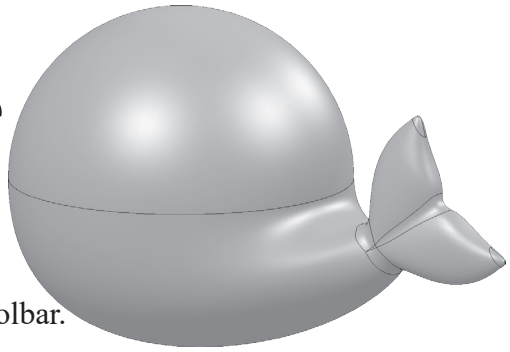
Chapter 2

Whale
Lid and Base



A. Revolve Lid.

Step 1. If necessary, open your **WHALE** part file.

Step 2. Click **Features** Features on the Command Manager toolbar.

Step 3. Click **Revolved Boss/Base** Revolved Boss/Base on the Features toolbar.

Step 4. In the Revolve Property Manger set:
click Whale sketch in graphis area
under Axis of Revolution , **Fig. 1**
click in Axis of Revolution box
click **line**, **Fig. 2**
under Direction 1
Direction 1 Angle **90**
under Direction 2
Direction 2 Angle **90**
under Selected Contours
click in Selected contours box
click **contour inside Arc**
click OK .

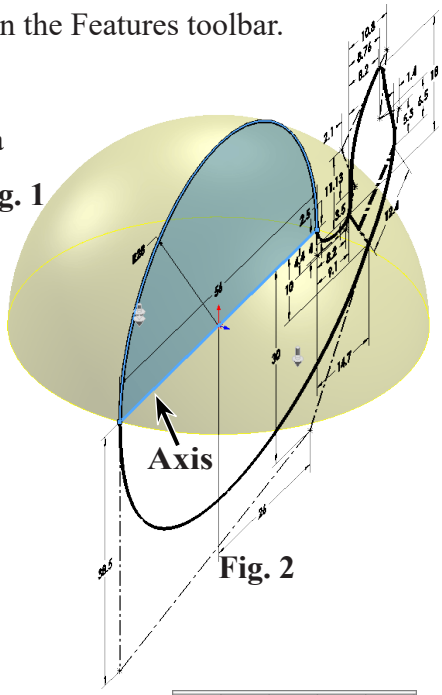


Fig. 2

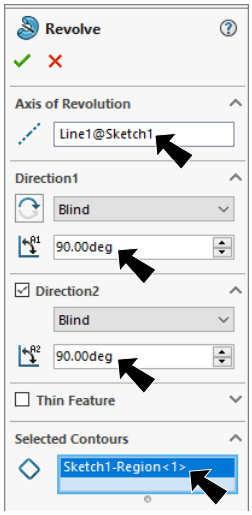


Fig. 1

B. Create Plane 1.

Step 1. **Rename Sketch1** to **MASTER**. To rename sketch, expand Revolve1 feature and slowly click twice over the Sketch1 name (**F2**) and key-in **MASTER**, **Fig. 3**.

Step 2. **Rename Revolve1** body to **LID**. To rename, expand **Solid Bodies** folder in the Feature Manager. Slowly click twice over Revolve1 and key-in **LID**, **Fig. 3**.

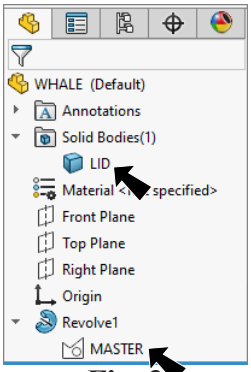


Fig. 3

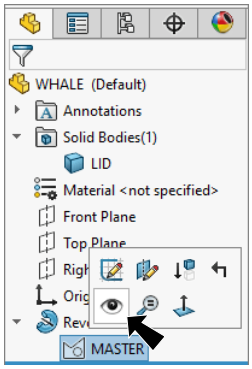


Fig. 4

Step 3. **Show MASTER Sketch**. To show, expand Revolve1 in the Feature Manager, click MASTER Sketch and **Show** on the context toolbar, **Fig. 4**.

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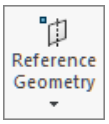
Step 4. Click **Reference Geometry** 

on the Features toolbar and **Plane** from the menu.

Step 5. In the Plane Property Manager set:
under First Reference, **Fig. 5**
click **centerline in fluke**, **Fig. 6**
click **Perpendicular**
under Second Reference
click **construction line**
click OK .

C. Base Loft Profile.

Step 1. Rotate view to view to **view bottom of Lid body**, hold down middle mouse button (wheel) and drag to rotate view, **Fig. 7**.

Step 2. Click **Plane1** in graphic area and click **Hide** on the context toolbar, **Fig. 7**.

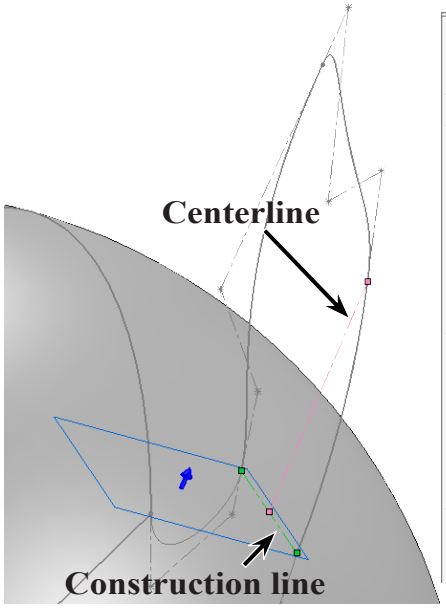


Fig. 6

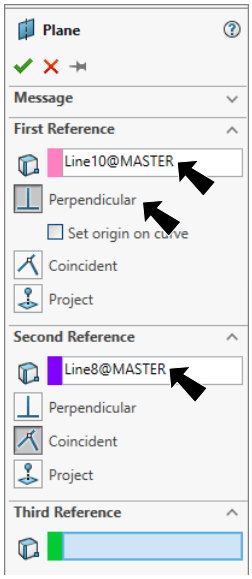


Fig. 5

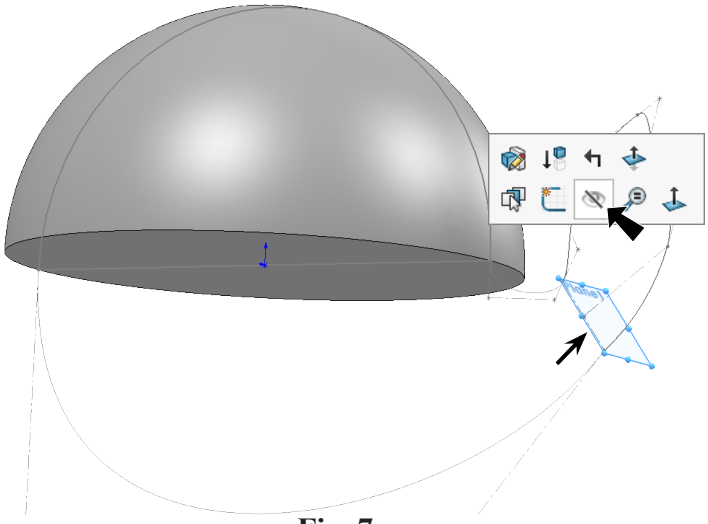


Fig. 7

D. Base Loft Profile.

Step 1. Click **Plane1** in the Feature Manager and click **Sketch** on the sketch toolbar, **Fig. 8**.

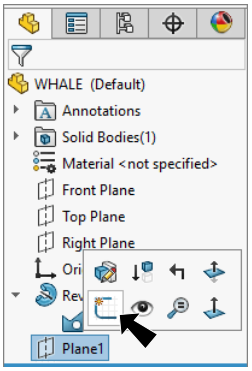


Fig. 8

Step 2. Click **Circle** **(S)** on the Sketch toolbar.

Step 3. Sketch **circle from Midpoint of construction line in the Master Sketch to coincident to Spline**, **Fig. 9**.

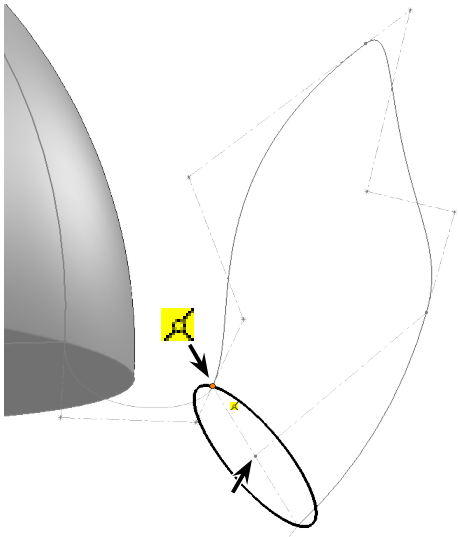


Fig. 9

Step 4. Click **Exit Sketch** on the Sketch toolbar.
Note: Confirm this sketch is Sketch1 not Sketch2, **Fig. 10**.

E. Base Loft Guide Curve 1.

Step 1. Click **Right Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 10**.

Step 2. Click **Normal To** on the Standard Views toolbar. **(Ctrl-8)**

Step 3. Click **Convert Entities** on the Sketch toolbar.

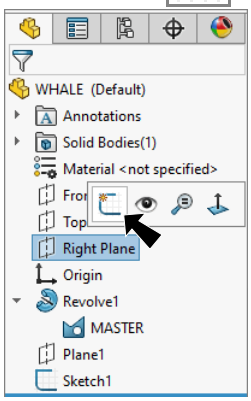


Fig. 10

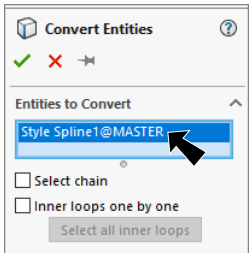


Fig. 11

Step 4. In the Convert Entities Property Manager:
under Entities to Convert, **Fig. 11**
click **Spline 1**, **Fig. 12**
click OK .

Step 5. Click **Exit Sketch** on the Sketch toolbar.

