

Onshape Lesson 9

In this lesson you will create a threaded rod with Acme threads. In subsequent lessons you will include this threaded rod as a part of an assembly representing a linear actuator. Linear actuators are used in robotics when linear movement is needed. The linear actuator you will design is of the screw type, where rotation of the threaded rod is translated into a linear movement by a threaded nut connected to the rod.

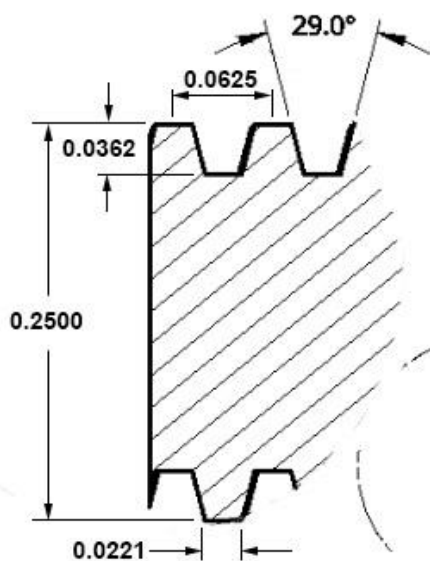
In designing a threaded rod, it is advisable to consult a machinist's handbook for established standards. A handbook is available at this address:

http://www.nashua.edu/paradisem1/Machinery's%20Handbook%2027th/27_Thread_09A.pdf

On page 1725 of the handbook there is the following information of interest:

“In addition to general-purpose fastener applications, certain threads are used to repeatedly move or translate machine parts against heavy loads. For these so-called translation threads a stronger form is required. The most widely used translation thread forms are the square, the Acme, and the buttress. Of these, the square thread is the most efficient, but it is also the most difficult to cut owing to its parallel sides and it cannot be adjusted to compensate for wear. Although less efficient, the Acme form of thread has none of the disadvantages of the square form and has the advantage of being somewhat stronger. The buttress form is used for translation of loads in one direction only because of its non-symmetrical form and combines the high efficiency and strength of the square thread with the ease of cutting and adjustment of the Acme thread.”


From the above passage in the handbook we learn that the Acme thread is designed for “translation,” which is another way to say linear movement.




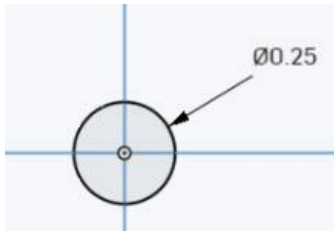
The drawing to the left is a cross section of a $\frac{1}{4}$ inch diameter rod with Acme threads. Notice that the angle of the threads is 29 degrees, which is a standard for Acme threads. Also notice that at the top and bottom of the threads there are horizontal, flat surfaces. This is also a characteristic of the Acme thread.


The handbook indicates that a $\frac{1}{4}$ inch diameter rod with Acme threads should have 16 threads per inch, which is another standard. The **pitch** of the threads is the distance from the middle of one thread to the middle of an adjacent thread. The drawing to the left indicates that the pitch for the $\frac{1}{4}$ inch rod is 0.0625 inches ($1/16 = 0.0625$).

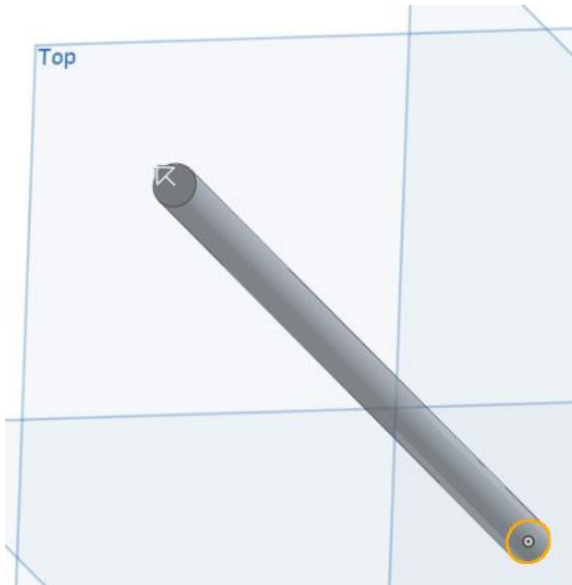
Before we can cut the threads on the rod, we need two additional dimensions: width of the flat at the thread crest (0.0221 inches) and the height of the thread (0.0362 inches). These dimensions were calculated using the information available in the handbook. Now we have all the measurements needed.

