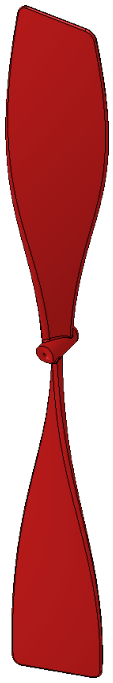
Chapter 8

Delta Dart Propeller



A. Base for Blade.

Step 1. Click File Menu > New, click **Part Metric** and OK.

Step 2. Click **Top Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 1**.

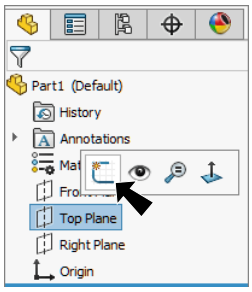


Fig. 1

Step 3. Click **Center Rectangle** in the **Rectangle flyout** on the Sketch toolbar.

Step 4. Sketch center rectangle at Origin , **Fig. 2**.

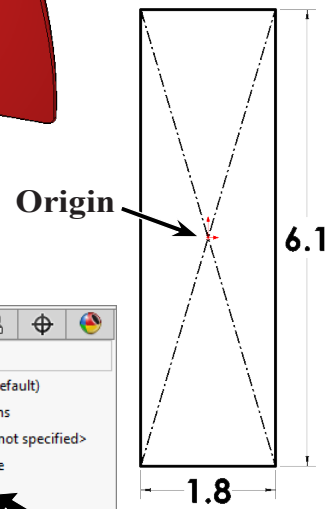


Fig. 2

Step 5. Click **Smart Dimension** (**S**) on the Sketch toolbar.

Step 6. Dimension rectangle **6.1 by 1.8**, **Fig. 2**.

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

B. Create Plane.

Step 1. Click **Trimetric** on the Standard Views toolbar.

Step 2. Click **Top Plane** in the Feature Manager, **Fig. 3**.

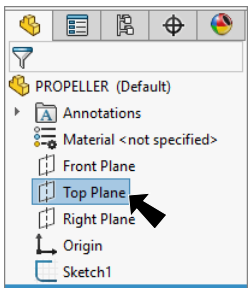
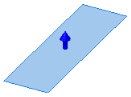


Fig. 3



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. 4**

Distance **67** and press **ENTER**
click in graphic area and press F key to **Zoom to Fit**
the new plane should be **above sketch**, **Fig. 5**
if in wrong direction, check Flip offset

click OK .

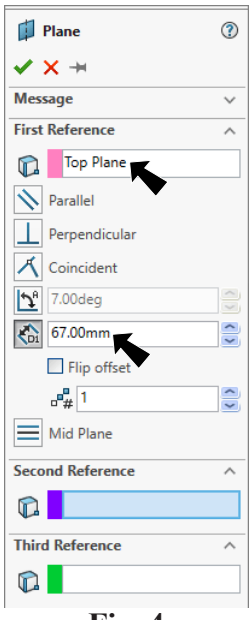


Fig. 4

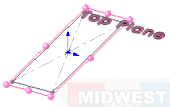


Fig. 5

C. Save as "PROPELLER".

Step 1. Click File Menu > Save As.

Step 2. Key-in **PROPELLER** for the filename and press ENTER.

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D. Create Sketch in Plane 1.

Step 1. Click **Plane1** in the Feature Manager and click **Sketch** on the sketch toolbar, **Fig. 6**.

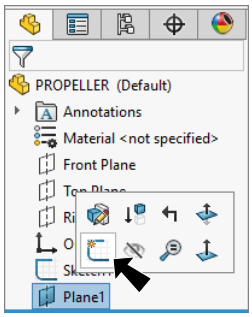


Fig. 6

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

Step 3. Click **Center Rectangle** **(S)** on the Sketch toolbar.

Step 4. Starting from the Origin sketch a rectangle, **Fig. 7**.

Step 5. Click **Smart Dimension** **(S)** on the Sketch toolbar.

Step 6. Dimension rectangle **.65 by 16.5**, **Fig. 8**.

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

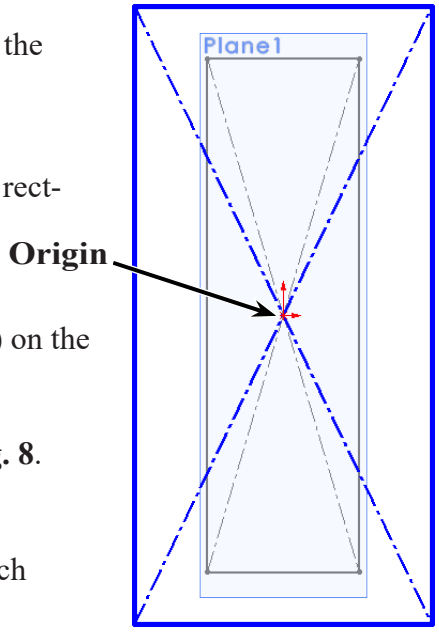


Fig. 7

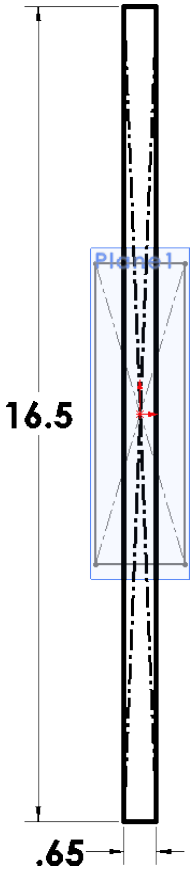


Fig. 8

E. Hide Plane1.

Step 1. Click **Trimetric** on the Standard Views toolbar.

Step 2. Click **Plane1** in graphic area and click **Hide** on the context toolbar, **Fig. 9**.

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

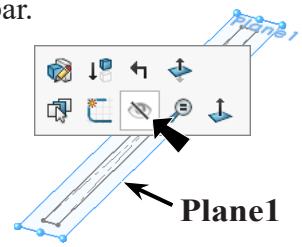


Fig. 9

F. Guide Curve 1

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

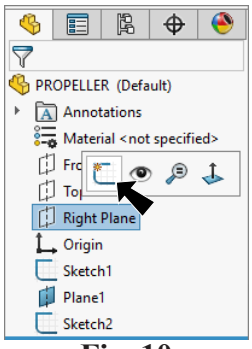


Fig. 10

Step 2. Click **Style Spline** in the **Spline flyout** on the Sketch toolbar.

Step 3. Sketch a **4 control vertex point Spline** to left of Sketches, **Fig. 11**. Press Escape to end spline.

Step 4. Zoom in around **top endpoint of Spline and left end of Sketch2**, **Fig. 11**.

Step 5. **Ctrl click endpoint of Spline and left end line of rectangle in Sketch2** to select both. **Release Ctrl key** and click **Make Pierce** on the context toolbar, **Fig. 12**. Make Pierce adds a Pierce relation between spline and rectangle.

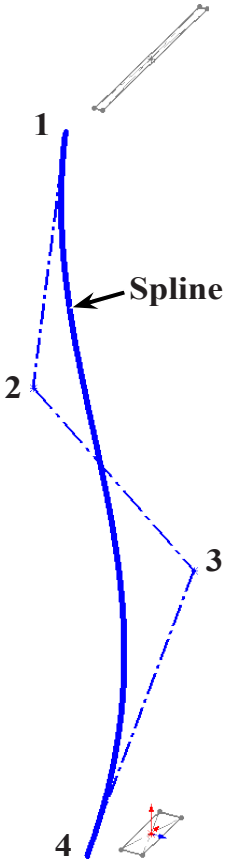


Fig. 11

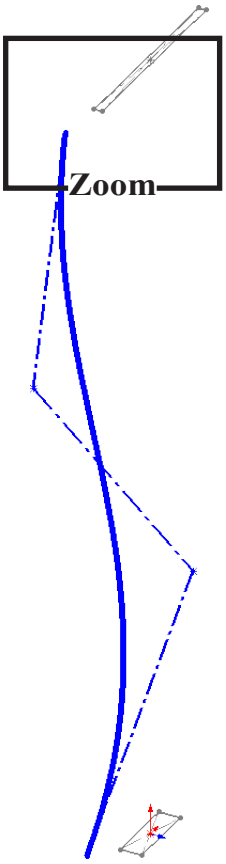


Fig. 12

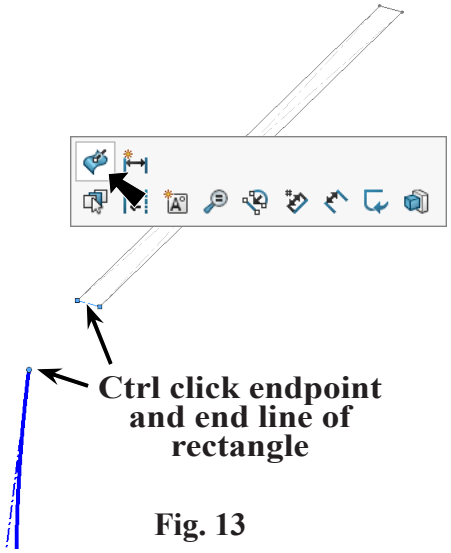


Fig. 13

Step 6. Zoom out (F) and zoom in around **bottom endpoint of Spline and left end of Sketch1**, **Fig. 14**.

