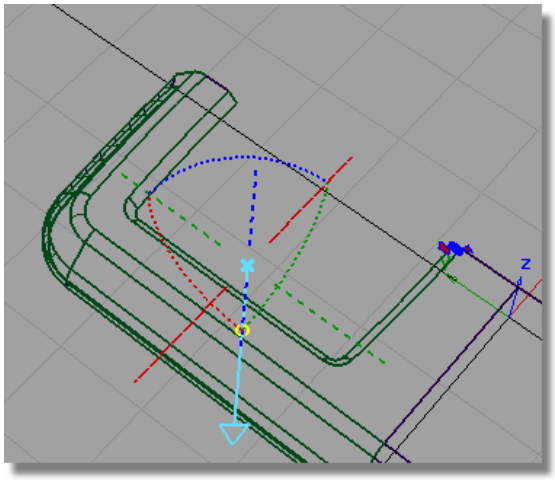
2 Select the edges of the screen to create the draft surface from.



3 Click **Go** to create the draft surface.

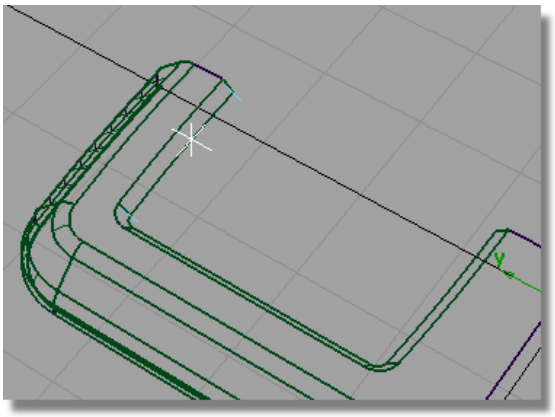


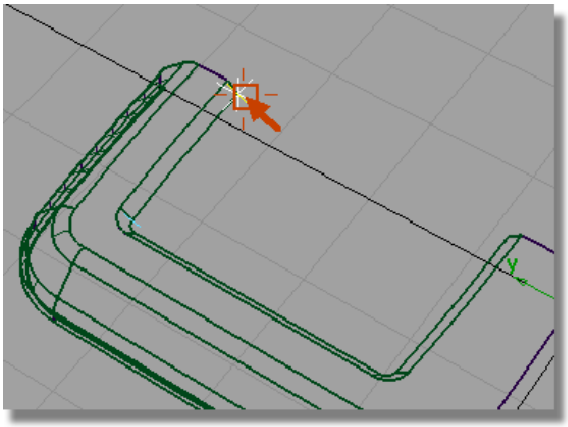
If the surfaces are built in the wrong direction, click the blue dotted line to switch the pull direction of the Draft surface.

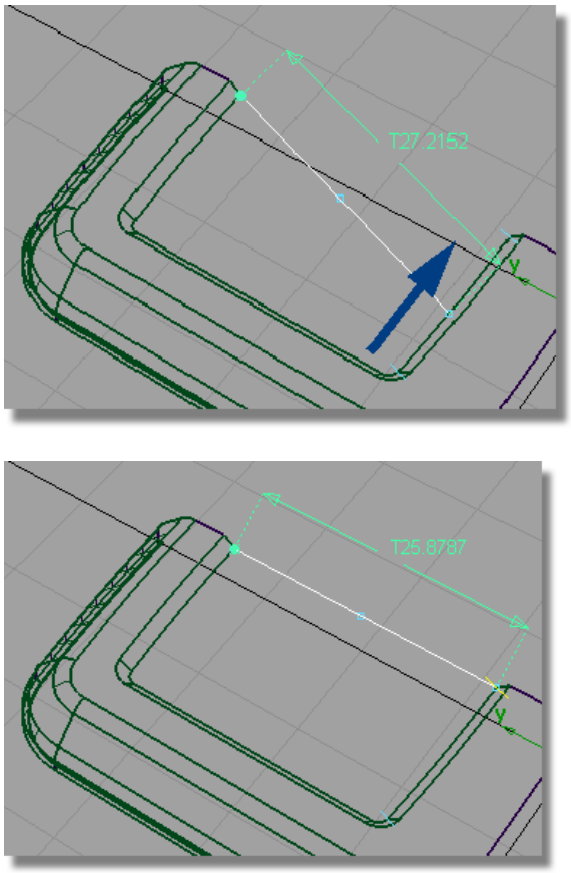


To finish off the screen, create a planar surface for the face of the screen.

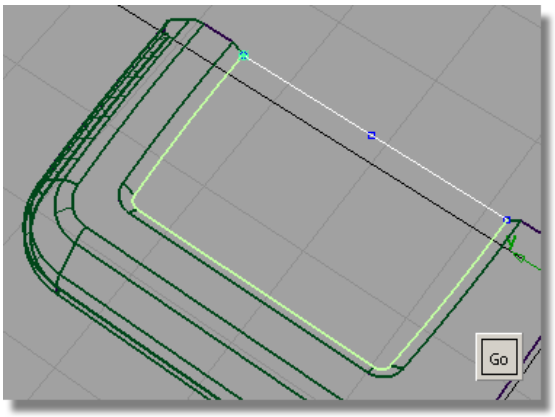
4 Choose Curves > Keypoint Curve Toolbox, then Keypoint Curve Tools > Lines > Line and use the curve snap (*Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac)) to create a curve for the center-line of the screen face.



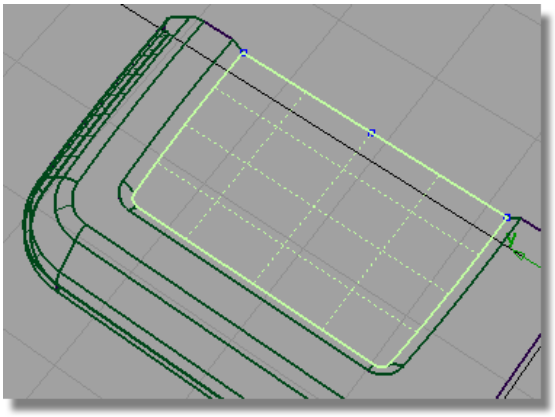




5 Choose Surfaces > Planar Surfaces > Set Planar and select all the lower edges of the screen chamfer.



6 Click **Go** to create the planar surface.



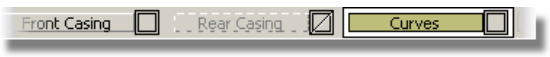
7 Assign all the surfaces to the **Front Casing** layer.

You now have lots of curves, so it's a good idea to organize them onto a separate layer.

8 Choose Layers > New to create a layer.



9 Change the layer name to **Curves**.



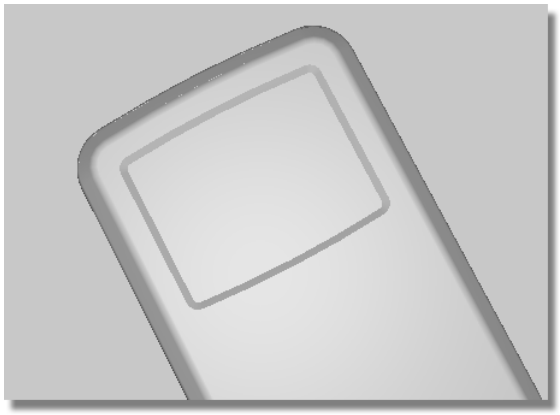
10 Use Pick > Template to select the templated curves, and **Assign** them to the new **Curves** layer.

11 Use Pick > Component to pick any remaining curves and **Assign** them to the **Curves** layer.

12 Make the **Curves** layer invisible.

13 Turn **Symmetry** on for **Front Casing** layer, and use diagnostic shading to evaluate the design.

(If you want, use the **Show** menu in the window title bar to turn off the **Model** and **Grid** for a better view.)



Saving your work

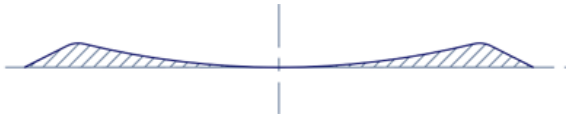
Save your work in the `wire` directory of the `Lessons` project. Name your file `myMP3Player4.wire`.

Part 5: Center Navigation Key

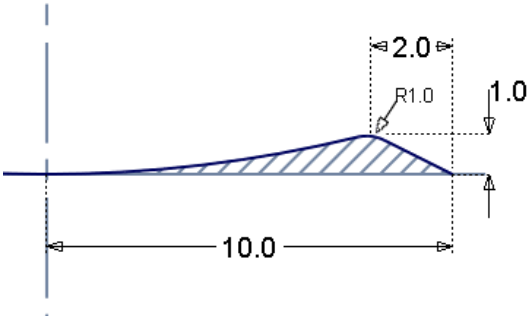
For most symmetrical designs, it is helpful to build the geometry centrally, around the origin. This will let you use the mirroring tools to duplicate geometry.

So, you will build the Navigation Key (and the control buttons in the next section) at the origin, and later move them into the correct location on the front casing.

A cross-section of the Navigation Key is shown below. Only the part of the key that will be seen above the casing will be built.

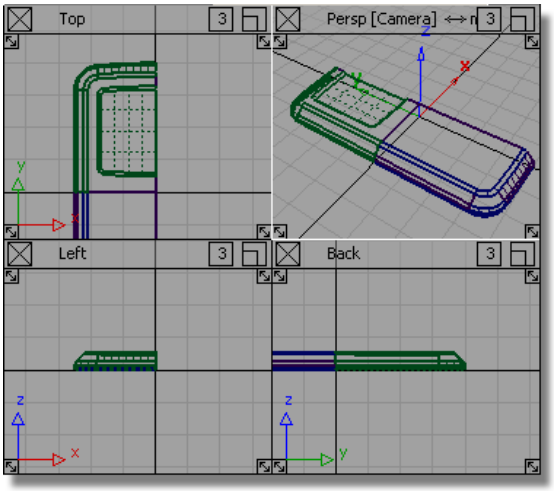


The dimensions for the Navigation Key profile are shown below. This will be revolved to create the button surfaces.



Opening the tutorial file (optional)

If you successfully completed Part 4, proceed to the next step: Navigation Key Curves below.



If you were not successful in part 4, open the file called `MP3Player_part5.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 4.



Watch **Part 5** of the tutorial.

Navigation Key Curves

You will create the cross-section profile of the Navigation key using **Keypoint** curves, and then **Revolve** them to create the surfaces.

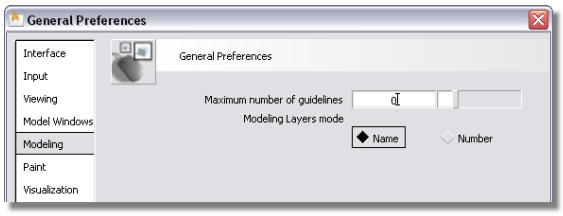
1. Turn off the visibility of the **Front Casing** layer.
2. Choose Layers > New to create a layer for the central navigation key. Change the layer name to **NaviKey**.



Maximize the **Left** window.

First you will create a construction line to specify the tangency for the center of the button.

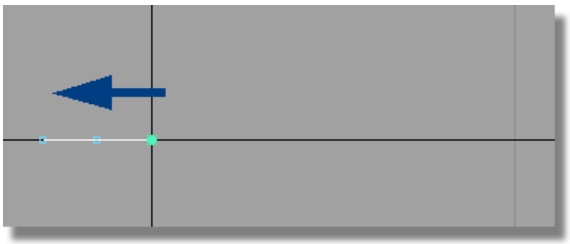
TIP It can be useful to turn off the guidelines when you are using **Keypoint** curves. To do this, choose Preferences > General Preferences ❒ to open the option window. In the **Modeling** section, choose zero for the **Maximum Number of Guidelines**. This prevents any guidelines from being created.



3. Choose Curves > Keypoint Curve Toolbox, then Keypoint Curve Tools > Lines > Line and use *Grid Snap* (the *Alt* (Windows) or *Command* (Mac) key) to place the start point at the origin.



Use the *middle mouse button* to place the second point of the line horizontally to the left of the origin. The length of the line isn't important, as it will only be used to help create a tangent arc.



Now you will draw the line for the outer chamfered edge.

4 Choose Curves > Keypoint Curve Toolbox , then Keypoint Curve Tools > Lines > Line again. When prompted to enter the start point of the line, use *Grid Snap* (*Alt* (Windows) or *Command* (Mac) key) to place the start of the line at the grid point at 10 mm in the X direction.



When prompted to place the end point of the line, type in **R-2,0,1**.

TIP The letter **R** is used to switch from **ABS**olute to **REL**ative dimensioning.



Now you will create an arc for the center of the button.

5 Choose Curves > Keypoint Curve Toolbox, then Keypoint Curve Tools > Arcs > Arc Tangent to Curve . You are prompted to

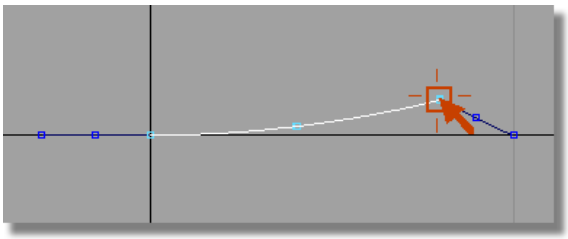
```
Select curve at location to make arc tangent to.
```

Click the first line, and without releasing the mouse button drag the start of the arc to the end of the line at the origin.





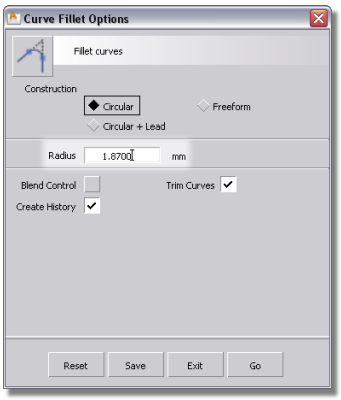
You are prompted to enter the end point of the arc. Use the *Point Snap* (*Ctrl* (Windows) or *Control* (Mac) key) to place the end point of the arc on the top keypoint of the angled line.



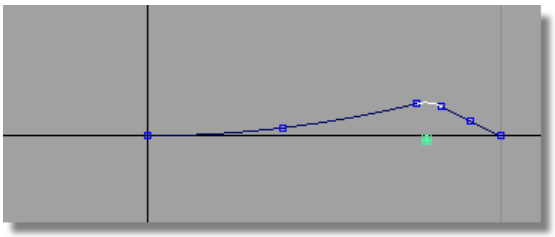
6 The horizontal line you created isn't needed any more, so use Pick > Object to select it and press the *Delete* key to remove it.

7 Choose Curve Edit > Create > Fillet Curves and double-click to open the option window.

Change the **Radius** to **1.87**.



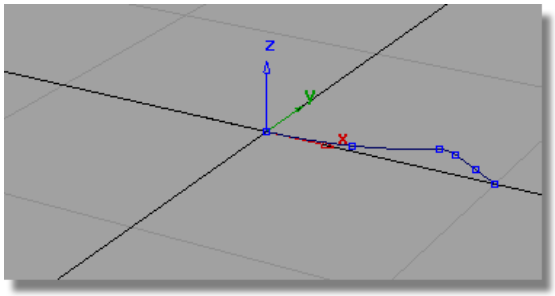
Follow the prompts to create a 1.87-mm radius fillet between the curves.



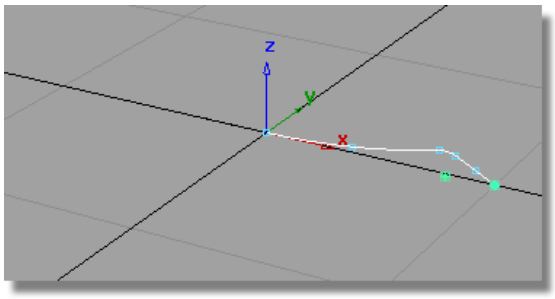
Revolving the Surfaces

Now you will revolve the profile curves to create the button surfaces.

1 Maximize the **Perspective** window.



2 Choose Pick > Object and select the profile curves.



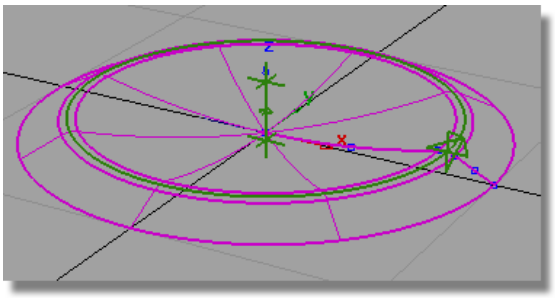
3

4 Choose Surfaces > Revolve and double-click to open the option window.

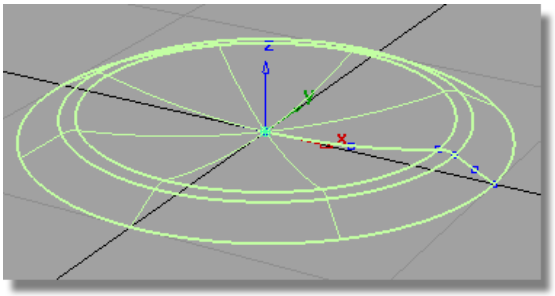
Choose the **Global** option for the **Axes**. This will allow you to revolve many curves at once, around the origin, not around each curve's pivot point.



Click the **Go** button and the surfaces will be revolved.

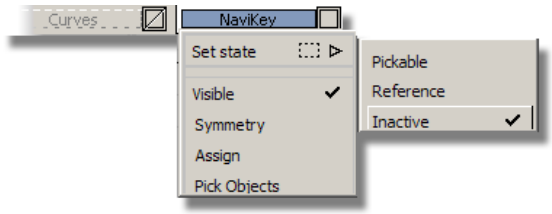


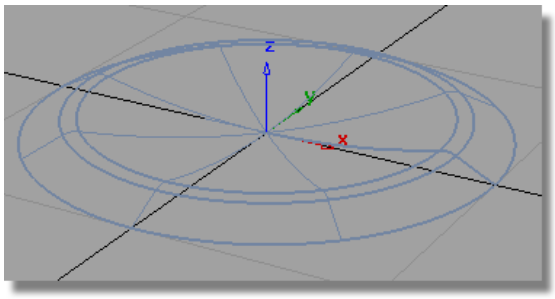
5 Choose Pick > Object and the surfaces will automatically be selected.



6 Choose Edit > Group to group the surfaces together to create the navigation button.

Assign the grouped surfaces to the **NaviKey** layer, and make it inactive.





Assign the curves to the **Curves** layer.

Saving your work

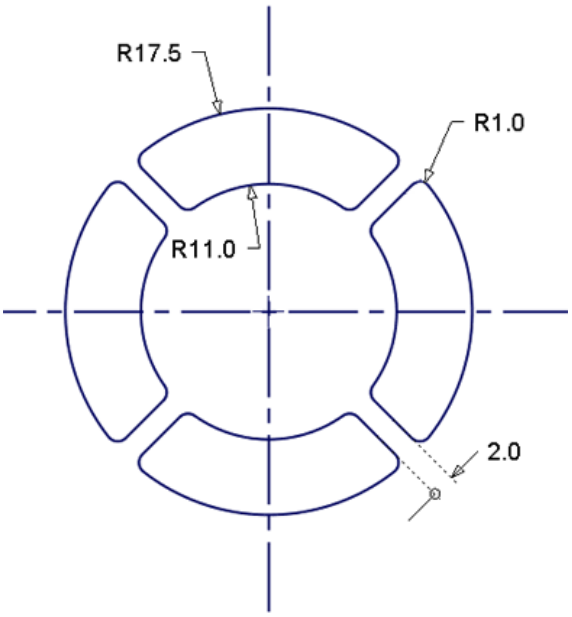
Save your work in the `wire` directory of the `Lessons` project. Name your file `myMP3Player5.wire`.

Part 6: Control Button

There are four Control Buttons, so you will start by creating only one, and then later duplicate it to create the other three.

Each button is symmetrical, so to save time, you will only build one half of one button, and use mirroring to create the other half.

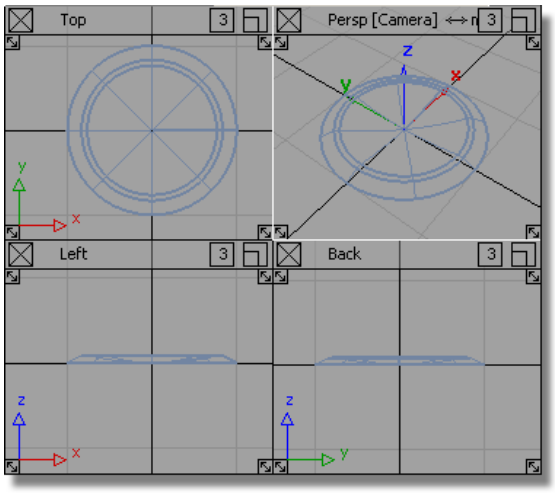
The dimensions for the buttons are shown below.



The button surfaces will be created using the **Revolve**, and **Round** tools.

Opening the tutorial file (optional)

If you successfully completed Part 5, proceed to the next step: Control Button Revolved Surface below.



If you were not successful in part 5, open the file called `MP3Player_part6.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 5.



Watch **Part 6** of the tutorial.

Control Button Revolved Surface

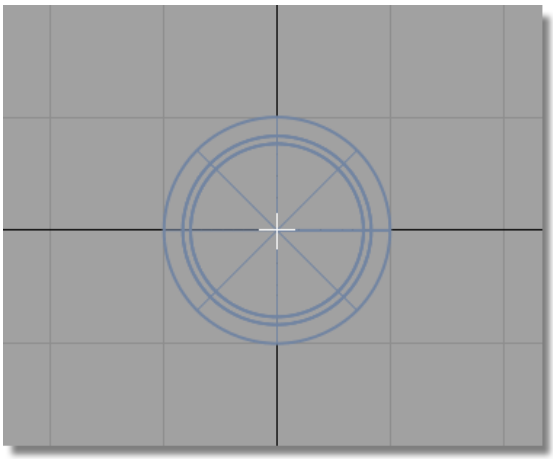
First, you will create the outline circles for the button design.

1. Maximize the **Top** window
2. Choose Layers > New to create a layer. Change the name of the layer to **Control Buttons**.



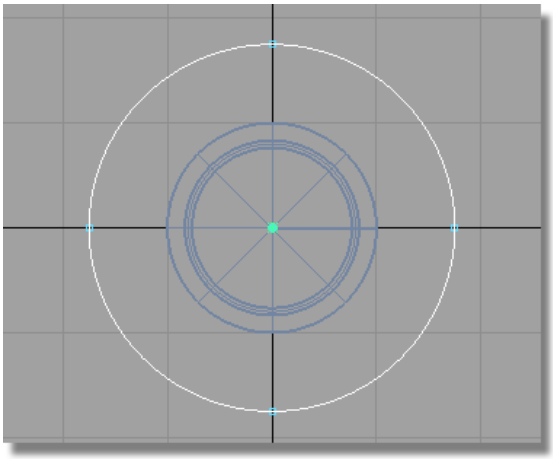
3. Choose Curves > Keypoint Curve Toolbox , then Keypoint Curve Tools > Circular Arc . You are prompted to enter the center of the circle.

   Type in **0** to place the center of the circle at the origin.

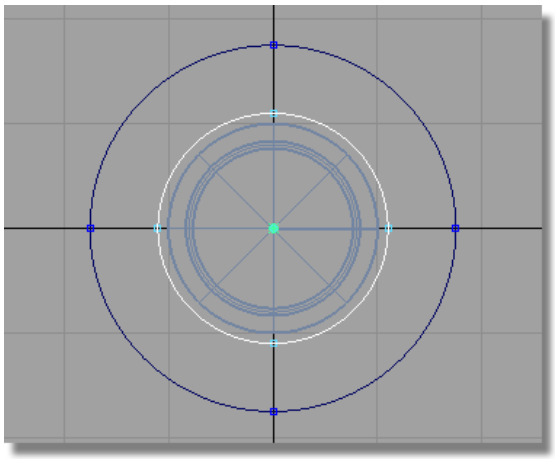


You are prompted to enter a point on the radius of the circle.

Type in **17.5** to create a circle with a radius of 17.5 mm.

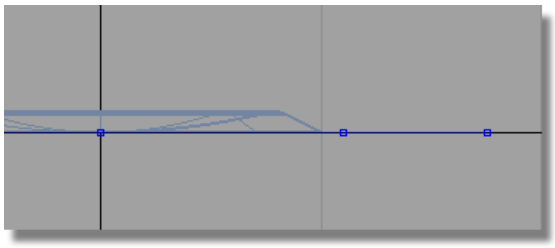


4 Choose Curves > Keypoint Curve Toolbox, then Keypoint Curve Tools > Circular Arc again, and create a circle with the center at the origin and a radius of 11 mm.

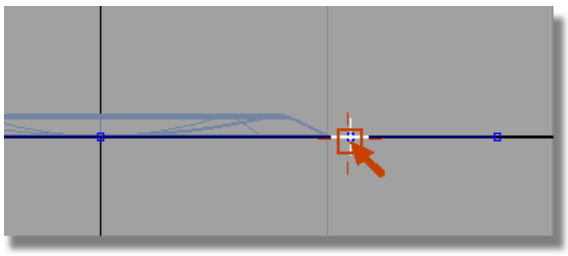


Now you will use these circles to create an arc for the top surface of the buttons.

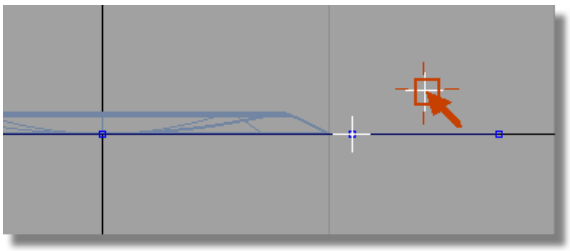
Maximize the **Left** window and zoom into the right-hand side of the circles. You will use the **Keypoints** on the two circles to locate the arc.



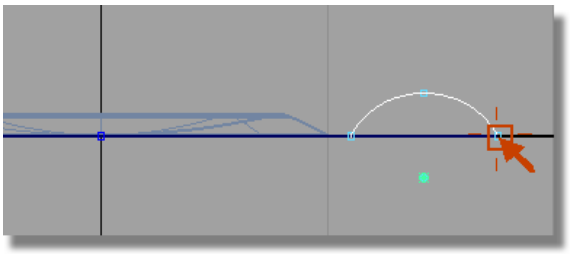
5 Choose Curves > Keypoint Curve Toolbox , then Keypoint Curve Tools > Arcs > Arc (Three Point) . You will be prompted to place the start point of the arc. Use point snap (*Ctrl* (Windows) or *Control* (Mac) key) and select the keypoint on the inner circle.



When prompted for the next point on the arc, select an approximate location for the peak of the curve. This doesn't need to be accurate, as later you will set the radius of the arc accurately using the Information window.



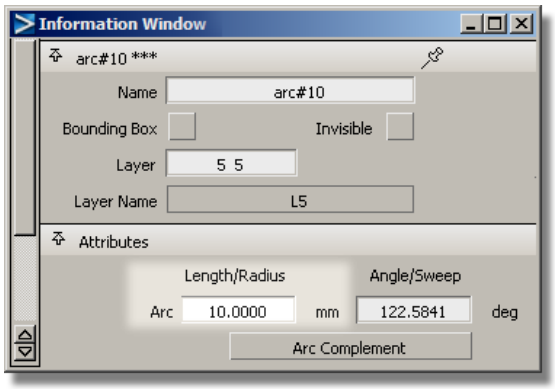
When prompted to place the end point of the arc, use the point snap (*Ctrl* (Windows) or *Control* (Mac) key) again and choose the keypoint on the large circle.



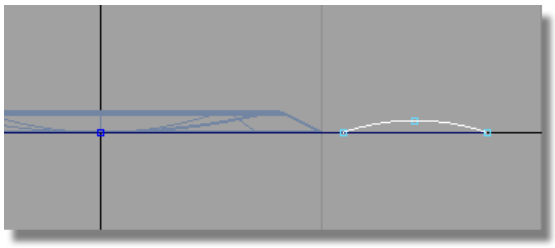
The arc is created at an approximate radius, but with an accurate start and end point.

6 With the arc still selected, choose Windows > Information > Information Window .

Open the **Attributes** section, and change the **Arc Length/Radius** to **10**.

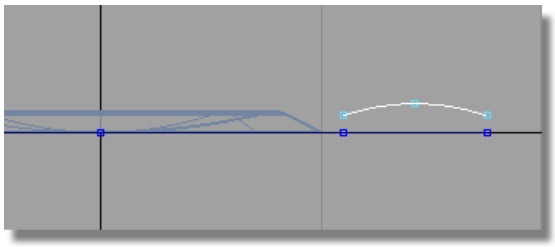


The radius is changed, but the end points remain in the same locations.

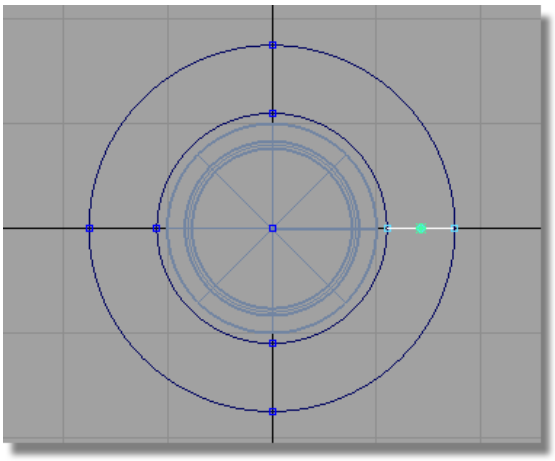


Now you will move the arc up to raise the button surface above the casing.

7 With the arc still selected, choose Transform > Move and type in **0,0,0.75** to move the arc up 0.75mm in the z-direction.

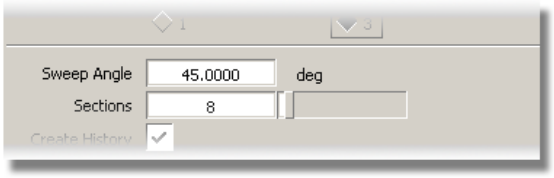


8 Maximize the **Top** window. Leave the curve selected, as it will now be used to create a revolved surface.

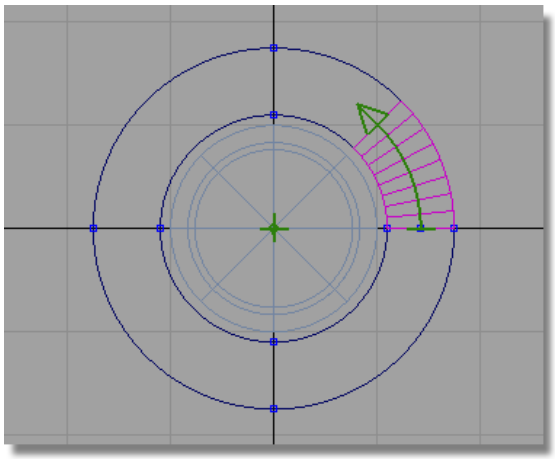


9 Choose Surfaces > Revolve and double-click the icon to open the option window.

Change the **Sweep Angle** to 45, and ensure that **Axes** is set to **Global**, then click **Go**.



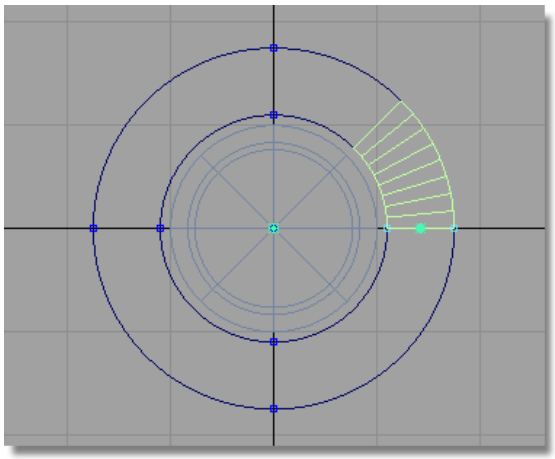
TIP When revolving a smaller amount, you can reduce the number of sections to reduce the isoparms in the revolved surface.



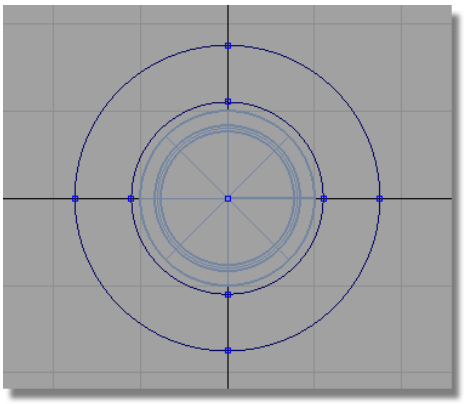
The revolved surface is created.

Now you will temporarily hide the revolved surface and the arc, to make it easier to work on the outline curves.

10 Choose Pick > Object and select the surface and the arc.



11 Choose ObjectDisplay > Invisible to temporarily hide the surface and the curves.

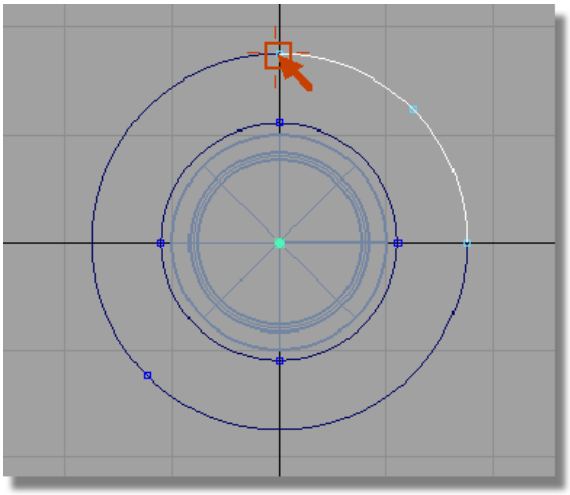


Creating the Control Button Draft Surfaces

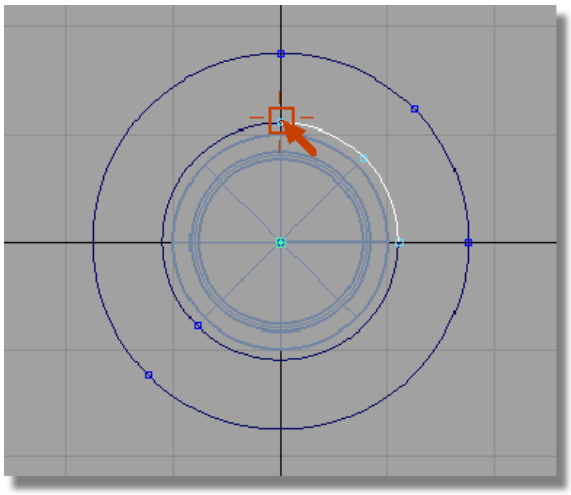
Now you will trim the two circles to create the button outline.

1 Choose Curves > Keypoint Curve Toolbox , then Keypoint Curve Tools > Break & Join > Break Curve at Keypoint .

Click the top keypoint of the outer curve.



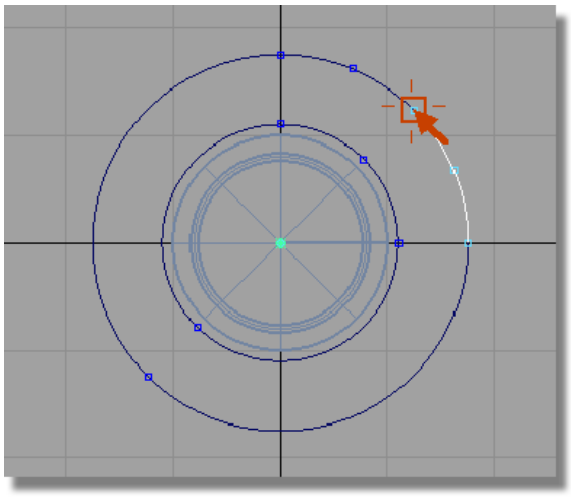
Still in the **Break at Keypoint** tool, click the top keypoint of the inner curve.

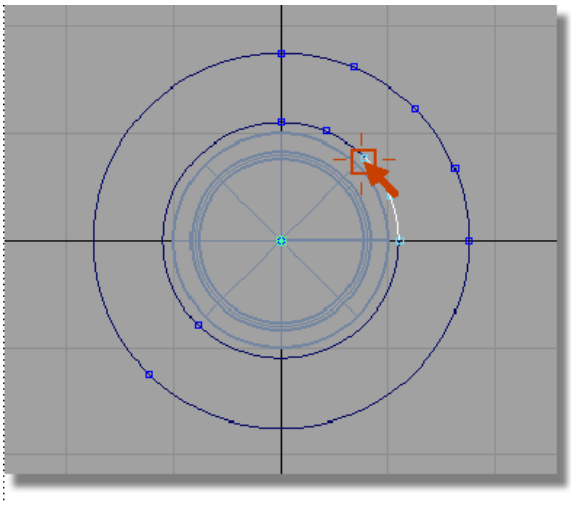


The curve is split, and the top right-hand segments now have keypoints at their centers.

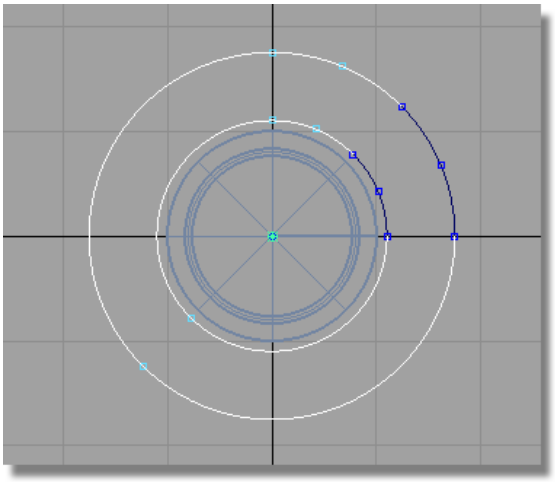
You will now break the curves at these keypoints to create a 45 degree segment.

Click the middle keypoint of each curve to break it into 45 degree segments.

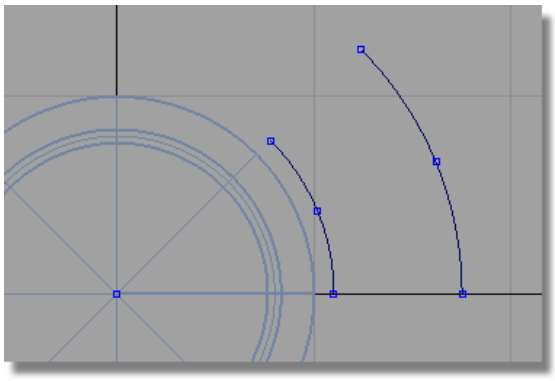




2 Choose Pick > Object and select the parts of the circles you don't need.



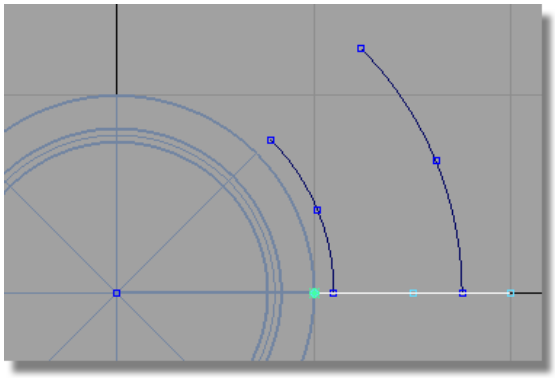
3 Press the *Delete* key to delete the curves.



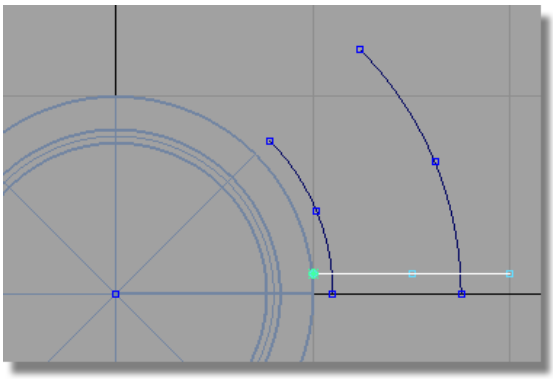
Trimming Curves

Next, you will trim the two arcs and the line to create the outline of a single button.

1 Choose Curves > Keypoint Curve Toolbox , then Keypoint Curve Tools > Lines > Line and snap to the grid points (*Alt* (Windows) or *Command* (Mac) key) to create a horizontal line. You will create the line over-long so that it can be used for trimming.

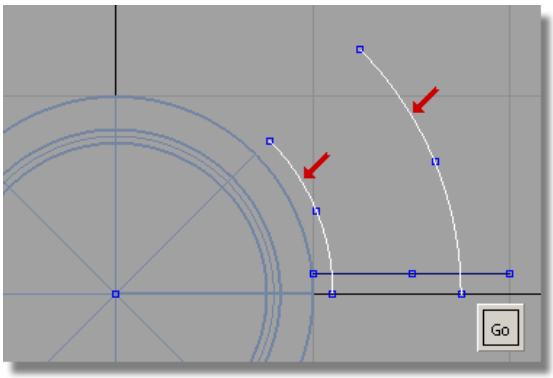


2 Choose Transform > Move and type in 0,1 to move the line up by 1 mm in the y-axis.

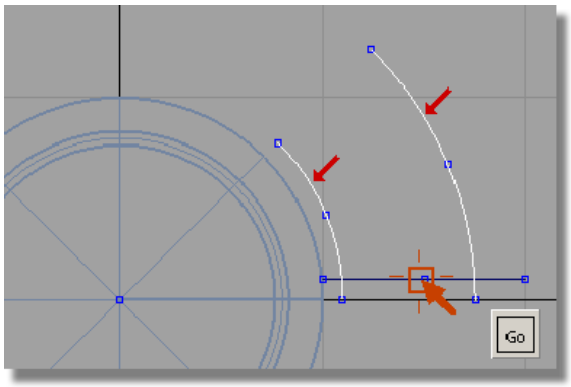


3 Choose Curve Edit > Curve Section .

You will be prompted to select a curve to trim. Click both arcs, above the line and click the GO button

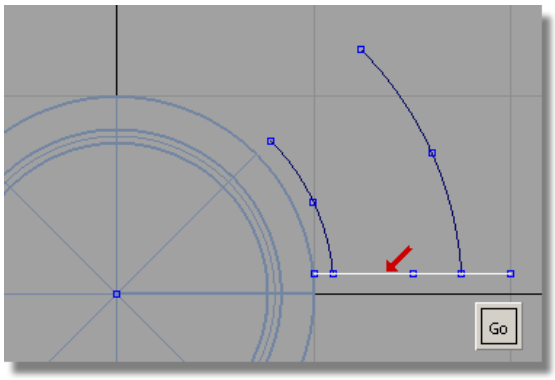


You will be prompted to select the trimming curves. Choose the line.

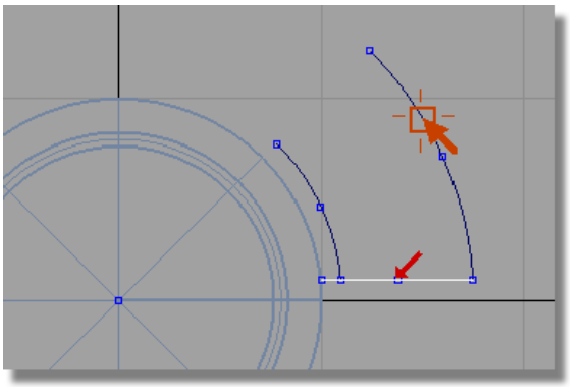


The arcs are trimmed.

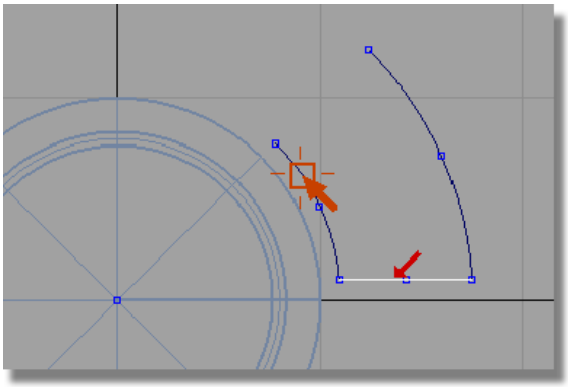
4 Choose Curve Edit > Curve Section again and this time choose the line. Make sure you select the curve in between the arcs, to keep that part of the line.

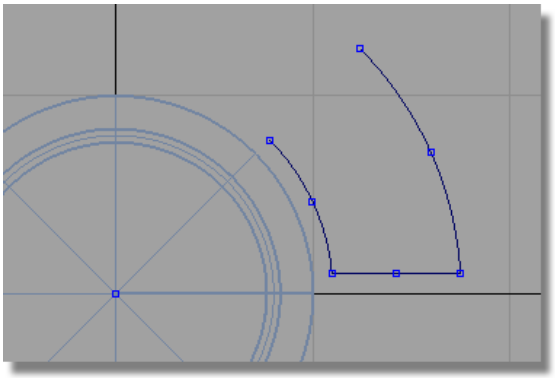


When prompted to select the trimming curves, first choose the outer arc.



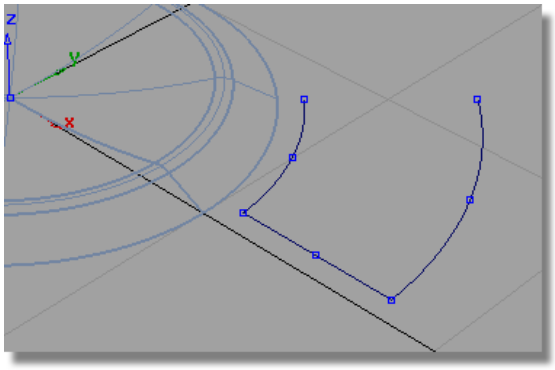
Then choose the inner arc to complete the trimming.



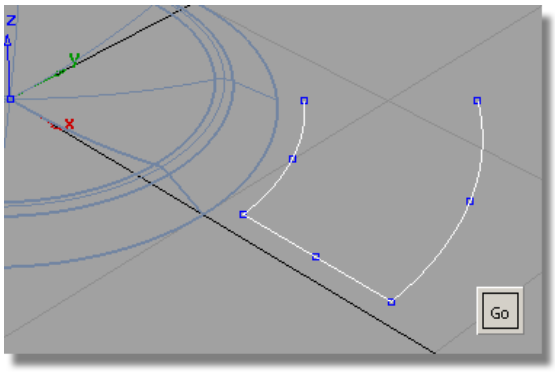


Creating the Draft Surfaces

1 Maximize the **Perspective** window.

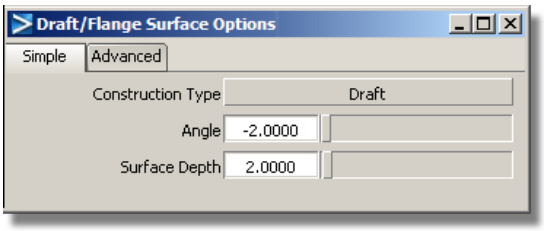


2 Choose Pick > Object and select all the curves.

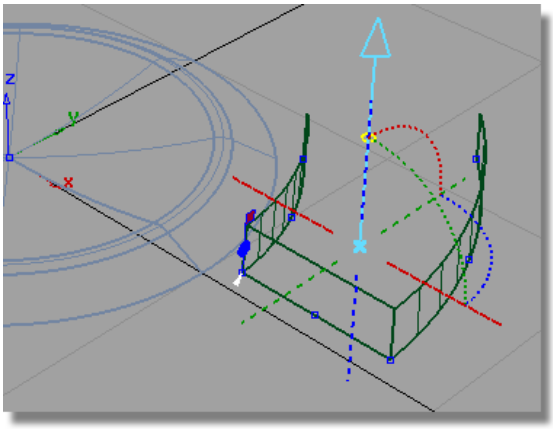


3 Choose Surfaces > Draft Surfaces > Draft/Flange and double-click to open the option window.

Modify the settings to **Draft Angle -2** degrees, and a **Surface Depth** of **2** mm

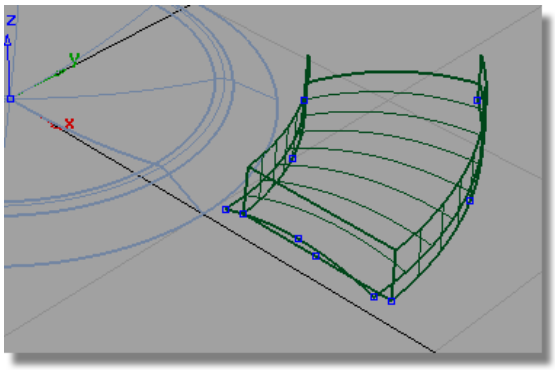


TIP The pull direction may be set to –z from the last Draft operation. Click the dotted blue line to make sure the pale blue arrow is pointing upwards in a positive z direction.



NOTE Depending on your curves, you may need to change the **Draft Angle** to **+2** to get the side walls falling inwards with the draft.

