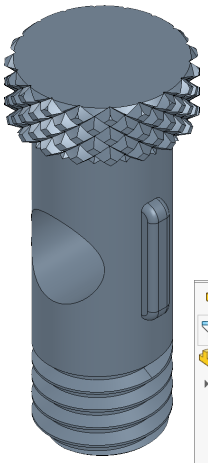
Chapter 3

Whomp Rocket

Bolt



A. Extrude1 Sketch1 Head.

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**.

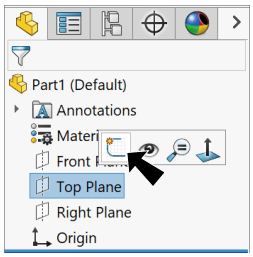


Fig. 1

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

Step 4. Sketch **circle at Origin** , **Fig. 2**.

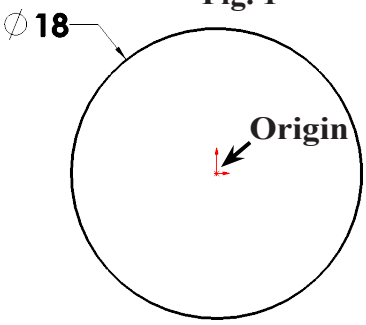


Fig. 2

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

Step 6. Dimension **diameters 18**, **Fig. 2**.

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

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

Step 9. In the Boss-Extrude Property Manager set:

under Direction 1, **Fig. 3**

End Condition **Blind**

Depth **6**

click OK .

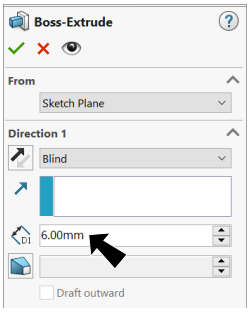


Fig. 3

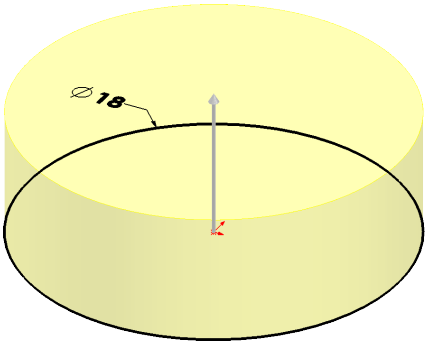


Fig. 4

B. Save as "BOLT".

Step 1. Click File Menu > Save As.

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

http://www.cudacountry.net email:cudacountry@hotmail.com

C. Extrude2 Sketch2 Shank.

Step 1. Click **Top Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 5**.

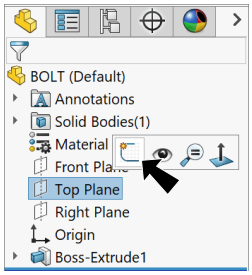


Fig. 5

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

Step 3. Sketch **circle at Origin** , **Fig. 6**.

Step 4. Click **Smart Dimension** (**S**) on the Sketch toolbar.

Step 5. Dimension **diameter 13**, **Fig. 6**.

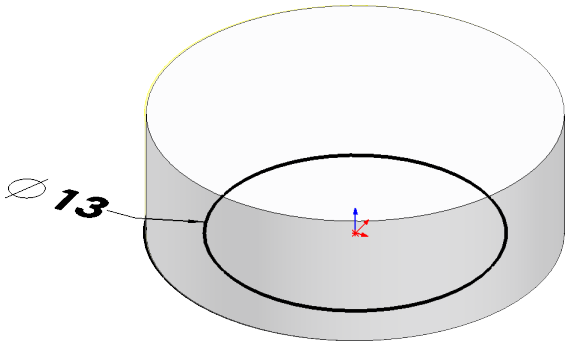


Fig. 6

Step 6. Click **Features** on the Command Manager toolbar.

Step 7. Click **Extruded Boss/Base** on the Features toolbar.

Step 8. In the Boss-Extrude Property Manager set:

under Direction 1, **Fig. 7**

End Condition **Blind**

Reverse Direction

Depth **35**

click OK .

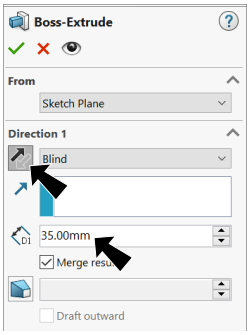


Fig. 7

Step 9. Save (**Ctrl-S**).

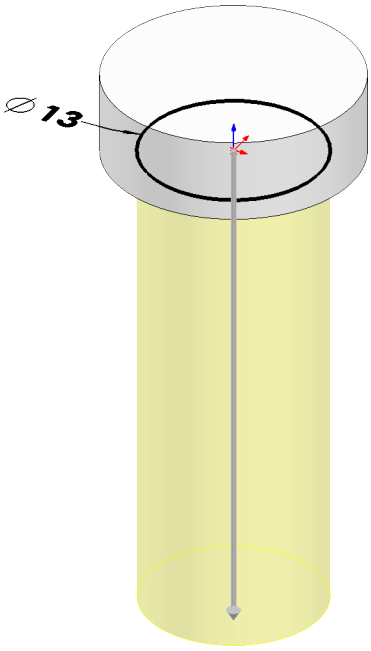


Fig. 8

D. Extrude-Cut1 Sketch3 Air Hole.

Step 1. Click **Front Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 9**.

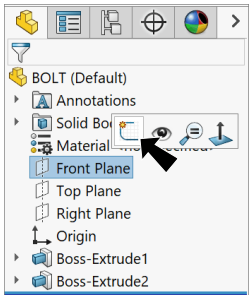


Fig. 9

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 at Origin** , **Fig. 10**.

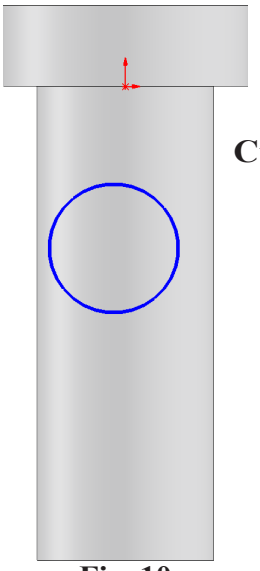


Fig. 10

Step 5. **Unselect Circle tool**. To unselect, **right click graphics area and click Select** from menu.

Step 6. **Ctrl click centerpoint of circle and Origin** to select both. Release Ctrl key and click **Make Vertical** on the context toolbar, **Fig. 11**.

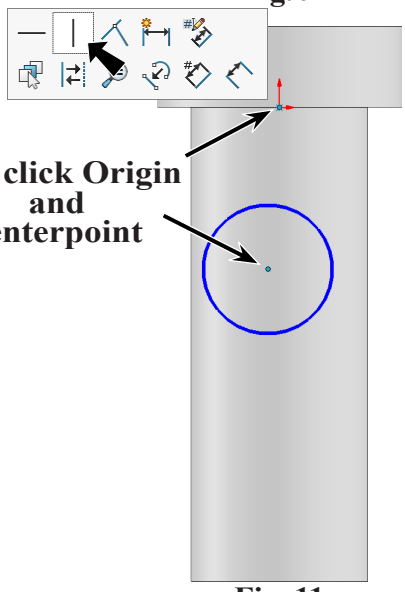


Fig. 11

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

Step 8. Add dimensions, **Fig. 12**.

