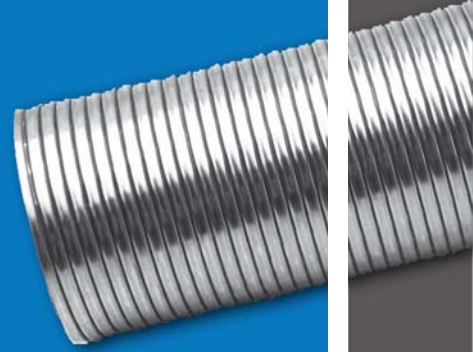




Flexible Metal Tubing (Flex) Measurement and Cutting

Nelson Global Products' Flexible Metal Tubing (Flex) is available in stainless steel, aluminized or galvanized and is sold in a partially compressed state, providing 10% more length than competitive products sold in fully extended lengths! This document provides detailed information about properly measuring, cutting and joining Flex tubing.



Measuring Flex

- Difference between natural lie, fully compressed and fully extended states
- Determining the measured length
- Measuring in the extended state

Cutting Flex

- Approved methods

Joining Flex to Straight Pipe

- Type of clamps to use



Introduction

Nelson Global Products' Flexible Metal Tubing (Flex) is strip-wound flexible round metal conduit, 2-6" (50.8-152.4 mm) ID. Flex is commonly used to absorb relative motion and vibration between a vehicle's engine, frame and cab and as a means to account for dimensional differences and tolerance stack-up in the exhaust system. To avoid early failures that can occur when the flexibility of the tubing being used to adjust for misalignments is compromised, the tubing must be installed so that its maximum flexibility is preserved.

Nelson Global Products provides bulk Flex in over length rolls to assure that the correct amount of natural lie tubing is provided to the customer. In many cases, these rolls of bulk Flex tubing are subsequently cut to length for the end user. Inconsistent measurement and cutting procedures can result in apparent shortages of bulk tubing.

To prevent any misunderstandings, Nelson Global Products recommends a standard method for measuring Flex. The following terms are used to describe the Flex tubing:

Fully Extended: The tubing is in a fully expanded state and the convolutions are completely open. Approximately 20% less metal is required than fully compressed.

Fully Compressed: The tubing in a fully compressed state and the convolutions are completely closed. Approximately 20% more metal is required than fully extended.

Natural Lie: The average of fully compressed and fully extended lengths. Approximately 10% more metal is required than fully extended and 10% less metal is required than fully compressed. This is also referred to as the partially compressed state.

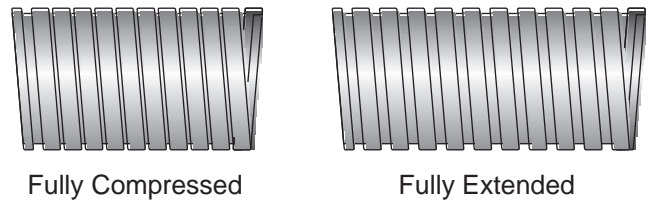


Figure 1: Flex States

- Bulk Flex tubing is sold in 10' and 25' rolls measured in the **natural lie state**.
- Cut to length Flex is measured in the **fully extended state**.

Measuring Flexible Metal Tubing

Shipping will cause the tubing to compress beyond the natural lie state. Before cutting Flex tubing, one end of the tube must be anchored and the other end pulled to its fully extend state and quickly released so that it snaps back into its natural lie condition.

Whenever Flex tubing is measured or cut, it must be properly oriented. The piece being cut from the tube must come off the open end of the bulk length of tube. The open end is the end at which the wraps appear to be on top of each other as they move away from the end of the tube. When measuring or cutting Flex tubing, keep the open side of the tube to your right.

Figure 2 shows how to measure length with the Flex in the proper orientation - open end on the right. Note how wraps are on top of one another when looking right to left and underneath one another when looking left to right.

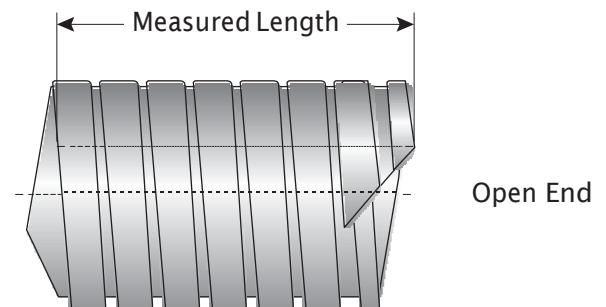


Figure 2: Flex Measured Length with Open End to the Right

Measurement of Flex should be done by laying out the tube on a level surface and curving the entire tube or section into a tight radius so that the inner side of the curved tube has its convolutions touching as shown in Figure 3. When the inner radius of the Flex tubing is fully compressed, the outer radius will be fully extended and the center line of the tube will be at its natural lie length as depicted in the figure.