1. Create a new document in Onshape and name it Lesson 9.
2. Create a new sketch on the top plane and set the view normal to the sketch plane.
3. Using the Circle tool  , draw a circle with its center at the center point of the top plane.

Then use the Dimension tool  to set the diameter of the circle to 0.250 inches. Now close the sketch.

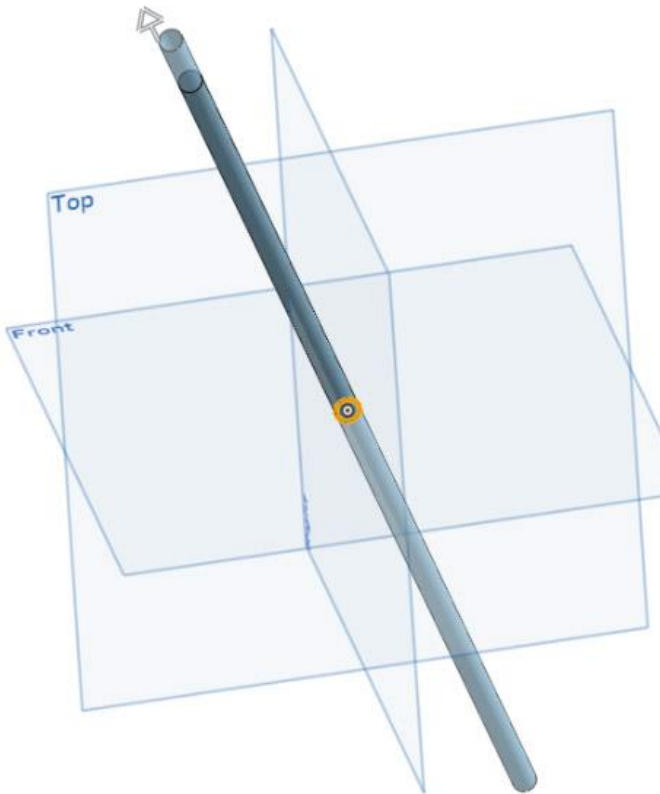



4. Select the Extrude tool  . Select the sketch you just completed to extrude it. Extrude the circle to a distance of 8 inches to create a rod. Then close the extrude.



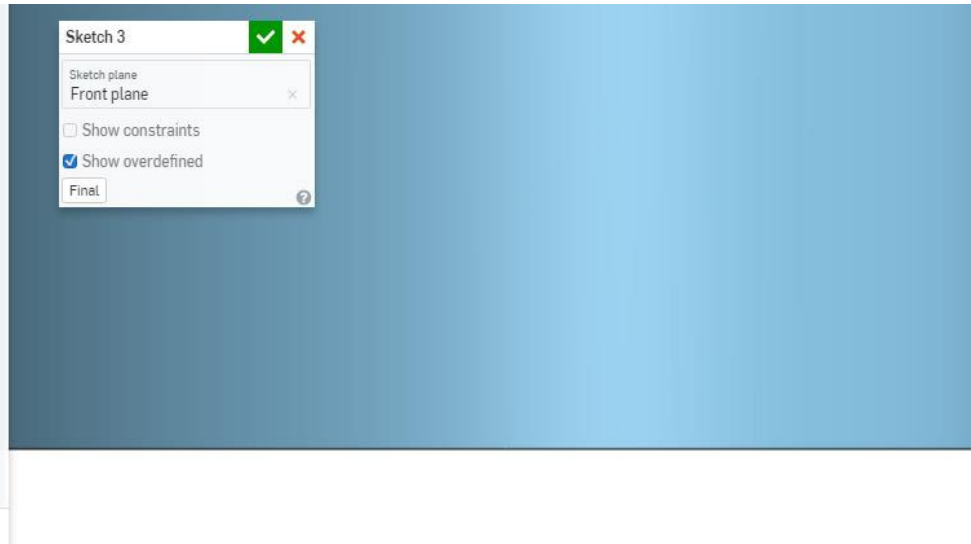
5. The remaining steps will result in a cutting of the threads on the rod. This will be done by sweeping a profile of the thread along a helix of 16 revolutions per inch. In order to cut a complete set of threads, including at the ends of the rod, our helix must extend beyond the ends of the rod. Therefore, we should not connect the helix to the rod. Instead, you will now create a cylindrical surface around the rod and attach the helix to it.
6. Create a new sketch on the top surface and make the view normal to the sketch plane. Draw a circle of 0.250 inch diameter, centered at the center of the top plane. Then close the sketch.