Step 7. **Ctrl click endpoint of Spline and left end line of rectangle in Sketch1** to select both. **Release Ctrl key** and click **Make Pierce** on the context toolbar, **Fig. 15**.

Step 8. Click **Right** on the Standard Views toolbar. (**Ctrl-4**)

Step 9. Click **Smart Dimension** (**S**) on the Sketch toolbar.

Step 10. Dimensions control vertex points, **Fig. 16**.
Tip: To flip the 1.2 dimension, key in -1.2.

Step 11. Click **Exit Sketch** on the Sketch toolbar.

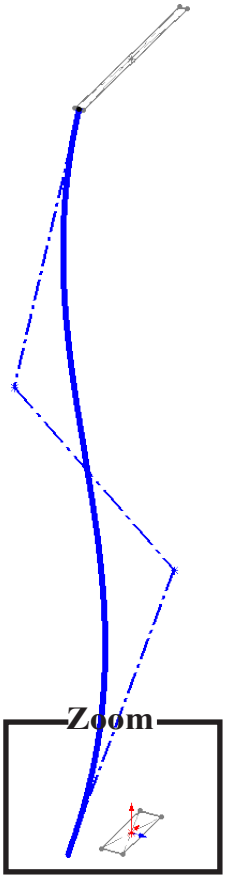


Fig. 14

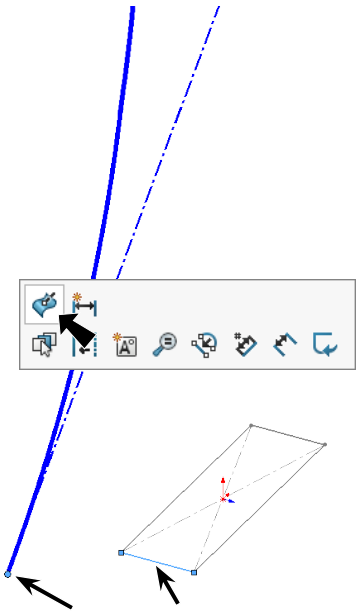


Fig. 15

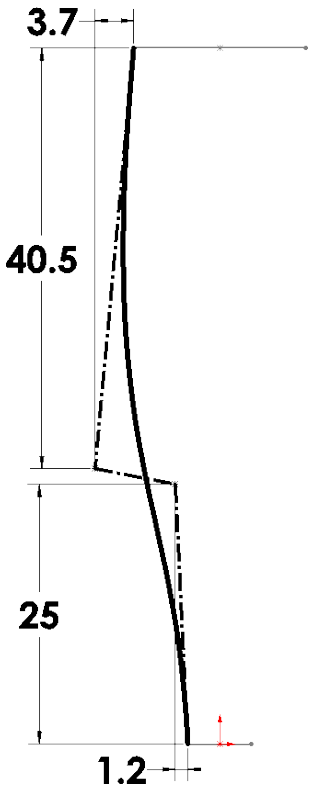


Fig. 16

G. Guide Curve 2

Step 1. Click **Right Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 17**.

Step 2. Click **Style Spline** in the **Spline flyout** on the Sketch toolbar.

Step 3. Sketch a **4 control vertex point Spline** to right of Sketches, **Fig. 18**. Press Escape to end spline.

Step 4. Click **Trimetric** on the Standard Views toolbar.

Step 5. Zoom in around **top endpoint of Spline and left end of Sketch2**, **Fig. 19**.

Step 6. **Ctrl click endpoint of Spline and right end line of rectangle in Sketch2** to select both. **Release Ctrl key** and click **Make Pierce** on the context toolbar, **Fig. 20**.

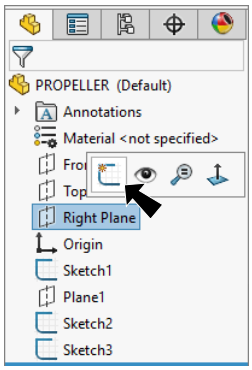


Fig. 17

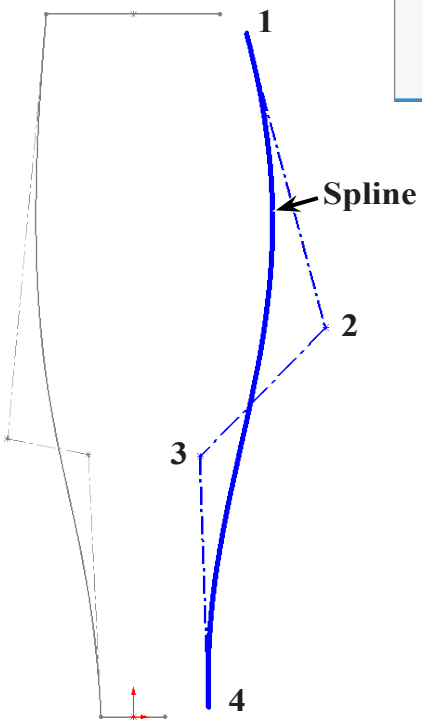


Fig. 18

Fig. 19

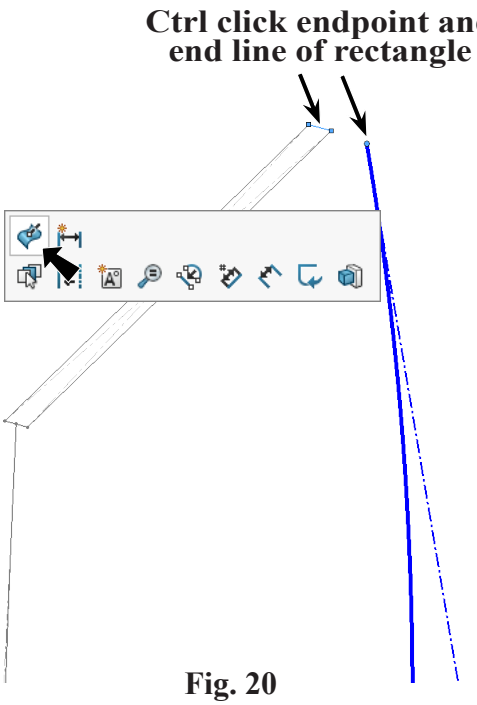


Fig. 20

Step 7. Zoom out (F) and zoom in around **bottom endpoint of Spline and left end of Sketch1**, **Fig. 21**.

Step 8. **Ctrl click endpoint of Spline and right end line of rectangle in Sketch1** to select both. **Release Ctrl key** and click **Make Pierce** on the context toolbar, **Fig. 22**.

Step 9. Click **Right** on the Standard Views toolbar. (**Ctrl-4**)

Step 10. Click **Smart Dimension**

(**S**) on the Sketch toolbar.

Step 11. Dimensions control vertex points, **Fig. 23**.

Step 11. Click **Exit Sketch**

on the Sketch toolbar.

Step 12. Save. Use **Ctrl-S**.

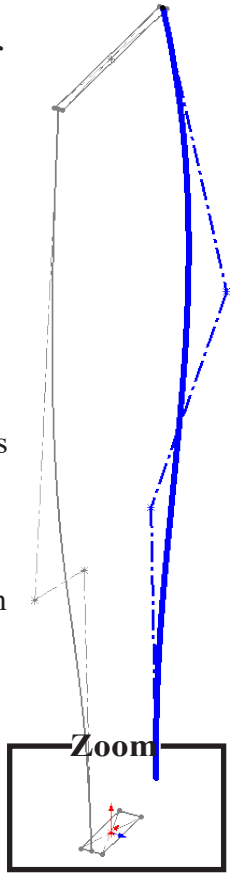


Fig. 21

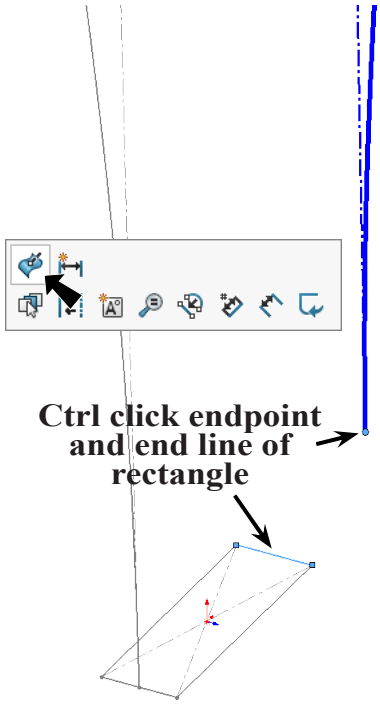


Fig. 22

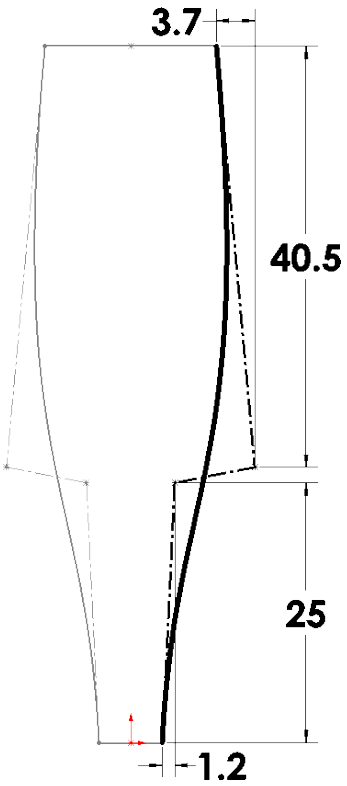


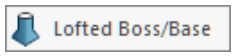
Fig. 23

H. Loft.

Step 1. Click **Trimetric** on the Standard Views toolbar.