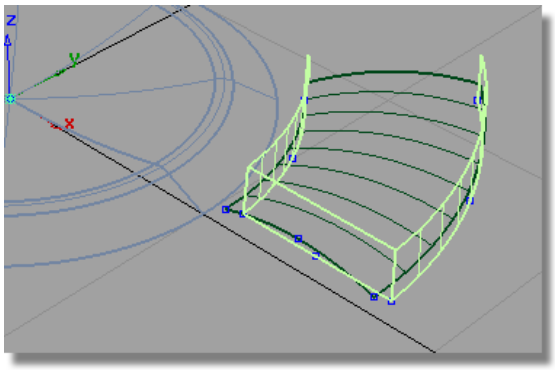
4 Choose ObjectDisplay > Visible to make the revolved surface of the button visible again.



Intersecting and trimming the buttons

Now you will **intersect** and **trim** the button surfaces to create a trimmed model and then use the **Round** tool to complete the button design.

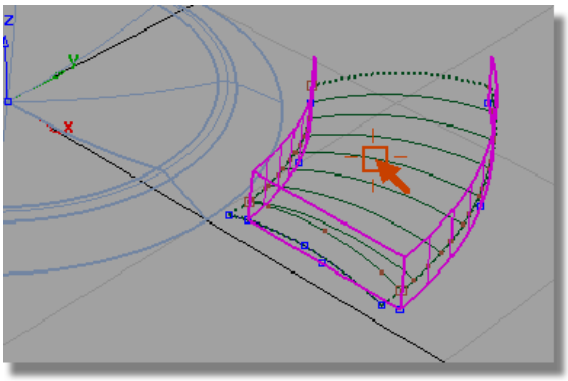
1 Choose Pick > Object and pick the draft surfaces.



2 Choose Surface Edit > Create CurvesOnSurface > Intersect .

As the draft surfaces have already been selected, you will be prompted to select the intersecting surfaces.

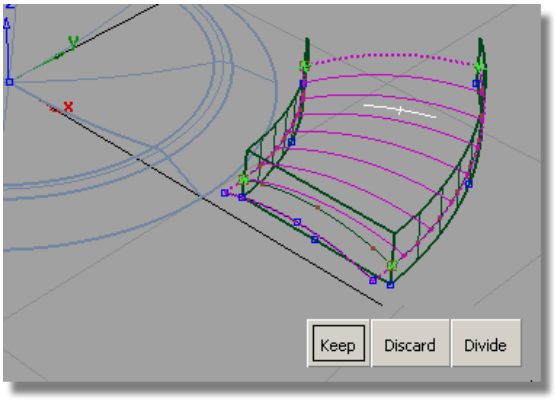
Click the revolved surface.



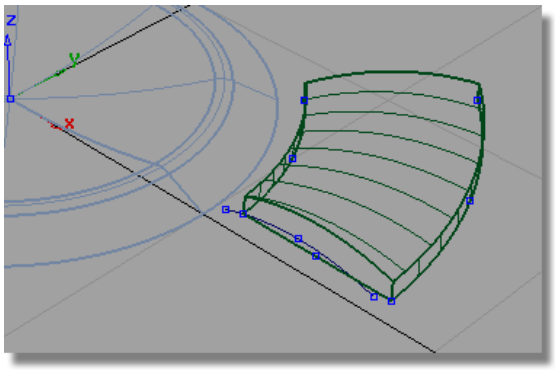
The surfaces are intersected and curves-on-surface created.

3 Choose Surface Edit > Trim > Trim Surface .

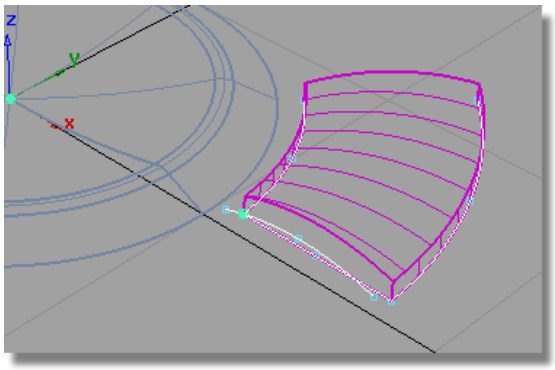
Follow the prompts to trim the revolved surface to keep the inner part.



Trim the draft surfaces to keep the lower parts.



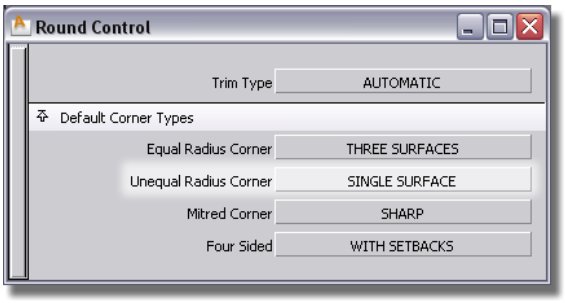
4 Choose Pick > Component to select all the curves and **Assign** them to the **Curves** layer.



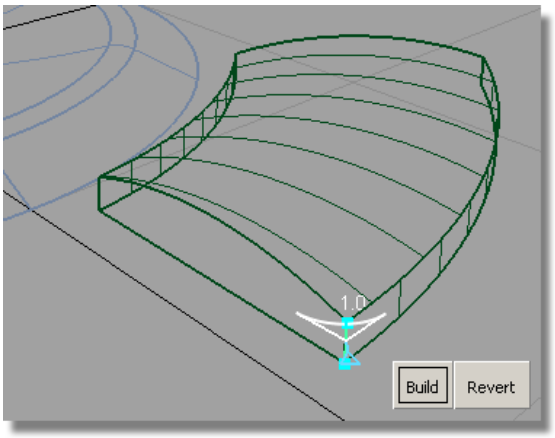
Rounding Multiple Edges

1 Choose Surfaces > Round and double-click the option box to open the option window.

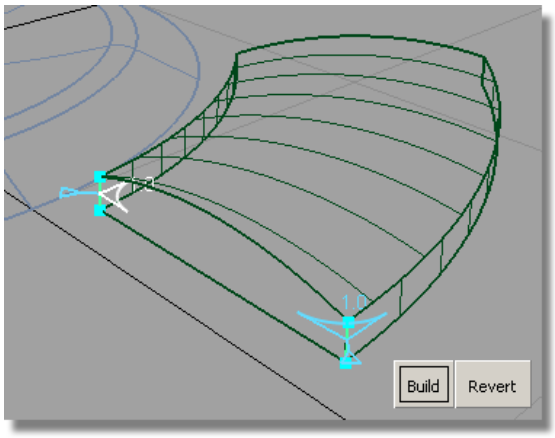
2 Change the **Unequal Radius Corner** to **Single Surface** to create a simple rounded corner.



3 Select one of the side edges, and type in 1 at the prompt line to set the round radius to 1 mm.

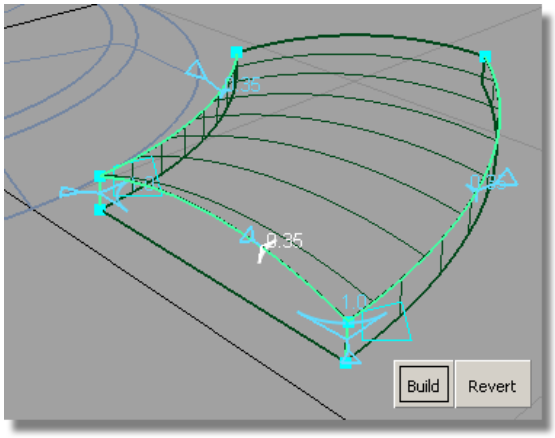


4 Select the other side edge and leave the radius value at 1.

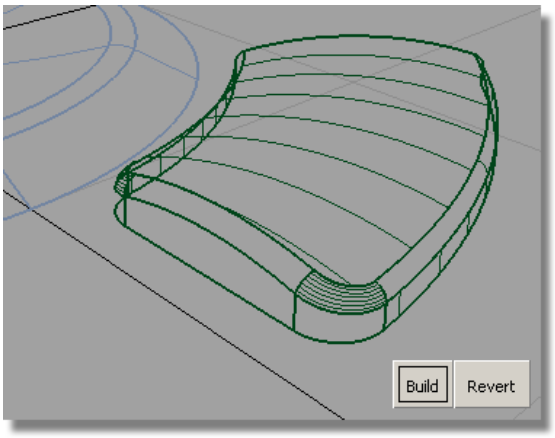


5 Select one of the top edges and type in 0.35 in the prompt line to change the round radius to 0.35mm.

6 Select the other three top edges.



7 Click the **Build** button to create the round.



The advantage of using the round tool on multiple edges is that the blended corner surfaces are built automatically.

Saving your work

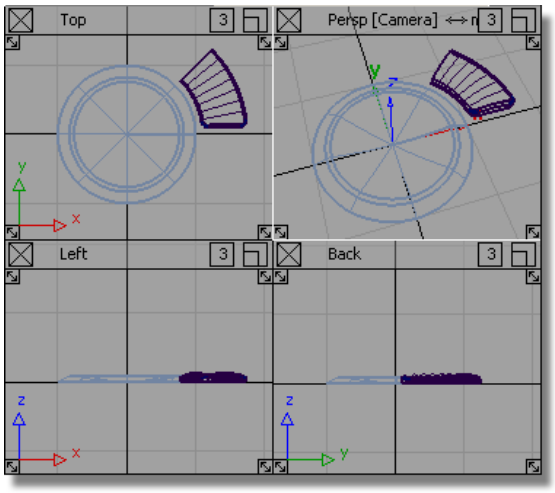
Save your work in the `wire` directory of the `Lessons` project. Name your file `myMP3Player6.wire`.

Part 7: Completing the Model

You will now complete the MP3 Player design by duplicating the control buttons, and moving all the buttons into the correct position on the front casing.

Opening the tutorial file (optional)

If you successfully completed Part 6, you can proceed directly to the next step: Creating Four Buttons below.



If you were not successful in part 6, open the file called `MP3Player_part7.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 6.

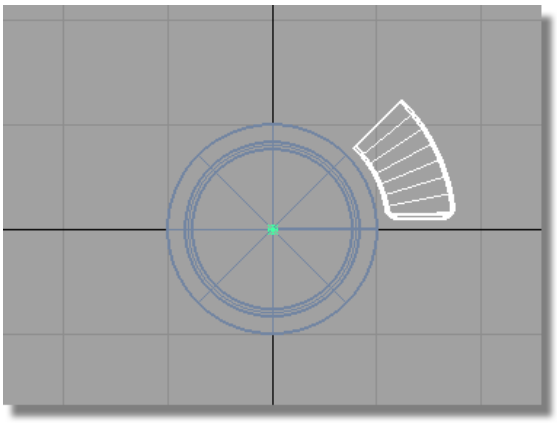
Creating Four Buttons



Watch **Part 7** of the tutorial.

First, you will rotate the half-button into the correct orientation, and then mirror the surfaces to create one full button.

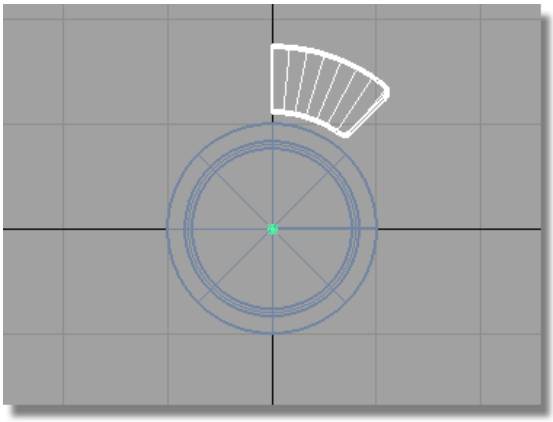
1. Maximize the **Top** window.
2. Choose Pick > Object and select all the surfaces.



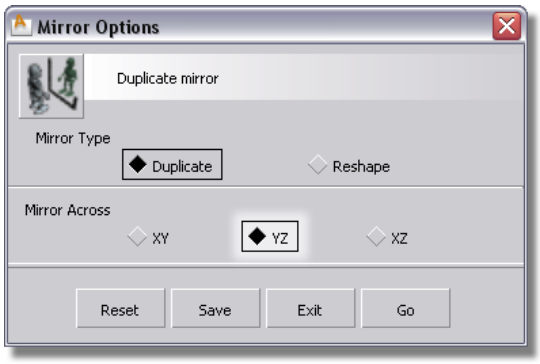
3 Choose Edit > Group to group them all , with a single pivot point at the origin.

4 Choose Transform > Rotate and type in **0,0,45**.

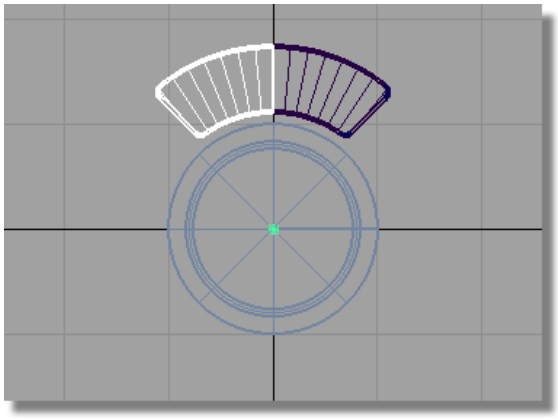
You will be asked about losing construction history, answer **Yes**.



5 Choose Edit > Duplicate > Mirror ❒ and select the **YZ** plane to **Mirror Across**.

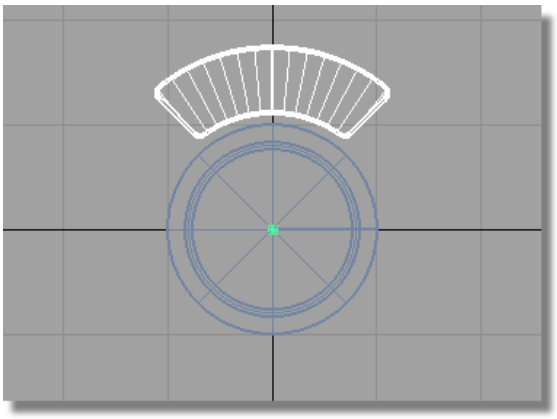


6 Click **Go** to create the mirrored geometry.



7 Choose Pick > Object and select both halves of the button.

8 Choose Edit > Group to group them as a single button.

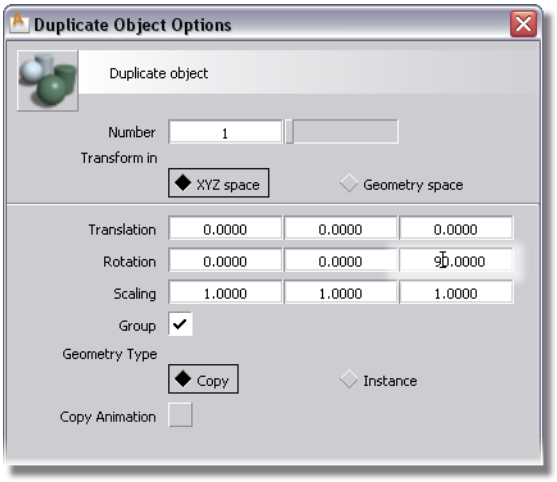


You now have one complete button, in the desired orientation, so now you will create three additional buttons.

Choose Edit > Duplicate > Object ❒

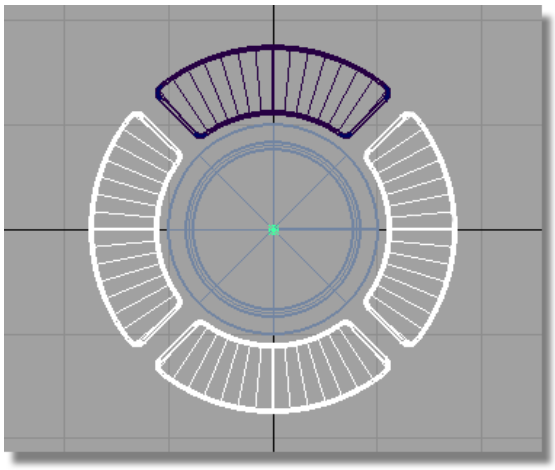
First, click the **Reset** button at the bottom of the option window. This will restore all the default settings.

Then set the **Number** of duplicates to **3**, and the **Rotation** to **90** degrees in the **z-axis**.

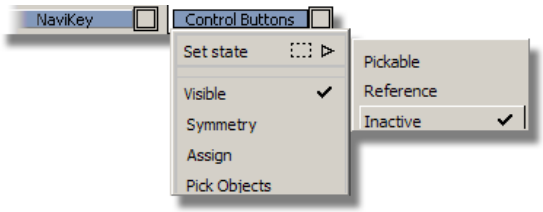


Click Go to create the duplicates.

The four buttons are created.



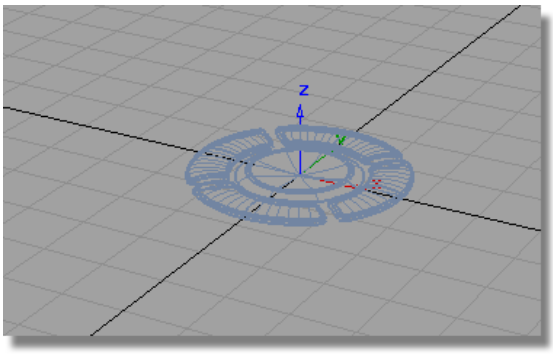
9 Make sure that all the buttons are on the Control Buttons layer, and set the layer to inactive.



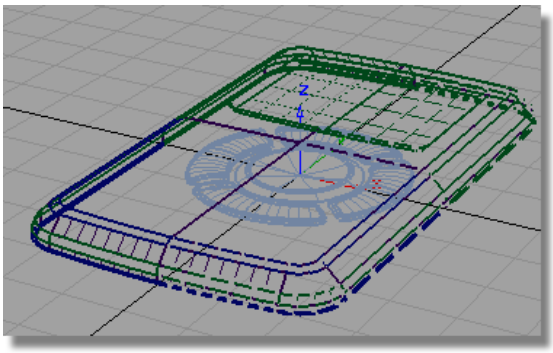
Positioning the Buttons

Now you will move the buttons into their correct location, centered on the lower part of the Front Casing.

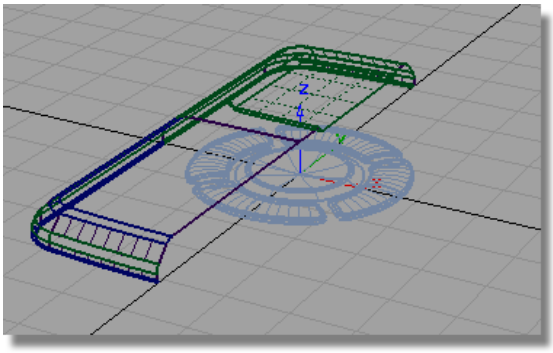
1 Maximize the Perspective window.



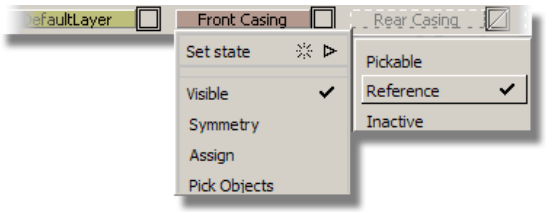
2 Make the Front Casing layer visible.

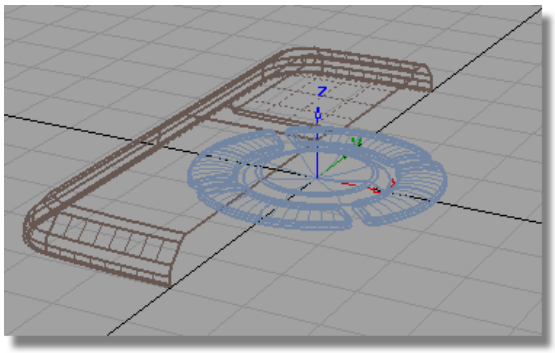


3 Turn off the Symmetry on the layer.



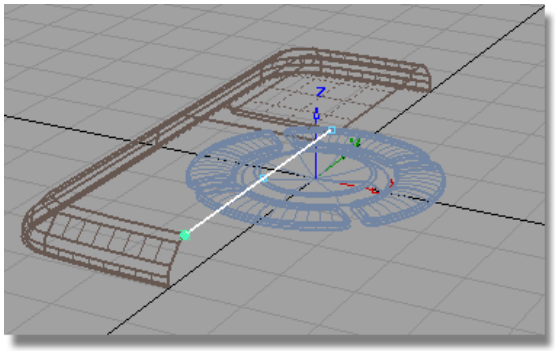
4 Set the state of the **Front Casing** layer to **Reference**, so that it can be snapped to, but not fully pickable.





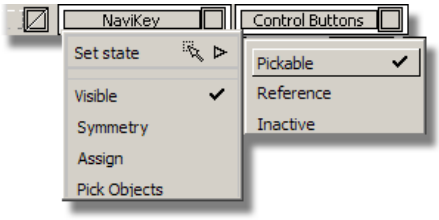
5 Choose Curves > Keypoint Curve Toolbox, then Keypoint Curve Tools > Lines > Line and use curve snap (*Ctrl* and *Alt* (Windows) or *Control* and *Command* (Mac) keys) to place the curve along the edge of the casing.

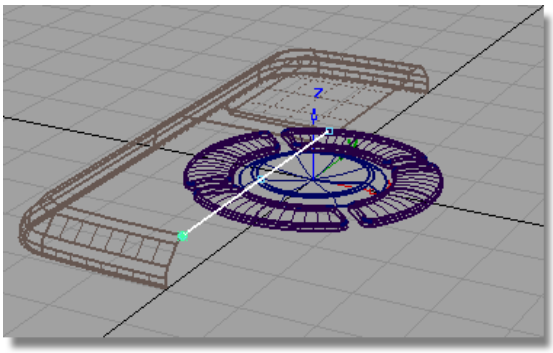




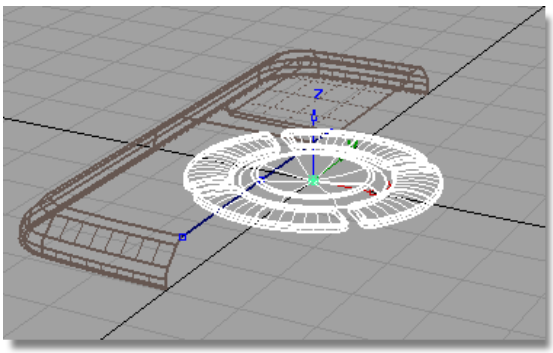
You will now use the center keypoint on the new line to position the buttons.

6 Make the **NaviKey** and the **Control Buttons** layers **Pickable**.



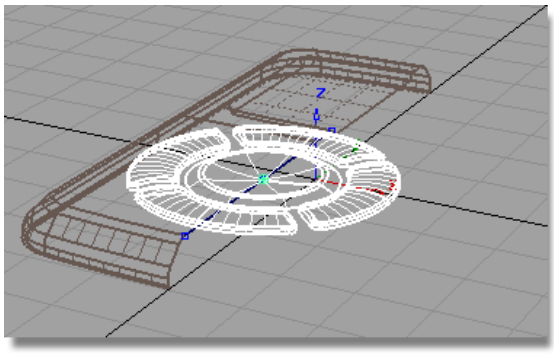


7 Choose Pick > Object and select all the buttons.

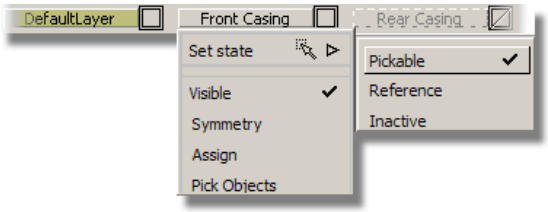


8 Choose Transform > Move . Use the point snap (*Ctrl* (Windows) or *Control* (Mac) key) to position the keys on the center Keypoint of the line.

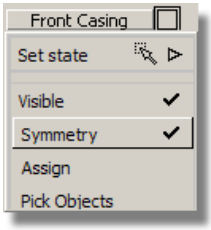
You will be asked if you want to delete construction history: answer **YES**.

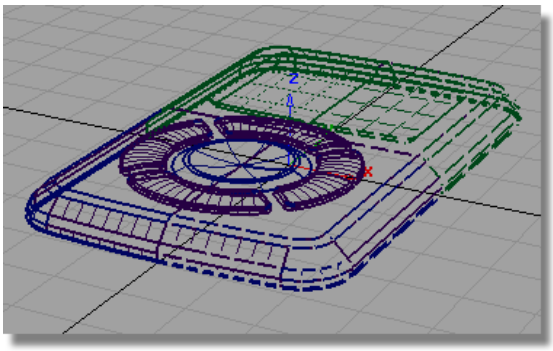


9 To convert the **Layer Symmetry** geometry into real geometry, first set the state of the layer back to **Pickable**.



10 Then, turn on the Symmetry for the layer.

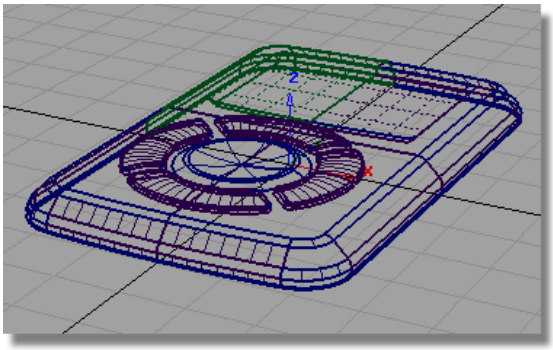




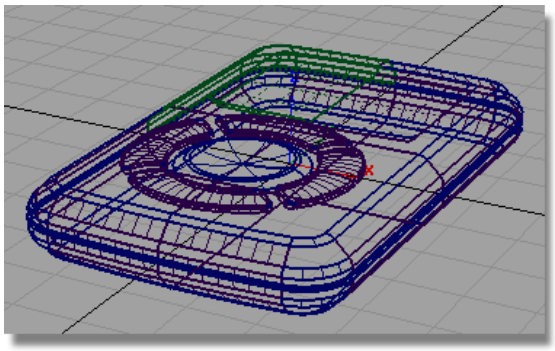
11 Select the layer and use choose Layers > Symmetry > Create Geometry .



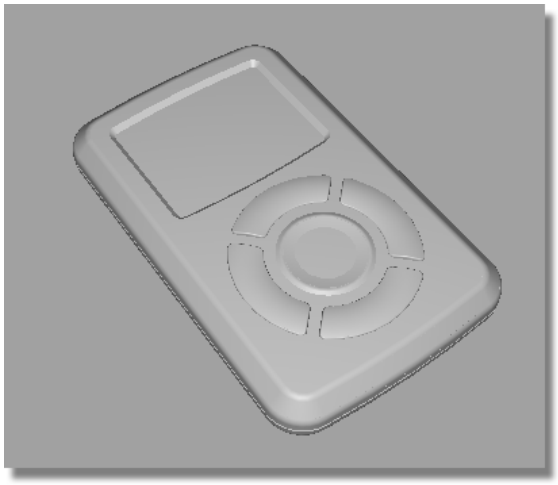
The mirrored geometry is no longer shown in dotted lines, and can be modified independently.



12 Do the same for the **Rear Casing** layer to complete the MP3 Player design.



13 Use the diagnostic **Shading** to evaluate the design.



14 Use the **Show** menu in the window title bar to turn off the **Model** and **Grid** for a better view.

Saving your work

Save your work in the `wire` directory of the `Lessons` project. Name your file `myMP3Player7.wire`.

Conclusion

Congratulations! You have created an accurate model of the MP3 Player.

You have learned to:

- Use Keypoint curves to create accurate geometric shapes.
- Create surfaces with a draft angle.
- Set up Construction Options for accurate modeling.
- Create edges with a radius using the Fillet and Round tools.
- Create symmetrical and duplicated geometry.

Quiz

Working accurately to dimensions will be an important part of most of your design projects. Complete this quick quiz to reinforce the tools and techniques you used.

1. How do you set up which modeling units (for example, mm or inches) you will use for a model?

   (a) In the **Preferences > General Preferences** window.

   (b) In the **Windows > Information > Information Window**.

   (c) In the **Preferences > Construction Options** window.

   (d) Type in the units, that is, '**mm**' after you enter the value.

   (e) In the **Construction > Grid Preset** option window.

2. When projecting a curve, what determines the direction the curve is projected in?

   (a) You are prompted to type in the direction.

   (b) The active window: the curve will be projected perpendicular to the window view.

   (c) There is an option in the **Project** option window.

   (d) Hold down the *Shift* key when selecting the curve.

   (e) It is determined by the mouse button you use to select the curve.

3 How do you modify the radius of an Arc or Circular Arc after you have created it.?

(a) In the **Attributes** section of the **Windows > Information > Information Window**.

(b) Use **Object Edit > Query Edit** and click the curve.

(c) You have to delete the curve and create a new one.

(d) Pick and scale the curve.

(e) Use **Locators > Measure > Distance** to apply a dimension, and then change the number on the dimension.

4 Building geometry at the origin is a good idea because….

(a) Grouping objects will create a pivot point at the origin.

(b) The **Edit > Duplicate > Mirror** tools can be used to create symmetrical geometry.

(c) The **Layer** symmetry tools can be used to work with symmetrical geometry.

(d) You can use the center grid lines for snapping geometry to.

(e) All of the above.

5 The **Round** tool has what advantage over the Surface Fillet tool?

(a) It is more accurate

(b) You can chain select a row of edges

(c) It has Construction History

(d) It automatically trims the surfaces

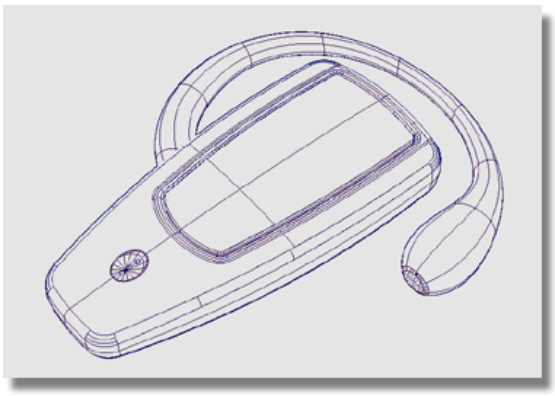
(e) The Round tool can create a corner surface between three edges.

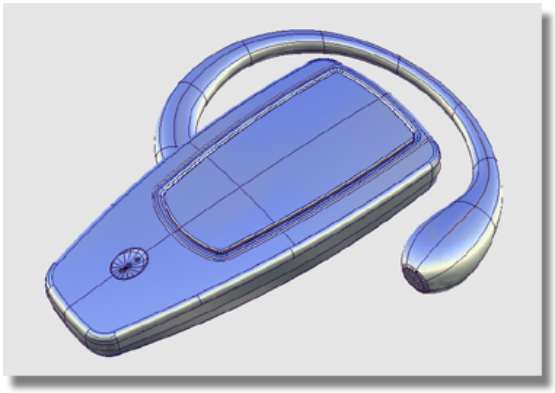
On Your Own

Now you can create accurately sized models, and use geometric shapes to create a disciplined design. The Draft surface tool is particularly useful when designing plastic molded parts, but can equally be used to quickly create any edge surface.

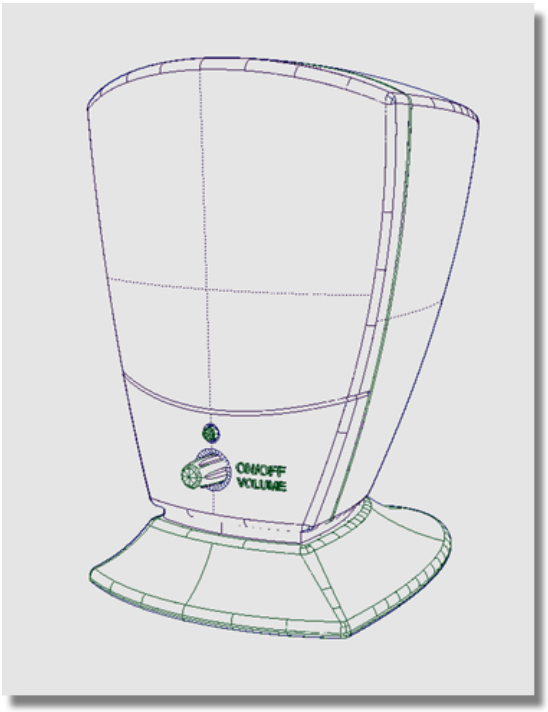
Below are some examples of similar projects that you can try.

This headset for a cell phone is constructed in a similar way to the MP3 player, using arcs and Draft surfaces.



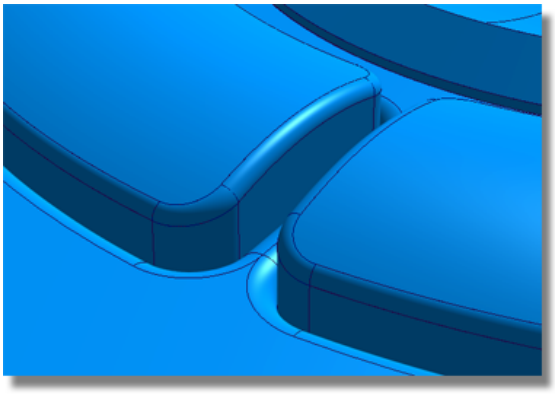


Most computer speakers make good subjects for practicing your modeling. Take measurements and try to replicate the shape as accurately as you can.

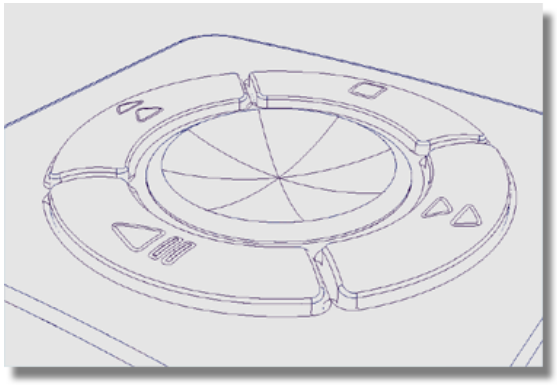

ON/OFF
VOLUME

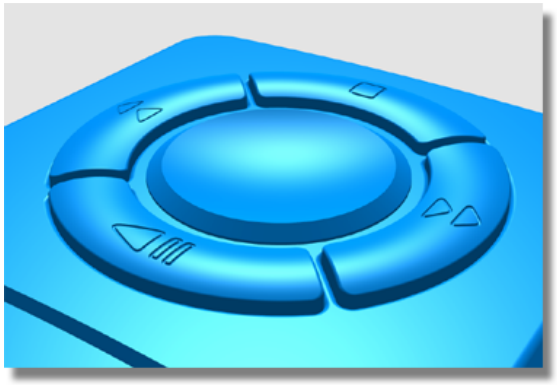


Have a look back at the Vacuum Cleaner tutorial to remind yourself how the button was detailed. You can finish off your MP3 player model by recessing and filleting the buttons and the button holes in a similar way.



You can use **Surfaces > Tubular Offset** to create grooves from projected curves-on-surface. Use the Help > Alias Help if you haven't used this tool before.





Quiz Answers

Answers to the MP3 Player Tutorial quiz

1. (c) In the **Preferences > Construction Options** window
2. (b) The active window: the curve will be projected perpendicular to the window view.
3. (a) In the **Attributes** section of the **Information Window**.
4. (e) All of them

5 (e) The Round tool can create a corner surface between three edges.

Modeling a Sports Shower Gel Bottle

8

Learning Objectives

In this lesson, you will build a sports shower gel bottle. This lesson introduces you to surface continuity. You will learn how to:

- Create smooth transitions between surfaces
- Model accurately for manufacture
- Use Layer Symmetry
- Change the degree of a curve

We will expect you to know how to do certain things, like opening and saving files, picking objects, and moving around in the views, without being told which tool to use. If you cannot remember, check the previous tutorials.

New tools used in this tutorial

- Object Edit > Align > Align
- Object Edit > Attach > Detach
- Surfaces > Boundary Surfaces > Square
- Surfaces > Swept Surfaces > Rail surface (Birail surface)
- Surfaces > Multi-Surface blend > Freeform blend

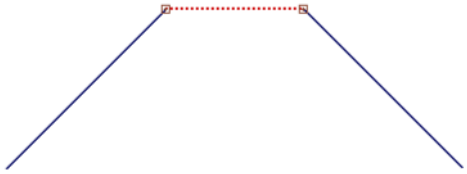
New Concepts

Continuity

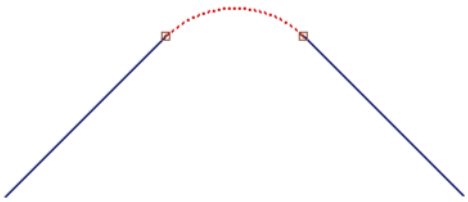
In this exercise, you will learn how to create continuity between surfaces and between curves.

The three main types of continuity used in Alias are shown in the illustrations of three curves below.

Positional Continuity The dashed curve touches the two solid curves, but there is an angle between them and so there is a sharp break between the curves.



Tangent Continuity The dashed curve has no angle difference where it meets the solid curves. The **Round** surface tool and the **Curve Fillet** tool create this type of continuity.

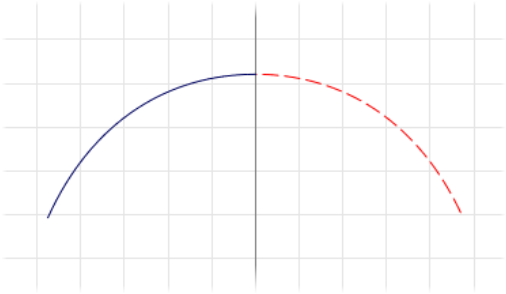


Curvature Continuity The dashed curve blends in even more smoothly to the solid curves.



There is one other use of continuity that you will use in this tutorial: **Implied Tangent**.

Implied Tangent A curve or surface is created on the center line, and will be mirrored. The Implied Tangent tools make sure that the two surfaces (original and mirrored) will be tangent to each other.



Understanding these concepts and using the tools that control them enables you to create smooth, organic designs in Alias.

Construction Tolerances

Construction Tolerances are important as well, when matching surfaces.

Construction tolerances specify the accuracy of the Position, Tangent, and Curvature continuity when surfaces are built. This is important if the model is used for manufacture or is transferred to another CAD system.

For more detailed information, please read the explanation in Using Alias of continuity and in the Reference manual, Preferences > Construction Options .

Part 1: Creating Primary Surfaces

In this section, you will use the **Square**, **Skin**, and **Align** tools to create the basic shape of the shower gel bottle.

You will build the front half of the bottle, which will later be mirrored to complete the design. You will create a smooth connection between both halves by controlling the implied tangent continuity across the center line.

When you create the shoulder surface, you will blend it smoothly to the main bottle surface using tangent continuity.



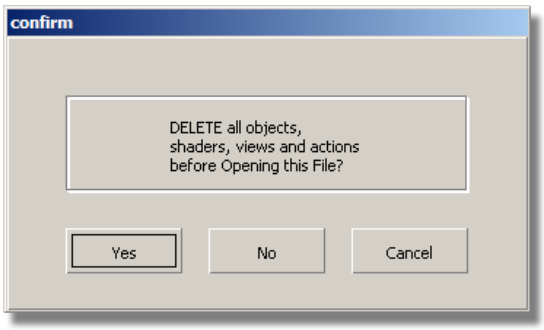
Watch **Part 1** of the tutorial.

Opening the tutorial file

The tutorial file has curves for building the shower gel bottle.

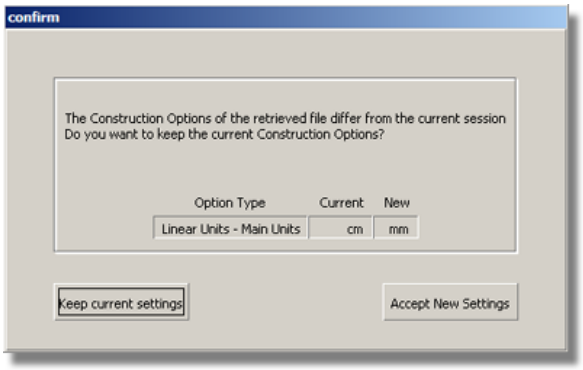
1. Choose File > Open to open the File Browser.
2. In the File Browser, locate the `CourseWare` directory and set it as the **Current Project**.
3. Open the file called `showergel.wire`, located in the `wire` directory in the `CourseWare` project.

   (For information on how to open a file, see Opening the tutorial file on page 82.)



4 A dialog box appears, asking if you want to delete all objects, shaders, views, and actions. Click **Yes**.

5 If your values for construction tolerances differ from those in the `showergel.wire` file, you will be presented with a dialog.



6 Click **Accept New Settings** to use the construction tolerances in showergel.wire.

The file is opened.

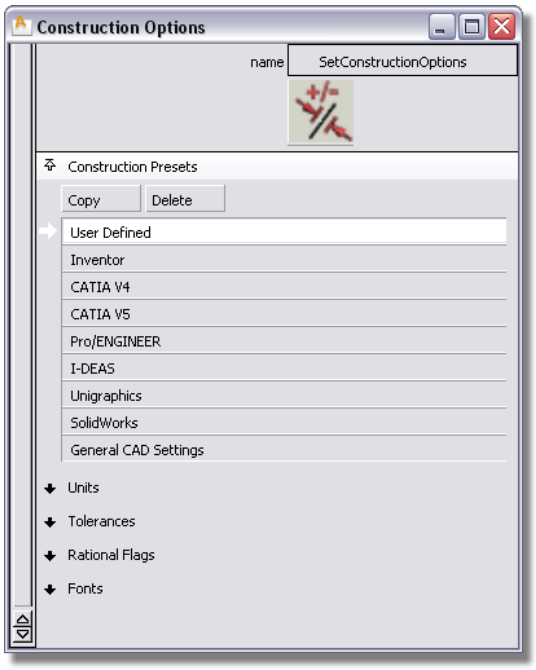
The main bottle curves are visible and placed on a layer named **Curves**.

Other curves are on layers that are not currently visible; you will use these later in the tutorial.

Setting the Construction Tolerances

Before you start to create your model, you will choose the construction tolerances you want to work to.

1 Choose Preferences > Construction Options .

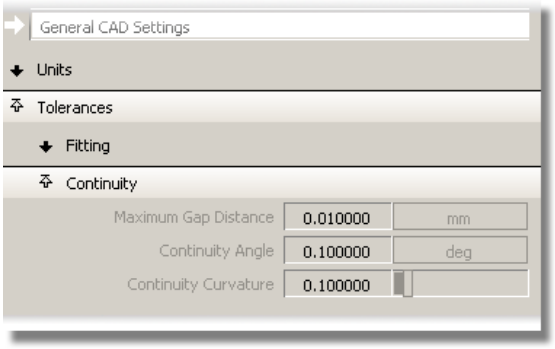


The **Construction Preset** is set to **User Defined**. While this is suitable for rapid concept development, a more accurate setting will be needed for data transfer to a CAD or Rapid Prototyping system.

2 In the option window, choose **General CAD Settings**.



To see what tolerances you will be working to, open the tolerances section of the Construction Options window.



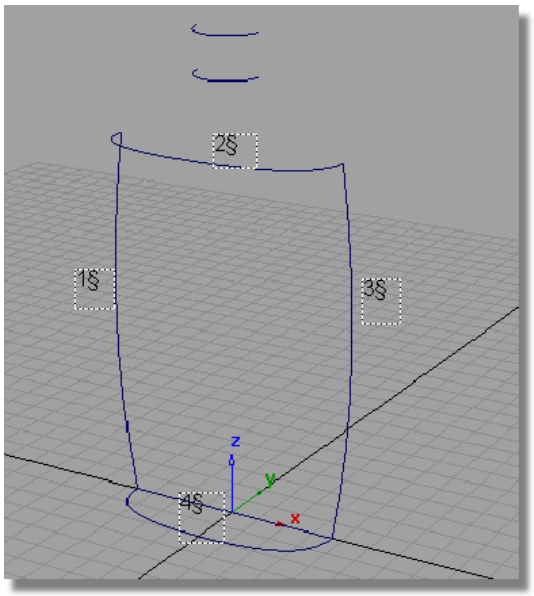
TIP For future projects, you can choose settings that match the CAD system you will be exporting data to.

3 Close the Construction Options window.

Creating the Main Bottle Surface

You will start by creating the main bottle shape using a **Square** surface.

1 Maximize the **Perspective** view.

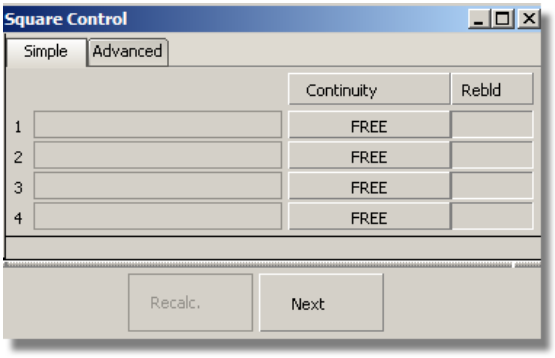


2 Check that the **Bottle** layer tab is shown in **yellow**, indicating the new surfaces you create will be assigned to it. If not, click the layer tab to make it active.



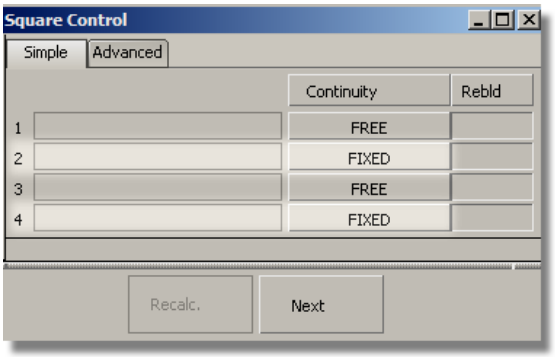
3 Choose Surfaces > Boundary Surfaces > Square .

4 Double-click the icon to open the option window.

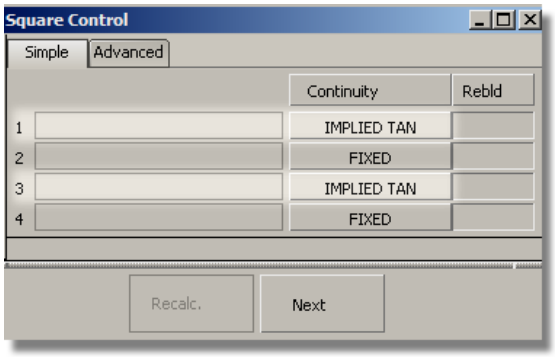


In the **Square** option window, the four boundaries of the square are listed.

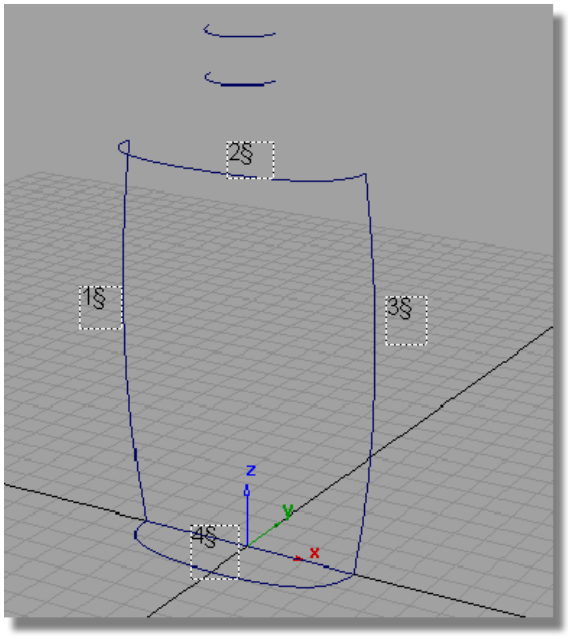
For boundaries, **2** and **4** change the continuity option to **Fixed**. This ensures that the square surface accurately matches the curves.



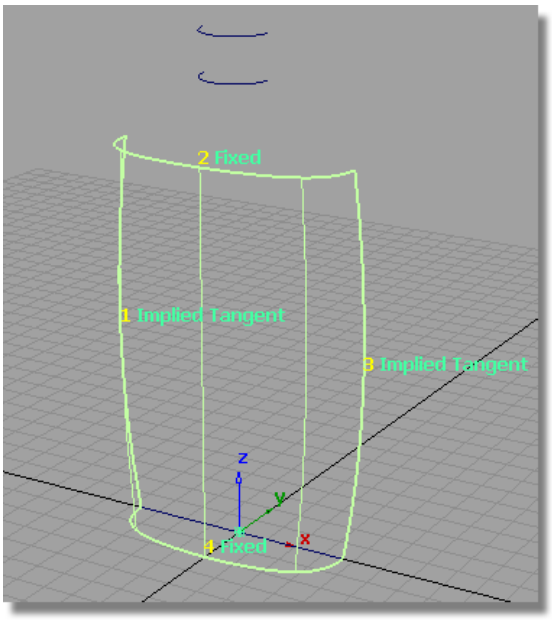
For boundaries 1 and 3, change the **Continuity** option to **Implied Tangent**. The Implied Tangent option ensures the surfaces will align smoothly across the center line.



You are prompted to select the four boundary curves. Click the curves in the order shown.

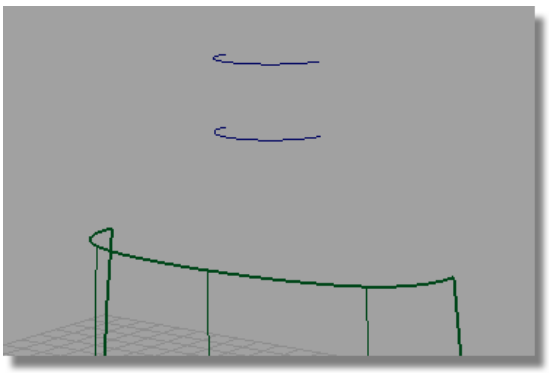


When the fourth curve is selected the square surface is created.

