Modeling an Airplane

In this tutorial you will create the exterior of a classic, WWII airplane, the Lockheed P-38 Lightning. You'll use primitive objects and modifiers to create the parts. Viewport background bitmaps will act as guides to help you shape your plane.

Lockheed P-38 Lightning model

In this tutorial, you will learn how to:

- Set up the viewports with background images to help in building the model.
- Use primitive objects as the basis for each part of the airplane.
- Edit the model at sub-object levels.
- Adjust the pivot point and hierarchy of the model in preparation for use with a game engine.

Skill level: Beginner to Intermediate

Time to complete: 1 hour 30 minutes

Setting Up the Airplane Scene

The first task is to set the modeling units to meters and create a calibration box. Aircraft designers have always used the metric system for specifying dimensions. As a default, 3ds Max is set to generic units, so you'll need to change this.

Set up units of measurement:

1. From the Customize menu, choose Units Setup.

   The Units Setup dialog appears.

2. Choose Metric, then click OK.

   Now when you create anything, the dimensions will be displayed in meters.

3.  In the Create panel, on the Object Type rollout, click Box.

   Look at the Parameters rollout; the size values are now displayed in meters.

   The next step is to set up the viewport backgrounds.

Build the calibration box:

An actual P-38 has a wingspan of 15.85 meters, and a length of 11.532 meters. With the wheels extended, it has a height of 3 meters. You'll use this information to make a box of that size so you can get an idea of how much space the model will take up.

1. Activate the Top viewport.

2.  In the Create panel, on the Object Type rollout, click Box.

   The Box button turns gold to show it's active and ready to create.

3. Open the Keyboard Entry rollout, and enter the following values (you needn't type the "m"; 3ds Max adds it automatically when you press Enter or Tab):

   - Length: **11.532m**
   - Width: **15.85m**
   - Height **3m**

   TIP You can use the Tab key to move from one field to the next.

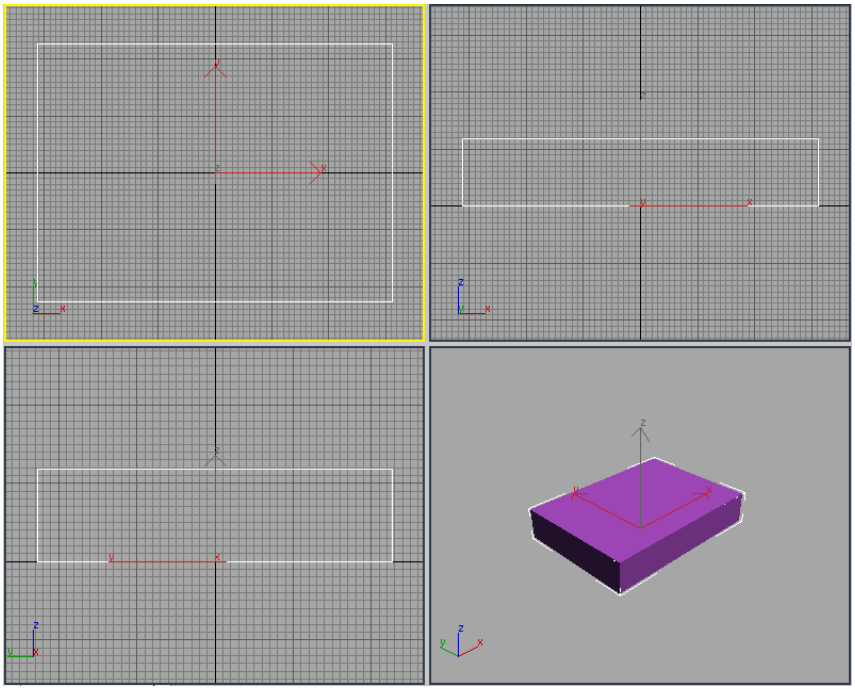
4. Once these values are entered, click Create.

   A box appears in the viewports.

5. In the command panel, name the object **calibration box**.

6  In the viewport navigation controls at the bottom-right corner of the interface, click Zoom Extents All.

The box is now visible and centered over the three background bitmaps. It doesn't matter if your box is a different color than the one in the illustration.



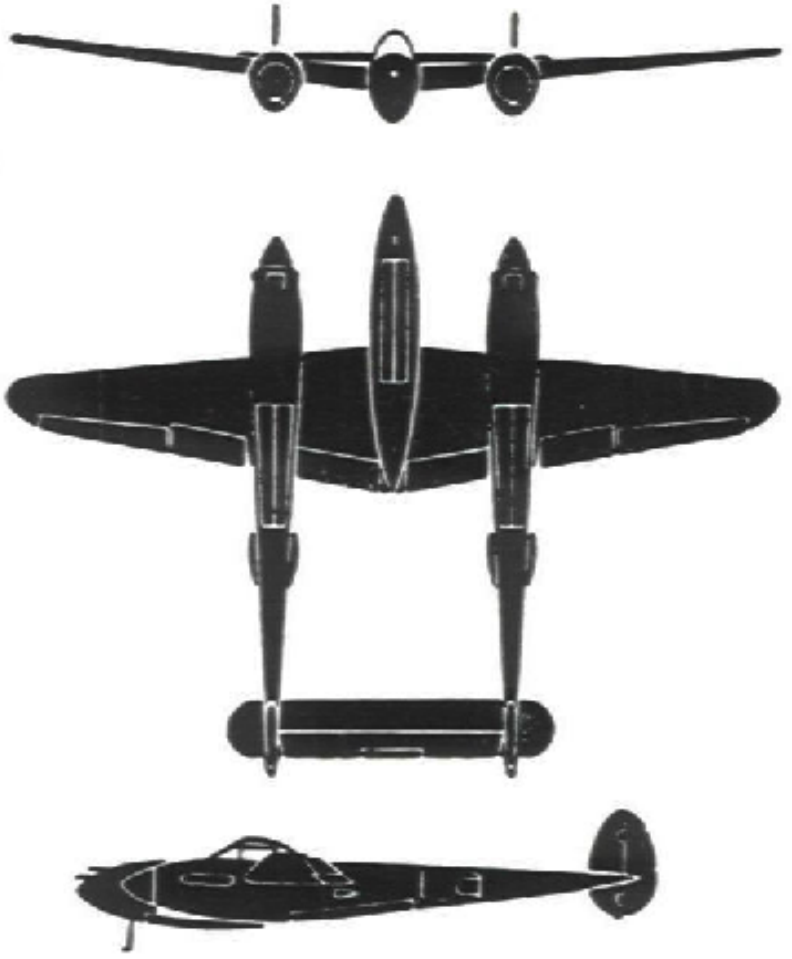
The calibration box.

Setting Up Viewport Backgrounds

You can load images or drawings in viewport backgrounds to use as patterns for building your airplane. Each viewport can have its own background, so you can load a corresponding image in the Front, Side, and Top viewports to guide you as you build your model.

In general, when modeling something you've previously visualized or seen, it's best to start with sketches from several different viewpoints, such as top,

side, and front. Also, the drawings should all be to the same scale, if possible. In this lesson, you'll use three drawings of a P-38 Lightning taken from WWII plane-spotting cards.



Three views of the P-38 Lightning from a set of plane-spotting cards

Set up viewport backgrounds:

1 Move your cursor to the Top viewport and right-click to make it active.

2 On the menu bar, choose Views > Viewport Background.

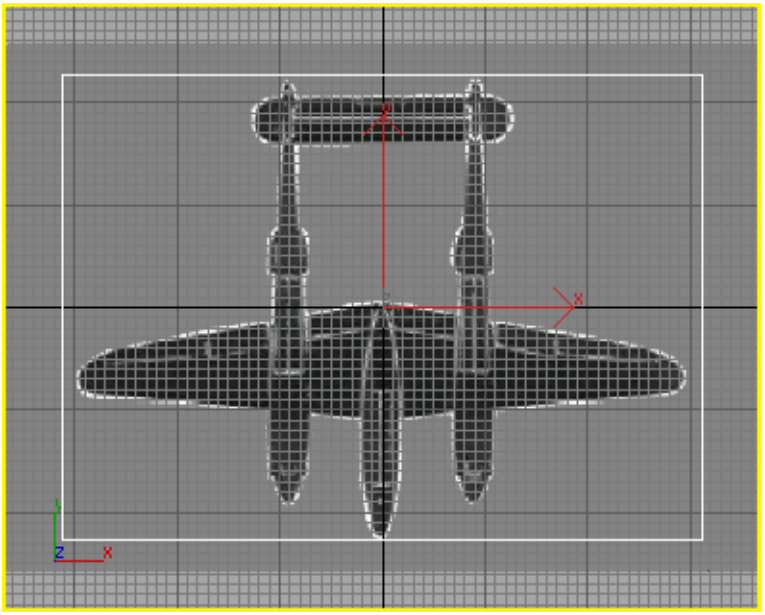
TIP You can also use the keyboard shortcut: Alt+B.

3 In the Viewport Background dialog's Background Source group, click Files.

4  On the Quick Access toolbar, click the New Scene button, navigate to the *\sceneassets\images* folder and choose *p38topview.jpg*. Click Open.

5 In the Aspect Ratio group, choose Match Bitmap. Click OK.

A sketch of the top view of the fighter is visible in the Top viewport and the Viewport Background dialog closes.



Top viewport displays the Top view background image.

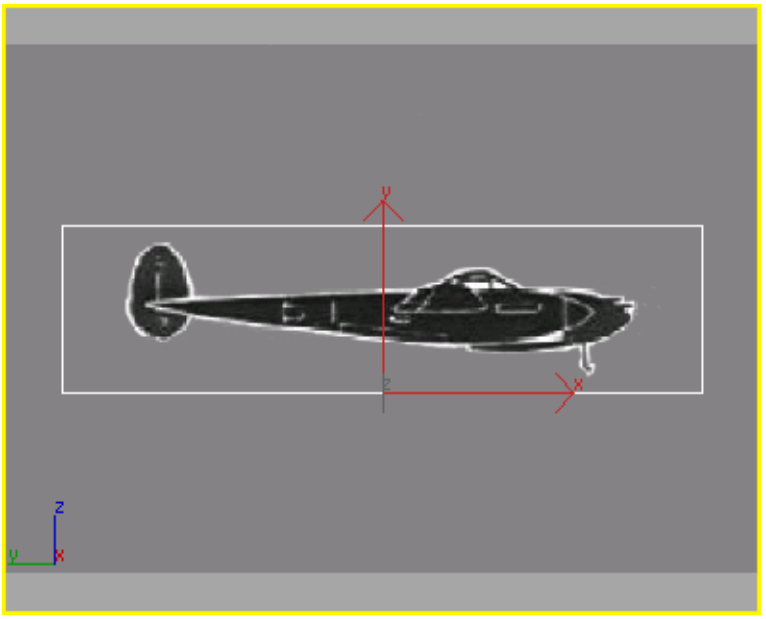
6 Turn off the grid display by pressing the G key.

7 Choose Views > Viewport Background to again open the Viewport Background dialog.

8 At the lower left, click the arrow by the Viewport field, and choose Left.

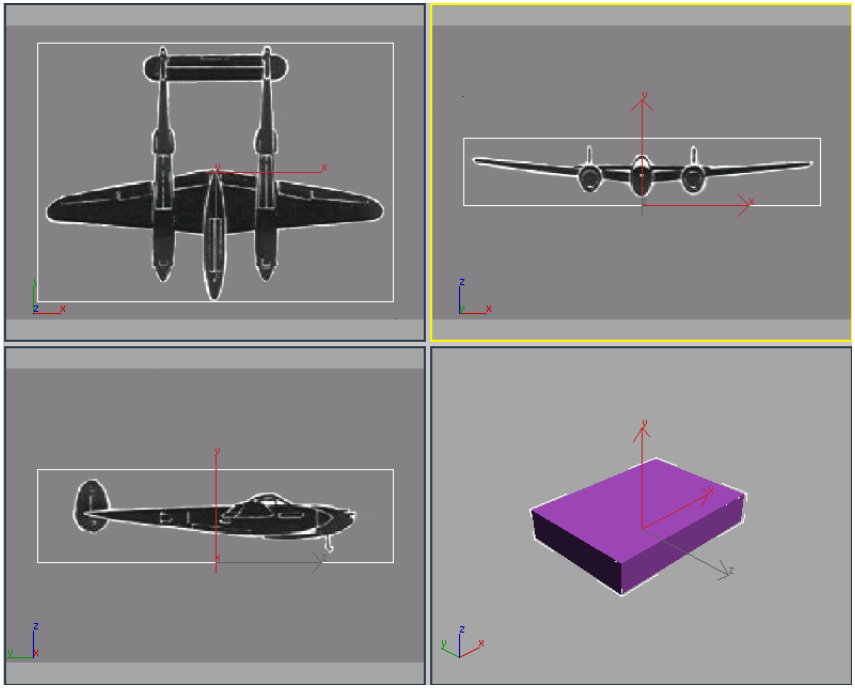
The Left viewport becomes active.

9 Click Files and choose *p38leftview.jpg* for the Left viewport. Again, choose Match Bitmap. Click OK. Turn off the grid display again.



Left viewport with its corresponding background image.

10 Right-click in the Front viewport and press Alt+B to open the Viewport Background dialog again. Click Files again and choose *p38frontview.jpg* for the Front viewport. Choose Match Bitmap, then click OK. Turn off the grid display.

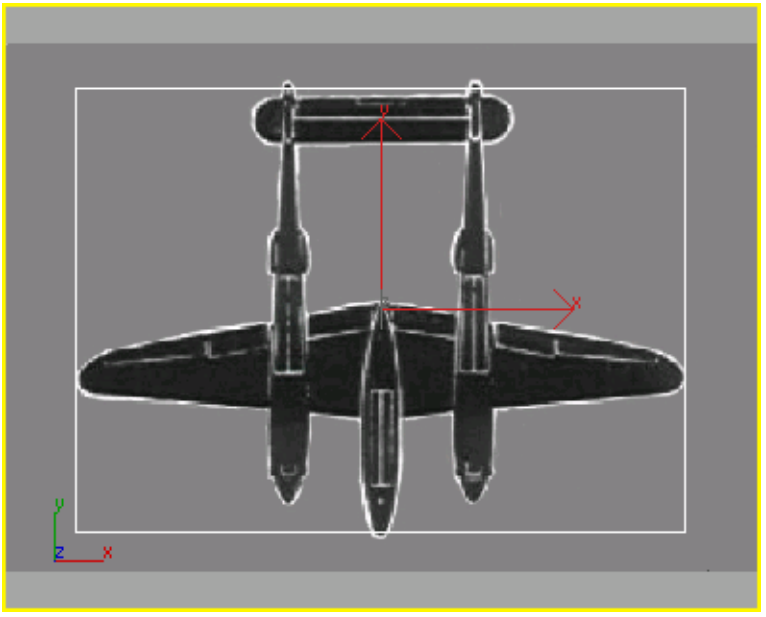


The three images are displayed in their appropriate viewports.

Next you will zoom and pan each view to more closely match the background images to the calibration box to make sure the three viewports are in the same scale. Each image is currently centered within the calibration box.

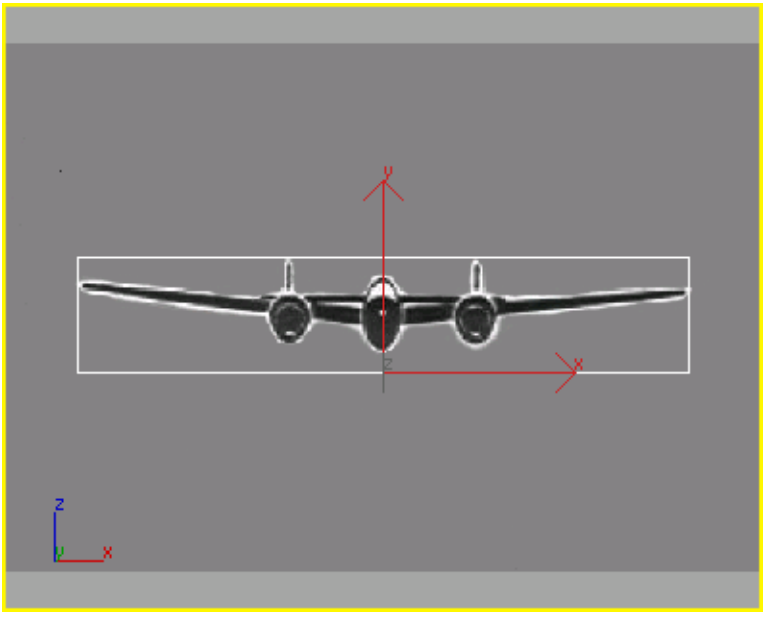
Calibrate the viewports:

1. Activate the Top viewport.
2.  In the viewport navigation controls, at the lower right, click Zoom. Zoom the Top viewport until the width of the box matches the width of the wings. Match the wingspan as closely as you can.
3.  Click Pan in the viewport controls, and then pan the viewport to center the box over the bitmap vertically. It won't be perfect, the two rudders will extend slightly beyond the calibration box.