Step 2. Click **Features**

on the Command Manager toolbar.

Step 3. Click **Lofted Boss/Base** 

on the Features toolbar.

Step 4. In the Loft Property Manager set:

under Profiles, **Fig. 24**

click the **same position on the two rectangle sketches**, **Fig. 25**

Sketch2

Sketch1

under Guide Curves

click in the Guide Curves box

click the two Guide Curve splines

Sketch3

Sketch4

click OK .

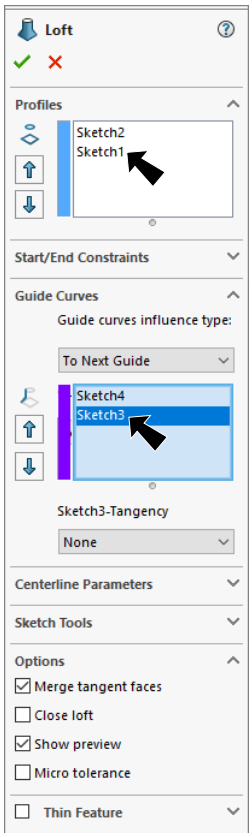


Fig. 24

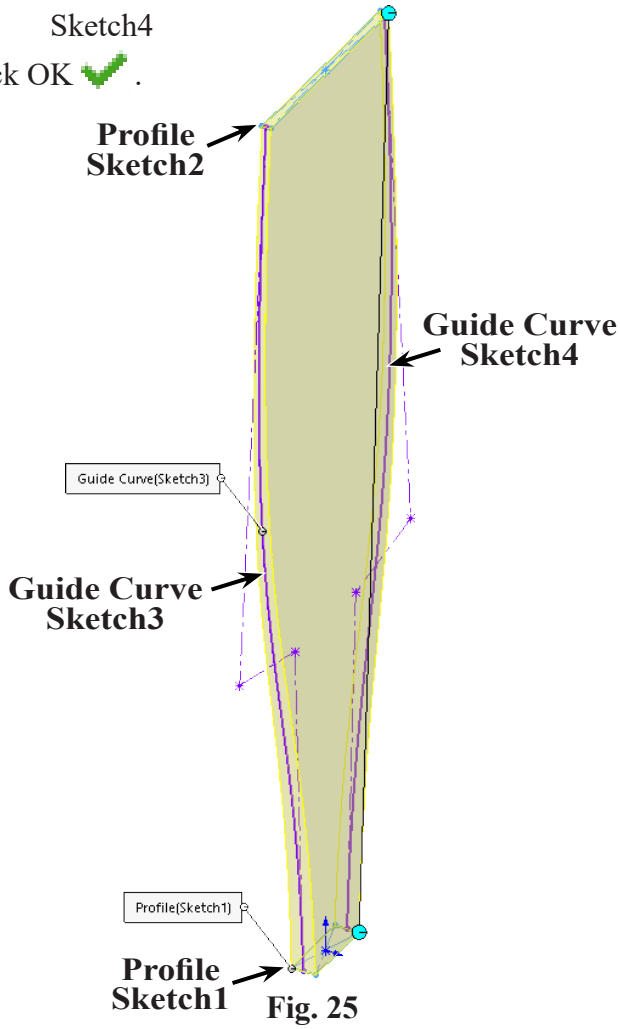


Fig. 25

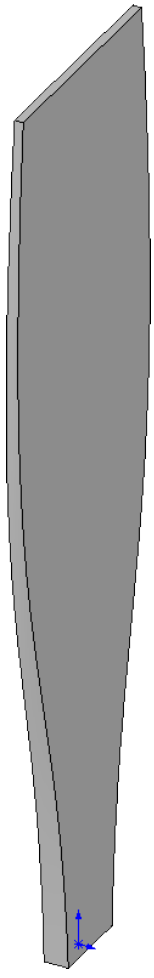


Fig. 26

I. Flex Blade.

Step 1. Click Insert Menu > Features > Flex.

Step 2. In the Flex Property Manager set:
under Flex Input, **Fig. 27**
click the **Loft** in graphics area

select **Twisting**

Angle **-73 degrees**

under Trim Plane 1

Trimming distance **1**

under Triad

Y Rotation Origin **-23**

click OK .

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

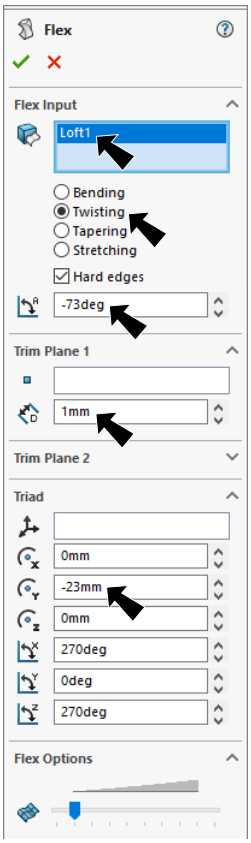


Fig. 27

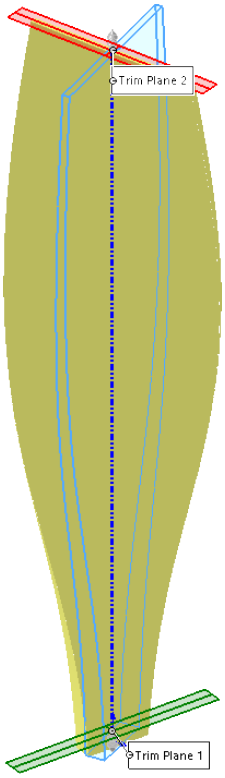


Fig. 28

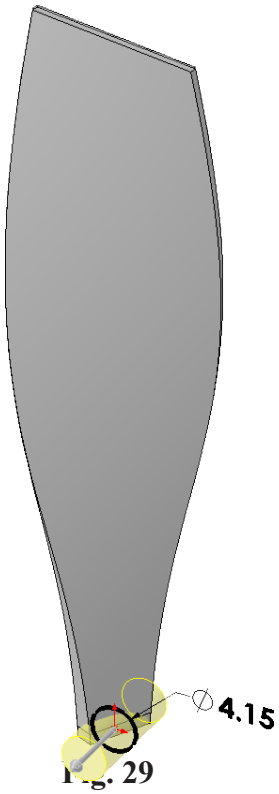


Fig. 29

J. Hub.

Step 1. Click **Front Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 30**.

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

Step 3. Click **Circle** **(S)** on the Sketch toolbar.

Step 4. Sketch circle for the hub at Origin , **Fig. 31**.

Step 5. Click **Smart Dimension** **(S)** on the Sketch toolbar.

Step 6. Dimension circle **diameter 4.15**, **Fig. 31**.

Step 7. Click **Trimetric** on the Standard Views toolbar.

Step 8. Click **Features** on the Command Manager toolbar.

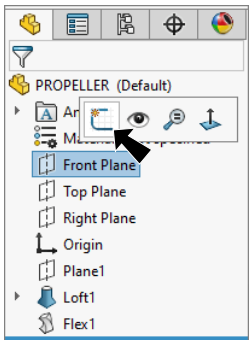


Fig. 30

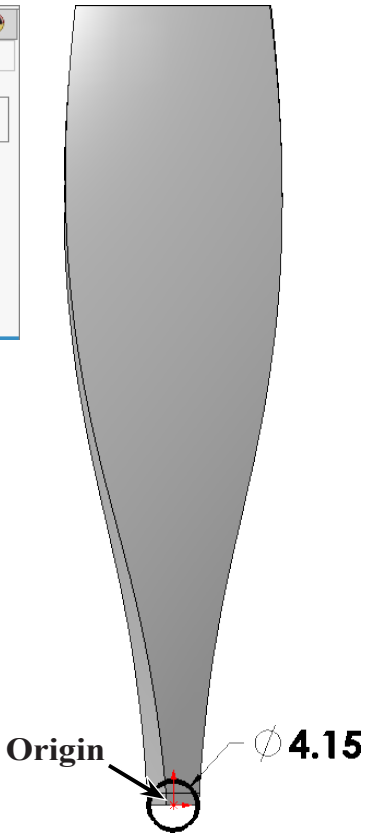
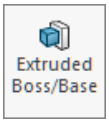


Fig. 31

Step 9. Click **Extruded Boss/Base** 

on the Features toolbar.

Step 10. In the Boss-Extrude Property Manager set:
under Direction 1, **Fig. 32**
End Condition **Mid Plane**
Depth **10.7**

check **Merge result**
click OK .