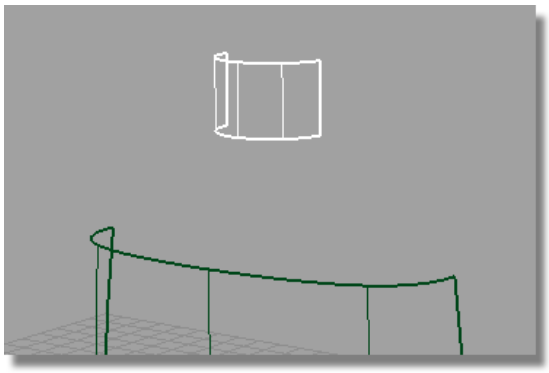


Creating the Neck Surface

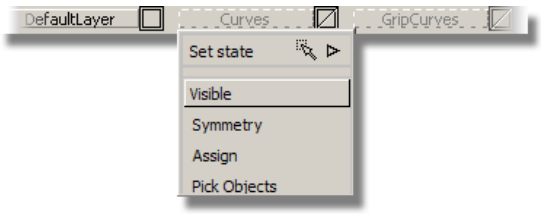
1 Adjust the view to see the curves for the neck of the bottle.



2 Choose Surfaces > Skin and, when prompted, select the two neck curves to create the neck surface.



3 Now that you have built the main surfaces, turn off the **Curves** layer, leaving only the surfaces visible on the screen.



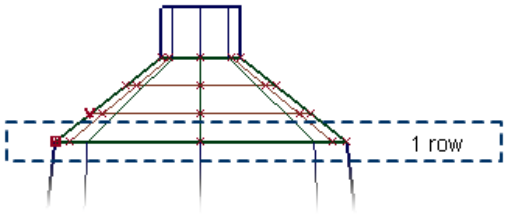
Creating the Shoulder Surface

The shoulder surface needs to blend smoothly from the main body surface.

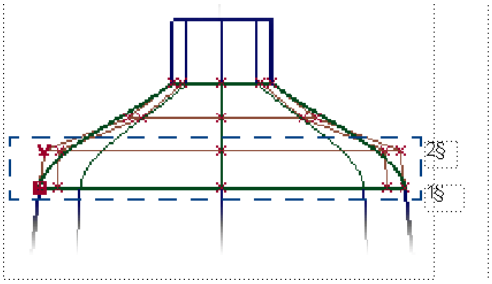
First, you will create the shoulder as a simple skin surface from the body to the neck. You will then create **continuity** between the shoulder and body, using the **Align** tool.

It is useful to understand how the **Align** tool creates the desired continuity, and you can see this by observing how the **CVs** and **Hulls** change as the Align tool is applied.

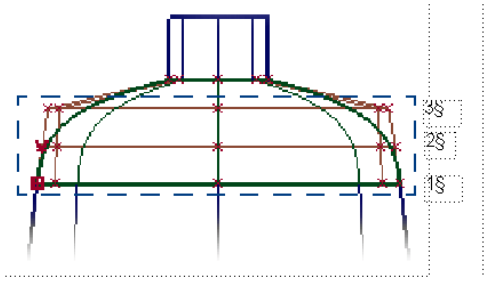
Positional Continuity One row of CVs is aligned to the other surface. This is the default continuity when you create the skin surface.



Tangent Continuity **Two** rows of CVs are aligned to the other surface.



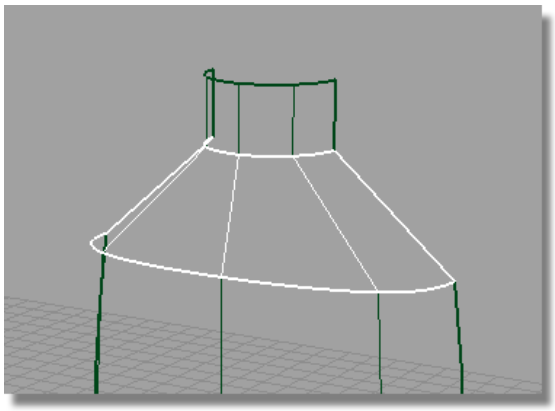
Curvature Continuity **Three** rows of CVs are aligned to the other surface.



Creating the Shoulder Surface

First, create the shoulder surface with positional continuity.

1. Choose the Surfaces > Skin tool.
2. When prompted, select the edges of the body and neck surfaces to create the shoulder skin surface.

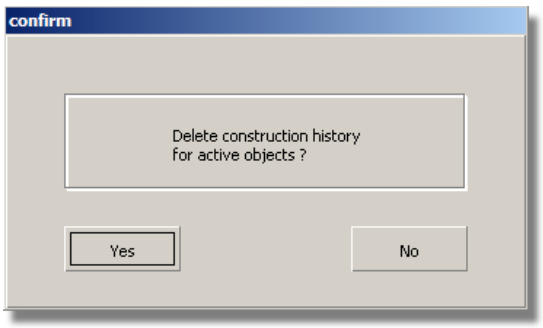


Aligning the Shoulder Surface

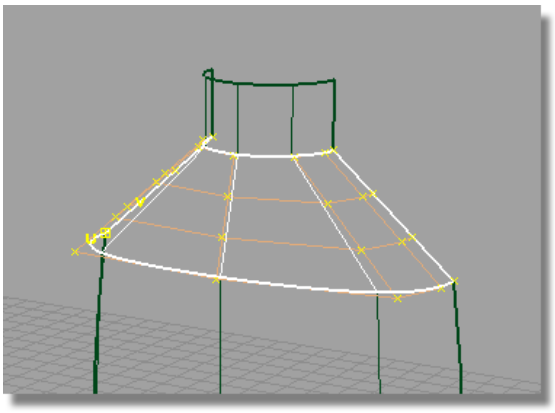
Now, you will use the **Align** tool to modify the shoulder surface, making it **Tangent** to the body surface.

First, delete the **Construction History** of the shoulder skin, to allow it to be modified.

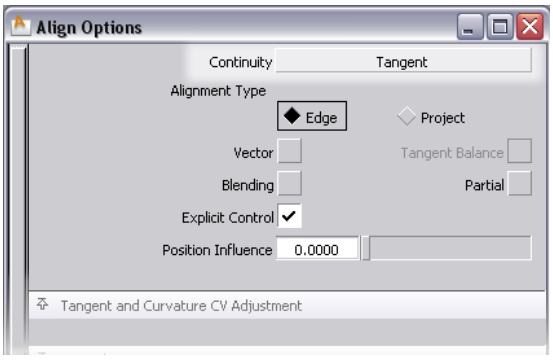
1 With the shoulder surface still selected, choose Delete > Delete Construction History and answer **Yes** when prompted.



2 With the surface still selected, turn on the CVs by clicking the **Cv/Hull** check box on the Control Panel. This makes it easier to see the results of the **Align** tool.

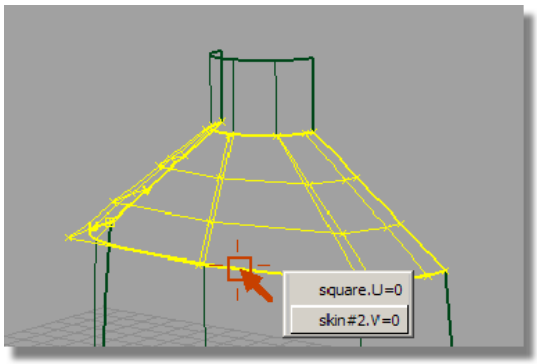


3 Choose Object Edit > Align > Align 2008 . Double-click the **Align** icon to open the option window. Set **Continuity** to **Tangent**.

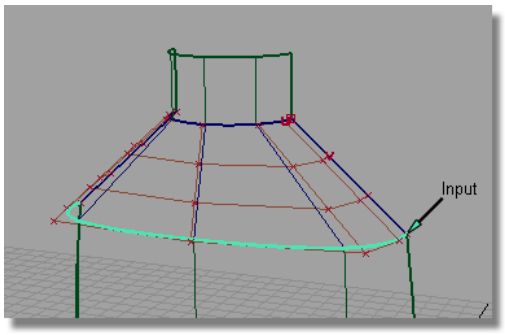


You are prompted to select the boundary of the surface to be aligned (the input). This is the skin surface you created for the shoulder.

4 Move the cursor to the junction of the bottle and shoulder surfaces. Click the edge of the surface and select the skin surface from the pick chooser.



The selected edge is highlighted and labeled as “Input”.

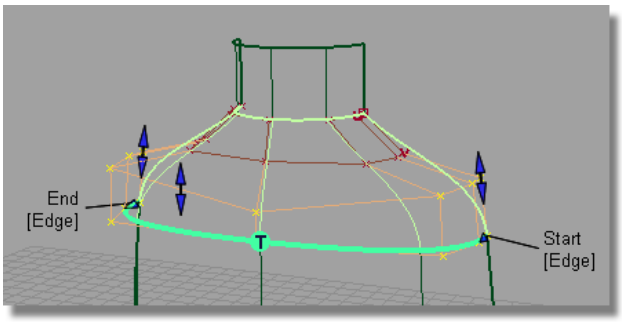


You are prompted to select the object to align to (the master).

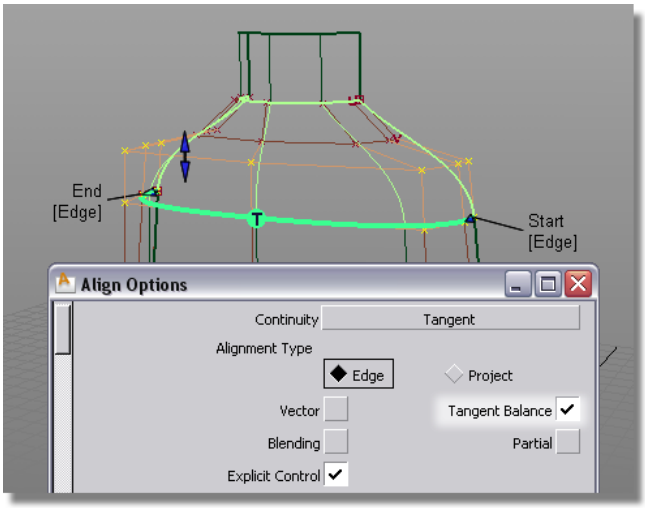
5 Click on the boundary between the two surfaces again to select the edge of the body.

The top edge of the body surface is automatically selected.

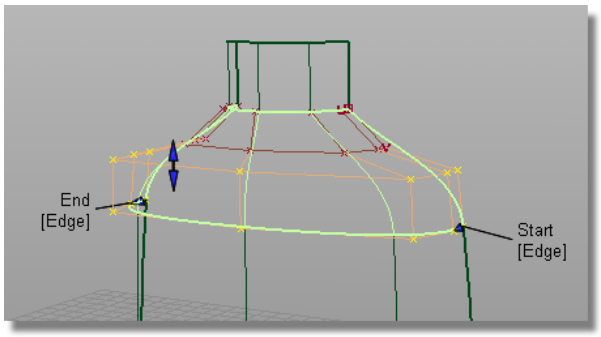
The CVs of the shoulder surface are modified to align the shoulder to the bottle surface with tangent continuity, as indicated by the **T** on the green indicator.



6 Turn on **Tangent Balance**. This adjusts the hull shape of the input surface to match that of the master. (Turn on the CVs and hulls on the master to see this).

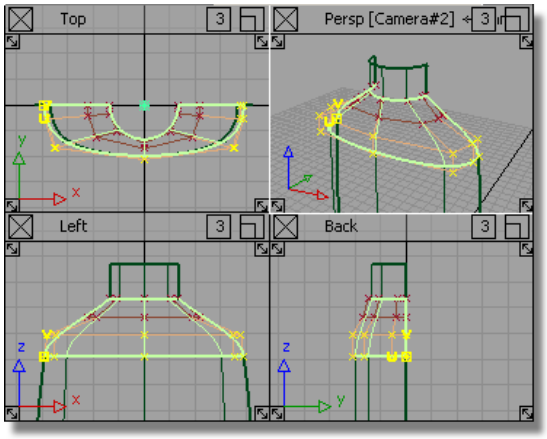


7 Scroll to the bottom of the option window and turn off **Continuity Check** to remove the continuity indicator.



Now, you will modify the character of the shoulder blend by moving and scaling the CVs and Hulls.

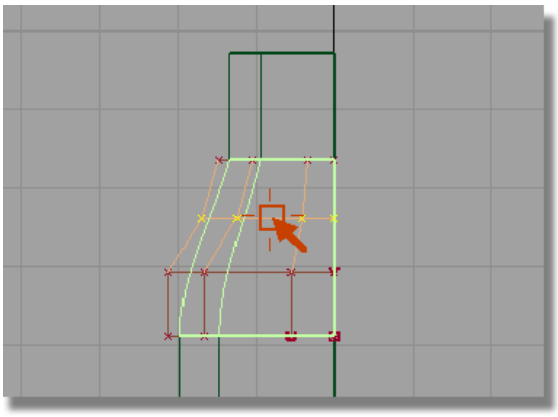
8 Use the **F9** hotkey to show the four modelling windows.



9 Choose Pick > Nothing to deselect the surface.

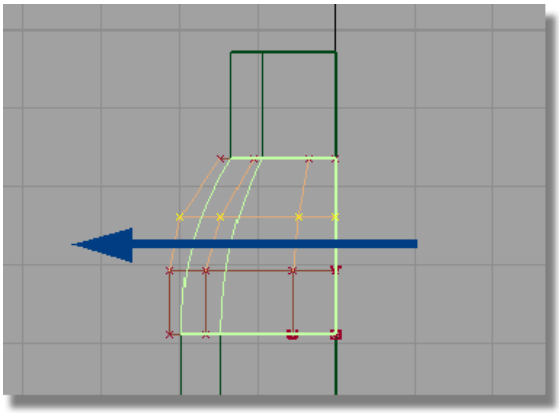
10 Choose Pick > Point Types > Hull .

11 In the **Back** window, select the hull of the second row of CVs from the top by clicking the red hull line.

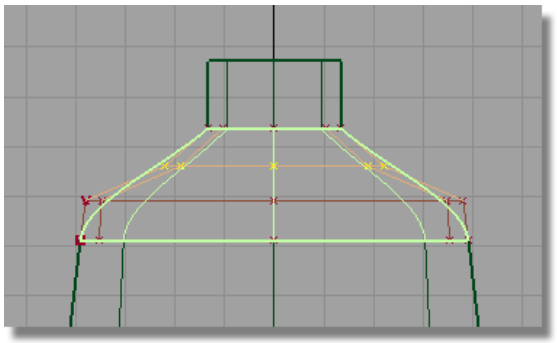


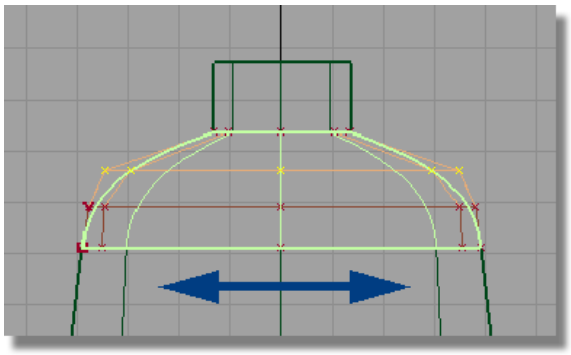
12 Choose Transform > Non-p Scale and drag with the *middle mouse button* to create a smooth shoulder shape.

NOTE The pivot point for the CVs defaults to the origin, so the CVs will scale correctly.

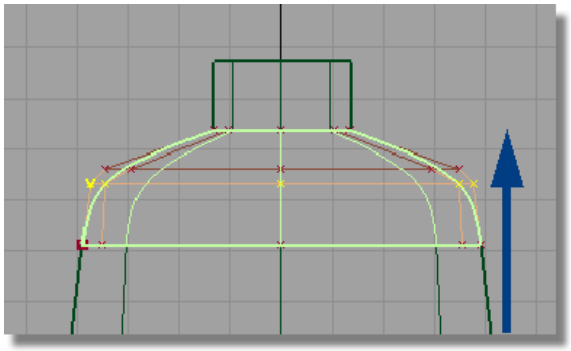


13 In the **Left** window, drag with the *middle mouse button* to refine the shoulder shape.





14 With the *right mouse button* click the hull of the third row of CVs and drag upwards to sharpen the shoulder profile.

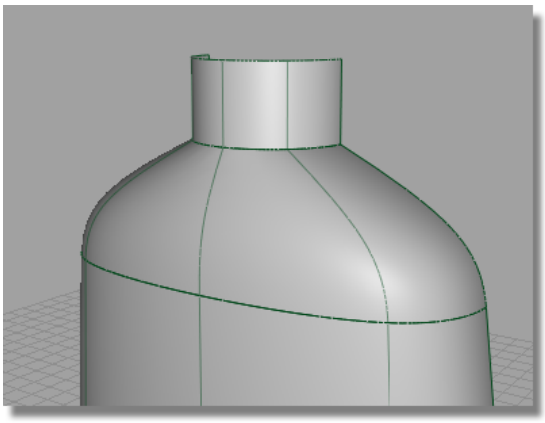


Continue to adjust the vertical position of the hulls until you are happy with the design.

15 Choose Pick > Nothing to deselect the CVs.

16 Turn off the CVs and hulls, using the **Control Panel**.

17 Use **diagnostic shading** to evaluate the result.



TIP Set the **Continuity** option to **Curvature** in the **Align** tool to adjust the third row of CVs and get an even smoother transition.

Saving your work

Now you will save the scene as a new file.

1 Save your work in the `wire` directory of the `Lessons` project.

2 Name your file `myshowergel.wire`.

For information on creating the Lessons project, or saving your work, see Saving your work in a Windows environment on page 96 or Saving your work in a Mac OS X environment on page 100.

Part 2: Creating the Finger Grip

Having created the basic form of the bottle, you will now add the features that give it a ‘sports’ character.

The finger grip area is created by removing part of the body surface, and replacing it with a birail surface which follows the grip profile, and blends in smoothly to the body.

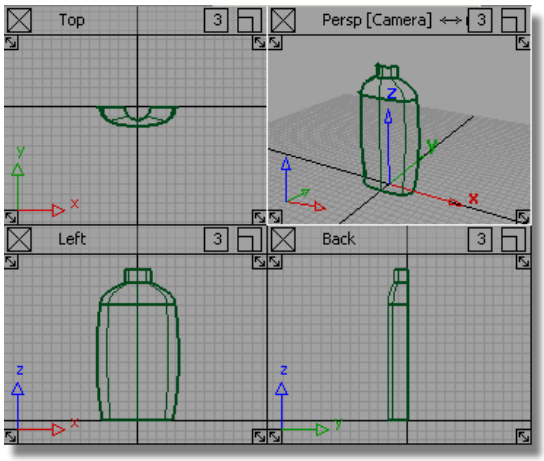


Watch **Part 2** of the tutorial.

Opening the tutorial file (optional)

If you successfully completed Part 1, proceed to the next step: Making Space for the Grip Detail below.

If you were not successful in part 1, open the file called `showergel_part2.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 1.



Making Space for the Grip Detail

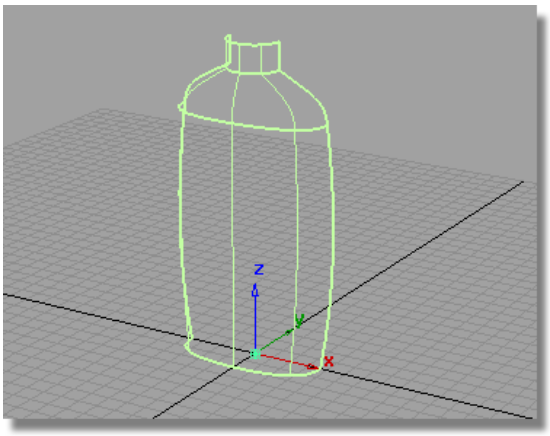
To make space for the finger grip, you will split the body surface and discard the part which will be replaced by the grip feature.

Because the isoparms on the surface are at a convenient location, you can use the **Detach** tool to split the surface at an isoparm. You can snap to a particular isoparm, using the *Ctrl* (Windows) or *Control* (Mac) key.

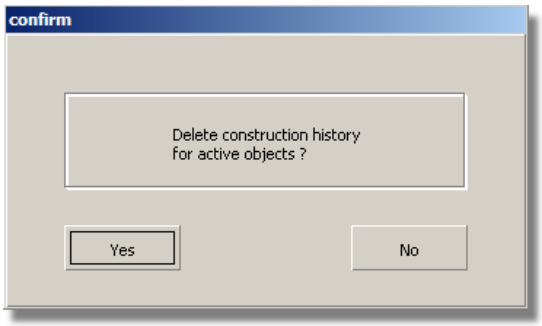
Before detaching, delete the construction history of the surfaces.

1 Maximize the **Perspective** window.

2 Choose Pick > Object and select all the surfaces.

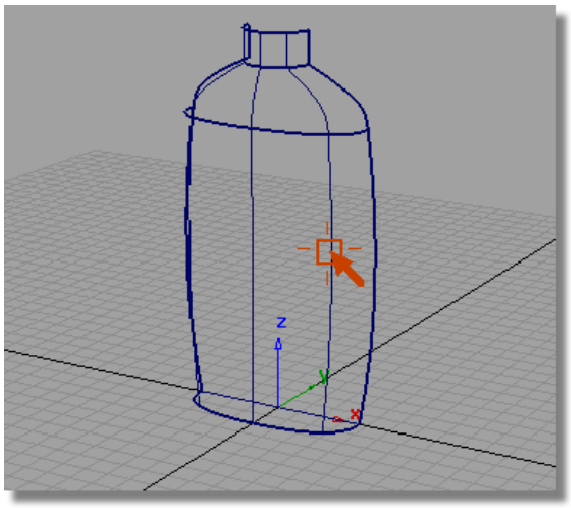


3 Choose Delete > Delete Construction History and answer **Yes** when prompted.



NOTE Detaching leaves a good quality edge on the surface. However, it is not reversible, so we recommend you save before using Detach!

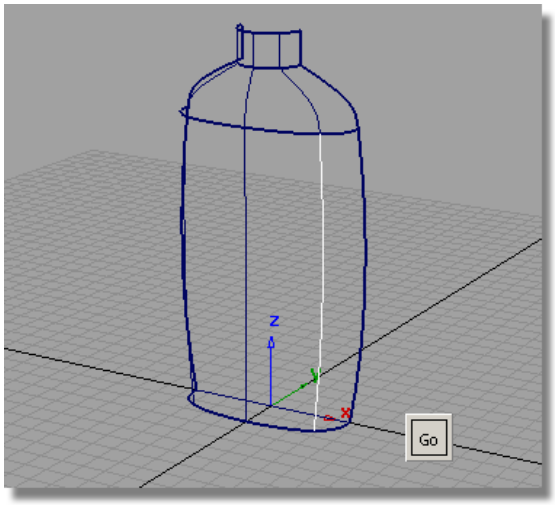
4 Choose the Object Edit > Attach > Detach tool. Hold down the *Ctrl* (Windows) or *Control* (Mac) key and select the isoparm shown.



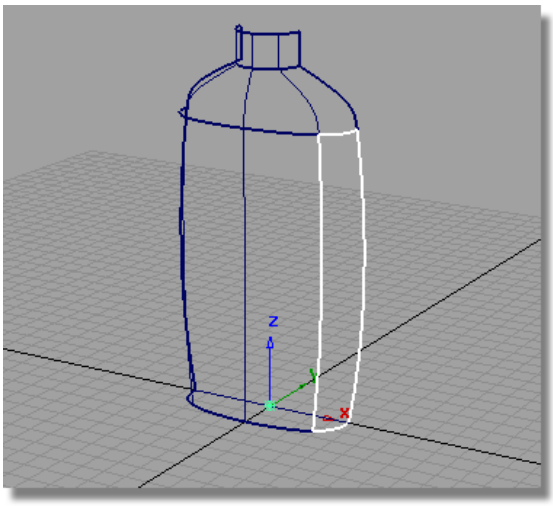
TIP Move the mouse to check that the detach tool has locked on to the isoparm.

The isoparm is highlighted and a **Go** button appears.

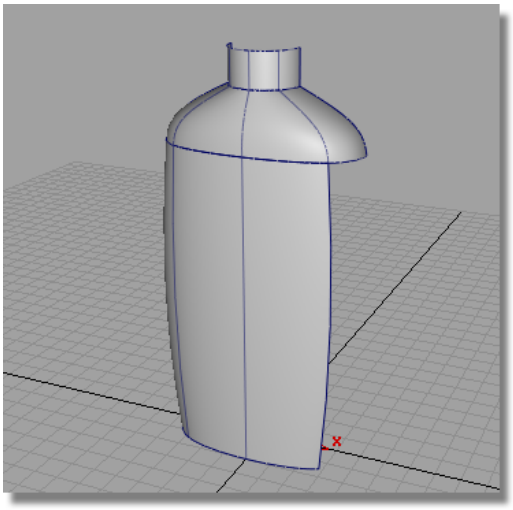
5 Click **Go** to detach the surface.



6 Choose Pick > Object and select the smaller piece of surface.

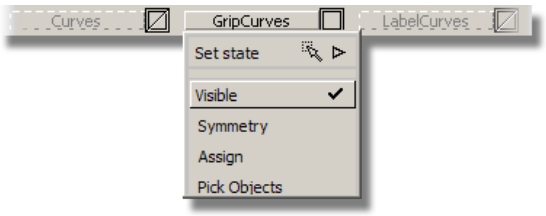


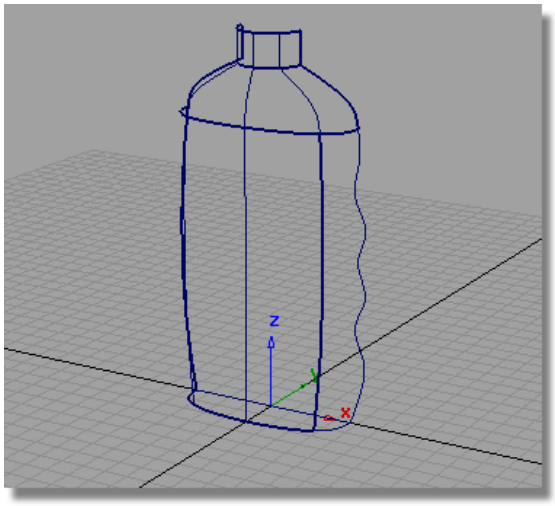
7 Press the *Delete* key to delete the small surface.



A curve has been provided on the **GripCurves** layer to define the profile of the finger grip.

8 Turn on the visibility of the **GripCurves** layer by selecting **Visible** from its layer tab menu.





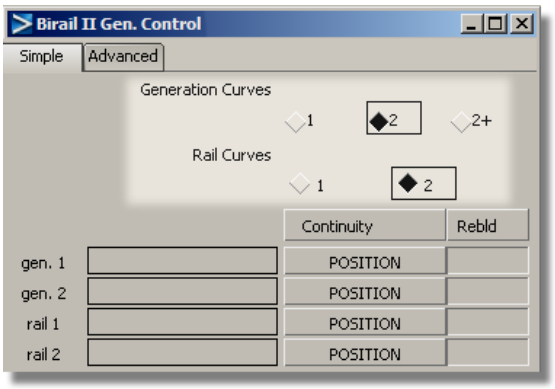
Creating the Birail Surface

Now, you will create a **Birail** surface for the finger grip. The **Birail** will be **tangent** to the edge of the body surface and **tangent** to the shoulder surface. It will match the curve at the base with **positional** continuity, and have **Implied Tangency** on the finger grip curve, where the surface will later be mirrored.

1 Choose Surfaces > Swept Surfaces > Rail Surface . Double-click the icon to open the option box.

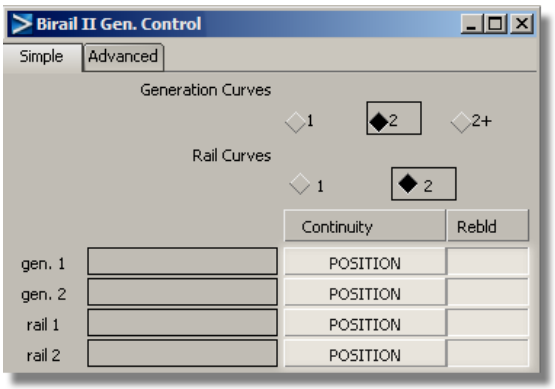
In the **Generation Curve** section, choose **2**.

In the **Rail Curve** section, also choose **2**.



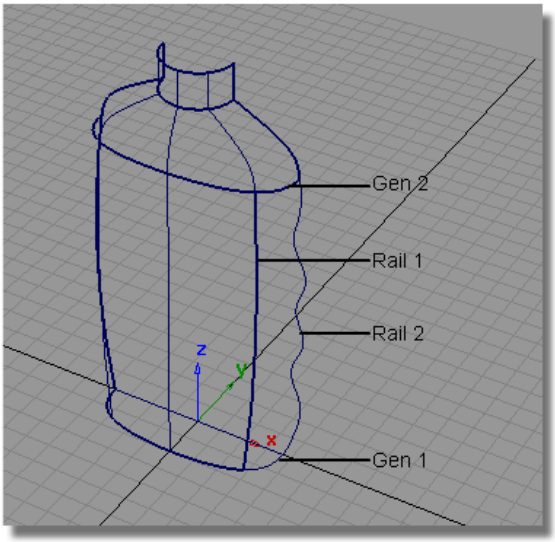
2 Choose **Position** for each of the four **Continuity** options (you will change these after the Birail surface is created).

If any of the **Rebld** boxes are checked, click in them to remove the check.

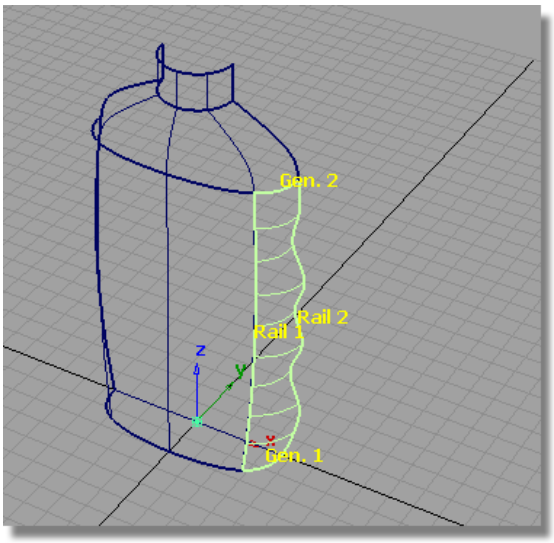


TIP The **Rebld** option can improve the parameterization of an edge, typically a trimmed edge. As all your edges and curves have good parameterization, you don't need to use it in this case.

3 You are prompted to select the edges of the birail. Select the curves in the order shown:



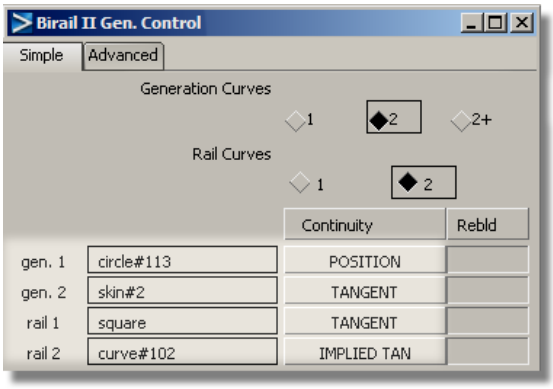
The birail surface is created.



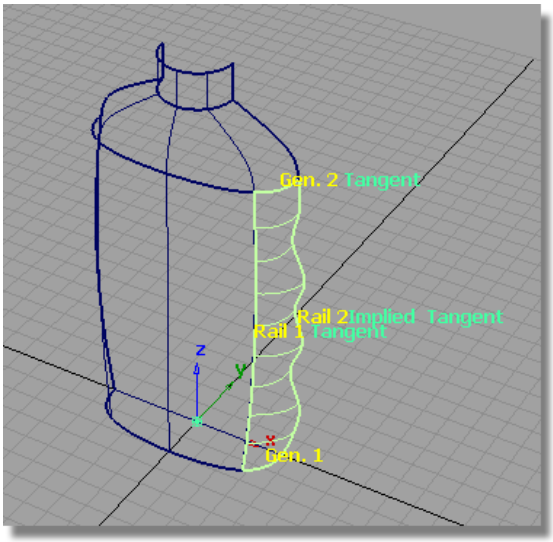
With the surface still selected, and the option window still open on screen, you can now adjust the continuity options at each edge.

4 Change the following continuity settings:

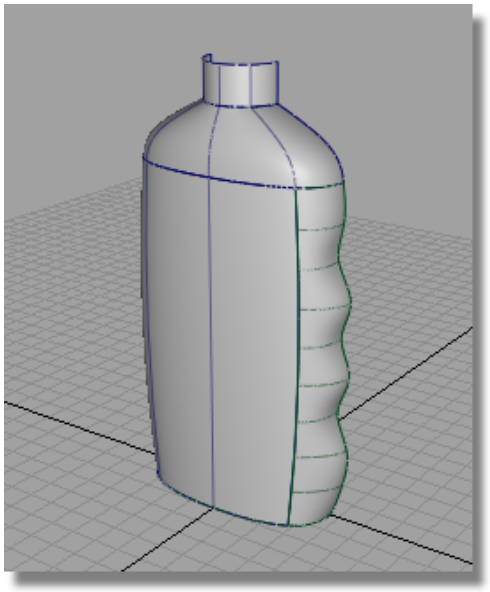
gen2	Tangent
rail1	Tangent
rail2	Implied Tangent



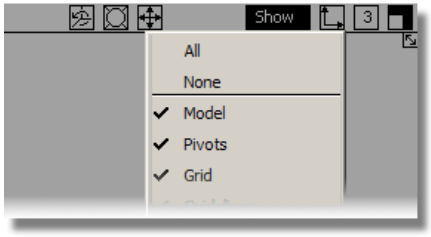
The surface is rebuilt with the new continuity settings.



5 Choose Pick > Nothing to deselect the surface and use **diagnostic shading** to evaluate the design.



TIP Use the **Show** menu on the window pane to turn off the model and the grid. Remember to turn them on again when you remove the shading.

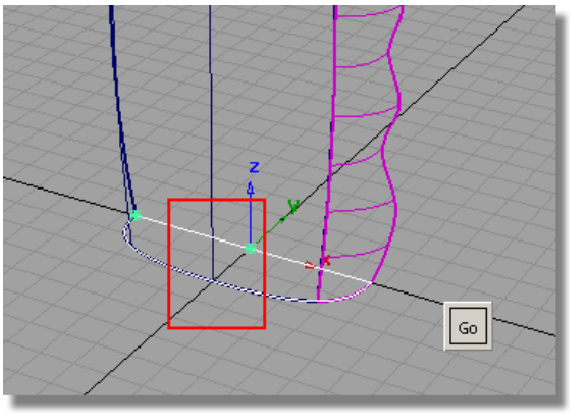


Creating the Base Surface

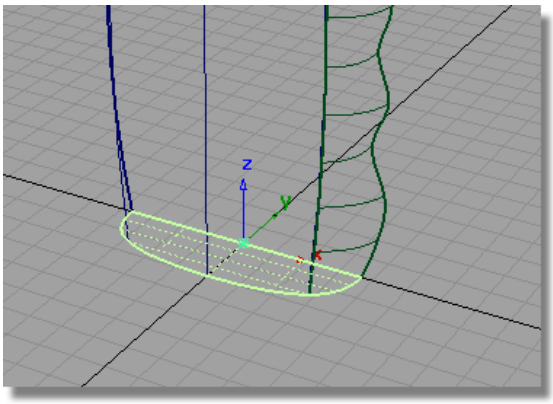
The base of the bottle will be created as a flat plane.

1 Choose Surfaces > Planar Surfaces > Set Planar .

2 You are prompted to drag/select curves. Drag a pick box over the two base curves.



3 Click **Go** to create the planar surface.



TIP The space bar can be used as a short cut instead of clicking **Go**.

4 Make sure that all the surfaces are assigned to the **Bottle** layer.

5 The curves are no longer needed, so turn off the visibility of the **GripCurves** layer.

Save your work

1 Save your work in the `wire` directory of the `Lessons` project.

2 Name your file `myshowergel2.wire`.

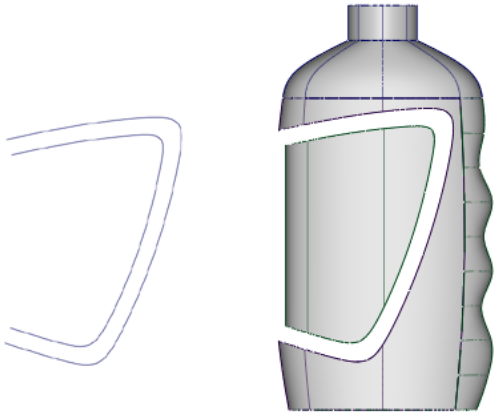
Part 3: Label Surface

In the Vacuum exercise, you intersected surfaces to create curves-on-surface that could then be used for trimming.

In this exercise, you will **Project** a curve onto the surface, which will create the curves-on-surface needed for trimming.

First, you will trim out the label shape from the main body surface.

Then, you will create a recessed surface for the label panel. This will be trimmed slightly smaller so there is a space for a smooth blend surface to be built.



NOTE You cannot use **Detach** in this case to 'cut' the surface, as the desired shape does not follow the isoparms of the surface.

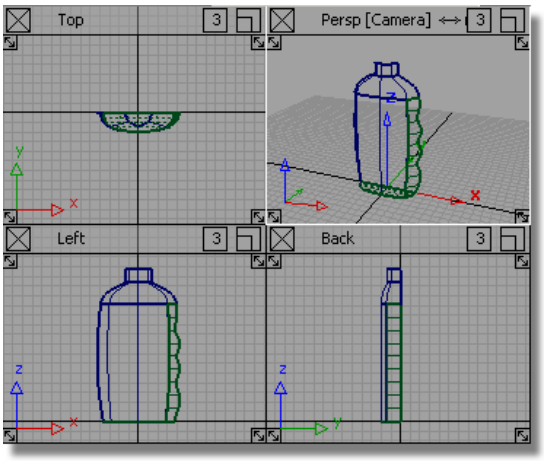


Watch **Part 3** of the tutorial.

Opening the tutorial file (optional)

If you successfully completed Part 2, proceed to the next step: Trimming the Label Area below.

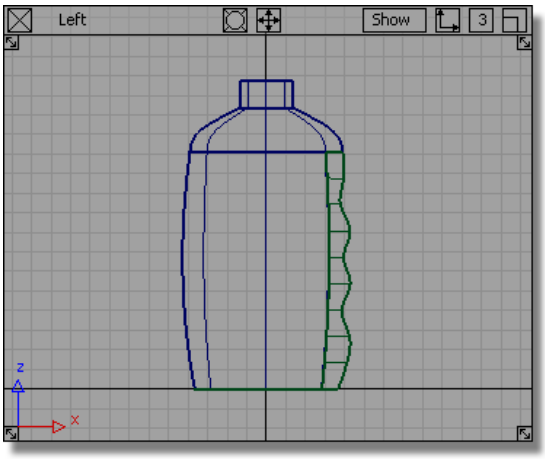
If you were not successful in part 2, open the file called `showergel_part3.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 2.



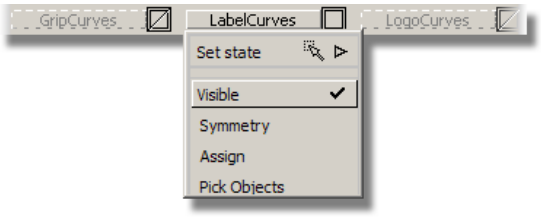
Trimming the Label Area

First, you will project the label shape curve onto the bottle surface. The projection direction will be determined by the active window, so you will use the **Left** window.

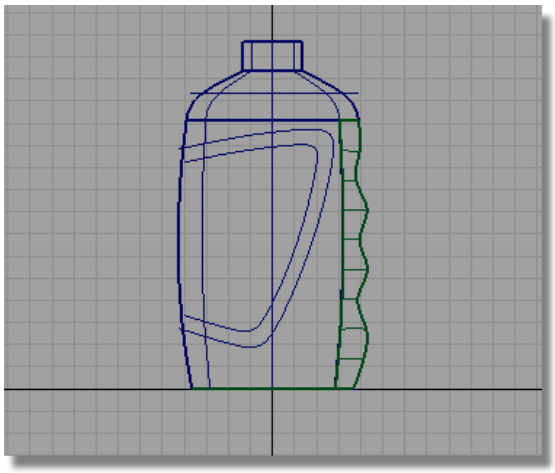
1 Maximize the **Left** window.



2 Make the **LabelCurves** layer visible.



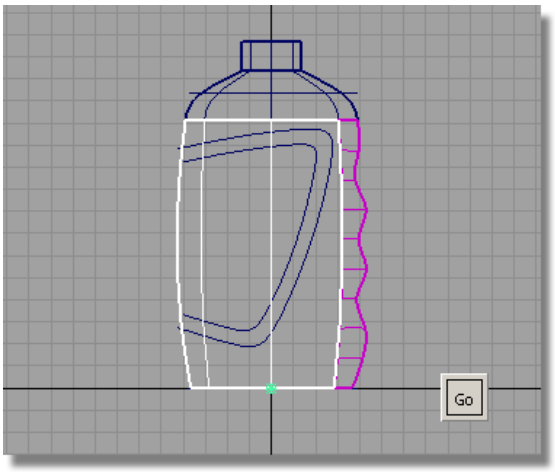
The layer has two curves for the outline of the label. The outer curve will be used to trim away the main body surfaces.



Now, you will **Project** the outer label curve onto the body surface.

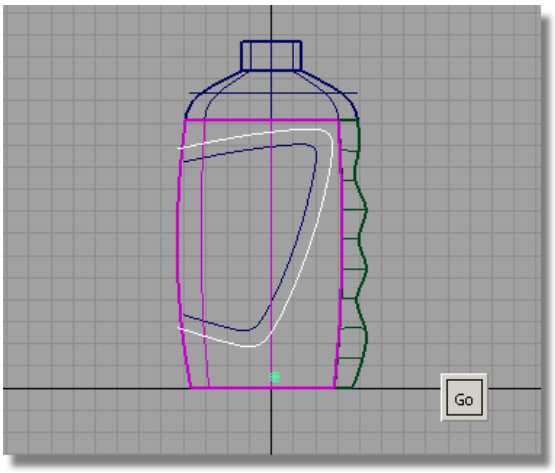
3 Choose Surface Edit > Create CurvesOnSurface > Project .

4 You are prompted to select a surface. Click the main bottle surface to select it.



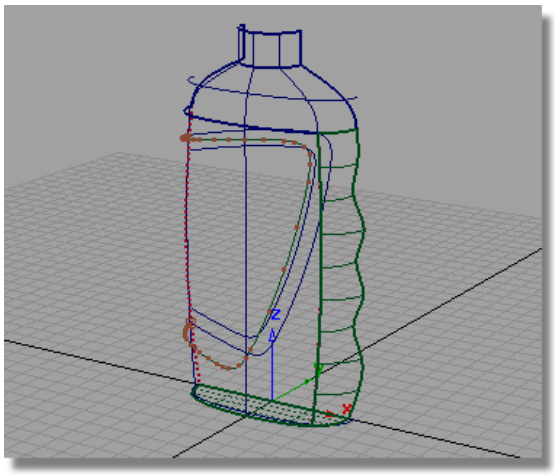
5 Click **Go** to accept the surface.
You are then prompted to select the projecting curves.

6 Click the outer label curve to select it, and then click **Go**.



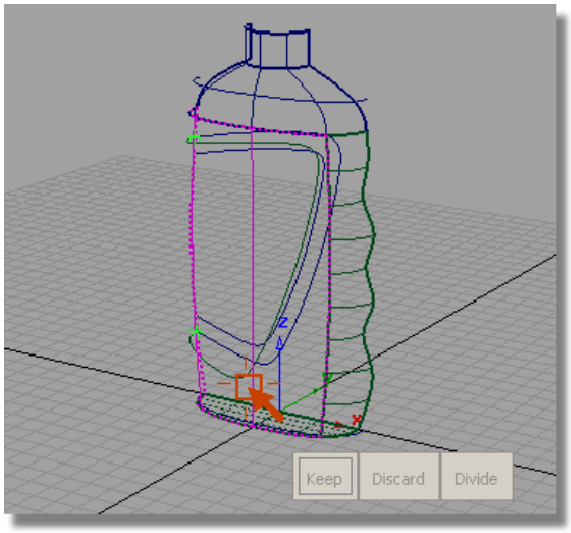
The curve is projected onto the surface.

7 Maximize the **Perspective** view to see the curves-on-surface more clearly.

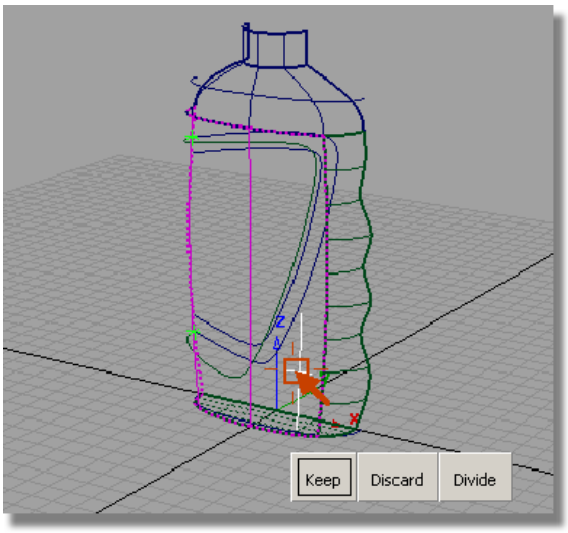


8 Choose Surface Edit > Trim > Trim Surface .

9 You are prompted to select the surfaces to trim. Click the main bottle surface to select it.



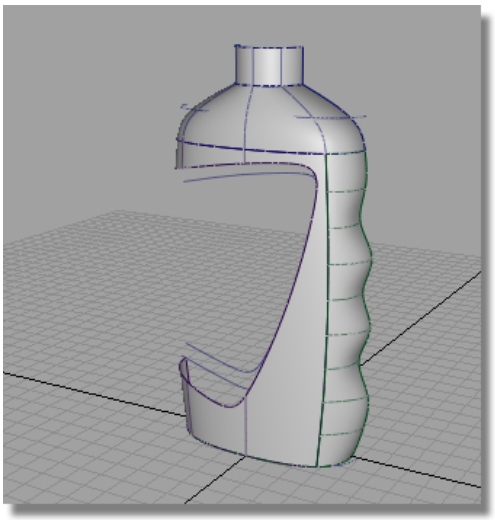
10 You are then prompted to select **REGIONS**. Click the part of the surface you want to keep (the part outside the label area).



11 Click **Keep** shown in the bottom right corner of the window.

The surface is trimmed.

12 Use **diagnostic shading** to verify the surface has been trimmed correctly.



TIP If the trimming is not correct, click **Revert** at the bottom of the screen to go back one step and re-select the trim regions. If you want to correct the trim at a later stage, you can use **Surface Edit** > **Trim** > **Untrim** to restore the surface to its untrimmed state.

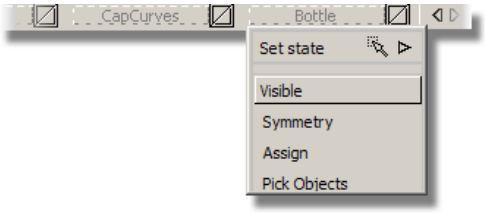
Creating the Label Surface

If the bottle is to have a paper label, paper can only bend in one direction at a time if it is to have no folds or wrinkles. Therefore the label surface should only bend in one direction. This is called single-curvature.

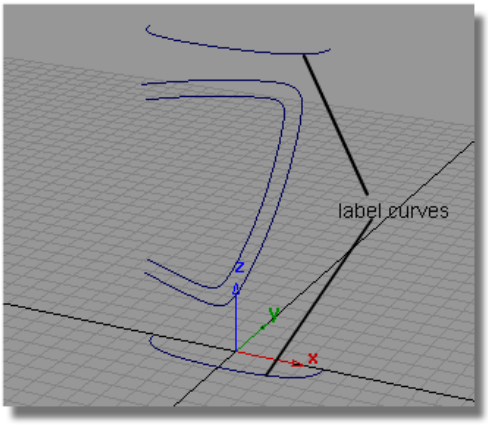
You will create a single-curvature surface by using a **Skin** surface between two identical curves.

First, organize your model using the layers.

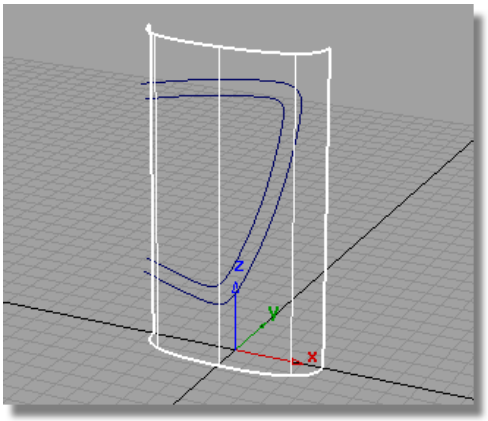
1 Make the **Bottle** layer invisible using the layer sub-menu.