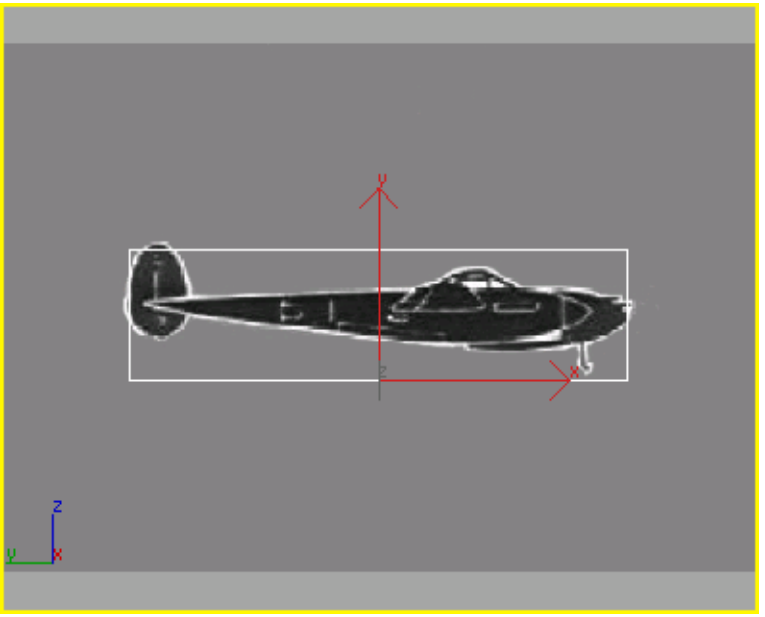
Top viewport aligned with calibration box

4 Zoom the Front viewport. Again match the wingspan first using zoom, then pan to adjust the vertical height. Since the landing gear is not shown in the plane-spotting card, align the top of the box with the tops of the rudders.



Front viewport aligned with the calibration box.

5 Now repeat zooming and panning in the Left viewport.



Left viewport aligned with calibration box

All three viewports are now calibrated so the picture in the viewport represents the approximate dimensions of the P-38.

You can zoom and pan the background images in the viewport if you want to center or enlarge them. To zoom or pan the background images do the following:

Zoom the background images and calibration box:

1. Activate the Top viewport, then choose Views > Viewport Background.
2. Turn on Lock Zoom/Pan.

   Turning on Lock Zoom/Pan locks the background image and objects together, so if you use the zoom or pan buttons from the viewport navigation controls, you can zoom in on the background image and objects or shift them horizontally or vertically.

   This is very handy if you have a detailed background sketch and know you will be zooming in to work on objects.
3. Repeat this for the Left and Front viewports.

You will notice the background image shifts when you close the Viewport Background dialog.

TIP Sometimes the background image can shift out of alignment with your geometry. This is inconvenient, but there is a workaround.

If you open a saved file or notice the background image has shifted, do one of the following:

-  Use the viewport navigation Zoom and Pan buttons to make the background images the correct size and position in the viewports. Turn off Lock Zoom/Pan, and then use the same navigation tools to align the geometry with the bitmaps. You can use Ctrl+Alt+B to toggle Lock Zoom Pan.

-  You can also move the objects in the scene to match the background image. Then, if you use Zoom Extents, the image will be centered with the geometry.

Hide the calibration box:

1. You don't need the calibration box now, so you can hide it. To do so, select the box in any viewport, right-click, and then choose Hide Selection from the quad menu.

    You can always unhide the calibration box and repeat the above procedure to re-calibrate. To unhide the box, go to the Display panel and choose Unhide By Name, then in the dialog, select the box.

2. Save your work as **myp38_backgrounds.max**.

Creating the Wings

There are many different modeling approaches you could take to building the wings. Here, you'll use a Box primitive with a Taper modifier.

You'll be continuing from the previous section, Setting Up Viewport Backgrounds on page 128 or open *p38_calibrated_start.max* from the *\modeling\p38_lightning* folder.

Create the wing using a box:

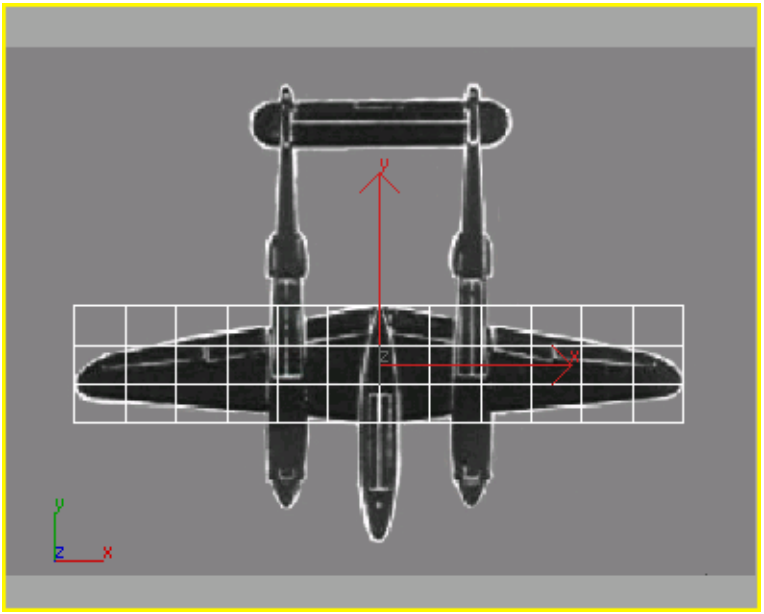
1  On the Create panel, on the Object Type rollout, click Box.

2 In the Top viewport, do the following to draw a box from upper left to lower right, approximately around the front wingspan:

- Click once at the upper left, then drag to the lower right with the mouse button down. As you move the mouse, the values for length and width change in the parameter fields.
- When you release the mouse button, you have set the length and width of the box, and now are setting the height, which you can see increasing in the Perspective viewport. Moving the mouse up creates a positive height, moving down creates a negative height. As you move the cursor the values change in the parameter fields.
- Click again to set the height.

3 On the Create panel, you can immediately adjust the values in the Parameters rollout. Enter the following values:

- Length=**3.048m**
- Width=**15.85m**
- Height=**0.305m**
- Length Segs=**3**
- Width Segs=**12**
- Height Segs=**3**



The Box with 12 width and 3 length segments.

You need to increase the number of segments so the modifiers for tapering and bending the wings will work correctly.

4 In the Name and Color rollout, type **wing**.

The object is now named *wing*.

Next you'll change the shape of the wing's profile so it looks like an airfoil.

Shape the wing into an airfoil:

1 Activate the Left viewport, and make sure the wing is selected.

2  From the viewport navigation controls, click Zoom Extents.

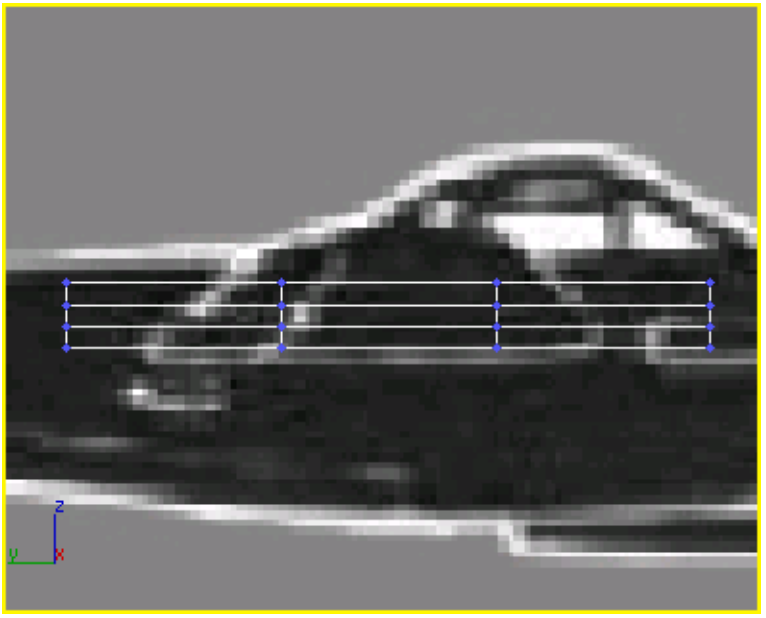
You'll zoom in on the wing object.

3 From the menu bar, choose Modifiers > Mesh Editing > Edit Mesh.

You'll need this to perform some sub-object editing to the vertices that make up the wing.

4  In the Selection rollout, click the Vertex button.

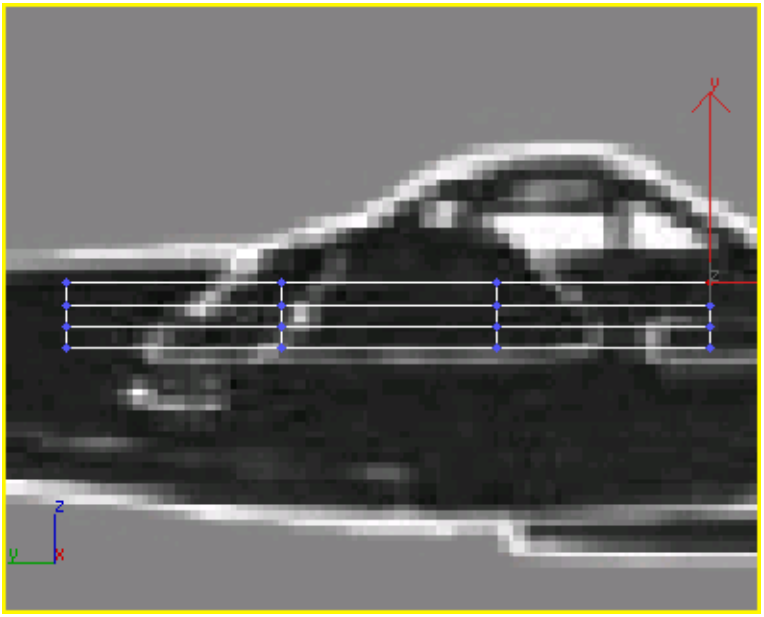
Look at the box in the Left viewport with vertex selection on. Each tick you see is actually twelve vertices lined up on top of one another. When you want to select and move them, you need to drag a selection window around them. Otherwise you will only select one vertex, rather than all of them.



The vertices appear as blue ticks at every intersection of the model.

5 Draw a selection window around the upper right set of vertices.

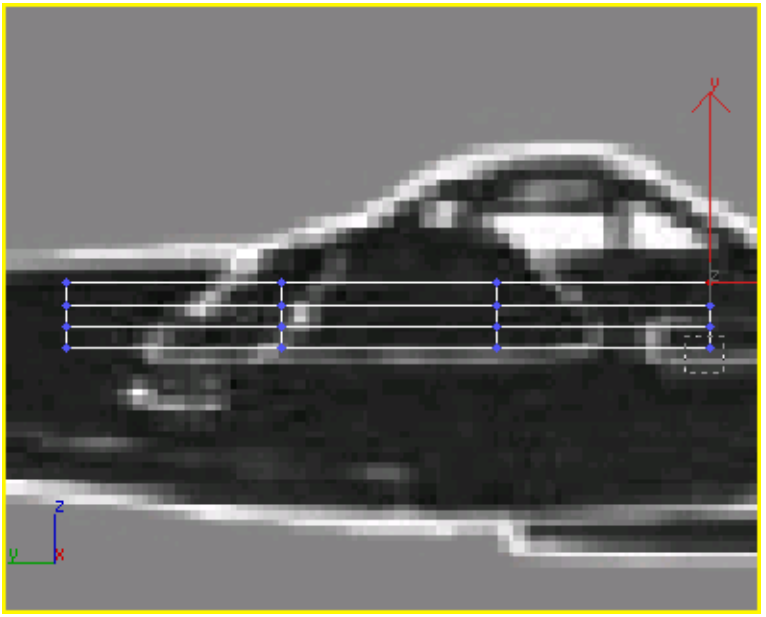
The X,Y,Z tripod jumps to the selection set and the selected ticks turn red.



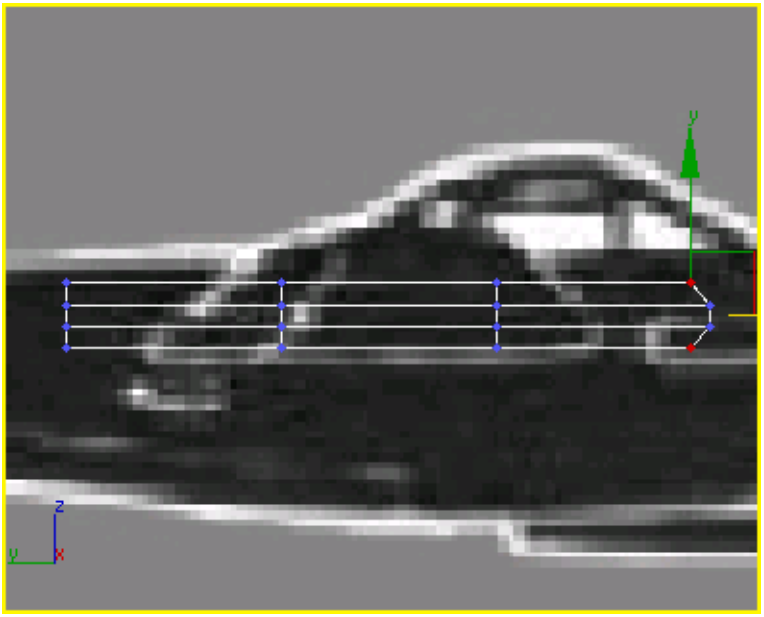
Selected vertices display in red.

6 Hold down the Ctrl key and drag a selection window around the vertices at the lower right.

The Ctrl key allows you to add to an existing selection set. The X,Y,Z tripod jumps to the center of the selection set.

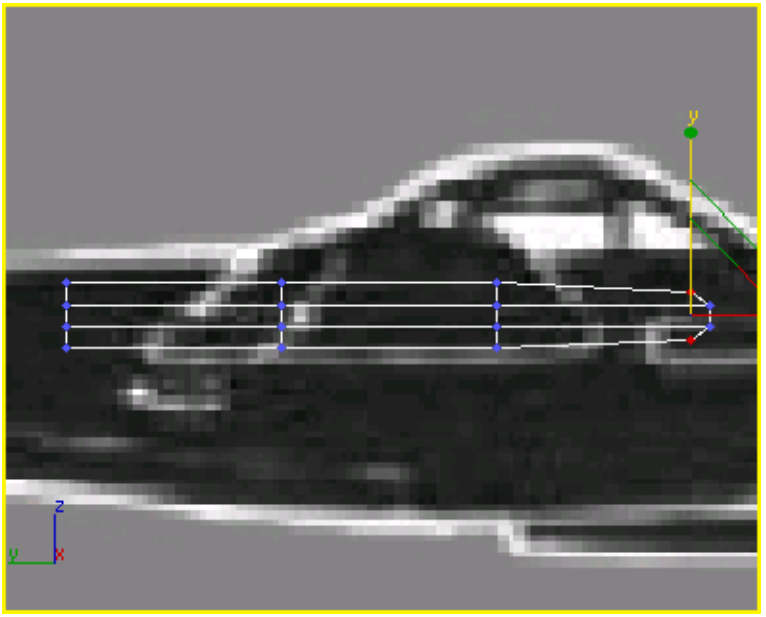


 On the main toolbar, click the Select and Move button and move the cursor over the X axis of the tripod. Click and drag the cursor to the left so the leading edge of the wing looks beveled.



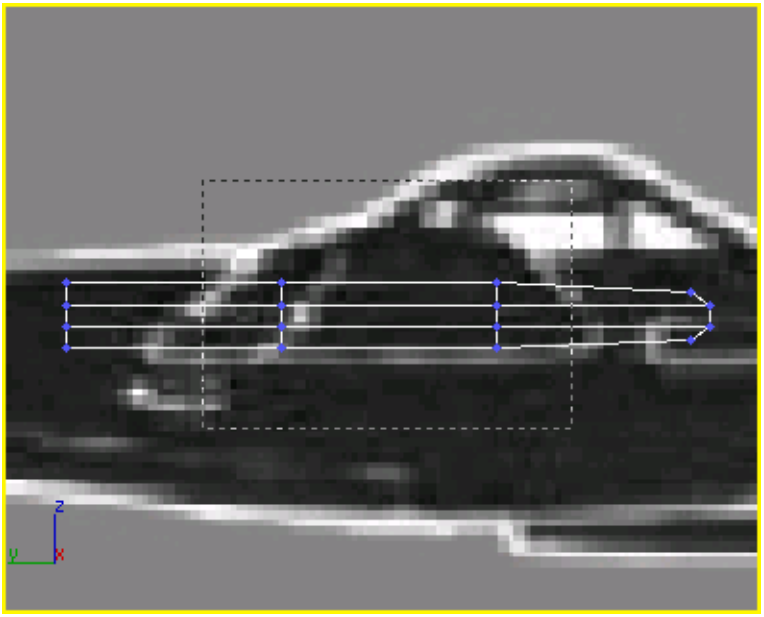
7  Click Select And Non-Uniform Scale. Then scale the vertices along the Y axis to 75%.

TIP Watch the Y field of the coordinate read out at the bottom below the time slider.

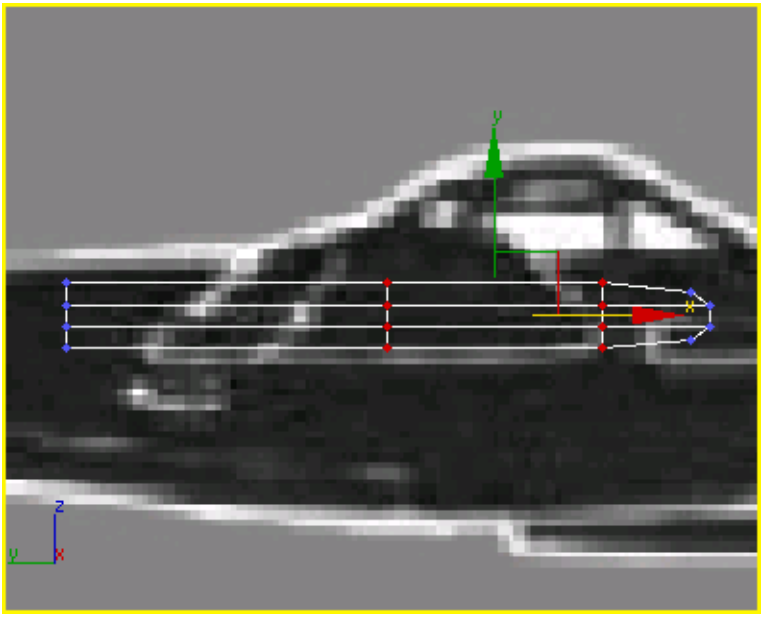


Scale the vertices to start rounding off the leading edge of the airfoil.