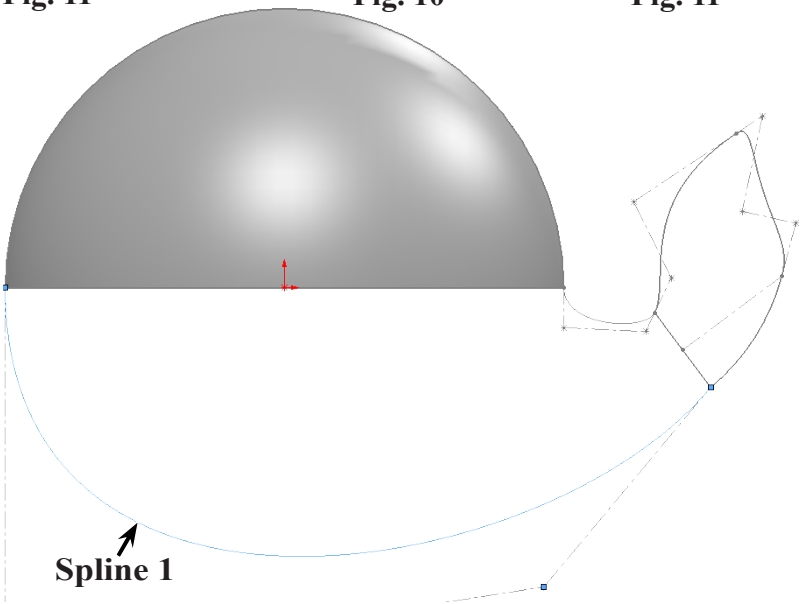


Fig. 12

F. Base Loft Guide Curve 2.

Step 1. Click **Right Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 13**.

Step 2. Click **Convert Entities** on the Sketch toolbar.

Step 3. In the Convert Entities Property Manager:
under Entities to Convert, **Fig. 14**
click **Spline 2**, **Fig. 15**
click OK .

Step 4. Click **Exit Sketch** on the Sketch toolbar.

Step 5. Save. Use **Ctrl-S**.

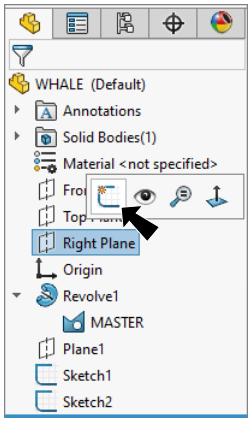


Fig. 13

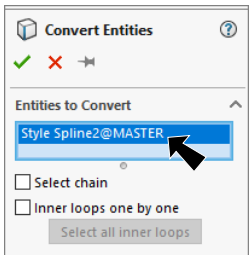


Fig. 14

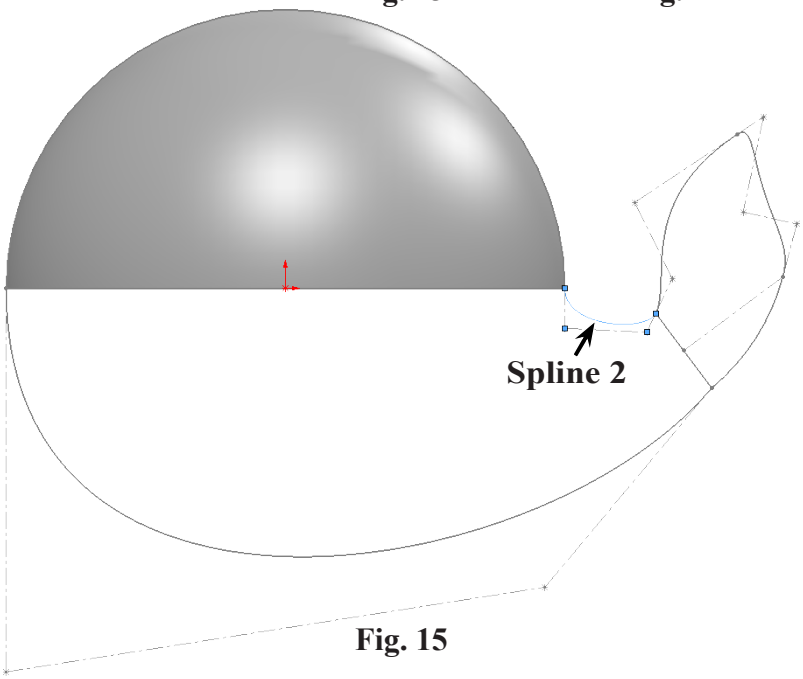


Fig. 15

G. Base Loft.

Step 1. Rotate view to view to view **bottom of Lid body**, hold down middle mouse button (wheel) and drag to rotate view, **Fig. 17**.

Step 2. Click **Features** Features on the Command Manager toolbar.

Step 3. Click **Lofted Boss/Base** Lofted Boss/Base on the Features toolbar.

Step 4. In the Loft Property Manager set:

under Profiles, **Fig. 16**

click **bottom edge of LID**, **Fig. 17**

click **Sketch1** (circle)

expand Start/End Constraints

Start constraint **Normal To Profile**

under Guide Curves

Expand the flyout Feature Manager design tree (click ▸) in the top left corner of the graphics area and click **Sketch2 and Sketch3**.

Guide curves influence type **To Next Guide**

under Options

uncheck **Merge results**

click OK ✔ .

Step 5. Save. Use **Ctrl-S**.

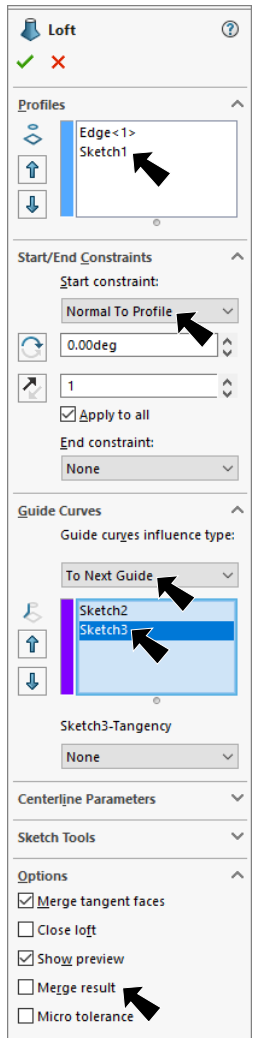


Fig. 16

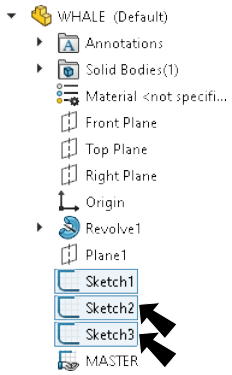


Fig. 18

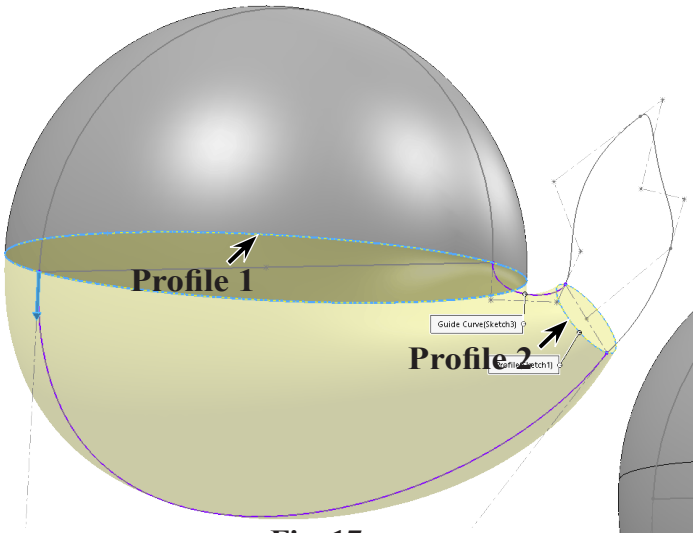


Fig. 17

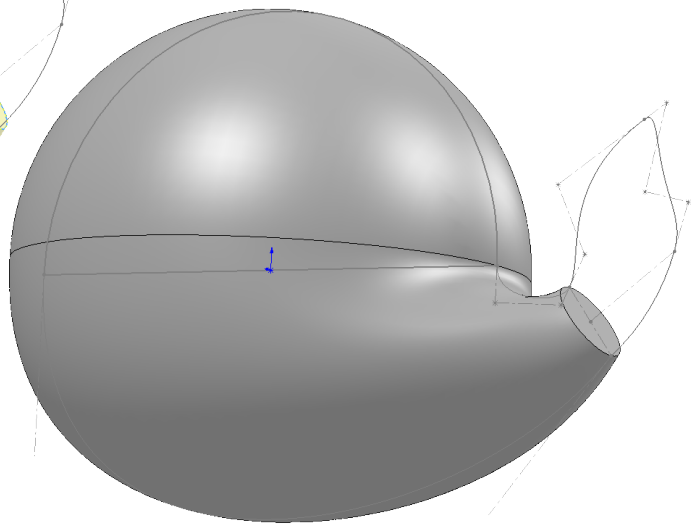


Fig. 19

H. Create Plane 2 and Plane 3.

Step 1. Zoom in around **Tail Flukes** area, **Fig. 20**. To zoom, place the cursor over the flukes area and spin the wheel on mouse back.

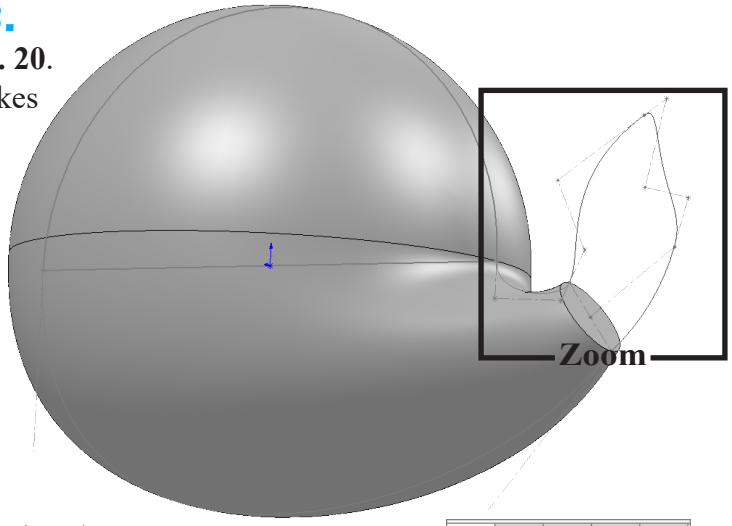


Fig. 20

Step 2. **Hide LID** body. To hide, expand **Solid Bodies** folder in the Feature Manager. Click **LID** body and **Hide** on the context toolbar, **Fig. 21**.