There are two identically shaped curves for the skin surface; these will be used to create the label.



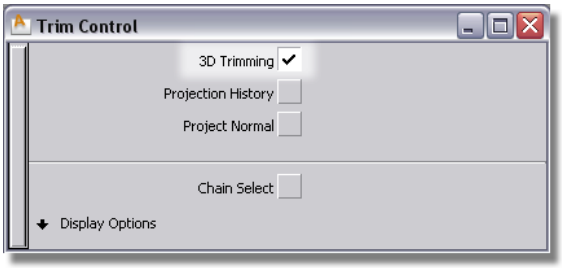
2 Choose Surfaces > Skin . Follow the prompts and select the two label surface curves to create a skin surface.



Next, you will project the label outline curve onto the surface and trim the surface to the shape of the label.

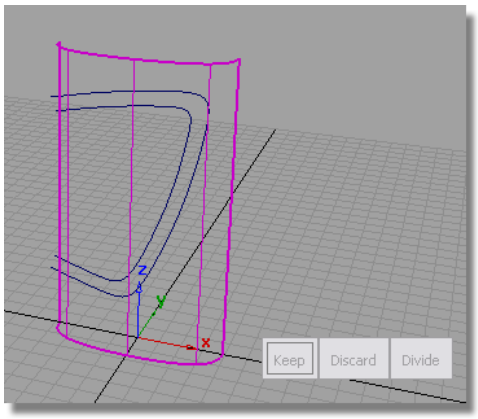
This time we will show how both operations can be executed at once by using the **3D Trimming** option in the **Trim Surface** tool.

3 Choose Surface Edit > Trim > Trim Surface . Double-click the icon to open the option box. Turn on **3D Trimming**, then close the option box.



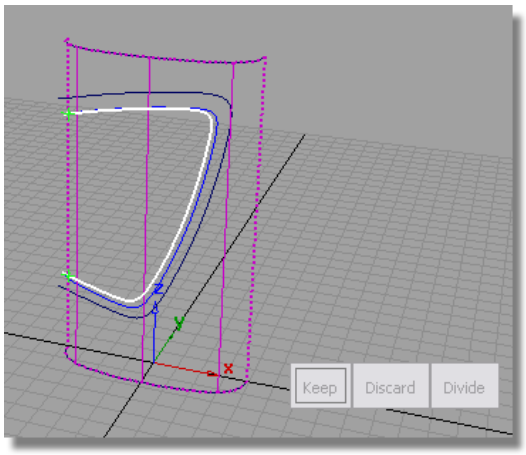
You are prompted to select the surfaces to trim.

4 Click the label surface to select it.



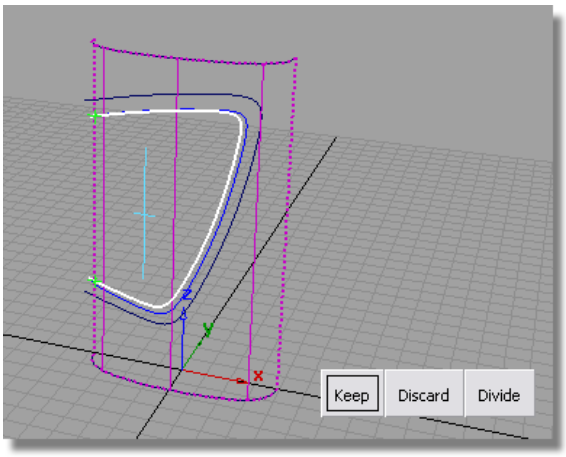
You are prompted to select curves to PROJECT.

5 Click the inner label shape curve to select it.



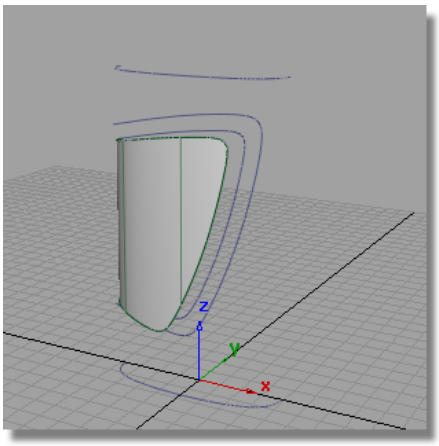
You are then prompted to select REGIONS.

6 Click the part of the surface you want to keep (the part inside the label area). Then, click **Keep** shown in the bottom right corner of the window.

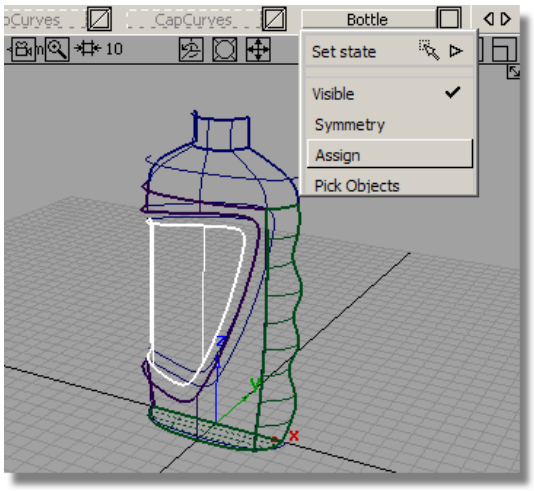


The surface is trimmed.

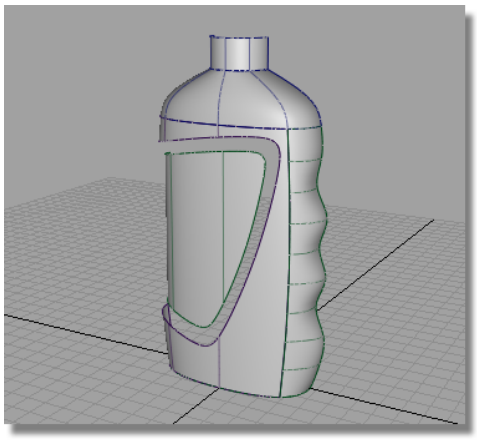
7 Turn on **diagnostic shading** to verify this.



8 Make the **Bottles** layer visible, and assign the new surface to it.



9 Make the **LabelCurves** layer invisible



Save your work

1 Save your work in the wire directory of the Lessons project.

2 Name your file `myshowergel3.wire`.

Part 4: Adding Blend Details

Creating the Blend Surface

The label surface is recessed back from the main bottle surface. The gap between the two surfaces will be bridged by a **Birail** surface, which will give the label area its character.

To create the **Birail**, you will use the two trimmed edges as **Rails**, and create two new curves for the **Generation** curves.

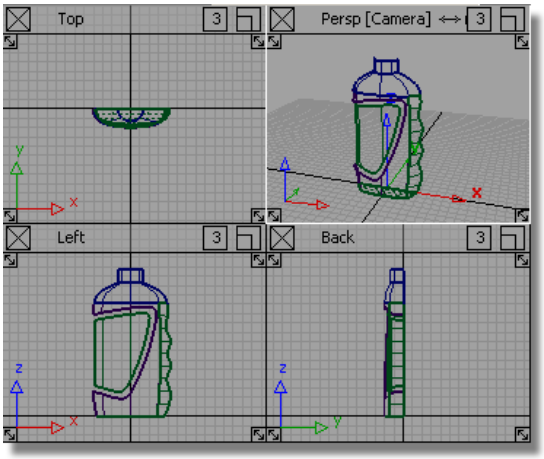


Watch **Part 4** of the tutorial.

Opening the tutorial file (optional)

If you successfully completed Part 3, proceed to the next step: Creating the Generation Curves below.

If you were not successful in part 3, open the file called `showergel_part4.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 3.



Creating the Generation Curves

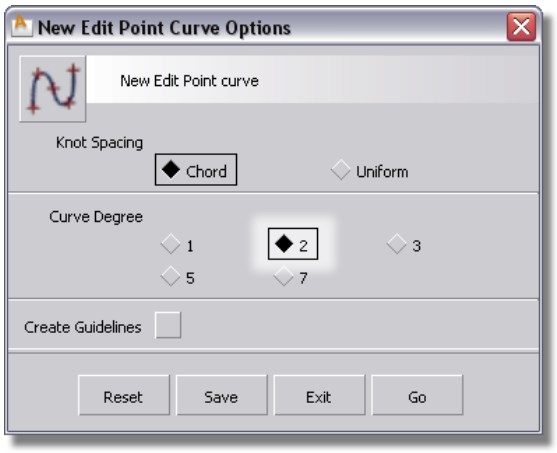
Previously, you used the **Align** tool to create tangent continuity between two surfaces. Now, you will use the **Align** tool to create a tangent relationship between a curve and the edge of a surface.

To keep the **Birail** surface smooth and taut, you will use a curve with only 3 CVs to define the character of the blend. Two CVs will control tangent continuity to the label surface, and the third will control positional continuity to the body surface.

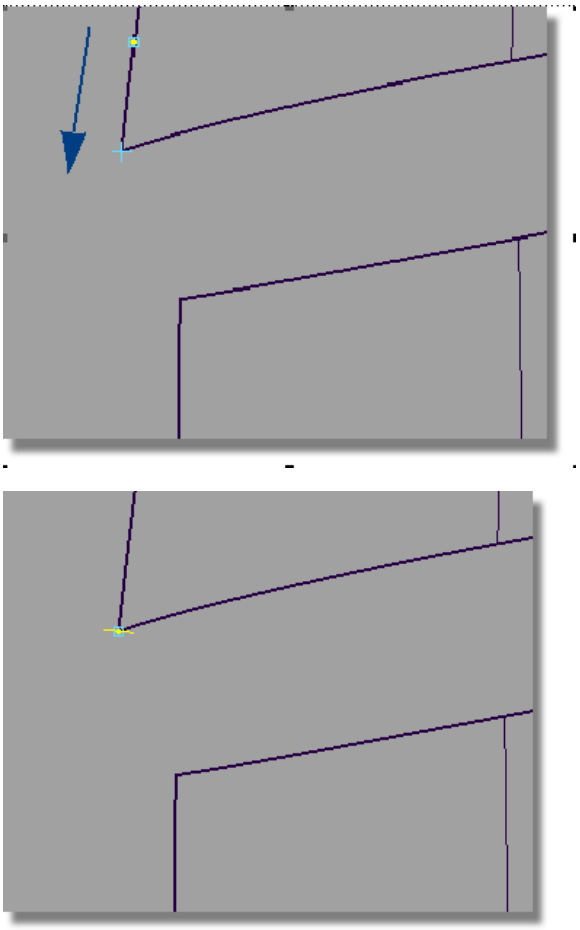
TIP Using the minimum number of CVs needed in a curve or a surface helps to keep your model light and smooth.

---

1. Zoom in to the area at the top of the label.
2. Choose Curves > New Curves > New Edit Point Curve.
3. Double-click to open the option window. In the **Curve Degree** section choose **2**. This will create a single-span curve with only 3 CV points.

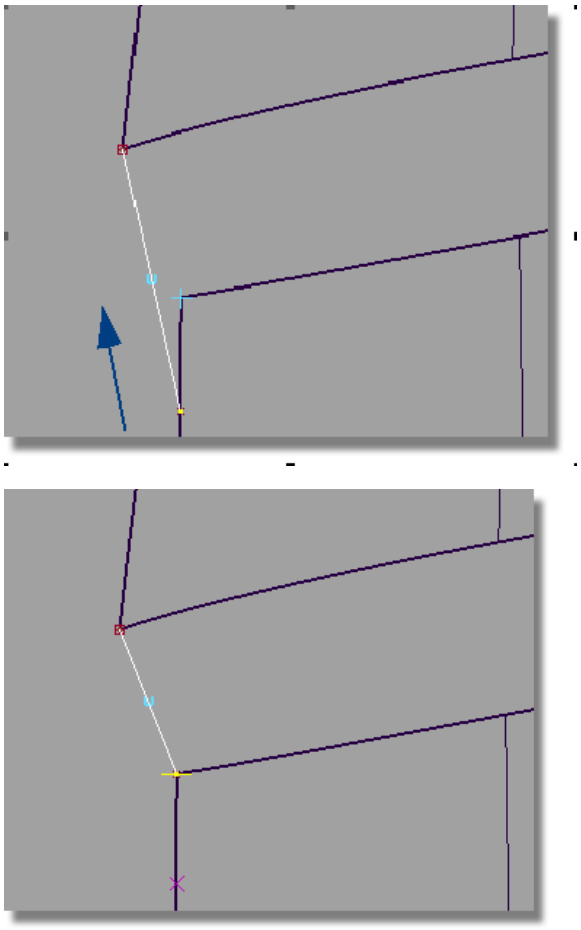


4. Use *Curve Snap* (*Ctrl* + *Alt* (Windows) or *Control* + *Command* (Mac) keys together) and click the edge of the body surface. Then, without releasing the mouse button, drag to the bottom of the edge until the blue cross turns to a yellow one, confirming that you have accurately reached the corner of the surface.



The first edit point of the new curve is placed.

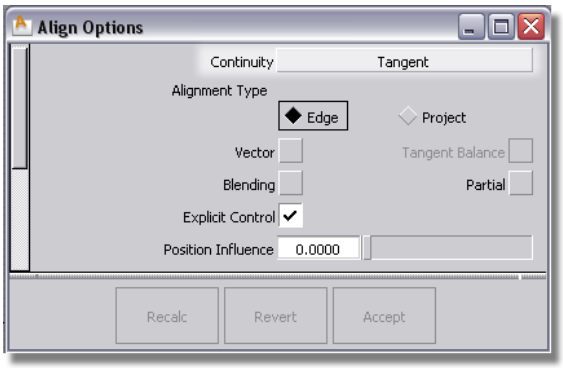
5 Use *Curve Snap* again and click the edge of the label surface, then without releasing the mouse button, drag to the top of the edge.



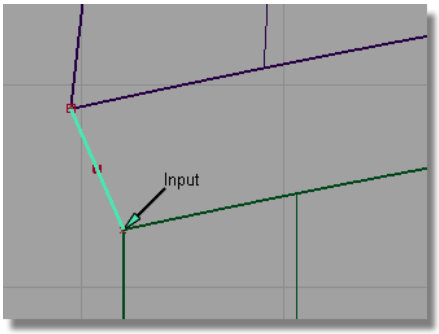
NOTE The Birail tool requires that all boundaries are accurately aligned, so it is important that the curve is snapped accurately to the corner.

6 Choose the Object Edit > Align > Align tool. Double-click the icon to open the option window.

In the **Continuity** section, choose **Tangent**.

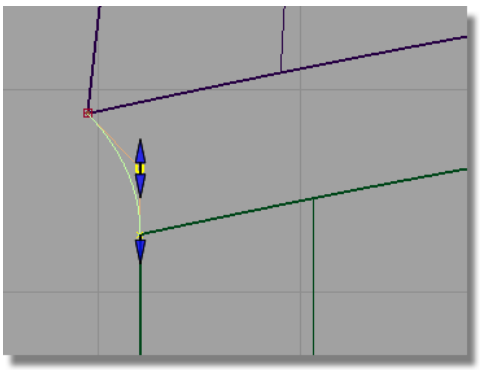


7 You are prompted to select the object to align (input). Click the curve, near the label surface.



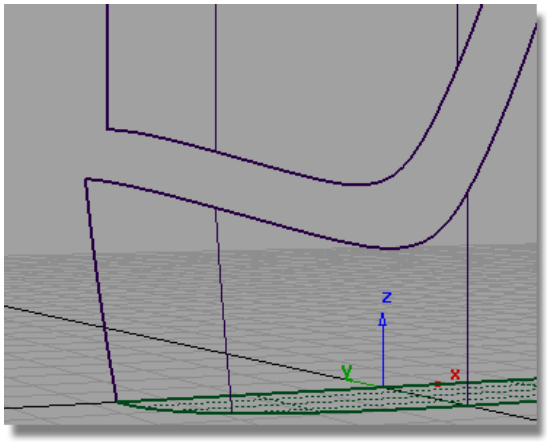
8 You are prompted to select the object to align to.

Click the vertical edge of the label surface, near the curve.

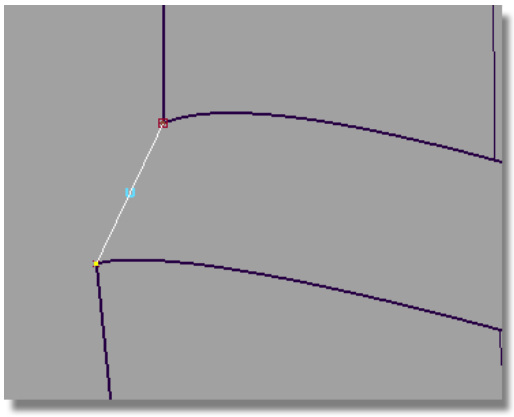


The curve is adjusted to be tangent to the surface.

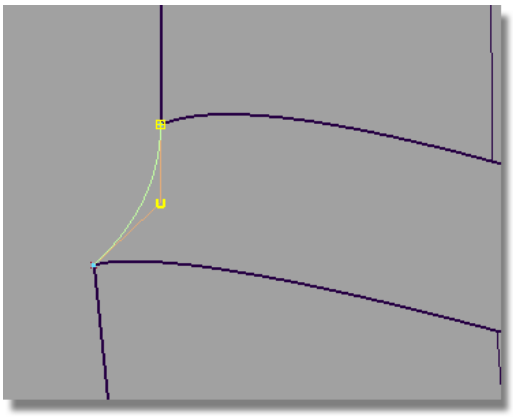
9 Adjust the view so you can see the lower part of the label surface.



10 Create another Degree 2 edit point curve across the gap, using curve snap to place the curve edit points exactly at the corner of the surfaces.



11 Use Object Edit > Align > Align again to align the curve to the label surface.



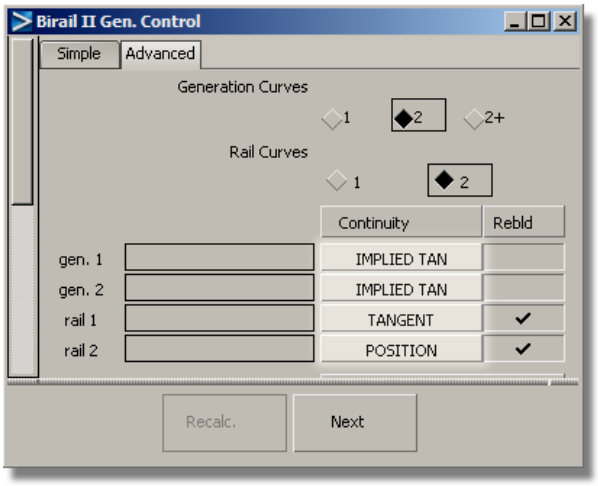
12 Zoom out to see the whole label area.

Building a Birail Surface with Continuity

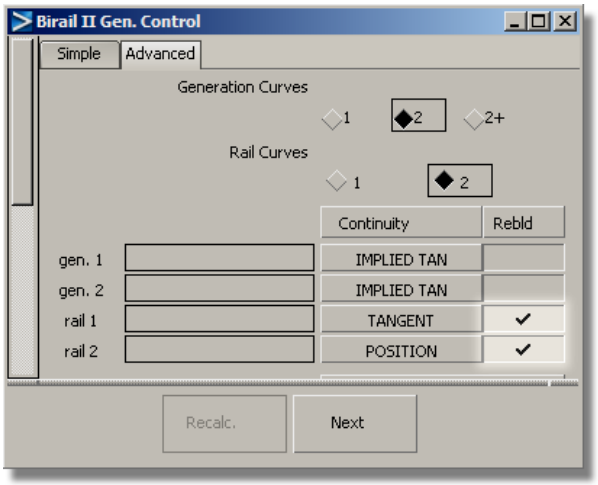
1 Choose the Surfaces > Swept Surfaces > Rail Surface tool. Double-click the icon to open the option window.

2 Check that the options are set for 2 generation curves and 2 rail curves. Adjust the Continuity settings to:

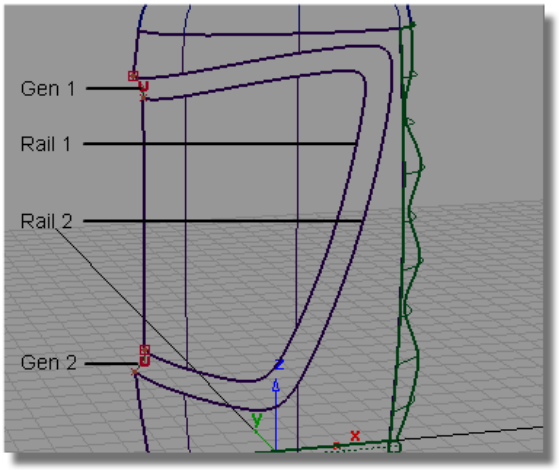
gen 1	Implied Tangent
gen 2	Implied Tangent
rail 1	Tangent
rail 2	Position



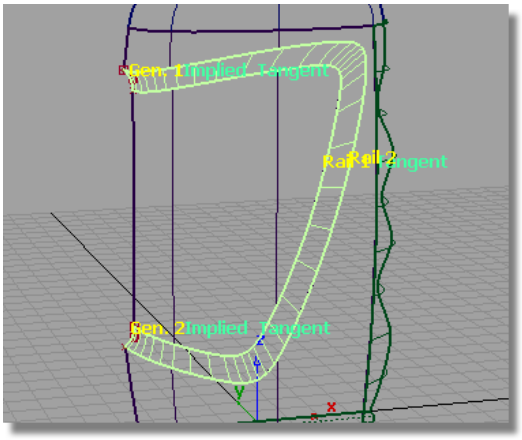
3 Because the **Rails** will be the trimmed edges of surfaces, choosing the **Rebld** option on the two rails will improve the quality of the surface.



4 You are prompted to select the curves in order. Choose the curves and edges as shown.



The Birail surface is created.



5 Choose Pick > Nothing to de-select the surface.

6 Choose Pick > Object , then pick and assign the two curves you created to the **Curves** layer.

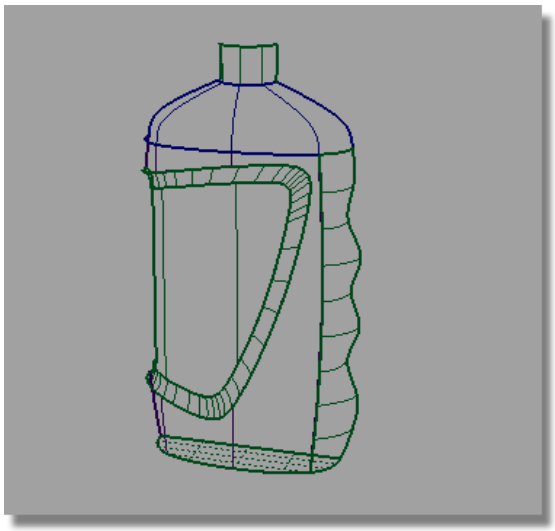
7 Use **diagnostic shading** to evaluate the result.



Completing the Model with Round Surfaces

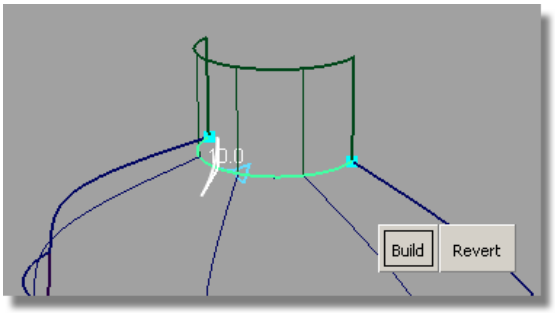
To complete the model, you will soften all the sharp edges with **Round** surfaces.

1 Remove the **diagnostic shading** from the model.



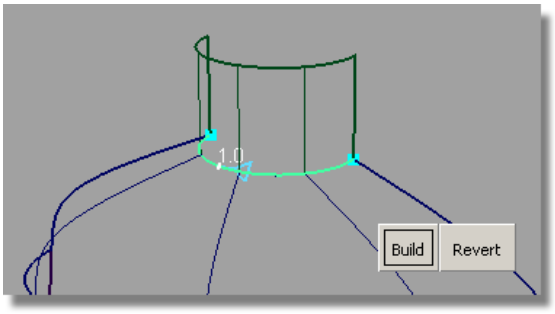
2 Zoom in to the neck area.

3 Choose the Surfaces > Round tool. Click the edge between the neck and the shoulder surfaces.



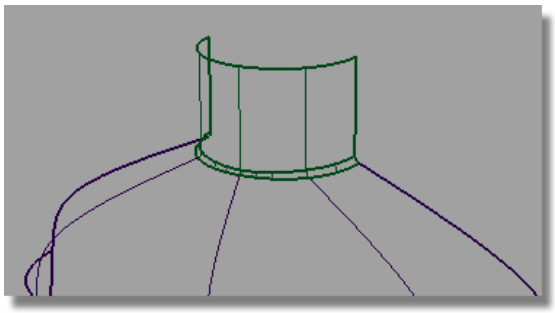
4 The default radius value is shown, and highlighted in white.

5 Type in a new radius value of **1**. Then, press *Enter* (Windows) or *Return* (Mac).



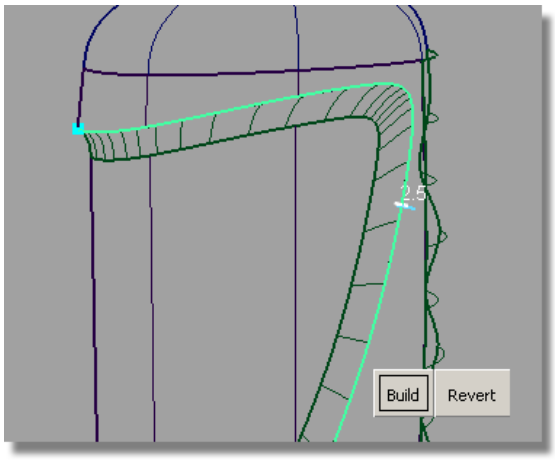
6 Click the **Build** button. A round fillet is created.

7 Choose Pick > Nothing to remove the round indicators.

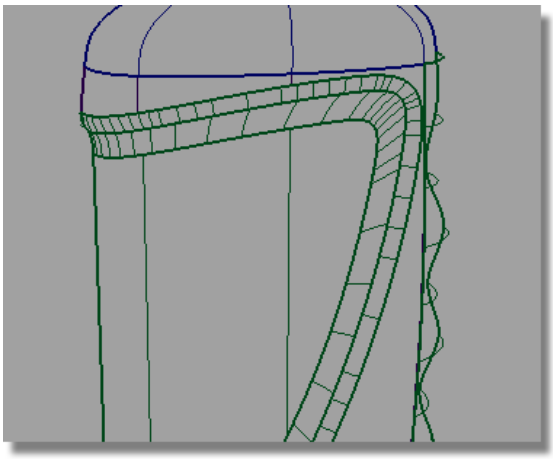


8 Adjust the view to look at the edge of the label panel.

9 Use the Surfaces > Round tool again to create a fillet along the sharp edge of the label birail surface.



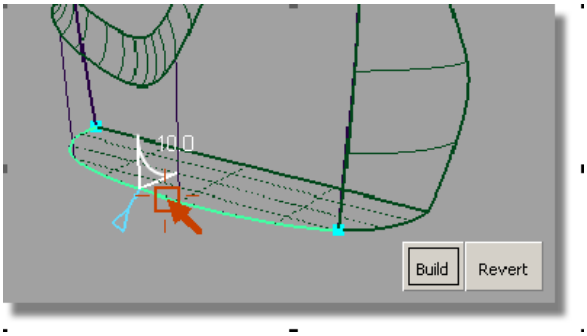
10 Choose Pick > Nothing to remove the round indicators.



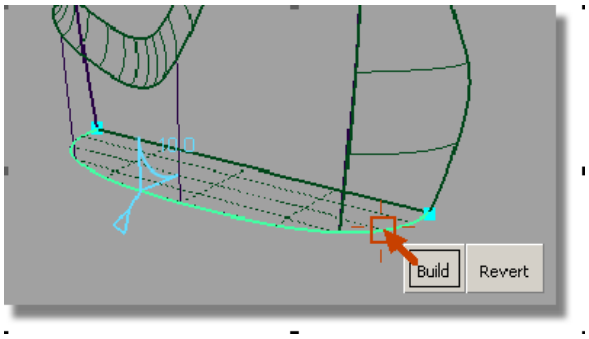
11 Adjust the view to look at the base of the bottle.

12 Use the Surfaces > Round tool again to create a fillet.

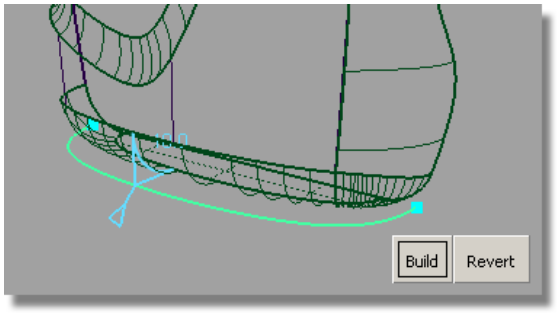
As there are two edges at the base, click first on main bottle surface edge.



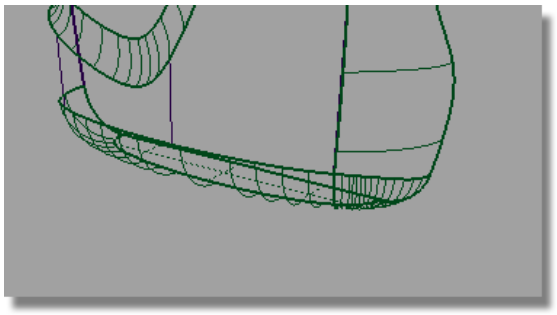
Type in a **Radius** value of **10**. Then, click the edge created by the finger grip surface and the base. The round surface will then be built along both edges.



13 Click the **Build** button to create the round surface.



14 Choose Pick > Nothing to remove the round indicators.



15 Make sure that all the new surfaces are assigned to the **Bottle** layer.



16 Adjust the view and use the **diagnostic shading** to evaluate the rounds.

Save your work

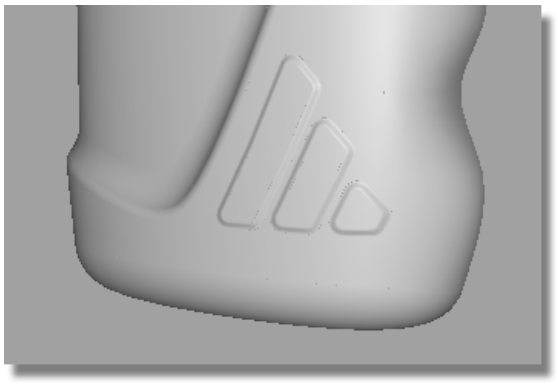
1 Save your work in the `wire` directory of the `Lessons` project.

2 Name your file `myshowergel4.wire`.

Part 5: Embossed Logo Details

In this section, you will create an embossed logo at the base of the pack.

You will use an offset surface to create the logo surface; trimming to create the logo outline, and a **Freeform Blend** to join it to the main surface smoothly.



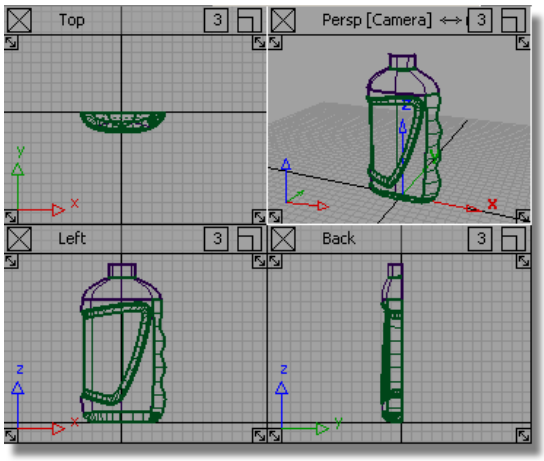


Watch **Part 5** of the tutorial.

Opening the tutorial file (optional)

If you successfully completed Part 4, you can proceed directly to the next step: Trimming the Body Surfaces below.

If you were not successful in part 4, open the file called `showergel_part5.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 4.



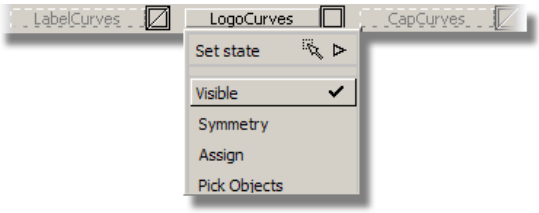
Trimming the Body Surfaces

The transition surface will be created using the **Freeform Blend**. This tool quickly creates a tangent or curvature blend between two edges, and is particularly useful when the edges are made up of many sections.

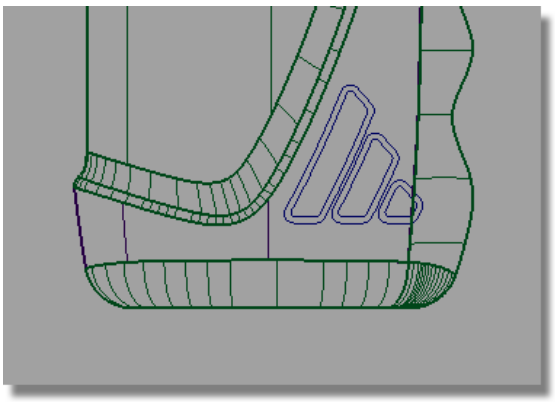
The embossed logo surface will be created using the **Offset** tool.

You will start by projecting the outer logo curves onto the main surfaces.

1 First, make the **LogoCurves** layer visible.

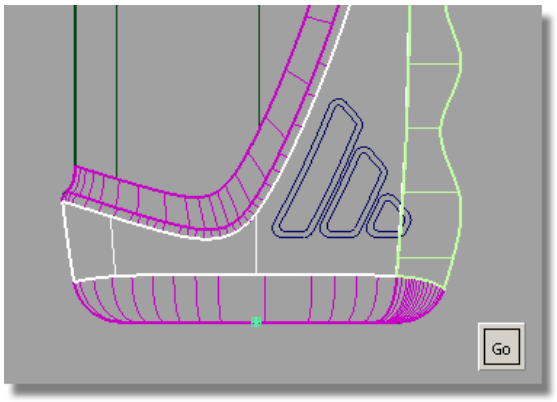


2 Maximize the **Left** window to specify the direction of projection.

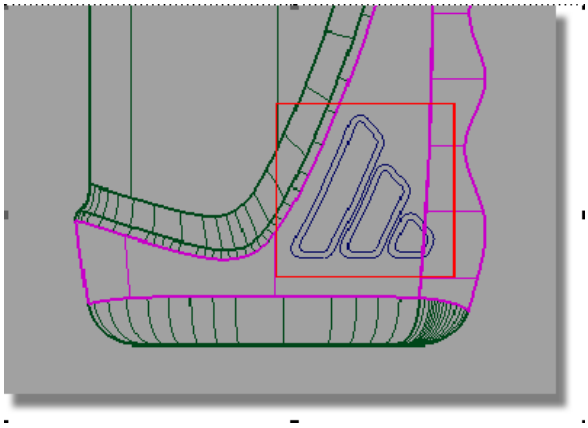


3 Choose Surface Edit > Create CurvesOnSurface > Project .

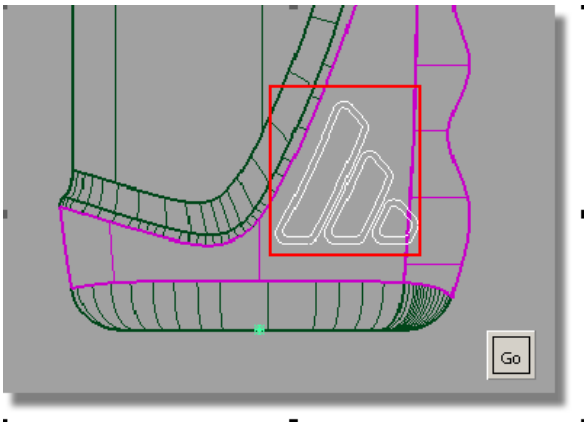
4 You are prompted to select the surfaces. Select the main bottle surface and the finger grip surface.



5 Click **Go**. You are prompted to select the curves to project. As there are many curves in the logo detail, drag a selection box over all the curves.

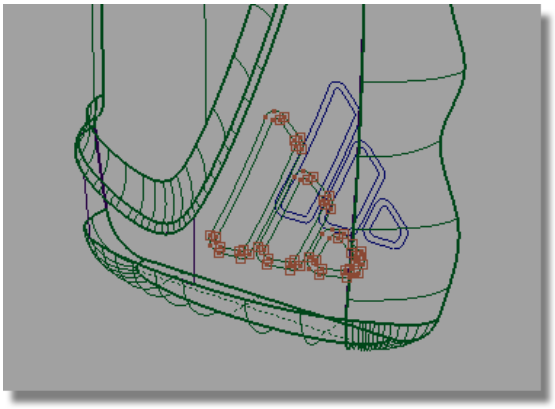


All the curves are highlighted.



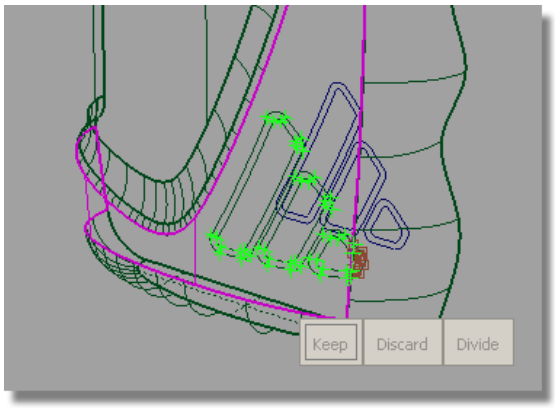
6 Click **Go** to project the curves. Curves-on-surface are created on the two surfaces.

7 Maximize the **Perspective** window to see the curves-on-surface more clearly.

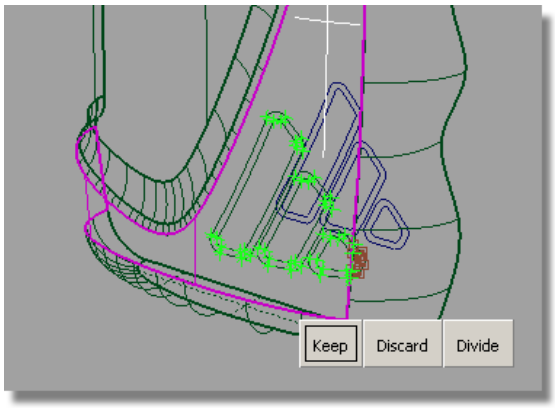


Next, you will trim away the main surfaces.

8 Select the Surface Edit > Trim > Trim Surface tool. You are prompted to select the surface to trim. Click the main bottle surface first.

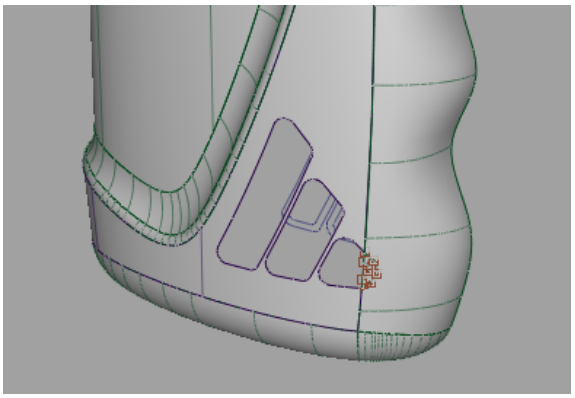


9 When prompted to select the trim regions, click the part of the bottle surface to keep, as shown.



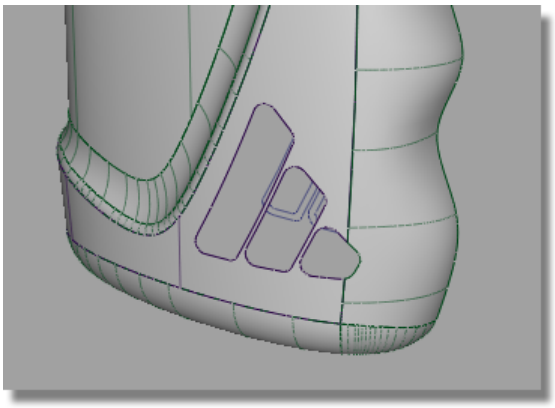
Click the **Keep** button to trim the surface.

The surface is trimmed to the outer curves, the inner curves are ignored.



Do the same for the finger grip surface, trimming away the small corner of the logo that crosses into the surface.

10 Select the Surface Edit > Trim > Trim Surface tool and follow the prompts to trim the finger grip surface.



The surfaces have now been trimmed to allow the logo details to be embossed.

Creating the Offset Surfaces

To create an 'embossed' effect, the main bottle surface will be offset by 0.5 mm, outwards from the bottle. This will then be trimmed to the inner logo curves.

You will first create a layer for the new offset surface.

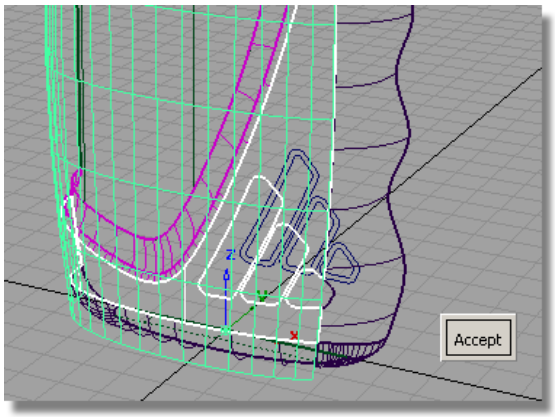
1 Choose Layers > New to create a layer.



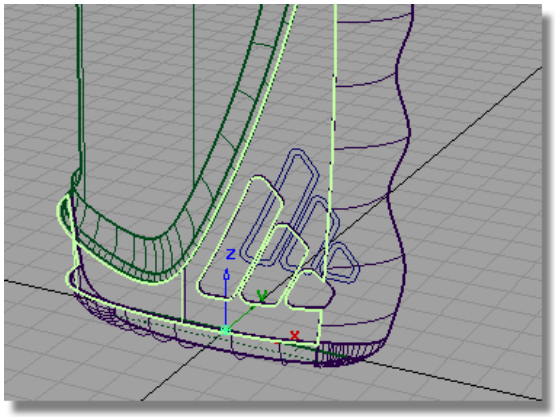
The layer will only be used to temporarily organize the model, so there is no need to re-name it.

Now, create the offset surface.

2 Choose Object Edit > Offset and select the main bottle surface.

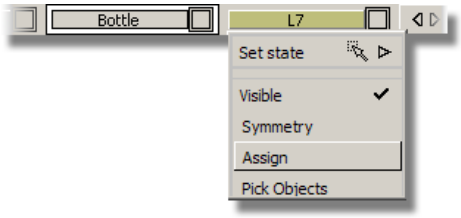


3 At the prompt line, type in an offset value of **0.5**. Click **Accept** to create the surface.

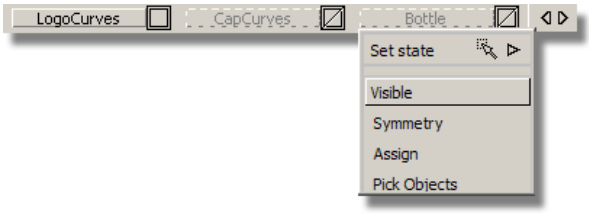


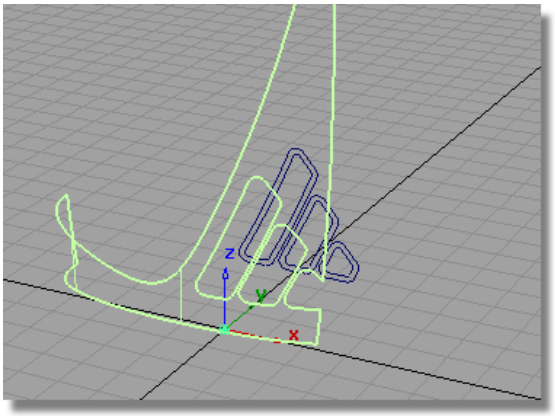
4 Choose Pick > Object and you will see the new surface is already highlighted.

5 **Assign** the surface to the new layer.



6 Make the **Bottle** layer invisible so only the new surface is showing on the screen.

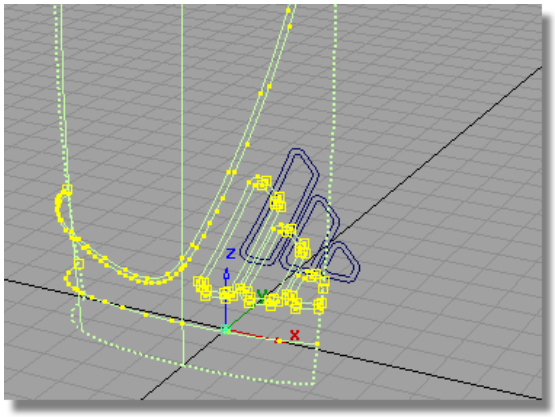




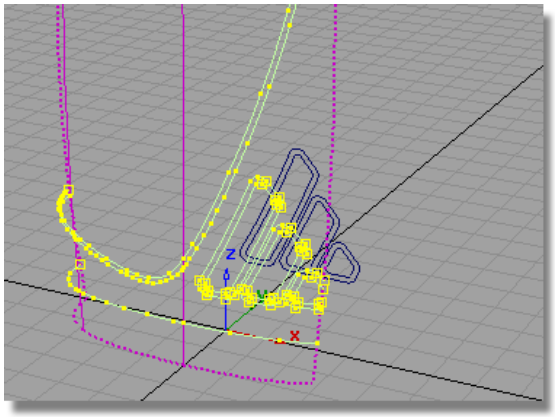
When the surface was offset, the curves-on-surface and trims were offset with it. As you don't want these, you will un-trim the surface and remove the curves-on-surface.

7 With the surface still selected, choose Surface Edit > Trim > Untrim. Double-click the icon to open the option window.

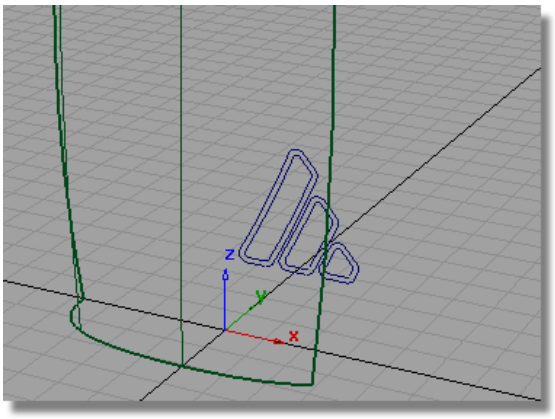
8 Choose the **All** option, so the surface will be fully untrimmed in one operation.



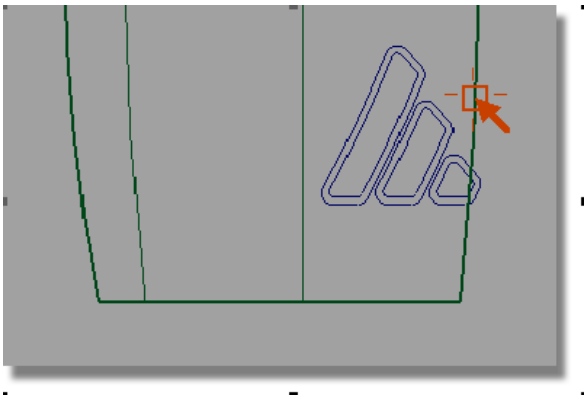
9 Choose Pick > Object Types > Curve on Surface and drag a pick box over all the curves-on-surface to select them.



10 Press the *Delete* key to delete the curves-on-surface.

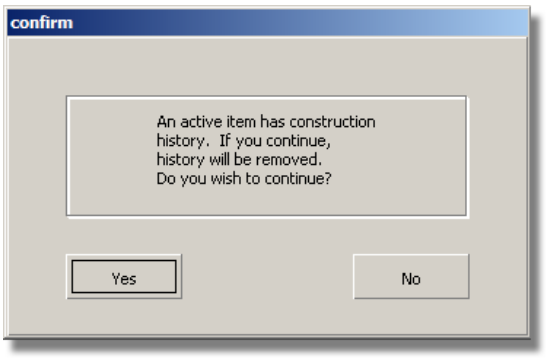


11 Maximize the **Left** view. You can see that the logo curves extend beyond the surface by a small amount. The easiest solution is to extend the surface slightly so the curves fit.

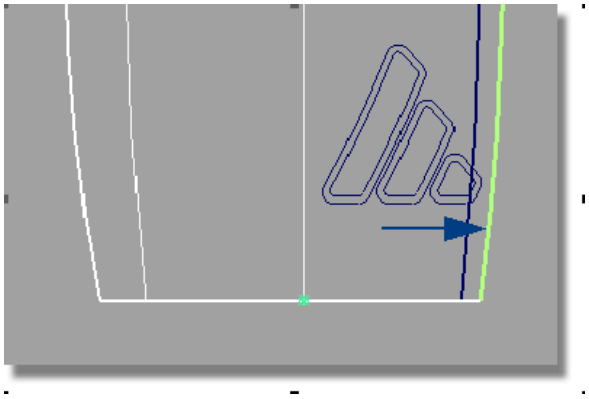


You will use the **Extend** tool interactively, to extend the surface a small amount by eye.

