



Tension Spring Tutorial

Using Cobalt™, Xenon™, Argon™

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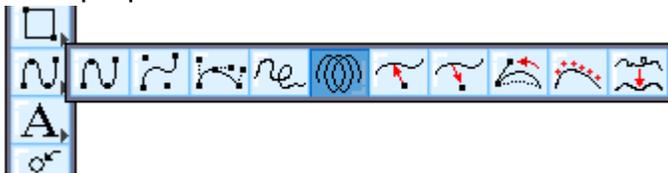
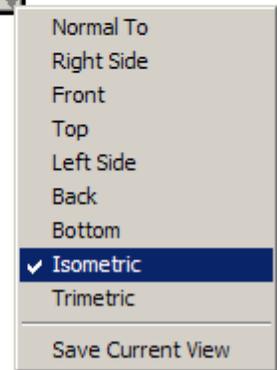
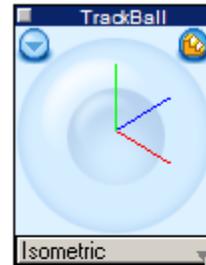
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Creating a Composite Curve Tension Spring

Start a new file and save it with the name, **Tension Spring**. All units noted in this tutorial are in inches. Begin by creating the helical portion of the spring, which is only one piece of the curves required to complete our part. Once all of the curves are created, use the sweep command to create the final part.

Creating the Helix

- Switch the drawing view to Isometric using one of the following methods:
 - View>Isometric.**
 - Right-mouse click, **View>Isometric.**
 - Use the keyboard shortcut (the letter F).
 - Use the drop down menu on the Trackball.
- Starting at the origin and along x-axis, create a helix curve with the following properties:



- Pitch: **.10"**
- Diameter: **.25"**
- Length: **1.25"**
- Draft Angle: **0**

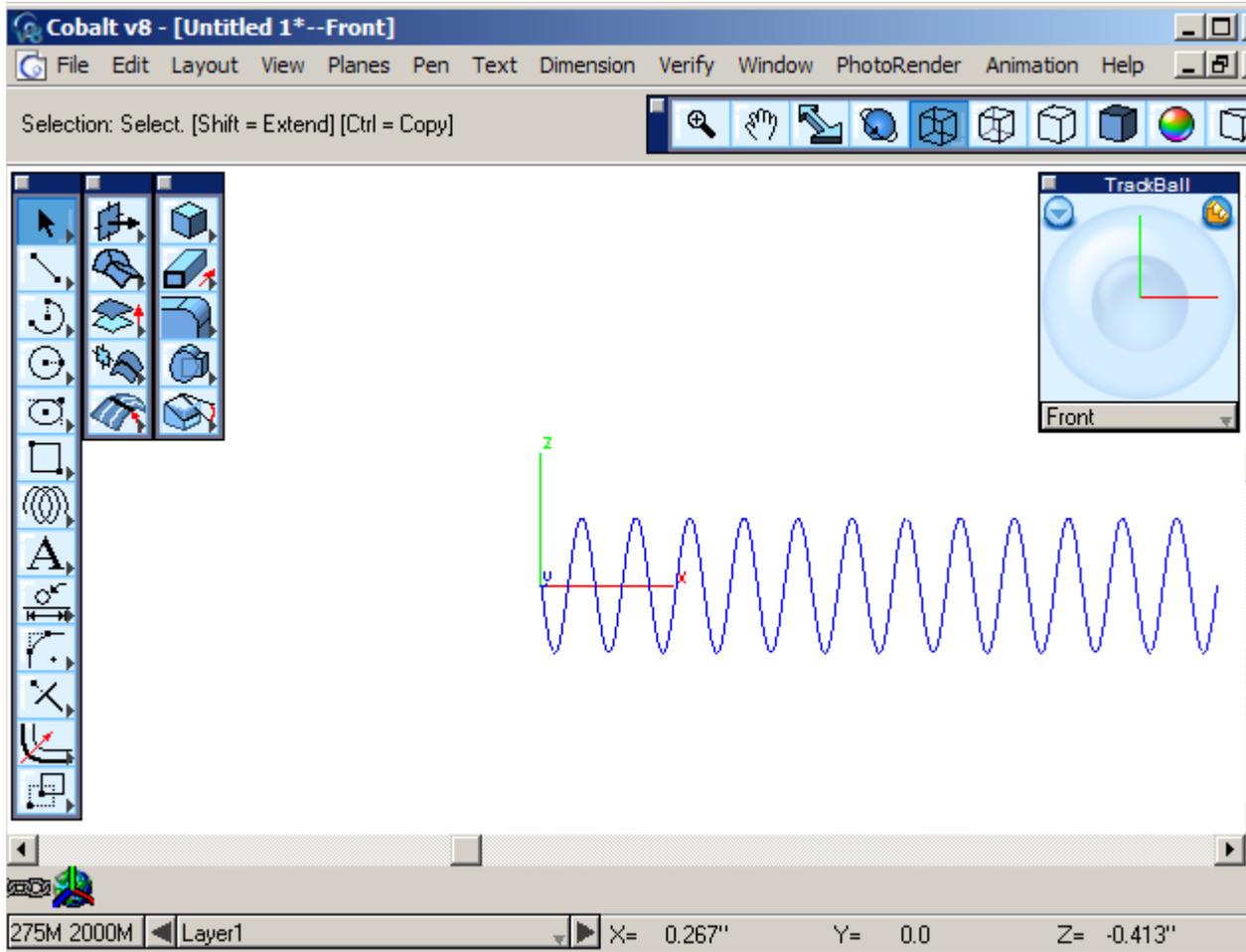
- Zoom All using CTRL+F (Windows) or COMMAND+F (Mac) to see the helix clearly. This is all it takes to create a helix. (At any time the parameters of the helix can be edited through the Edit Objects box.)



