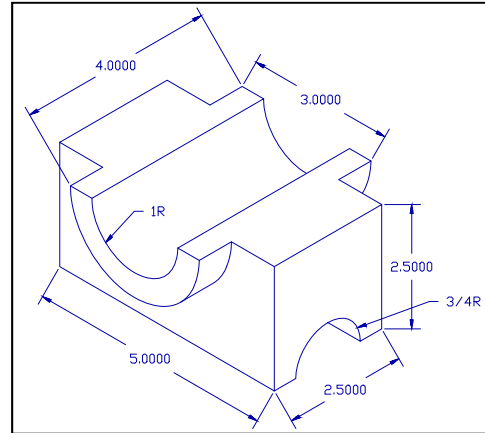


Chapter 7 – Isometric Drawings

In this assignment, we are going to look at creating isometric drawings with AutoCAD. These drawings appear to be three dimensional but they are not. An AutoCAD isometric drawing is a 2 dimensional drawing just like a paper drawing.

AutoCAD provides some tools to aid us in creating the drawing, but not very many. Mostly, we will be using the same commands that we used in creating orthographic drawings.



We are going to draw the figure shown on the right. We will use the dimensions shown on the figure and make a drawing that is dimensionally correct as we have done in the past.

We will start by drawing an isometric box that makes up the main body of the object. From there, we will add the semicircular hole at the bottom and the half cylinder at the top.

The first thing we need to do is to put AutoCAD in the isometric mode. This mode is entered through the **SNAP** command.

SNAP

ON/OFF/Rotate/Style <1.000>
Standard/Isometric
Vertical Spacing <1.000>

S *{Put into isometric mode}*
I
.4

SNAP

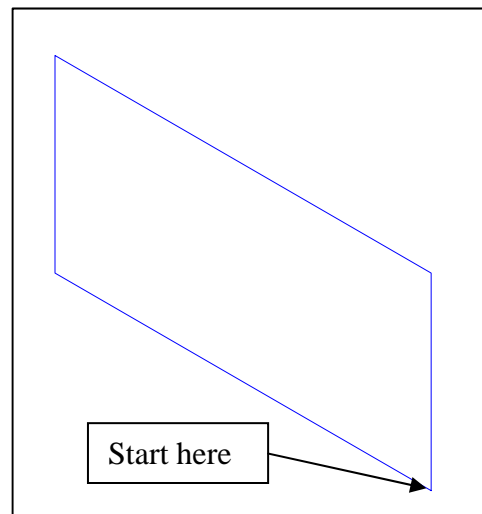
ON/OFF/Snap **OFF** *{Stop snapping to grid points}*

Now we can draw the left face of the box. Use the **LINE** command and click on the lower right corner of the right face of the box. We will use polar coordinates to make the lines at 30 degree angles.

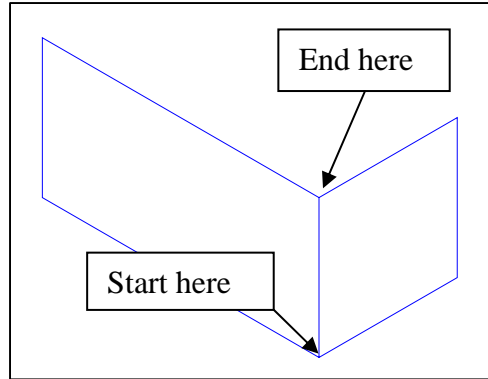
LINE

From Point: *{Click on the screen where you want the object to start}*

To Point: @5<150
To Point: @2.5<90
To Point: @5<330
To Point: C



Next draw the right face of the box. In one of the earlier lessons, we turned on the snapping to the endpoint of a line with the **OSNAP** command. You can achieve the same thing by typing **end** when the program is expecting a point. Press return after typing **end** then click on the end point of a line, arc, or circle.

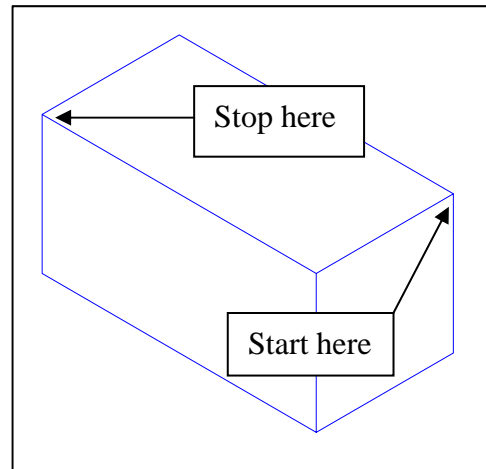


LINE

From Point: **end** *{type this to tell the program that you want to use the end point of a line to start the new line that you are drawing}*
of *{click on the starting point above}*

To Point: @2.5<30
To Point: @2.5<90
To Point: @2.5<210

The top of the box will be drawn next. We will start with the top right corner of the box we have just finished drawing.