7. Select the Extrude tool. Select the sketch you just created as the object to extrude. Extrude this circle as a **SURFACE, symmetrically**, for a distance of **18 inches**. You should now have a cylinder that completely encloses the rod and extends well beyond it at both ends (much longer at one end than the other, but this does not matter). Close the extrude.




8. Select the Helix tool . Then select the cylinder you just made as the attachment-object for the helix. Since the cylinder is 18 inches long and we want 16 turns of the helix per inch, that calculates to 288 revolutions of the helix. Set the number of revolutions to 288. Then close the helix.

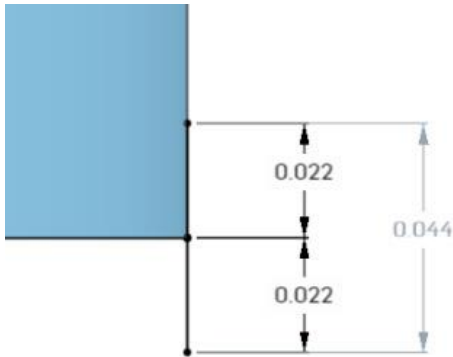
9. Create a new sketch on the front plane and set the view normal to the sketch plane. Zoom your view into the bottom of the cylinder as seen in image below.




10. Select the Use tool  . Click on the bottom edge of the cylinder.

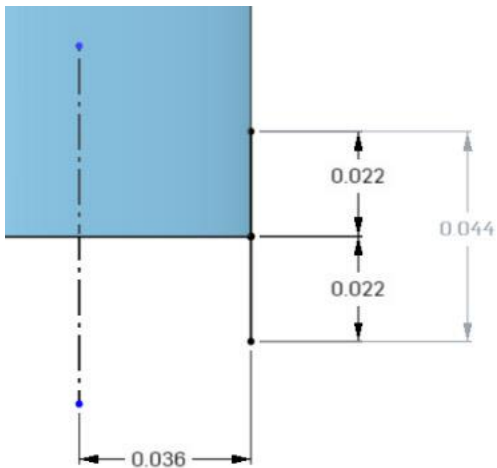


11. Using the Line tool  , draw two lines, each 0.0221 inches long. The lines should be vertical as seen below.

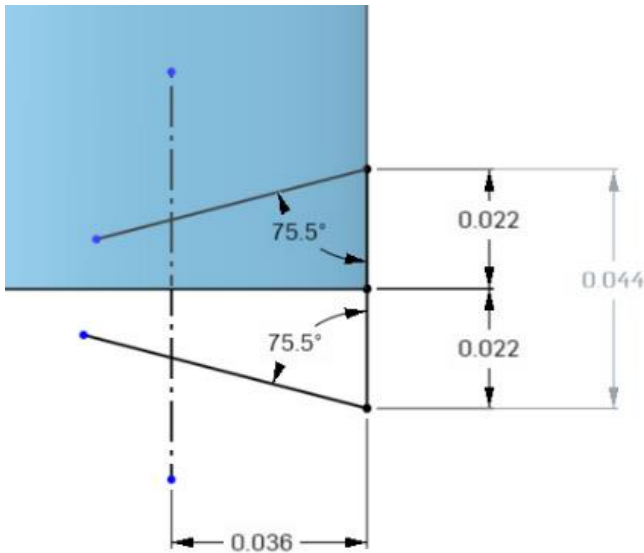


12. Use the Line tool to draw a vertical line as seen below. Convert the line to a construction line

using the Construction tool  . Use the Dimension tool to set the construction line 0.0362 inches from the right edge of the cylinder as seen below.