Creating the Tension Spring Arms

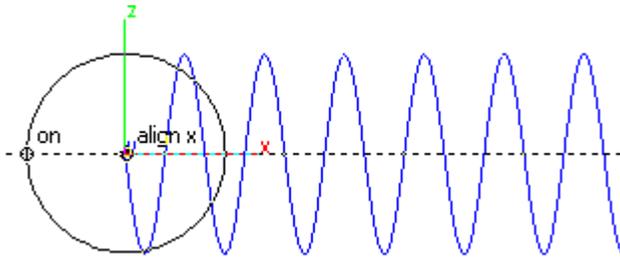
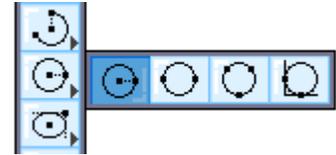
The next step is to create the arms for the tension spring. This will be accomplished by adding several curves together after slightly modifying them.

4. Switch the drawing view to Front, using one of the methods listed above. The exception is the keyboard shortcut: the letter S.

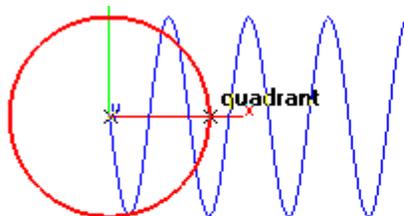


Once in the Front View, Zoom All command. Now move the helix around the screen so that it is positioned as in the image above. (Use the Zoom Out keyboard shortcut [and then pan the drawing using the space bar on the keyboard.)

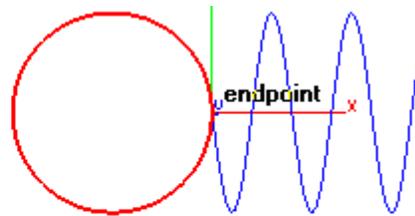
5. Draw a circle using the **Center-point Circle** tool. Place the center of the circle at the endpoint of the helix. Make the diameter of the circle .25".



6. Using the **Selection** tool  move the circle. Grab the circle by its quadrant and move that quadrant to the endpoint of the helix.

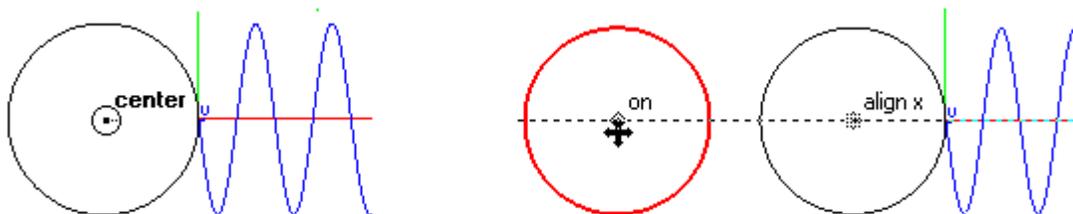


Move the circle by this quadrant location...



... to the endpoint of the helix.

7. Start to create a second circle using the center point of the previous circle. Using the same circle tool, click the center point of the existing circle. **DO NOT** press ENTER or move the mouse. Using the TAB key move to the X location in the Status Box and subtract .5" from the value shown by simply clicking at the end of the current number and typing **-.5"**. (Be sure to include the - sign so that circle moves to the left.) Now press ENTER.