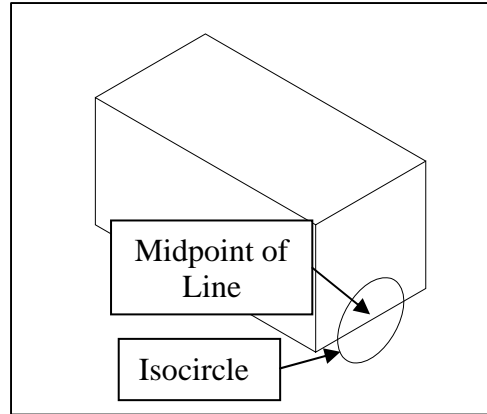
LINE

From Point: **end**
of *{click on upper right point of box}*
To Point: @5<150
To Point: **end**
of *{complete point by clicking on end of the correct point}*

When you have finished, you should have a box like the one shown on the right.

Next we need to draw the arcs making up the object. These are actually ellipses because of the isometric view. We use the **ELLIPSE** command to draw them. AutoCAD does not draw elliptical arcs but it does draw complete ellipses and we can trim these to create elliptical arcs. We will start with the arc at the bottom of the box shown in the

picture at the right. Use the **CTRL E** key combination to change the mouse pointer so that the lines are parallel with the edges of the right face (<**Isoplane right**>).



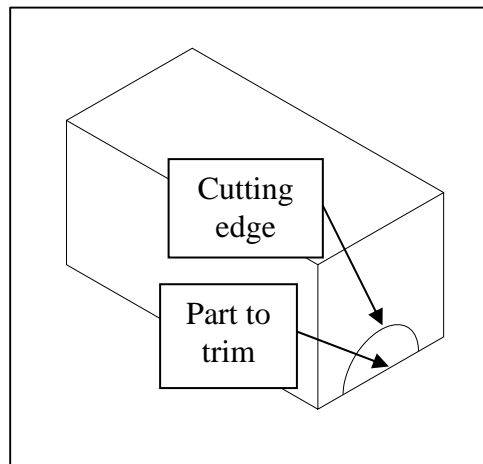
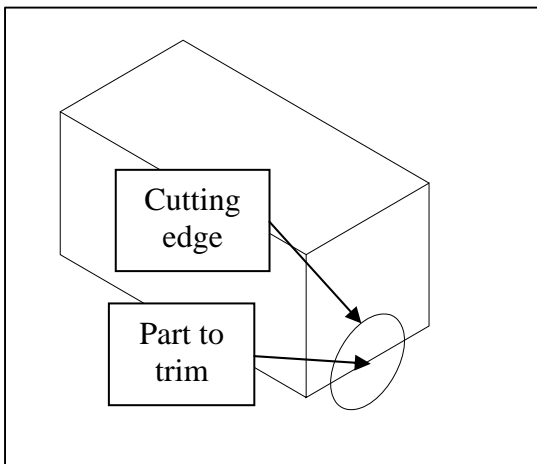
ELLIPSE
 <axis end point
 1>/Center/Isocircle: **I**

Center of circle: **MID** *{We want the center of the Isocircle to be at the midpoint of the line}*
 of *{select the line at the bottom of the right face}*
 <Circle radius>/Diameter: **.75**

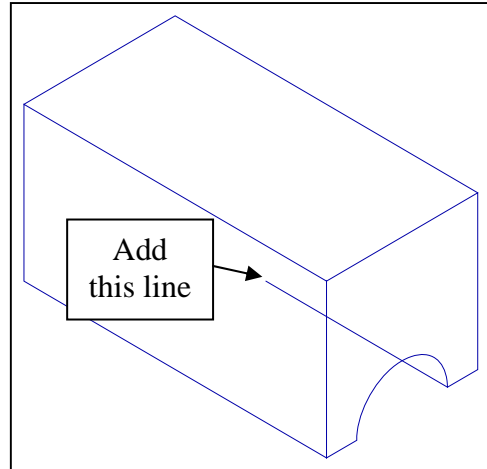
Now we can erase the part of the ellipse we do not need with the **TRIM** command.