12 Choose Object Edit > Extend and click the edge shown. You will be asked if you want to remove the construction history – answer **Yes**.



13 The edge is still highlighted. Click and carefully drag the *left mouse button* to extend the surface just beyond the inner logo curves.



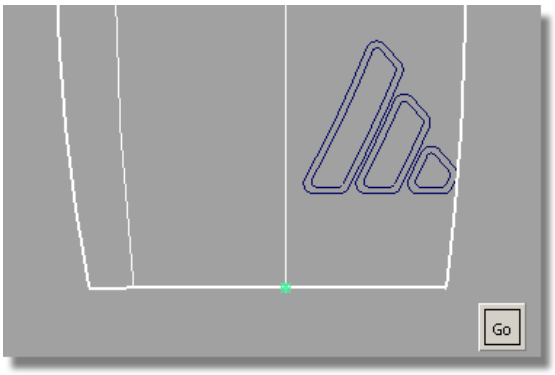
TIP If you over-extend the surface, type in 0 at the prompt line to return the surface to its original shape.

Trimming the Offset Surfaces

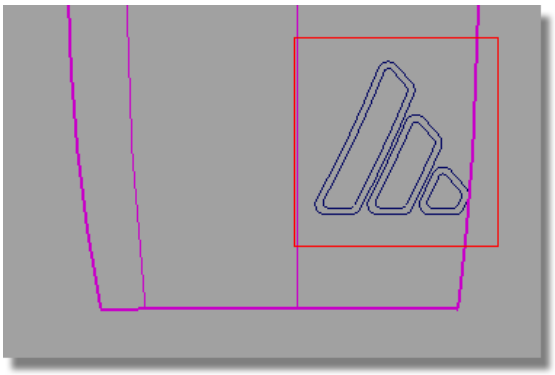
Now, you will project the curves onto the offset surface, so it can be trimmed to the inner logo shapes.

1 Choose Surface Edit > Create CurvesOnSurface > Project .

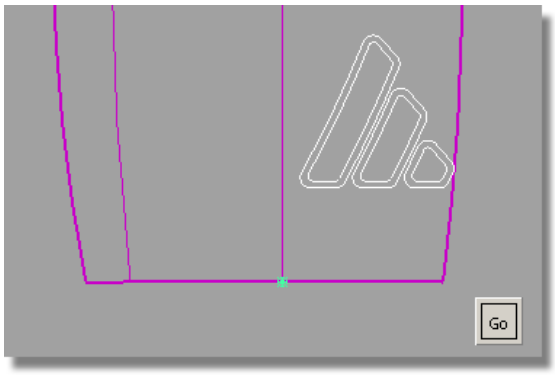
2 When prompted to select the surfaces, select the offset surface and click **Go**.



3 When prompted to choose the curves to project, use a drag box to select all the curves.

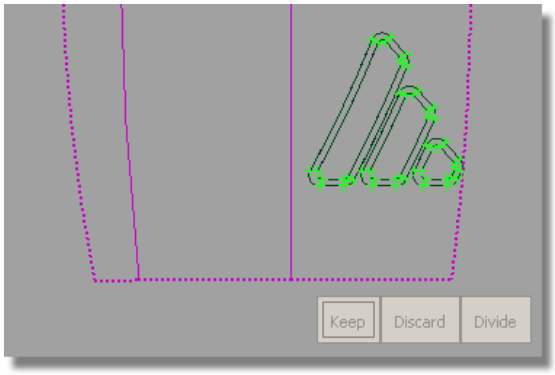


4 Click **Go** to project them onto the surface.

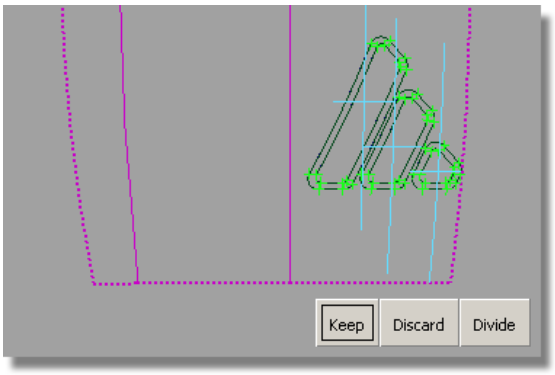


Next, you will trim the offset so that only the three inner shapes remain.

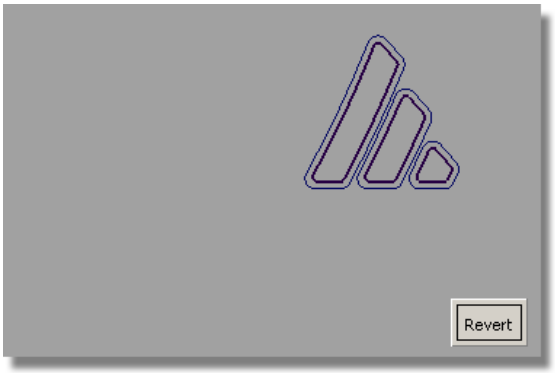
5 Select the Surface Edit > Trim > Trim Surface tool and click the offset surface when prompted.



6 When prompted, select the three inner **Regions**, and click **Keep**.



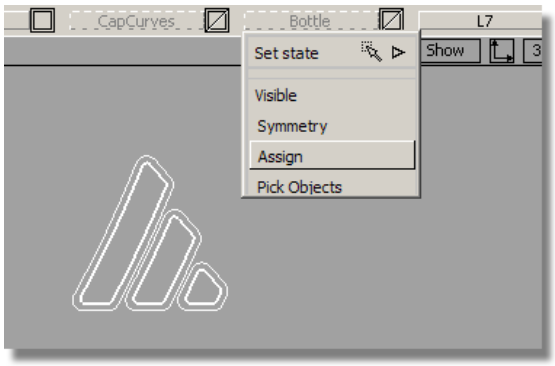
The surface is trimmed into the three parts of the logo.



Now is a good time to tidy up the layers.

7 Choose Pick > Object and select the offset surface.

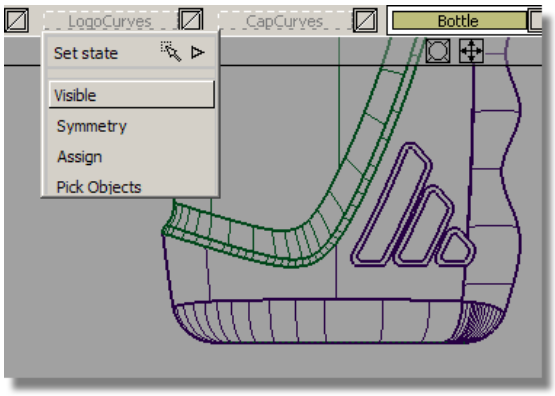
8 On the **Bottle** layer tab, select **Assign**.



The surface disappears from the screen because it has been placed on an invisible layer.

9 Make the **Bottle** layer visible and check that the new offset surface is there.

10 Make the **LogoCurves** layer invisible.

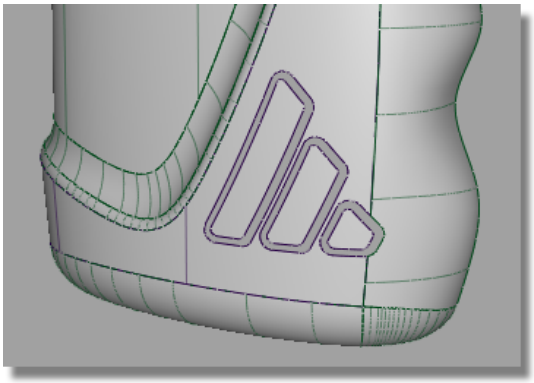


11 Remove the temporary layer by choosing Layers > Delete > Unused Layers .

Creating the Freeform Blend Surfaces

To give a smooth 'embossed' edge to the logo, you will use the Freeform Blend tool to blend from the outer to the inner shapes.

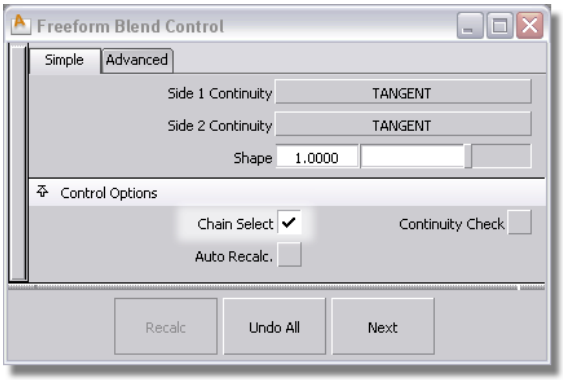
1 Maximize the **Perspective** view and use diagnostic shading to check that the gaps have been created for the blend surfaces.



Next, you will create the freeform blend surface. As the logo shapes were made up of many curves, you can use the **Chain Select** option to select the whole edge.

2 Choose Surfaces > Multi-Surface Blend > Freeform Blend , and double-click the icon to open the option window.

3 Choose the **Chain Select** option, and leave the option window open on screen.

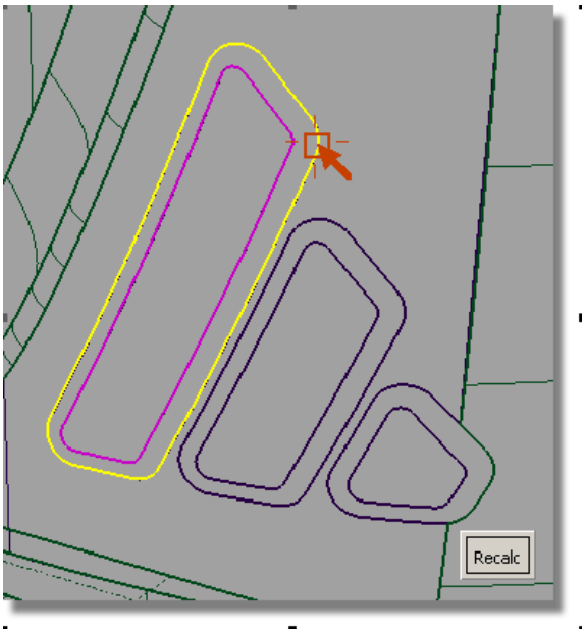


4 You are prompted to pick the input surface curves. Click the edge of the first logo offset surface as shown.



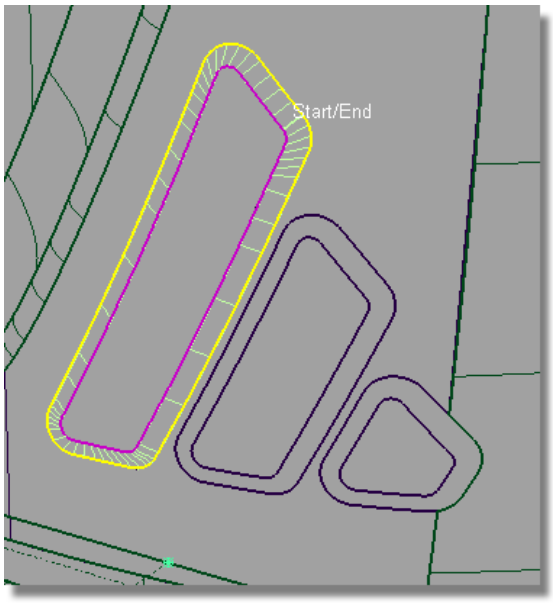
The whole edge is selected and highlighted in pink.

5 Next, click the edge on the bottle surface.

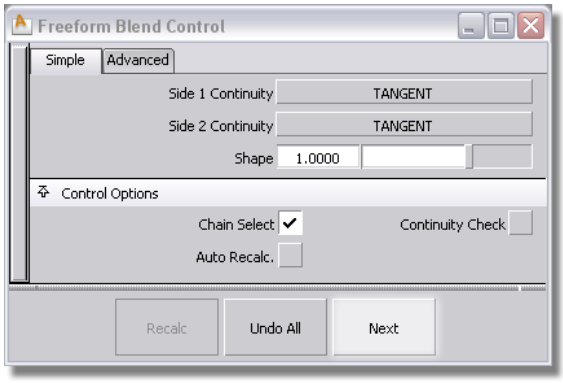


The edge is selected and highlighted in yellow.

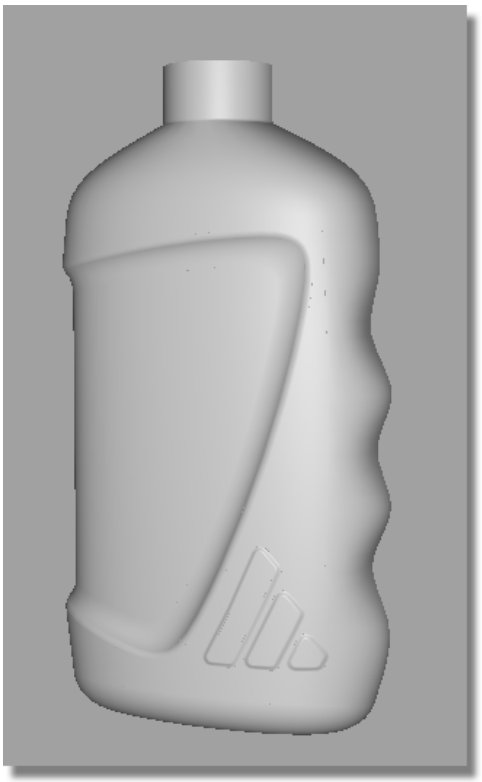
6 Click **Recalc** to build the Freeform Blend.



7 To continue building the blend surfaces, click **Next** in the **Freeform Blend** option window.



8 Repeat the process to create the other two blends.



9 Use **diagnostic shading** to evaluate the logo embossing.

10 Finally, make sure all the surfaces are assigned to the **Bottle** layer.

Save your work

1 Save your work in the `wire` directory of the `Lessons` project.

2 Name your file `myshowergel5.wire`.

Part 6: Completing the Model

In this section, you will complete the model by mirroring the surfaces and creating a cap.

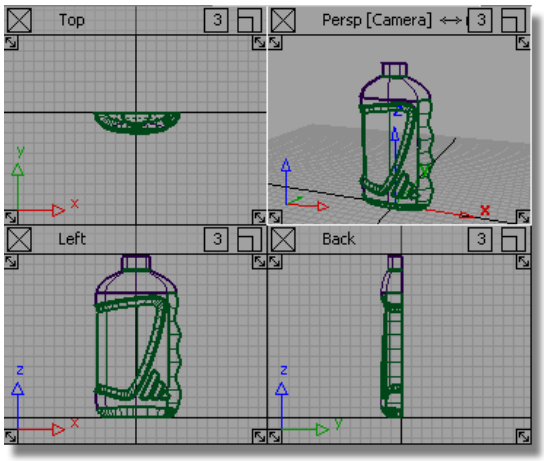


Watch **Part 6** of the tutorial.

Opening the tutorial file (optional)

If you successfully completed Part 5, proceed to the next step: Mirroring the surfaces below.

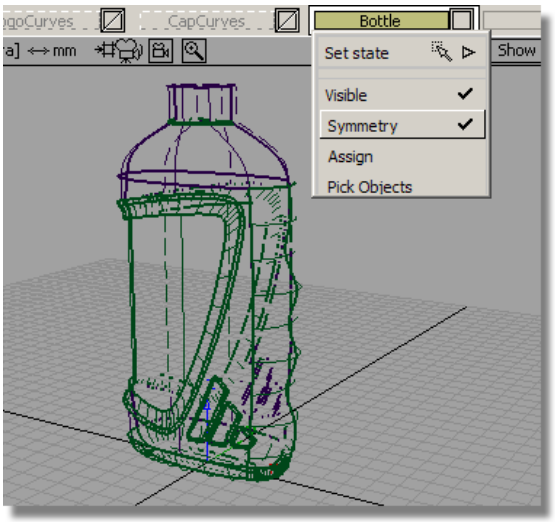
If you were not successful in part 5, open the file called `showergel_part6.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 5.



Mirroring the Surfaces

Finally, you will mirror all the surfaces using the **Layer Symmetry** tools.

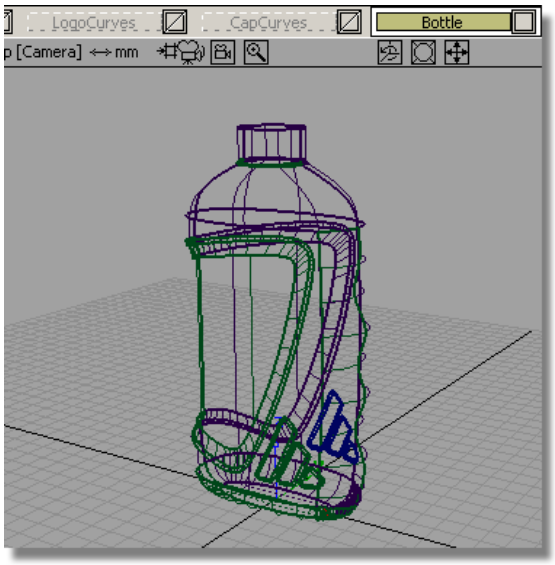
1 Turn on **Symmetry** for the **Bottle** layer using the sub-menu on the layer menu.



2 Click in the layer tab to make the layer active. It will be shown in yellow with a white border.

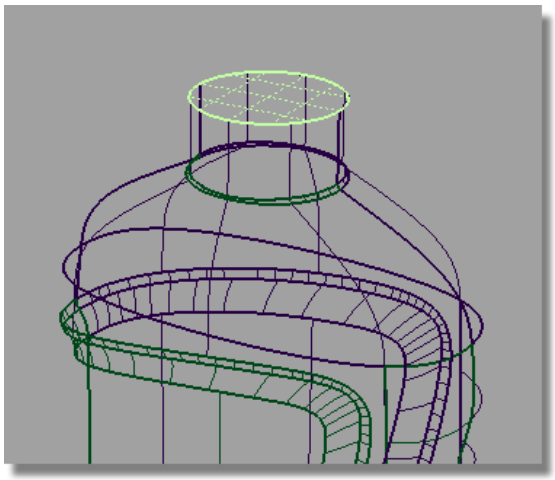


3 Choose Layers > Symmetry > Create Geometry to convert the mirrored image of the geometry into actual geometry.



To complete the model as a closed volume, add a planar surface to the top of the neck.

4 Choose Surfaces > Planar Surfaces > Set Planar and select the two top edges of the neck. Click **Go** to create the surface.



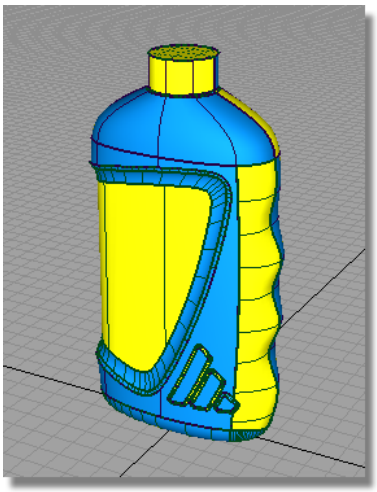
Volume Measurement

If you have built your model carefully so there are no gaps between the surface patches, you can calculate the volume enclosed by those surfaces.

For the volume calculation to be accurate, all the surfaces need to face outwards.

As you build you model, you aren't concerned with the surface orientation, and surfaces will randomly face inwards or outwards.

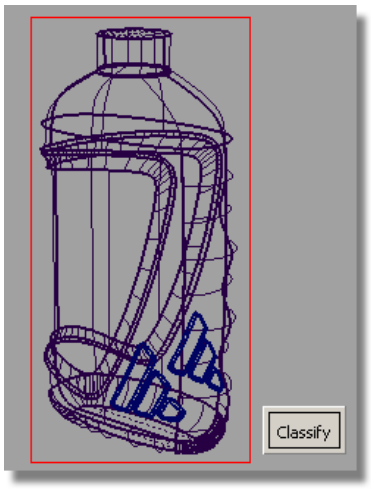
NOTE The Surface Edit > Orientation > Set Surface Orientation tool can be used to show surface orientation (blue shading means that the surface faces outwards, yellow, inwards).



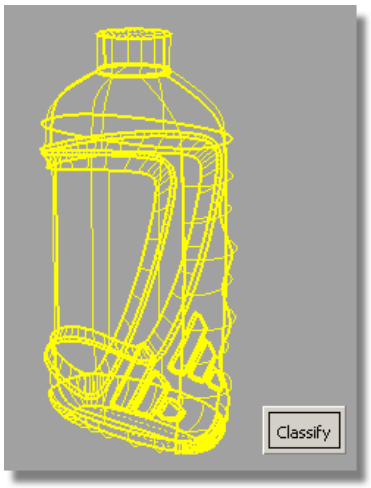
For an accurate volume calculation, you need all the surfaces to face outwards. So you will first unify the orientation of the surfaces.

Preparing the Model for Volume Calculation

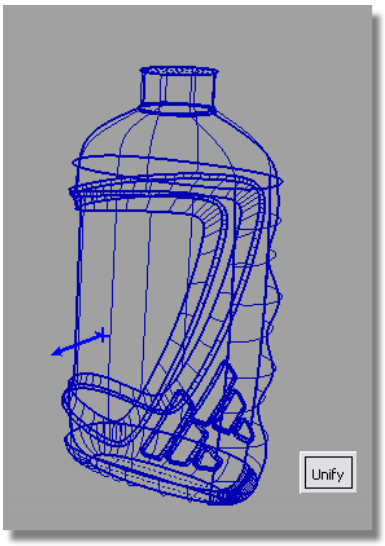
1. Make sure that only the bottle surfaces are visible on screen.
2. Choose Surface Edit > Orientation > Unify Surface Orientation . Drag a pick box over the whole model to select all the surfaces.



3 The surfaces are highlighted,



4 Click **Classify**.
The surfaces are highlighted in blue, and a **Unify** button is shown.



A blue arrow is also shown, indicating the orientation of the surfaces. This arrow should point out, away from the model. If it doesn't, click it to switch the direction.

5 Click **Unify** to unify the surface orientations. A message is shown in the prompt window confirming the surfaces have been unified.

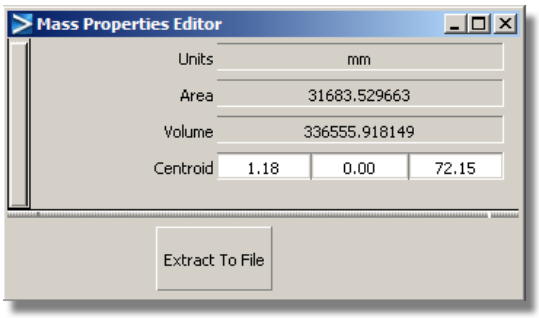


Calculating the Volume

Now, you will calculate the volume of the bottle.

1 Choose Pick > Object and select all the surfaces.

2 Choose the Evaluate > Mass Properties tool. The volume is created and displayed in a separate window.



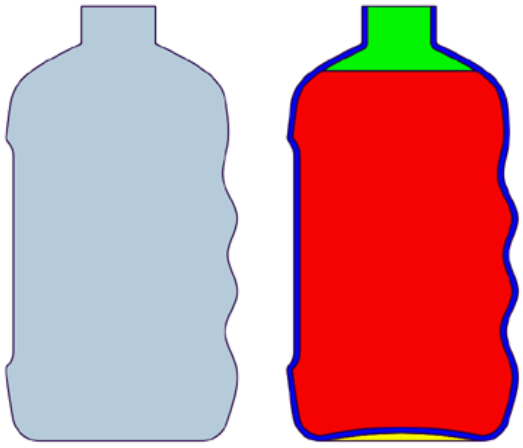
Interpreting the Calculated Volume

The figure given in the mass properties window is in cubic millimeters. Most packaging designs are measured in milliliters.

To make the conversion, divide by 1000.

So, in this example, a volume of 336555 cubic millimeters is 336.5 milliliters.

Also, the volume measured is the external volume of the whole bottle. This will include the liquid, the airspace at the top of the bottle and the thickness of the plastic itself. Making an allowance of 25% is a good approximation of the extra volume all these factors add to the desired product volume.

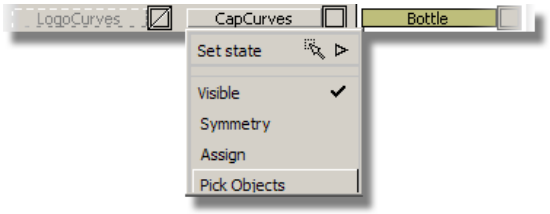


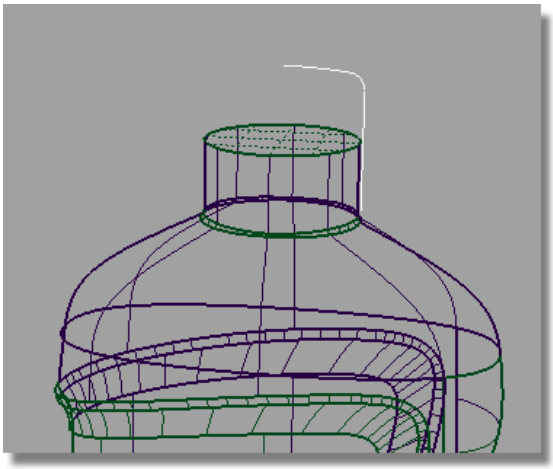
So, if our target is a product volume of 250 ml, you would expect to add 25% to account for the plastic material and airspace, giving a target of 312.5 ml for the external shape modeled. This would then be displayed as 312500 mm3 in the Mass Properties window.

Revolving a Cap

To finish off the model, you can build a simple cap from curves supplied on the **CapCurves** layer.

1. Turn on the visibility of the **CapCurves** layer.
2. Select all the cap curves using **Pick Objects** on the layer sub-menu.

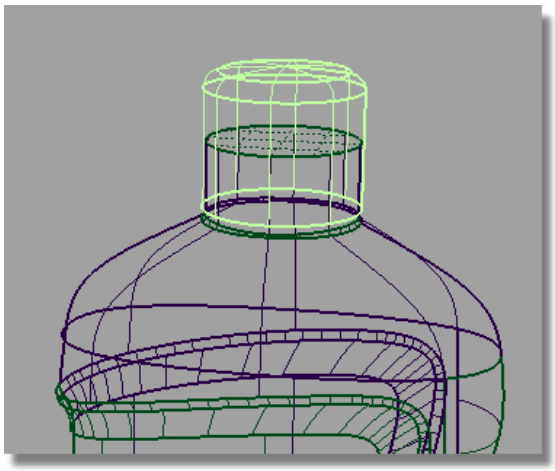




3. Choose Surfaces > Revolve and double-click the icon to open the option window.
4. In the **Axes** section, select **Global**. This enables you to revolve all the curves at the same time around the origin.



5 Click **Go** in the option window to create the cap surfaces.



6 Assign the new cap surfaces to the **CapCurves** layer.
The Shower Gel pack design is now complete.



Save your work

1. Save your work in the `wire` directory of the `Lessons` project.
2. Name your file `myshowergel6.wire`.

Conclusion

Congratulations! You have completed the Shower Gel Bottle, and have an understanding of continuity and how to build smooth forms in Alias.

You have learned how to:

- Create smooth transitions between surfaces
- Model accurately for manufacture
- Use Layer Symmetry
- Change the degree of a curve

Quiz

Now that you have completed this shower gel modeling tutorial, do this quick quiz to help you remember the tools and techniques you have learned.

1. Which of the following can be toggled on and off using the Show menu on the window pane?
   - (a) Model
   - (b) Lights
   - (c) Grid
   - (d) Pivots
   - (e) Locators
   - (f) All of the above
2. Which of the following tools have a Chain Select option?
   - (a) Round
   - (b) Tubular Offset
   - (c) Freeform Blend
   - (d) Profile Blend
   - (e) Tube Surface
   - (f) Draft / Flange
3. Where can you set up a mirror image of your geometry, one that will update each time you modify or build a surface?
   - (a) Use **Edit > Duplicate > Mirror**

- (b) Use **Transform > Rotate**
- (c) In the Layer tab, use the **symmetry** setting.
- (d) Use the symmetry setting in the Control Panel
- (e) Use the Symmetry setting in each surface tool

4 How many CVs does a single-span, degree 2 curve have?

- (a) one
- (b) two
- (c) three
- (d) four
- (e) five

5 What kind of continuity does the **Round** surface produce?

- (a) You can choose either Tangent or Curvature
- (b) None
- (c) Positional only
- (d) Tangent only
- (e) Curvature only

6 What is important when calculating the volume of a model?

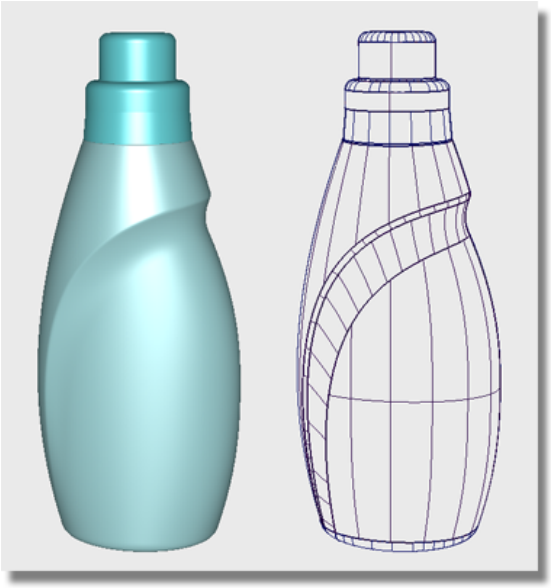
- (a) The surfaces represent a closed volume
- (b) The surfaces all face outwards
- (c) There are no duplicate surfaces
- (d) Which units are set up in the Construction options
- (e) All of the above

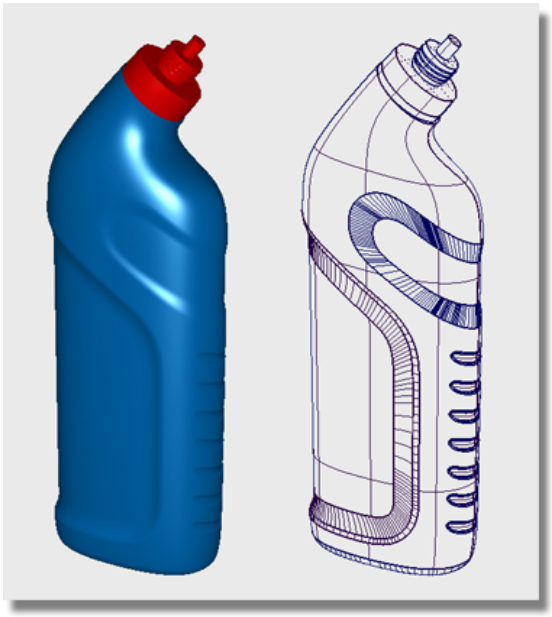
On Your Own

This exercise has given you an introduction to the tools that can create continuity between surfaces. Mastering these techniques fully takes time and practice, and is one of the advanced topics to study in Alias.

Below are some ideas for practicing and exploring these techniques.

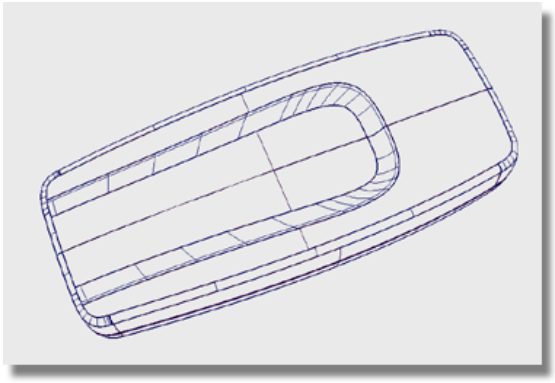
Packaging design is a good area to look for freeform and smooth surfaces. Below are two examples of shapes and features that you could try.

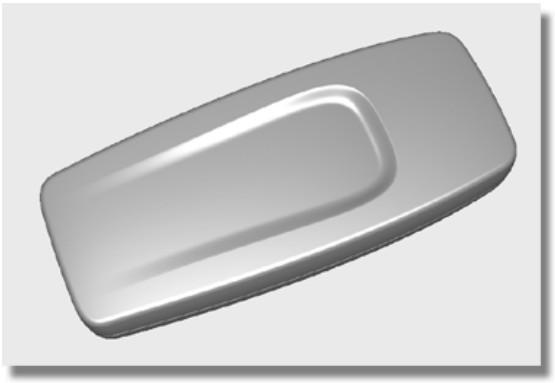




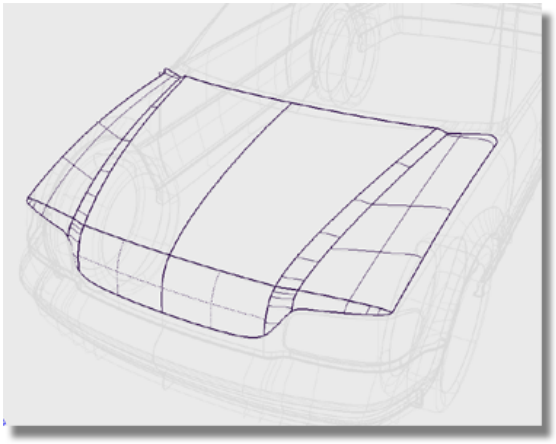
The techniques you learned modeling the label area on the Shower gel bottle can be used to create features on product designs and vehicle designs as well.

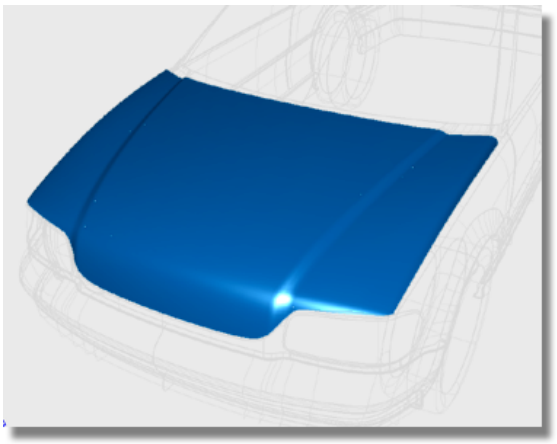
The finger recess on the back of this cell phone is created in the same way as the recessed label.





The raised center section of this car hood is blended into the main surface using a Birail with curvature continuity.





If you are using Surface or Automotive versions of Alias, you have more options for creating curvature continuity surfaces.

If you are using one of these products, try rebuilding the shower gel bottle with curvature continuity instead of tangent.

Look at the model supplied for Shaders and Lights on page 631. This version of the shower gel bottle has been created using curvature continuity.

Quiz Answers

Answers to the Shower Gel Bottle Tutorial quiz

1. (f) All of them
2. (b), (c), (d) and (e)
3. (c) In the Layer tab, use the symmetry setting
4. (c) Three
5. (d) Tangent only
6. (e) All of them are important.

An introduction to Rendering

9

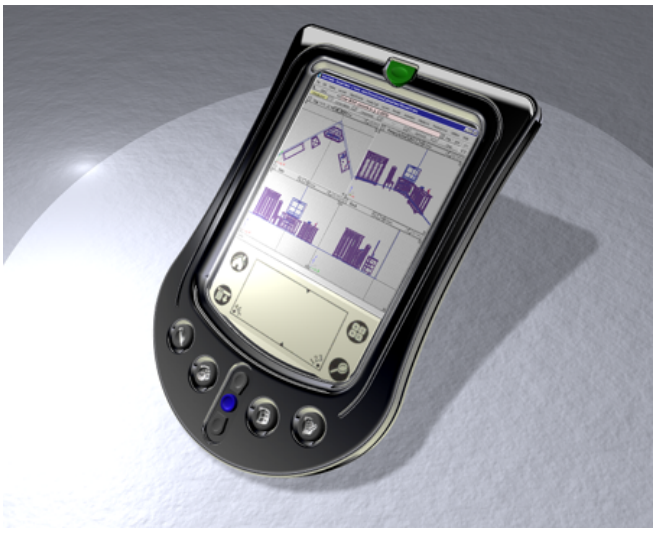
Learning objectives

In this tutorial, you will learn the foundations of rendering and experiment with the toggle shade tool.

You will learn:

- rendering theory
- resolution theory
- shaders and texture theory
- the Multi-lister
- the hardware shader
- editing shaders and textures
- assigning shaders

To complete this tutorial, you will be supplied with the model of a personal digital assistant (PDA). We will examine some of the key concepts of rendering, like the **Render Globals** settings window, resolution, and the powerful interactive form of rendering, Hardware Shading.



New menu items used in this tutorial

- Window Display > Hardware Shade
- Render > Globals
- Render > Multi-lister > List shaders

Overview

After you have created objects, lights, and shaders, you can bring these elements together in the final rendering process. Alias offers industry standard sizes and types of rendering with adjustable quality levels. Generally, the better the rendering quality required, the longer the renderer takes.

The rendering pipeline

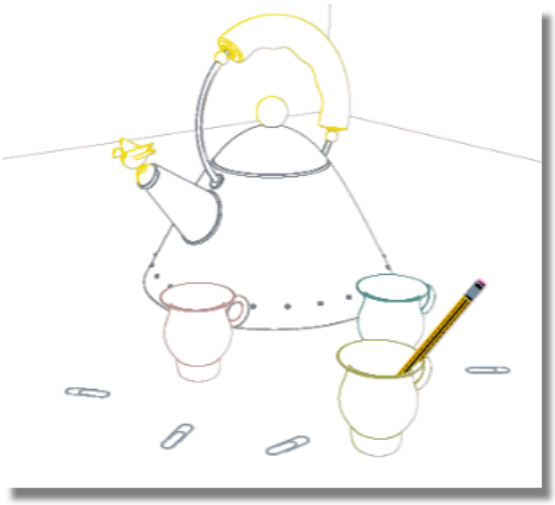
The rendering process requires that you set up surfaces, cameras, lights, and any animation channels that may have been used in the scene. When a rendering is executed, all of the information about the scene is either streamed directly to the renderer for immediate rendering, or it is exported to a special file called the **SDL** file (**Scene Description Language**). This file can be

saved and rendered later using a command line batch renderer. Users with programming experience can also edit the **SDL** file to change how it will render.

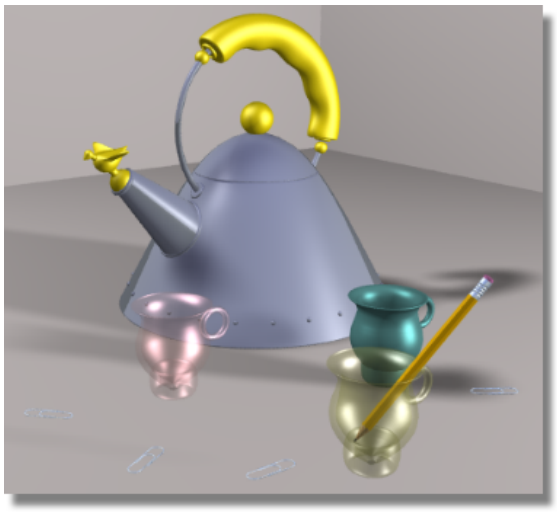
Rendering types

To decide which rendering type is required for your work, you must decide on the look you want.

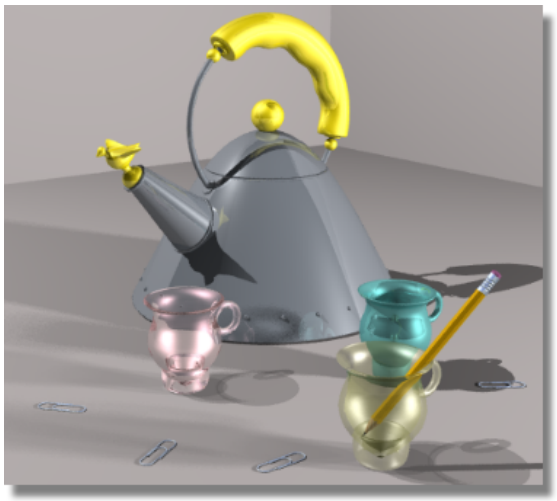
Hidden-line - This rendering type produces an outline rendering of the scene and renders objects using flat unshaded color.



Raycast - This rendering type produces a smooth shaded rendering of the scene that includes shadowing capabilities. Raycasting is faster than Raytracing, but lacks the extra realism added by true reflections and refractions. If necessary, reflections can be simulated in a Raycast rendering using environment maps and linear transparency. For long animations, Raycasting is often used to keep the rendering time for each frame short.



Raytrace - This rendering type gives a smooth shaded rendering of the scene that includes reflections, refractions, and shadows.



Render globals

Before rendering, you must decide on both the size of the image and how detailed the image will be. The **Render Globals** window, under the **Render** menu, is used to set the size and resolution of the image, the quality of anti-aliasing, the raytrace rendering limits, and many other rendering

parameters. Since many of the settings change the rendering time, you must balance the need for quality with that of size.

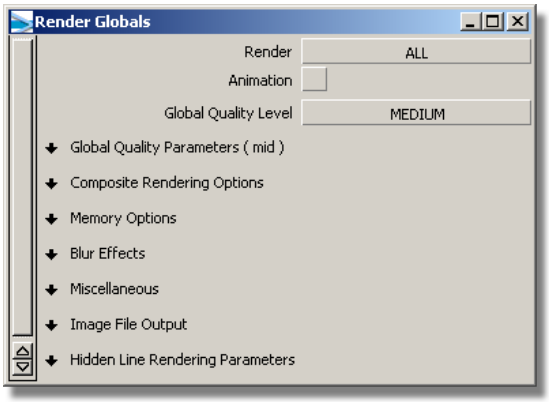
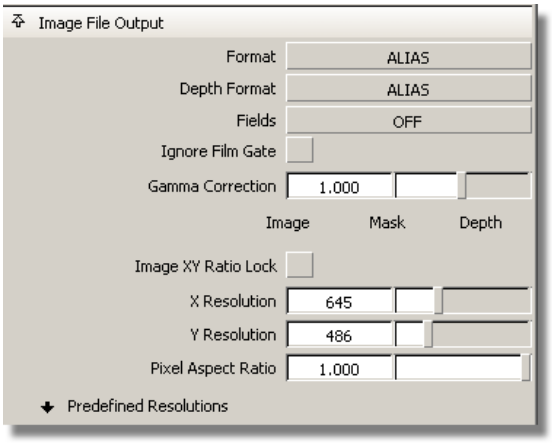


Image file output

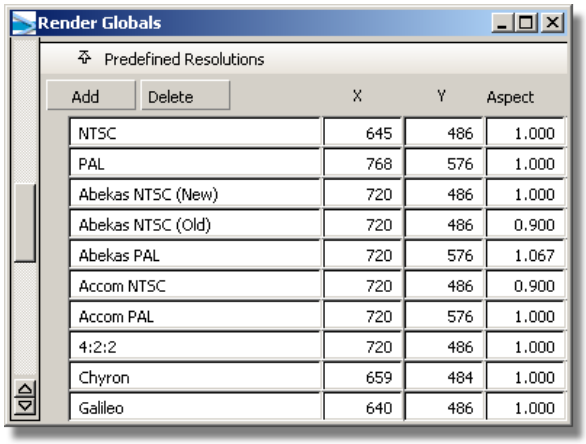
In the **Image File Output** section of the **Render Globals** window, you can set which cameras or orthographic views are rendered and the size of the rendered images.



Renderings are bitmap images that consist of a matrix of pixels, each holding a particular color. The size of the rendering is set in pixels, representing the number of colored squares along the X and Y axis of the rendering.

The **Predefined Resolutions** section of the **Render Globals** window contains a comprehensive list of image size standards you can choose from.

As an example, North American image size for video is 645 x 486, which defines the **NTSC** standard.



If you want to render for print, you need to render at a pixel resolution that will give you enough pixels for the size of the printing job. Many print jobs use 300 pixels per inch (ppi) as a standard. To determine the final dimensions, you must multiply the resolution by the desired image size in inches. For instance, a 3" x 4" rendering would require a resolution of 900 (3 x 300) x 1200 (4 x 300) pixels. If you use the metric system, your standards may be a little different.

TIP Try not to render images larger than required. Adding size to the render resolution can add significantly to your render time.

Resolution - some theory

In order for a bitmap image to look good, the pixels must be as small as possible, so they are not easily perceived individually by the human eye. Every bitmap image has a resolution that determines how many pixels fill an inch, pica, or centimeter. A 10 ppi (pixels per inch) image displays 10 pixels in every linear inch of image. A 72-ppi image has 72 pixels per linear inch, and a 300-ppi image has 300 pixels per linear inch. As the image resolution gets higher, the image quality improves, to a certain extent.

If you are taking the image to press, check with your printer to find the number of lines per inch that are used — and double the number of lines to determine the maximum resolution you should be using. If you have a well anti-aliased picture, you can probably use a lower value (but always make it at least as high as the number of lines per inch).

For example, if your printer is using 85 lines per inch (say, for a newspaper), your image should be rendered at a maximum resolution of 85 x 2, or 170 pixels per inch. If your printer is using 150 lines per inch, your image should be rendered at a maximum resolution of 150 x 2, or 300 pixels per inch. Any resolution greater than twice the lines per inch will not likely improve the image — it will just take longer to render, and may cause some fine detail to drop out.

These next two images show the same file — but, at different resolutions. The first image is 40 ppi, and the second is 150 ppi.



Image rendered at 40 ppi



Image rendered at 150 ppi

Resolution is used to determine how big an image will display or print on an output device. Your monitor is an output device, as is your printer. Your monitor is typically capable of 95 dpi (dots per inch). Therefore, if you want to see a 4" x 5" image on your monitor, you need (95 dpi x 4") pixels and (95 dpi x 5") pixels, or 380 x 475 pixels. If you wanted to print the same image at the same size on a 300-dpi printer (which usually has 57 lines per inch), you would need (57 lpi x 2) x 4" pixels and (57 lpi x 2) x 5" pixels or 456 x 570 pixels. As you can see, the higher the image resolution, the more pixels you are going to need to see the same size of image.

Visualizing a PDA



Watch **the tutorial**.

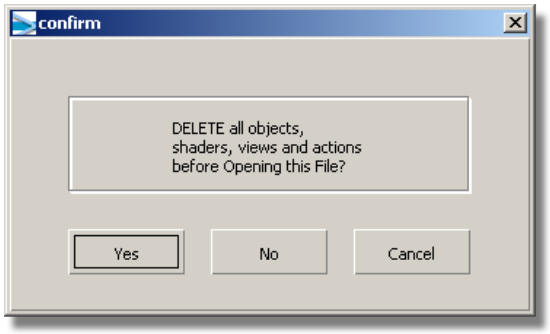
To open the tutorial file

1 Open the file called `pda_rendering.wire`, located in the `wire` sub-directory of the `CourseWare` directory.

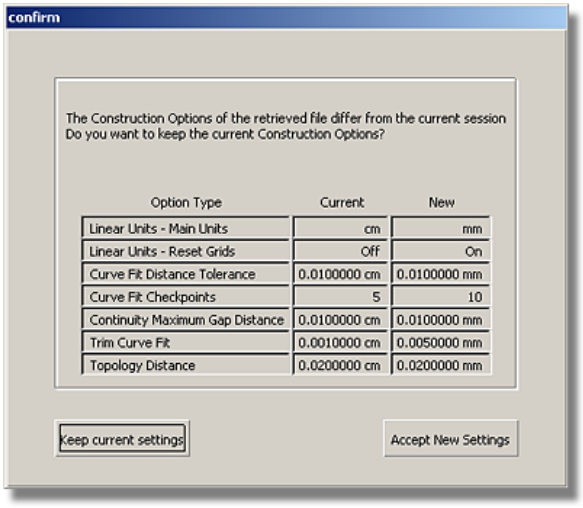
NOTE For information on how to open a file, see Opening the tutorial file on page 82.

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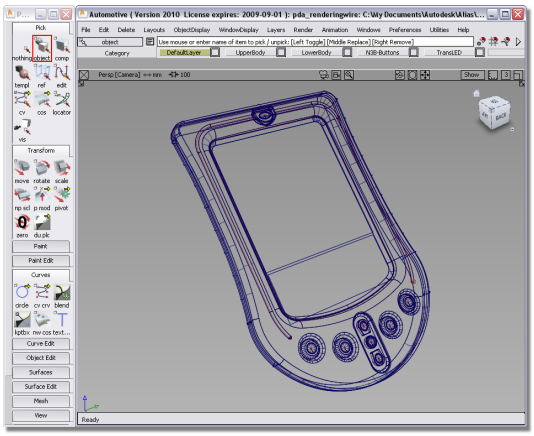
2 A dialog box appears, asking if you want to delete all objects, shaders, views, and actions. Click **Yes**.



3 If your construction tolerance values differ from those in the `pda_rendering.wire` file, you will be prompted by a Construction Options dialog box. Click **Accept New Settings** to use the construction tolerances in the `pda_rendering.wire` file.



The file is displayed.



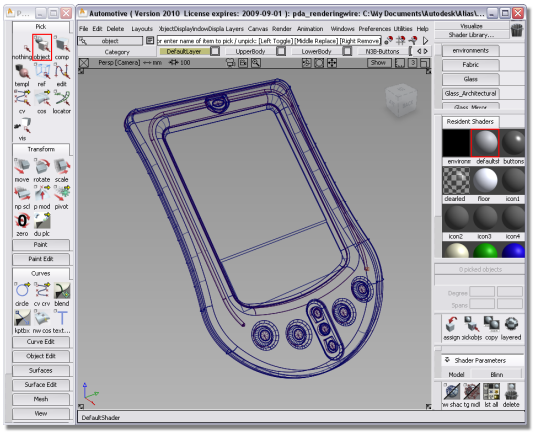
4 Next, choose Preferences > Workflows > Visualize . This will hide all tools not needed for visualization or rendering work.