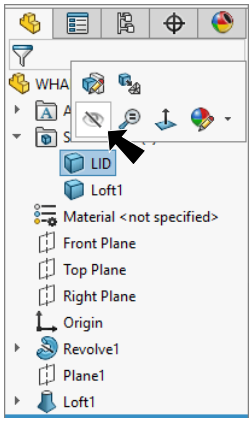


Fig. 21

Tip: Toggle Hide/Show bodies by moving the cursor over the body in graphics area and press **Tab** key to hide or **Shift - Tab** to show.

Step 3. Click **Reference Geometry** on the Features toolbar and **Plane** from the menu.

Step 4. In the Plane Property Manager set:
under First Reference, **Fig. 22**
click **flat rear face of Loft1**, **Fig. 23**
Offset distance **8.5**
Number of planes to create **2**
click OK .

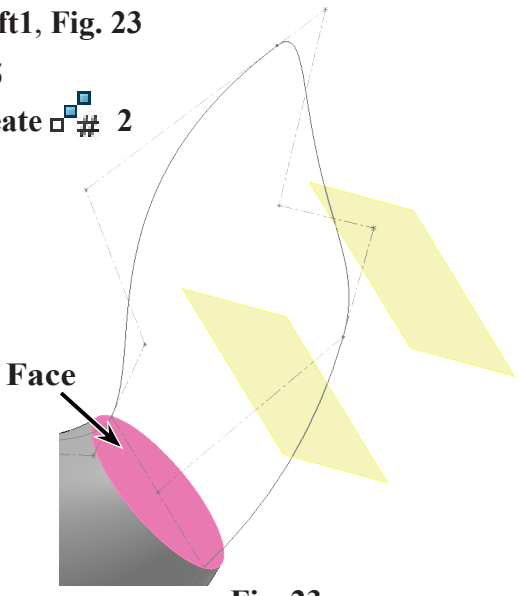


Fig. 23

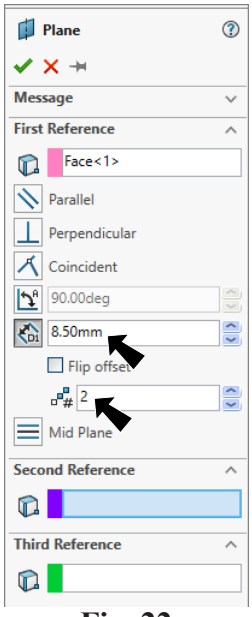


Fig. 22

I. Create Boundary Profile 1.

Step 1. **Hide both Planes** . To hide Plane2, click **Plane** in the Feature Manager and click **Hide** on the context toolbar, **Fig. 24**. Repeat and **hide Plane3**.

Tip: Click View Menu > Hide/Show > Planes, to hide Plane.

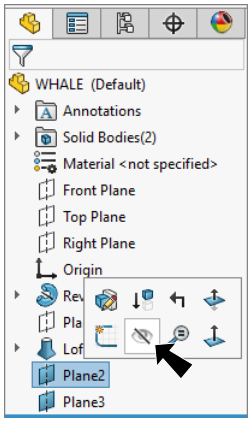


Fig. 24

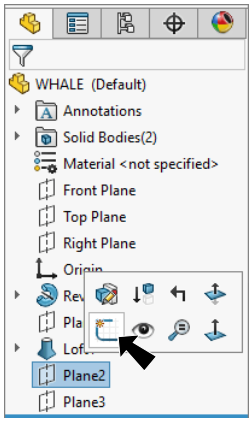


Fig. 25

Step 2. Click **Plane2** in the Feature Manager and click **Sketch** on the sketch toolbar, **Fig. 25**.

Step 3. Click **Ellipse** on the Sketch toolbar.

Step 4. Sketch an ellipse, **Fig. 26**. To sketch ellipse, click between flukes splines to place the center of the ellipse. Drag out and click to set the major axis. Drag down and click again to set the minor axis.

Step 5. **Right click graphics area and click Select** from menu to unselect Ellipse tool.

Step 6. **Ctrl click major axis point and spline in Master Sketch** to select both. **Release Ctrl key** and click **Make Pierce** on the context toolbar, **Fig. 27**. Make Pierce adds a Pierce relation between ellipse and Master Sketch.

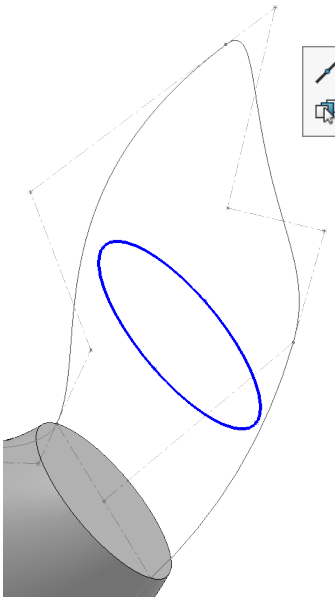


Fig. 26

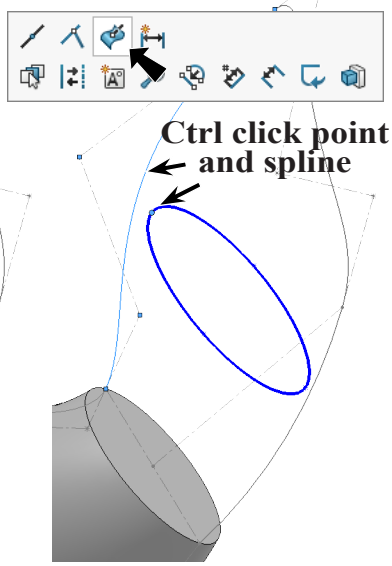


Fig. 27

Step 7. **Ctrl click opposite major axis point and flute arc in Master Sketch** to select both. **Release Ctrl key** and click **Make Pierce** on the context toolbar, **Fig. 28**.

Step 8. Click **Smart Dimension** (**S**) on the Sketch toolbar.

Step 9. Dimension **minor axis 8**, **Fig. 29**.

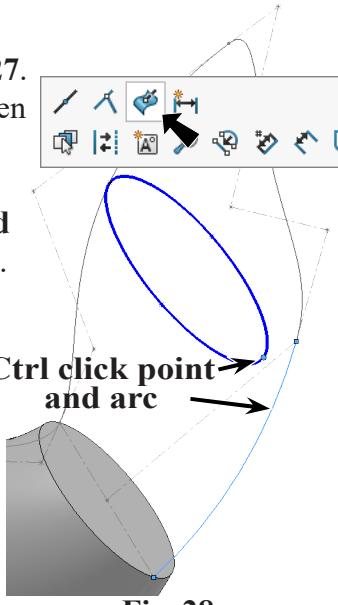


Fig. 28

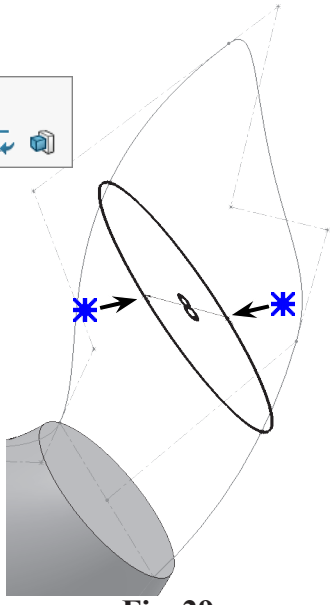


Fig. 29

Step 10. Click **Exit Sketch** on the Sketch toolbar.

J. Create Boundary Profile Sketch 2.

Step 1. Click **Plane3** in the Feature Manager and click **Sketch** on the sketch toolbar, **Fig. 30**.

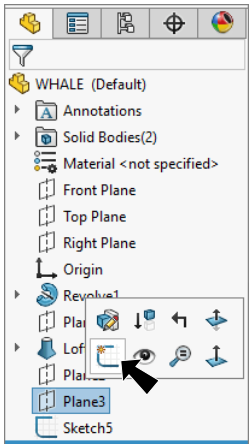


Fig. 30

Step 2. Click **Ellipse** on the Sketch toolbar.

Step 3. Sketch an ellipse, **Fig. 31**.

Step 4. **Right click graphics area and click Select** from menu to unselect Ellipse tool.

Step 5. **Ctrl click major axis point and spline in Master Sketch** to select both. **Release Ctrl key** and click **Make Pierce** on the context toolbar, **Fig. 32**.

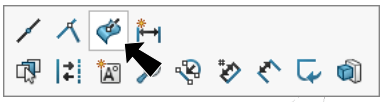


Fig. 31

Fig. 32

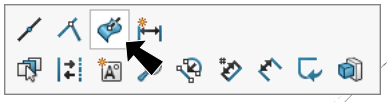
Step 6. **Ctrl click opposite major axis point and spline in Master Sketch** to select both. **Release Ctrl key** and click **Make Pierce** on the context toolbar, **Fig. 33**.

Step 7. Click **Smart Dimension** **(S)** on the Sketch toolbar.

Step 8. Dimension **minor axis 2.2**, **Fig. 34**.

Step 9. Click **Exit Sketch** on the Sketch toolbar.

Step 10. Save. Use **Ctrl-S**.



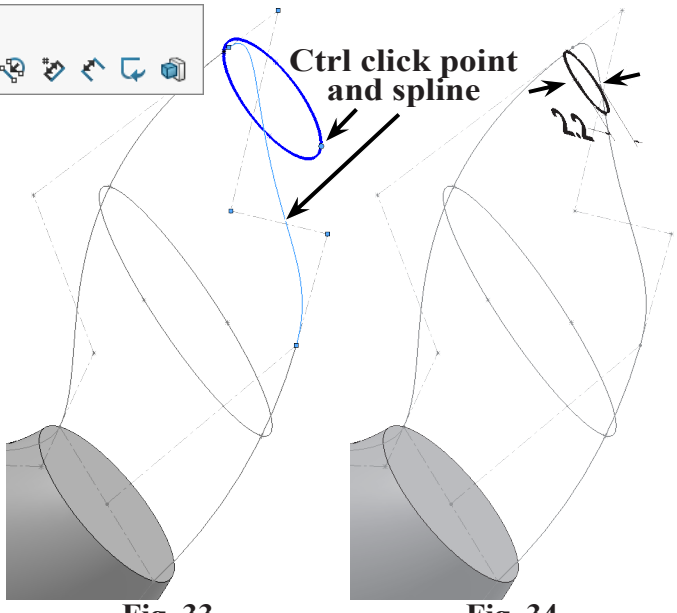


Fig. 33

Fig. 34

K. Create Boundary Guide Curve 1.

Step 1. Click **Right Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 35**.