TRIM
 Select cutting edge(s) ...
 Select objects: *{select the line}*
 Select objects to trim: *{select bottom of circle}*

TRIM
 Select cutting edges ...
 Select objects: *{select upper half of isocircle}*
 Select object to trim *{Select the line through the isocircle}*
 Select object to trim



We need to add a line at the bottom edge of the arc. We can do this by drawing a line that is too long then trimming it with the **TRIM** command. This will complete the bottom part of the object.



LINE

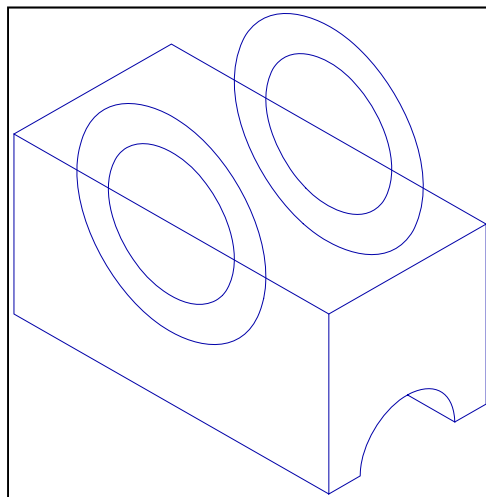
From point: **END**
of *{select end of arc}*
To point: **@3<150**

TRIM *{Select the arc as the cutting surface and trim the line that we have just drawn. The arc and line are shown in the figure below}*

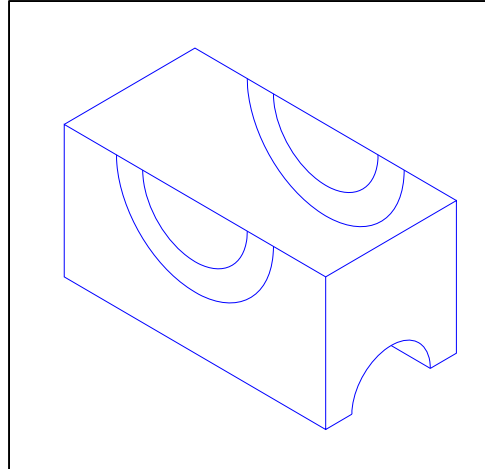
We must start on the half cylinder that intersects the top of the block. We will do this by drawing four ellipses along the side of the block. Use the **CTRL E** command to place the mouse pointer lines parallel to the edges of the left face of the box.

ELLIPSE

<Axis endpoint 1>/Center/Isocircle: **I**
Center of circle: **MID**
of *{Select top left edge of box}*
<Circle radius>/Diameter: **1**



Repeat the **ELLIPSE** command to create the larger, 3 inch diameter ellipse then repeat it two more times to create the ellipses on the other side of the box. After you have draw the ellipses, trim their tops with the **TRIM** command. Use the edges of the box as the cutting planes. The figure on the right shows the **isocircles** after trimming.



The next step is to form the ends of the half cylinder shape. We can do this by moving the inside diameter arcs to the ends of the cylinder and copying the outside diameter arcs to the ends of the cylinder.

MOVE

Select objects: *{Select the inner circles on the left side}*
 Base point or displacement: **END**
 of *{Select the end of the inside arc}*
 Second point of displacement: **@.75<210**

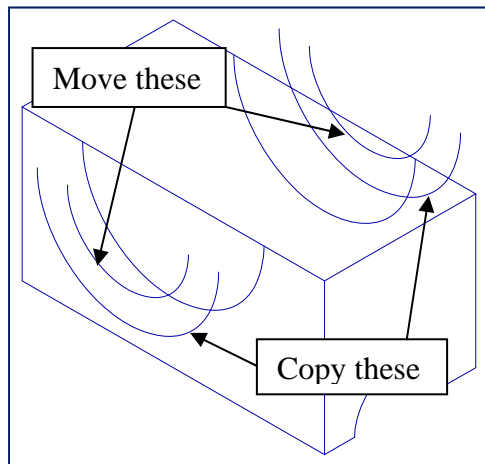
Repeat this command for the other side and move the inside arc .75 inches at an angle of 30 degrees.

Next copy the outside diameter arcs to their end positions on the cylinder. You can do this with the **COPY** command.