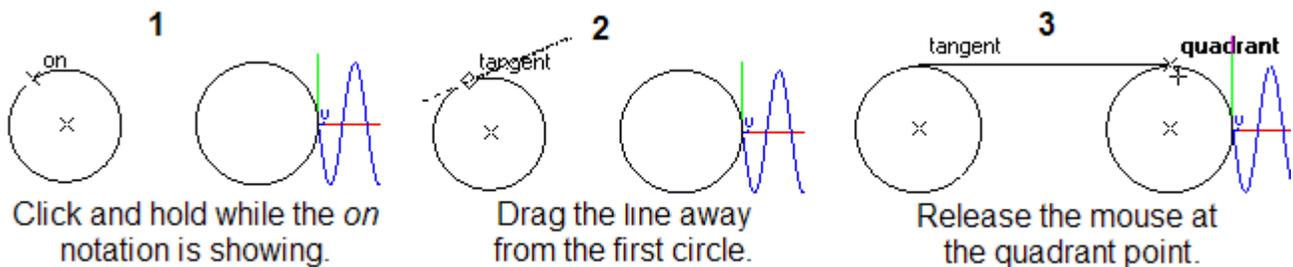
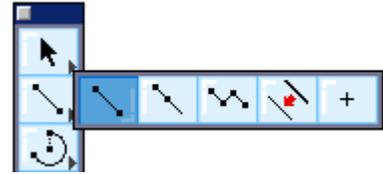


Use the center alignment to create a second circle.

Curve Modification

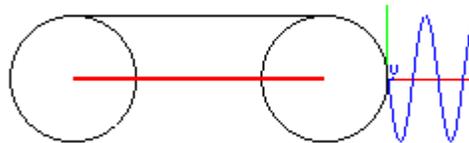
The next operation is to dissect these circles creating the shape for the arm of the tension spring.

8. Create a tangent line from one circle to the other. This operation is very simple in Ashlar-Vellum programs. Use the **Single Line** tool to create the tangent line (see the illustration below). One important thing to note: when creating the line, make sure that the *on* notation is active.



9. Create a copy of the line by holding down the CTRL (Windows) or OPTION (Macintosh) key. Click the center of the left circle to create an exact copy of the original line.

Single Line: Pick beginning point. [Ctrl = Copy Previous]



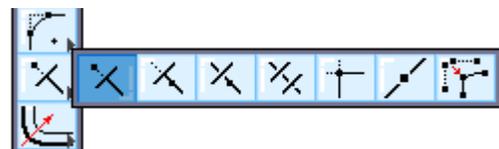
Resulting copied line runs center to center.

Now trim the unwanted pieces of the circle away.

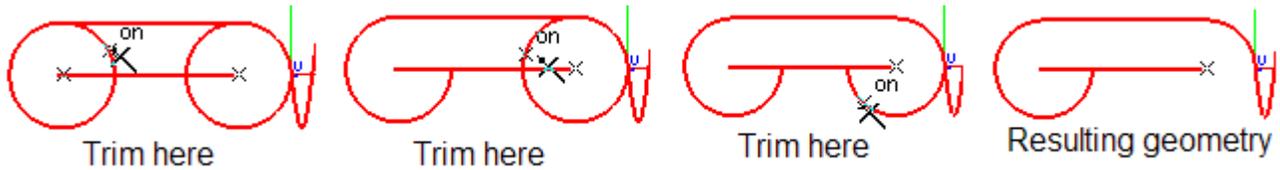
10. Select all of the geometry created to this point. There are several ways to accomplish this:

- Double click the **Selection** tool. 
- From the Edit Menu, choose Select All.
- Right-mouse click and choose **Select All > All Objects**.

11. Select the **Simple Trim** tool.



12. Trim the sections indicated below. If trimming the sections does not give the result like in the picture below, tangency was not achieved when creating the line between the two circles in step eight. Go back to that point and try again.

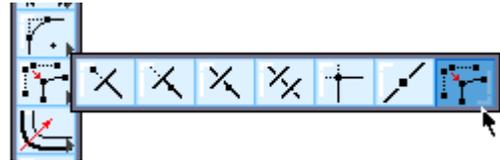


13. Delete the center line.

Now, the resulting geometry must be joined together.

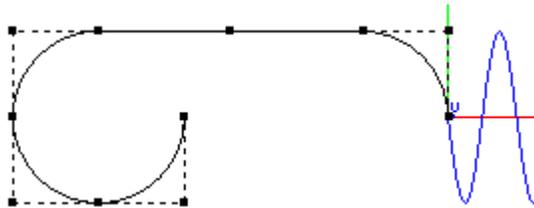
14. Select the **Connect Curve** tool. Notice the Message Line:

Connect Curve: Select two curves to connect end points. [Ctrl = Join]



Using the CTRL (Windows) or OPTION (Macintosh) key, join multiple curves together, creating one entity.

