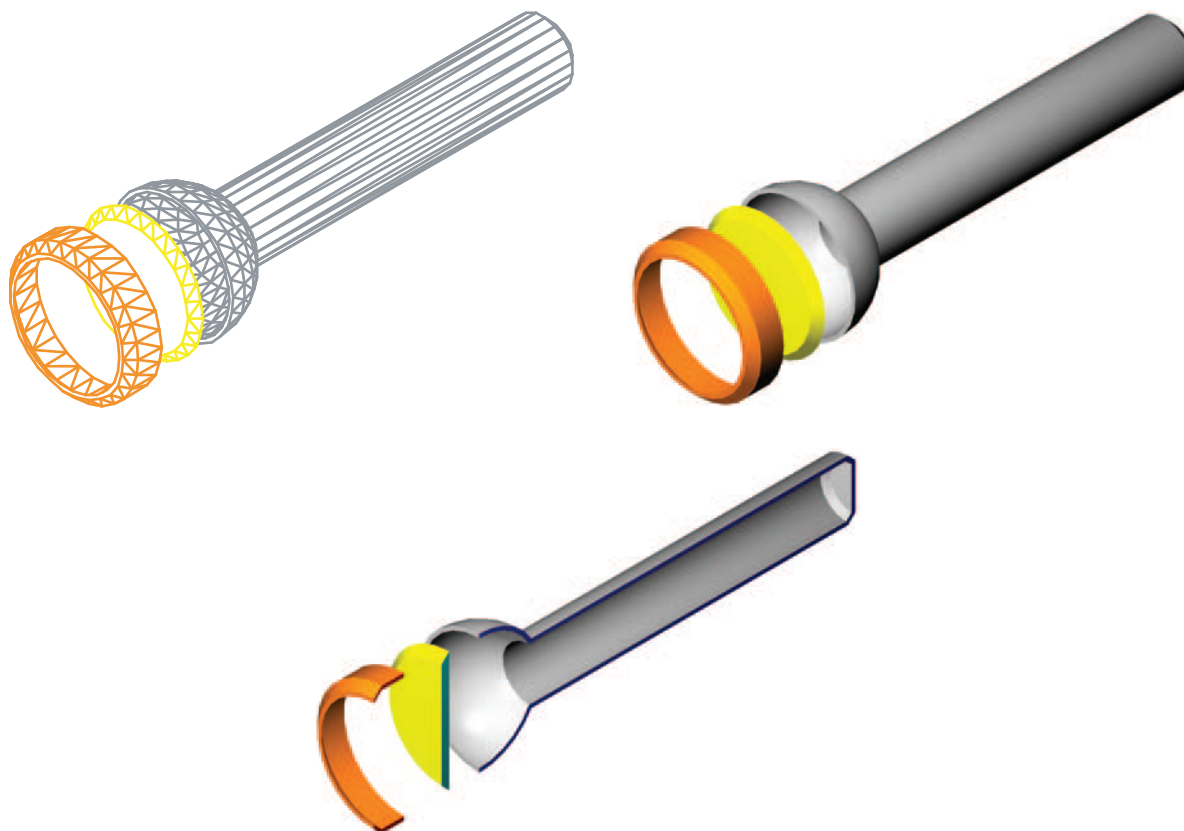


Solid Modeling Tutorial

Introduction

This tutorial is provided as a supplement to the solid modeling techniques presented in Chapters 1 through 14. It is a step-by-step process intended as a guide. Directions are given for each step of the process, but exact details regarding which commands to use, where to find commands, and exact coordinate locations are not always given. This allows you to use your knowledge of AutoCAD, consult the AutoCAD help documentation, and refer to the text for answers. The model for this tutorial is the injected-plastic handle, cap, and lens for a flashlight shown in the illustration below. Change viewpoints, UCSs, and visual styles as needed while working through this tutorial.



Drawing Setup

Start a new drawing using the acad3D.dwt template. Set **FACETRES** to 2.000. Set your preferred object snaps. The **Center** object snap may be especially useful for this tutorial. Finally, create the following four layers with the indicated colors.