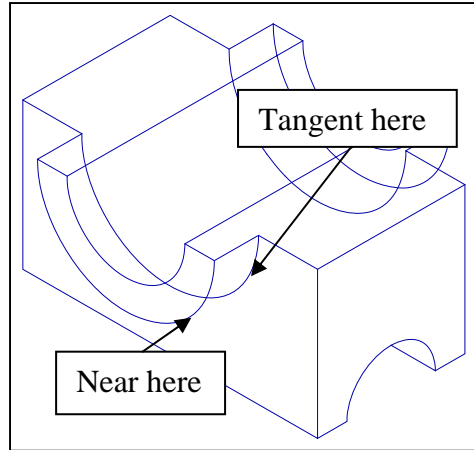
COPY

Select objects: *{Select the outer arc on the left side of the object}*
 <Base point of displacement>:
 of *{Select the end of the arc}*
 Second point of displacement:
@.75<210

Copy the arc on the other side of the object using a similar command sequence. When you finish you should have the picture shown on the right.



Use the **TRIM** and the **ERASE** commands to remove the edges of the box that cannot be seen.



Next, we will draw the line tangent to the arcs. This line forms the outside edge of the cylinder. Press **CTRL E** until the mouse pointer lines are parallel to the right face of the box and then type:

LINE

Point from: **NEAR**

of

{Click on one of the arcs as close as you can to the tangent point.. You may have to zoom in on the arc to select it.}

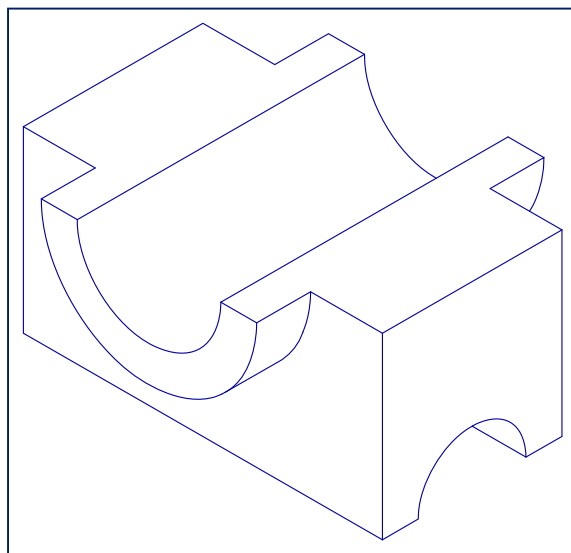
Point to: **TAN**

of

{Select the other arc. You should move the mouse pointer as close to the tangent point as possible.}

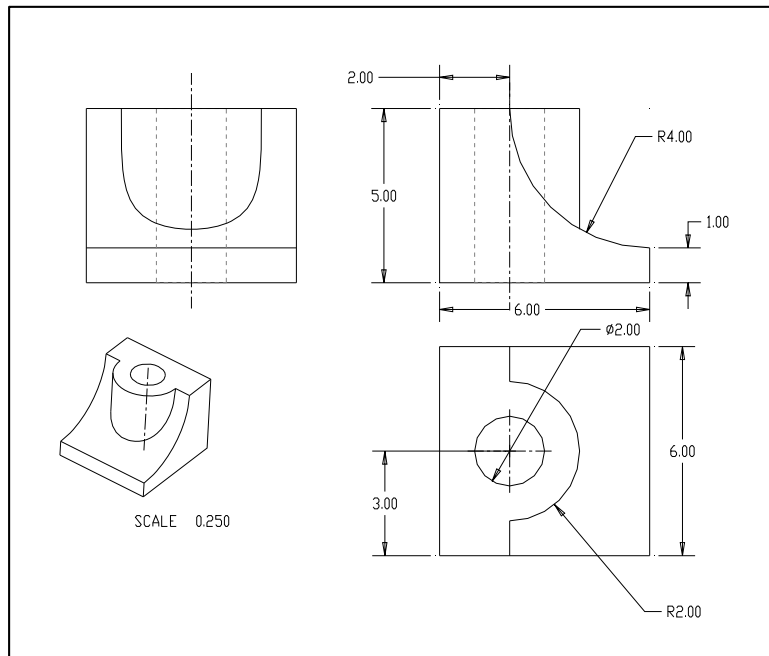
Finally we do a little more trimming and erasing of the arcs on the cylinder and we have the finished drawing shown below.