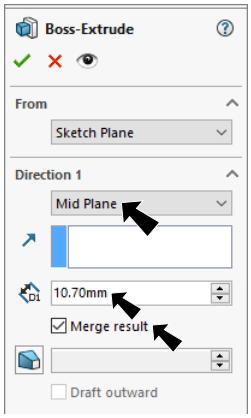


Fig. 32

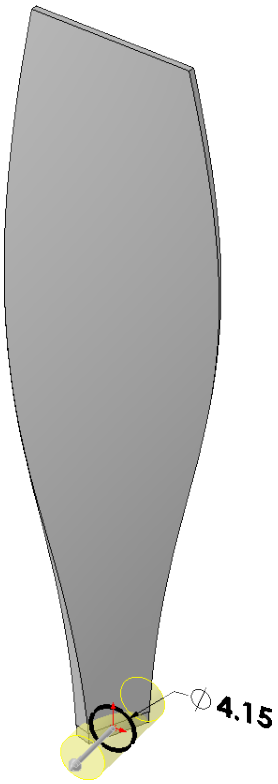


Fig. 33

K. Cut Hole.

Step 1. Click the **front face** of the hub and click **Sketch** on the context toolbar, **Fig. 34**.

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

Step 3. Sketch a circle for the hole at Origin , **Fig. 35**.

Step 4. Click **Smart Dimension**

(S) on the Sketch toolbar.

Step 5. Dimension circle **diameter 1.2**, **Fig. 35**.

Step 6. Click **Features**

on the Command Manager toolbar.

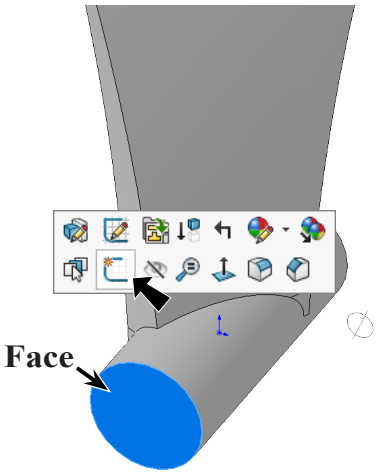


Fig. 34

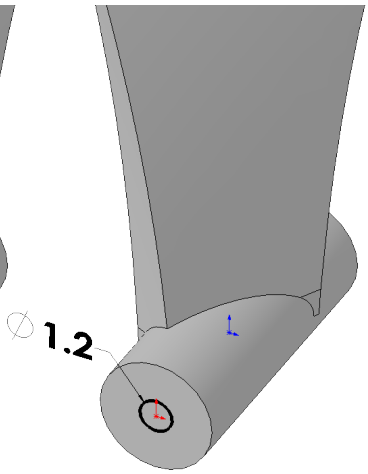
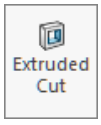


Fig. 35

Step 7. Click **Extruded Cut** 

on the Features toolbar.

Step 8. In the Cut-Extrude Property Manager set:
under Direction 1, **Fig. 36**
End Condition **Through All**
click OK .

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

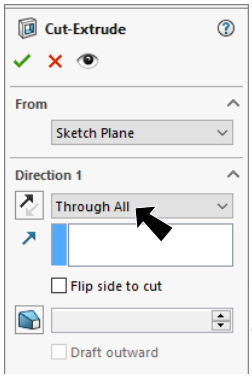


Fig. 36

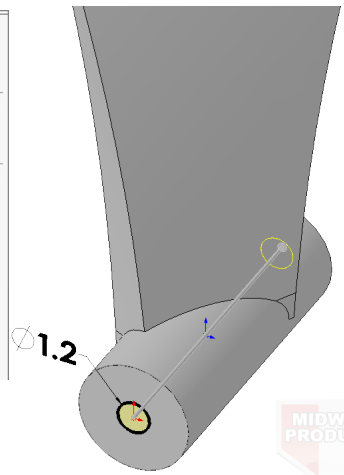


Fig. 37

L. Fillet Blade Tip Edges.

Step 1. Zoom in around **blade tip**, **Fig. 38**. To zoom, place the cursor over the blade tip and spin the wheel on mouse back.

Step 2. Click **Fillet**

on the Features toolbar.

Step 3. In the Fillet Property Manager set:
select **FilletXpert**, **Fig. 39**

Radius **2**
click **top corners edges of blade**, **Fig. 40**
click **Apply**.

Step 4. Click **Zoom to Fit** **(F)** on the View toolbar.

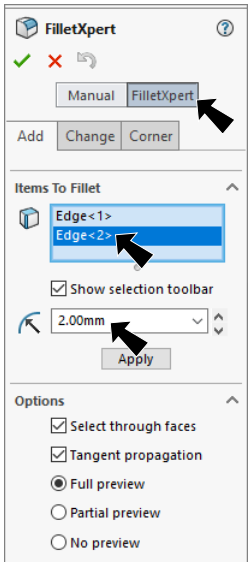


Fig. 39

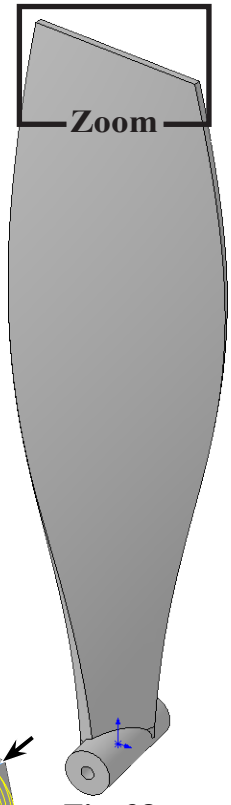


Fig. 38

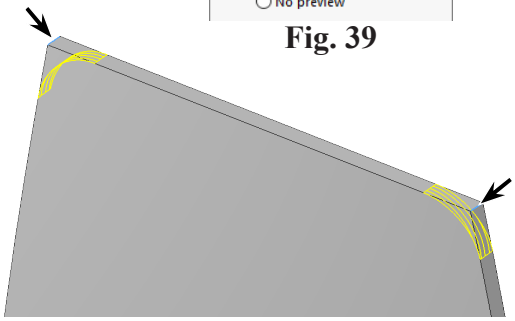


Fig. 40

M. Variable Fillet Blade Front.

Step 1. Still in Fillet Property Manager:

select **Manual**, **Fig. 41**
under Fillet type

select **Variable Size Fillet**
under Variable radius Parameters

Radius **.3**

right click front edge of blade and click **Select Tangency** to select the front edge, **Fig. 42**

click **Set All** button, **Fig. 41**.

Set **both Unsigned Variable radius at bottom to 1**, **Fig. 43**. The radius at top should be set to .3. To set radius, click Unsigned and key in radius and press ENTER.

Click OK .