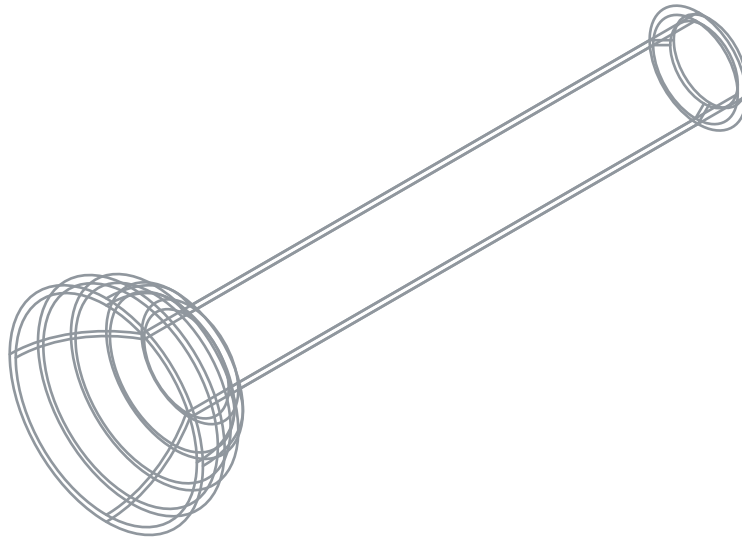
Layer	Color
Handle	Color 9
Cap	Color 30
Lens	Color 50
Construct	green (or your preference)

Constructing the Handle

The handle is the portion of the flashlight where the batteries are inserted. This is constructed from two solid primitives—a cylinder and a sphere.

1. Make the Handle layer current.
2. Switch to the FRONT UCS.
3. Draw a $\varnothing 2$ cylinder at 0,0,0 with a height of 12 units.
4. Draw a $\varnothing 4$ sphere centered on the near end of the cylinder.
5. Make the Construct layer current.
6. Draw a 5 unit cube. Use the cube to remove the front half of the sphere.
7. Move the hemisphere .5 units along the positive Z axis of the FRONT UCS.
8. Union the sphere and cylinder.
9. Place a .25 unit, 45° chamfer on the small-diameter end of the handle.
10. Using the **SOLIDEDIT** command, create a shell with an offset distance of .125 units. Remove the large-diameter surface when creating the shell.

The handle is now a hollow shell .125 thick. This represents the plastic piece removed from the injection mold. See the illustration below.

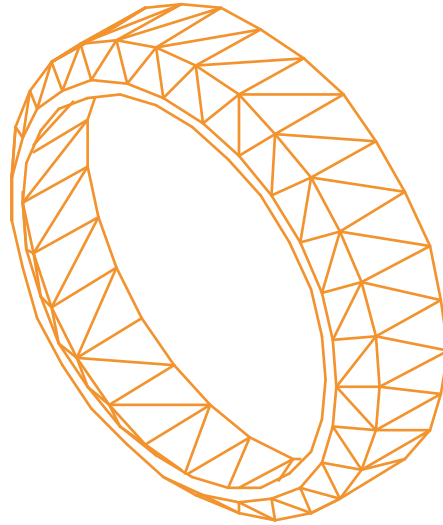


Constructing the Cap

Now, the cap for the flashlight needs to be created. The cap is the portion that snaps onto the handle and contains the lens. It is created from a cylinder.

1. With the FRONT UCS current, move the UCS origin 15 units along the positive Z axis. Save the new UCS as CAP.
2. Make the Cap layer current.
3. Draw a cylinder with a diameter of 4.25 units and a height of one unit centered at the CAP UCS origin.
4. Chamfer the near end of the cylinder with a .25 unit, 45° chamfer.
5. Make the Construct layer current.
6. Draw a $\varnothing 4$ circle centered at the CAP UCS origin.
7. Imprint the circle onto the cylinder body. Delete the source object.
8. Extrude the new face (imprinted face) into the cylinder .75 units with a 0° taper.
9. Extrude the face an additional .25 units into the cylinder with a 45° inward taper.

The cap is now a hollow shell with a thickness of .125 units. See the illustration below. Like the handle, this represents the plastic piece removed from the injection mold.