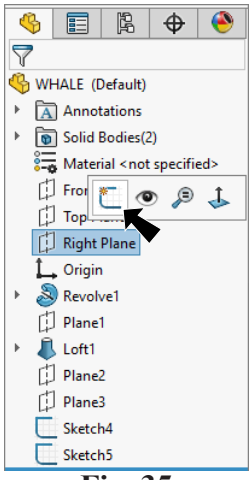


Fig. 35

Step 2. Click **Convert Entities** on the Sketch toolbar.

Step 3. In the Convert Entities Property Manager:
under Entities to Convert, **Fig. 36**
click **forward Spline in Master Sketch**, **Fig. 37**
click OK .

Step 4. Grab the top endpoint of converted spline, **Fig. 38**.

Step 5. Drag endpoint down to coincident with the ellipse, **Fig. 39**.

Step 6. Click **Exit Sketch** on the Sketch toolbar.

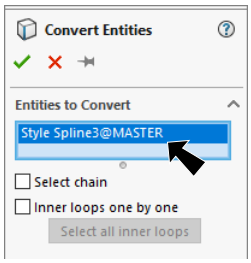


Fig. 36

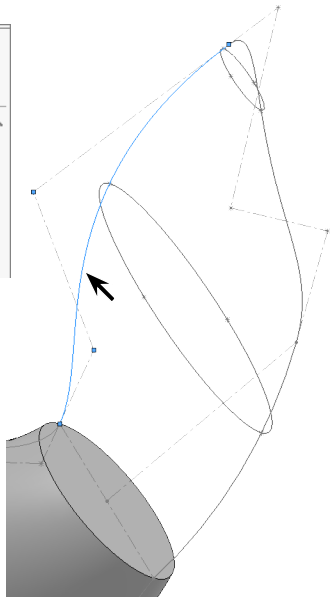


Fig. 37

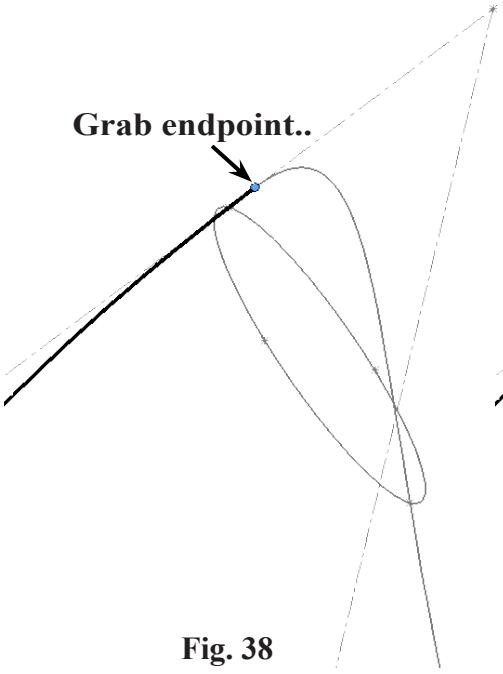


Fig. 38

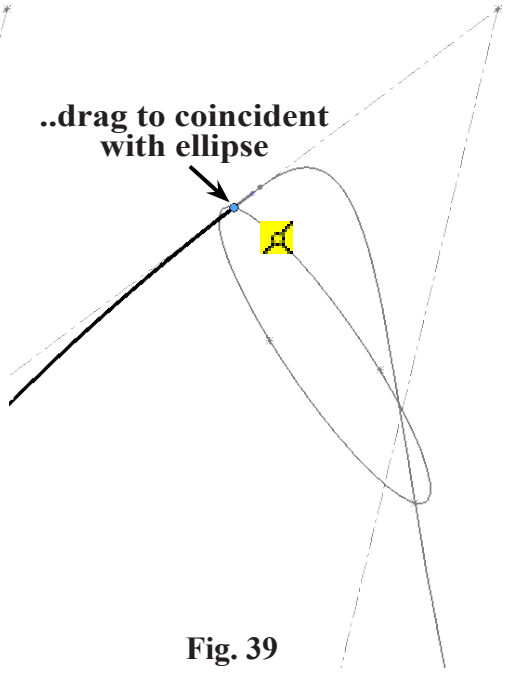


Fig. 39

L. Create Boundary Guide Curve 2.

Step 1. Click **Right Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 40**.

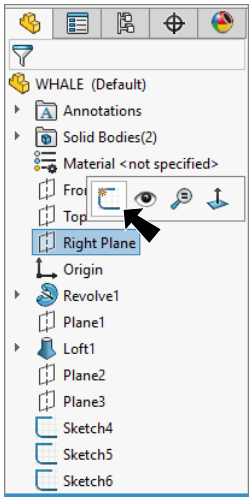


Fig. 40

Step 2. Click **Convert Entities** on the Sketch toolbar.

Step 3. In the Convert Entities Property Manager:
under Entities to Convert, **Fig. 41**
click **rear Spline in Master Sketch and arc**, **Fig. 42**
click OK .

Step 4. Grab the top endpoint of converted spline, **Fig. 43**.

Step 5. Drag endpoint down to coincident with the ellipse, **Fig. 44**.

Step 6. Click **Exit Sketch** on the Sketch toolbar.

Step 7. Save. Use **Ctrl-S**.

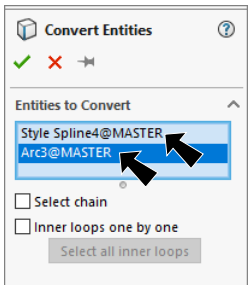


Fig. 41

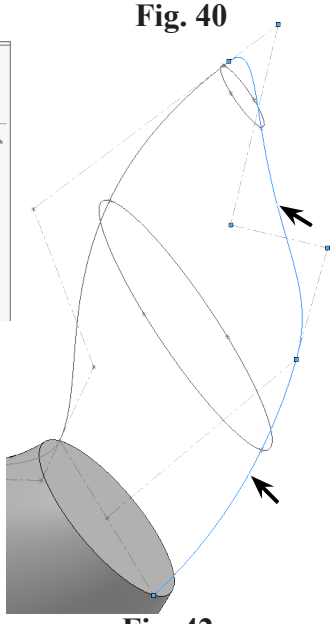


Fig. 42

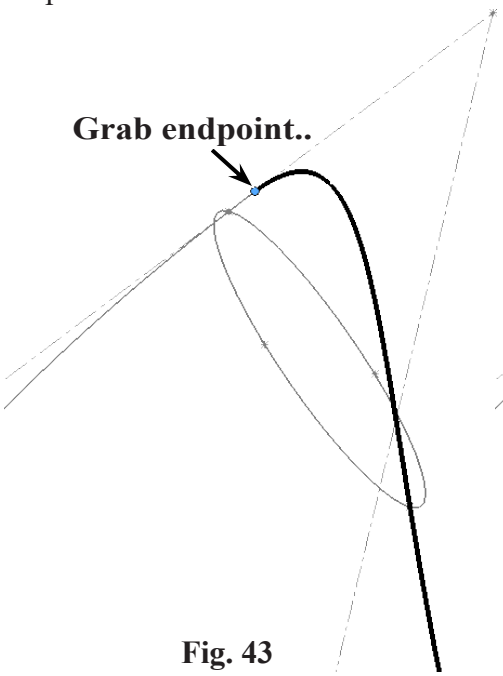


Fig. 43

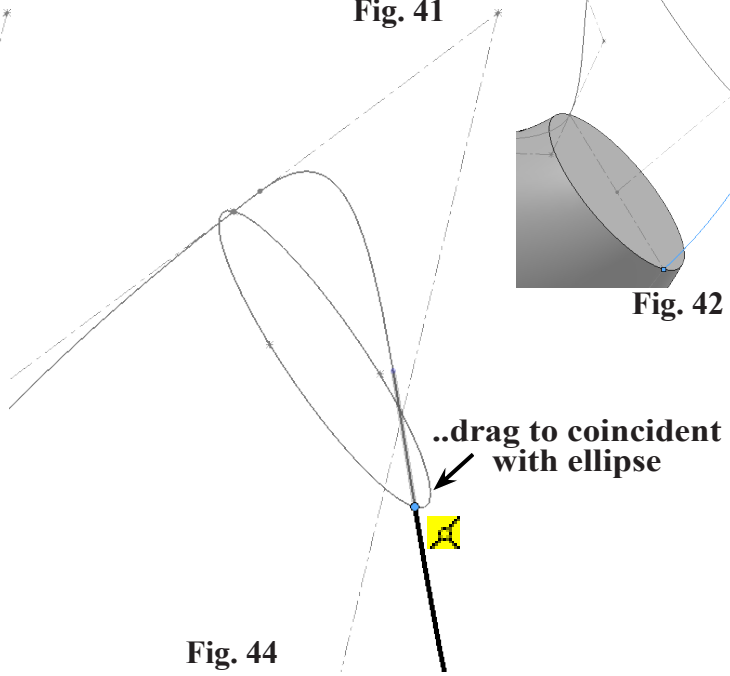
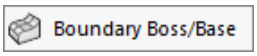


Fig. 44

M. Boundary Boss.

Step 1. Click **Boundary Boss/Base**  on the Features toolbar.

Step 2. In the Boundary Property Manager set:

under Direction 1, **Fig. 45**

click **edge of Loft1 body**, **Fig. 46**

click **Sketch4 (ellipse)**

click **Sketch5 (ellipse)**

under Direction 2

click in the Direction 2 box

expand the flyout Feature Manager design tree and click **Sketch6 and Sketch7**, **Fig. 47**

under Options

uncheck **Merge results**

click OK ✔ .

Step 3. Save. Use **Ctrl-S**.