8 Drag a selection window around all the vertices in two center columns of vertices.

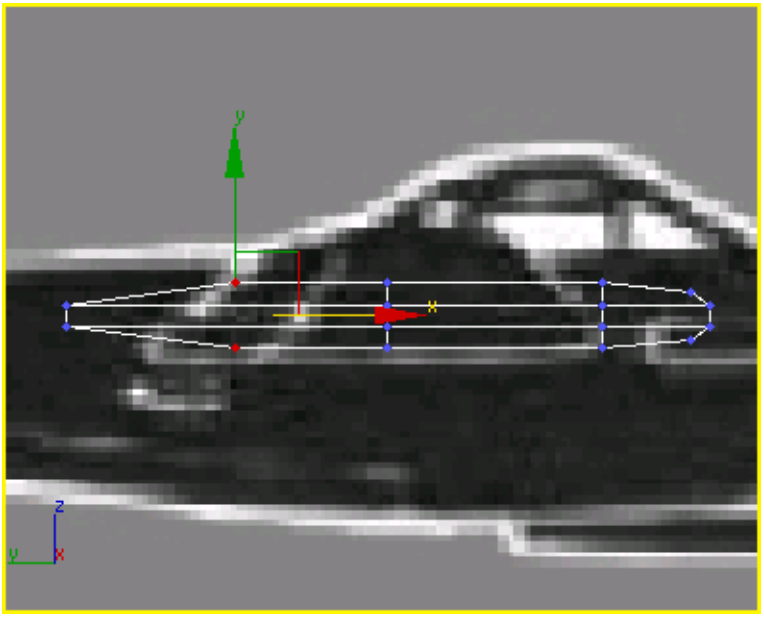


9  Move this set of vertices along the X axis to the right about 0.5m. Again, watch the coordinate readout at the bottom.



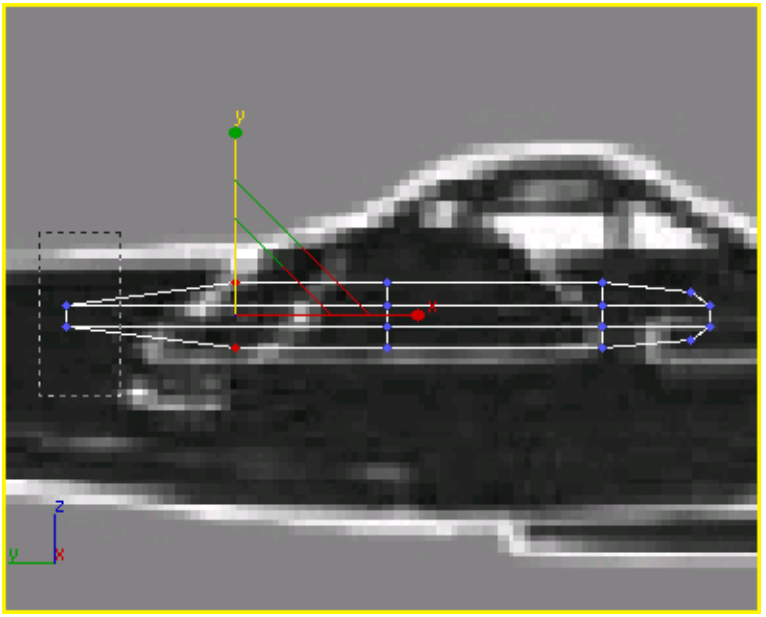
10 Drag another selection window around the vertices at the upper left corner. Then hold the Ctrl key and drag a selection window around the vertices at the lower left corner.

11  Move this set of vertices along the X axis to the right about 0.8m.

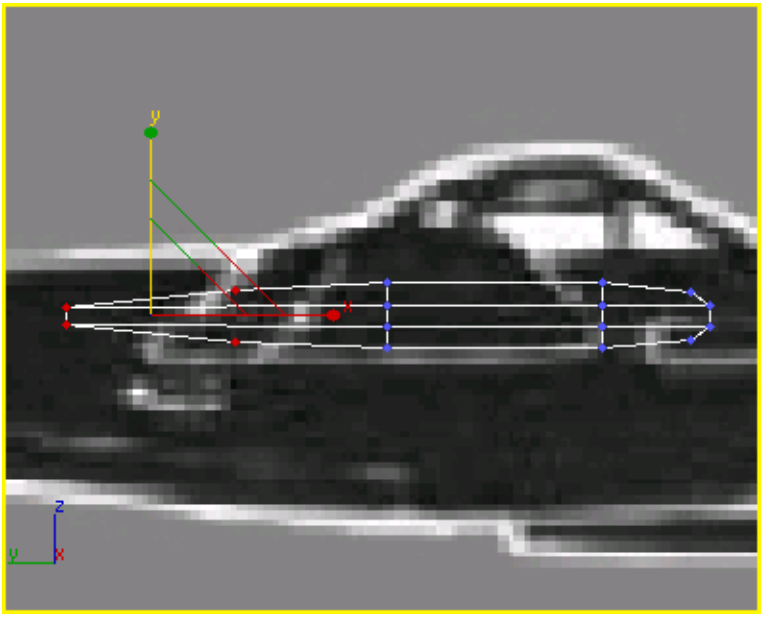


The airfoil is beginning to take shape.

12  Click Select And Non-Uniform Scale, hold down the Ctrl key and drag a selection window around all the left-most set of vertices.



13 Scale this selection set along the Y axis to 75%

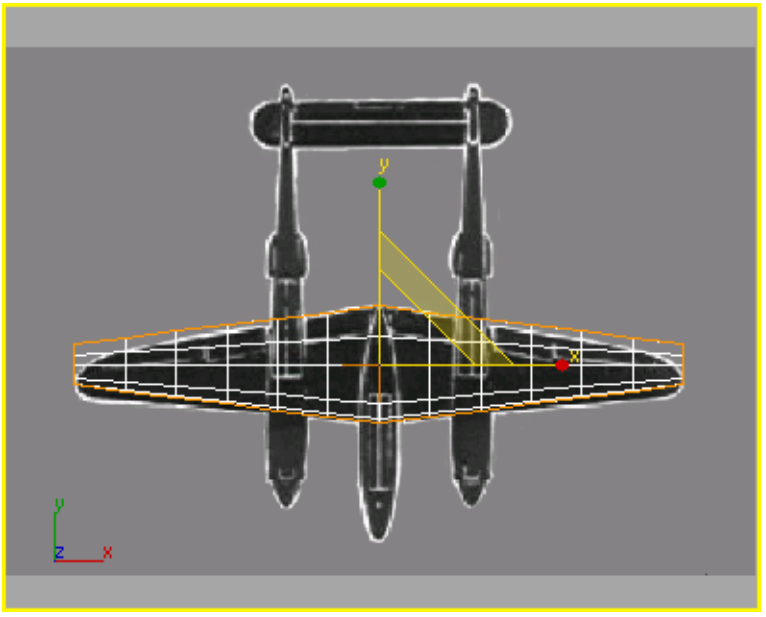


Now you've got a pretty good approximation of an airfoil.

Now that you have your airfoil, you'll make further changes to the shape of the wing using a Taper modifier.

Add a taper modifier:

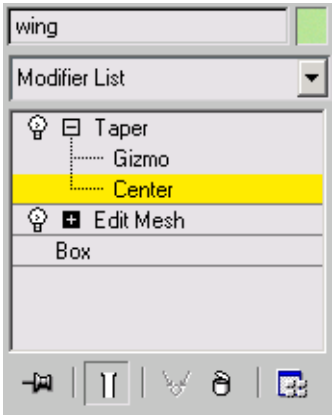
1.  Activate the Top viewport, and make sure to turn off Vertex mode.
2. From the menu bar, choose Modifiers > Parametric Deformers > Taper.
   An orange taper gizmo appears in the viewport over the box.
3. On the command panel, in the Taper Axis group, change the Primary value to **X**.
4. In the same group, turn on Symmetry.
5. Set the amount of the taper to **–1.3**.



The box is starting to resemble the P-38's wing shape.

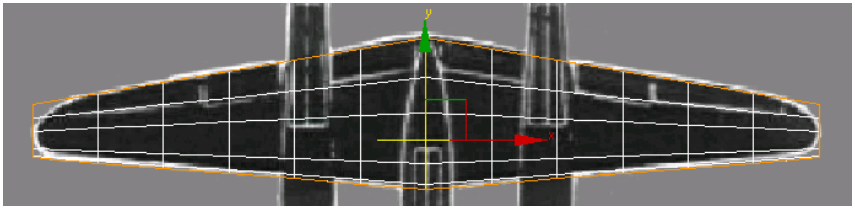
Next you'll move the Taper Center to refine the wing's shape.

6  In the modifier stack display, expand the Taper hierarchy by clicking the box marked with a plus sign. When the Taper expands, click Center.



At the Center sub-object level, you can adjust the location of the center of the Taper. Moving a modifier's center will alter its results.

7 In the Top viewport, move the center of the taper forward along the Y axis toward the nose of the plane, until the wings' shape more closely matches the background image.



8 When you've finished moving the center, click Taper in the modifier stack to turn off the Center sub-object selection.

9 The Taper has affected the height of the wings. In the modifier stack, click Box, then increase the wing height to **0.4318m**.

NOTE Because you're making a change that affects a topology-dependant modifier, Edit Mesh, you'll see a warning. Click Yes to make the height change. If you're not sure, click Hold/Yes. Hold/Yes creates something like a clipboard copy of the entire scene. If the change you make is undesirable, use Edit menu > Fetch to restore the scene to its state before you made the change.

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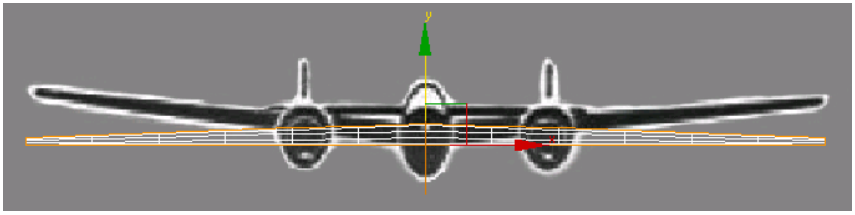
10  Activate the Front viewport and move the wing along the Y axis so it is centered over the background bitmap.



Move the wings up in the Front viewport.

Next you'll convert the box to an editable polygon object, and then move some vertices to round off the wing tips.

Convert the box:

1. Save your file as **myp38_wing.max**.

   TIP Get in the habit of saving your scene frequently at key points. Saving before converting the box is a good time, because the conversion removes the stack parameters. If, at a later time, you find that you have to make further adjustments to the Box geometry or Taper modifier, you can reload the saved model.

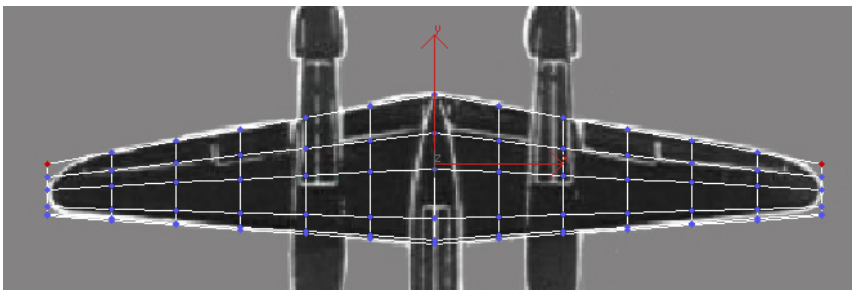
2. In any viewport, select the box, if it's not already selected.
3. Right-click and choose Convert to: > Convert to Editable Poly.

   The box is now an editable poly object.

Round off the wing tips:

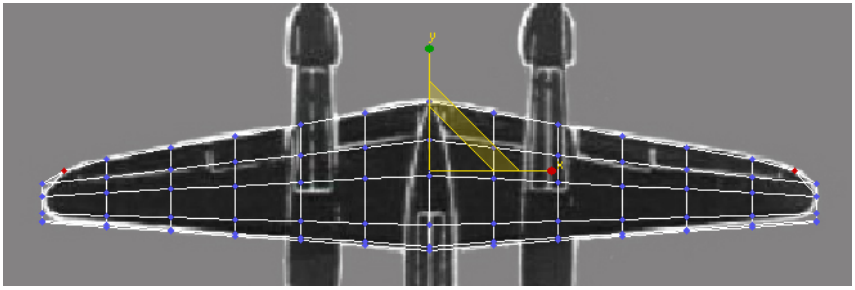
1.  On the Selection rollout on the command panel, click Vertex.

   Some vertices from previous operations are already selected.
2. In the Top viewport, draw a selection window to select the vertices in the upper-left corner of the wing. While holding down the Ctrl key, drag another selection window around the same set of vertices at the opposite wing tip.

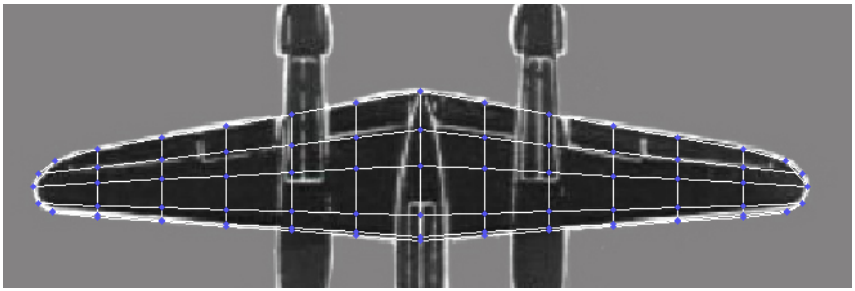
   Select the vertices at each end of the wing.

3.  On the main toolbar, click Select And Non-Uniform Scale. Then use the Transform gizmo to scale the vertices in the top view so the ends of the wing tips are rounded.



Scale the vertices to round off the wing tips.

4 Repeat the vertex selection and scaling until the wing tips are rounded.



The wing tips are rounded.

In the Top viewport you need to select all the vertices on the outside edges of the wings. You can accomplish this by using the selection rectangle with the Ctrl key.

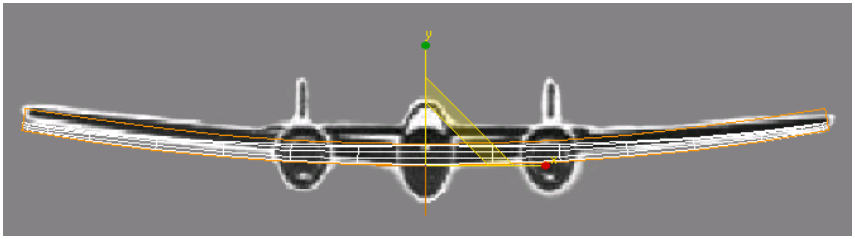
Add a Bend modifier:

1 In the Selection rollout, click Vertex to turn it off.

2 Click the arrow to the right of the Modifier List. In the drop-down list, find the Object-Space Modifiers group, and choose Bend.

3 Set the Bend Axis to **X**.

4 Change the Bend Angle to **–20**.



Bend the wings up.

5 Just for fun, spin the Direction spinner. Watch the wings stroke in the air. Right-click or press Ctrl+Z to undo when you're done having fun.

6 Save your work as **myp38_wing2.max**.

Next, you'll add the stabilizers and rudders. These are easy to do.

Adding the Stabilizer and Rudders

Continue from the previous lesson, Creating the Wings on page 136 or open *p38_wing.max* from the *\modeling\p38_lightning* folder.

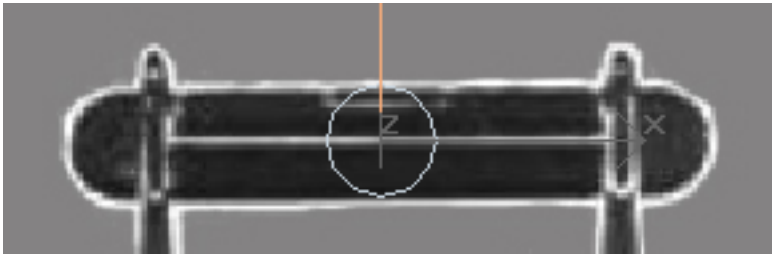
In this lesson, you'll add the horizontal stabilizer and the twin rudders. You'll use cylinders and editable poly techniques to build these pieces.

Add the horizontal stabilizer:

1 Click the Top viewport to activate it.

2  From the Create panel, click Cylinder.

3 In the Top viewport, drag out the radius of the cylinder in the center of the horizontal stabilizer. When you release the mouse button, you then drag to set the height of the cylinder. Moving the mouse upward gives a positive height; moving it downward gives a negative height. Give it a positive height.



Create a cylinder to make the stabilizer.

4 Edit the Parameters, as follows:

- Radius=**0.66m**
- Height=**0.051m**
- Height Segments=**1**
- Sides=**14**

5 In the Name And Color rollout, type **stabilizer**.

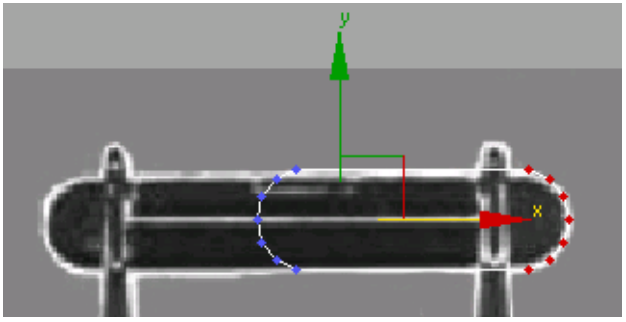
Naming your objects proves useful later.