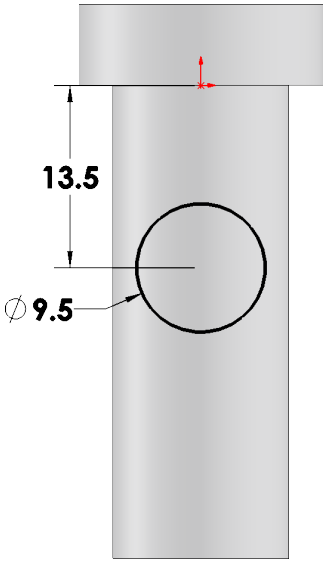


Fig. 12

Step 9. Click **Features** on the Command Manager toolbar.

Step 10. Click **Extruded Cut** on the Features toolbar.

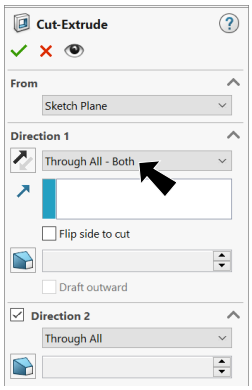


Fig. 13

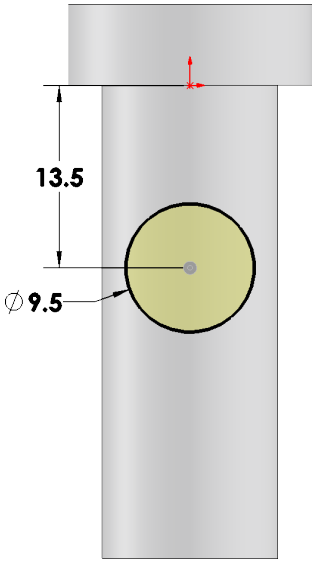


Fig. 14

Step 11. In the Cut-Extrude Property Manager set:
under Direction 1, **Fig. 13**
End Condition **Through All - Both**
click OK .

E. Create Plane1 Key.

Step 1. Click **Top Plane** in the Feature Manager to display Plane is graphics area, **Fig. 15**.

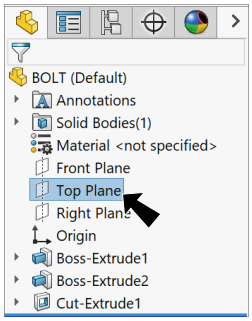


Fig. 15

Step 2. In graphics area **Ctrl drag Top plane down** and release, **Fig. 16**.

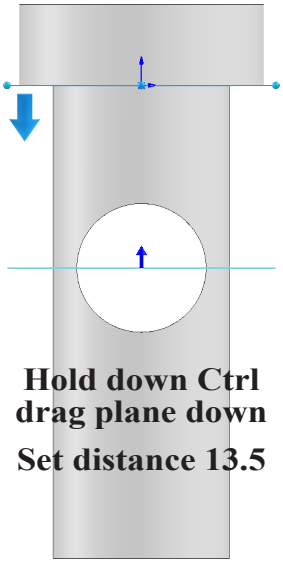


Fig. 16

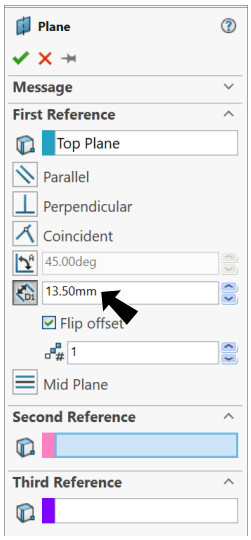


Fig. 17

Step 3. In the Plane Property Manager set:
under First Reference, **Fig. 17**

Distance D1 **13.5**
and press **ENTER**.
The new plane should be centered on hole, **Fig. 16**.
Click OK .

F. Extrude3 Sketch4 Key.

Step 1. **Hide Plane1** . To hide, click **Plane1** in the graphics area and **Hide** on the context toolbar, **Fig. 18**.

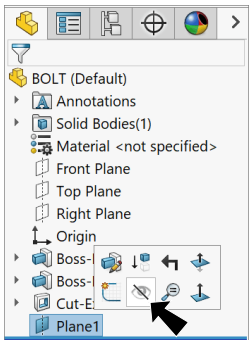


Fig. 18

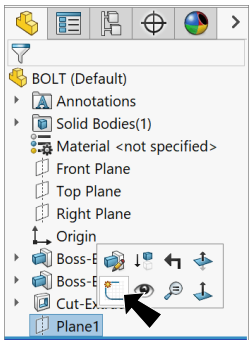


Fig. 19

Step 2. Click **Plane1** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 19**.

Step 3. Click **Normal To** on the Standard Views toolbar. **(Ctrl-8)**

Step 4. Click **Corner Rectangle** in the **Rectangle flyout** on the Sketch toolbar.

Step 5. Sketch **corner rectangle to right of Origin** , **Fig. 20**.

Step 6. **Unselect Rectangle tool**. To unselect, **right click graphics area and click Select** from menu.

Step 7. **Ctrl click midpoint of left vertical line** and **Origin** to select both. Release Ctrl key and click **Make Horizontal** on the context toolbar, **Fig. 21**.

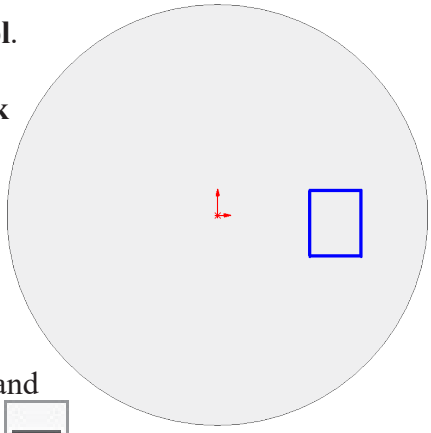


Fig. 20

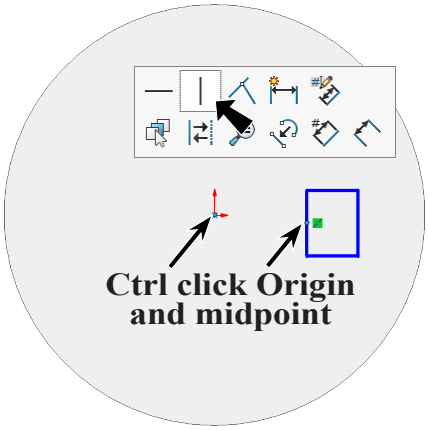


Fig. 21

Step 8. Click **Smart Dimension** 

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

Step 9. Add dimensions, **Fig. 22**.

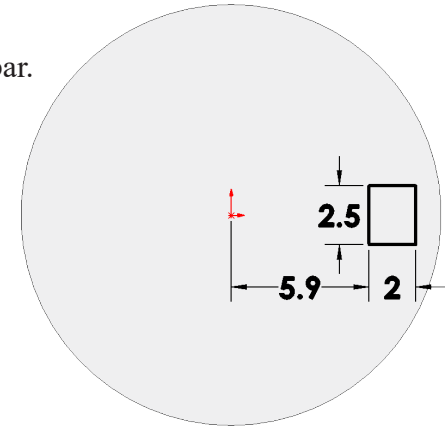


Fig. 22

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

Step 11. In the Sketch Fillet Property Manager set:
under Fillet Parameters, **Fig. 23**
Radius  **.7**
click **right side corners**, **Fig. 24**
click OK  **twice**.

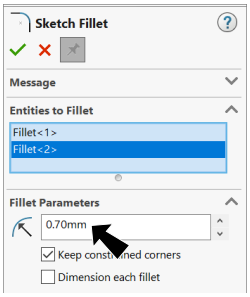


Fig. 23

Step 12. Click **Trimetric**  on the Standard Views toolbar.

Step 13. Click **Features** 

on the Command Manager toolbar.