We can now place the view on the drawing sheet by selecting the “Layout1” tab at the bottom of the screen and following the procedures we discussed in Chapter 6.



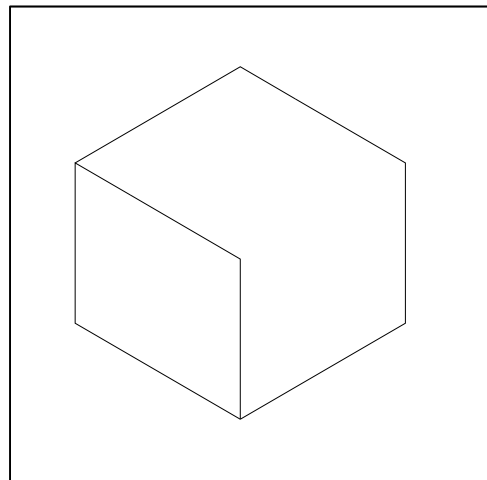
Difficult Curves

Sometimes when drawing an isometric view, the curves that you must draw cannot be drawn with an ellipse. A simple example is shown in the drawing below.

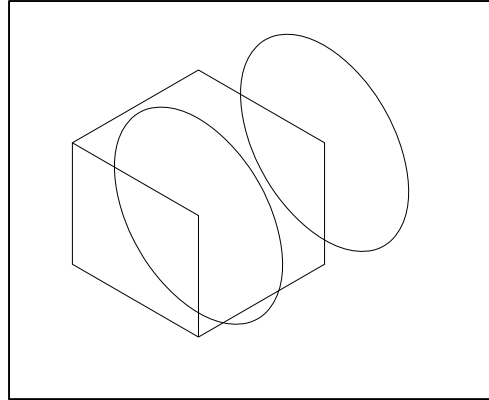


The curve where the cylinder meets the curved surface cannot be drawn with a simple ellipse or ellipse. It can be drawn however and we will illustrate it with the object shown above.

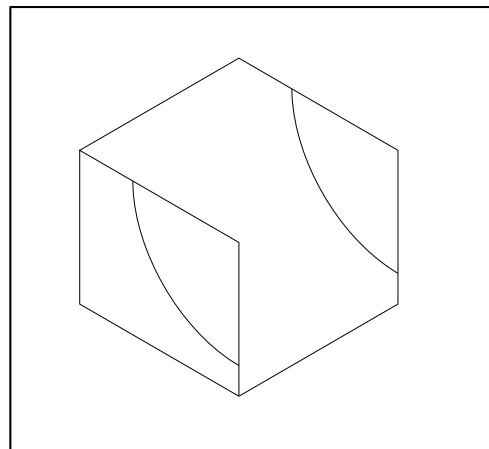
Start by drawing simple isometric object like the one shown on the right. Use the drawing above for the dimensions of this box.



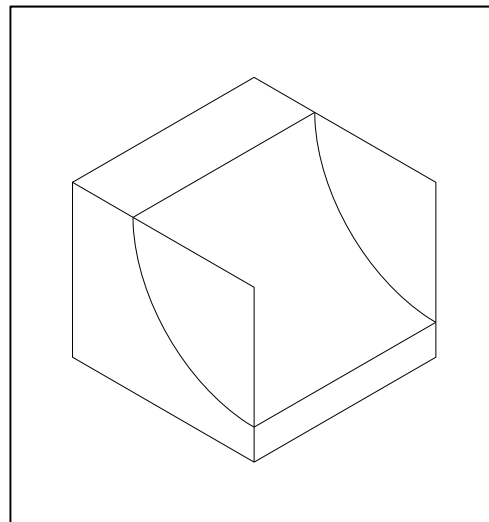
Next we will add two ellipses to either side. The ellipses have a radius of 4.00. The object with the ellipses is shown on the right.



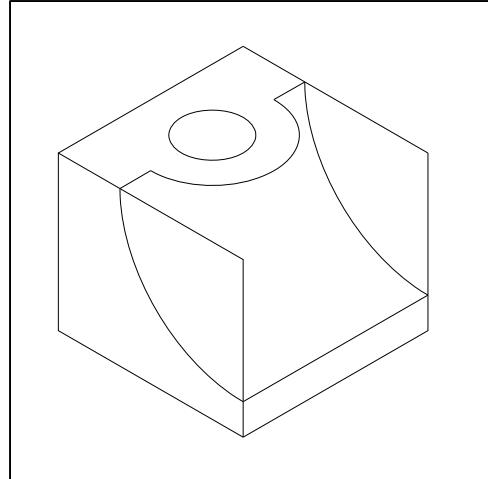
When you have completed the ellipses, trim them so that only the parts that are edges of the object are remaining. The edges of the box can be used as the cutting planes.