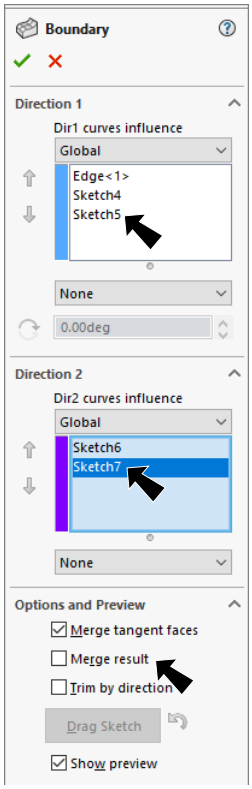


Fig. 45

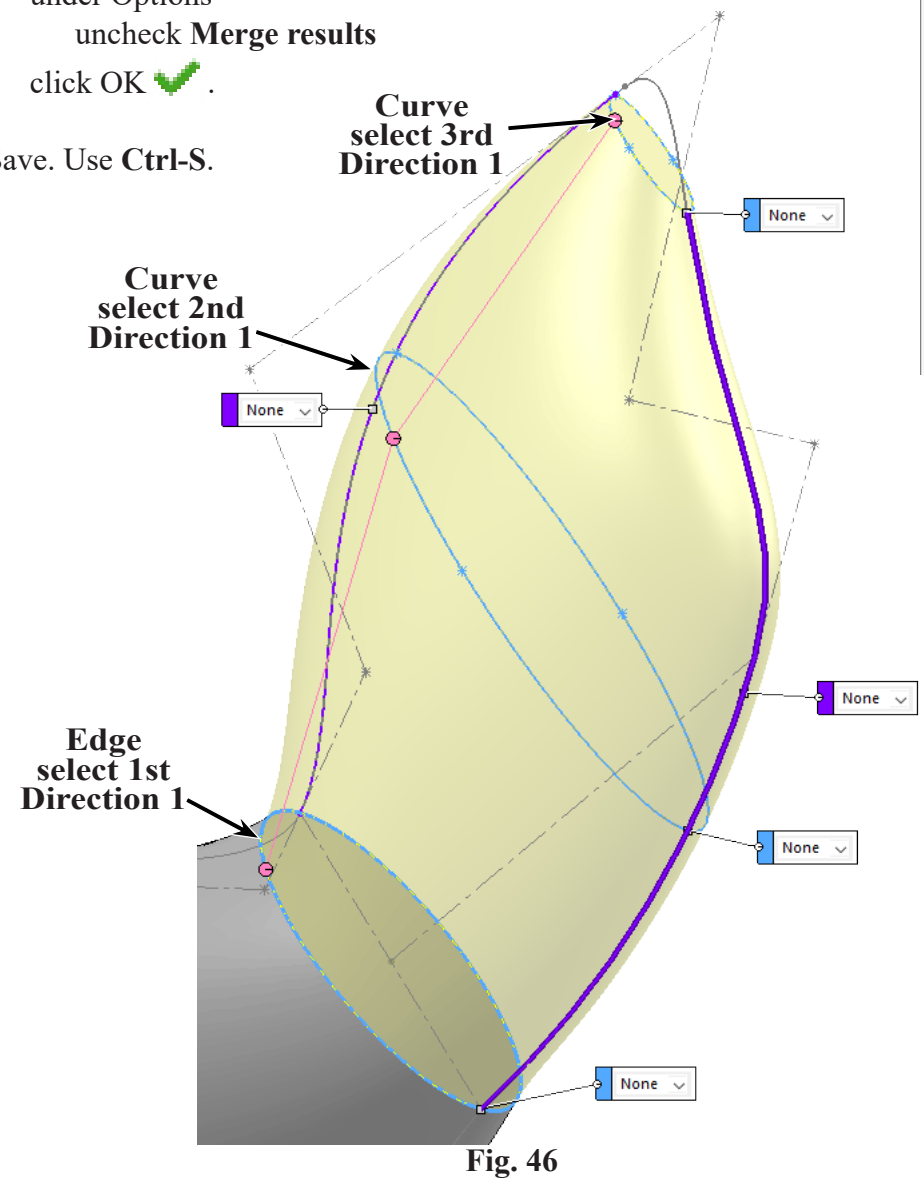


Fig. 46

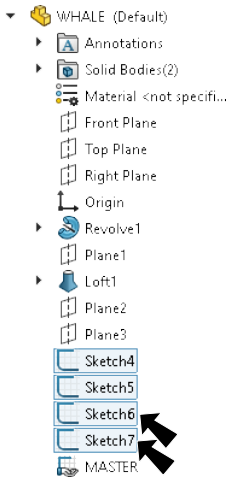


Fig. 47

N. Fluke Tip Loft Profile Sketch 1.

Step 1. Click **top face of Boundary1** and click **Sketch** on the context toolbar, **Fig. 48**.

Step 2. With the face still selected, click **Convert Entities** on the Sketch toolbar, **Fig. 49**.

Step 3. Click **Line** **(L)** on the Sketch toolbar.

Step 4. Sketch **line across major axis points at splines**, **Fig. 50**.

Step 5. Click **Trim Entities** **(S)** on the Sketch toolbar.

Step 6. In the Trim Property Manger:

select **Trim to closest** , **Fig. 51**

Trim **rear half of ellipse**, **Fig. 52**
Click segment to trim.
Results in **Fig. 53**.
Click OK when done

Step 7. Click **Exit Sketch** on the Sketch toolbar.

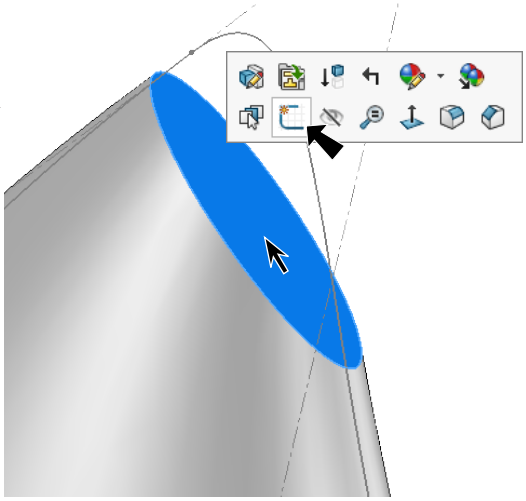


Fig. 48

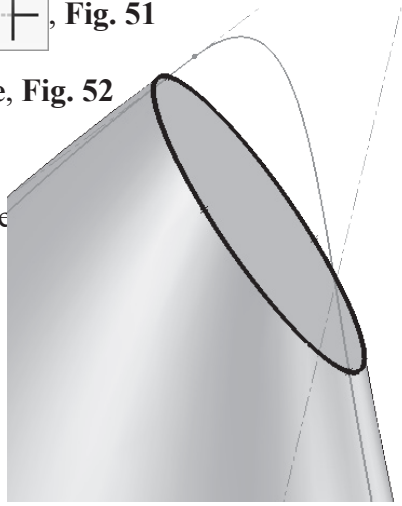


Fig. 49

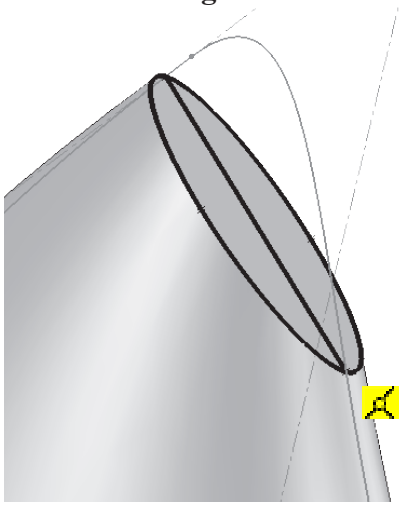


Fig. 50

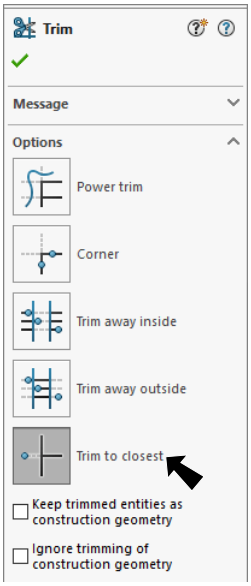


Fig. 51

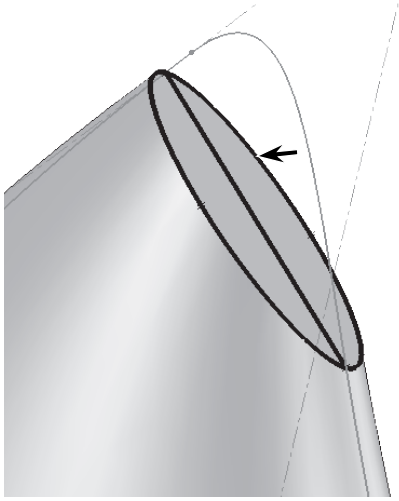


Fig. 52

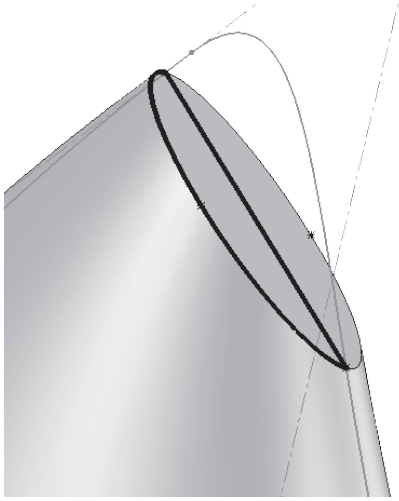


Fig. 53

O. Fluke Tip Loft Profile Sketch 2.

Step 1. Click **Right Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 54**.

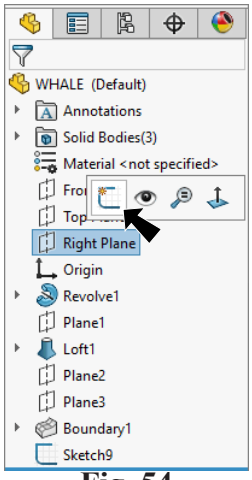


Fig. 54

Step 2. Click **Convert Entities** on the Sketch toolbar.

Step 3. In the Convert Entities Property Manager:
under Entities to Convert, **Fig. 55**
click **both Splines in Master sketch**, **Fig. 56**
click OK .

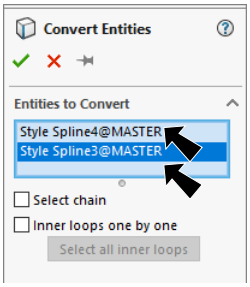


Fig. 55

Step 4. Click **Line** **(L)** on the Sketch toolbar.

Step 5. Sketch **line across major axis points at splines**, **Fig. 57**.

Step 6. Click **Trim Entities** **(S)** on the Sketch toolbar.