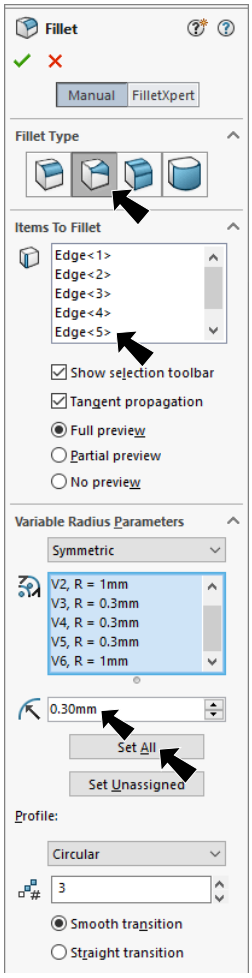


Fig. 41

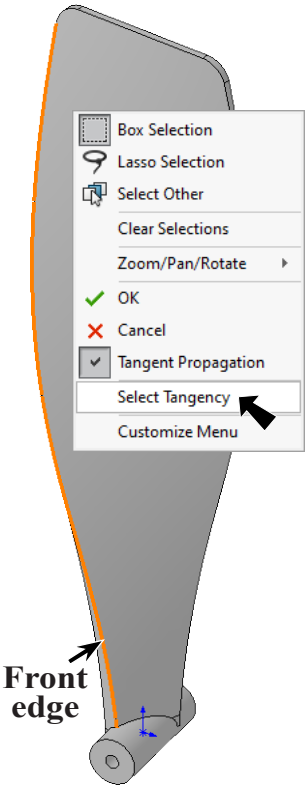


Fig. 42

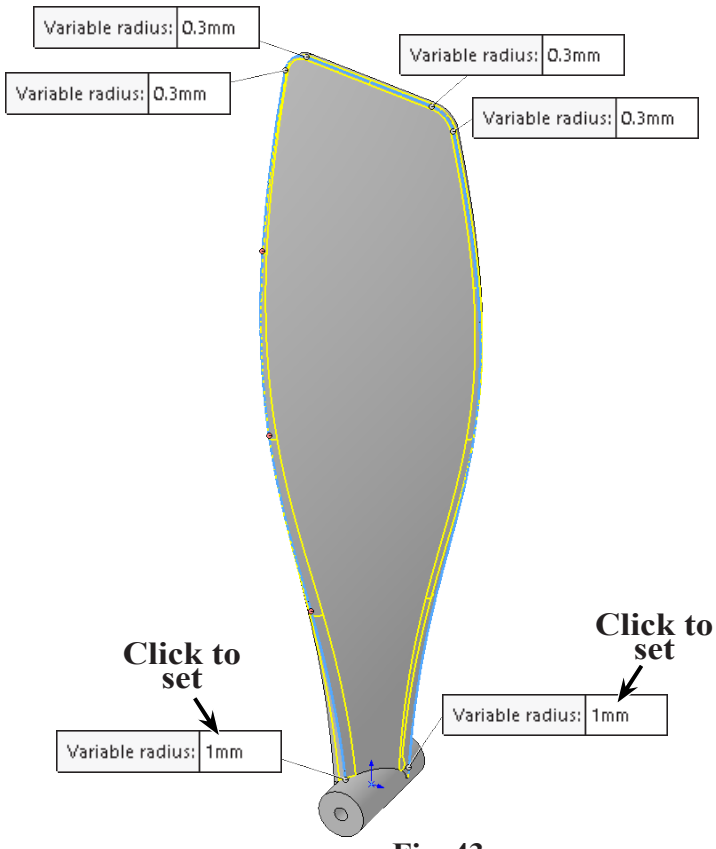


Fig. 43

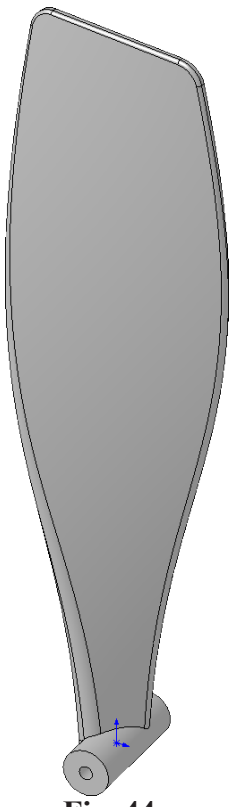


Fig. 44

N. Variable Fillet Blade Back.

Step 1. Click **Back** on the Standard Views toolbar.

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

Step 3. In the Fillet Property Manager set:

select **Manual**, **Fig. 45**
under Fillet type

select **Variable Size Fillet**
under Variable radius Parameters

Radius **.3**

right click front edge of blade and click **Select Tangency** to select the front edge, **Fig. 46**

click **Set All** button

Set **both Unsigned Variable radius at bottom to 1**, **Fig. 47**.

Click OK .

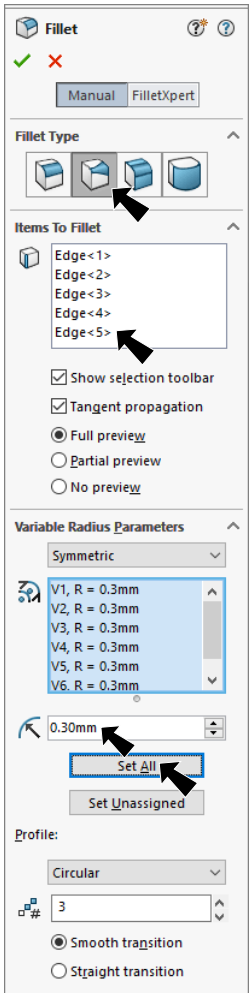


Fig. 45

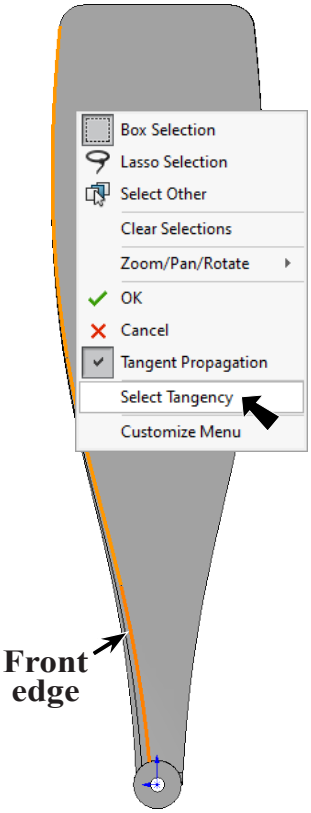


Fig. 46

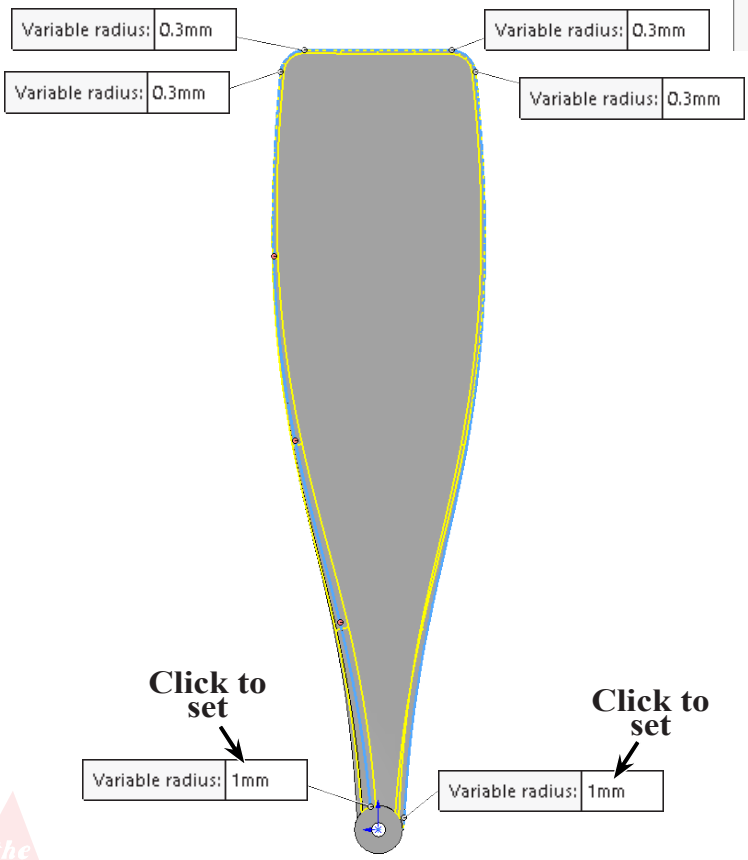


Fig. 47

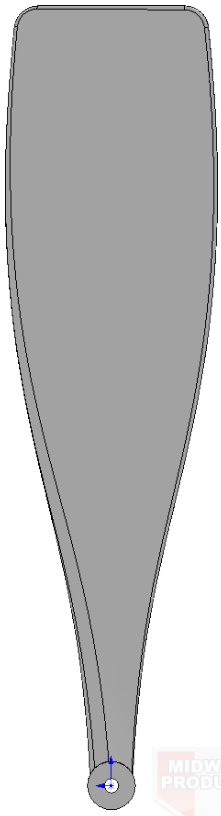


Fig. 48

O. Fillet Hub.

Step 1. Click **Trimetric** on the Standard Views toolbar.

Step 2. Zoom in around **hub**, **Fig. 49**. To zoom, place the cursor over the hub and spin the wheel on mouse back.

Step 3. Click **Fillet** on the Features toolbar.

Step 4. In the Fillet Property Manager set:
select **FilletXpert**, **Fig. 50**
Radius **.3**
click **side edge of blade at hub**, **Fig. 51**
click **Right Loop** **7 edges** on Fillet pop-up
click **Apply**, **Fig. 50**

Radius **1.6**, **Fig. 53**
click **rear cylindrical edge of hub**, **Fig. 54**
click OK .