5 Close the tool palette. To pick objects or components, you can use the marking menus.

6 Choose Windows > Control Panel . This opens up a frame in the window containing frequently used tools for the visualization process. Between the menus, marking menus, and control panel, you have all the tools you need to work on an image at your fingertips.

7 Click the Maximize icon on the Perspective view to expand it.

Your Alias window should look like the following illustration.

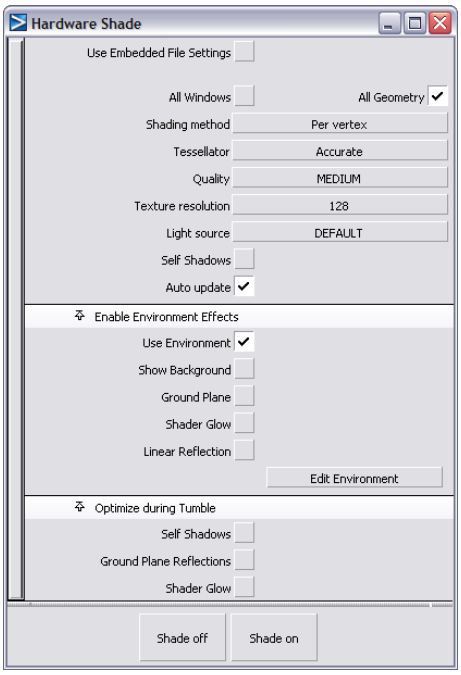


Shaded mode

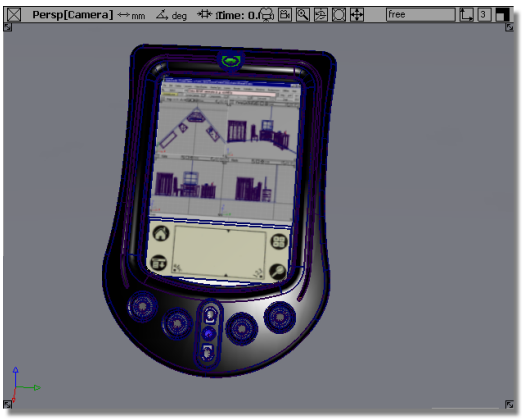
As a first step in the journey to understanding rendering, you will use shaded mode. This tool provides a fast colored and shaded reference of a model in a modeling window. You can also enable textures, shadows, reflections, and more. For more information about all the functionality of this mode, see WindowDisplay > Hardware Shade .

To enable shaded mode

1 Choose WindowDisplay > Hardware Shade ❒ to open the **Hardware Shade** window.



2 In the **Hardware Shade** window, click the **Shade on** button to shade the model in the **Perspective** view.



Tumble about to get a good view of the model.

Click **Shade off**.

3 Close the option window.

4 Now choose WindowDisplay > Hardware Shade without opening the option window. It applies the Shade settings to the window, without having to open the window.

   You will notice that color and surfaces have been applied to the wire frame of the personal digital assistant (PDA). These colors and textures are created by a number of shaders, which are visible in the **Resident Shaders** tab of the Visualization panel.

5 Now, turn off Shade by choosing WindowDisplay > Hardware Shade again.

   We will take a quick look at shaders, and the tools you can use to change them.

Shaders and textures

After you have created wire frames, such as those supplied in the PDA model, you will want to see them wrapped in surfaces that can then be transformed into rendered images. To make the rendered images as striking and realistic as possible, you need to apply shaders and textures to your objects.

Alias uses shaders to define the appearance of your objects, so they look as if they were created with real materials. Textures can also be applied to the shaders to create more sophisticated visual effects. As you will discover in later tutorials, you can even add special effects to shaders to make them appear semi-transparent or to give them a sense of 3D relief.

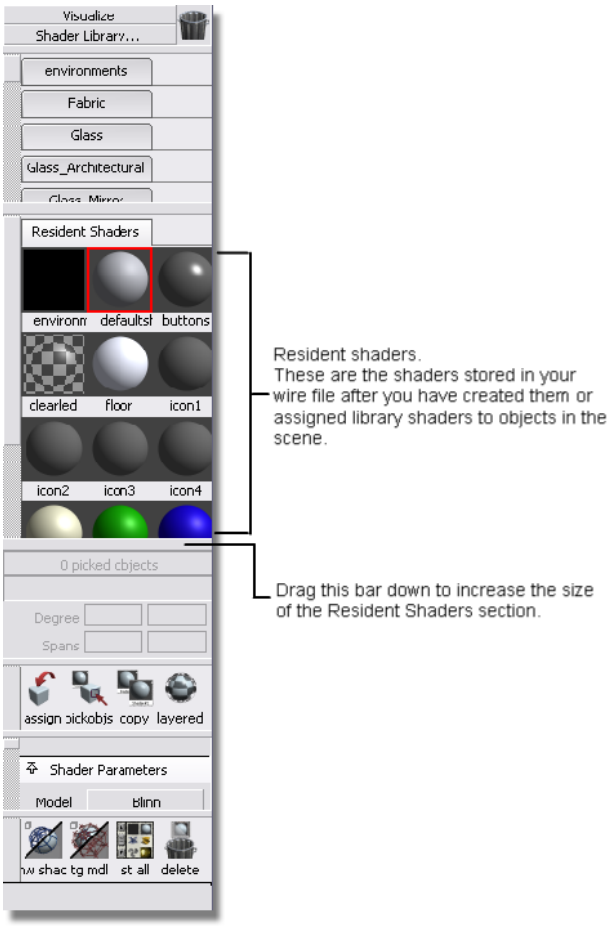
Shaders

Shaders determine what surfaces look like (for example, color, reflectivity, and roughness). Once you create a shader, you can assign it to one or more surfaces. You can also layer more than one shader on any given surface.

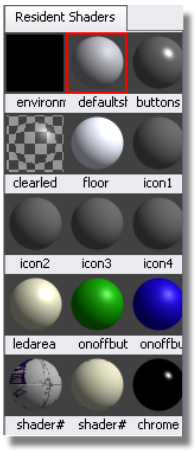
The Visualization panel

The visualization panel provides you with fast access to libraries of shaders and to the most-used capabilities of the multi-lister.

In the previous section of this tutorial, when you switched to shaded mode via WindowDisplay > Hardware Shade , you were viewing a shader we already applied to the model. Let's now look at the shaders in the Visualization panel.

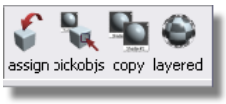


1 Drag the bar down until you see all the shaders in this wire file. The resident shaders section should now look similar to the following image.



All of these spheres are shaders that are assigned to different parts of the PDA. To see which sphere is assigned to which part of the PDA, click a sphere.

2 Choose the second icon from the left in this section of the panel:



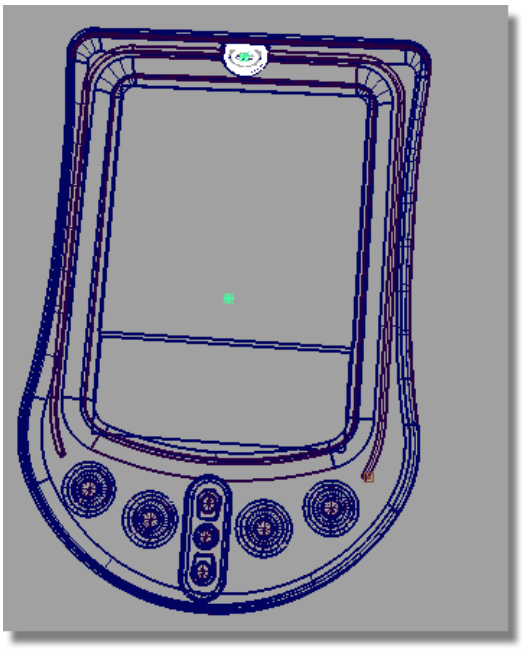
This tool picks objects by the current shader. You can choose each shader and click this tool to see which shaders are assigned to what parts of the model by looking in the Perspective view after you have clicked this tool.

3 Click each shader, and then click the **Pick Objects by Current Shader** tool to see the assignments.

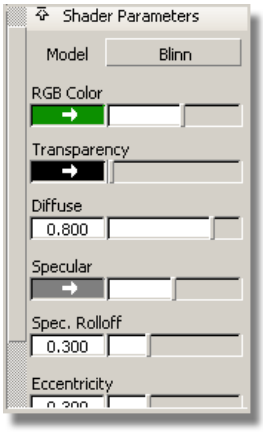
You can also modify some attributes of shaders in the visualization panel.

4 Click the green shader, and then Pick Object by Current Shader.

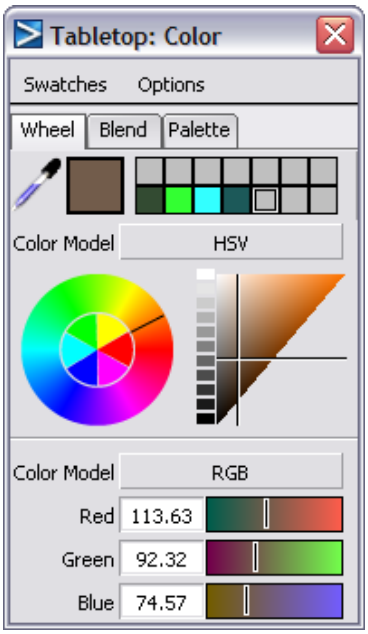
You will see that the button at the top of the PDA is highlighted.



5 Push the bar under the Resident Shaders section up to reveal the Shader Parameters for this shader. The most commonly used shader parameters are shown in this section of the panel.



6 Click the green rectangle under **RGB Color**. This opens the color palette, so you can choose a different color for the shader.

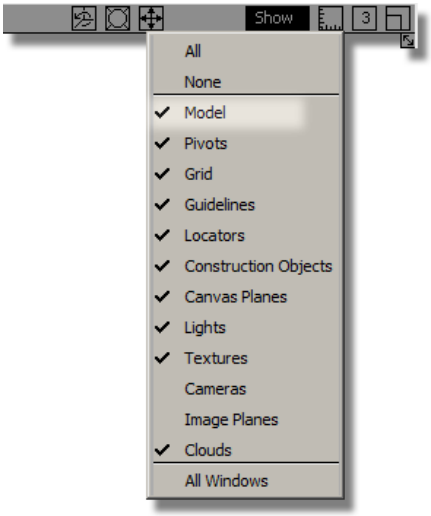


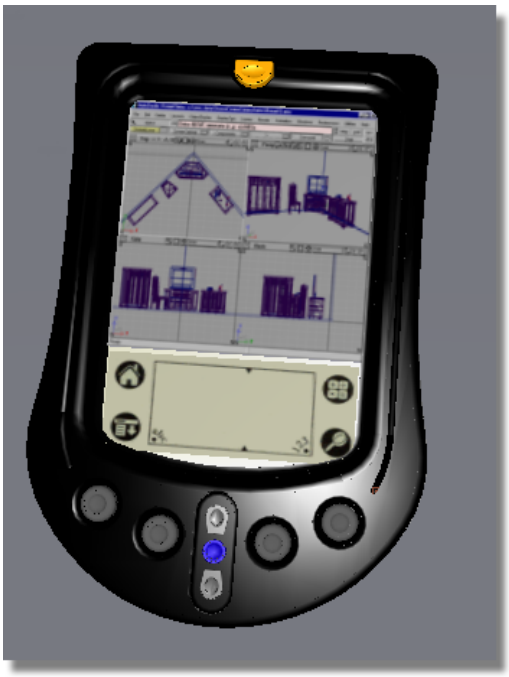
7 Change the color to orange by clicking the color wheel. You can modify the color's intensity in the HSV triangle. Close the window when you have got a bright orange selected.

8 Notice that the color rectangle in the Visualization panel has changed to orange.

9 Use the marking menu to pick nothing, then choose WindowDisplay > Hardware Shade to see the model with an orange button.

10 For a better view without the wireframe, choose **Model** (unchecking it) from the **Show** menu on the window bar to hide the wireframe.


Show
3
All
None
Model
Pivots
Grid
Guidelines
Locators
Construction Objects
Canvas Planes
Lights
Textures
Cameras
Image Planes
Clouds
All Windows



In addition to editing shaders, you can also create new shaders by copying and modifying existing shaders, or import new shaders to your model from a library by double-clicking a shader in the library.

The Multi-lister

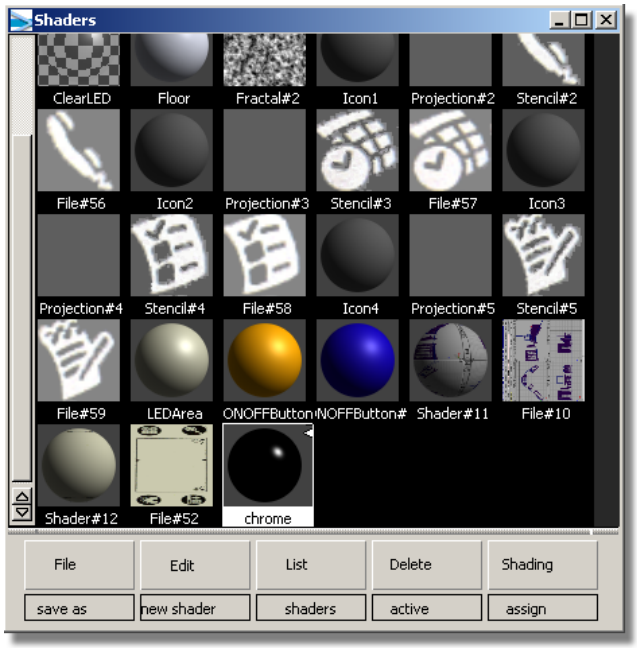
The Multi-lister is the full interface you use to create, edit, manage, and display shaders, textures, lights, and the environment. You also use the Multi-lister to access the **Control Window** and the **Color Editor.**

To open shaders in the Multi-lister

1. Choose Render > Multi-lister > Shaders. A number of shaders have been supplied for this tutorial. You can adjust the size of the icons by clicking the *right mouse button* over the background of the multi-lister, and choosing either Large Icons or Small Icons. The images in this tutorial show small icons.

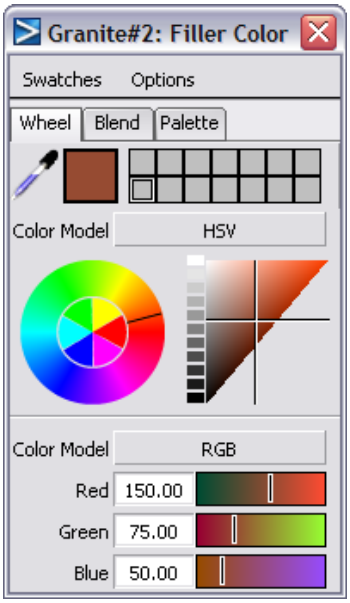
   The **Chrome** shader was applied to the PDA case. Next, you will edit it to make it reflect an environment.

2. In the **Shaders** window, double-click the **Chrome** icon.



The **Chrome** editor is opened. Notice there are two tabs: Software and Hardware. You can use either tab for this exercise. The Hardware tab shows a subset of the fields available on the Software tab: these fields are used in **WindowDisplay > Hardware Shade**.

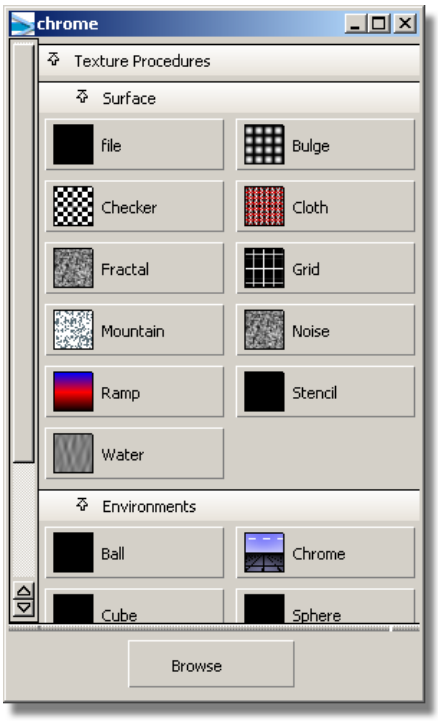
NOTE If you use the Hardware tab, you must first set the **Shading method** to **Per pixel** or **Per vertex** in the **Hardware Shade** option window.



3 In the Shader Name field, rename the shader to **Case**.

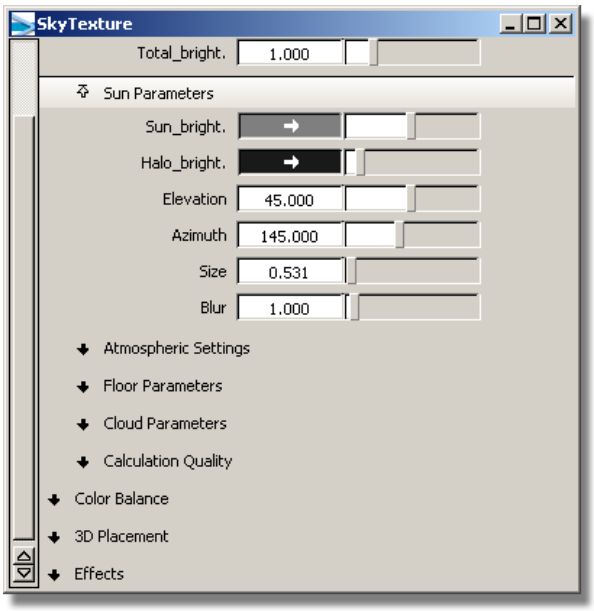
4 Click the **Map...** button associated with the Reflection parameter found in the Phong Shader Parameters section.

This opens the texture editor for the **Chrome** reflection.

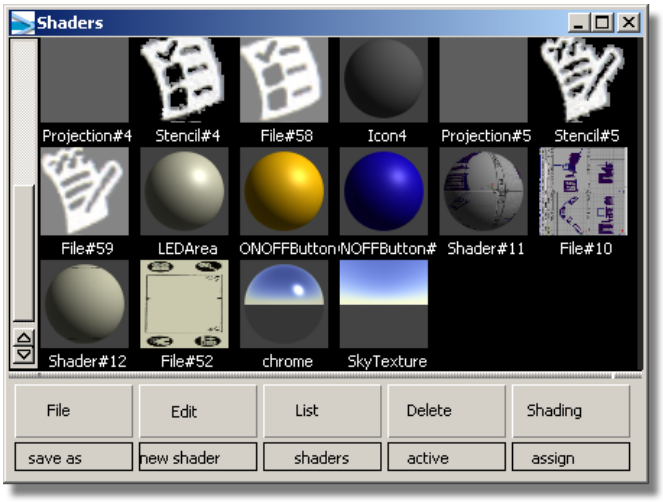


5 Scroll down and click the **Sky** button located in the Environments section.

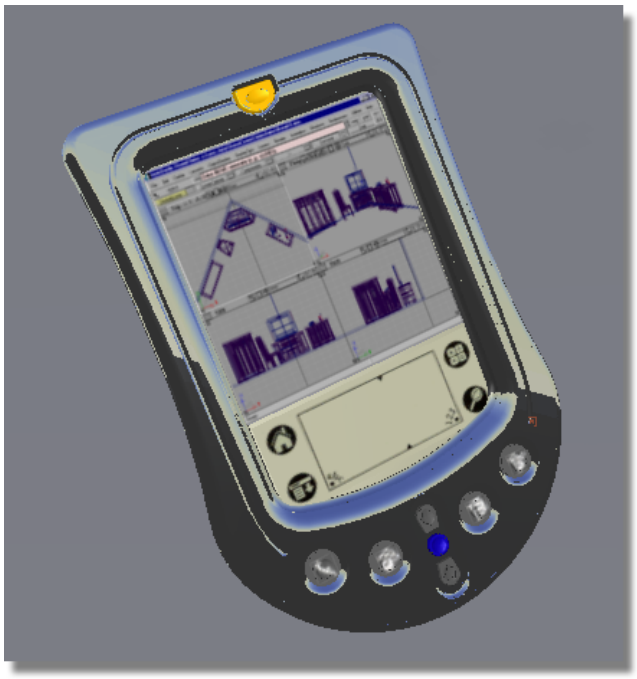
This opens the **SkyTexture** editor.



The **Shaders** window is updated to reflect the changes. Note how the **Chrome** shader wears the **Sky** texture.



6 To see the effect of your changes, look at the shaded model in the perspective window.



Now it is reflecting the sky.

Conclusion

Congratulations! You have completed this tutorial.

You now know

- some rendering and image resolution theory
- the Multi-lister
- shaded mode
- how to edit shaders and textures
- the visualization panel

Quiz

Test your grasp of the material.

Now that you have completed the Introduction to Rendering tutorial, try this quick quiz to see how much material you have retained.

1. Which rendering type offers true reflections, refractions, and shadows?
   - (a) Raytracing
   - (b) Hidden-line
   - (c) Raycasting
   - (d) Shade mode

2. If you are taking an image to press, check with your printer as to the number of _____ that are used.
   - (a) Dots per inch
   - (b) Lines per inch
   - (c) Pixels per inch
   - (d) All of the above

3. Shaders determine what _____ look like.
   - (a) Surfaces
   - (b) Models
   - (c) Images
   - (d) All of the above

4. The _____ is the primary interface you use to create, edit, manage, and display shaders, textures, lights, and the environment.
   - (a) Control window
   - (b) Toggle shade settings
   - (c) The multi-lister
   - (d) The shaders window

On Your Own

Experiments of your own design.

Now that you have begun your journey into the rendering of images, try experimenting with the knowledge you have learned.

For example, you can

1. Continue to apply the **Cloth** shader to the other gears in the drill model.
2. Create new shaders that can be applied to the drill.
3. Experiment with the parameters found in the **Toggle Shade Settings** options box.

Quiz Answers

Answers to the skill-testing questions found in the Introduction to Rendering tutorial.

1a. The raytracer rendering type offers true reflections, refractions, and shadows

2b. If you are taking an image to press, check with your printer as to the number of lines per inch that are used.

3a. Shaders determine what surfaces look like.

4c. The multi-lister is the primary interface you use to create, edit, manage, and display shaders, textures, lights, and the environment.

How did you do on this quiz? If you got all of the answers correct, congratulations! If you missed any of the answers, you may want to review this tutorial before moving on.

Shaders and Lights

10

Learning objectives

In this tutorial, you will learn how to create shaders and lights, and use Hardware Shade to create rendered images of your design.

To complete this tutorial, you will be supplied with a scene of two plastic bottles.



New tools used in this tutorial

- Window Display > Hardware Shade
- Render > Multi-lister > Lights

- Render > Create lights > Directional
- File > Export > Current window
- File > Show image

You will learn how to:

- Create and edit shaders
- Create and edit lights
- Modify the Environment shader
- Use Hardware Shading
- Create an Image File from your scene

Introduction

The scene you will render will need different materials for the cap, bottle, and label.

As well as having different colors, each material has different properties, such as the size of the highlight, the brightness and color of the highlight, and the reflectivity.

In this tutorial, you will learn how to simulate different materials by creating **Shaders** and adjusting the **Shader Parameters**.

First, you will set up Hardware shading to view your model as a rendered scene.

Then, you will create new shaders for the cap and the bottle, and apply a graphic image to the label surface.

Finally, you will light the scene and cast shadows onto a floor plane, creating a final composition, which you will output as an image file.

Part 1: Creating Shaders

In this section, you will use **Hardware Shade** to render a scene, and create **shaders** for the caps, bottles and labels.

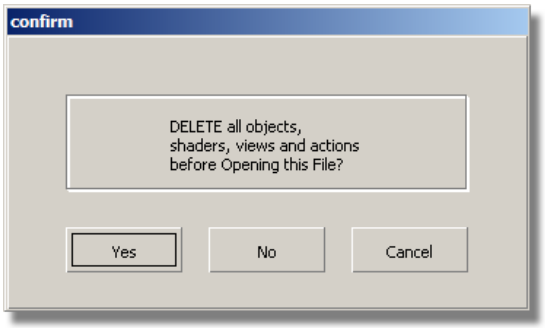


Watch **Part 1** of the tutorial.

Opening the tutorial file

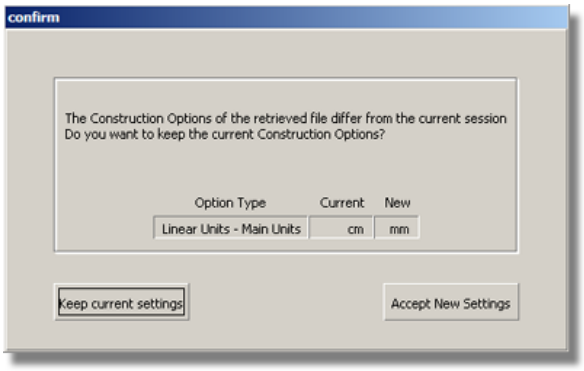
1. Choose File > Open to open the File Browser.
2. In the File Browser, locate the `CourseWare` directory and set it as the **Current Project**.
3. Open the file called `Render_Basics.wire`, located in the `wire` directory in the `CourseWare` project.

For information on how to open a file, see Opening the tutorial file on page 82.



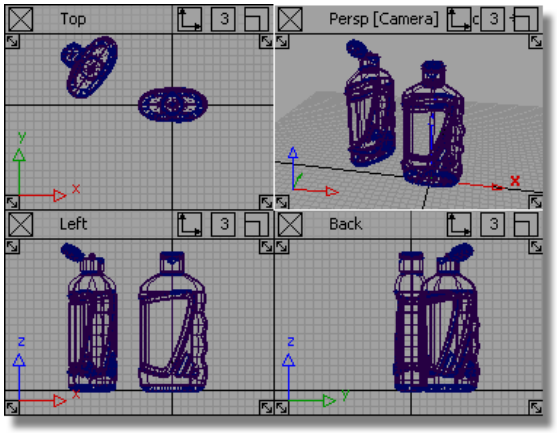
A dialog box appears, asking if you want to delete all objects, shaders, views, and actions. Click **Yes**.

If your values for construction tolerances differ from those in the `Render_Basics.wire` file, you are presented with a dialog:



Click **Accept New Settings** to use the construction tolerances in `Render_Basics.wire`.

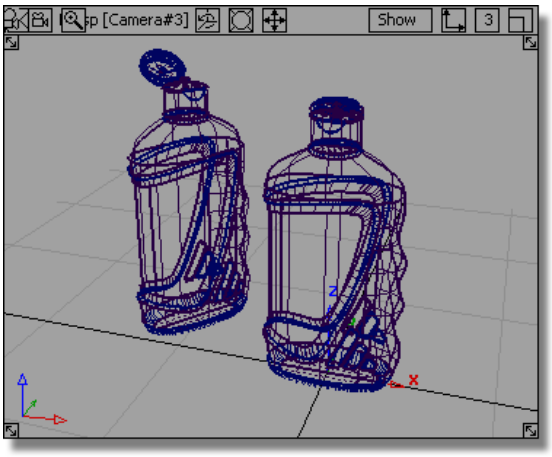
The file is opened. The scene has two shower gel bottles in different positions, one with the cap open, and one with it closed.



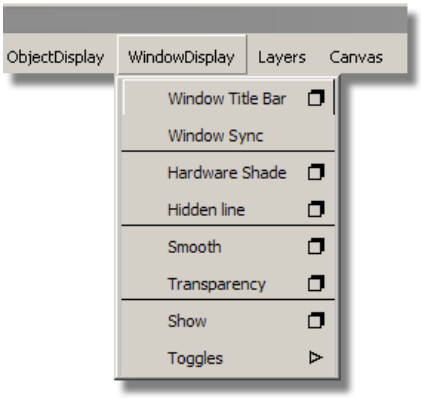
Viewing a Shaded Scene

When setting up a model to be rendered, it is useful to work interactively with a rendered view. For this exercise, you will use **Hardware Shade** to work directly on a shaded scene.

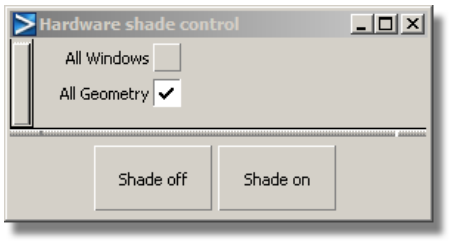
1 Maximize the **Perspective** view.



2 Choose WindowDisplay > Hardware Shade ❐ to open the Hardware Shade Options.



3 Choose **All Geometry** from the option window and click **Shade on** at the bottom of the option window.



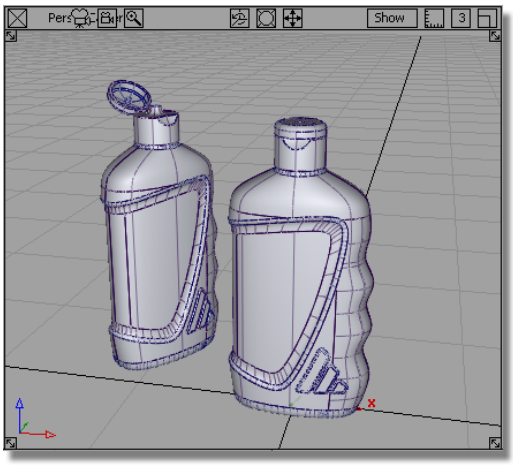
The bottles are now visualized using the Hardware Shading.

Choosing a Shading Model

The bottles are using the Default shader, which has the Blinn shading model. There are four types of shading model in Alias:

- **LAMBERT** is useful for representing matte surfaces like plaster walls, paper, or blackboards.
- **PHONG** is more complex, and gives highlights suitable for high-gloss plastic, glass, and metals.
- **BLINN** provides more flexible highlights that can be adjusted for softer plastics, satin finishes, and natural materials.
- **LIGHTSOURCE** makes the object look like it emits light, like an incandescent bulb or flame.

As you gain more experience with shaders, you will understand which Shading Models will produce the results you want.



Next, you will create three new shaders one for the bottle, cap, and label. After that, you will choose the right shading model for each one.

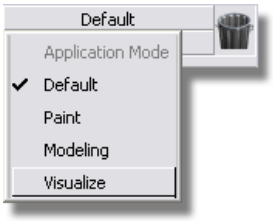
Using the Visualize Control Panel

For this part of the tutorial, you will use the Visualize Control Panel to create and modify shaders.

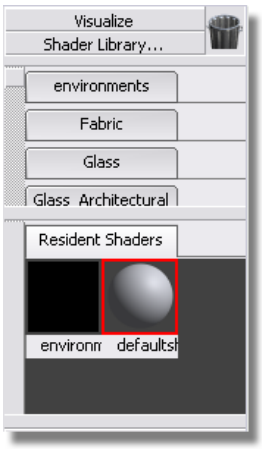
TIP If the **Control Panel** is not currently shown, choose Windows > Control Panel to turn it on.

---

1 At the top of the **Control Panel**, choose the **Visualize** option.

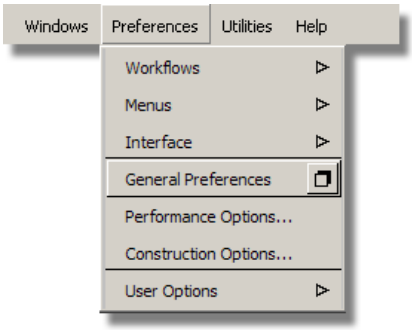


The **Default Shader** is shown in the **Resident Shaders** section.

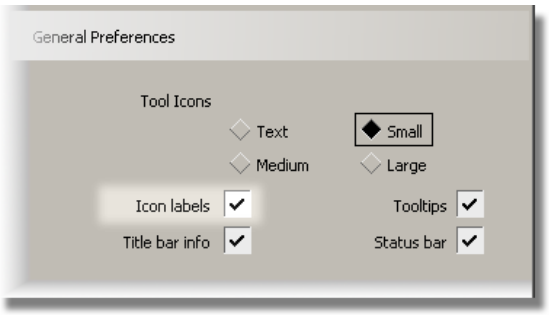


If the name of the Default Shader is not shown underneath the grey shader ball, you can turn on the icon labels in the **General Preferences**.

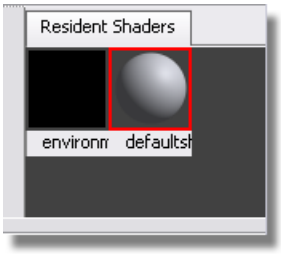
2 Choose Preferences > General Preferences ❐ to open the preferences window.



3 The **Interface** section is opened. Check the **Icon labels** box to turn on the icon text.



The **Resident Shaders** section in the **Visualize Panel** now shows the name of the **Default shader** underneath the shader ball icon.



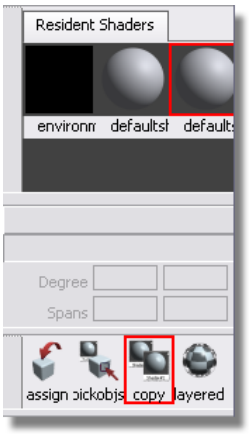
It is good practice to not use or modify the default shader, as you will copy it to create new shaders.

So first, you will create a shader for the bottle.

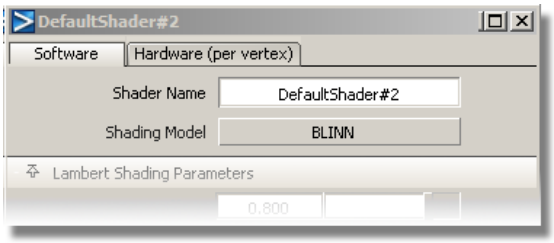
Creating a Bottle Shader

1 Click the **Default shader** to select it.

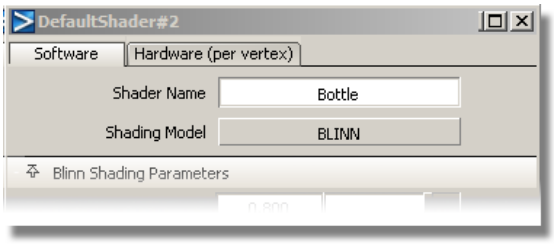
Below the resident Shaders section, there are four icons. Click the **Copy Current Shader** icon to create a shader.



2 Double-click the new shader icon to open the shader editor.
The default settings are shown.

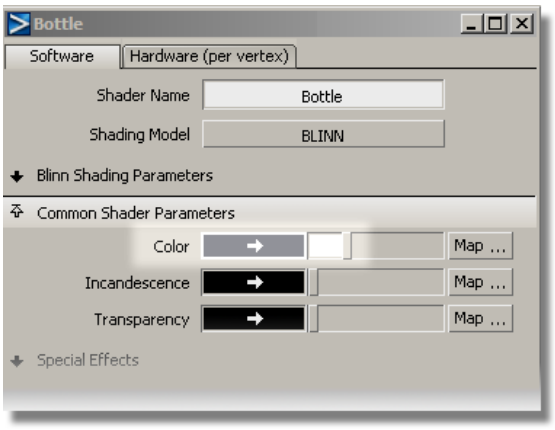


3 Change the **Shader Name** to **Bottle**, and leave the **Shading Model** set to **BLINN**. This will give a soft highlight for the bottle plastic.

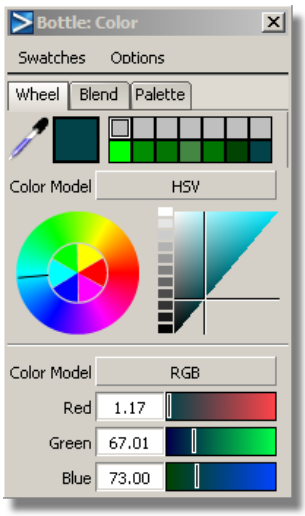


Now, you will choose a color for the bottle.

4 In the shader editor, open the **Common Shader Parameters** section.

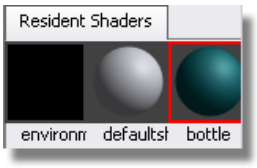


Click the grey color chip to open the Color Editor.



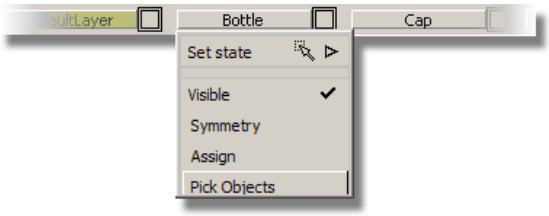
5 In the Color Editor, choose a color for the bottle.
The color chip updates, and the Bottle shader shows the new color.



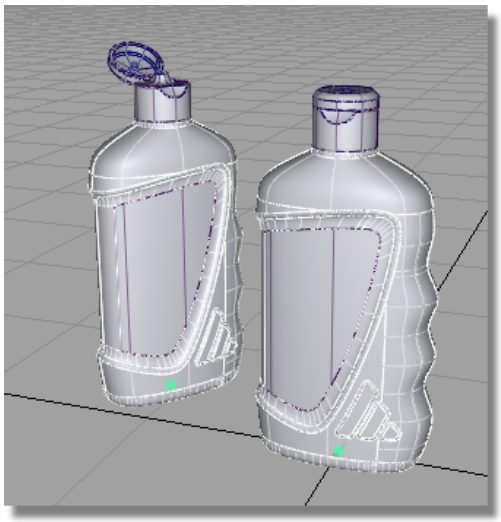


Now, you will **Assign** the new shader to the bottle surfaces.

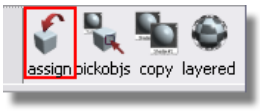
6 Select the bottle surfaces by using the **Pick Objects** option on the **Bottles** layer sub-menu.



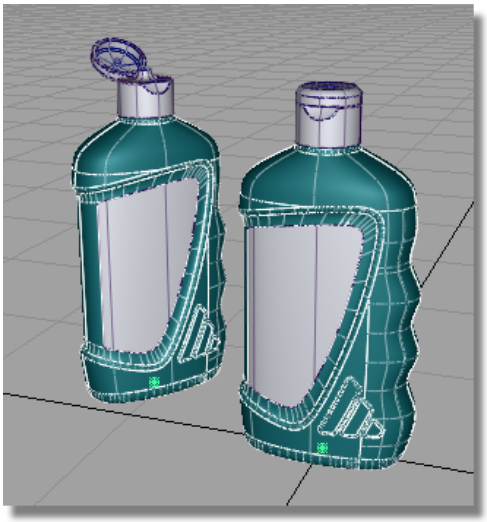
All the bottle surfaces are selected.



7 Click the **Assign** icon on the **Visualize Panel** to assign the new shader to the bottle surfaces.

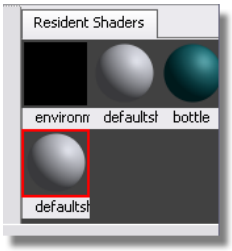


The bottle surfaces are now shown in the new shader color.



Now, you will repeat this process for the cap shader.

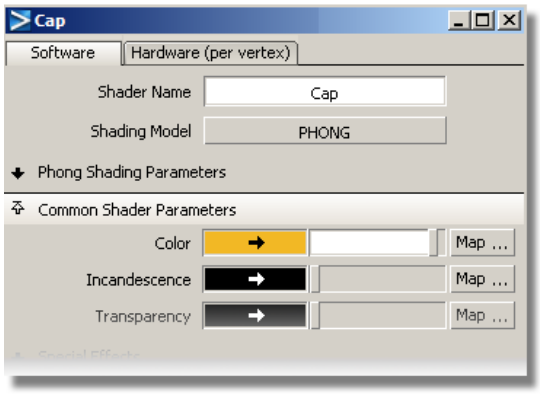
8 Click the default shader to select it. Then, choose the **Copy Current Shader** tool to create a second new shader.



9 Double-click the icon of the second new shader to open the shader editor.

Change the **Shader Name** to **Cap** and the **Shading Model** to **PHONG**.

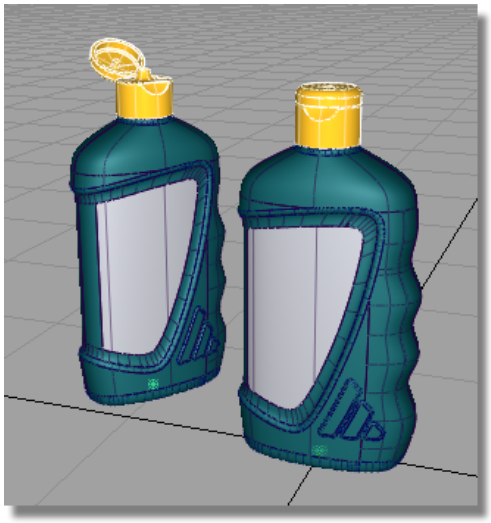
In the **Common Shader Parameters** section, choose a color for the cap.



Now, you will assign the shader to the cap surfaces.

10 Pick the cap surfaces using the **Cap** layer sub-menu.

11 **Assign** the **Cap** shader to the cap surfaces using the **Assign** icon in the **Visualize Panel**.



A small bright highlight appears on the caps illustrating a glossy plastic material.

12 Close the shader editor window.

13 Choose Pick > Nothing to de-select the label surfaces.

Modifying Shaders in the Visualize Panel

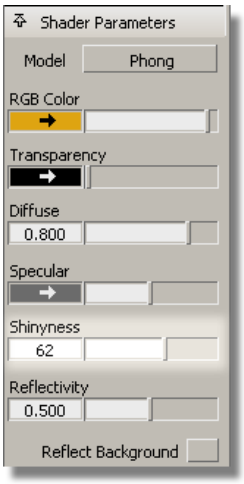
The most common parameters for a shader can be accessed in the **Visualize Panel**.

Now, you will give the cap a more shiny appearance, and the bottle a softer finish.

1 Click the **Cap** shader to select it and open the **Shader Parameters** section of the **Visualize Panel**.



2 Modify the **Shinyness** value to make the highlight on the cap smaller.

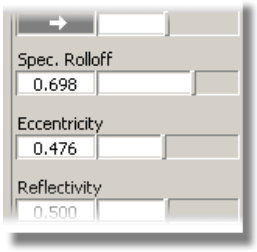


The cap material should look more shiny.

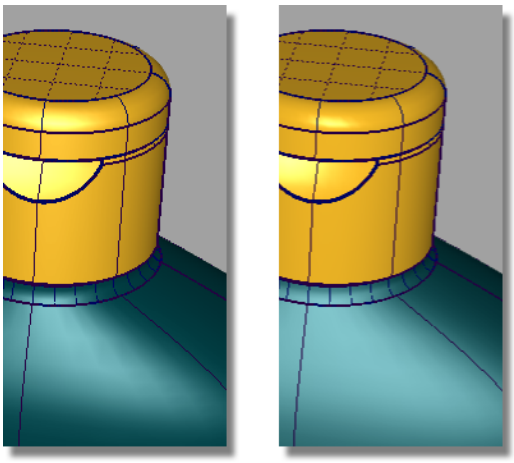
TIP You can use Render > Direct Render to see the changes more accurately.

3 Click the **Bottle** shader to select it.

4 In the **Shader parameters** section, modify the **Eccentricity** and **Spec. Rolloff** values to make the bottle plastic look less shiny, with a softer surface finish.



The two images below show the changes you will see in the materials.



TIP Only the most commonly used parameters are shown in the **Visualize Panel**. To access all the parameters for each shader, either double-click the shader ball icon, or use Render > Multi-lister> Shaders.

Saving your work

Now, you will save the scene as a new file.

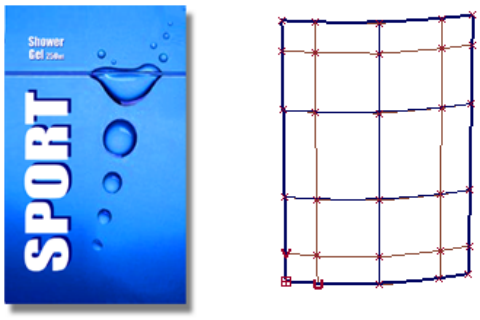
1. Choose File > Save As to open the File Browser.
2. Save your work in the `wire` directory of the `Lessons` project.
3. Name your file `myRender_Basics1.wire`.

Part 2: Adding a Label

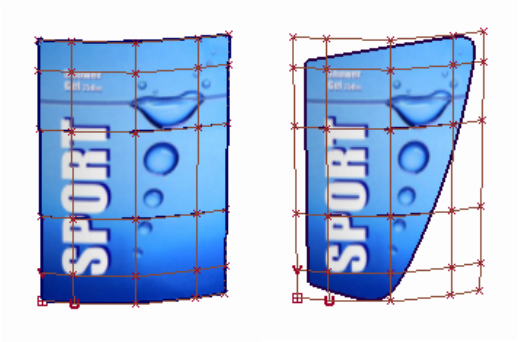
In this part of the tutorial, you will take a graphic design for the label of the shower gel bottle, and apply it to the label surface.

The process of applying the graphic is called Mapping.

The graphic file (shown on the left) is in a standard format, such as a .tif or .jpg. It can be mapped onto a surface (shown on the right).



The result is that the graphic file follows the U and V directions of the surface. If the surface is trimmed, the graphic appears on the part of the surface that is visible.



To apply the graphic as a colored label, you will map the **Color** parameter.

TIP Mapping can be used on many of the shader parameters, such as transparency, bump, or reflection.

Opening the tutorial file (optional)

If you successfully completed Part 1, proceed to the next step: Create a Label Shader, below.

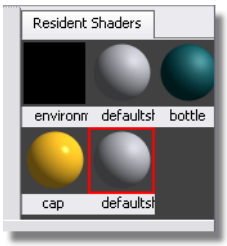
If you were not successful in part 1, open the file called `Render_Basics_part2.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 1.



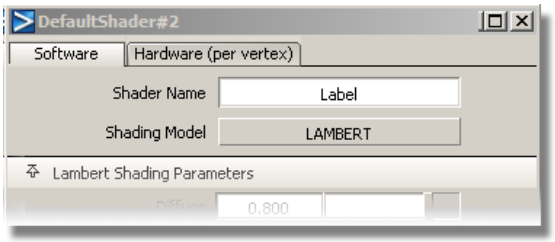
Watch **Part 2** of the tutorial.

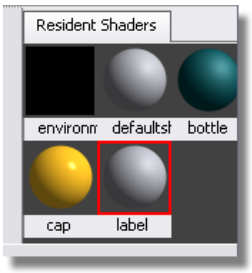
Create a Label Shader

1 Click the **Default** shader to select it. Then, choose the **Copy Current Shader** tool to create a third shader.



2 Double-click the icon of the new shader. Change the **Shader Name** to **Label** and set the **Shading Model** to **LAMBERT** to represent a matte paper label.

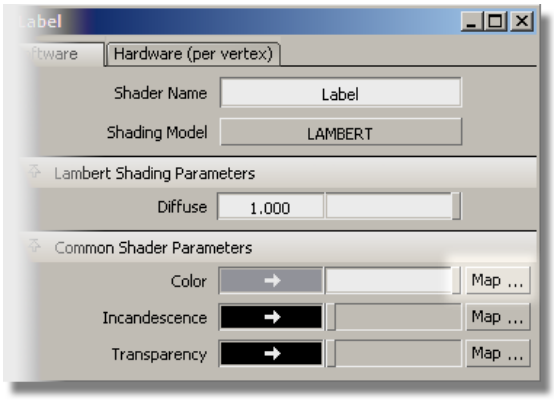




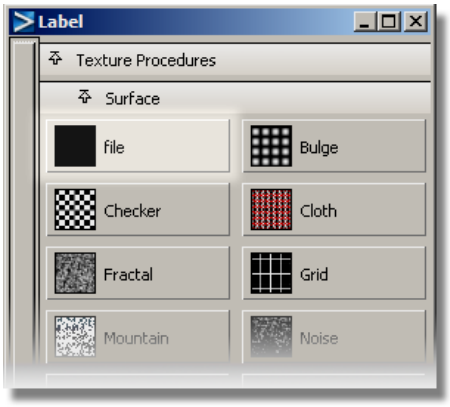
You don't need to change the color of the shader, as you will now map the label graphic onto the **Color** channel. The graphic image will replace the default grey color.

Mapping the Color Channel

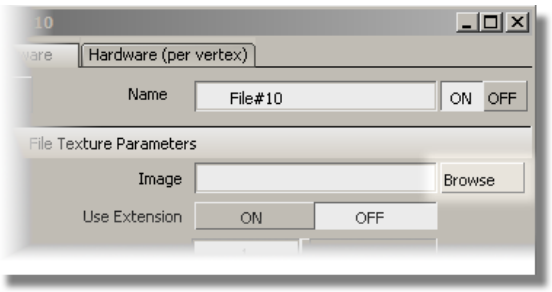
1 In the **Label** shader editor, click the **Map...** button beside the **Color** parameter.



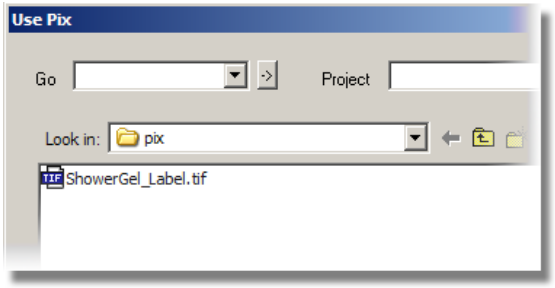
2 The **Texture Procedures** window appears. Choose the **Surface > file** texture.