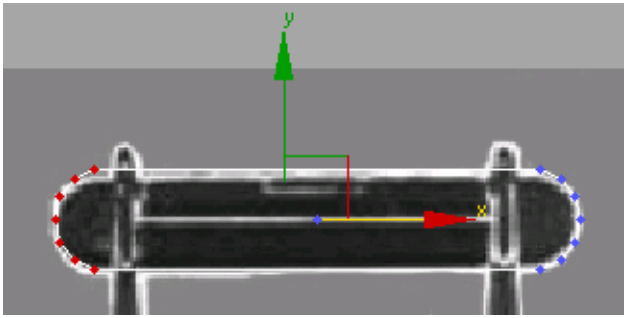
6 Right-click the cylinder and choose Convert to: > Convert to Editable Poly.

7  In the Modify panel, on the Selection rollout, click Vertex.

Now the vertices are visible in the cylinder.

8  Select half the vertices, and move them to the right. Select the other half of the vertices and move them to the left.

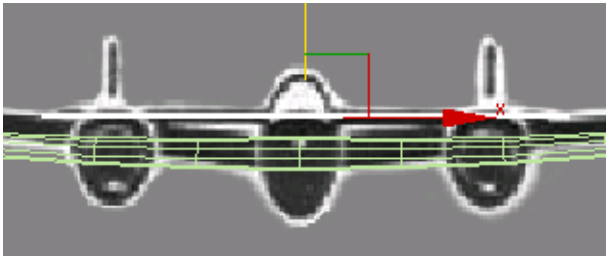




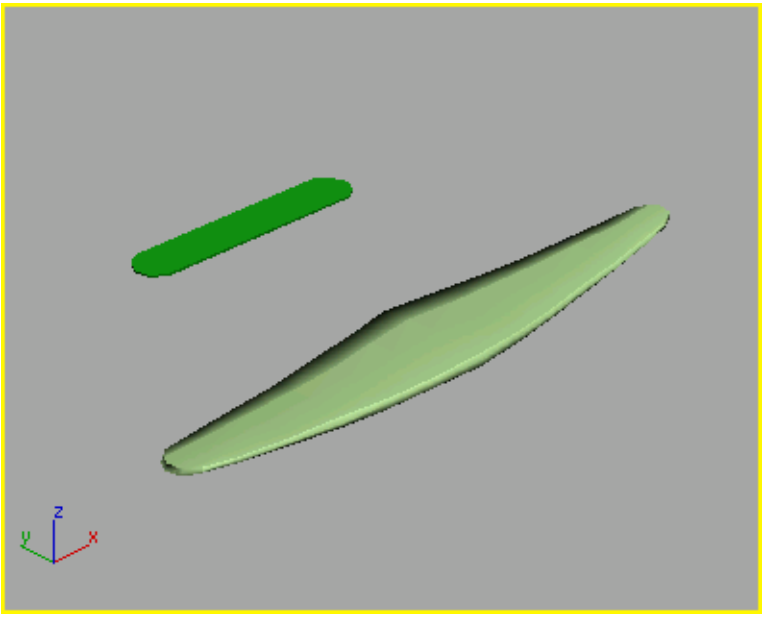
Move the vertices to match the top view of the stabilizer in the background image.

9  Click Vertex selection again to turn it off.

10  In the Front viewport, move the stabilizer up along the Y axis so it lines up with the background image.



Align the stabilizer with the background image.



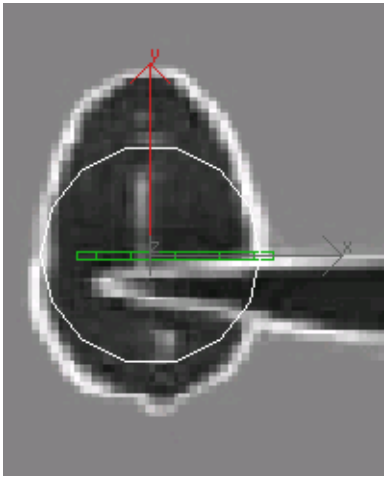
Wingspan and stabilizer in Perspective viewport

Next, you will construct the twin rudders.

Just like the stabilizer, you'll use a cylinder, converted to an editable poly object, to create one of the rudders. In this case, you'll use the soft-selection feature when you select and move vertices. After the rudder is properly shaped, you'll use the Symmetry modifier to create the second rudder.

Create the twin rudders:

1.  Click the Left viewport to active it and click Zoom Extents if necessary.
2.  On the Create panel, turn on Cylinder.
3. In the Left viewport, draw a cylinder over the rudder.



Start with a cylinder to make the rudder.

4 Set the following parameters:

- Radius=**0.72m**
- Height=**0.051m**
- Height Segments=**1**
- Sides=**15**

5 On the Name And Color rollout, enter the name **rudder**.

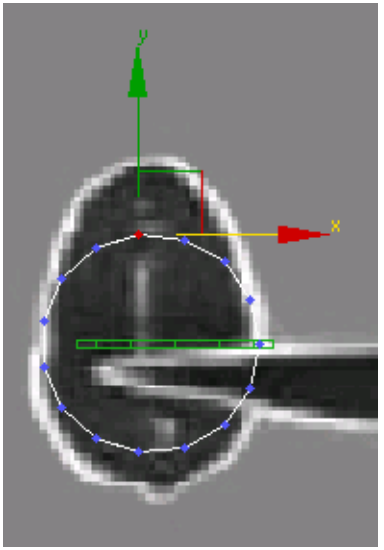
6  Click the Modify panel tab, and then right-click the Cylinder in the modifier stack. Choose Convert To: Editable Poly.

The modifier stack no longer shows the cylinder; it now shows Editable Poly instead.

7  In the Selection rollout, click Vertex.

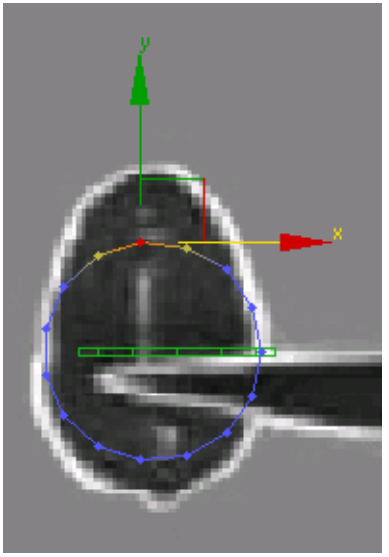
8 In the Left viewport, drag a selection window around the top vertices.

Remember that there are vertices at the top and bottom of the cylinder, so even though a single red dot appears in the viewport, you are actually selecting two vertices.



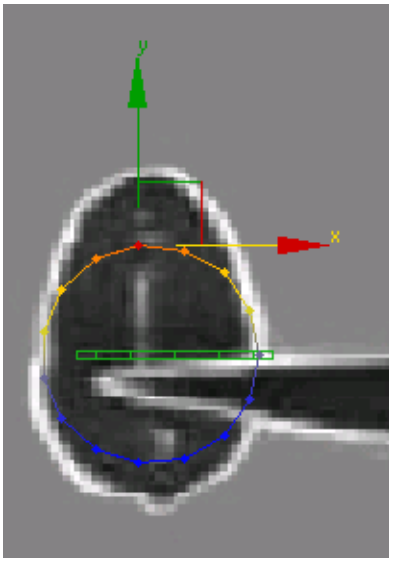
Select the top vertex.

9 Open the Soft Selection rollout, and turn on Use Soft Selection. Now the red dot is flanked by yellow-green dots.

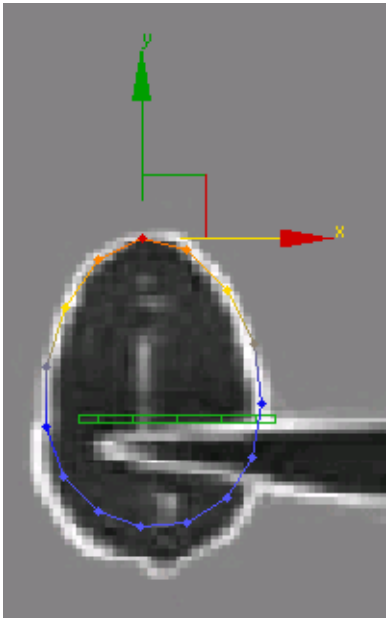


Soft Selection display

10 In the Soft Selection rollout, increase the Falloff value to **1.524m**.
The selection expands in the viewport.

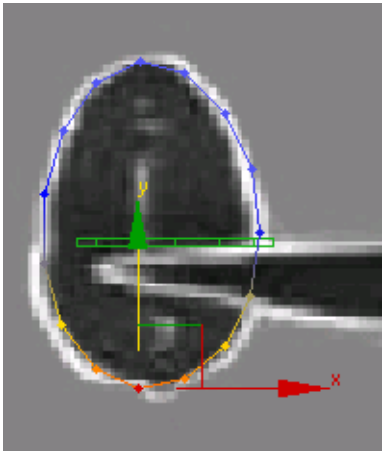


11 Using the Transform gizmo, move the selection upward to shape the rudder.



The rudder begins taking shape.

12 Select the bottommost vertex, and move it down to finish the shape.



The rudder is fully shaped.

13 In the modifier stack, click Editable Poly to turn off sub-object selection.

14 In the Top viewport, select and move the rudder to the left into position.

Use Symmetry to create the second rudder:

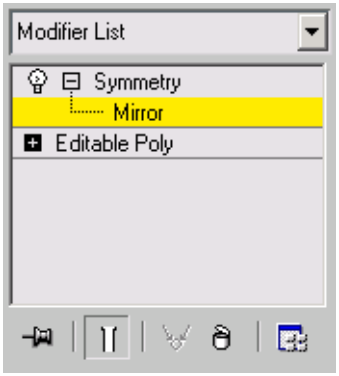
There are several ways that you could create the second rudder but you'll use the Symmetry modifier for this part of the lesson.

1  Make sure the *rudder* object is selected and open the Modify panel.

2 Open the Modifier List and select Symmetry.

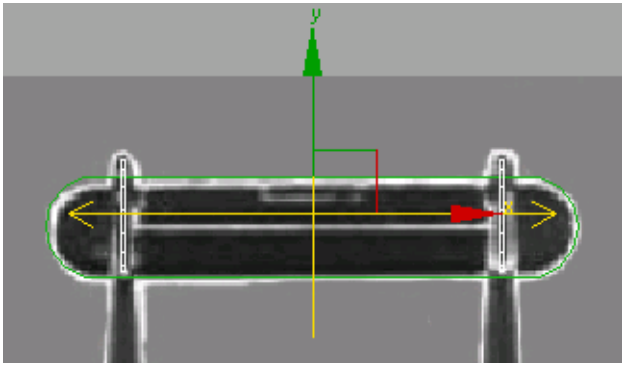
3 In the Parameters rollout, change the Mirror Axis to **Z**.

4  In the modifier stack display, expand the Symmetry hierarchy by clicking the box marked with a plus sign. When Symmetry expands, click Mirror.



At the Mirror sub-object level, you can adjust the location of the mirror axis.

5 In the Top viewport, drag the Mirror gizmo to the center of the stabilizer. When the new rudder lines up with the background image, release the mouse button.

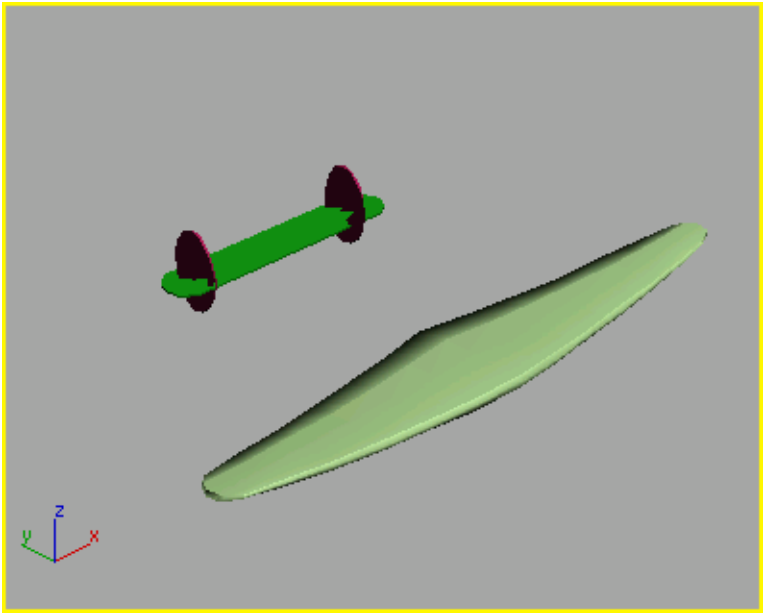


The new rudder

6 Click Mirror again to turn it off.

7 Rename the object **rudders**.

The Symmetry modifier adds geometry to an existing object. It does not make a clone of the original so both rudders are treated as a single object.



The completed tail section and wings.

8 Save your work as **myp38_wing_and_tail.max**.

In the next lesson, Creating the Sponsons on page 163, you'll create the sponsons that support the tail section and house the engines.

(Optional) Separate the rudders:

It's not really necessary, but if you want to separate the rudders, you can do so by adding an Edit Mesh modifier.

1 Open the Modifier List and apply an Edit Mesh modifier to the rudders.

2  From the Selection rollout, choose Element.

3 In the Top viewport, select the right-hand rudder.

4 From the Edit Geometry rollout, click Detach.

The Detach dialog appears.

5 In the Detach As field, enter the name **starboard rudder** and click OK.

6 Turn off the Element button and rename the selected object as **port rudder**.

Creating the Sponsons

The P-38 was a rugged aircraft because it had twin sponsons that supported the tail, housed the engines and superchargers and contained self-sealing fuel tanks. The airplane could sustain damage to either side, and still fly, thus presenting a formidable challenge to any opponent in a dogfight.

In this lesson, you'll model the sponsons using the same techniques you've already practiced on the wing and tail section. You'll also use the Bevel tools to create the engine exhaust gates.

Create the starboard sponson:

1 Continue from the previous lesson, Adding the Stabilizer and Rudders on page 153 or open *p38_wing_and_tail.max* from the *\modeling\p38_lightning* folder.

2  On the Create panel, click Cylinder.

The Cylinder button turns gold, showing it is active and ready to use.

3 In the Front viewport, drag a cylinder out over the left sponson so the radius approximates that in the background image.

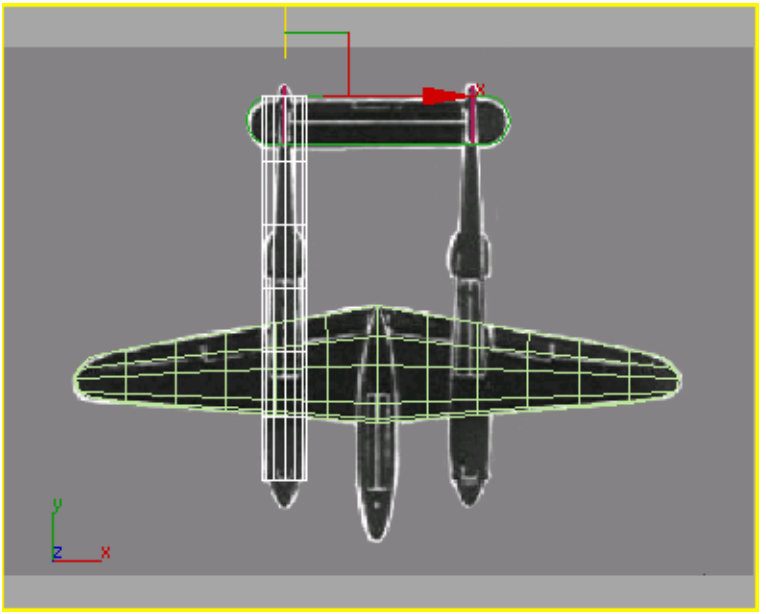
Don't worry about the height, you'll adjust that in a moment. Drag the height to any value.

4 Edit the Cylinder parameters, as follows:

- Radius=**0.558m**
- Height=**10.0m**
- Height Segments=**6**
- Cap Segments=**1**
- Sides=**12**

5 On the Name and Color rollout, change the name of the object to **starboard sponson**.

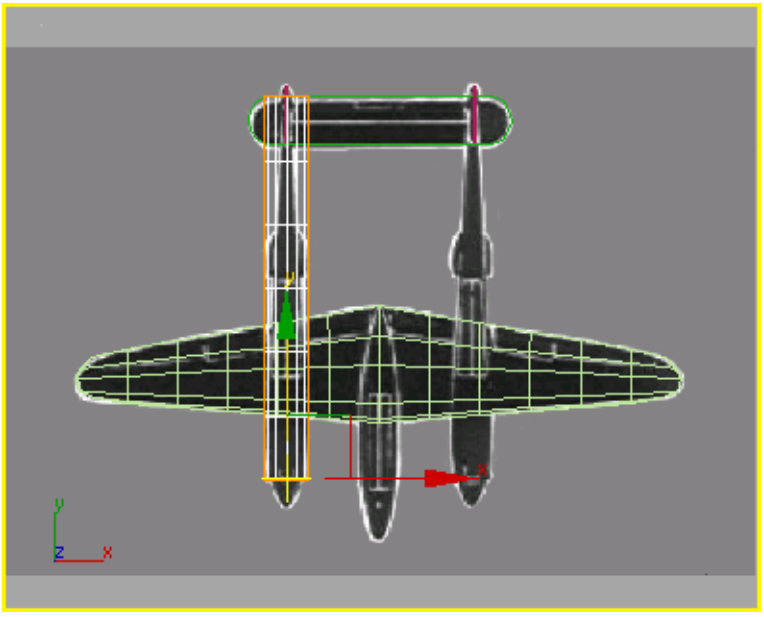
6  In the Top viewport, move the cylinder so it is over the sponson on left side of the background image (this is actually the right side of the plane, hence "starboard"). Position it so the rounded cap at the end, called the propeller spinner, is visible.