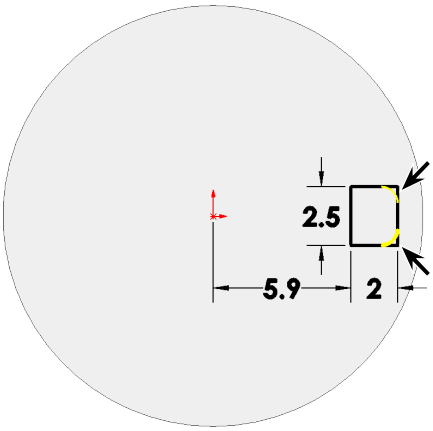
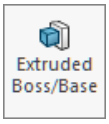


Fig. 24

Step 14. Click **Extruded Boss/Base** 

on the Features toolbar.

Step 15. In the Boss-Extrude Property Manager set:
under Direction 1, **Fig. 25**
End Condition **Mid Plane**
Depth  **10**
click OK  .

Step 16. Save  (**Ctrl-S**).

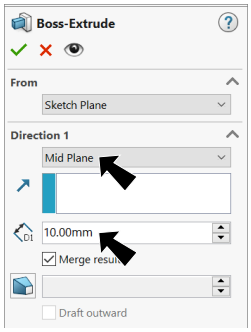


Fig. 25

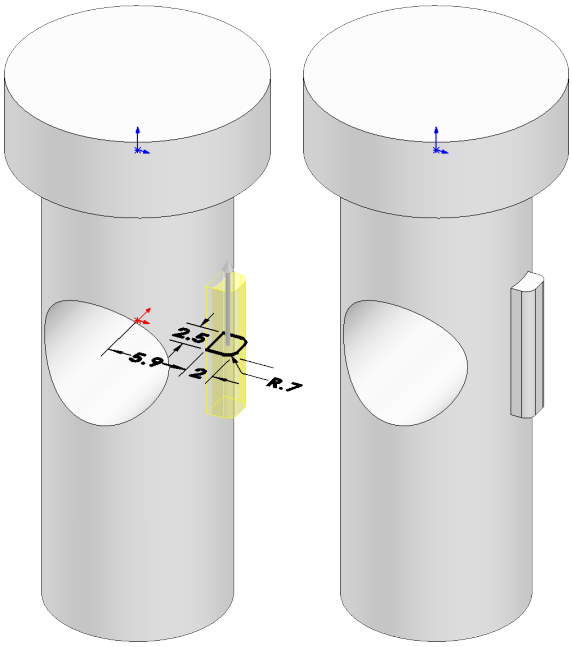


Fig. 26

Fig. 27

G. Revolve Sketch5 Key Cap.

Step 1. Click the **top face of key Boss-Extrude3** and click **Sketch**  on the context toolbar, **Fig. 28**.

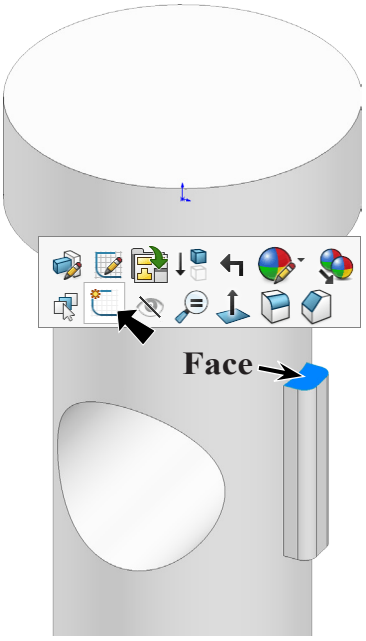


Fig. 28

Step 2. With the face still selected, click **Convert Entities** 

on the Sketch toolbar, **Fig. 29**.

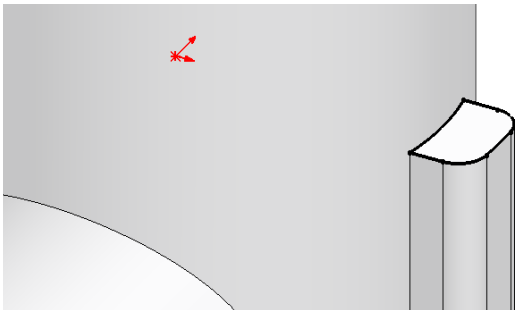


Fig. 29

Step 3. **Delete inside converted arc**, **Fig. 30**.

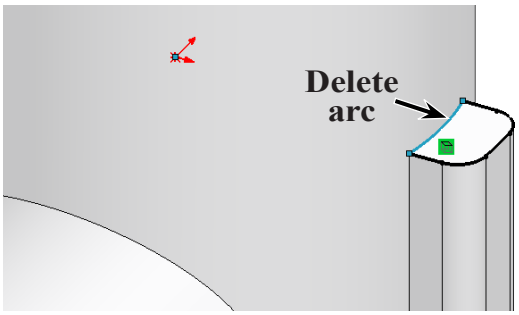


Fig. 30

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

Step 5. Sketch **line across inside endpoints**, **Fig. 31**.

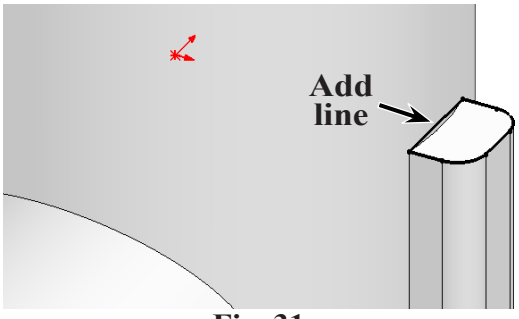


Fig. 31

Step 6. Click **Features** 

on the Command Manager toolbar.

Step 7. Click **Revolved Boss/Base** 

on the Features toolbar.

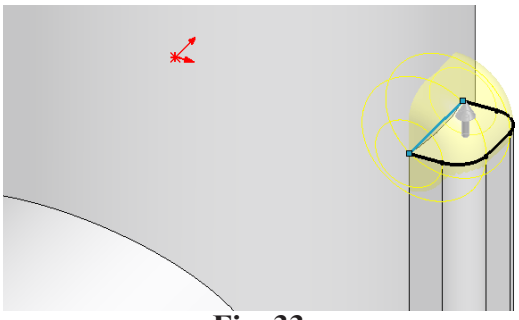


Fig. 33

Step 8. In the Revolve Property Manger set:

under Axis of Revolution 
click **inside line**, **Fig. 32**

click OK  .

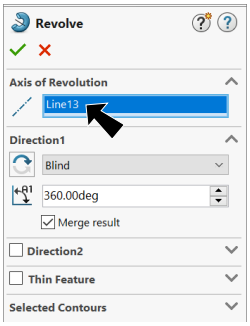


Fig. 32

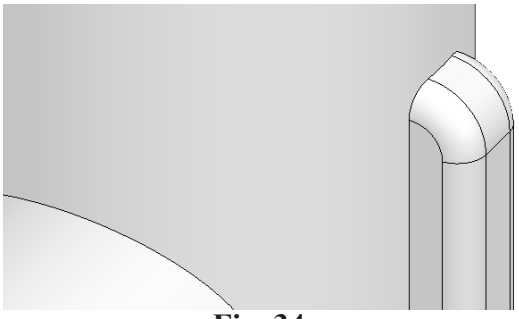


Fig. 34

H. Mirror1 Key Cap.

Step 1. **Ctrl click Plane1** and **Revolve1** feature to select plane and feature, **Fig. 35**.

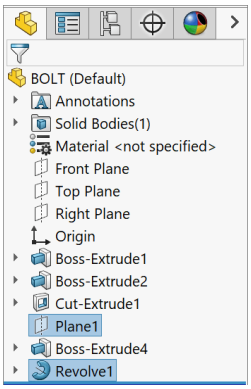


Fig. 35

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

Step 3. In the Mirror Property Manager click OK ✔, **Fig. 36**.