Step 7. In the Trim Property Manger:
select **Trim to closest**
Trim **converted splines at both front and rear**, **Fig. 58**.
Results in **Fig. 59**.
Click OK .

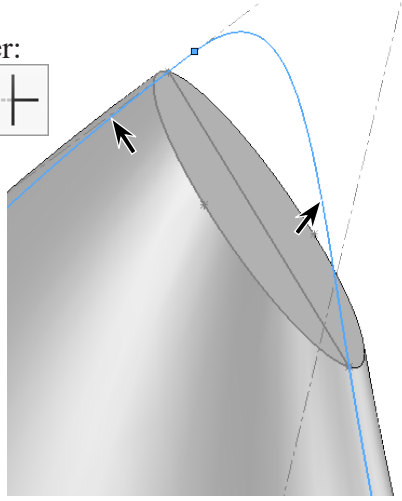


Fig. 56

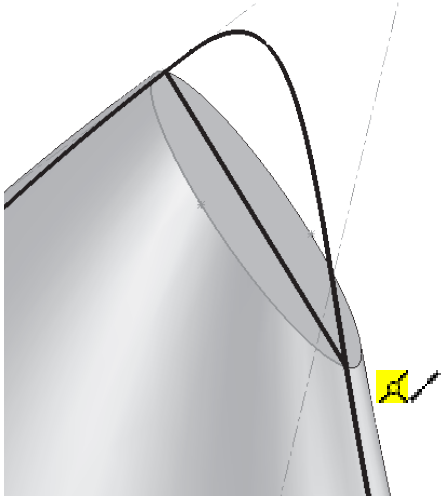


Fig. 57

Step 8. Click **Exit Sketch** on the Sketch toolbar.

Step 9. Save. Use **Ctrl-S**.

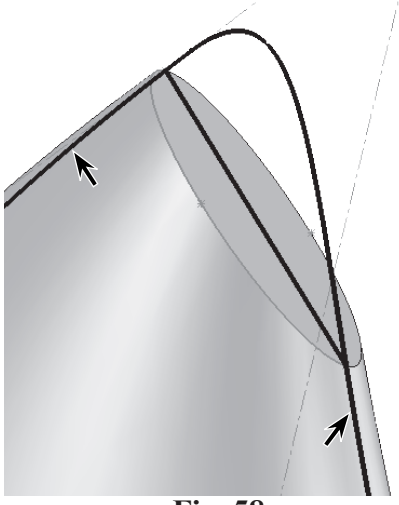


Fig. 58

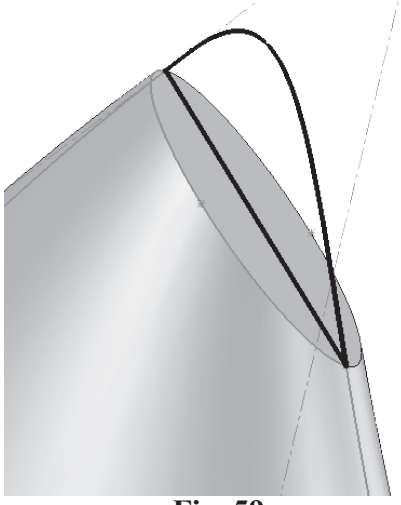
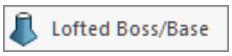


Fig. 59

P. Loft Fluke Tip.

Step 1. Click **Lofted Boss/Base** 

on the Features toolbar.

Step 2. In the Loft Property Manager set:

under Profiles, **Fig. 60**

click **Sketch8 (converted trimmed ellipse)**, **Fig. 61**

right click Sketch9 and click **Select Other** from menu, **Fig. 62**

select **Sketch9 in Select Other** dialog box

drag the connector down to other connector, **Fig. 63**

expand Start/End Constraints

Start constraint **Tangency To Face**

End constraint **Normal to Profile**

under Options

uncheck **Merge results**

click OK .

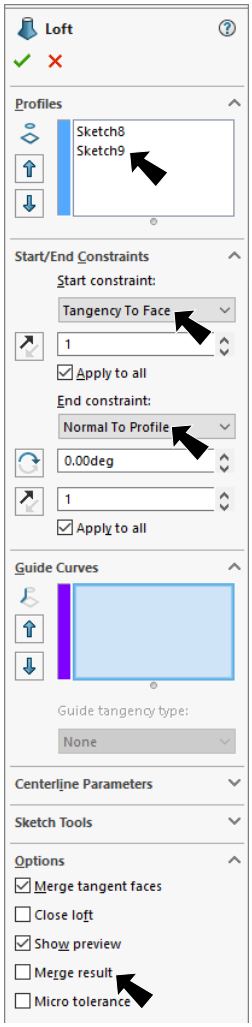


Fig. 60

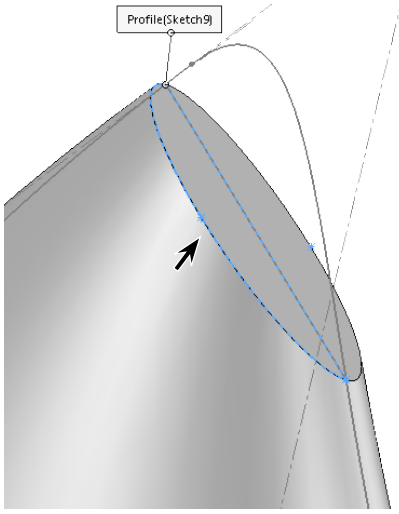


Fig. 61

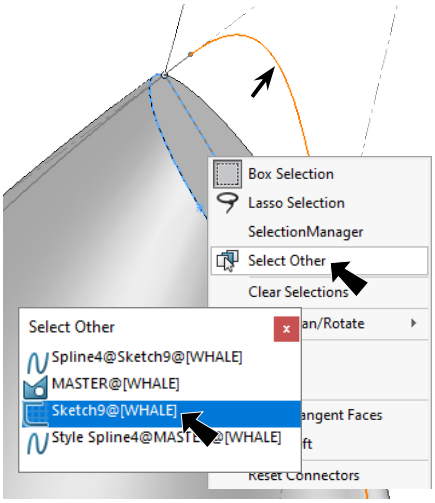


Fig. 62

Grab connector..

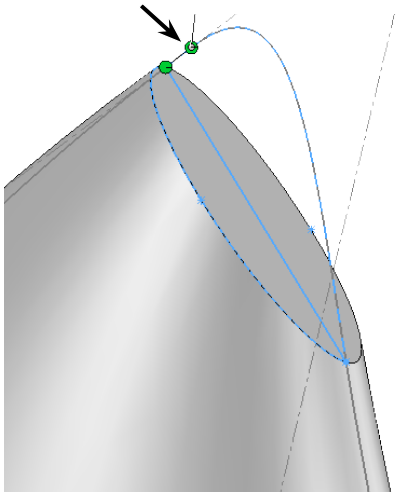


Fig. 63

..drag to align with other connector

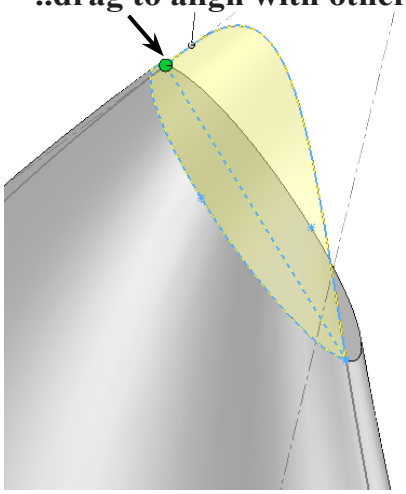


Fig. 64

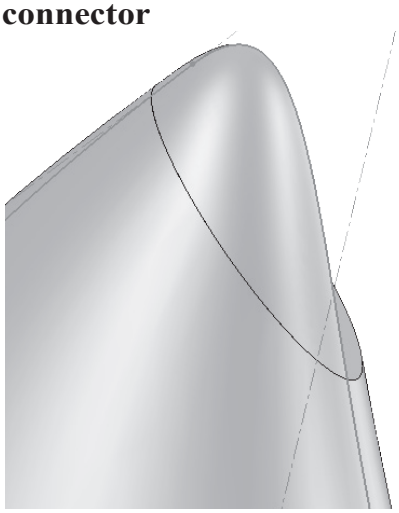


Fig. 65

Tip: The Master Sketch interferes with selection of Loft sketch. We could hide Master Sketch and select Loft sketch without using Selecting Other, except we will be using Master Sketch next for creating mirror plane.

Q. Mirror Loft Fluke Tip.

Step 1. Click **Right Plane** in the Feature Manager to select Plane, **Fig. 66**.

Step 2. Click **Mirror** Mirror on the Features toolbar.

Step 3. In the Mirror Property Manager set:
expand **Bodies to Mirror**, **Fig. 67**
click **fluke tip loft**, **Fig. 68**
under Options
check **Merge solids**
click OK .

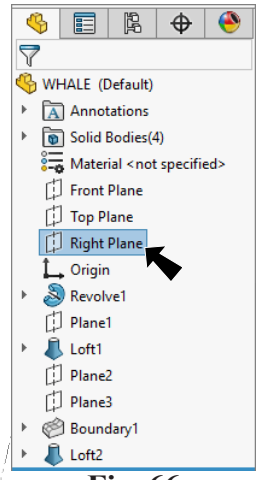


Fig. 66

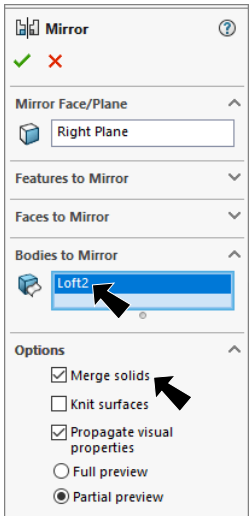


Fig. 67

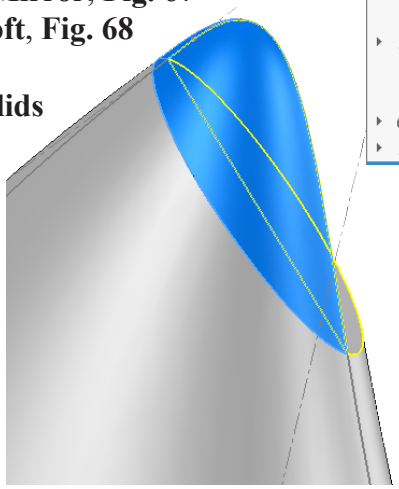


Fig. 68

R. Create Plane4 to Mirror Flukes.

Step 1. Click **Reference Geometry** Reference Geometry on the Features toolbar and **Plane** from the menu.