7  Go to the Modify panel. From the Modifier List, find the Object-Space Modifiers group, and choose Taper.

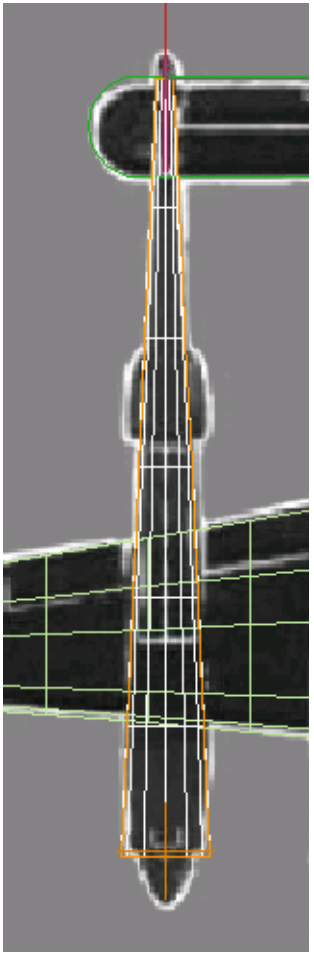
8 In the modifier stack, expand the Taper hierarchy so the Center and Gizmo are visible, then click the Center to select it.

9 In the Top viewport, move the center so it is at the front of the cylinder.



10 In the stack, click Taper to turn off sub-object selection.

11 Now adjust the taper Amount to **0.8**.



Tapered sponson aligned with the background image.

(The front of the sponson is just behind the propeller spinner.)

12  In the Front viewport, rotate the sponson about 15 degrees about its Y axis so the left and right sides are vertical.

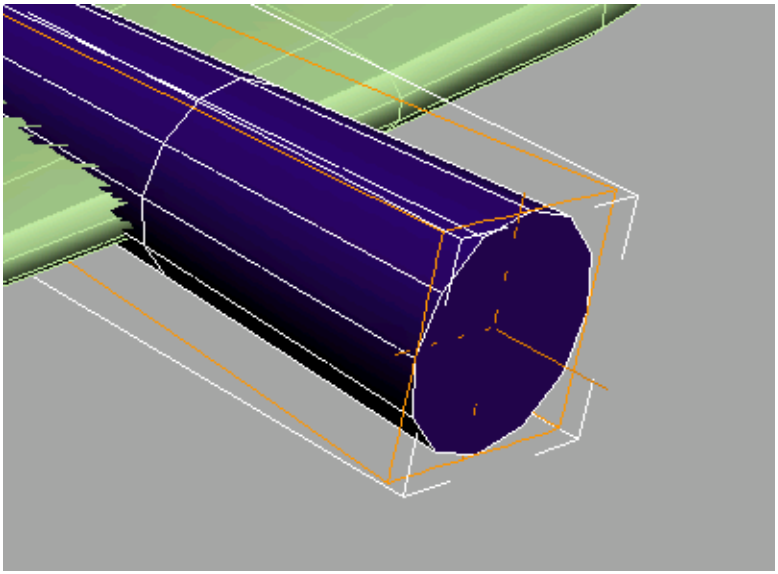
TIP Alternatively, for greater precision you could enter **15** into the Y-coordinate field at the bottom.

Later in this lesson, you'll further shape the sponson by repeating the same technique as before: converting to Editable Poly, selecting rows of vertices, and moving them into position over the background image.

But first you'll create the propeller cap, or "spinner," at the forward end of the cylinder using a hemisphere and AutoGrid.

Add the propeller spinner:

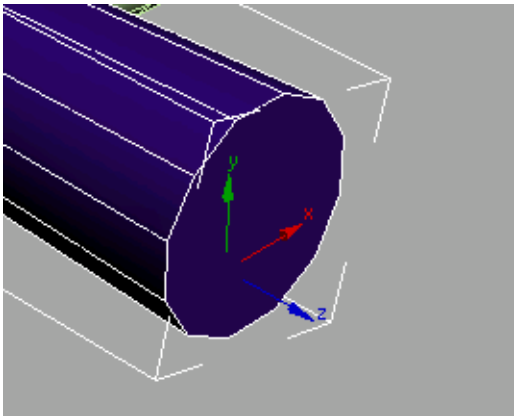
1  Zoom into the Perspective viewport so you have a close view of the front end of the cylinder. Click the viewport label, and set the shading mode to Smooth + Highlights and Edged Faces.



2  Open the Create panel. In the Object Type rollout, click to turn on Sphere.

3 Turn on AutoGrid, the check box below Object Type. Now move your cursor over the surface of the end of the cylinder.

An axis tripod follows your cursor, showing you where the sphere will be drawn.



4 In the Parameters rollout, turn on Base To Pivot.

This lets you draw a sphere off the end of the cylinder.

5 Move your cursor over the end of the cylinder, and draw a sphere.

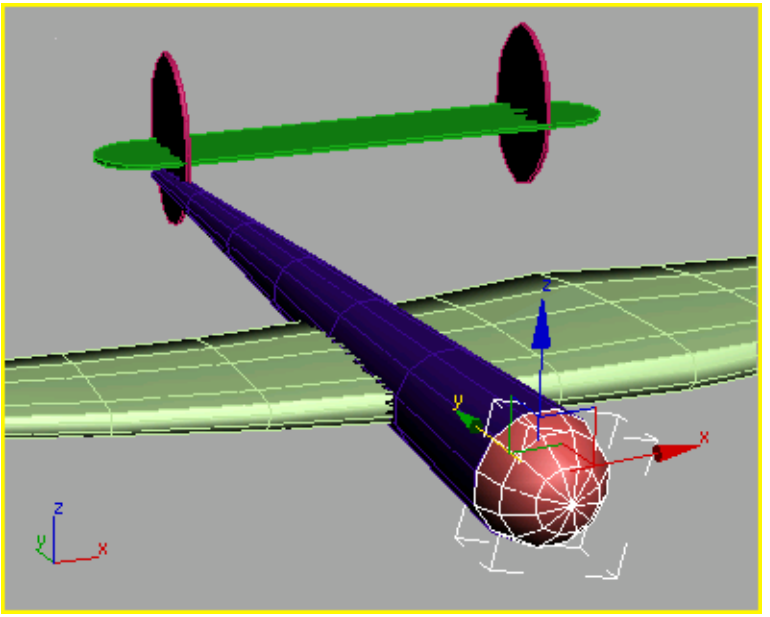
It doesn't matter what size; you will adjust the parameters after you draw it.

6 Edit the Parameters, as follows:

- Radius=**0.558m**
- Segments=**12**
- Hemisphere=**0.5**
  Now instead of a sphere, there is a hemisphere.

7  Rotate the hemisphere so the 12 segments of the cylinder and the hemisphere are at the same angle. Fifteen degrees about the Y axis.

8  On the main toolbar, click the Align button, then click the cylinder. In the Align Position (World) group, turn on X Position and Z Position. This properly aligns the hemisphere and the cylinder. Click OK



The spinner is aligned to the end of the sponson.

9 Rename this object **starboard spinner**.

10 Save your scene as **myp38_sponson.max**.

You'll be converting the sponson cylinder to an editable poly so it's a good time to save your scene.

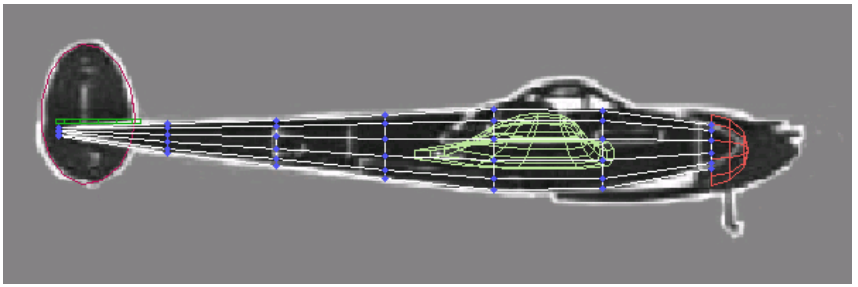
Finish shaping the sponson:

1 Select the sponson cylinder object and right-click. Choose Convert To: > Convert To Editable Poly from the quad menu.

2  In the Selection rollout, click Vertex.

3  In the Left viewport, select a column of vertices and then on the main toolbar, choose Non-Uniform Scale from the scale flyout. Non-uniform scale them closer together, watching the bitmap as a guide. Then right-click, choose Move from the quad menu, and position the row.

4 Repeat this process for all seven columns of vertices in the Left viewport, so the outline of the sponson matches the background more closely.



Select one column at a time, scale, then move.

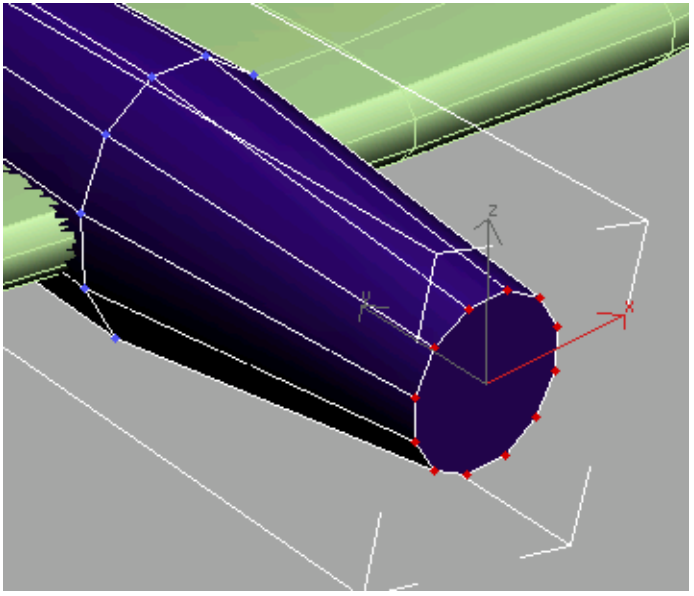
5  Click the Vertex selection button to turn it off, then select the spinner hemisphere in the viewport.

6 Move the propeller spinner away so you can see the end of the sponson in the Perspective viewport.

7  Select the cylinder again and turn on Vertex selection.

8 Select the vertices in the forward end of the cylinder and non-uniform scale them about the X axis only. Use the Transform gizmo X arrowhead, and watch the coordinate display in the status bar. Scale down to **60** percent along the X axis.

This returns the end of the cylinder to a more circular shape.



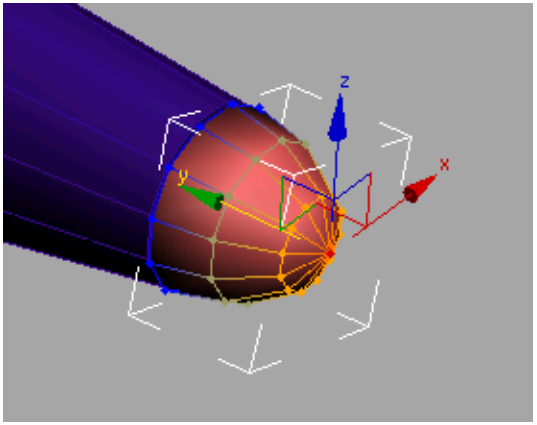
9 Turn off sub-object selection by clicking Vertex again in the Selection rollout, then move the hemisphere back into place. Change its radius so it fits over the end of the sponson again.

Finish the propeller spinner:

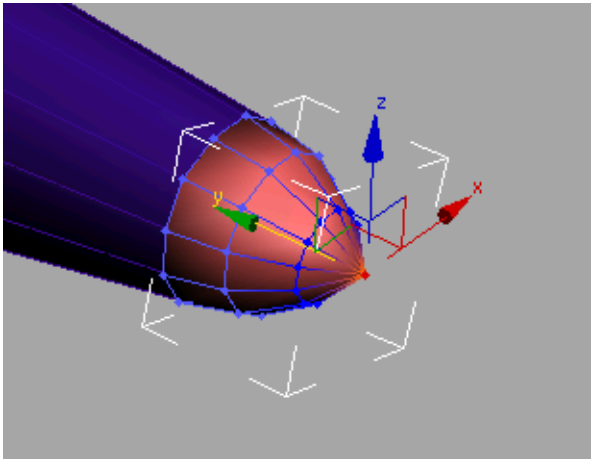
1 Collapse the hemisphere to an editable poly by right-clicking, and choosing Convert to: Convert to Editable Poly.

2 In the Perspective viewport, select the vertex in the center of the hemisphere.

3 In the Soft Selection rollout, turn on Use Soft Selection and adjust the Falloff so the second ring of vertices turns yellow, but the last rows do not. Move the selection forward along the Y axis.



4 Lower the soft selection so only the vertex at the tip is selected, and move the tip forward to form the bullet shape.



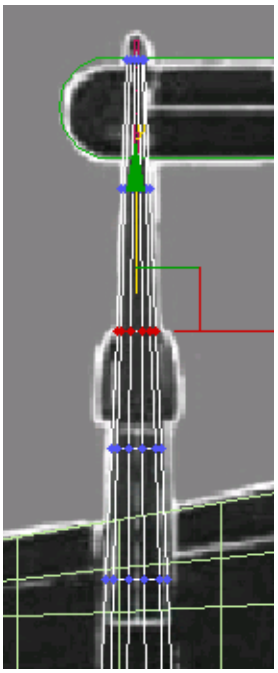
5  Click the Vertex selection button to turn it off.

The sponson is almost finished. There is a blister on either side of the sponson that serves as the exhaust waste gate outlet. You'll create this next, using the Bevel features.

6 Save your scene as **myp38_sponson2.max**.

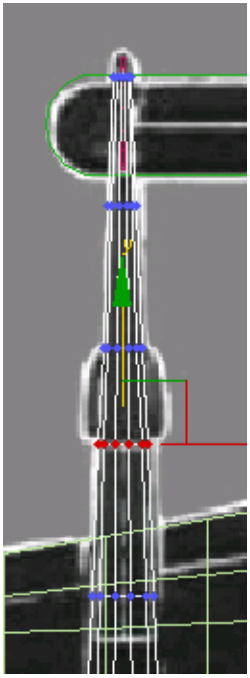
Create the exhaust gate outlet:

1. Select the sponson.
2.  Turn on Vertex selection for the sponson.
3. In the Top viewport, select the third row of vertices from the top and move them down so they are at the end of the exhaust gate.



Select and move these red vertices down.

4. Select the fourth row and move them up, so they are positioned at the start of the exhaust gate.



Select and move these red vertices up.

The vertices now line up in the top view, but need adjustment in the left view.

5 In the Left viewport, scale the selected vertices smaller along the Y axis, as necessary against the profile of the background image.

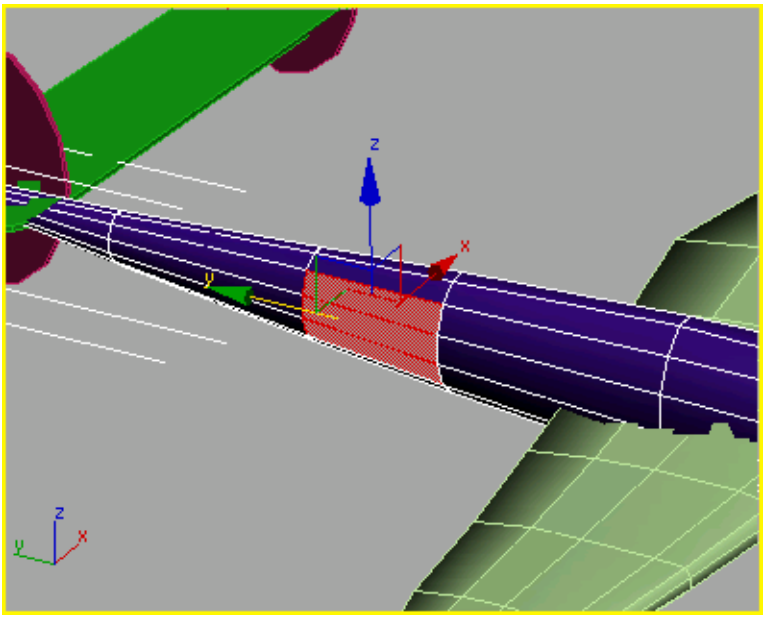
6  On the Selection rollout, choose Polygon.

This lets you select polygons instead of vertices.

7  Make sure the Select Object button is turned on. In the Left viewport, drag a selection window over the polygons shown in the illustration below.

The selected polygon displays in red. If you don't see a fully shaded polygon, only surrounding edges, click the plus (+) sign next to the Left

viewport label and choose Configure. In the Rendering Options group, turn on Shade Selected Faces.