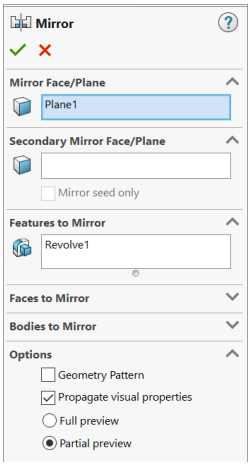


Fig. 36

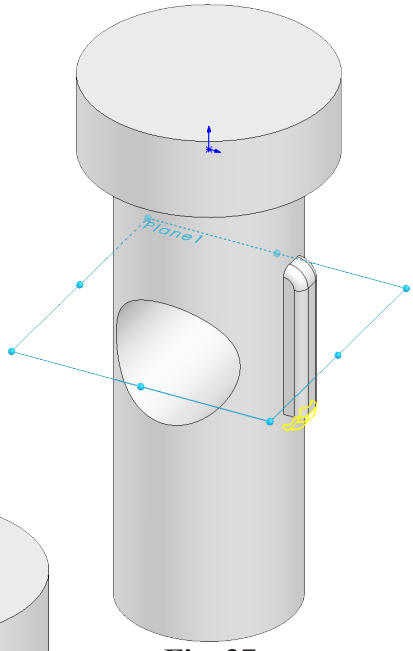


Fig. 37

Step 4. Save (**Ctrl-S**).

I. Thread Feature.

Step 1. Click **Thread** Thread in the **Hole Wizard flyout** Hole Wizard on the Features toolbar.

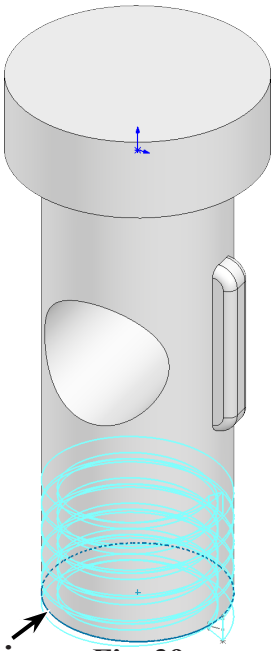
Step 2. In the Thread Property Manager set:

under Thread Location, **Fig. 38**
click **bottom circular edge of Shank (Extrude2), Fig. 39**
check **Offset**
Offset Distance 2
Reverse Direction

under End Condition
select **Blind**
Depth **10**

under Specification
Type **Metric Die**
Size **M14x2.0**
Thread method **Cut thread**

under Thread Options
select **Right-hand thread**
click OK ✔.



Thread location bottom edge

Fig. 39

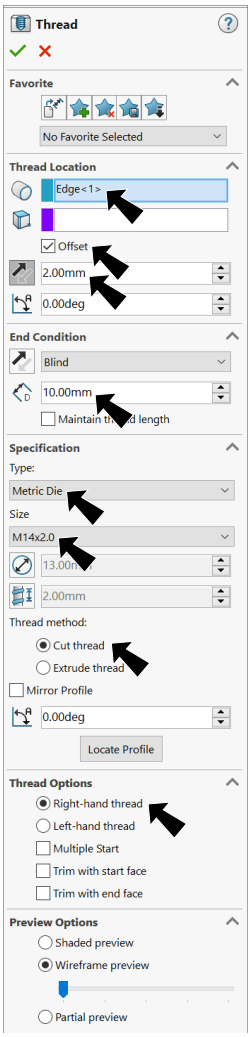


Fig. 38

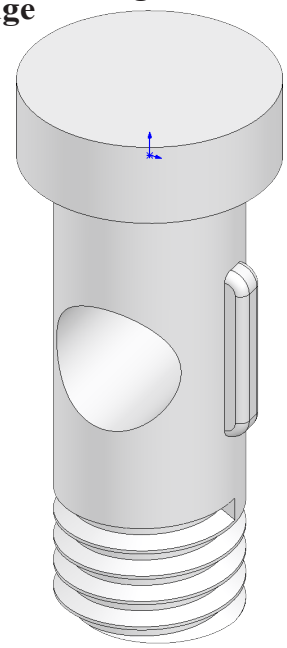


Fig. 40

Step 3. Save (**Ctrl-S**).

J. Create Plane2 Thread Runout.

Step 1. Rotate view up to view root of threads, use **Up Arrow key**  **two times**.

Step 2. Click **Top Plane** in the Feature Manager to display Plane is graphics area, **Fig. 41**.

Step 3. In graphics area **Ctrl drag Top plane down** to approximately top of threads and release, **Fig. 42**.

Step 4. Zoom in on top of threads, **Fig. 42**.

Step 5. In the Plane Property Manager set:
under Second Reference, **Fig. 43**
click **vertex of bottom thread root at end**, **Fig. 44**.
The new plane should parallel with Top Plane and at vertex.
Click OK .

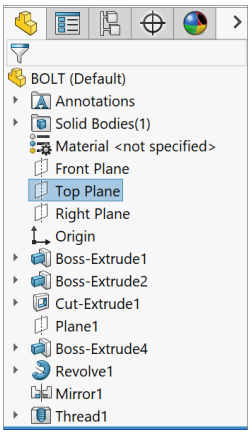


Fig. 41

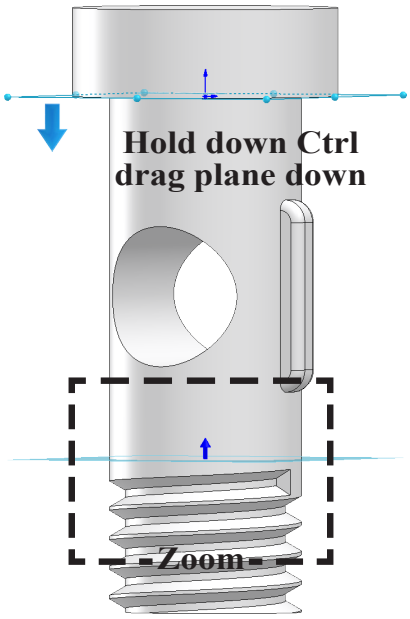


Fig. 42

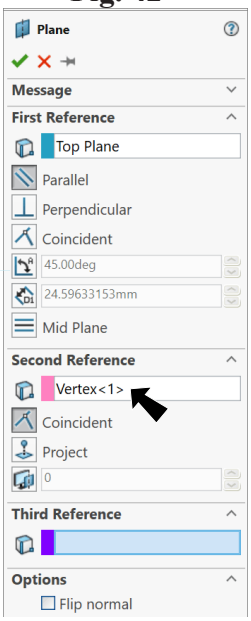


Fig. 43

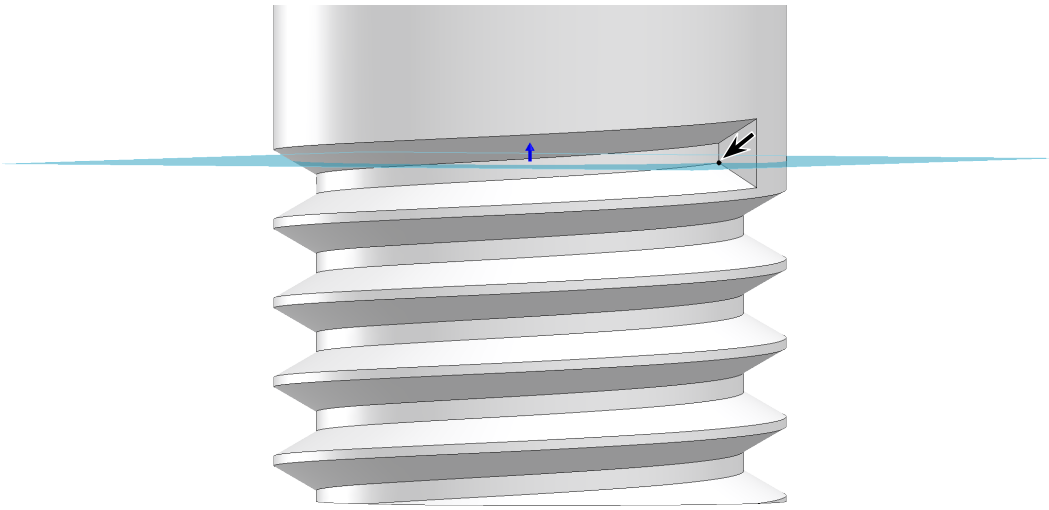


Fig. 44

K. Helix1 Thread Runoff.

Step 1. **Hide Plane2** . To hide, click **Plane1** in the graphics area and **Hide** on the context toolbar, **Fig. 45**.