3 The **File Texture** editor is opened. Choose the **Browse** button next to the **Image** section.

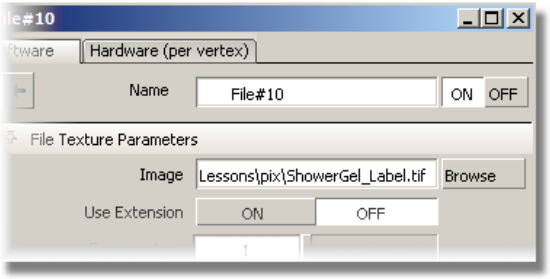


The File Browser opens into the `pix` directory of the `Lessons` project. To retrieve the file that contains the label image, navigate to the `CourseWare` directory.



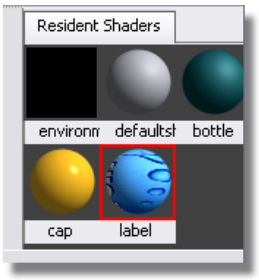
4 Select the `ShowerGel_Label.tif` image.

The pathname of the label file is shown in the Image section.



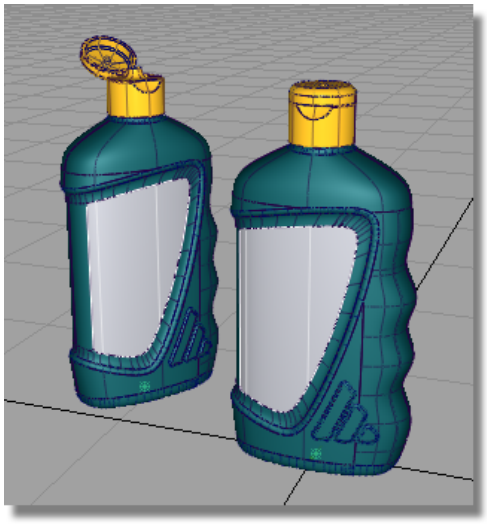
Leave the editor window open on the screen, as you will use it later to modify the position of the label.

The shader icon in the **Visualize Panel** shows the label wrapped around the shader ball.



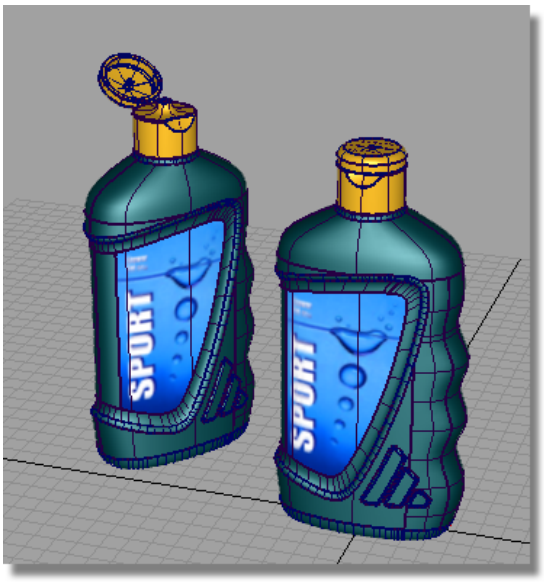
Now, you will assign the label shader to the label surfaces.

5 Pick the label surfaces using the Layer sub-menu.



6 Assign the Label shader to the label surfaces using the Visualize Panel **Assign** icon.

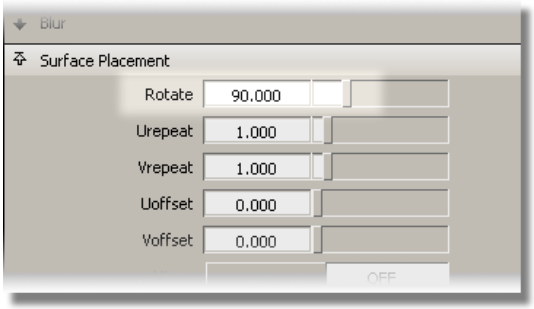
7 The label graphic now appears on the label surfaces.



8 Choose Pick > Nothing to de-select the surfaces.

9 The placement of the label can be modified in the **Surface Placement** section of the texture editor window.

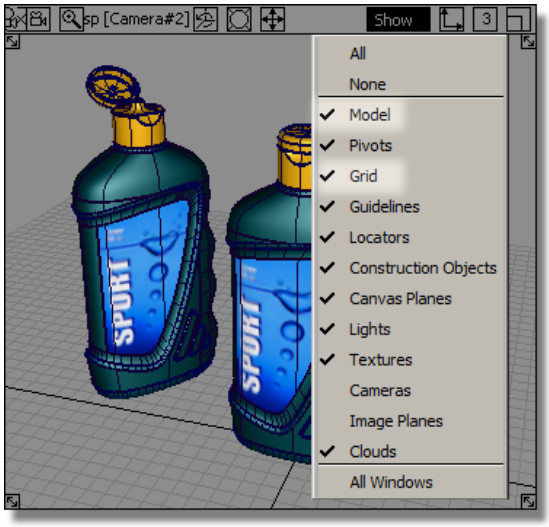
10 In the **Rotate** section, type in 90 degrees to see an alternative label position.

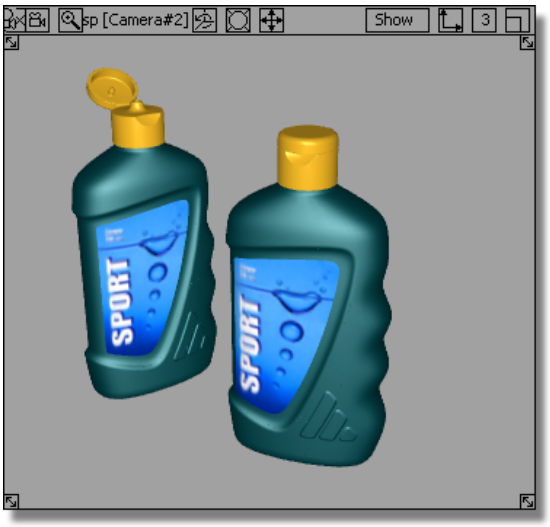




11 Return the label rotation to zero degrees, to get the correct label view.

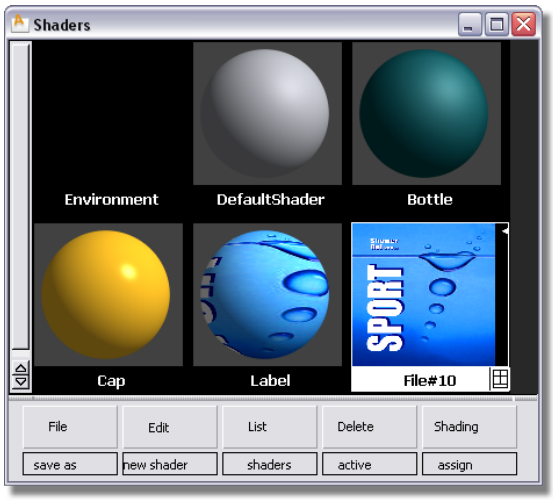
Toggle off the wireframe and grids using the **Show** button in the **Perspective** window pane.



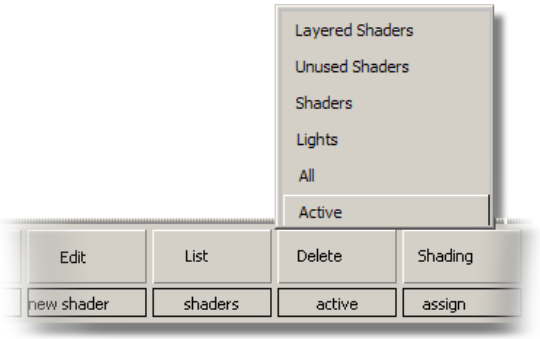


TIP To see how the label graphic is applied to the shader choose Render > Multi-lister > Shaders. The Multi-lister is an alternative to the Visualize Panel for working with shaders. (You will use it in the next section to work with lights.)

In the Multi-lister, you can see the label graphic is shown as a **File Texture** attached to the **Label shader**. If you want to delete the label graphic, you can select it in the Multi-lister and use **Delete > Active** on the **Multi-lister** menus.



NOTE Don't use **Delete** > **Active** from the main menus, as this will delete any geometry selected in the scene!



Save your work

1. Save your work in the `wire` directory of the `Lessons` project.
2. Name your file `myRender_Basics2.wire`.

Part 3: Lighting the Scene

Opening the tutorial file (optional)

If you successfully completed Part 2, proceed to the next step: An overview of lights used in Alias below.

If you were not successful in part 2, open the file called `Render_Basics_part3.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 2.



Watch **Part 3** of the tutorial.

An overview of lights used in Alias

Lights illuminate objects. If your scene contains no lights, it will render entirely black.

There are different types of lights you can use:

- Ambient Light
- Directional Light
- Spotlight
- Point Light
- Linear Light
- Area Light
- Volume Light

For most of your scenes, you will use one **Ambient** light and either a **Directional** light or **Spotlight** for the main lighting effects. Additional lights may be used occasionally, to create special lighting effects or to fill in dark areas.

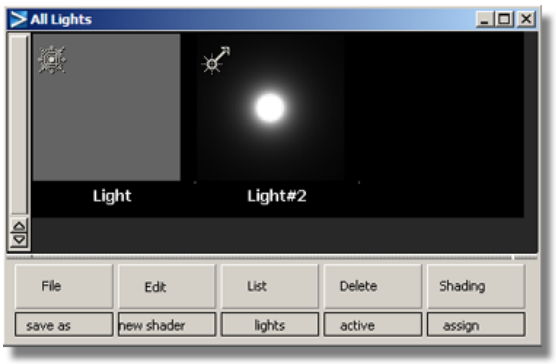
Default Lights

When you choose WindowDisplay > Hardware Shade , a set of default lights are automatically created to light your scene.

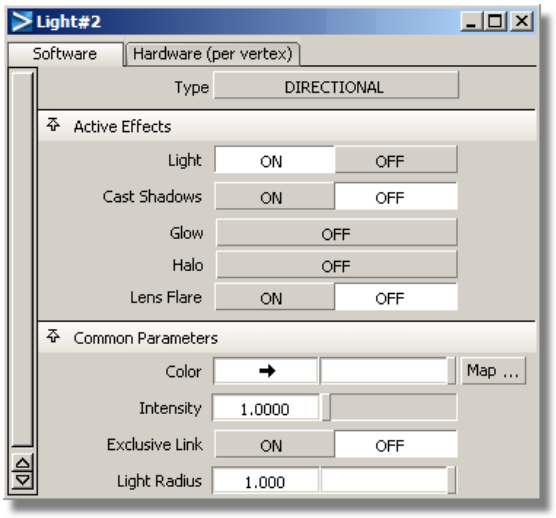
The default lights are one **Ambient** and one **Directional** light.

Lights in the Multi-lister

When you create lights, they are listed in the Multi-lister.

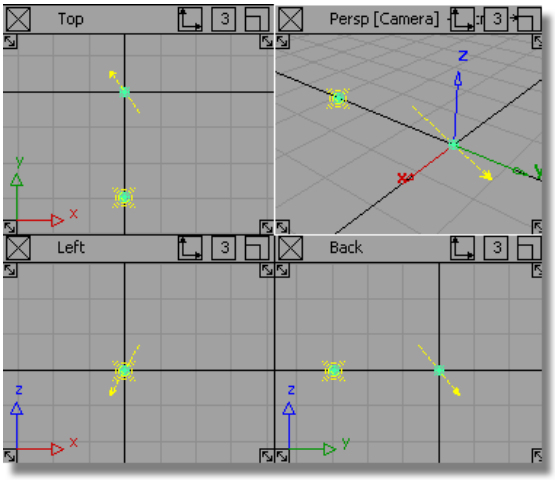


If you double-click a light icon in the Multi-lister, you open the **Light** editor. This is where you can set and edit the light parameters such as **Intensity** and **Color**.



Lights in the Modeling Windows

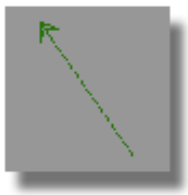
Lights are also shown in the modeling windows. This allows them to be positioned and rotated, so that lighting and shadows can be accurately controlled.



The lights are shown as green symbols (yellow when selected), a different one for each type of light.



Ambient light symbol



Directional light symbol

The light symbols can be toggled on and off using the **Show** panel on each window pane.

Shadows

The shadows a light casts can be used to help compose the scene.

In hardware shade, a virtual Ground plane can be enabled, which allows shadows to be cast. You can choose to cast these shadows from one of your lights, or from some preset lighting options.

In Software rendering (Render > Render), shadows will be accurately calculated as the light falls on the geometry. So, for example, you will need to create a floor surface for shadows to be cast onto a floor.

Lighting your Scene

Now, you will apply these concepts to the lighting in your scene.

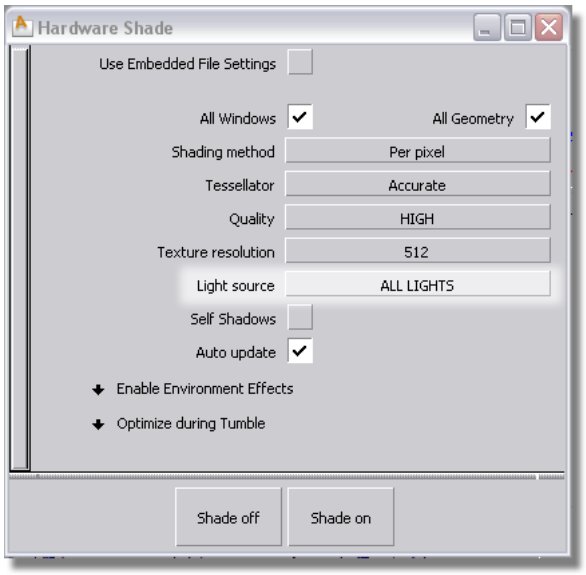
The initial **Hardware Shade** settings use a preset lighting option, which only gives you limited control over lighting in the scene.

Instead, you will use the default lights listed in the Multi-lister to light the scene. This will give you complete freedom to adjust the lights and shadows.

First, you will modify the **Hardware Shade** options to display the effects of the default lights in the scene.

➤ Choose WindowDisplay > Hardware Shade ❒ to open the option window.

In the **Light source** option of the **Settings**, choose **ALL LIGHTS**.



The lighting on your model changes, showing the effect of the Default lights in the Multi-lister.

In **Enable Environment Effects**, turn on **Ground Plane**.

Click **Shade on**.

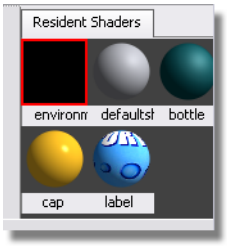


Shadows on a Ground Plane

Next, you will display the shadows cast by the lights, so you can design the lighting for your scene.

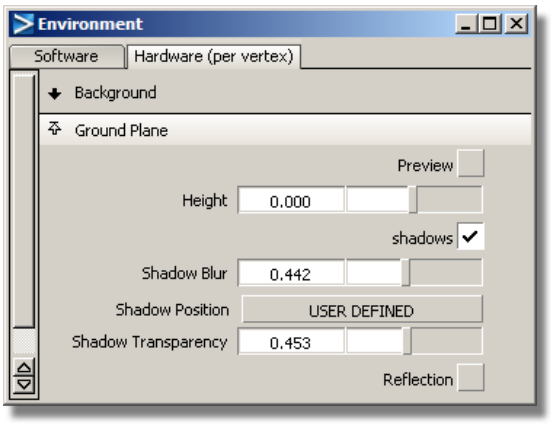
First, you will enable the 'virtual ground plane' in the Environment shader. This is an invisible floor plane that catches the shadows, but does not appear rendered in the scene.

1 Double-click the **Environment shader** to open its option window.



2 Click the **Hardware** tab at the top of the option window.

3 Open the **Ground Plane** section.



4 Check the **Shadows** box (if unchecked), and set **Shadow Position** to **USER DEFINED**.

5 Set **Shadow Blur** and **Shadow Transparency** until you get an acceptable shadow in the shaded view.



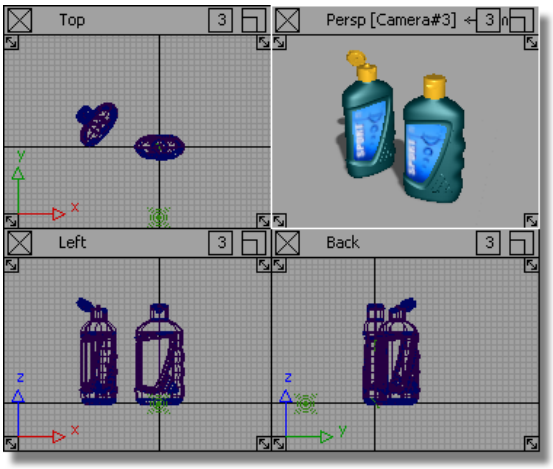
6 Close the **Environment** window.

NOTE If the shadow disappears after setting **Shadow Position** to **USER DEFINED**, open the Light editor for each of your lights, and set **Ground Plane Shadows** to ON. See Lights in the Multi-lister on page 658.

Changing the Light Direction

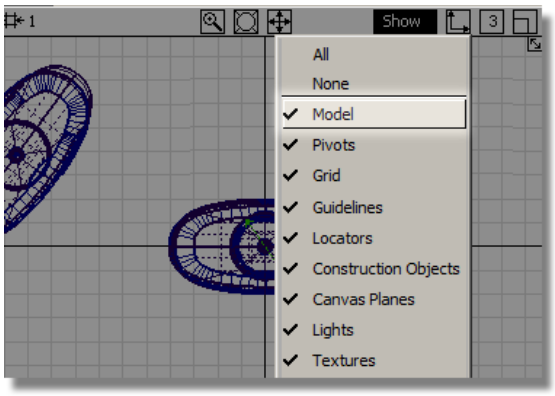
Now, you will rotate the Directional light to modify the shadow direction.

1 Choose Layouts > All Windows > All Windows or **F9** to show all four windows.



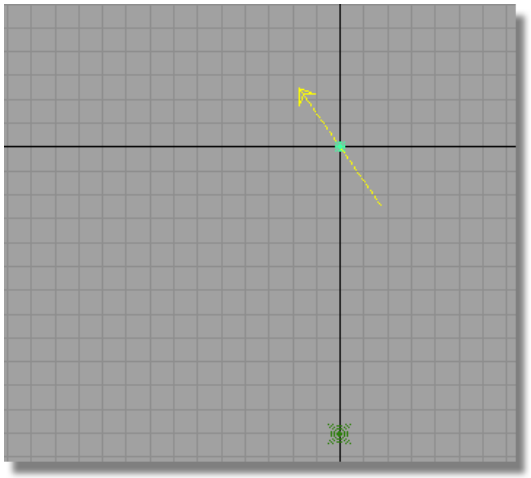
In the Top window, the two lights are shown, but are partly hidden by the model.

2 In the **SHOW** button in the Top window, choose **Model** to remove the wireframe view. This makes it easier to see the lights in the scene.



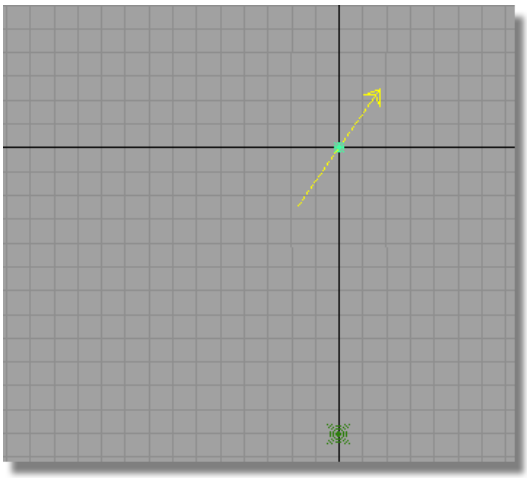
The two default lights are shown as green symbols.

3 Choose Pick > Object and select the Directional Light.



TIP You can **Transform** > **Scale** the light symbol to make it easier to see. This will not change the lighting effects.

4 Choose Transform > Rotate and use the *right mouse button* to rotate the light in the z-axis.



Observe the effect on the shadow in the perspective view, and position the shadow so that it falls to the right side of the bottles. This shadow position helps to emphasize the design of the finger grip.



TIP It is often easier to view and manipulate the lights in the 2D windows than in the Perspective window.

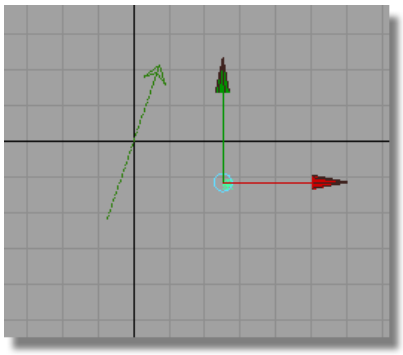
Creating a New Light

Now that you have changed the light to create an interesting shadow, the lighting on the bottles has changed.

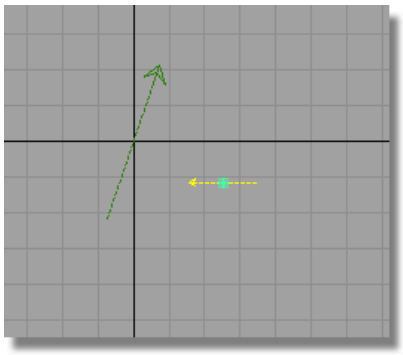
You will now create another light to fill in the dark areas.

1. Choose Render > Create Lights > Directional .
2. You are prompted to place the light in the scene. In the **Top** view, click near the origin to place the light.

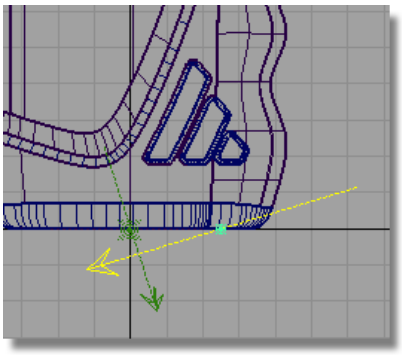
NOTE The location of a directional light does not affect the lighting in the scene, only the rotation of the light makes a difference.



3. With the light still selected, choose Transform > Rotate and click and drag the *middle mouse button* to rotate the light in the y-axis.



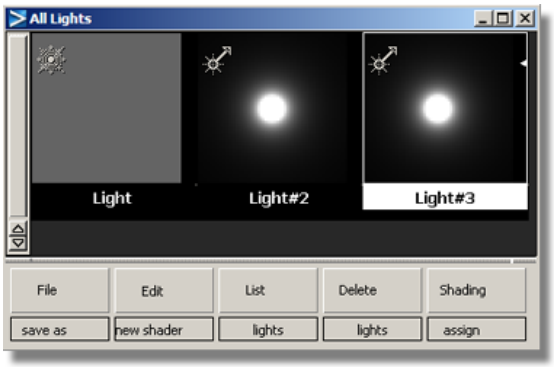
4 Observe the direction of the light in all the windows, and continue to rotate it in any of the three axes, until it is illuminating the dim areas of the bottles.





The bottles may be over-lit, as the new light has an **Intensity** of **1**. Now, you will modify the second light using the Multi-lister.

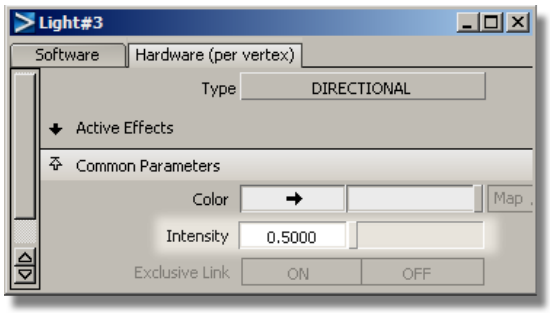
1 Choose Render > Multi-lister > Lights.



The new light is shown in the Multi-lister.

2 Double-click the new light icon to open the option window.

Open the **Common Parameters** section, and reduce the intensity to around **0.5**.



3 Check the shaded view and adjust the light intensity further, if necessary.



Save your work

1. Save your work in the `wire` directory of the `Lessons` project.
2. Name your file `myRender_Basics3.wire`.

Part 4: Creating an Image

In this section, you will use the Hardware shade rendering to create a high quality image that can be used for presentations or work-in-progress discussions.

Opening the tutorial file (optional)

If you successfully completed Part 3, proceed to the next step: Setting the Image Quality below.

If you were not successful in part 3, open the file called `Render_Basics_part4.wire`, located in the `wire` directory of the `CourseWare` project. This file contains the completed model from Part 3.

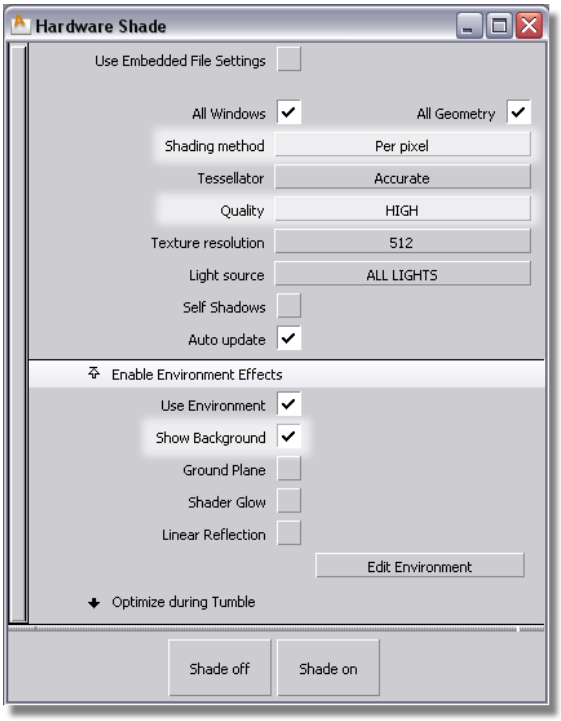


Watch **Part 4** of the tutorial.

Setting the Image Quality

First, set the quality of the **Hardware Shade** to High.

1. Maximize the Perspective window.
2. Choose WindowDisplay > Hardware Shade ❒.
3. Make sure that **Quality** is set to **HIGH** and **Shading method** is set to **Per pixel**, to create a high quality image.
4. In the **Enable Environment Effects** section, turn on **Show Background**.



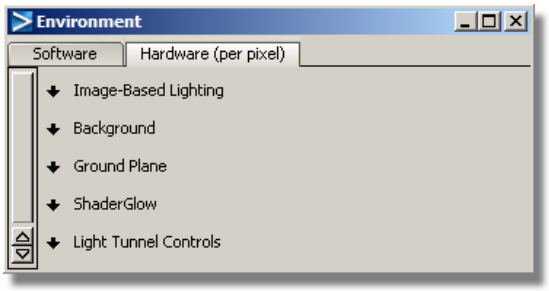
The background color defaults to black, which obscures the shadows.



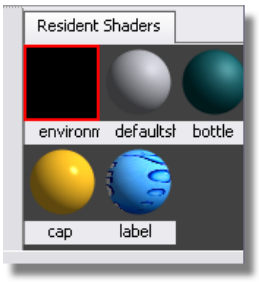
NOTE The **HIGH** quality settings may also slightly change how the lights appear on the surfaces. You can modify the intensity or direction of the lights to adjust the image.

Now, you will change the background color using the **Environment** shader.

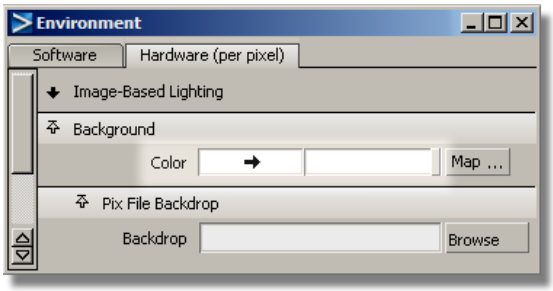
5 In the **Enable Environment Effects** section of the Hardware Shade window, click the **Edit Environment** button to open the Environment editor window.



NOTE If the Hardware Shade window is closed, you can also go to the **Visualize Control Panel** and double-click the **Environment** shader icon to open the Environment editor window.



6 In the **Background** section of the **Hardware** tab, change the color to white (or any other color).



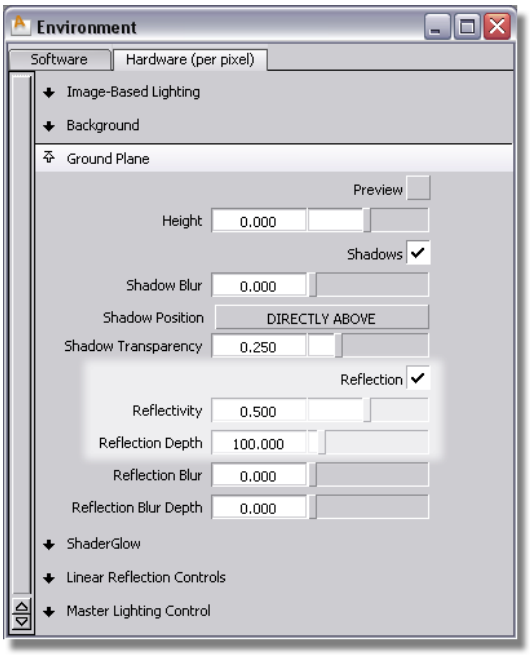
The shaded view updates to the new background color.



Adding Ground Plane Reflections

To add realism to the image, you can add a reflection in the ground plane.

1 In the **Ground Plane** section of the **Environment** shader options, check the **Reflection** option to see a reflection of your model in the ground plane.



2 Modify the **Reflectivity** and **Reflection Depth** options to change the reflections in the view.

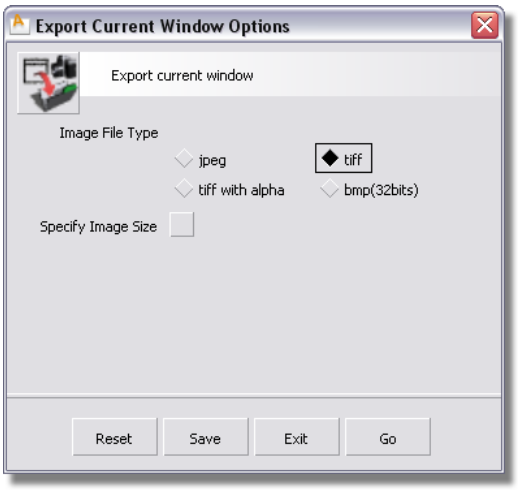


Exporting an Image

Now, you can set up the view and export the image.

1 Tumble the view to frame and compose the image you want to capture.

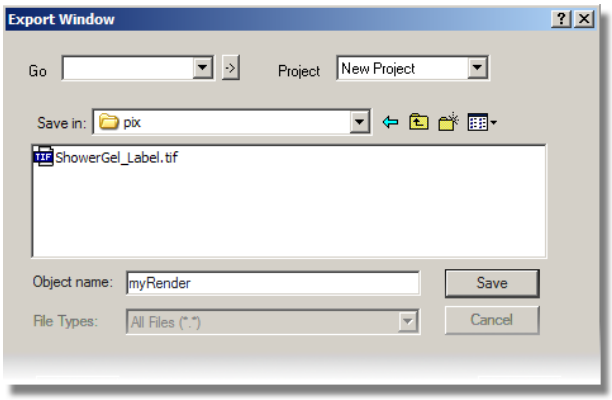
2 Choose File > Export > Current Window ❒ to open the option window.



The **Image File Type** defaults to **.tif**. You can specify an alternative format, if necessary.

The **Image Size** defaults to the screen size. You can choose an alternative image size by choosing **Specify Image Size**.

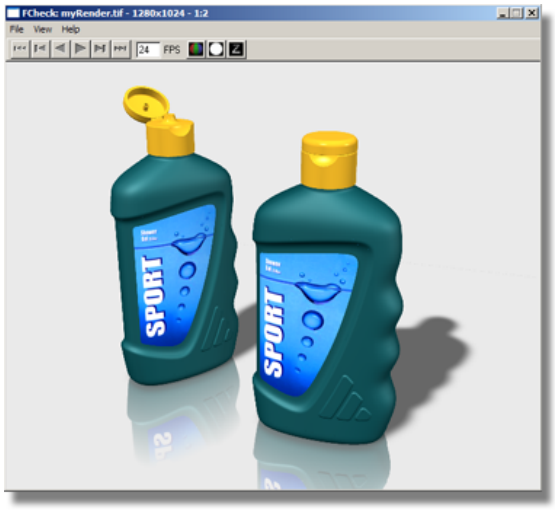
3 Click **Go** to save the image. The File Lister appears.



4 In the **Object Name** section (Windows) or **Save As field** (Mac), type in `myRender` and click **Save**.

The image is created and saved in the **pix** directory of your current project.

5 To view the image in Alias, choose File > Show Image .



Alternatively, you can view the image using any Windows or graphics software, or import it into your presentation documents.

Save your work

1 Save your work in the `wire` directory of the `Lessons` project.

2 Name your file `myRender_Basics4.wire`.

Conclusion

Congratulations! You have completed a visualization of the shower gel bottles. The basic skills you have learned in this tutorial will enable you to visualize your models to a high quality at every stage of your design.

You have learned to:

- Create and edit shaders
- Create and edit lights

- Modify the Environment shader
- Use Hardware Shading
- Create an Image File from your scene

Quiz

To help you remember the rendering techniques you used, try this short quiz.

1. Which **Shading Model** would you use to render a pool ball?
   - (a) Lambert
   - (b) Blinn
   - (c) Phong
   - (d) Lightsource
2. Which of the following **can't** you do in the Visualize Control Panel?
   - (a) Assign a shader to a surface
   - (b) Modify a light
   - (c) Change the color of a shader
   - (d) Change the shading model of a shader
   - (e) Select objects used by a particular shader
3. Where do you enable the **Ground Plane** option for receiving shadows?
   - (a) In the Light editor
   - (b) In the Shader editor
   - (c) In the Environment editor
   - (d) In the Hardware Shade Settings
   - (e) In the General Preferences
4. Which of these techniques you learned in this tutorial **won't** apply when you do a software render using **Render > Render**?
   - (a) Setting up shaders
   - (b) Setting up lights

- (c) Using a Ground Plane for shadows and reflections
- (d) Tumbling the view to set the scene viewpoint
- (e) Setting the Environment color

5 Which of the following does **not** affect the light cast by a **Directional** light?

- (a) Position in the modeling windows
- (b) Rotation in the modeling windows
- (c) The intensity value
- (d) The color
- (e) The layer it is on is not visible

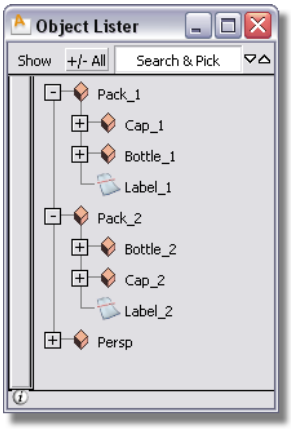
On Your Own

Now that you have an understanding of how to create shaders and lights, practice your skills on the following projects.

You can create new shaders to illustrate different color options for the design. Use the object lister to select the individual bottles and caps.

You may want to design your own label graphic and apply it to the label surfaces.

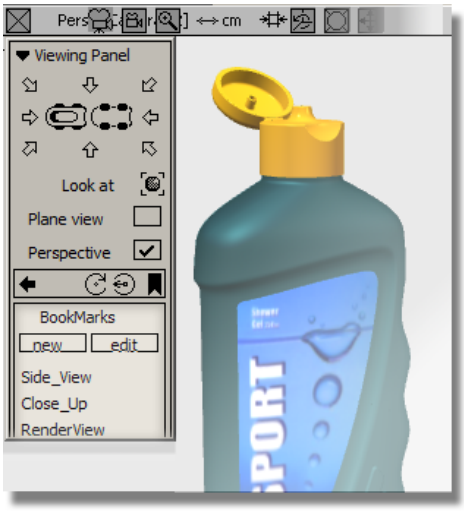




Use the scene you have just set up and create some detail views of the design.



Use Bookmarks to save particular views, so that you can re-render them as your design progresses.



All the previous models that you created can be rendered using the techniques shown.

For example the joystick handle is likely to be made from soft-touch plastics, so try using the Blinn shader. Vary the Eccentricity and Specular Rolloff values to create different plastic finishes for the different elements.



For the MP3 Player, you may want to drag some shaders from the shader library to create metallic finishes.



Quiz Answers

Answers to the Rendering Tutorial quiz

1. (c) Phong
2. (b) Modify a light
3. (c) The Ground Plane is enabled in the Hardware settings tab of the Environment shader editor.
4. (c) Using a Ground Plane for shadows and reflections
5. (a) The position of a Directional light doesn't affect the light it casts on the scene.

More rendering

11

Learning objectives

In this tutorial, you will learn more advanced rendering techniques, including color mapping, bump mapping, environment mapping, 3D textures, and raytracing.



In this tutorial, you will learn how to:

- edit the Render Globals parameters
- create a background environment
- create a sky texture
- create a fractal texture

- create a granite texture
- create a bulge texture
- delete a texture
- raytrace a scene
- adjust surface reflectivity

Part 1: Editing the Render Globals parameters

In this section, you will adjust the **Render Globals** parameters to improve the quality of the rendered image. Then, you will render the scene again, and save your work.

You will begin by re-rendering the scene from the last tutorial.

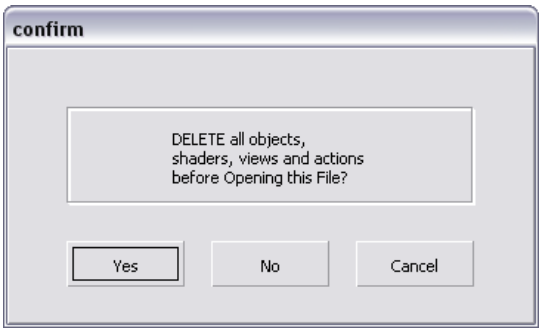


Watch **Part 1** of the tutorial.

Opening the tutorial file

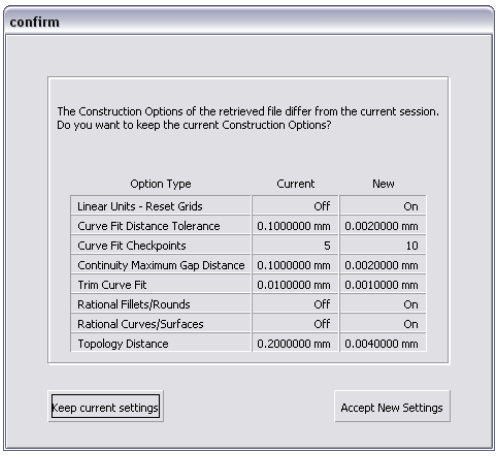
1. Choose File > Open to open the File Browser.
2. In the File Browser, locate the `CourseWare` directory and set it as the **Current Project**.
3. Open the file called `more_rend.wire`, located in the `wire` file of the `CourseWare` directory.

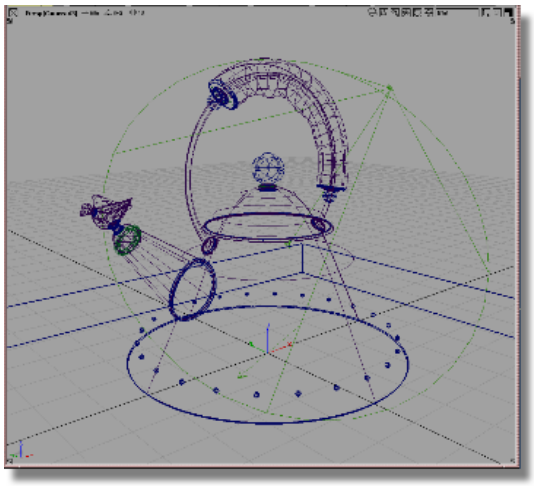
   For information on how to open a file, see Opening the tutorial file on page 82.



A dialog box appears, asking if you want to delete all objects, shaders, views, and actions. Click **Yes**.

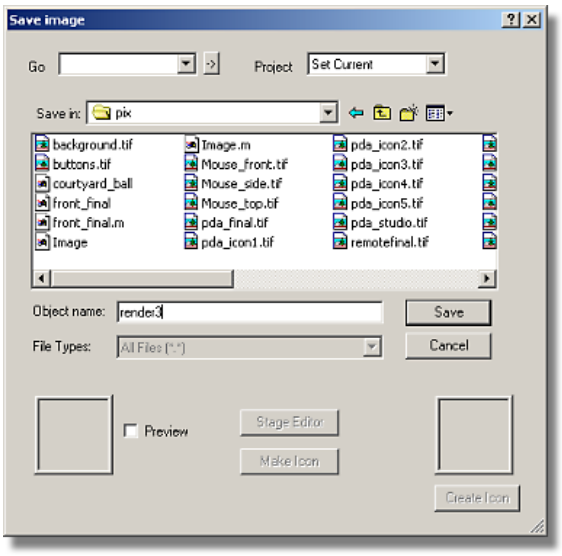
NOTE If your values for construction tolerances differ from those in the `more_rend.wire` file, you will be presented with a dialog. Click **Accept New Settings** to use the construction tolerances in `more_rend.wire`. The file is opened.





Rendering the scene

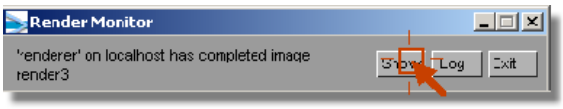
1. Choose Render > Render. The file browser opens.
2. In the File Browser, go to the `Lessons` project. Set the Lessons project as the **Current Project**.
3. In the `Lessons` project, open the `pix` directory.
4. Type `render3` in the **Object name** field (Windows) or **Save As** field (Mac), then press *Enter* (Windows) or *Return* (Mac) or click the **Save** button.



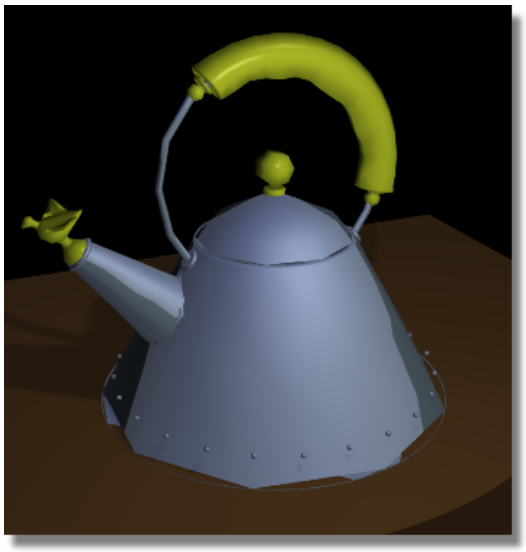
The file browser closes and the render begins.

When rendering begins, the Render Monitor opens.

5 When the render is complete, click the **Show** button on the Render Monitor.



The render is displayed.



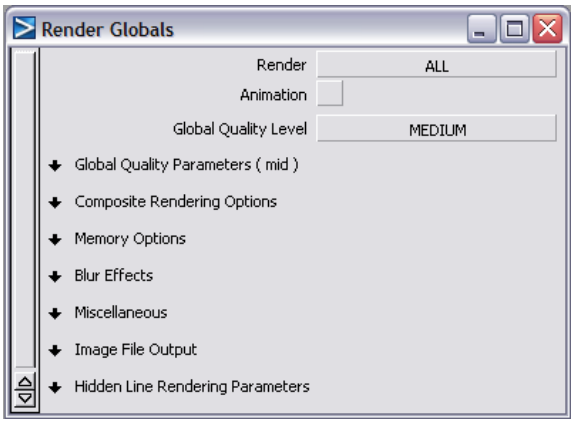
The body of the teakettle has a chrome material assigned to it, the grip has a plastic yellow material assigned to it, and the table top has a flat brown material assigned to it.

Also, you can see that the render is very faceted, especially any area with relatively high curvature, like the metal handle and the base of the teakettle. This faceting is often called "nickeling," after the faceted edges on old Canadian and American five-cent pieces. There are two variables that affect the quality of the render. The first is the overall quality setting that you assign to the rendering process in general, and the second is the tessellation of the model.

6 Click the close box on the rendered image and the Render Monitor to close both windows.

Editing the Render Globals parameters

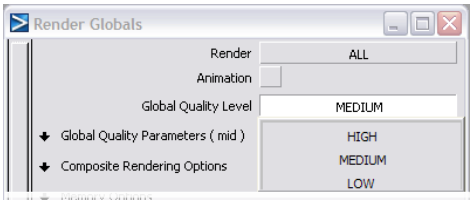
1 Select the **Render Globals** command (Render > Globals) to open the **Render Globals** window.



The **Render Globals** window allows you to set all the variables for the quality of the final render, including the size and type of image.

2 Click **MEDIUM** in the **Global Quality Level** field.

A pop-up menu appears.



Global Quality Level is one of the most important variables in the **Render Globals** window, because it specifies the quality of the final render. **LOW** produces a faster image, but the render quality will be significantly reduced: the final result will be faceted, and may not contain all the reflections that would be achieved with a higher setting.

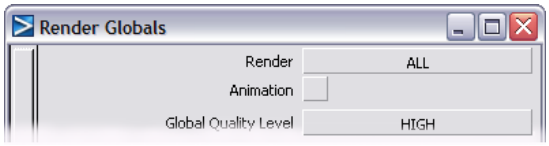
HIGH produces a very high quality image, but the image will also take longer to compute.

The rendering process is an iterative process. The typical rendering process is to set some variables in the scene and then render a test image to see the results, then change one or some variables and re-render the scene to see the new results.

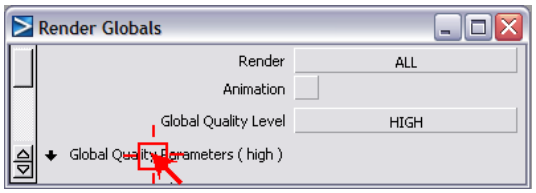
For this reason, when you are starting the rendering process, you will typically render the scene using **LOW** or **MEDIUM Global Quality Level**, to make the rendering speed faster. After you have achieved the

look you are happy with, you will render the scene at **HIGH Global Quality Level** to achieve a better quality result.

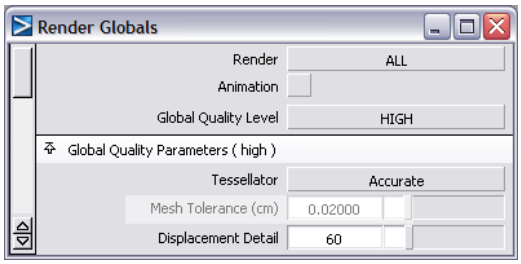
3 Set the **Global Quality Level** to **HIGH**.



4 Click the tab called **Global Quality Parameters** to open this section.



5 Set **Mesh Tolerance** to **0.02**.



When an image is rendered, its surface is divided into triangles. This process is called tessellation. Each surface of a model has a specific tessellation value. When the tessellation value is low, the surface is divided into few triangles and it may appear faceted when rendered, even if the **Global Quality Level** is set to **HIGH**. In some cases, the only way to reduce the faceting is to increase the model's tessellation value. Tessellation value is another important variable in the quality of a final render.

Mesh Tolerance is the maximum allowable distance (measured in centimeters) between a NURBS surface and its tessellated version. By setting **Mesh Tolerance** to a low value, you increase the quality of the final render. (What actually happens is that the tessellation value for the entire scene increases.)

6 Close the **Render Globals** window.

Rendering the image again

1 Select the **Render** command (Render > Render).

The file browser opens to the `pix` directory of the `Lessons` project.

Click the **Save** button to overwrite the previous file named `render3`.

A dialog box appears, asking if you want to overwrite or replace the file. Click **OK**.

The rendering process begins.

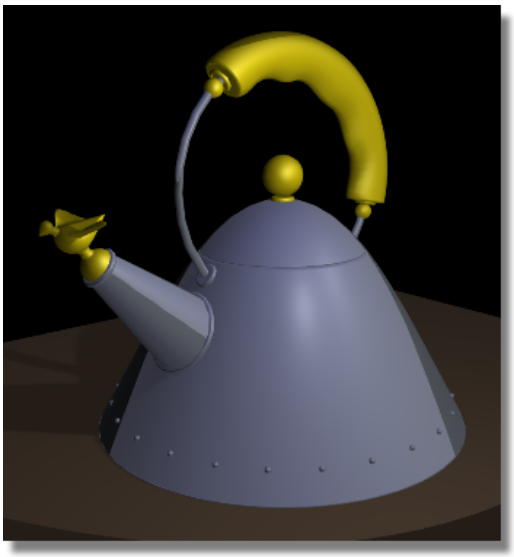
2 After the render has completed, click the **Show** button on the Render Monitor to view the image.

The entire model is much smoother; in particular, the handle and the base of the teakettle are no longer faceted.

3 Click the close box of the Render Monitor and rendered image windows to close them.

Save your work

1 Choose File > Save As to open the File Browser.



2 Save your work in the `wire` file of the `Lessons` directory.

3 Name your file `myadv_rend.wire`.

For information on creating the `Lessons` project or saving your work, see Saving your work on page 96.

Part 2: Creating a background environment

Next, you will create an environment that will be used to reflect onto the teakettle.



Watch **Part 2** of the tutorial.