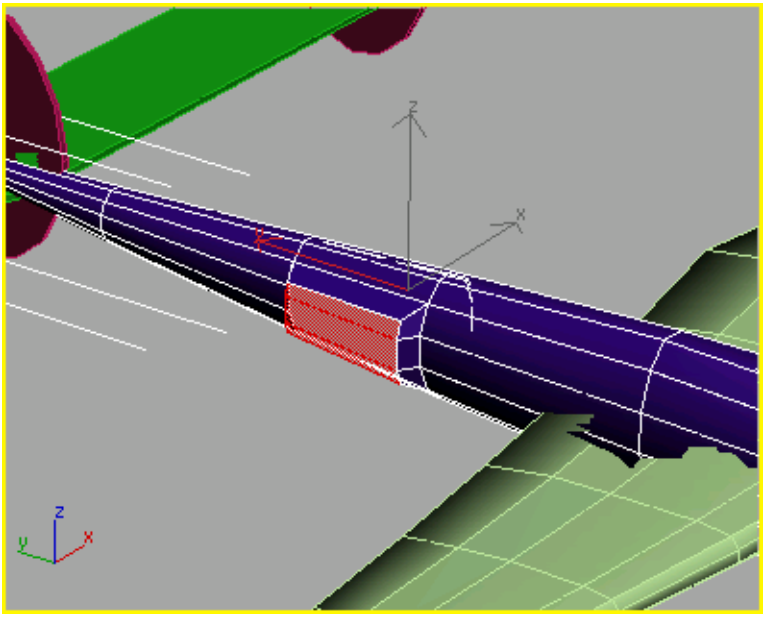
Dragging the selection window over these three polygons in the Left viewport also selects the three polygons on the opposite side of the sponson.

NOTE It's important to have Select Object active here. If Select And Move were active instead, after making the first corner of your selection window you'd start dragging the polygon around, giving you undesired results.

---

8  On the Edit Polygons rollout, click the Bevel Settings button to open the Bevel Polygons dialog.

9 Set the Height setting to **0.152m**. Set the Outline Amount to **-0.095m**. Click OK.

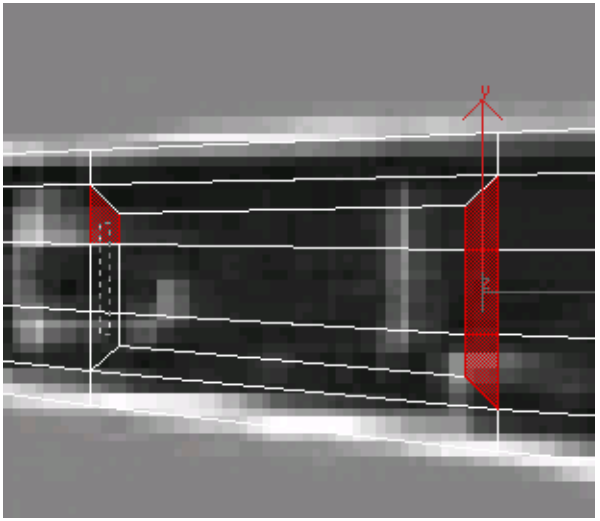


10  Region Zoom around the exhaust gate in the Left viewport.

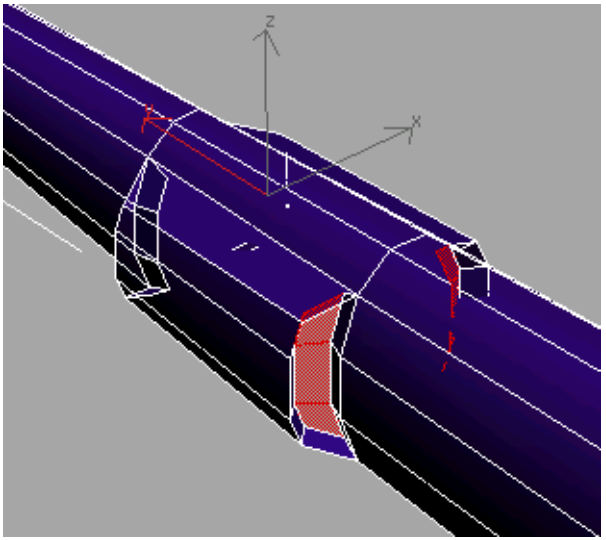
Because you have Lock Zoom/Pan turned on for the background image, you might see a dialog warning that some amount of memory is necessary to redisplay the background. Click Yes.

11 Once again, use a selection window to select the newly created polygons at the front of the exhaust gate, and then hold down the Ctrl key and drag another selection window across the polygons at the rear.

This will also select the polygons on the opposite side of the sponson.



12  Click the Bevel Settings button and set the Height to **-0.1m** and the Outline Amount to **-0.025m**. Click OK.



13 In the modifier stack, click Editable Poly to exit the sub-object level.

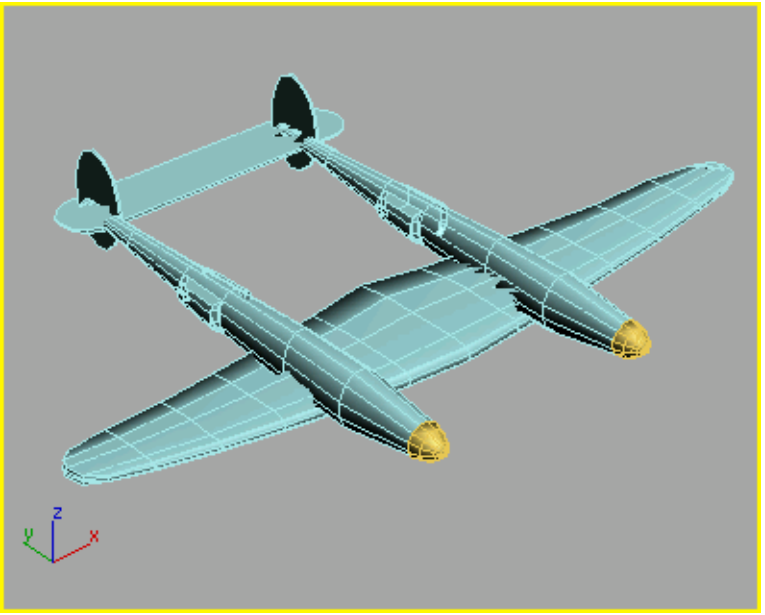
14 Save your scene as **myp38_sponson3.max**.

Next, you'll clone the starboard sponson and spinner to make the port sponson and spinner.

Clone the sponson:

1. Select the sponson, if it isn't selected already.
2. Hold down the Ctrl key and click the propeller spinner.
   Now both objects are selected.
3.  In the Top viewport, hold down the Shift key and move the selected objects to the right.
   The Clone Options dialog appears.
4. Name the clone **port sponson** and click OK.
5. Select the new propeller spinner on the port side and rename it to **port spinner**.

TIP Feel free to change the colors of all the objects so the plane looks more realistic.



The P-38's wing, sponsons, and tail

6 Save your work as **myp38_nogondola.max**.

All that remains is the central gondola and canopy detail.

Creating the Gondola

The plane is starting to look like a P-38, but it's missing the central gondola, the pilot cockpit. You will create the gondola using the same techniques you learned when you shaped the sponson. To ensure that the gondola is symmetrical, you'll use the Symmetry modifier.

Load a start file:

- Continue from the previous lesson, Creating the Sponsons on page 163, or load *p38_build_gondola.max* found in the *\modeling\p38_lightning* folder.

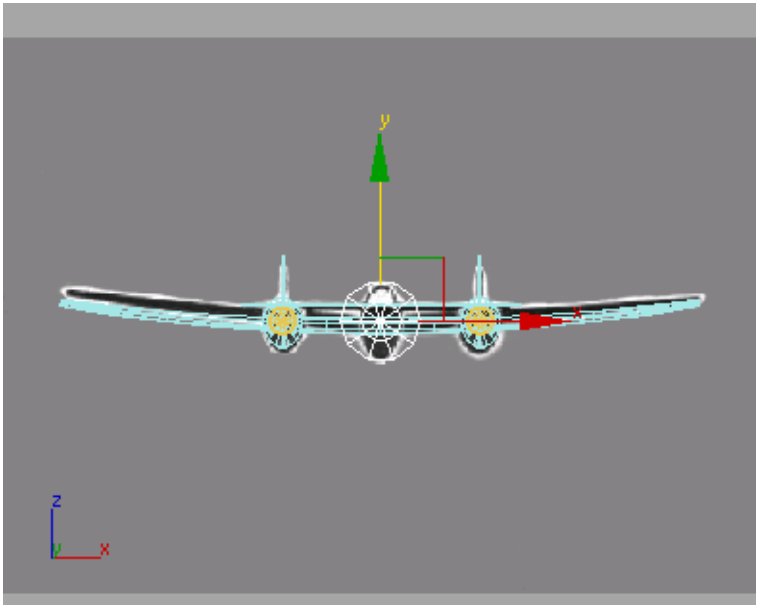
Create the gondola:

1  Go to the Create panel, and on the Object Type rollout, click to turn on Cylinder.

If you're continuing from the previous lesson, make sure AutoGrid is turned off.

2 In the Front viewport, drag out a cylinder over the gondola, until the radius approximately matches the height of the gondola in the background image.

Watch in the Top viewport as you drag the height of the cylinder, since the Front viewport will not show any difference.

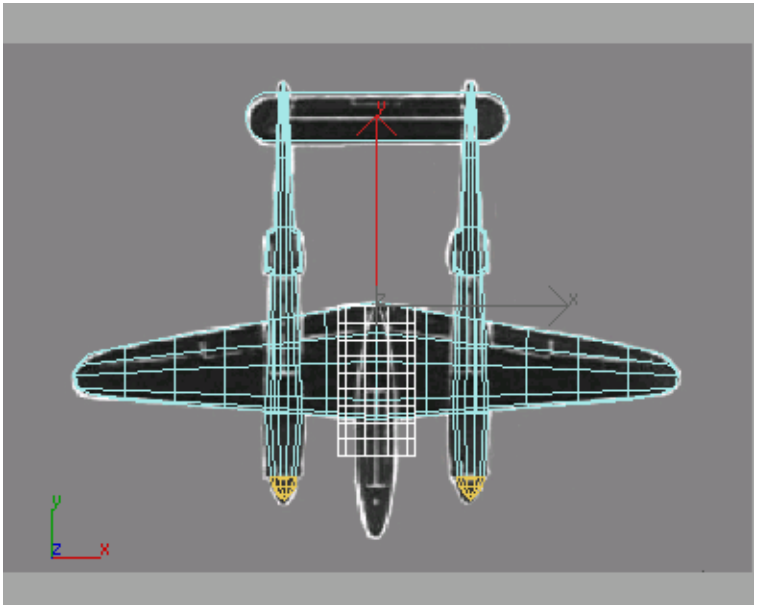


3 Edit the cylinder's parameters, as follows:

- Height Segments=**9**
- Cap Segments=**2**
- Sides=**10**

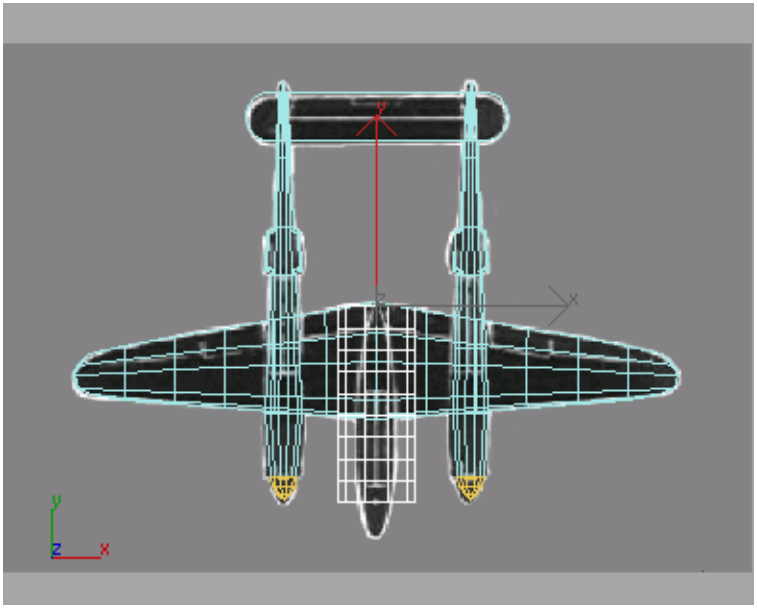
4 In the Name And Color rollout, name the object **gondola**.

5  If necessary, move the gondola object in the Top viewport so the top lines up with the trailing edge of the wing.



Line up the cylinder with the trailing edge of the wing.

6  On the Modify panel, adjust the height of the cylinder so it is even with the end of the sponsons, as illustrated below.



Start with a cylinder.

Shape the gondola:

1  Go to the Display panel, and hide everything but the gondola by clicking Hide Unselected in the Hide rollout.

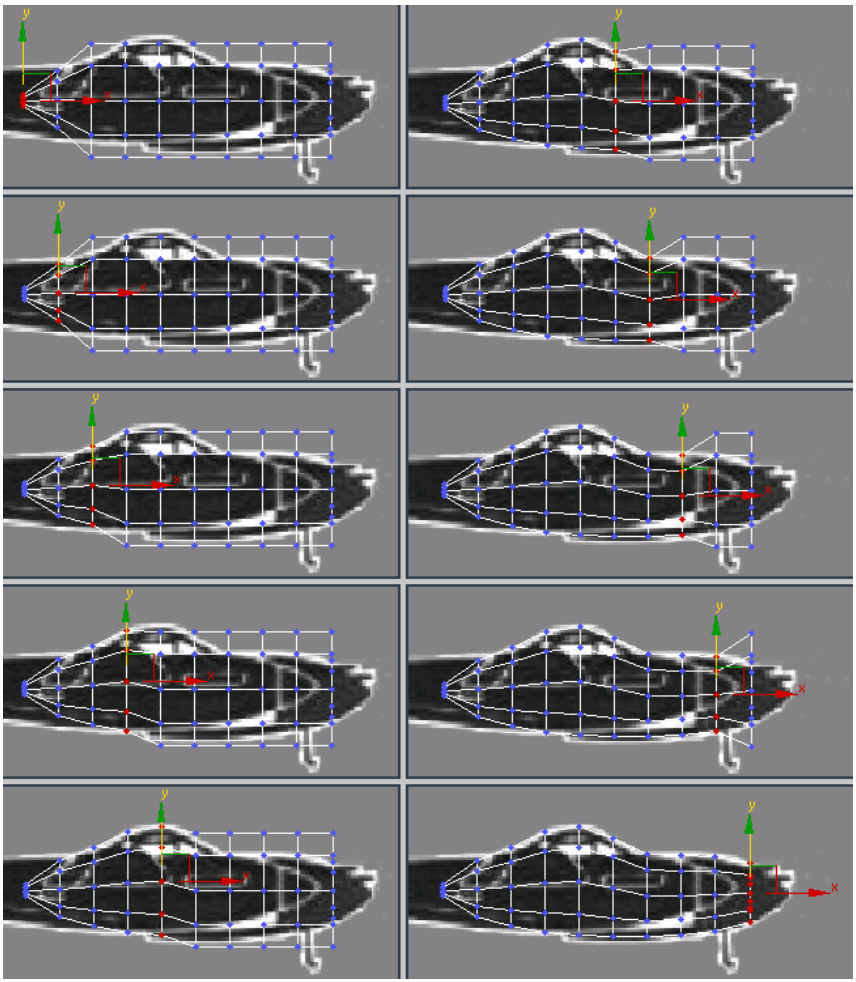
2  Go to the Modify panel. In the modifier stack, right-click Cylinder and choose Convert To: Editable Poly.

Now you can reposition the vertices over the background images.

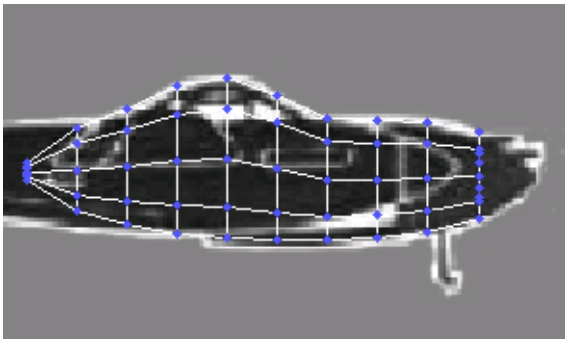
3  On the Selection rollout, click Vertex.

4 Starting at the rear of the gondola, in the Left viewport and do the following:

- Select the leftmost column of vertices.
- On the main toolbar, choose Non-Uniform Scale from the Scale flyout.
- Scale them to the approximate size to match the background image.
- Move them down to match the background image as well. Alternate between scaling and moving as you work your way forward.



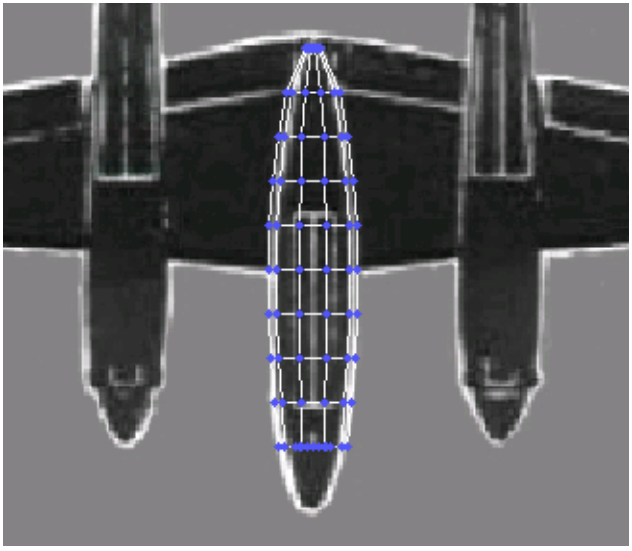
Scale and move the vertices to match the background.



Placement of vertices from Left viewport.