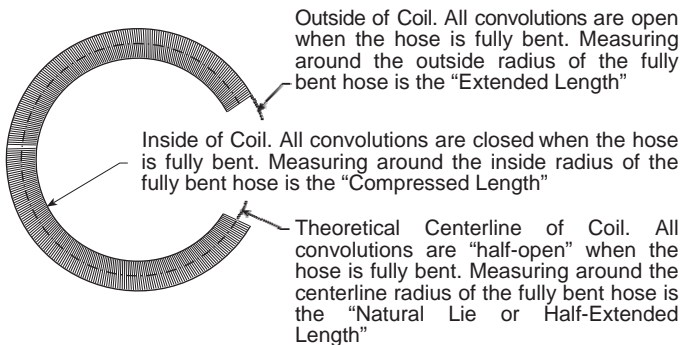


Figure 3: Measuring Flex Tubing Length

To measure in the extended state:

1. Orient the Flex tubing with the open end on the right. Measurement begins at the open end.
2. Coil the Flex tubing in a tight radius, as shown in Figure 3.
3. Measure along the outside of the radius where the convolutions are all open.
4. Mark the point on the outer radius where the cut is to be made.
5. Cut using one of the methods described in the following section.

If the Flex is to be sold in the natural lie state, measure the length off the bulk Flex roll after restoring it to its pre-shipping state. Use the cutting methods described in the following section.

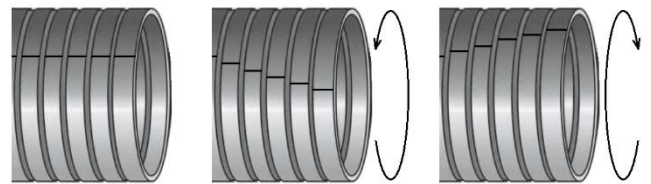
Cutting Flex

Flexible tubing can twist or unravel when cut, causing its diameter to change and make installation difficult. This occurs because flexible tubing must maintain flexibility to function properly, and therefore, cannot be tightly wound in the manufacturing process. However, flexible tubing can be managed for trouble-free installation by following these guidelines.

Resizing

If the diameter has changed, either through shipping relaxation or through manual manipulation, take the following steps to bring it back to the desired diameter.

Using a permanent marker, add a witness line to the last 12 inches of Flex. Then, stretch that section out to the Fully Extended state. (This will allow easier manipulation.) One full revolution of a 5" ID flex will result in a diameter change of about 1/8". Smaller tubes will need to be turned further for the same diameter change.

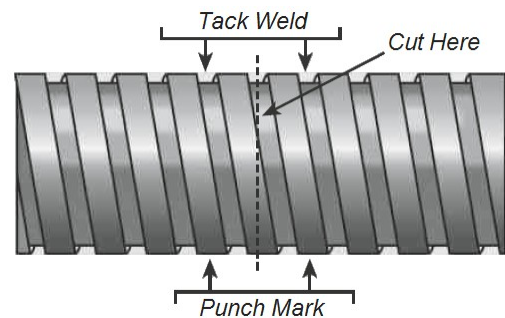


- If the ID is too large, turn the end Counter-Clockwise.
- If the ID is too small, turn the end Clockwise.

Follow the steps in **Prepare** below to avoid additional diameter changes.

Prepare

Place a tack weld between convolutions each side of the intended cut to keep ends from twisting or unraveling.



If a welder is not available, insert a mandrel or back-up pipe into the tubing and place a punch mark directly on convolutions each side of the intended cut. Heavy-duty tape over a de-greased pair also works. Cut through tape and leave in place, clamp over tape.

Cut

Ensure that the Flex tubing is straight and cut at the fully extended mark using one of these approved methods:

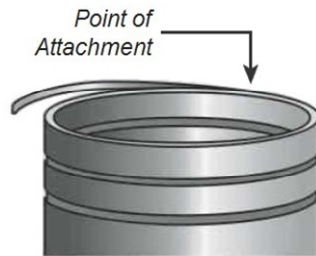
- Chop Saw: Use 1/16" (1.6 mm) wide blade for best results
- Band Saw: Use a no-set blade with 24-32 teeth per inch
- Hack Saw: Use a no-set blade with 24-32 teeth per inch

Trim

Each side of the cut will now leave a spiral "tail" that must be removed to the point at which it is attached. Bend each tail until it breaks, or bend and use a cutting shear to remove.

Deburr

Deburr both cut surfaces with a hand-operated drum sander or file.



Joining Flex to Straight Pipe

It is important to use the correct type of clamp to hold and seal the tube-to-flex joint. A TorcTite™ clamp (see Figure 4) or equivalent must be used at both ends of the Flex tubing. This style of clamp is preformed to fit properly on the outer diameters of the Flex tubing and mating tubes.



Figure 4: TorcTite™ Lap and Butt Clamps

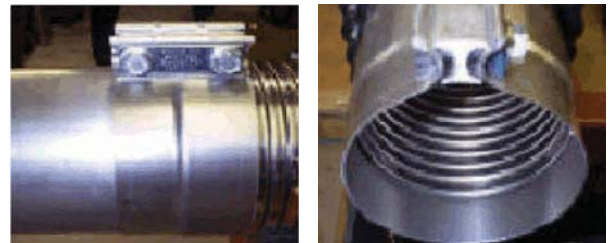


Figure 5: Flex Tubing, Correctly Joined