Step 2. Click **Plane2** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 46**.

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

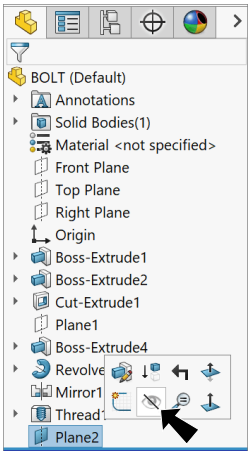


Fig. 45

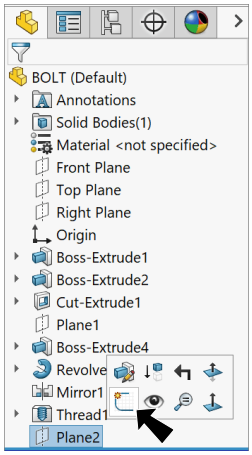


Fig. 46

Step 4. In the Convert Entities Property Manager:
under Entities to Convert, **Fig. 47**
click **circular edge of thread maximum diameter**, **Fig. 48**
click OK .

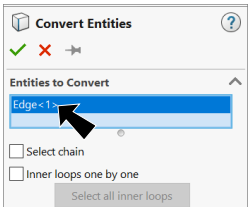


Fig. 47

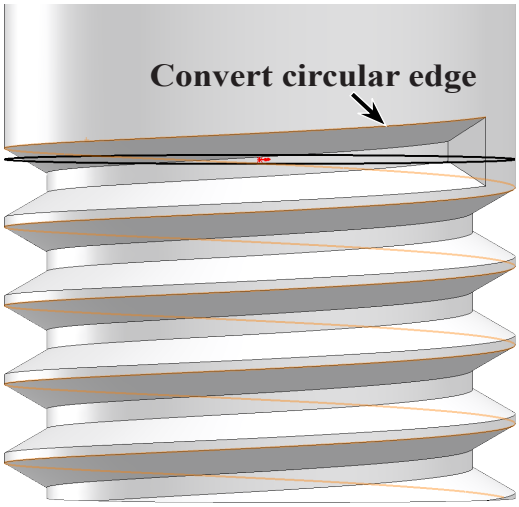


Fig. 48

Step 5. Click Insert Menu > Curve > Helix/Spiral.

Step 6. In the Helix/Spiral Property Manager set:
under Defined By, **Fig. 49**
select **Pitch and Revolution**
under Parameters
Pitch: 2
uncheck **Reverse direction**
Revolutions: .125
Start angle 90 deg
select **Counterclockwise**
click OK .

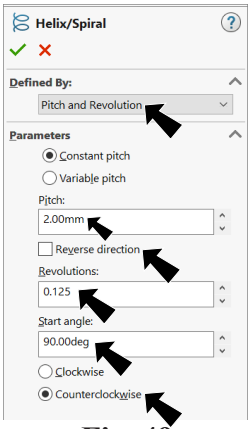


Fig. 49

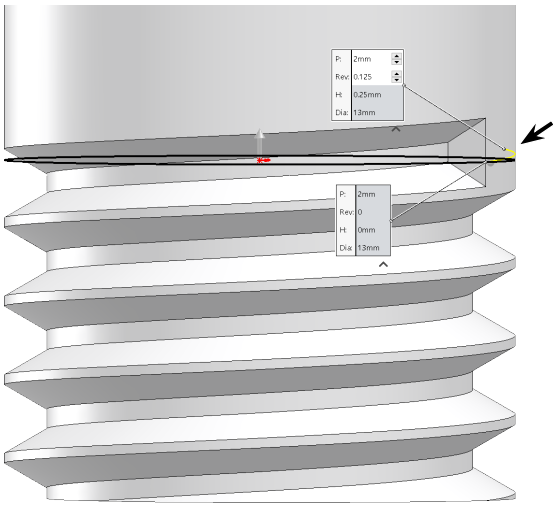


Fig. 50

L. 3D Sketch1 Thread Runoff.

Step 1. Rotate view to **better view of helix, Fig. 51**. Use **Left Arrow key**  **three times and Down Arrow key**  **once**..

Step 2. Click **3D Sketch**  in the **Sketch fly-out**  on the Sketch toolbar.

Step 3. Click **3 Point Arc**  **(S)** in the **Arc flyout**  on the Sketch toolbar.

Step 4. Sketch **arc with start endpoint at vertex of bottom thread root at end and end endpoint of arc at right end of Curve with radius in between points, Fig. 51**. Use **Tab key sketch** along the  **axis**.

Step 5. **Unselect Arc tool**. To unselect, **right click graphics area and click Select**  from menu.

Step 6. **Ctrl click bottom thread circular root edge and arc** to select both. Release Ctrl key and click **Make Tangent**  on the context toolbar, **Fig. 52**.

Step 7. **Exit 3D Sketch.** To Exit, click **Exit 3D Sketch**  in top right corner of graphics area.

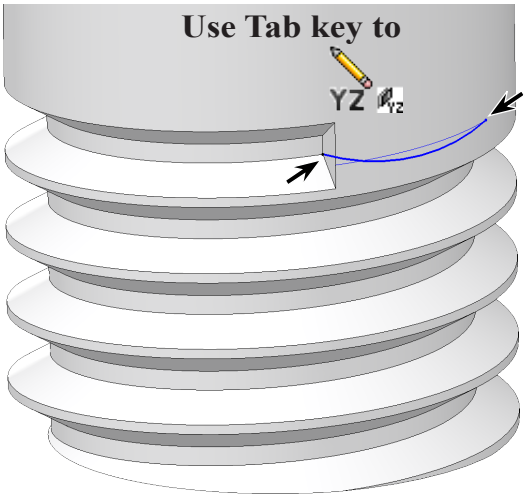


Fig. 51

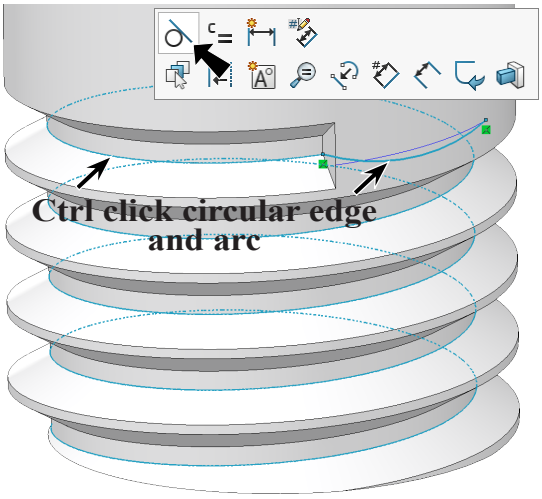


Fig. 52

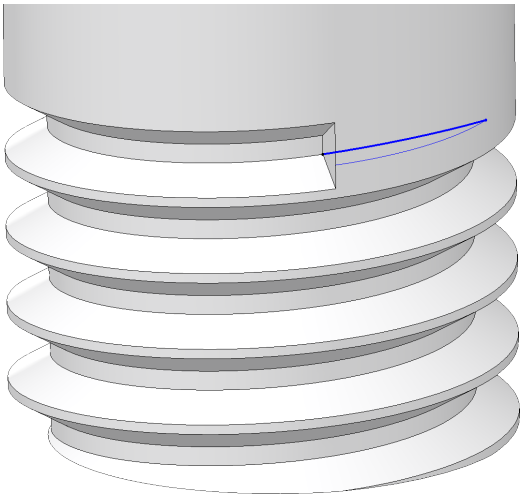


Fig. 53

M. Sweep Cut Thread Runoff.

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-Sweep Property Manager set:
under Profile and Path, **Fig. 54**

Profile
click **end face of Thread**, **Fig. 55**

Path
click **3D Sketch**
click OK ✔.