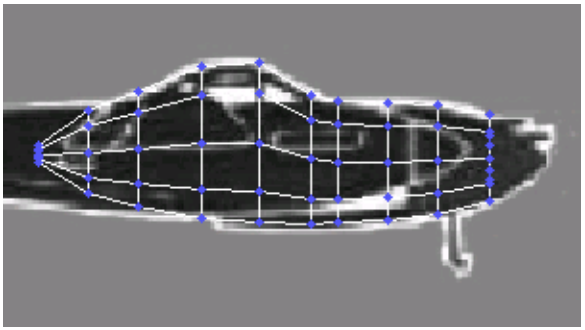
5 With all that work done, save your scene as **myp38_gondola.max**.

6 Activate the Top viewport and repeat the previous process. Select one row of vertices at a time and position them over the background image using Scale and Move tools. Using the Transform gizmo, scale each row only along the X axis.



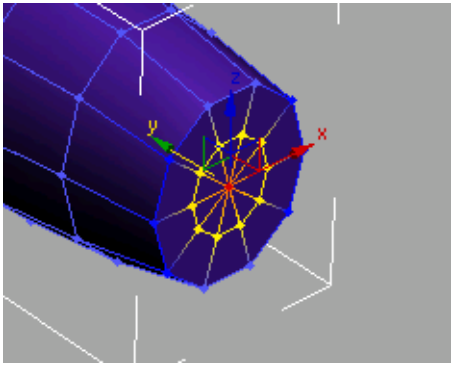
Vertex scaling and placement from the Top viewport.

7 In preparation of building the canopy, move and scale columns of vertices to match the outline of the cockpit in the Left viewport.

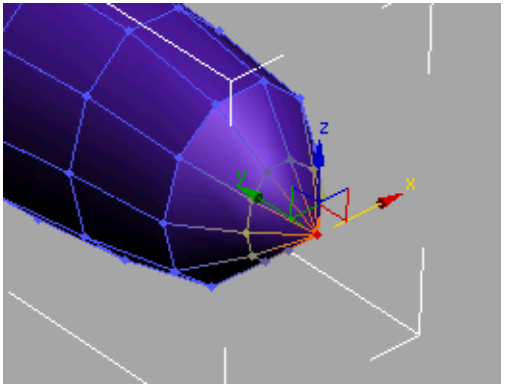


The 4th, 5th and 6th columns of vertices are moved and scaled.

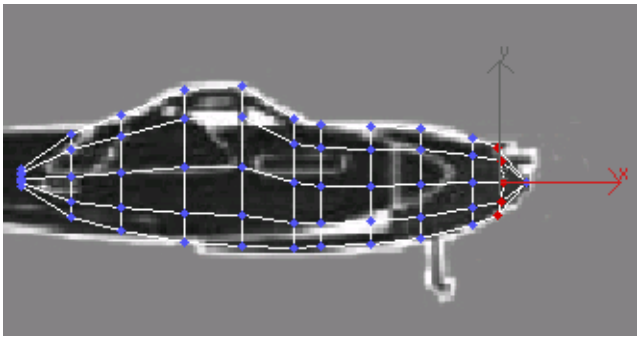
8 Activate the Perspective viewport and start creating the nose by selecting the single vertex at the center of the cylinder cap. Then turn on Soft Selection and adjust the Falloff so the next ring of vertices turns yellow.



9 While watching the Left and Top viewports, move the soft selection forward to form the nose. Turn off Soft Selection, and move the single end vertex to create the point.



10 The nose might be a little too pointy, so from the Left and Top viewports, scale an move the second column of vertices to round the nose.

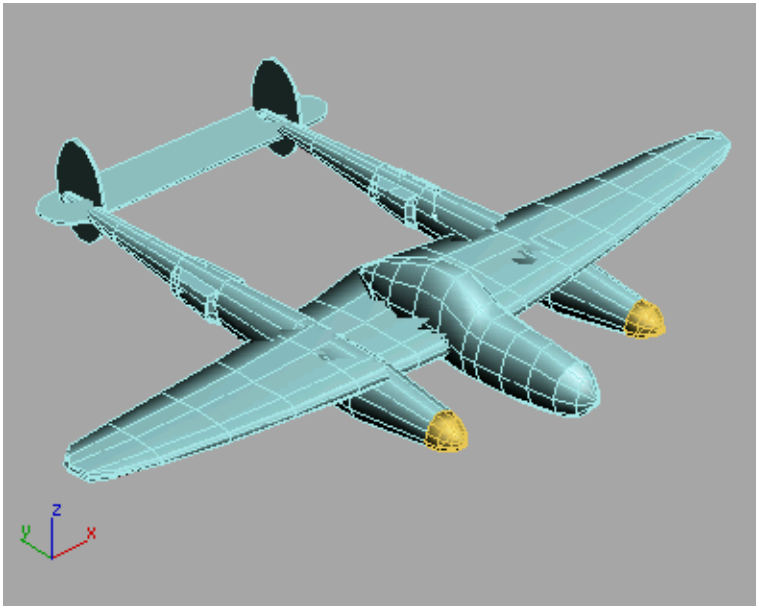


11  To unhide the rest of the airplane, on the Display panel, choose Unhide By Name. Select all the components you have created (everything except the calibration box).

12 Change the color of the gondola to match the rest of the plane.

13 Make adjustments as needed. Select the row of vertices at the rear of the gondola and move them along the Z axis in the Perspective viewport, so the rear taper is hidden in the wing.

You might also have to select the gondola and wing and move them up.



P-38 with gondola

14 Save your scene as **myp38_gondola2.max**.

You can create the canopy using a couple of editable poly tools. You'll cut and chamfer to create this detail of the cockpit.

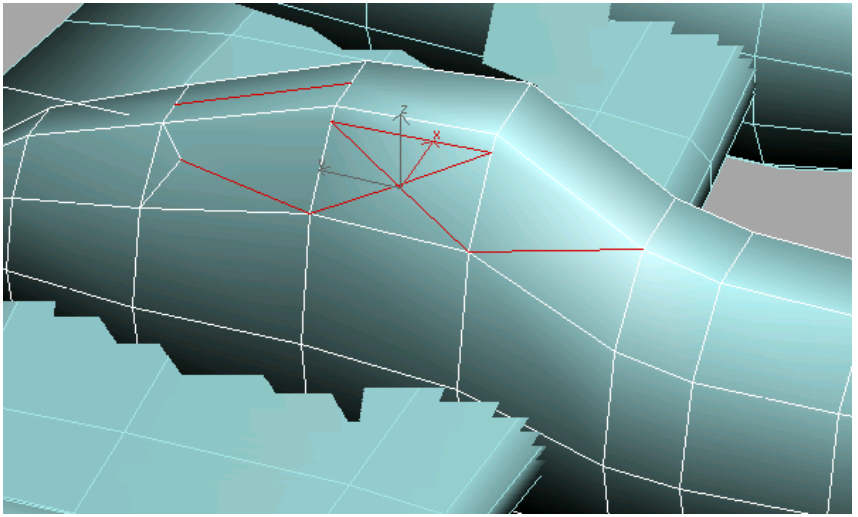
Add the canopy:

1 In the Perspective viewport, select the gondola, if it's not already selected, and zoom in so you can see a close view of the cockpit area.

2  On the Selection rollout, click Edge, then turn on Ignore Backfacing.

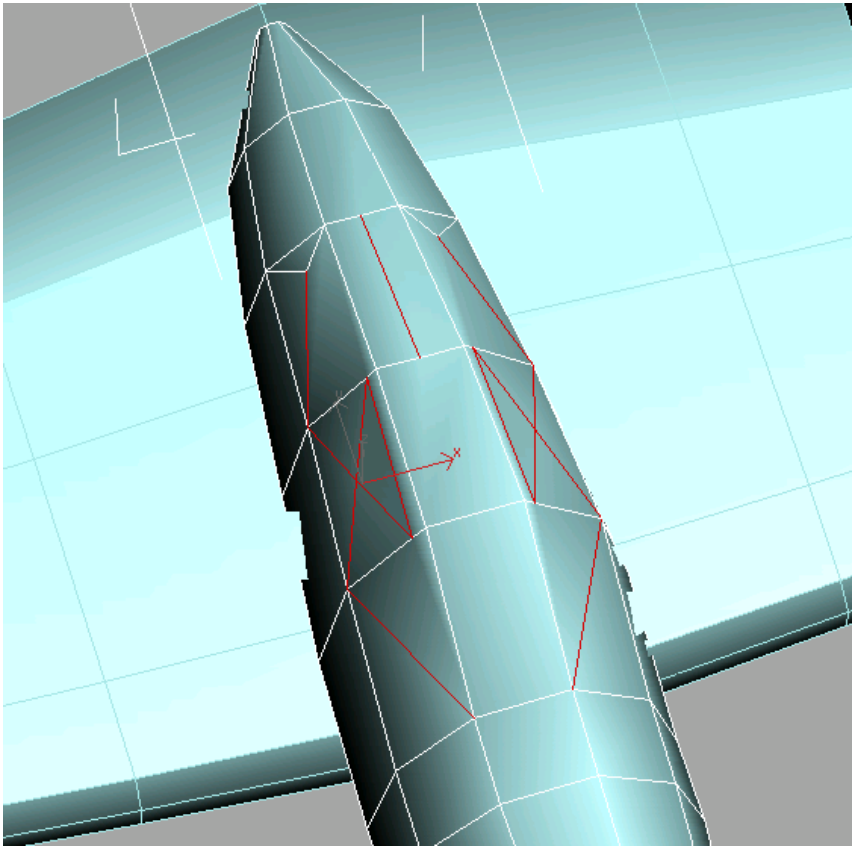
3 On the Edit Geometry rollout, turn on Cut.

4 Cut new edges into the cockpit. Click to set the beginning of an edge, then move the mouse to draw the new edge. Click again to set the end of the edge.



Cut these new red edges to form one side of the cockpit.

5  Orbit the view and make the same cuts on the other side of the cockpit.

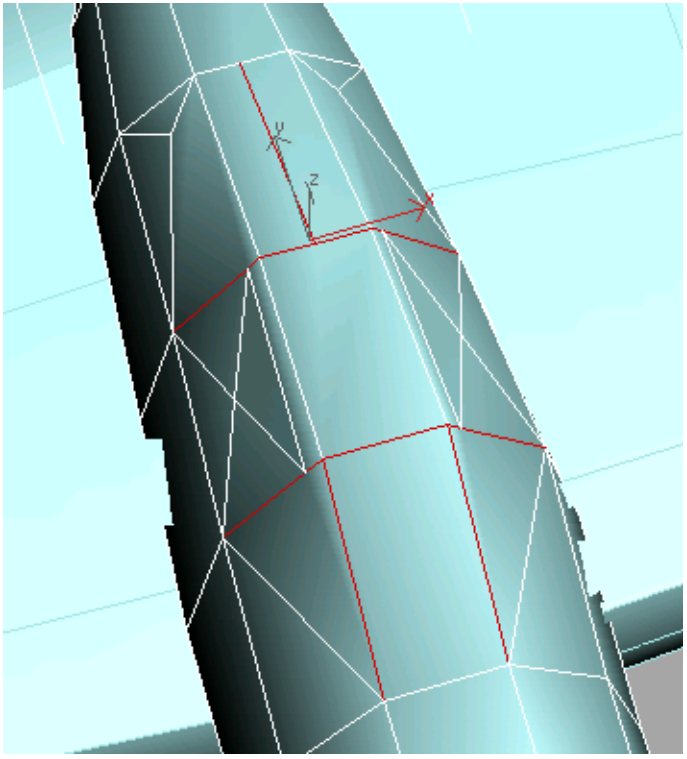


All these edges should be cut.

6 Click Cut again, to turn it off.

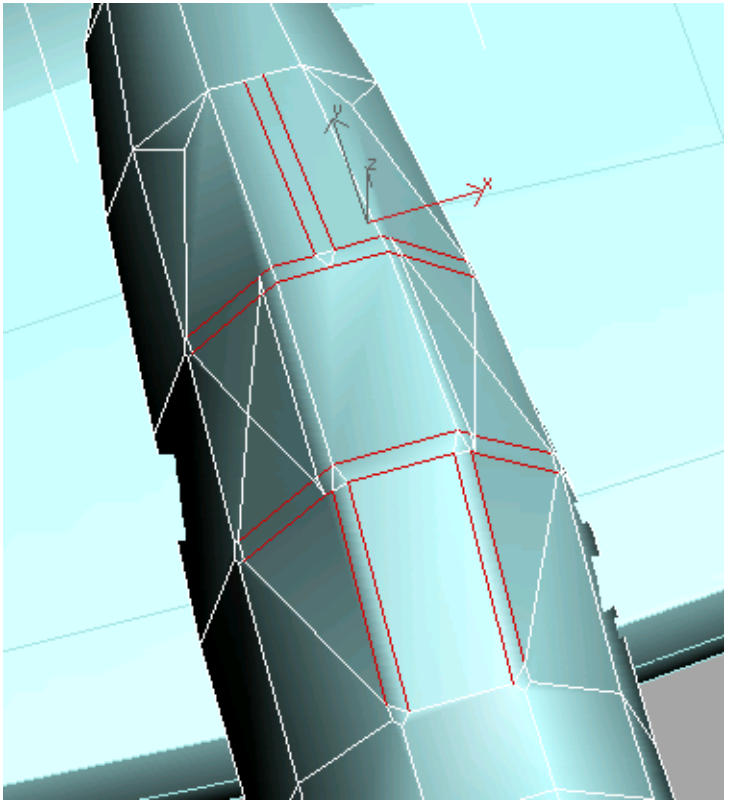
Now, you can chamfer edges to create the metal frame of the canopy.

7 In the Selection rollout, turn on Ignore Backfacing and select the edges around the cockpit, as illustrated below.



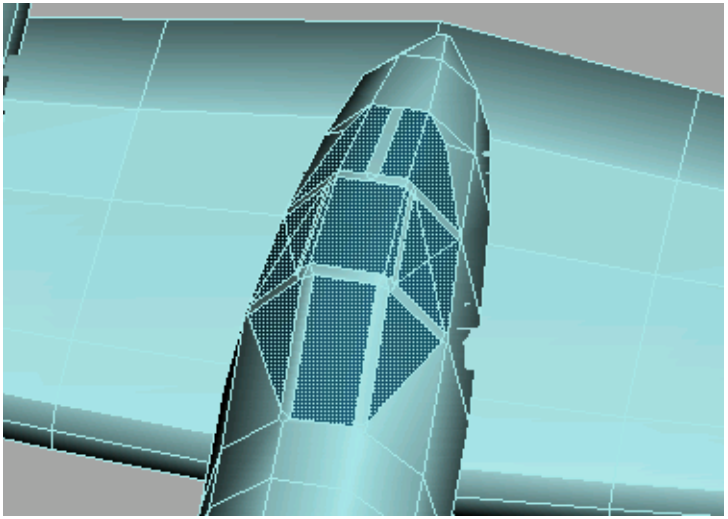
Select these red edges.

8 In the Edit Edges rollout, turn on Chamfer. Move your cursor over one of the selected edges, click and drag up until it looks like the illustration below, and then release the mouse button.



Chamfer edges to create the metal canopy frame.

9 You can apply a transparent material to the canopy faces for extra detail. To apply a material to selected polygons in the model, you would use a Multi/Sub-Object material.



P-38 gondola with completed canopy.

10 Save your work as **myp38.max**.

Make sure the gondola is symmetrical:

The Symmetry modifier was added to 3ds Max specifically for the purpose of building symmetrical models such as airplanes, boats, and characters.

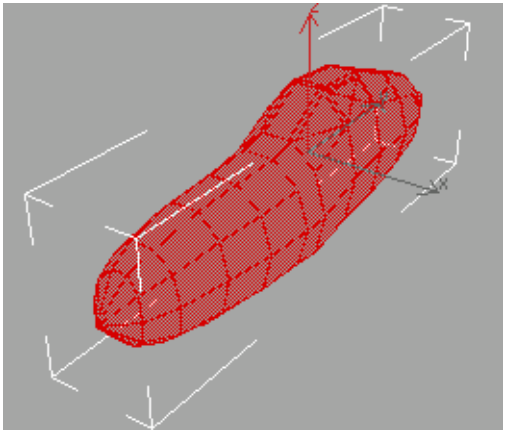
In the previous section, you cut a lot of edges to make up the canopy frame and glass. Some of those new edges may not be the same on either side of the gondola. Using the Symmetry modifier will ensure that the gondola is symmetrical.

You can continue from the previous procedure or open *p38_lightning.max*.

1 Select the gondola object.

2 In the Perspective viewport, right-click the gondola to open the quad menu and choose Isolate Selection.

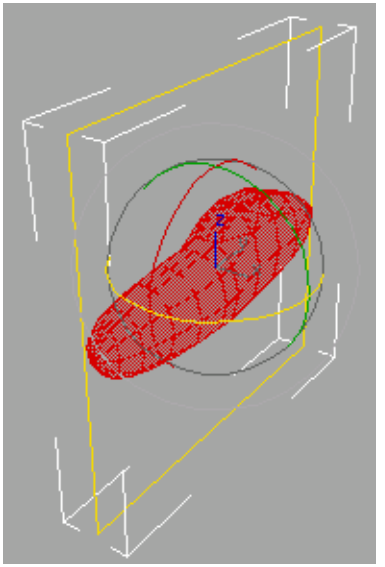
3  Open the Modify panel and turn on Element mode and select the gondola.



The selected element in red.

4 From the Edit Geometry rollout, click Slice Plane.
The gizmo appears, but it's not in the right orientation.

5  Click the Select And Rotate button from the main toolbar and enter **90** in the Z coordinate field below the time bar.



The slice gizmo is rotated correctly.