Creating a cloudy sky background environment

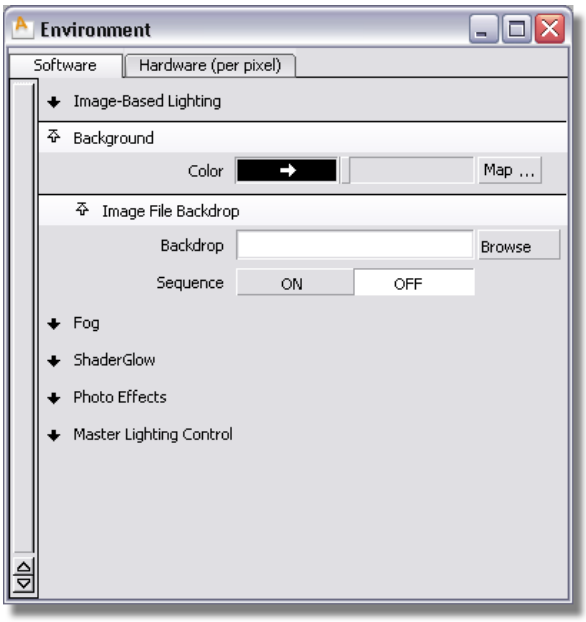
First, you will create a sky texture with clouds for the background of the scene.

1 Open the **Multi-lister** window, and display only the shaders **(Render > Multi-lister > Shaders)**.

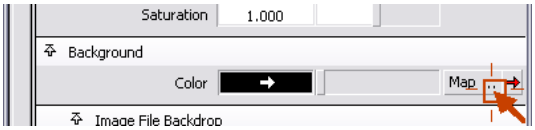
2 Double-click the **Environment** shader to open the **Environment** control window.



The environment shader allows you to determine the type of image that is produced in the background of your scene. The environment can be either a 2D image or a series of images that produces a 3D environment.

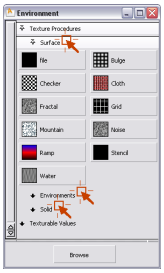


3 In the **Background** section, click the **Map** button next to the **Color** field to open the **Texture Procedures** window.

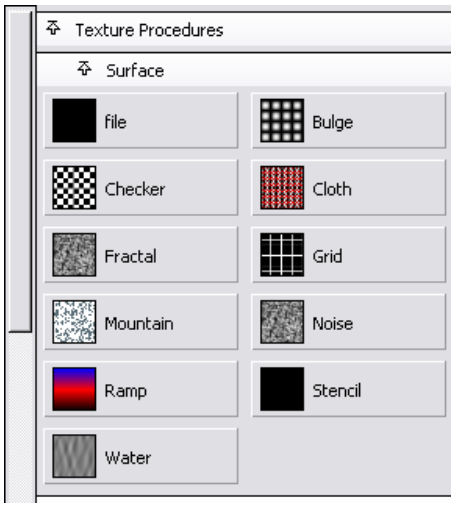


There are three types of textures: **Surface**, **Environments**, and **Solid**.

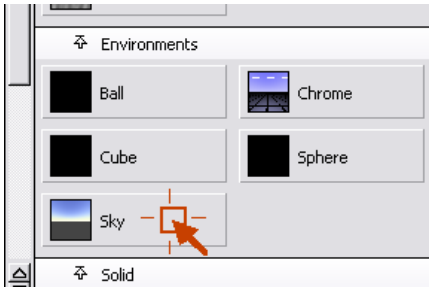
4 Click the three texture tabs to open them.



The **Surface** section contains 2D textures.



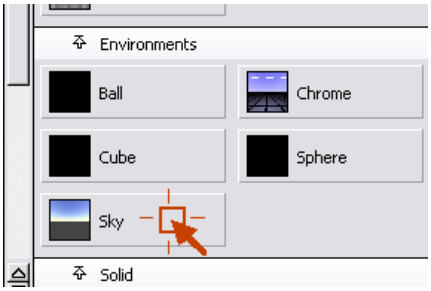
The **Environments** section contains procedural environments that give the appearance of real objects in the scene without adding additional geometry.



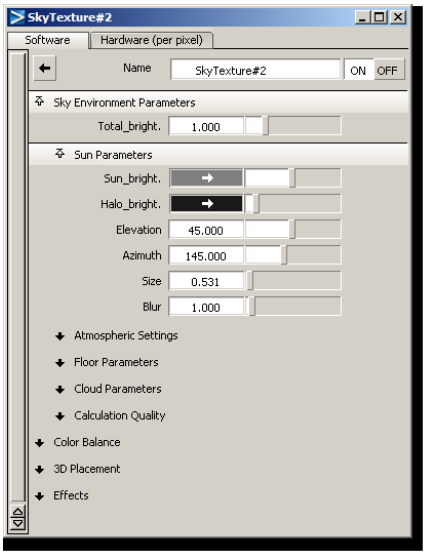
The **Solid** section contains textures that appear to be created from a block of solid material, like wood or marble.



5 Click the **Sky** button in the **Environments** section.

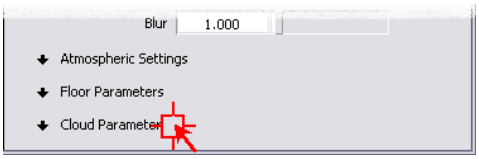


This opens a parameter window called **SkyTexture**. The sky texture is a very "procedural texture" that simulates a sky. "Procedural" means that the program executes a series of commands to create the texture, instead of using a 2D image of the sky. The sky texture can simulate a sunrise or sunset, or you can create a sunset as it might appear on some faraway planet.



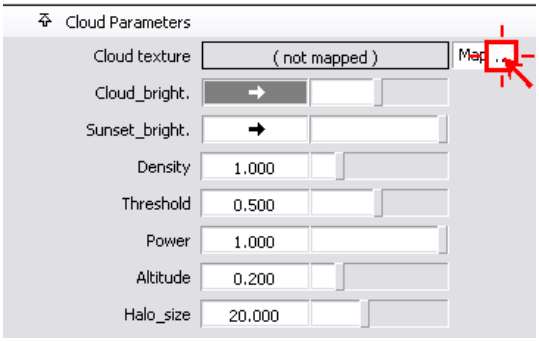
For this example, you will not be creating an animated sky, but you will create a static sky.

6 In the **SkyTexture Control Window**, click the **Cloud Parameters** tab.

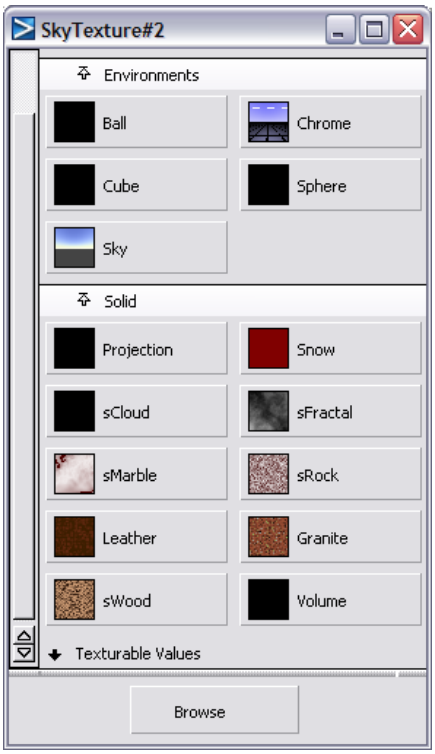


This section contains variables that control the clouds in the sky. Currently, there are no clouds in the sky texture, as you can see in the **Multi-lister** swatch. One way to create clouds is to map a two-dimensional texture to the **Cloud texture** variable.

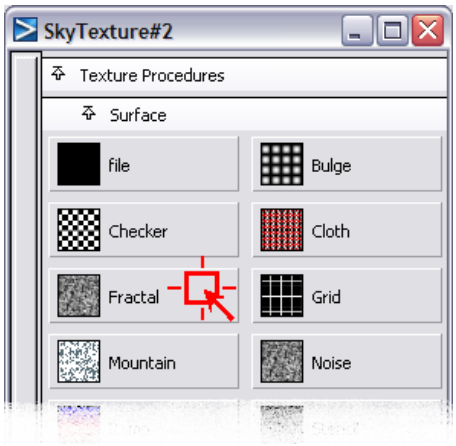
7 Click the **Map** button next to the **Cloud texture** variable.



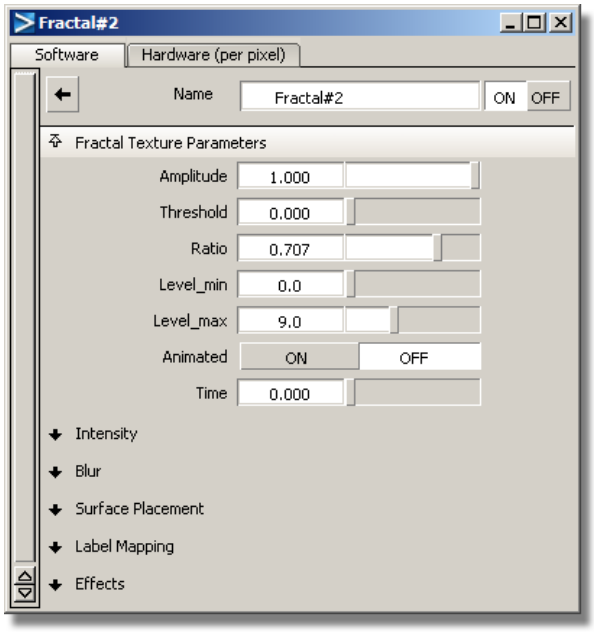
The **Texture Procedures** window appears.



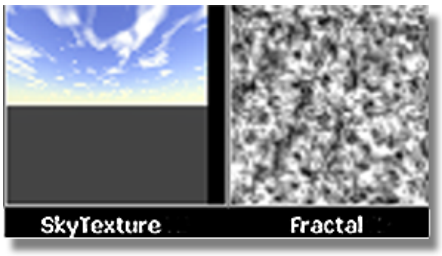
8 Click the **Fractal** button in the **Surface** section. This is a two-dimensional texture that works well to simulate clouds and other textures like fog or smoke.



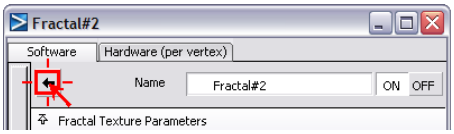
A new control window appears called **Fractal**. You do not need to edit the default variables for the fractal texture, because they are sufficient for producing a good cloud image.



NOTE The **Multi-lister** now contains a **Fractal** swatch. The Fractal texture is used to simulate clouds. These clouds are visible in the **SkyTexture** swatch.

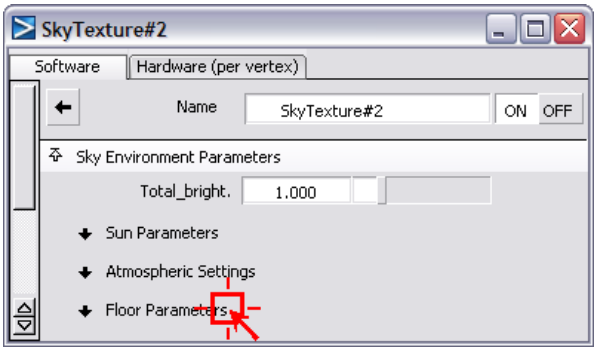


9 Click the left arrow at the top of the **Fractal** control window.



This brings you back to the **SkyTexture** control window.

10 Click the **Floor Parameters** tab to open this section.



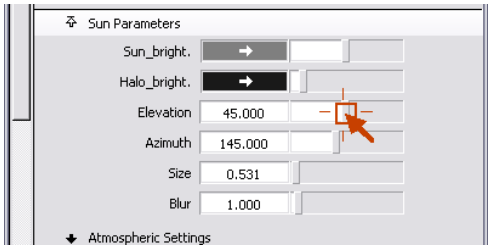
11 Click the **OFF** option next to the variable **Has_Floor**. This turns off the default floor in the Sky texture. We do not need the floor, because the table top obscures the ground.



The floor disappears from the **SkyTexture** swatch in the **Multi-lister**.

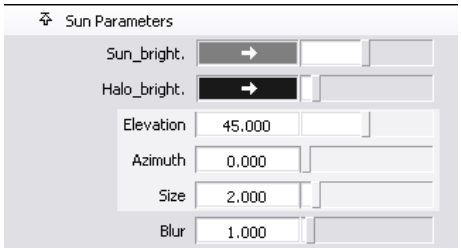


12 In the **Sun_Parameters** section, drag the slider in the **Elevation** field down towards zero. Notice that the sky texture in the **Multi-lister** becomes orange, as it does in real life at sunset, and finally black.



Now, drag the slider back to its maximum value. Notice how the sky texture changes from black to orange and finally to a very bright washed out color.

Set the **Elevation** value to 40, to mimic the sun at noon. Change the size of the sun variable from a value of **0.531** to **2.0** and change the azimuth value from **145.0** to **0.0**.



The **SkyTexture** swatch updates.



13 Close the **SkyTexture Control Window** and the **Multi-lister**.

Rendering the scene

Now, you will render the scene to see the sky texture.

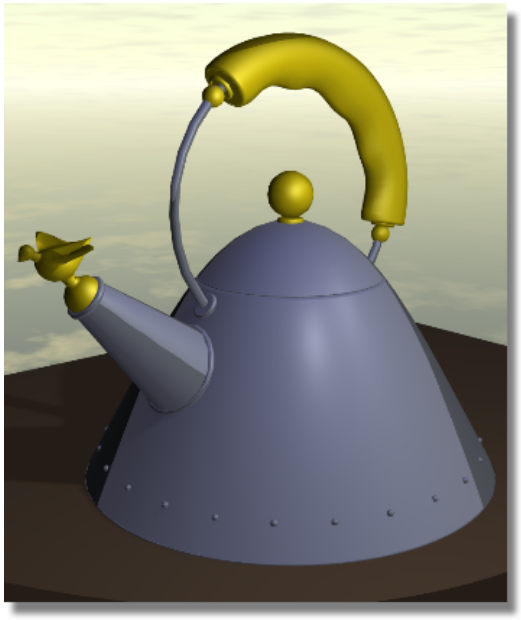
1 Select the **Render** command (Render > Render).

The File Browser opens to the `pix` directory of the `Lessons` project.

2 Type `render4` in the **Object name** field (Windows) or **Save As** field (Mac), then click the **Save** button.

The File Browser closes and the render begins.

3 Click the **Show** button on the Render Monitor to view the rendered image.



NOTE The sky texture is in the background of the image. Because the sky texture surrounds the scene, if you moved the camera angle and re-rendered the scene, you would see the sky from another position.

4 Click the close box in the Render Monitor window and the rendered image window to close them.

Save your work

1 Save your work in the `wire` file of the `Lessons` directory.

2 Name your file `myadv_rend2.wire`.

Part 3: Creating a 3D solid texture

Next, you will create a granite 3D solid texture that will be used for the tabletop.



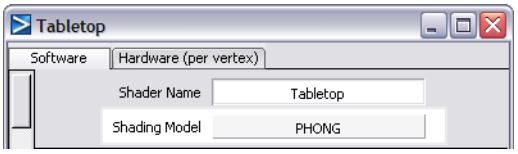
Watch **Part 3** of the tutorial.

Creating a granite texture

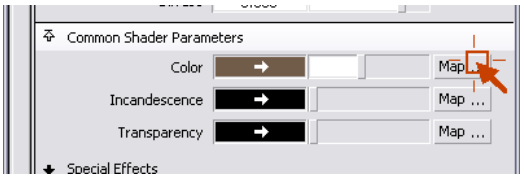
1. Open the **Multi-lister** window, and display only the shaders (Render > Multi-lister > Shaders).
2. Double-click the **Tabletop** shader to open the **Tabletop** control window.



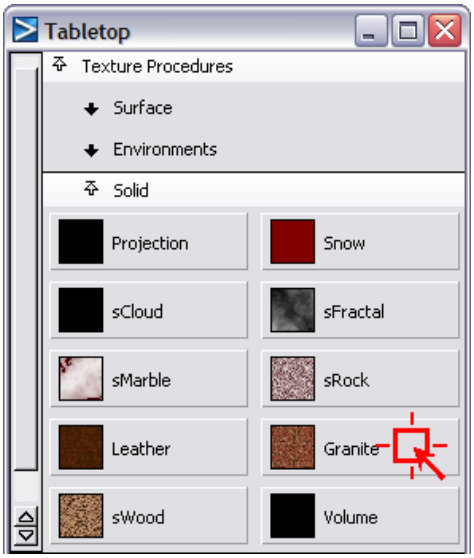
3. In the **Tabletop Control Window**, change the **Shading Model** to **Phong**. This will allow you to create a more reflective surface for the tabletop. Phong is good for polished stone -- the highlights are based on the light's color.



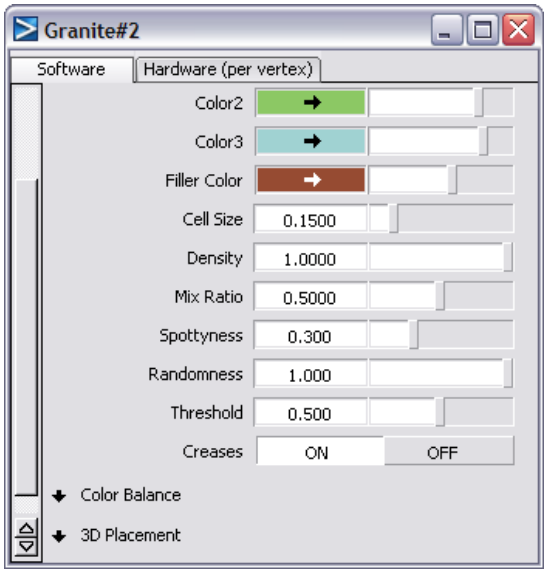
4. Click the **Map** button next to the **Color** field to open the **Texture Procedures** window.



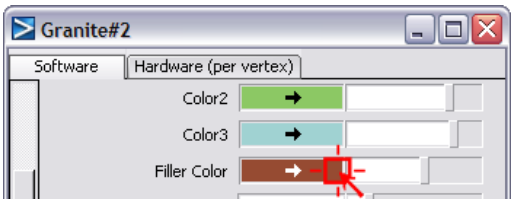
5 In the **Solid** section, click the **Granite** button.



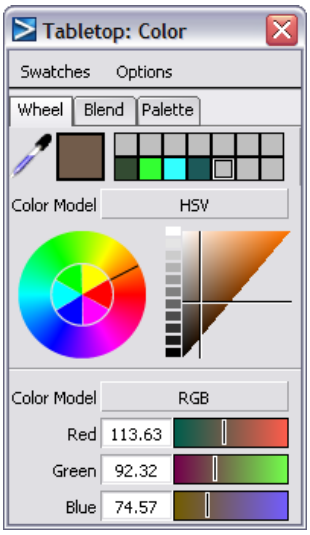
The **Granite Control** window opens.



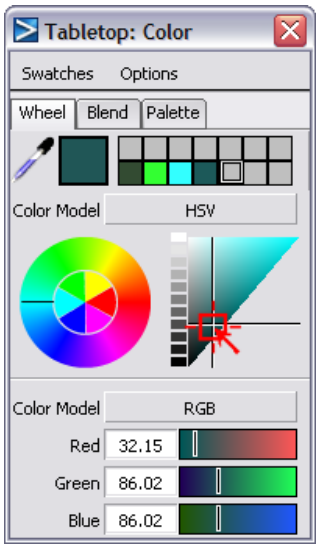
6 Within the **Granite Texture Parameters**, there are four variables that control the color of the granite. Click the color swatch next to the **Filler Color** parameter.



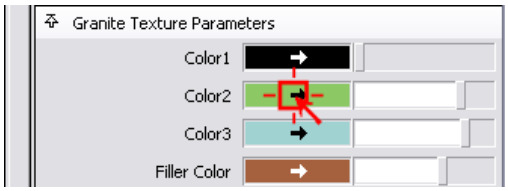
The **Color Editor** opens.



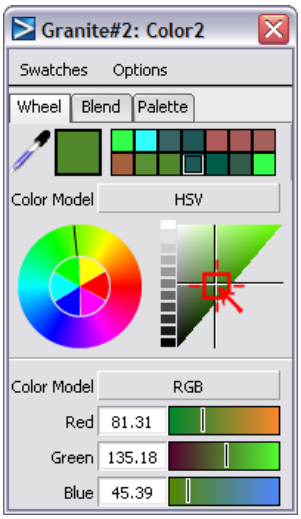
7 Select a teal color, or set the red value to **51**, green to **255**, and blue to **255**. Drag the cross hair cursor on the color triangle toward the bottom apex, which will darken the color.



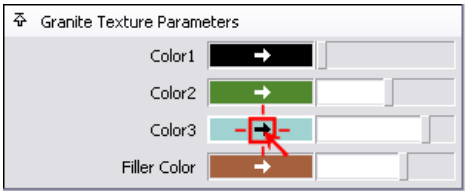
8 Now, you will change the colors of the small aggregate stone flecks within the granite. Click the **Color2** parameter to open the **Granite:Color 2 Editor**.



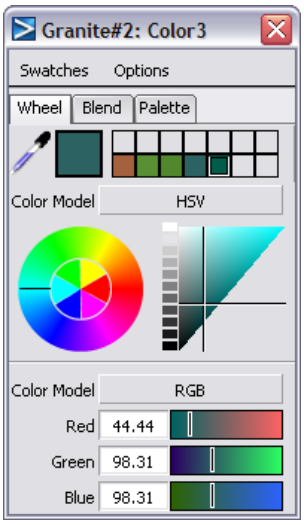
Darken the color by moving the cross hairs down on the triangle.



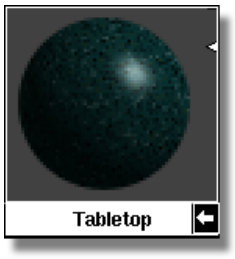
9 Click the **Color3** parameter to open the **Granite: Color 3 Editor**.



Darken it, as well.



10 Look at the **Tabletop** swatch in the **Multi-lister**. It displays the edited **Granite** texture.



NOTE The flat brown shader originally assigned to the **Tabletop** shader is invisible, because color textures supersede the shader color.

11 Close the **Color Editor**, **Granite Control Window**, and **Multi-lister**.

Rendering the scene

Now, you will render the scene to see the granite texture on the tabletop.

1 Select the **Render** command (Render > Render).
The File Browser opens to the `pix` directory of the `Lessons` project.

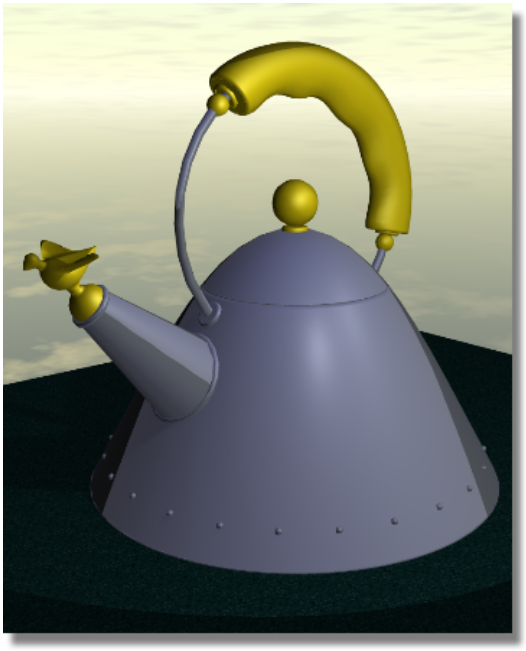
2 Click the **Save** button to overwrite the previous file named `render4`.

A dialog appears, asking if you want to overwrite the file. Click **OK**.

The rendering process begins.

3 Click the **Show** button on the Render Monitor to view the rendered image.

The tabletop now has a granite surface. Although the camera angle that you are using does not show the thickness of the tabletop, if you were to re-position the camera to view the table thickness and re-rendered the scene, the table would look like it was cut from a solid piece of granite.



4 Click the close box on the window bar of the rendered image to close it.

Save your work

1 Save your work in the `wire` file of the `Lessons` directory.

2 Name your file `myadv_rend3.wire`.

Part 4: Creating a 2D bump texture

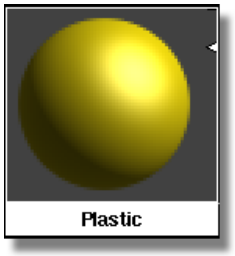
In this section, you will create a shader for the **Grip** surface by duplicating an existing shader. Then, you will apply a bump map to the new shader to create the effect of a bumpy surface.



Watch **Part 4** of the tutorial.

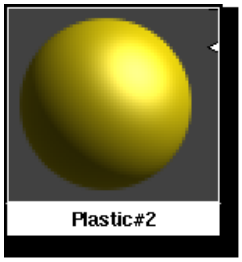
Creating a shader for the Grip surface

1. Open the **Multi-lister**.
2. Click the **Plastic** shader to make it active.

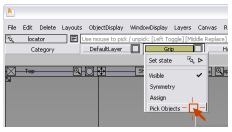


3. In the **Multi-lister**, select the **Copy** command (**Edit > Copy**).

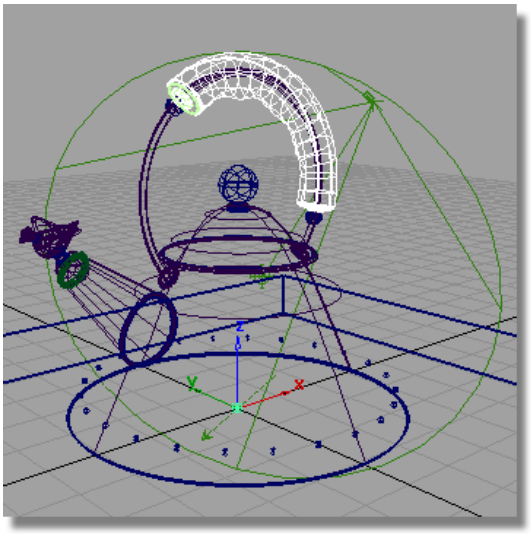
   A new shader is created called **Plastic#2**. We are creating a shader instead of modifying the original plastic shader, because the original shader was also shared by the Decorations layer. We don't want to change the shader on the decorations, just on the grip.



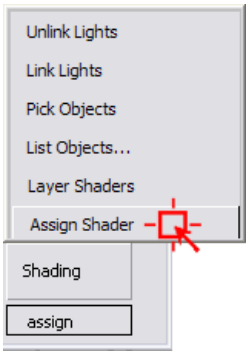
4 In the layer bar of the modeling window, click the **Grip** layer button, and select the **Pick Objects** option.



The grip becomes active.

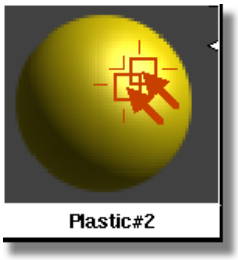


5 Assign the new **Plastic#2** shader to the grip.



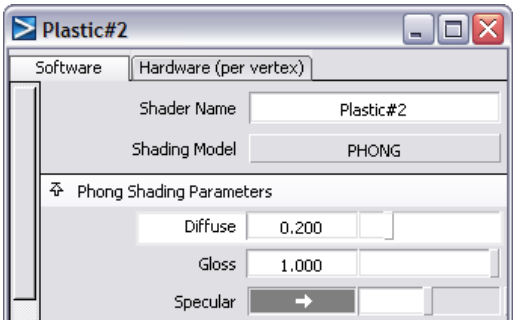
6 Choose Pick > Nothing to deselect all objects.

7 Double-click the **Plastic#2** shader to open the shader's control window.

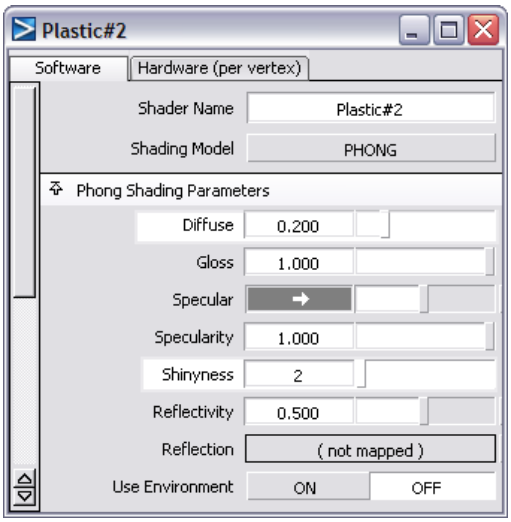


You will change the characteristics of the material to be more like a hard sponge. The surface will still be somewhat shiny, but will not be very reflective.

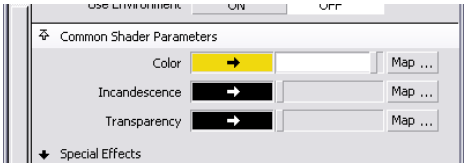
8 Set the **Diffuse** parameter to 0.2.



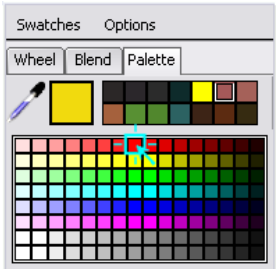
9 Set the **Shinyness** value to 2.



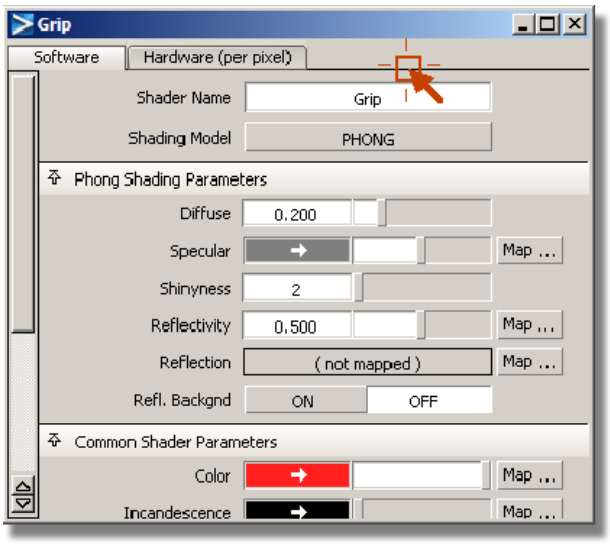
10 Click the color swatch to open the **Color Editor**.



11 In the **Color Editor**, click to open the **Swatches** section, click a red swatch, then close the Color Editor.



At the Shader Name cell, change the shader name to **Grip.**



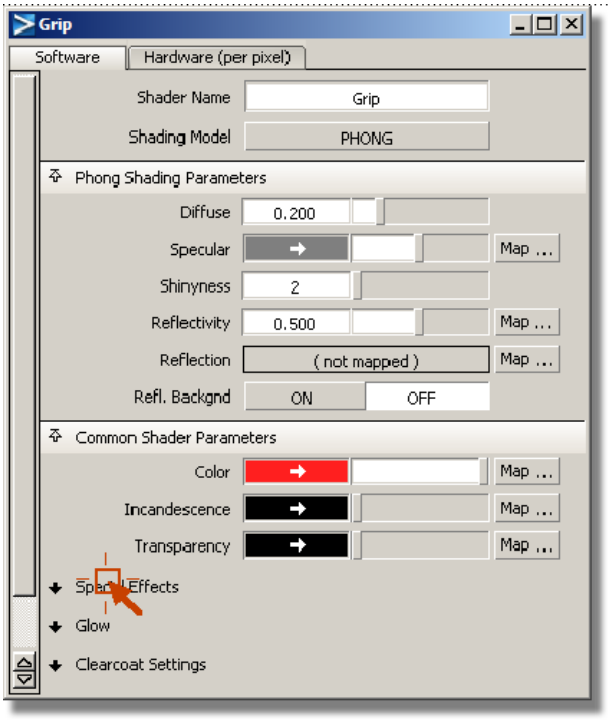
Creating a bump map for the Grip shader

To create an effect of a bump on a surface, you use a technique called bump mapping. Any image can be used as a source for creating a bump on a surface. Typically, the image used in a bump map is gray scale. For example, to create a golf ball, you would use an image that was all white with gray circles darkening to black at their centers on it. The computer would push the surface inwards everywhere there was a dark circle on the image. The darker the color, the farther it gets pushed from the surface.

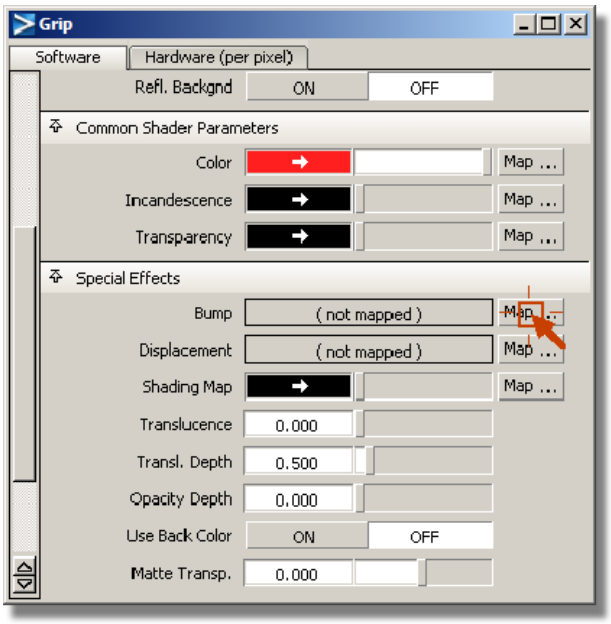
It is important to note that bump maps create the appearance of a bump on a surface, but do not affect the surface. The edge of a bumped object will retain its original smoothness. If you need to the edge or profile of an object to be bumpy as well, consider using a displacement map, which alters the surface when the image is rendered.

Now, you will create a bump map on the grip shader using a texture from within Alias.

1 In the **Grip** control window, click the **Special Effects** tab.

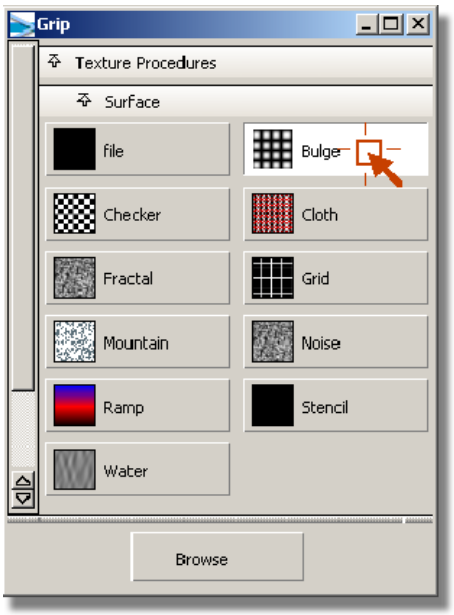


2 Click the **Map** button next to the **Bump** parameter.



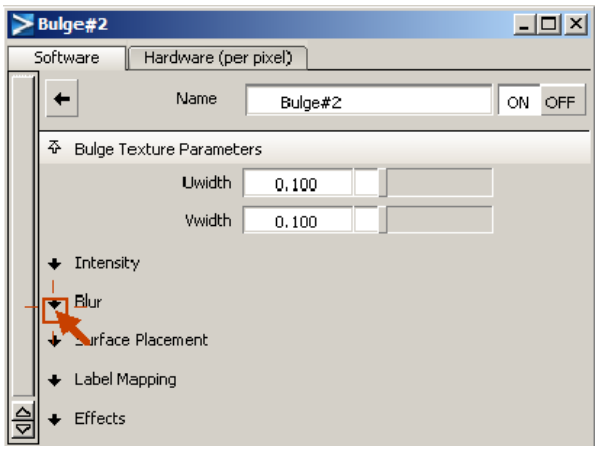
The **Texture Procedures** window is opened.

3 In the **Surface** section, click the **Bulge** texture. You will use this texture as the image in the bump mapping procedure.



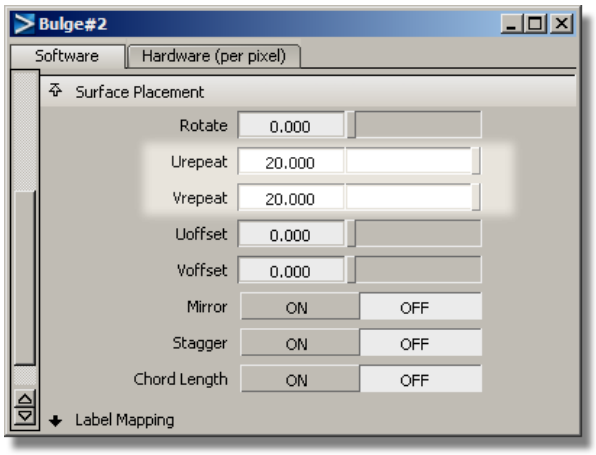
The **Bulge** control window is opened.

4 Click the **Surface Placement** tab to open it.



The **Surface Placement** parameters control the number of times the image is repeated across the surface.

5 Click the **Urepeat** field and type **20**, then press *Enter* (Windows) or *Return* (Mac). Click the **Vrepeat** field and type **20**, then press *Enter* (Windows) or *Return* (Mac).



6 Look at the **Grip** swatch in the **Multi-lister**. The bulge texture is apparent.



7 Close the control window and the **Multi-lister**.

Rendering the scene

Now, you will render the scene to see the bumpy grip texture.

1 Select the **Render** command (Render > Render).

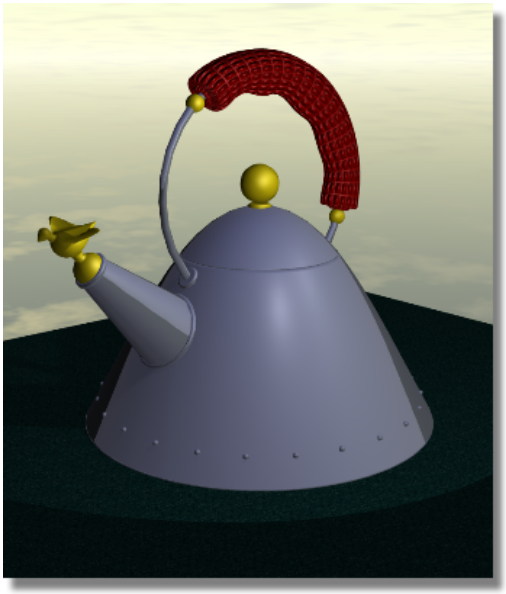
The File Browser opens to the `pix` directory of the `Lessons` project.

2 Type `render5` in the **Object name** field (Windows) or **Save As** field (Mac), then click the **Save** button.

The File Browser closes and the render begins.

3 Select the **Show** button on the Render Monitor to view the rendered image.

The grip now has a bumpy surface.



4 Close the rendered image and Render Monitor.

Save your work

1 Choose File > Save As to open the File Browser.

2 Save your work in the `wire` file of the `Lessons` directory.

3 Name your file `myadv_rend4.wire`.

Part 5: Raytracing

So far, you have been rendering your scene using a type of renderer called a raycast renderer. A raycast rendering requires a lot of tricks to make it look real, because raycasted images do not produce true reflections or refractions.

There is a second type of renderer called a raytracer. This type of renderer is much more accurate and can produce accurate reflections and refractions. Raytracing is also a process that takes much longer to compute than a typical raycast render.

In this section, you will learn how to raytrace an image. First, you will delete the **Chrome** texture from the **Metal** shader. Then, you will raytrace the scene.

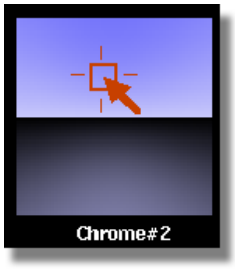


Watch **Part 5** of the tutorial.

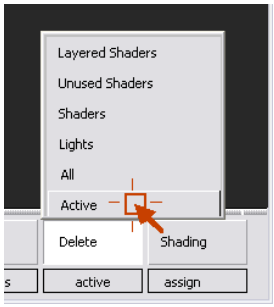
Deleting the chrome texture

In the previous tutorial, you applied a chrome texture to the teakettle surface. The chrome texture is assigned to the **Metal** shader. Now, you will delete this texture because it will not be needed when raytracing.

1 Open the **Multi-lister** window, and display only the shaders **(Render > Multi-lister > Shaders)**.

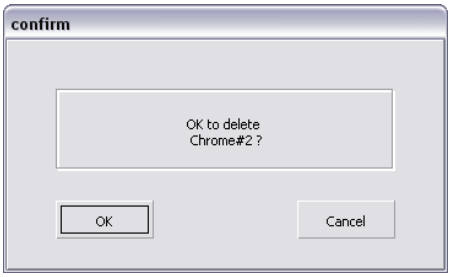


2 Click the **Chrome#2** swatch to make it active.



3 In the **Multi-lister**, select the **Delete Active** command [**Delete > Active**].

4 Click the **OK** button to confirm that you want the chrome to be deleted from the model.



5 Close the **Multi-lister**.

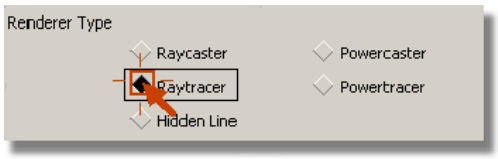
Raytracing the scene

1 Select the Render options command (Render > Render ❒) to open the **Rendering Options** window.

The **Rendering Options** window is opened.



2 In the **Renderer Type** section, click **Raytracer.**



3 Click the **Save** button to save **Raytracer** as the **Renderer Type**.



The **Rendering Options** window is closed.

4 Select the **Render** command (Render > Render).

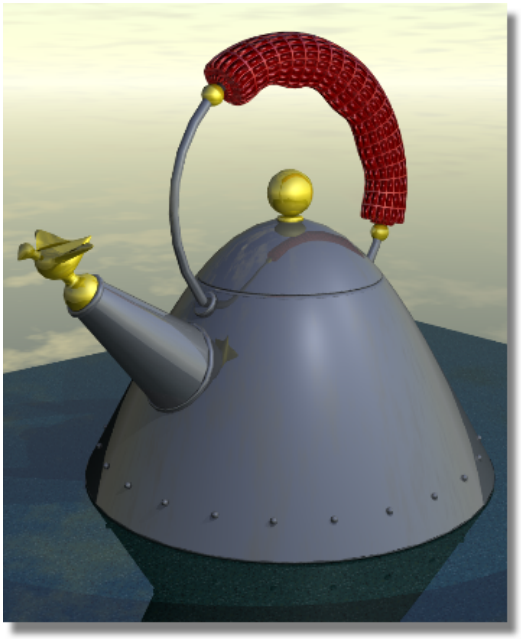
The File Browser opens to the `pix` directory of the `Lessons` project.

5 Type `render6` in the **Object name** field (Windows) or **Save As** field (Mac), then click the **Save** button.

The File Browser closes and the render begins.

Rendering a raytraced image takes longer than rendering a raycasted image. This is because raycasting requires more time to compute reflections and refractions in a scene.

6 Click the **Show** button on the Render Monitor to view the rendered image.



The sky texture is reflected in the entire scene, including the teakettle and the tabletop. The reflection of the grip is visible in the top of the teakettle, and the reflection of the teakettle is visible in the tabletop.

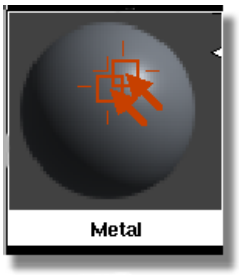
7 Close the rendered image and Render Monitor windows.

Adjusting the reflectivity of surfaces

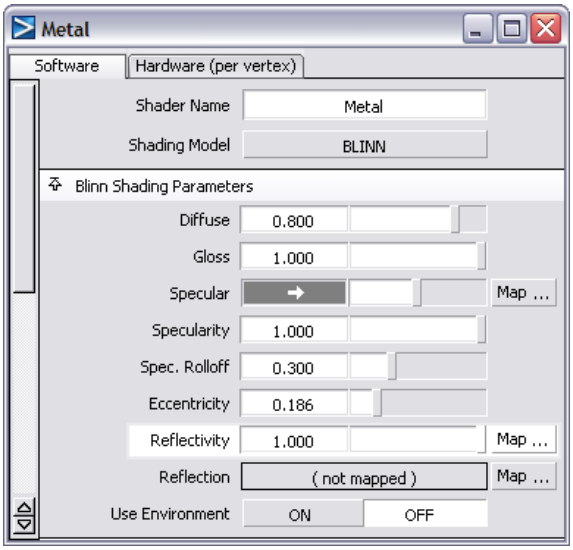
In some cases, you may prefer to limit the amount of reflection that occurs on a surface. Next, you will change the reflectivity of the teakettle and the color on the teakettle.

1 Open the **Multi-lister**.

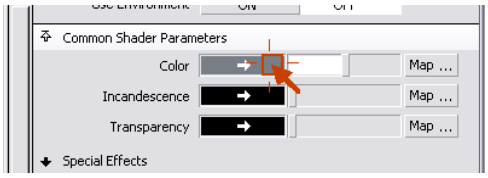
2 Double-click the **Metal** shader to open its **Control Window**.



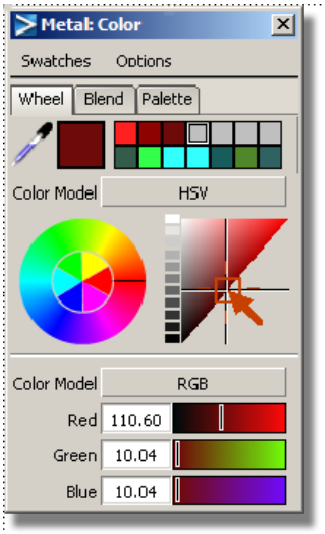
3 In the **Metal Control Window**, change the **Reflectivity** value from **0.5** to **1.0**. This will make the teakettle very reflective, similar to a mirror.



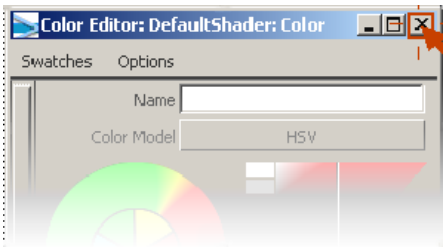
4 Click the **Color** field to open the **Color Editor**.



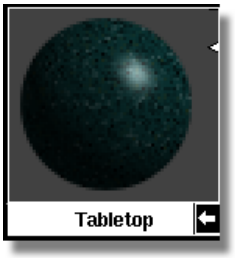
5 In the **Color Editor**, change the color of the metal surface from grey to red. Then, move the cross hairs along the long edge of the color triangle to make the color darker.



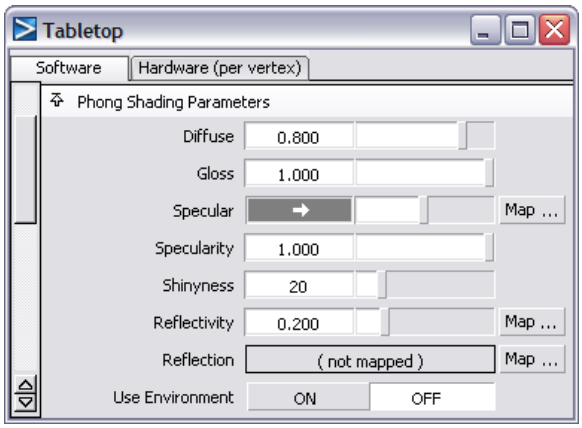
6 Close the **Color Editor**.



7 Click the **Tabletop** shader to display its parameters in the control window.



8 In the **Reflectivity** field change the setting from **0.5** to **0.2**. This will reduce the amount of reflection on the tabletop.



9 Close the **Tabletop** control window and the **Multi-lister**.

Raytracing the scene again

1 Select the **Render** command (Render > Render).

The File Browser opens to the `pix` directory of the `Lessons` project.

2 Type `render7` in the **Object name** field (Windows) or **Save As** field (Mac), then click the **Save** button.

The File Browser closes and the render begins.

3 Click the **Show** button on the Render Monitor to view the rendered image.



The teakettle is red, as opposed to gray. The reflectivity of the teakettle in the new render is very high, like a perfect mirror. The tabletop is not as reflective as it was in the previous render.

Save your work

1. Save your work in the `wire` file of the `Lessons` directory.
2. Name your file `myadv_rend5.wire`.

Conclusion

Congratulations! You have completed this rendering tutorial.

You now know how to:

- improve the quality of a final render by adjusting variables in the Render Globals window
- create a background environment, specifically a cloudy sky at noon
- create a solid three-dimensional texture (granite)

- create a two-dimensional bump texture (bulge)
- delete a texture
- raytrace a scene
- adjust the reflectivity of surfaces

Quiz

Now that you have RayTraced the teakettle, do this quick quiz to see how much you remember.

1. What method of rendering produces accurate reflections?
2. There are three buttons on the bottom of the Render Monitor. Name them.
3. In the color editor, what effect does lowering the value slider have on the color?
   - (a) makes it darker
   - (b) makes it lighter
   - (c) changes the hue
   - (d) makes the color more intense
   - (e) makes the color more pastel
4. To reduce the nickeling on an object when its rendered,
   - (a) fix the shading in the shader control window
   - (b) rebuild the model with more CVs to make it smoother
   - (c) adjust its tessellation in the Render Globals window

For the answers, see Quiz Answers on page 729.

On your own

Now that you have rendered the teakettle, try creating more complex shaders, environments and lighting for the other models you have created, like the shower gel bottle and the remote control. Practice raytracing the images.

Quiz Answers

Answers to Rendering the Teakettle Tutorial quiz

1. Raytracing.

2. **Show**, **Log**, and **Abort**/**Exit** are the three buttons on the Render Monitor. The third button changes its name from Abort to Exit when a render job completes.

3. (a) It makes the color darker.

4. (c). Adjust its tessellation in Render > Globals.

How did you do on this quiz? If you got all of the answers correct, congratulations! If you missed any of the answers, you may want to review this tutorial before moving on to the next tutorial.

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