Next, draw lines connecting the ends of the ellipse segment. These can be easily drawn with the mouse. **OSNAP** should be set to ON so that the mouse pointer will snap to the ends of the ellipse segments.



The cylinder intersects the top plane of the object, and we can draw ellipses at the intersection. The large one has a radius of 2 and the smaller one has a radius of 1. After drawing the ellipses, trim the larger one and the line passing through its center. This is illustrated in the drawing on the right.

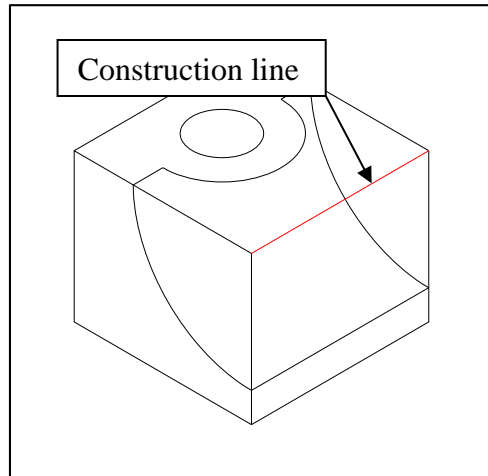


When you draw the ellipses, you can use the **MID** command to locate the center of the ellipses at the midpoint of the line passing through their centers.

ellipse

```
Specify axis endpoint of ellipse or [Arc/Center/Isocircle]: i
Specify center of isocircle: mid
of
Specify radius of isocircle or [Diameter]: 2
```

We can now draw a construction line to help us determine the intersection of the cylinder and the curved surface. Switch to the projection layer and add a line that connects the two corners of the box.



We are going to create evenly spaced construction lines perpendicular to and along the length of the construction line we have just created. We will use these lines to help us create a tessellated surface on the cylinder which we can intersect with a tessellated surface on the intersecting curve.

We start by creating 10 equally spaced points along the line. This is done with the **DIVIDE** command. Points are very small and you will probably not be able to see them, just accept the fact that they are there.

divide

```
Select object to divide:
```

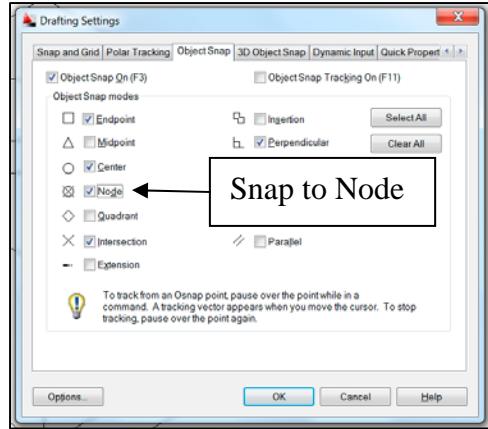
{Click on the construction line we have just created}

```
Enter the number of segments: 10
```

{Enter 10 and press return}

Next, we will turn on snapping to points so that AutoCAD can use these 10 equally spaced points as the beginning point of lines needed to construct the tessellated surface. Enter **OSNAP** to produce the dialog box shown on the right. Click on the “Node” snap mode then click on OK.

Turn ORTHO on and use CTRL-E until the mouse pointer has a line parallel to the back of the object we are drawing. Use the line command to draw the line. The results are shown below.



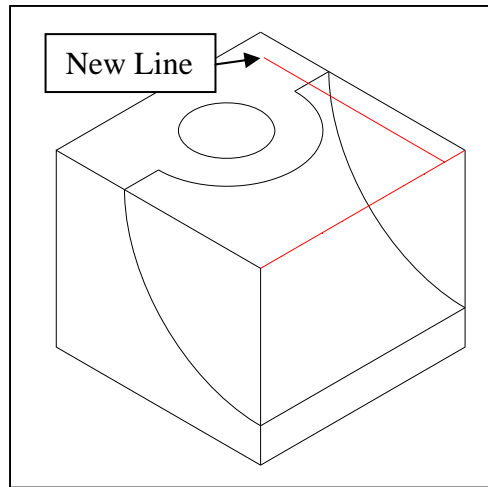
line

Specify first point:

Specify next point or [Undo]:

Specify next point or [Undo]:

{Move the mouse over to the first point we created and click}
{Extend a line parallel to the back of the object until it crosses the line connecting to the ellipses we drew}
{Press Enter}



Now we can copy this line creating a new line at each of the 10 points we created.