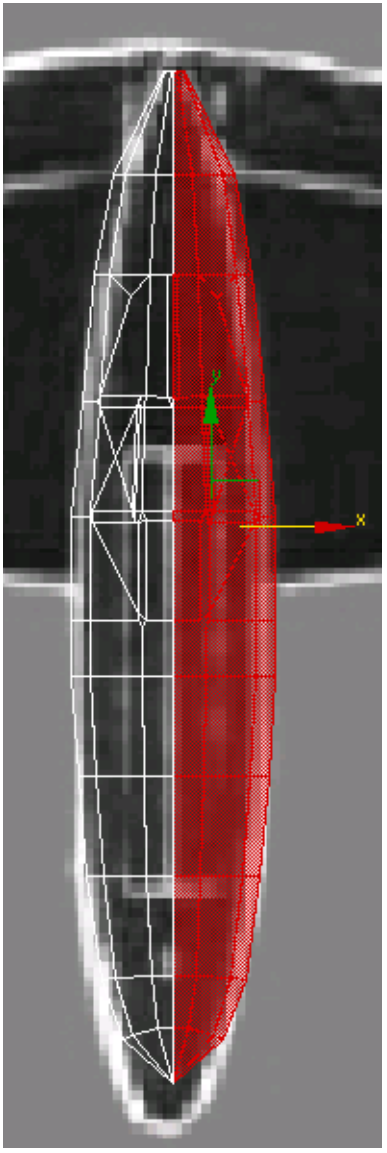
6  If necessary, move the gizmo left or right so it's centered on the gondola.

TIP Zoom in the Top viewport to better adjust the gizmo position.

7 When the gizmo is positioned correctly, click the Slice button. Turn off Slice Plane.

8  Turn on Polygon mode and in the Top viewport drag a selection window around the right side of the gondola.

TIP  In the Selection rollout, make sure Ignore Backfacing is turned off and maximize the Top viewport when dragging the selection window.



Half the gondola is selected.

9 Press the Delete key and, if asked if you want to delete isolated vertices, click Yes.

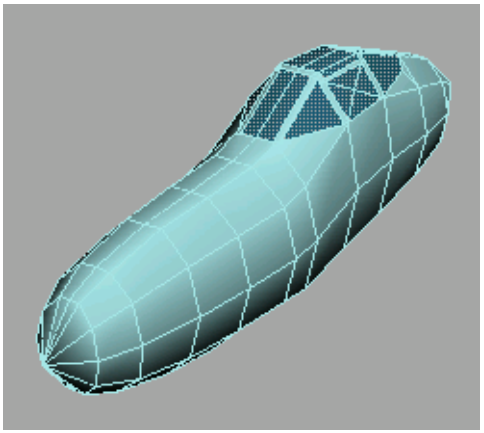
NOTE You might have to zoom in on the rear end of the gondola to select some very small polygons and delete them as well.

10  Turn off Polygon mode and choose Symmetry from the Modifier List.

The Mirror gizmo appears at the gondola's pivot point.

11 In the Parameters rollout out, turn off Slice Along Mirror.

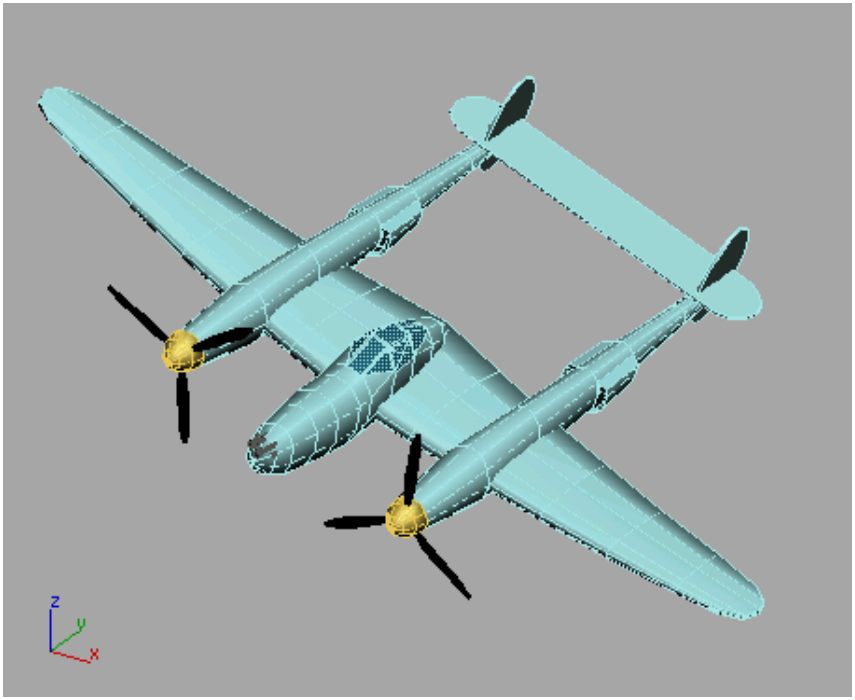
The new half is created and it is automatically welded.



The whole gondola

12 Turn off Isolation Mode to view the rest of the model.

13 If you're working on your own P-38, there are many more details you could add, such as propellers, machine guns, and landing gear. Feel free to continue on your own. The *p38_lightning.max* has some detail added.



Propellers and machine guns added

Finishing the Plane

One major step remains: to link the plane into a single hierarchy. Before it's airworthy, however, you'll also need to rotate it into the proper orientation and adjust a pivot.

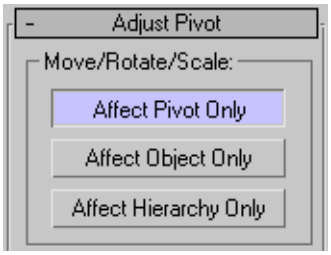
Load a start file

- Continue from the previous lesson, Creating the Gondola on page 180, or load *p38_lightning.max* found in the *\modeling\p38_lightning* folder.

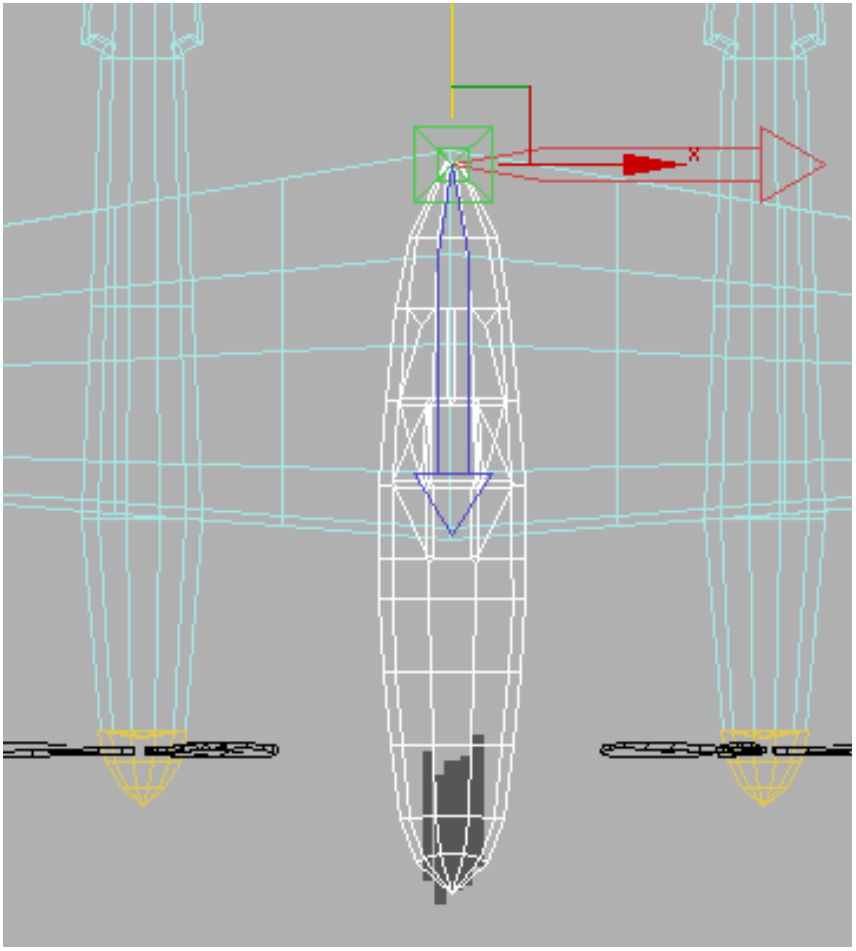
To work properly with Microsoft Flight Simulator (FS), the pivot point of an aircraft used by FS as its center, should be midway between the propellers, and a quarter of the way back from the front of the wings. In this procedure, you'll make that adjustment in the Top viewport.

Adjust the gondola pivot

1. Activate the Top viewport and press Alt+W to maximize it.
2. Select the gondola object.
3.  In the Command panel, click the Hierarchy tab. In the Adjust Pivot rollout, click Affect Pivot Only.

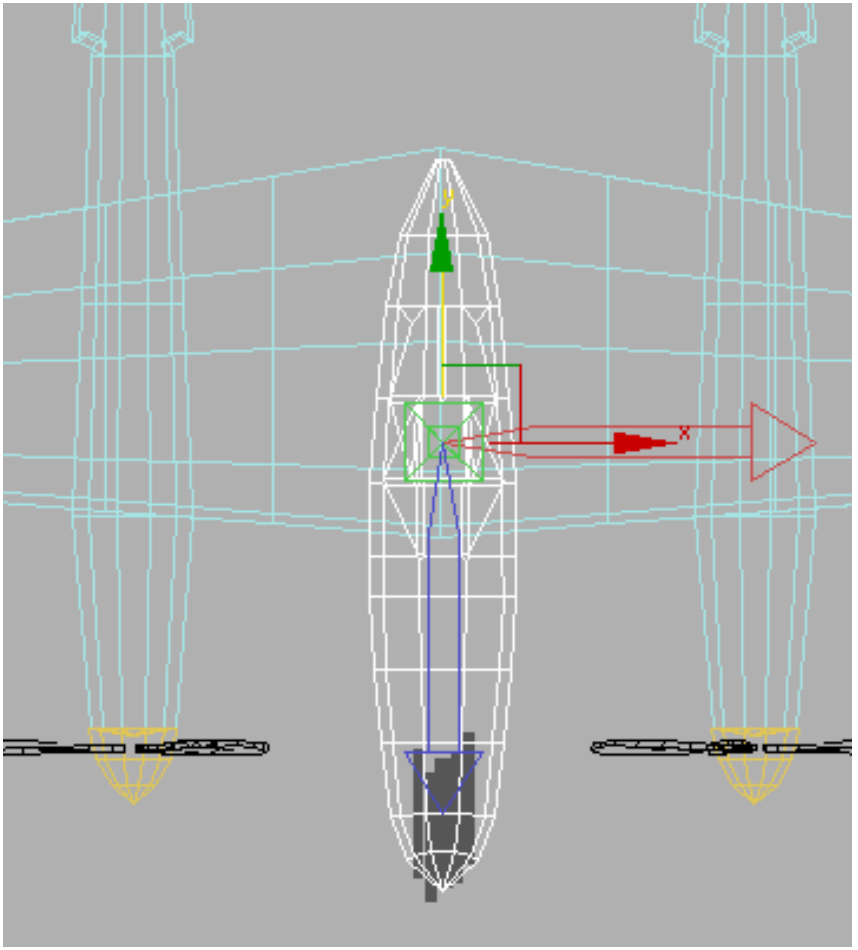


The gondola's pivot becomes visible, near its rear.



The gondola's pivot resembles the transform gizmo.

4  Use Select And Move to move the pivot downward along its Y axis so that the pivot is about a quarter of the way back from the front of the wings.



The gondola's pivot properly positioned.

5 In the Adjust Pivot rollout, click Affect Pivot Only again to turn it off.

Currently the plane looks like a single object, but it's really just a collection of unconnected parts. You can demonstrate this, if you like, by moving one of the parts, such as the gondola (if you do move it, be sure to undo before continuing). In this section, you'll connect all the parts into a hierarchy, so that moving the gondola moves the entire plane.

Build a hierarchy for the plane

1.  Using the Select And Link tool, link the wing object to the gondola object. Click on the wing and drag the cursor over to the gondola, then release.

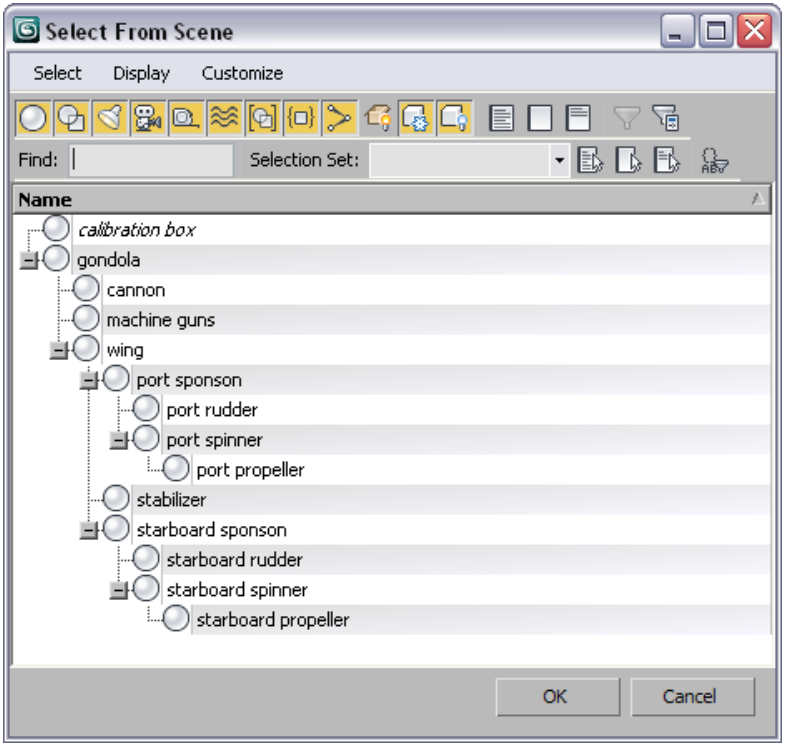
2. Next, link the two sponson objects to the wing object.

3. Continue linking until all objects belong to the same hierarchy, with the gondola as the topmost node. You can start in the Top viewport, but you'll probably need to use the others as you go along.

   How you link objects is up to you; the only firm rule is that the gondola must be above all the other objects in the hierarchy. As a rough guide, link small objects to larger nearby objects. For example, you might link the propeller objects to their related spinners, and then the spinners to their sponsons. This would create a three-level hierarchy, with the sponson at the top, the spinner as its child, and the propeller blades as the spinner's children and the sponson's grandchildren.

   As you work, keep switching to Select And Move and move the gondola to see which objects come along with it. When you're finished, no objects should be left behind when you move the gondola.

    You can also check the hierarchy by clicking the Select By Name button on the main toolbar (or press the H key). On the Display Menu, make sure Display Children is on (with a check mark next to it), and then choose Display > Expand All. This displays the hierarchy as an indented list, with the parent object at the top.



The final step is to rotate the plane so that it's pointing upward in the Top viewport. Otherwise you'll start out flying backward.

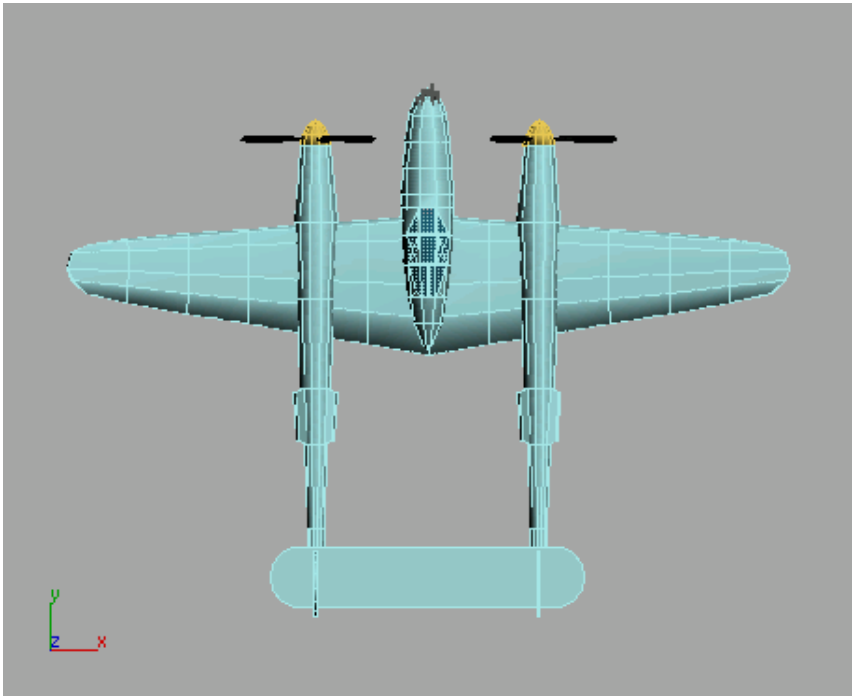
Turn the plane around

1. In the Top viewport, select the gondola.
2.  On the main toolbar, click the Select And Rotate button.
3. On the status bar at the bottom of the screen, in the Coordinate Display area, enter **180** in the Z field.

   When you press Enter, the displayed value changes to –180.0, which is the same thing, rotation-wise.

   Also, the plane reverses its orientation in the Top viewport, facing upward.



4 Save your work as **myp38.max**. Or you can open the completed file *p38_lightning_final.max*.

Summary

In this tutorial, you learned more about low-poly modeling using primitive objects like boxes, spheres and cylinders. You also made use of a background image to help in the modeling process.