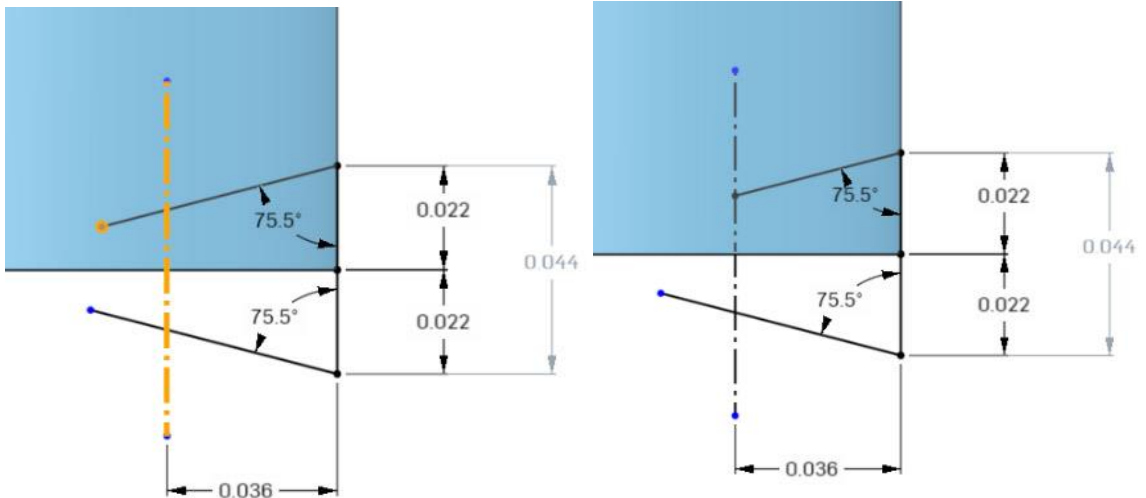
13. Use the Line tool to draw two lines as seen below. Use the Dimension tool to set the angle of each line to 75.5 degrees (which will result in an angle of 29 degrees between the two lines, the specification for Acme threads).



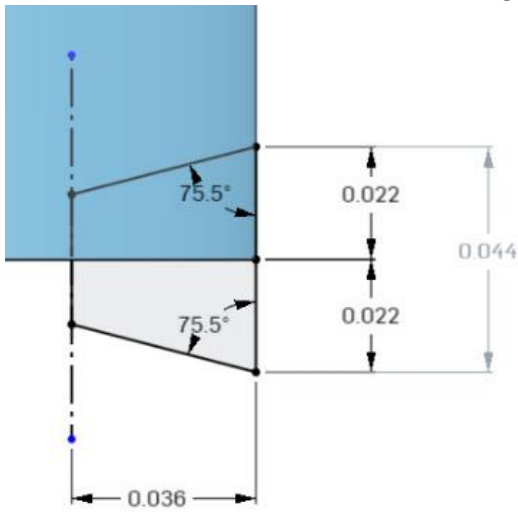
14. Make sure you do not have a tool selected. Then click on the end point of one of the lines drawn in the previous step. Then click on the construction line to select it as well. The end point and construction line should be highlighted in yellow as seen in image on left below. Now