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

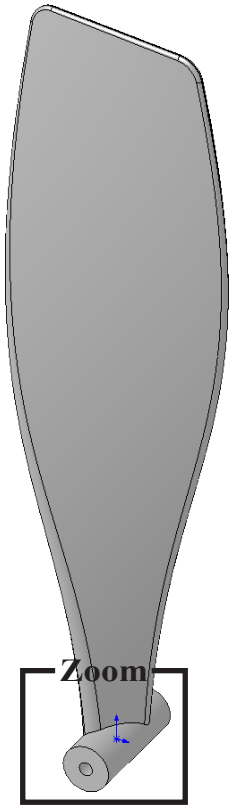


Fig. 49

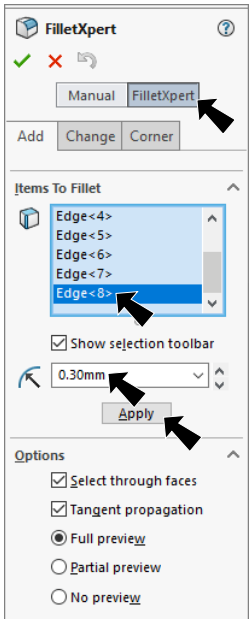


Fig. 50

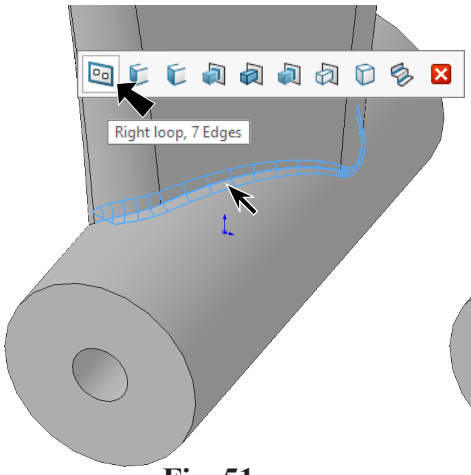


Fig. 51

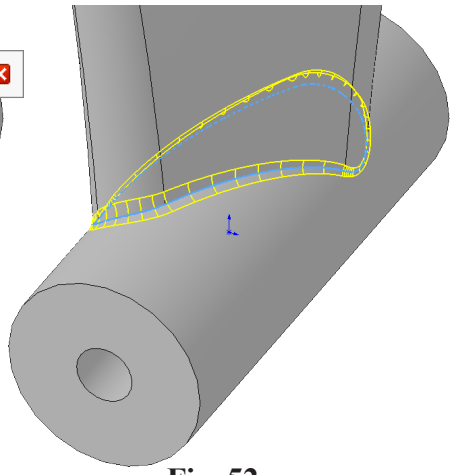


Fig. 52

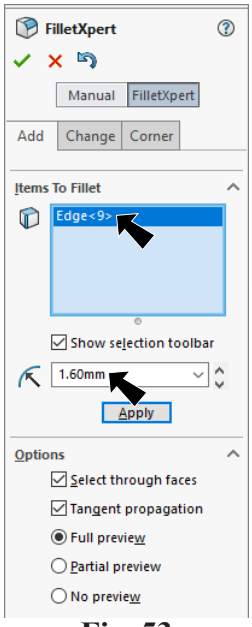


Fig. 53

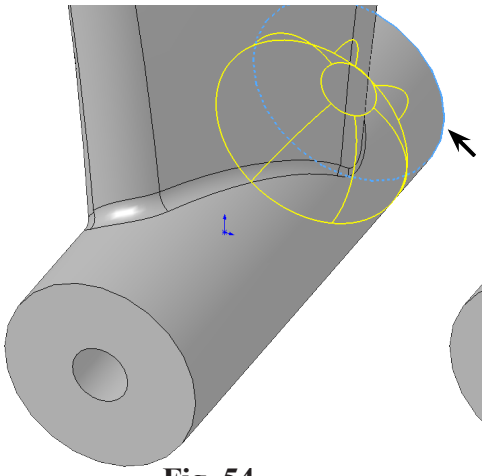


Fig. 54

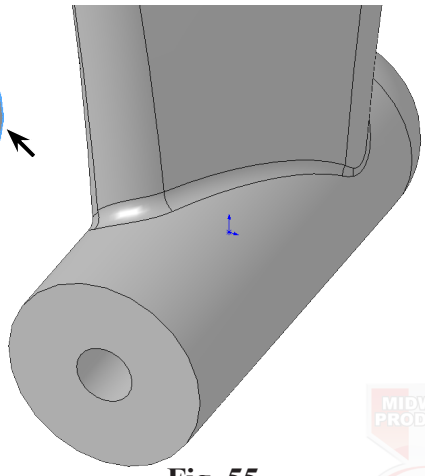
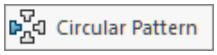


Fig. 55

P. Circular Pattern for Blade.

Step 1. Click **Zoom to Fit** **(F)** on the View toolbar.

Step 2. **Ctrl click the Loft1 and the first 4 Fillets** in the Feature Manager, **Fig. 56**. To Ctrl click, click Loft1, then hold down the Ctrl key and click the first 4 Fillet features.

Step 3. Click **Circular Pattern** 

in the **Linear Pattern flyout**

on the Features toolbar.

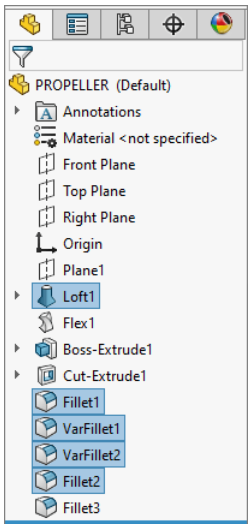


Fig. 56

Step 4. In the Circular Pattern Property Manager set:
under Direction 1, **Fig. 57**
Pattern Axis click **cylindrical face of hub**, **Fig. 58**
check **Equal spacing**
Number of Instances **2**
under Options
check **Geometry pattern**
click OK .

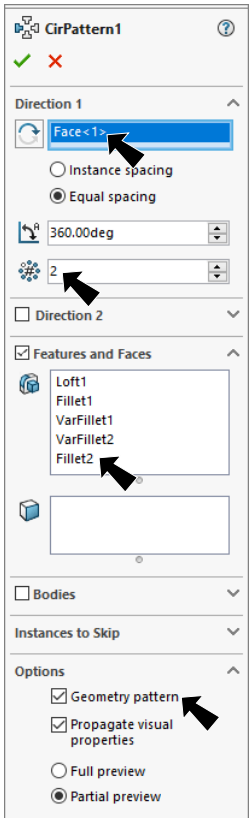


Fig. 57

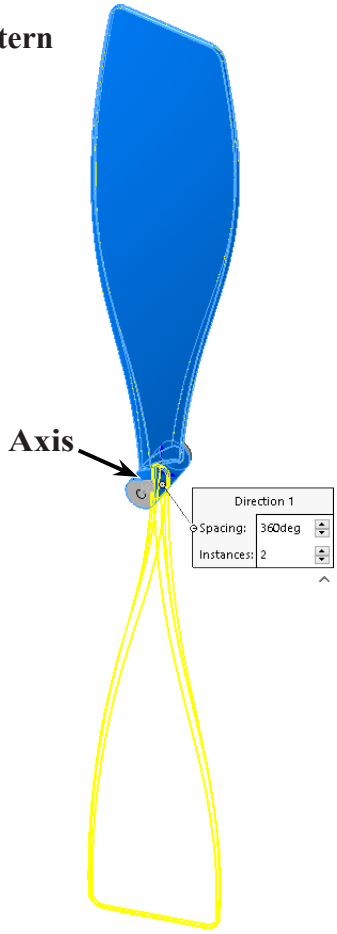


Fig. 58

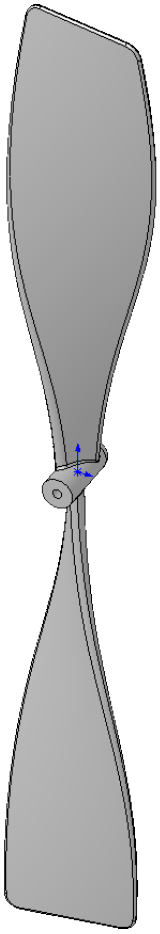


Fig. 59

Q. Sketch for Sweep Cut.

Step 1. Click **Trimetric** on the Standard Views toolbar.

Step 2. Zoom in around **hub**, **Fig. 60** To zoom, place the cursor over the hub and spin the wheel on mouse back.

Step 3. Click the **front face of hub** and click **Sketch** on the context toolbar, **Fig. 61**.

Step 4. With the face still selected, click **Convert Entities** on the Sketch toolbar, **Fig. 62**.

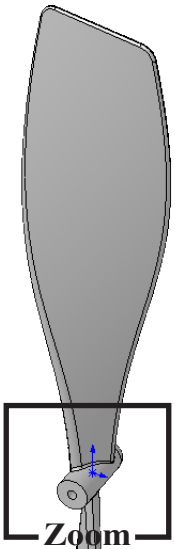


Fig. 60

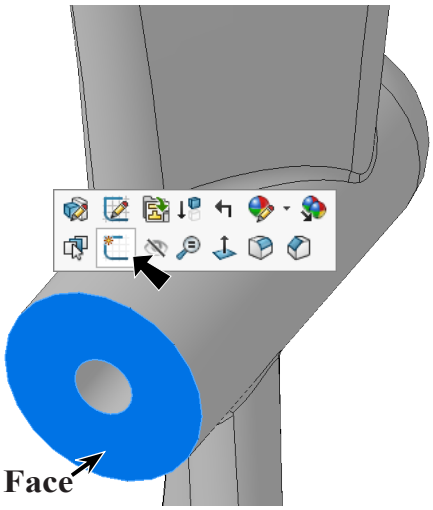


Fig. 61

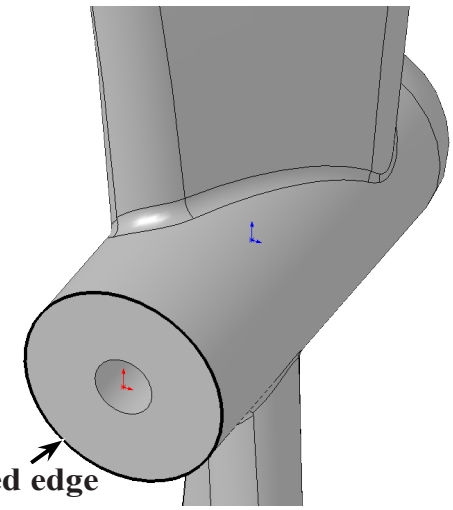


Fig. 62

R. Helix for Sweep Cut.

Step 1. Click Insert Menu > Curve > Helix/ Spiral.

Step 2. In the Helix/Spiral Property Manager set:

under Defined By, **Fig. 63**
select **Pitch and Revolution**

under Parameters
select **Constant Pitch**
Pitch: 2.7

check **Reverse direction**
Revolution: .98

Start angle 0

select **Counterclockwise**

click OK ✔ .