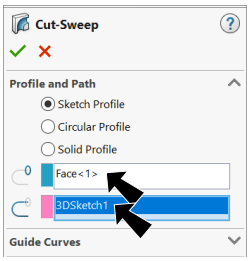


Fig. 54

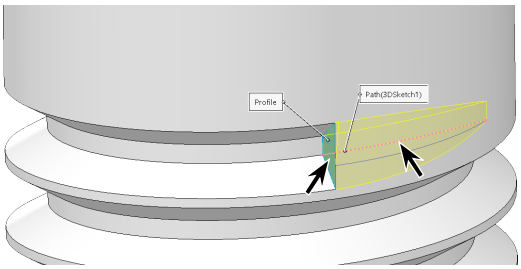


Fig. 55

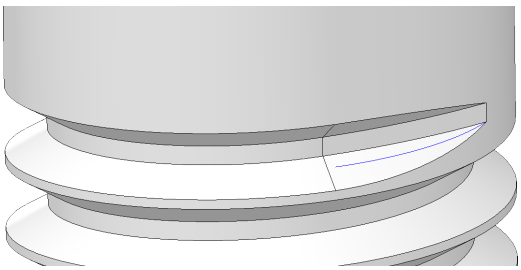


Fig. 56

N. Chamfer.

Step 1. **Hide Helix/Spiral** . To hide, click the **Helix/Spiral1** in the Feature Manager and **Hide** on the context toolbar, **Fig. 57**.

Step 2. Rotate view to vies both top and bottom circular edges. To rotate, click **Trimetric** on the Standard Views toolbar and **Up Arrow key** **three times**.

Step 3. Click **Chamfer** Chamfer in the **Fillet flyout** Fillet on the Features toolbar.

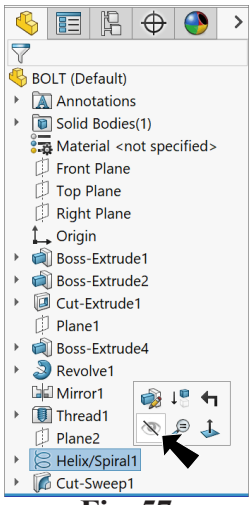


Fig. 57

Step 4. In the Chamfer Property Manager set:
under Chamfer Type, **Fig. 58**

select **Angle Distance**
under Chamfer Parameters

Distance .8

Angle 45°

click **top circular edge of head and bottom circular edge of shank**, **Fig. 59**

click OK ✔.

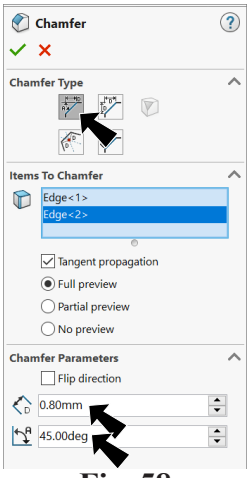


Fig. 58

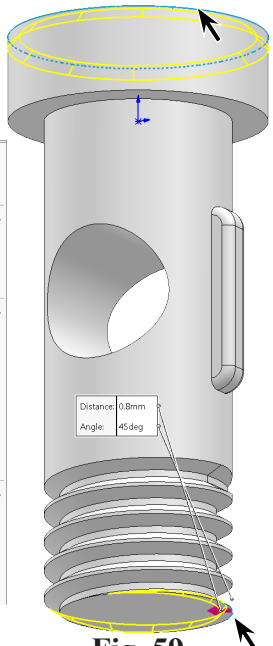


Fig. 59

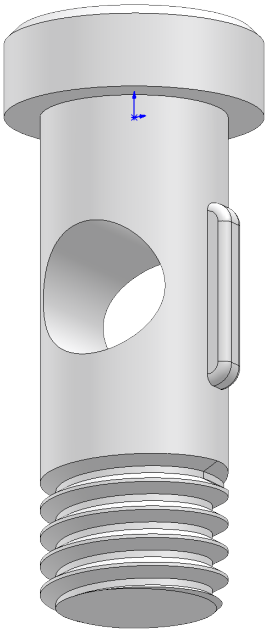


Fig. 60

Step 5. Save (**Ctrl-S**).

O. Helix2 Knurl.

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

Step 2. Click the **top face of head** and click **Sketch** on the context toolbar, **Fig. 61**.

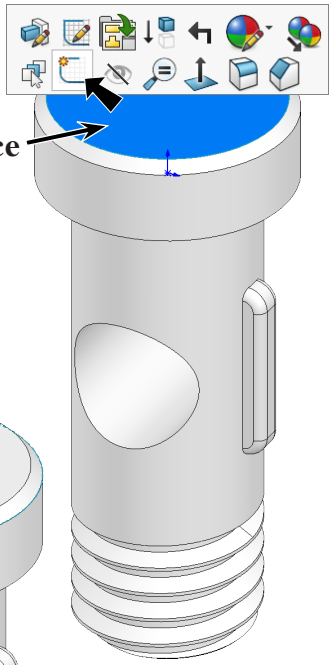


Fig. 61

Step 3. Unselect the face.

Step 4. Click **Convert Entities** on the Sketch toolbar.

Step 5. In the Convert Entities Property Manager:
under Entities to Convert, **Fig. 62**
click **outside circular edge of top chamfer**, **Fig. 63**
click OK .

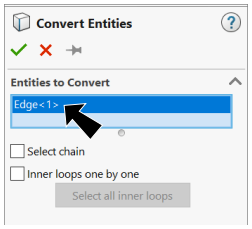


Fig. 62

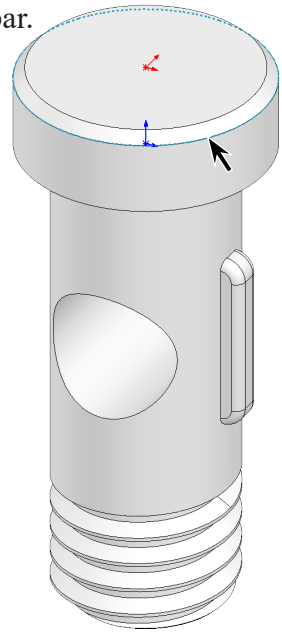


Fig. 63

Step 6. Click Insert Menu > Curve > Helix/Spiral.

Step 7. In the Helix/Spiral Property Manager set:
under Defined By, **Fig. 64**
select **Pitch and Revolution**
under Parameters
Pitch: 40
check **Reverse direction**
Revolutions: .15
Start angle 90
select **Clockwise**
click OK .