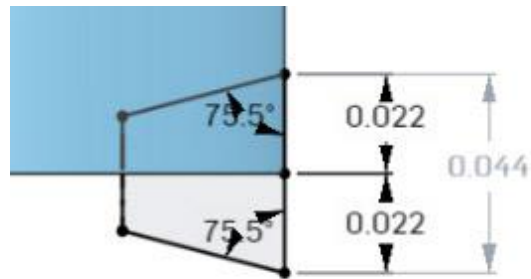
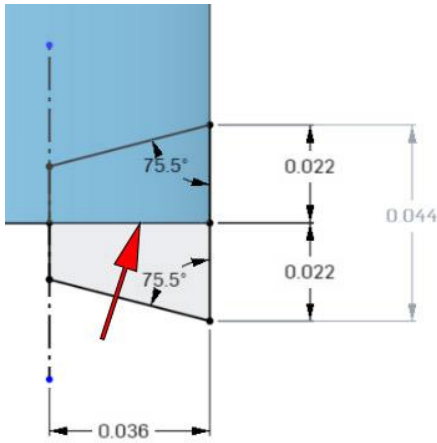
click on the Coincident tool to move the end point of the line and connect it to the construction line as seen in image to right below. Repeat this procedure for the other line angled at 75.5 degrees.




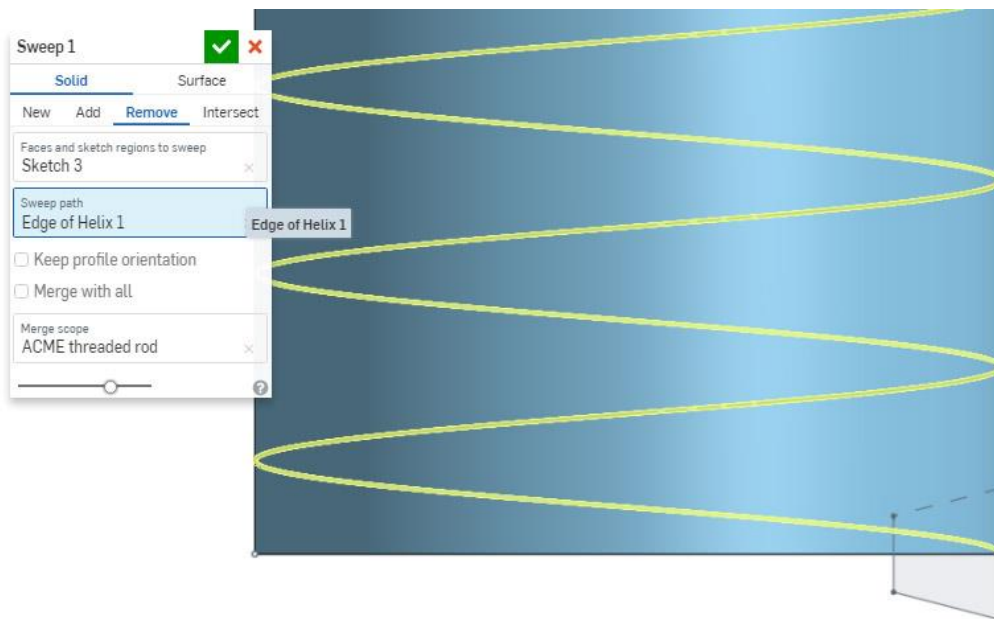
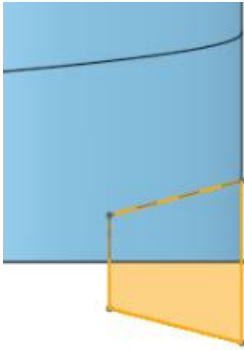
15. Use the Line tool to draw a line connecting the two ends of the 75.5 degree lines as seen below.



16. Use the Trim tool to remove the line at the red arrow pictured below on left. Also remove construction lines and remaining line segment at bottom of cylinder. You have completed the profile of the thread that will be used to cut threads in the rod. Close the sketch.



17. Select the Sweep tool . Select **Remove** in the Sweep 1 box. Then select the thread profile completed in the previous step as the object to sweep. Click in the Sweep path slot of the Sweep 1 box and then click on the Helix line to select it as the path (see second image below). Close the sweep.



18. You must hide the cylinder surface in order to see your threaded rod. In the parts list on the left, click on the eye for Surface 1 to hide it. Also click on the eye for the helix to hide it as well. Then zoom your view out and find the Acme threaded rod complete!