Copy

Select objects:
Select objects:
Current settings: Copy mode = Single
Specify base point or
[Displacement/mOde/Multiple] **O**

Enter a copy mode option
[Single/Multiple] <Single>: **M**

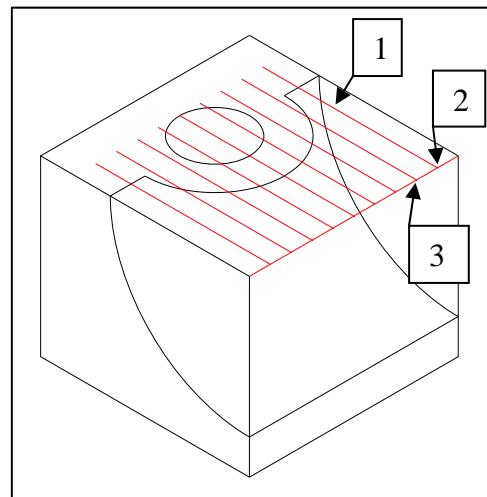
Specify base point:
Specify second point:

*{1 - Click on line}
{Press enter}*

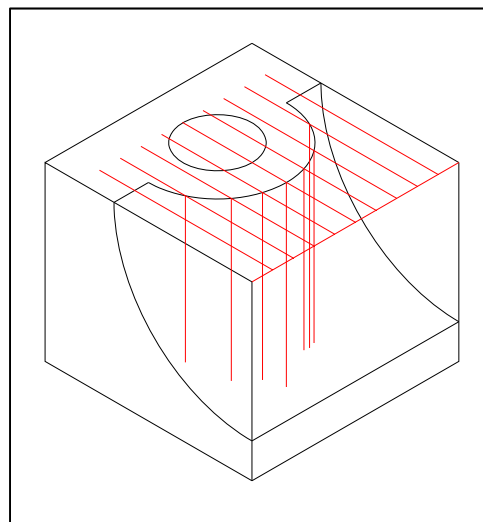
*{The current copy mode is Single.
Enter O to change the mode}*

*{Enter M to change the mode to
Multiple}
{2 - Click on base of line}
{3 - Click on next point. Continue
the process until all of the lines are
drawn.}*

The results are shown on the right.



Next we will extend lines down starting at the intersection of the lines we have just created and the cylinder. Use CTRL-E until one of the mouse pointer lines is vertical and draw the lines with the mouse. You only need to draw vertical lines where the construction lines cross the larger ellipse on the top of the object. The results are shown on the right.



Now we will copy the curves along the curved surface. These are can be created with the copy command.

copy

Select objects:
 Select objects:
 Current settings: Copy mode = Multiple
 Specify base point:
 Specify second point:

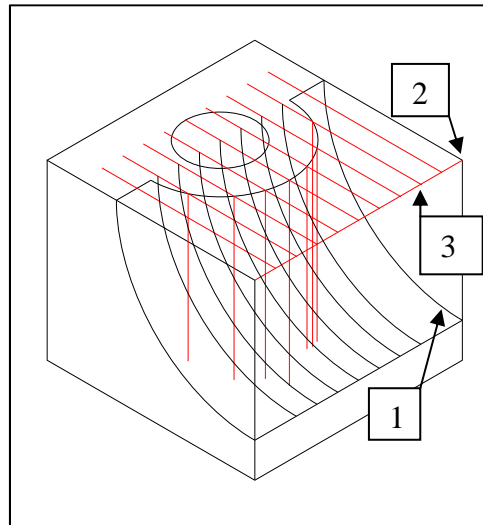
*{1 – Click on the curve}
 {Press Enter}
 {2 – Click on the center of the arc}
 {3 – Click on the first point we created. Continue the process until you have created all of the curves.}
 {Press Enter}*

Specify second point:

The results are shown on the right.