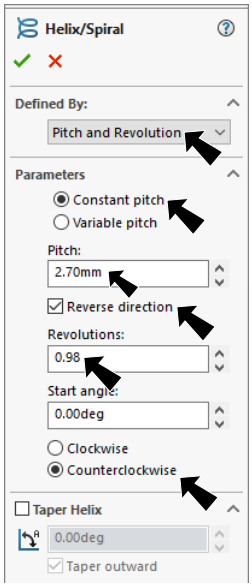


Fig. 63

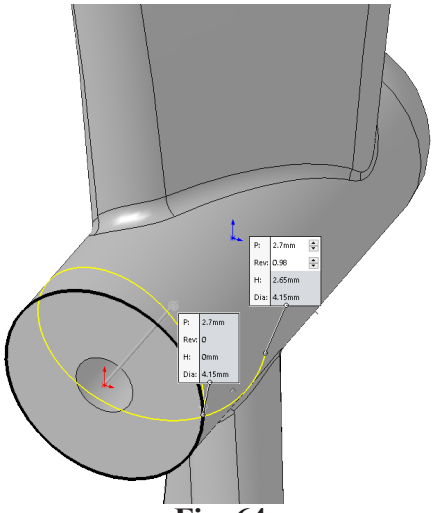


Fig. 64

S. Cut Sweep Sketch Profile.

Step 1. Click **Top Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 65**.

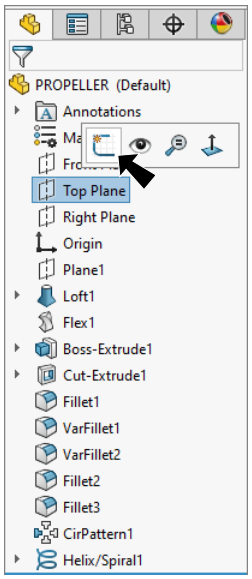


Fig. 65

Step 2. Click **Corner Rectangle** in the **Rectangle flyout** on the Sketch toolbar.

Step 3. Sketch a rectangle **out in front of the hub**, **Fig. 66**. Keep the right rear corner sort of close to the right edge of the hub.

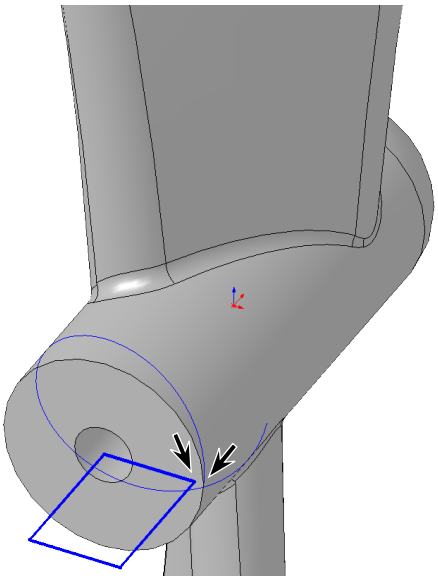


Fig. 66

Step 4. **Right click sketching and click Select** from menu to unselect Rectangle tool.

Step 5. **Ctrl click helix and vertex of rectangle** to select both.

Release Ctrl key and click **Make Pierce** on the context toolbar, **Fig. 67**. Make Pierce adds a Pierce relation between both sketch and helix.

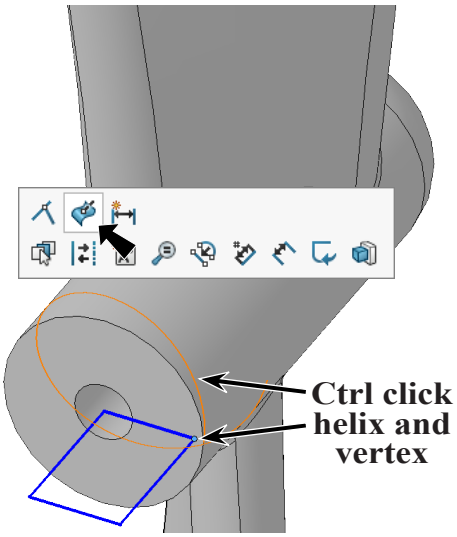


Fig. 67

Step 6. Click **Smart Dimension** (**S**) on the Sketch toolbar.

Step 7. Dimension rectangle **2.7 by 2**, **Fig. 68**.

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

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

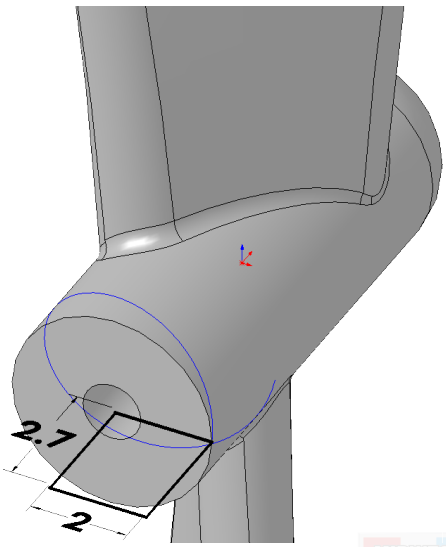


Fig. 68

T. Sweep Cut Helix.

Step 1. Click **Features** Features on the Command Manager toolbar.

Step 2. Click **Swept Cut** Swept Cut on the Features toolbar.

Step 3. In the Cut Swept Property Manager:
under Profile and Path, **Fig. 69**
Profile box, click **rectangle sketch, Fig. 70**
click in the **Path** box and click **helix**
expand Options
uncheck **Align with end faces**
click OK .

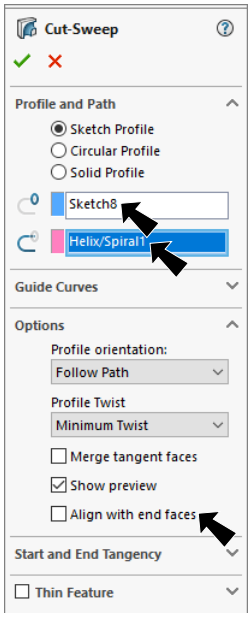


Fig. 69

Step 4. Click **Helix** in graphic area and click **Hide** on the context toolbar, **Fig. 71**.

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

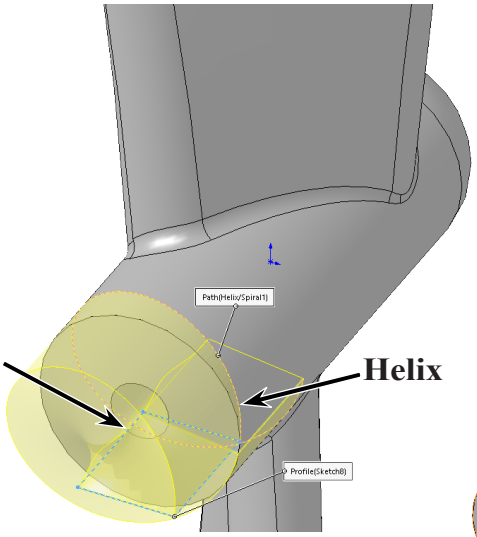


Fig. 70

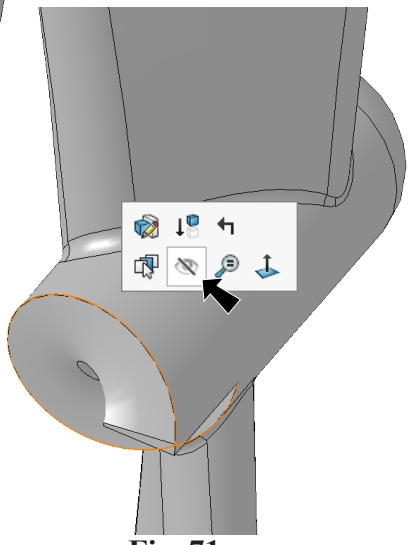


Fig. 71

U. Cut Hub.

Step 1. Click **Right Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 72**.

Step 2. Click **Normal To** on the Standard Views toolbar.

Step 3. Zoom in around **hub**, **Fig. 73**. To zoom, place the cursor over the hub and spin the wheel on mouse back.

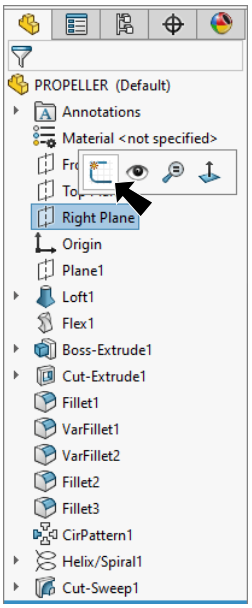


Fig. 72

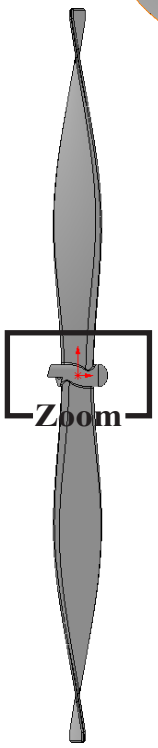


Fig. 73

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

Step 5. Sketch line from tip vertex of sweep cut to bottom sweep cut edge, **Fig. 74**.