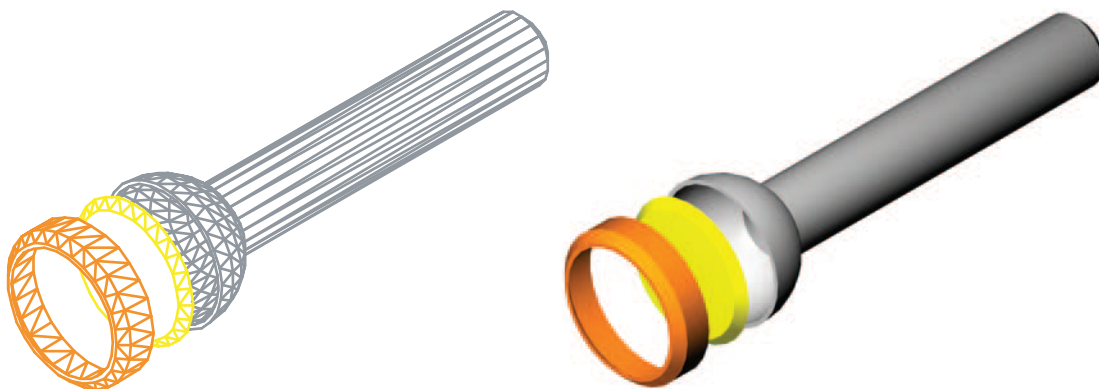


Constructing the Lens

The lens is the clear plastic piece inserted into the cap through which light from the bulb passes. This is simply a circle extruded with a taper.

1. With the **CAP** UCS current, move the UCS origin four units along the positive Z axis. Save the new UCS as **LENS**.
2. Make the **Lens** layer current.
3. Draw a $\text{Ø}4$ circle centered at the origin of the **LENS** UCS.
4. Extrude the circle .25 units along the positive Z axis with a 45° taper.
5. To place the lens between the cap and the handle, move it -5.5 units along the Z axis of the **LENS** UCS.

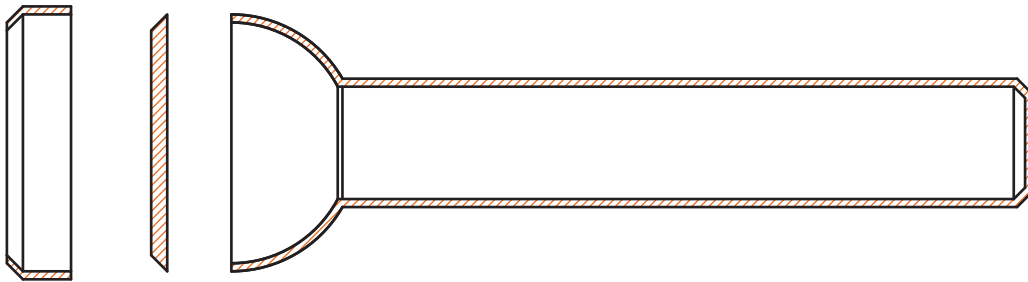
The model now looks like an exploded assembly view. You can also render or shade the scene. See the illustration below.



Creating the Cutaway View

The three objects represent the plastic pieces removed from the injection molds. Now, suppose you want to create a cutaway drawing to use in a presentation. First, draw a section plane down the centerline of all three objects and turn on live sectioning. Then, create a 2D section view as follows.

1. Set the hatch pattern to ANSI31 and select a proper hatch scale.
2. Set the hatch color to red.
3. Export the section view to a file named App-A_section.dwg.
4. Open and plot the section view drawing. See the illustration below.



Displaying the Model

With the model complete, you may want to create a “dynamic display” of the model. This may be useful to have on screen in AutoCAD as you discuss the design with others.

1. Set the Conceptual visual style current.
2. Turn the grid off.
3. Using the **3DCORBIT** command, set the display to a slow, continuous spin around the object.
4. As the model is rotating, switch the view between perspective and parallel projection.

Optional Additions

Once you have completed the model, you may want to add more detail. See the illustration below. For example, you may want to create two or three batteries and insert them in the handle. You may also want to model a small lightbulb and design a metal reflector to hold it inside the cap. Knurling can also be added around the circumference of the cap and handle to help grip the flashlight. Once you have modeled additional features, assign materials and place lights. Then, render the model. Make adjustments as necessary to achieve a realistic display.