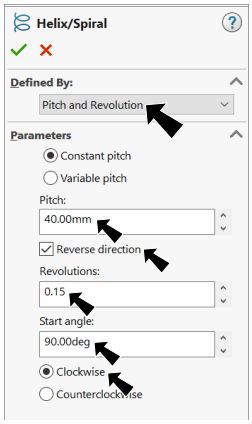


Fig. 64

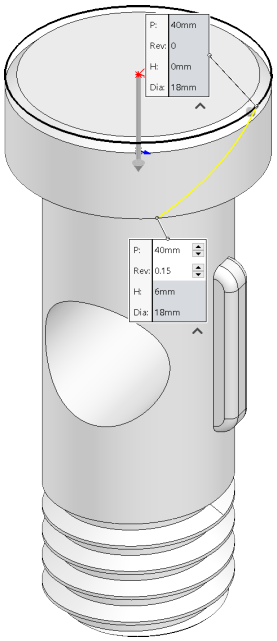


Fig. 65

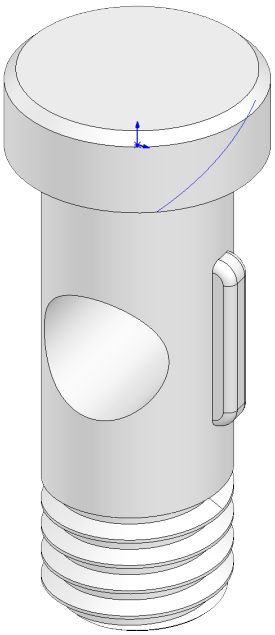


Fig. 66

P. Sweep Cut Knurl.

Step 1. Click the **top face of head** and click **Sketch** on the context toolbar, **Fig. 67**.

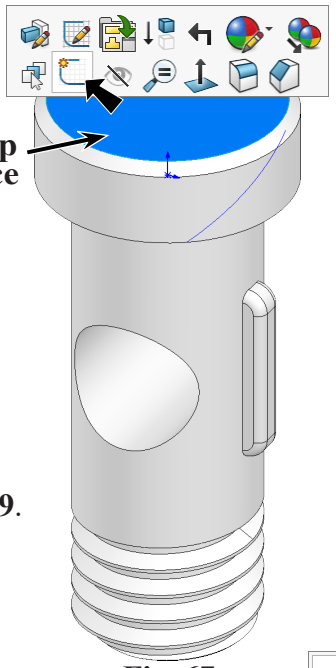


Fig. 67

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

Step 3. In Polygon Property Manager set under Parameters, **Fig. 68**
Number of Sides **4**.

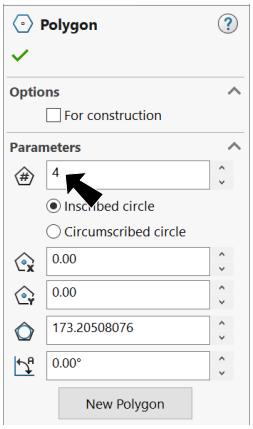


Fig. 68

Step 4. Sketch **polygon** to right of **Origin**, **Fig. 69**.

Step 5. **Unselect Polygon tool**. To unselect, **right click graphics area and click Select** from menu.

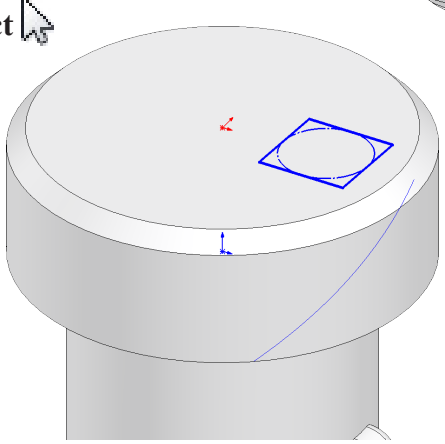


Fig. 69

Step 6. **Ctrl click opposite vertices of polygon** and click **Make Horizontal** on the context toolbar, **Fig. 70**.

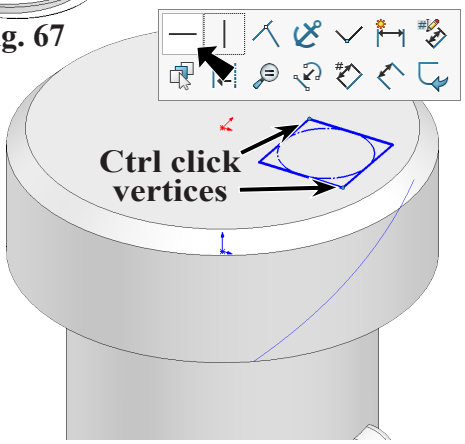


Fig. 70

Step 7. **Ctrl click centerpoint of polygon and helix** to select both. **Release Ctrl key** and click **Make Pierce** on the context toolbar, **Fig. 71**. Make Pierce adds a Pierce relation between sketch and helix.

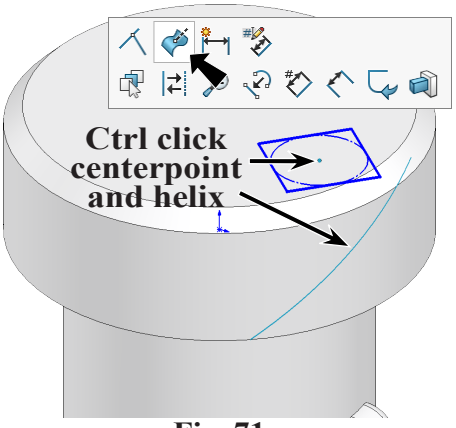


Fig. 71

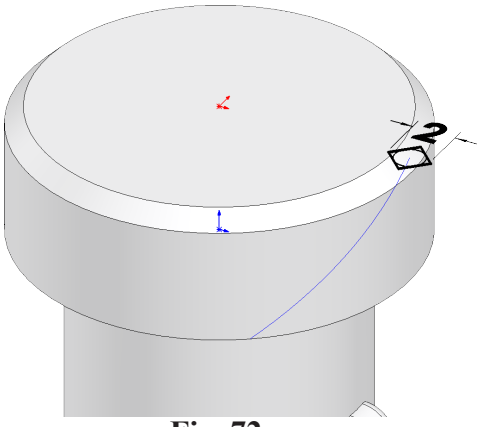


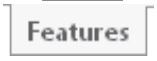
Fig. 72

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

Step 9. Dimension **opposite vertices 2**, **Fig. 72**.

Step 10. Click **Exit Sketch** 

on the Sketch toolbar.

Step 11. Click **Features** 

on the Command Manager toolbar.

Step 12. Click **Swept Cut** 

on the Features toolbar.

Step 13. In the Cut-Sweep Property Manager set:
under Profile and Path, **Fig. 73**
Profile click **Sketch8** (polygon), **Fig. 74**
Path click **Helix**
click OK .

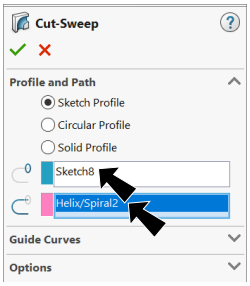


Fig. 73

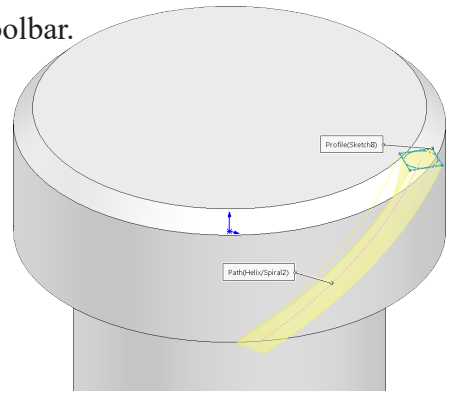


Fig. 74

Step 14. Save (**Ctrl-S**).