Step 2. In the Plane Property Manager set:
under First Reference, **Fig. 69**
click click **construction line**, **Fig. 70**
click **Perpendicular**
under Second Reference
click click **centerline in fluke**
click OK .

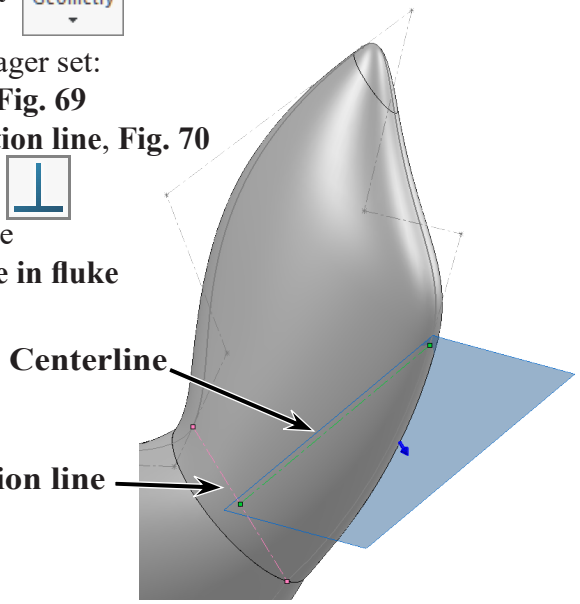


Fig. 70

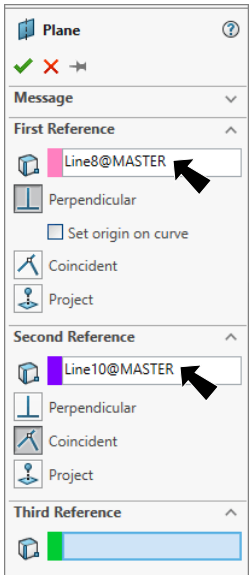


Fig. 69

S. Mirror Loft Fluke Tip.

Step 1. Click **Plane4** in the Feature Manager to select Plane, **Fig. 71**.

Step 2. Click **Mirror** Mirror on the Features toolbar.

Step 3. In the Mirror Property Manager set:
expand **Bodies to Mirror**, **Fig. 72**
click **Boundary** and **Fluke Loft tip**, **Fig. 73**
under Options
uncheck **Merge solids**
click OK .

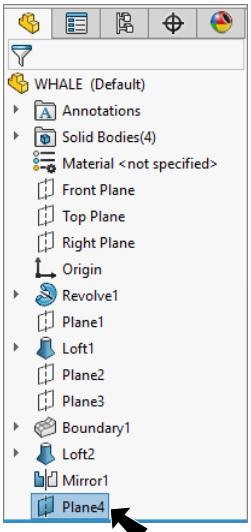


Fig. 71

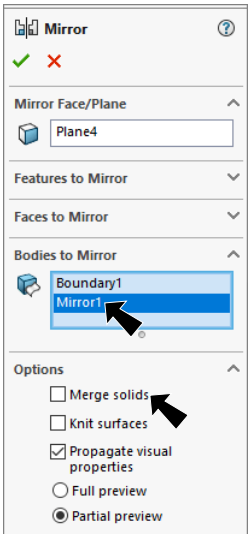


Fig. 72

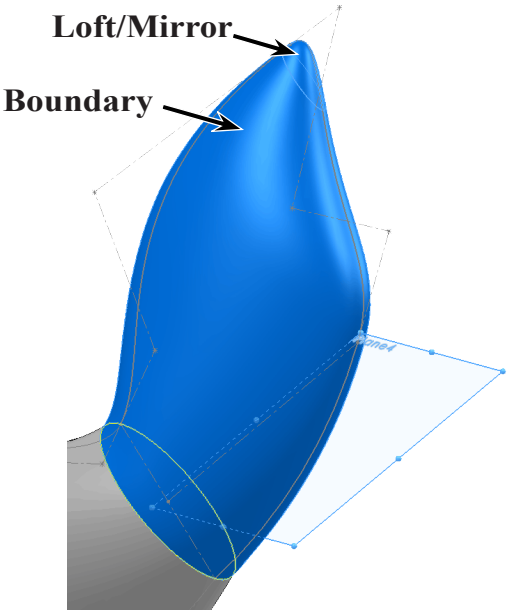


Fig. 73

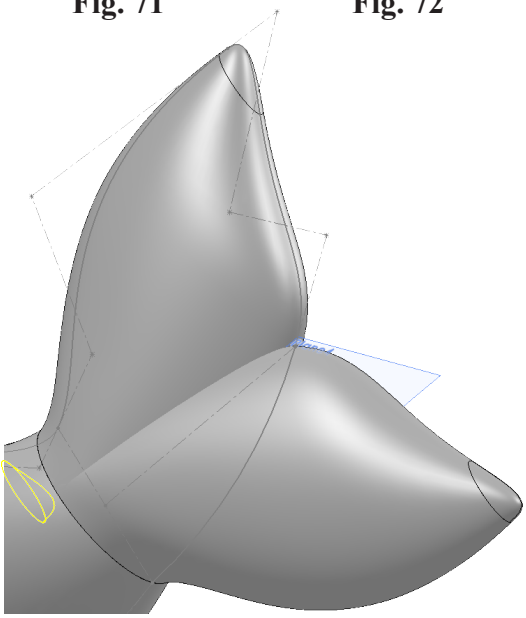


Fig. 74

T. Extrude Boss.

Step 1. **Hide Master Sketch**. To hide, expand Revolve1 in the Feature Manager, click Sketch1 and **Hide** on the context toolbar, **Fig. 75**.

Step 2. **Hide Plane4** . To hide Plane4, Click **Plane4** in the Feature Manager and click **Hide** on the context toolbar, **Fig. 75**.

Step 3. Click **Top Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 76**.

Step 4. Rotate view to view **top of Base**, hold down middle mouse button (wheel) and drag to rotate view, **Fig. 78**.

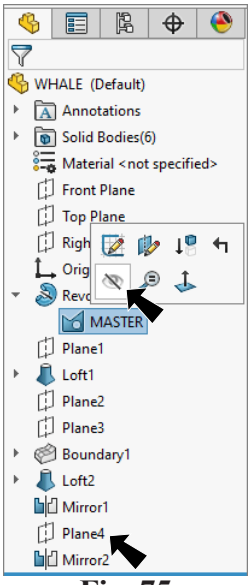


Fig. 75

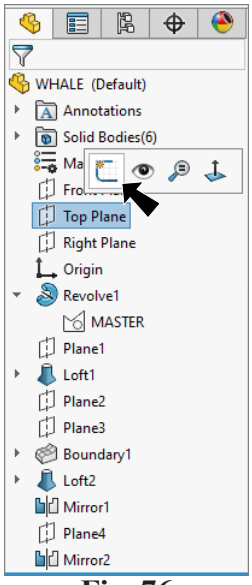


Fig. 76

Step 5. Click **Offset Entities** on the Sketch toolbar.

Step 6. In the Offset Entities Property Manager set:
under Parameters, **Fig. 77**

Distance **3**
check **Reverse**
click **top face, Fig. 78**
The yellow offset should be inside original sketch.
If it is not, uncheck Reverse.
click OK .

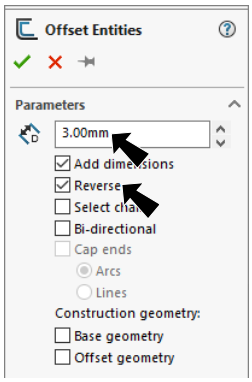


Fig. 77

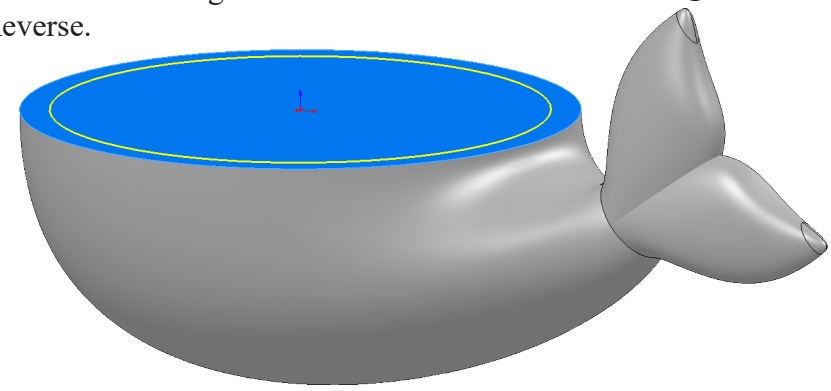


Fig. 78

Step 7. Click **Features** Features on the Command Manager toolbar.

Step 8. Click **Extruded Boss/Base** Extruded Boss/Base on the Features toolbar.

Step 9. In the Boss-Extrude Property Manager set:
under Direction 1, **Fig. 79**

Depth D1 **6**

click OK ✔ .

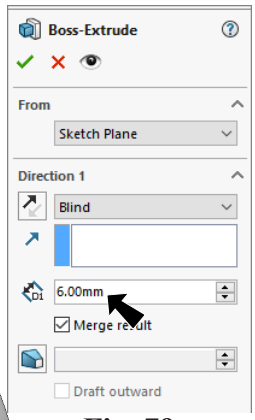


Fig. 79

Step 9. Save. Use **Ctrl-S**.

U. Shell.

Step 1. Click **Shell** Shell on the Features toolbar.

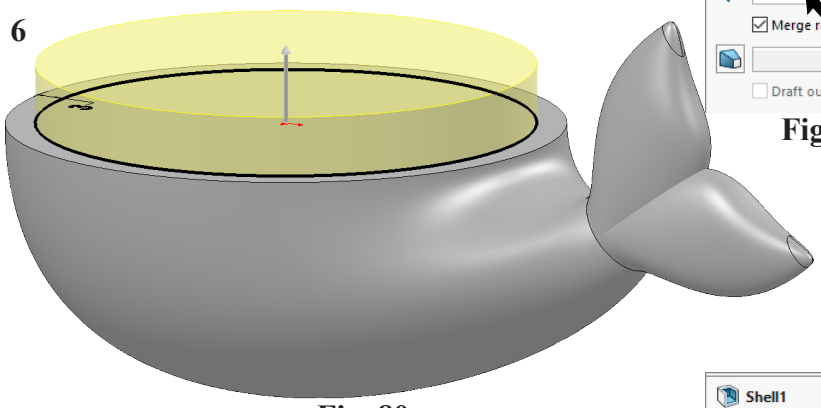


Fig. 80

Step 2. In the Shell Property Manager set:
under Parameters, **Fig. 81**

Distance D1 **2**

click **top face**, **Fig. 82** Click OK at message.

click OK ✔ .