15. Select the larger arc, hold down the CTRL or OPTION key, and then select the line. Select the resulting joined curves and add the smaller arc to it.
16. Show the points for the resulting joined curve (**Edit Menu>Show Points**). If the points of the curve do not look like the image below, tangency was not achieved when creating the line between the two circles in step eight. Go back to that point and try again.



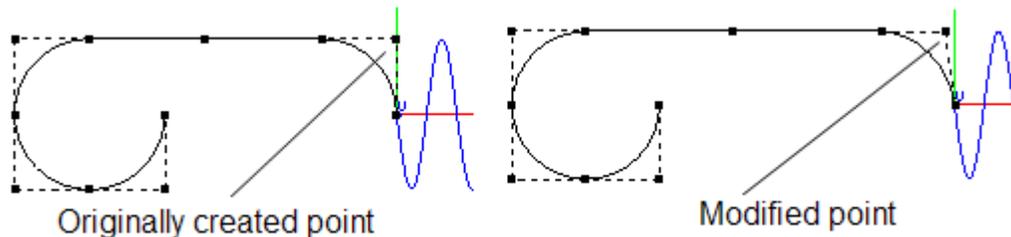
Modifying Tangency

The next steps will create tangency between our joined curves and the helix.

17. Select the **Modify Slope** tool from the **Spline** tools palette. Choose the **Reference** option from the drop down menu located in the Message Line



18. Select the joined curve for the first step of this tool. Select the helix as the second step of this tool. Select the vertex (the point at which the arc and the helix meet) for the last step of this tool. Notice how one point of the joined curve is repositioned creating the tangency.

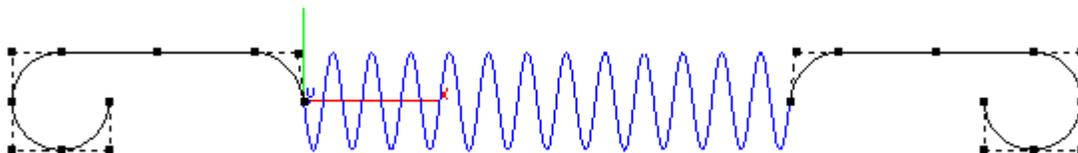


Next mirror the modified joined curve to the other side of the helix.

19. Select the **Mirror** tool.

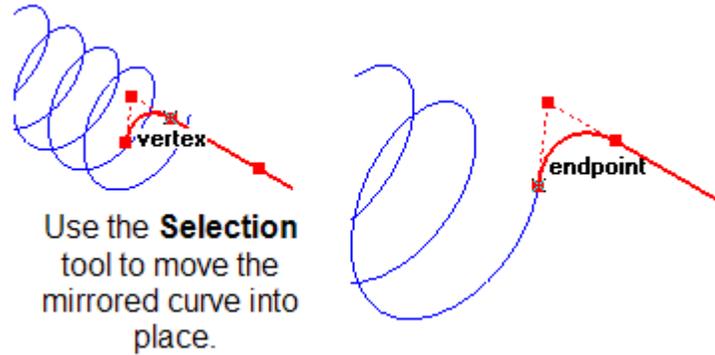


20. Select the modified joined curve (if it is not already selected) and choose a point roughly half way across the helix. The exact location doesn't matter because the mirrored part will be moved to the correct location. Click the top vertex of the circle (now a hook), then the bottom vertex of the circle. Make sure to hold down the CTRL (Windows) or OPTION (Macintosh) key to create a copy.



21. Change the drawing view to Isometric.

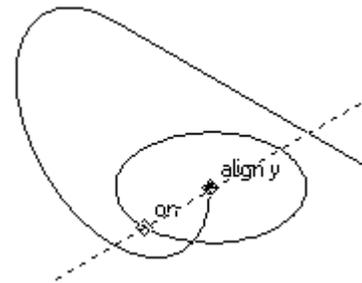
22. Move the mirrored curve into place using the **Selection** tool.



The last steps are very simple: create a circle profile that will be swept along the tension spring path, creating a solid part.

23. Take the **Center-point Circle** tool, create a .075" Diameter circle at the endpoint of either tension spring arm.

24. Select the **Swept Solid** tool.



25. Sweep the circle profile along all three pieces of the tension spring, the left arm, the helix and the right arm. (Hold down the SHIFT key to select these curves.)



That completes the tutorial. Some important things to note are:

- It was unnecessary to create work planes prior to creating geometry.
- All curve creation was easily and expertly accomplished with the aid of the Drafting Assistant.
- The ease in which tangency was created or modified.