Q. Circular Pattern Knurl.

Step 1. **Hide Helix/Spiral2** . To hide, **right click Helix** in the graphics area and **Hide** on the context toolbar, **Fig. 75**.

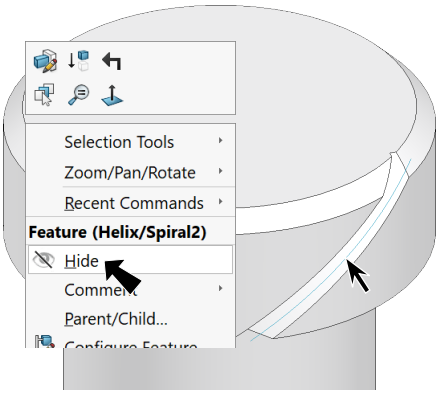
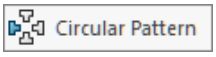


Fig. 75

Step 2. Click **Circular Pattern** 

in the **Linear Pattern flyout** 

on the Features toolbar.

Step 3. In the Circular Pattern Property Manager set:
under Features and Faces, **Fig. 76**
click **Cut-Sweep2** in graphics area, **Fig. 77**
under Direction 1
click in **Pattern Axis** box
click a **cylindrical face**
select **Equal spacing**
Number of Instances **18**
click OK .

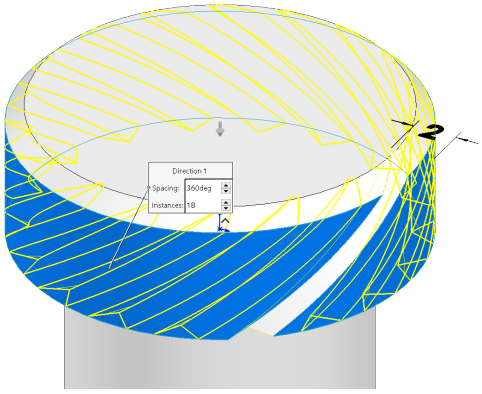


Fig. 77

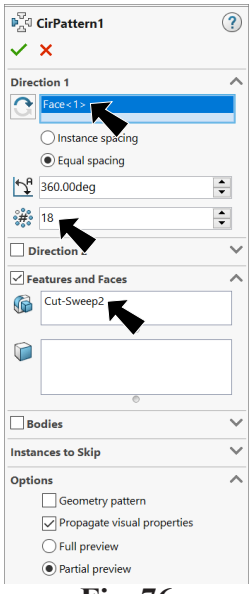


Fig. 76

Step 4. Save (**Ctrl-S**).

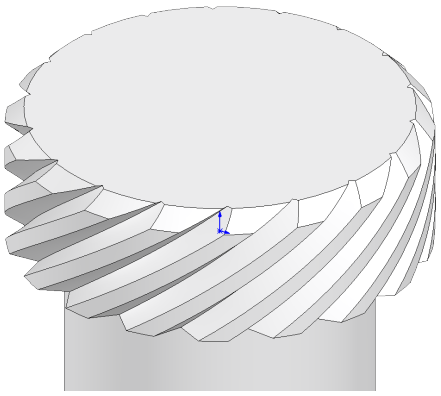


Fig. 78

R. Mirror Circular Pattern Knurl.

Step 1. **Ctrl click Front Plane** and **Circular Pattern1** feature in the Feature Manager to select plane and feature, **Fig. 79**.

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

Step 3. In the Mirror Property Manager click OK , **Fig. 80**.

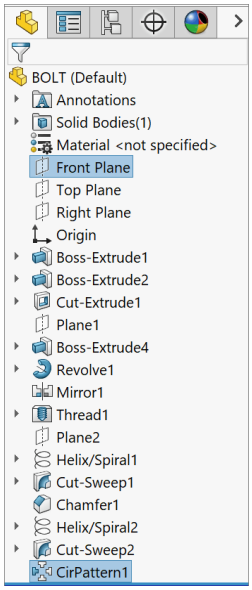


Fig. 79

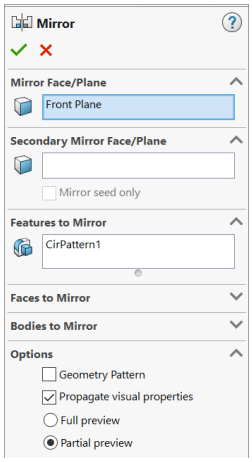


Fig. 80

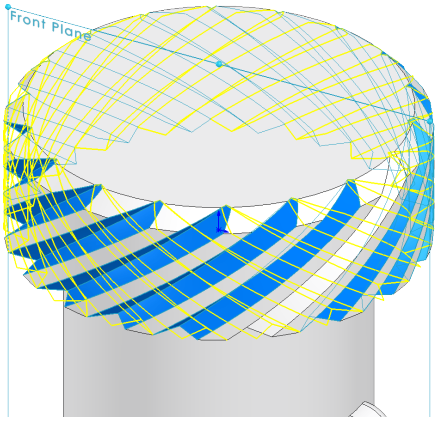


Fig. 81

S. Appearance: Blue.

Step 1. Click the part to select part, click **Appearances Callout** on the context toolbar and click **BOLT**, **Fig. 82**.

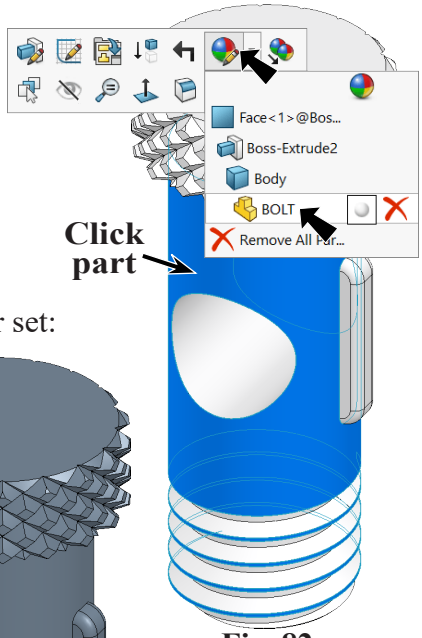


Fig. 82

Step 2. In the Appearances Property Manager set:
under Color, **Fig. 83**
set **RGB values**
R 112
G 128
B 144
click OK .

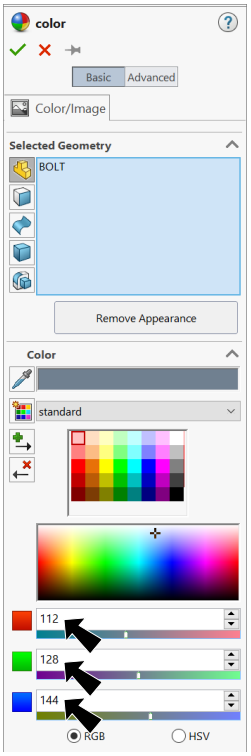


Fig. 83

Step 3. Save (**Ctrl-S**).
Note: The knurling design is deep cut for 3D printing.

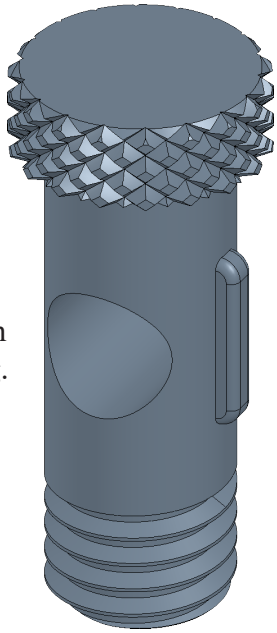


Fig. 84