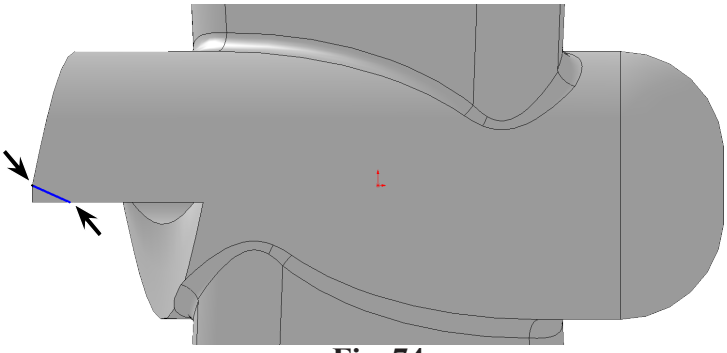


Fig. 74

Step 6. Click **Smart Dimension** (**S**) on the Sketch toolbar.

Step 7. Add **.58** dimension, **Fig. 75**.

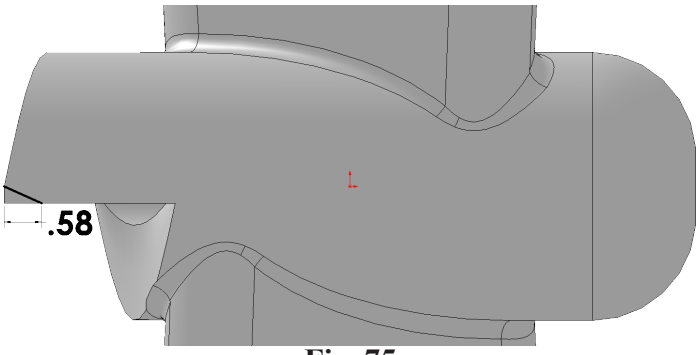


Fig. 75

Step 8. Click **Features** on the Command Manager toolbar.

Step 9. Click **Extruded Cut** on the Features toolbar.

Step 10. In the Cut-Extrude Property Manager set:
under Direction 1, **Fig. 76**
End Condition **Through All - Both**
check **Flip side to cut**
The **Direction arrow should point towards area to be cut away**, **Fig. 77.**
If arrow is pointing in wrong direction, uncheck **Flip side to cut**.
Click OK .

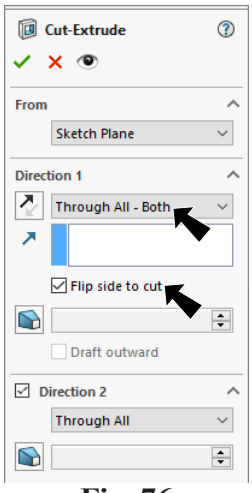


Fig. 76

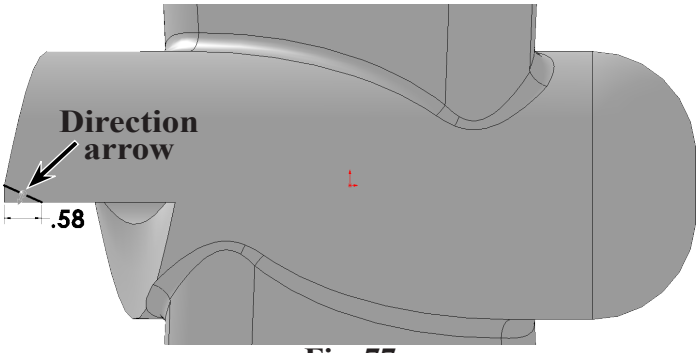


Fig. 77

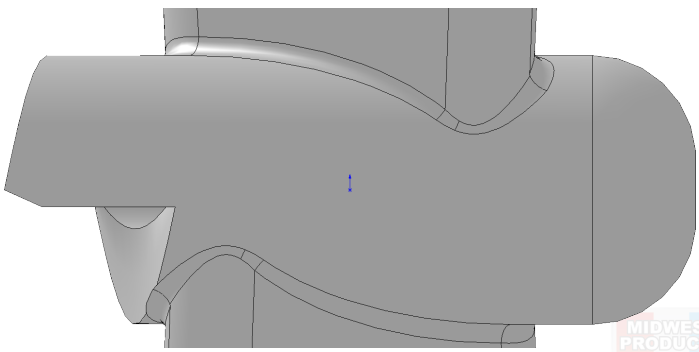


Fig. 78

V. Material POM Acetal Copolymer.

Step 1. Click **Trimetric** on the Standard Views toolbar.

Step 2. **Right click Material** in the Feature Manager and click **Edit Material**, **Fig. 79**.

Step 3. Expand **Plastics** in the material tree and select **POM Acetal Copolymer**. Click **Apply** and **Close**.

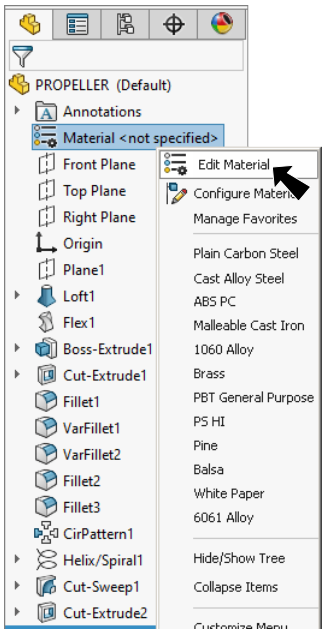


Fig. 79

W. Appearance Color.

Step 1. Click the **part**, click **Appearance Callout** on the context toolbar and click **PROPELLER**, **Fig. 80**.

Step 2. In the Appearances Task pane, expand **Plastic**, click **High Gloss** and in the lower pane select **red high gloss plastic**, **Fig. 81**.
Click OK in Property Manger, **Fig. 82**.

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

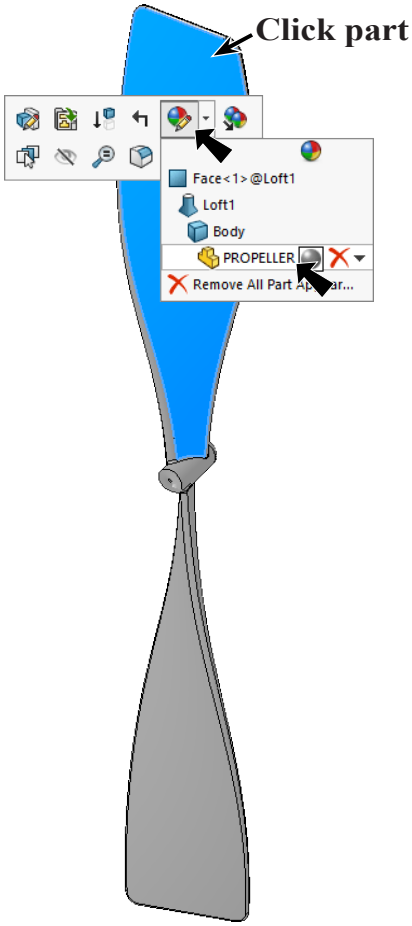


Fig. 80

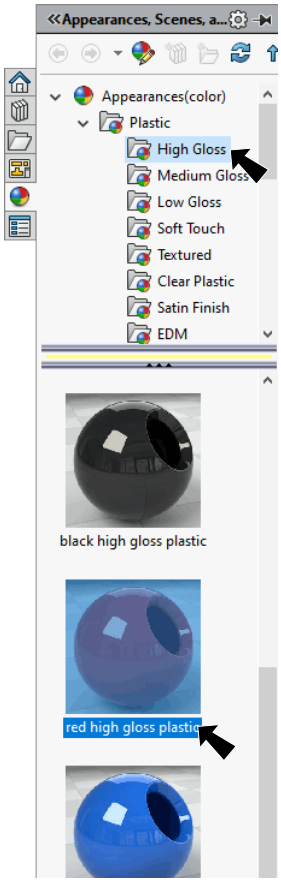


Fig. 81

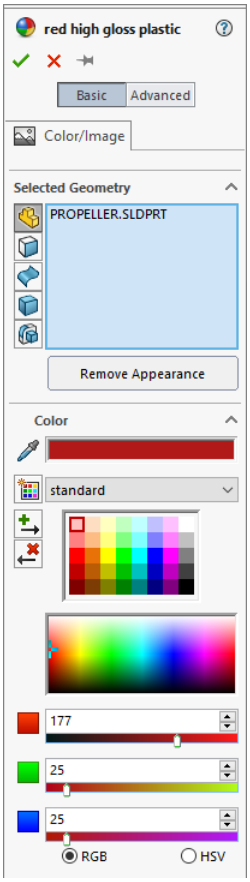


Fig. 82

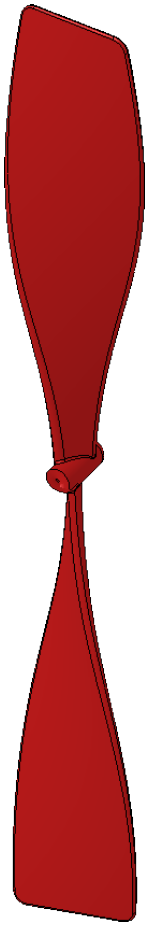


Fig. 83