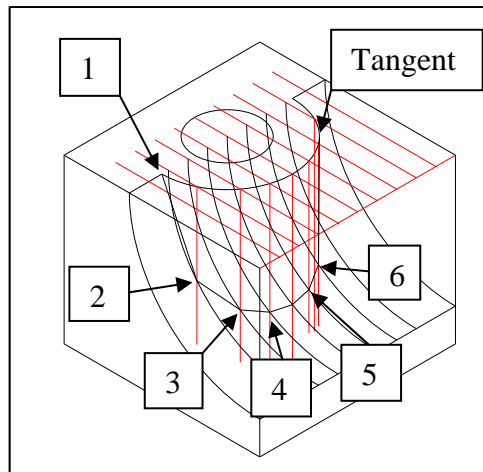
Now we can connect the intersections of the curves we have just created with the vertical lines we created in the previous step to generate the intersection of the two curved surfaces. We will use the **PLINE** command to create this line. The **PLINE** command creates a poly line that can be smoothed to generate a more realistic surface.

Switch to the object layer before you create this line. A significant amount of care must be exercised to make sure the correct vertical line connects to the correct curve.



pline

Specify start point: {1}
 Current line-width is 0.00
 Specify next point: {2}
 Specify next point: {3}
 Specify next point: {4}
 Specify next point: {5}
 Specify next point: {6}
 Specify next point: tan {Tangent point to curve}



Next, we need to remove all of the construction lines. The straight lines were drawn in the projection layer so these can easily be turned off. The curves, were copied so they are in the object layer. We can either erase them or we can change their layer to the construction layer. This can be done with the **CHANGE** command. The **CHANGE** command can be used to change many different attributes, but we will use it just to change the layer.

change

Select objects: 1 found

{Select each of the curves that were used as construction lines}

Select objects:

{Press Enter}

Specify change point or [Properties]: **P**

{Enter P to change the properties}

Enter property to change

[Color/LAyer/LType/ltScale/Thickness]: **LA**

{We are changing the layer}

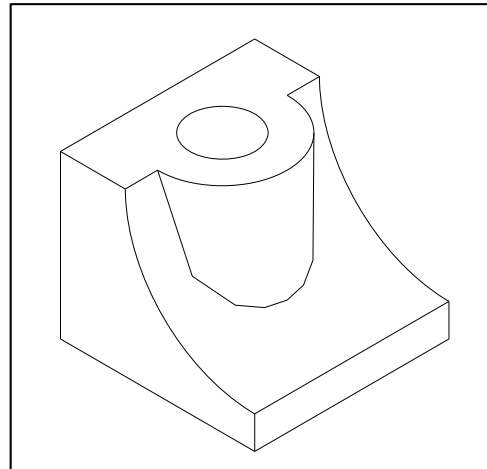
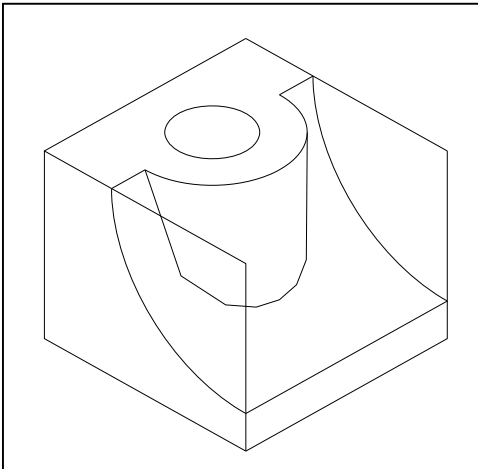
Enter new layer name <Iso>: **Proj**

{The new layer is Proj}

Enter property to change

[Color/LAyer/LType/ltScale/Thickness]:

Now that we have changed the curves to the “Proj” layer, we can turn them off. The resulting drawing is shown on the left. The drawing on the right shows the object after trimming the horizontal and vertical lines on either side of the object.



The drawing on the right looks reasonable, but the curve at the intersection of the two surfaces that we generated is not as smooth as it should be. We can use the **PEDIT** command to smooth the line.

PEDIT

Select polyline or [Multiple]: *{Click on the pline}*
Enter an option [... /Fit/Spline/ ...]: **s** *{Use the Spline option}*
Enter an option [... /Fit/Spline/ ...]: *{Press Enter}*

There are two options that allow you to smooth the curve. One is “Fit” and the other is “Spline”. The “Fit” option fits a smooth curve through the vertices of the original PLINE and the “Spline” option smooths the curve but does not force the line through the vertices. You might want to try both of these options and pick the line that looks the best.

The finished drawing is shown below.