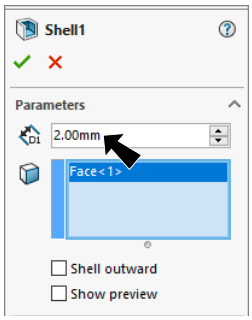


Fig. 81

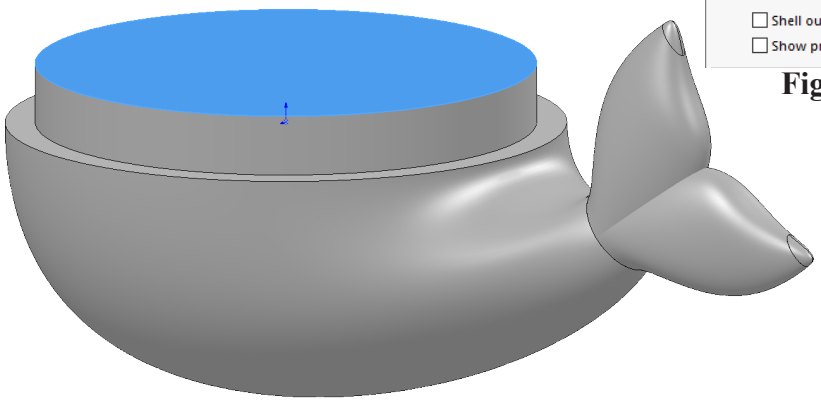


Fig. 82

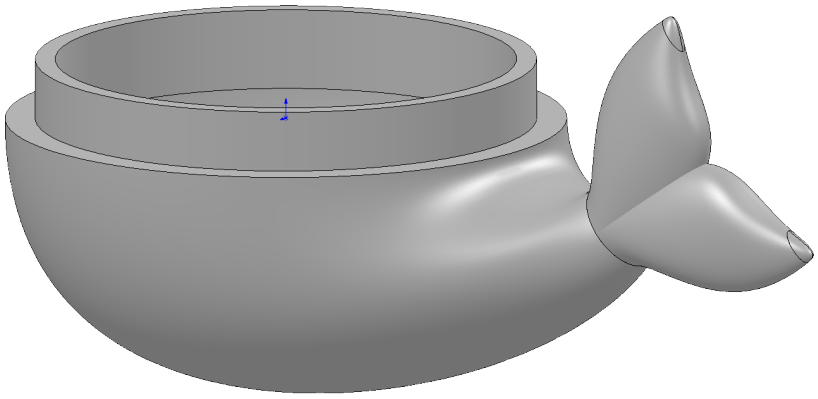


Fig. 83

V. Combine.

Step 1. Click Insert Menu > Features > Combine.

Step 2. In the Combine Property Manager:
under Operation Type, **Fig. 84**
select **Add**
drag a selection to select all, **Fig. 88**
click OK ✔ .

Tip: If the Combine errors out, go back to the Boundary1 (page 11) under Direction 1 **reselect the 3 profiles**, **Fig. 46**.

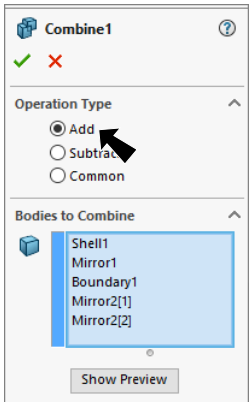


Fig. 84

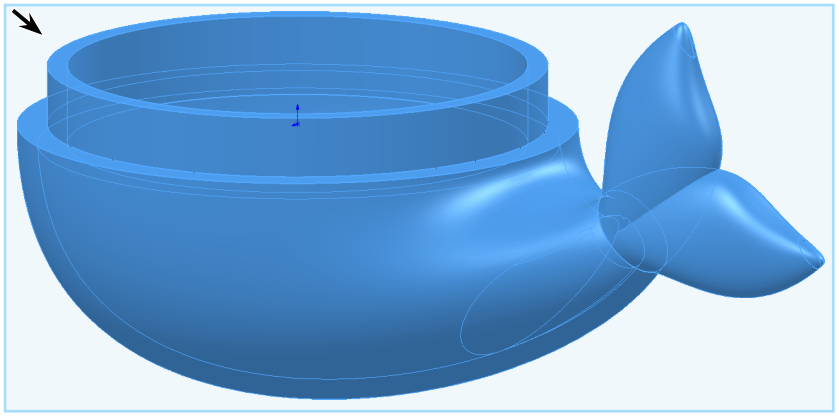


Fig. 85

W. Rename Combine1 to Base.

Step 1. **Combine1** body to **BASE**. To rename, expand **Solid Bodies** folder in the Feature Manager. Slowly click twice over Combine1 and key-in **BASE**, **Fig. 86**.

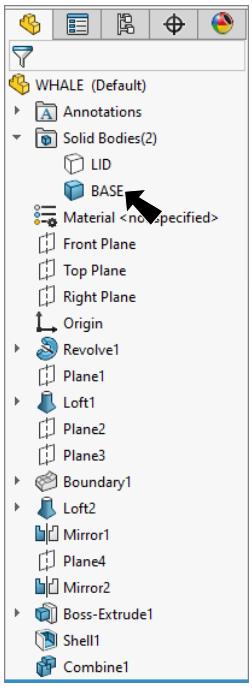


Fig. 86

X. Fillet 1.

Step 1. Click **Fillet** on the Features toolbar.

Step 2. In the Fillet Property Manager set:
select **Manual**, **Fig. 87**
under Fillet Type
select **Constant Size Fillet**
under Fillet Parameters
Radius **3**
Profile **Curvature continuous**
click **edge between flutes mirror**, **Fig. 88**
click OK .

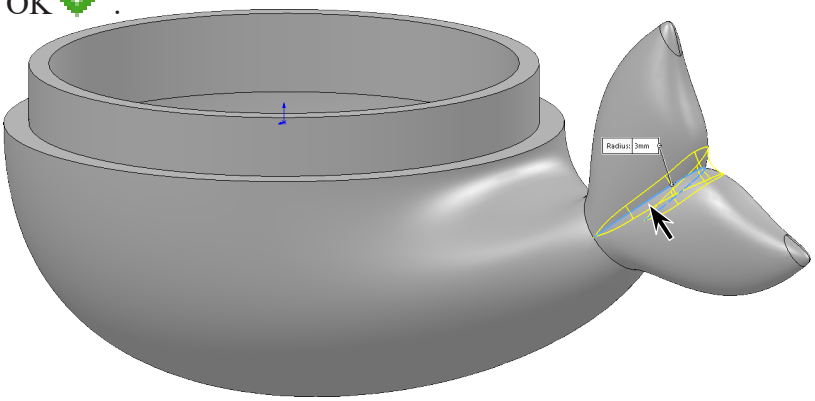


Fig. 88

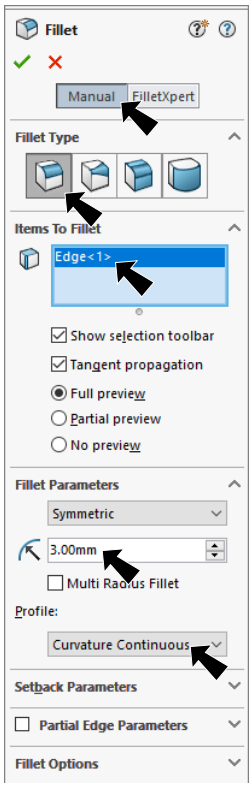


Fig. 87

Y. Fillet 2.

Step 1. Click **Fillet** on the Features toolbar.

Step 2. In the Fillet Property Manager set:
under Fillet Type, **Fig. 89**
select **Constant Size Fillet**
under Fillet Parameters
Radius **3**
Profile **Curvature continuous**
click **edges (2) between Loft1 and flutes**, **Fig. 90**
click OK .

Step 3. Save.
Use
Ctrl-S.

Tip: Save a copy if you are planning on trying both theard method.

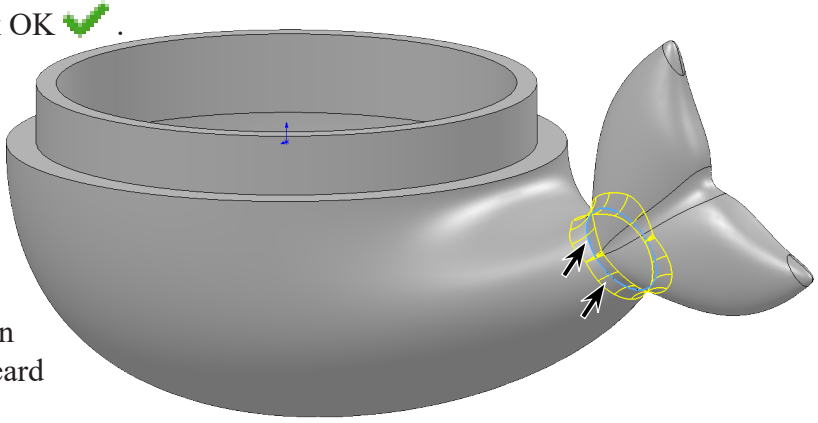


Fig. 90

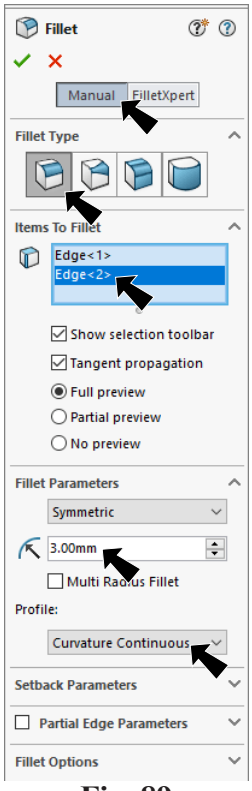


Fig. 89