

Bending Tutorial Using Template Bends

The Easy Way To Position Bends

Learning the operation of a bender is fairly easy. The real challenge is accurately placing the tubing into the bender so that the bend comes out in the right position. This short tutorial explains the simple process of template bending.

Make a sample bend called the *Template* as shown in Figure 1. A permanent mark scribed on the template allows you to measure and visualize where the bend should be placed in the tubing. Once bent the tubing will spring out to a larger radius than the forming die's size indicates. The larger the O.D. or the stronger the tubing, the greater the springback. For instance, chromemoly tubing will springback roughly twice as far as the exact same size and wall thickness of welded seam mild steel tubing. By using a template bend with the same kind of tubing you are going to bend, you do not have to worry about this springback because the template has already sprung out to its finished size.

You may ask if buying bending software is a good idea. I believe bending software can only be justified for two reasons: Creating part drawings if the software supports that function and for setting up a fully automatic CNC bender for the initial test of a part with multiple bends. Even using the software the bend locations usually need to be hand tweaked for accuracy before going into production. Most professional fabricators use a method similar to what is described here. It is extremely easy, accurate and fast. However, what if you need to bend 500 pieces. How would you use this process? Don't worry, it's a simple technique that I will explain later but first let's just complete a single piece job. To do this I'm going to go through the whole process that I use to make a four bend rollbar for a racecar as shown in Figure 2. This is a great example because it's a common request, there are no simple 90 degree bends, and it is generally a one-off piece. So hold on to your lug nuts, here we go.

Let's Make A Bend Template...

First, you need to make a template. For our example, we are going to use 1 1/2" o.d. x .120" wall welded seam mild steel tubing. As shown in Figure 1, the template is a piece of tubing bent to 90 degrees with approximately 6" of straight tubing on each side of the bend. Cut a piece of tubing roughly 30" long. Next, scribe an accurate line all the way around this tubing 6" from the end. An accurate and easy way to do this is to use an inexpensive pipe cutter. Your local home supply store should carry them in the plumbing department. A small lathe with a sharp cutter also does a good job. Scribe the line deep enough, roughly .015", so that when you paint the template, the line is still clearly visible. Hand scribing this line is difficult and not recommended. The tube should now resemble Figure 3.

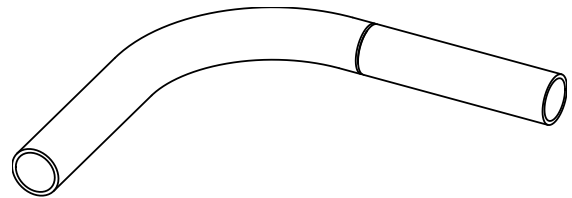
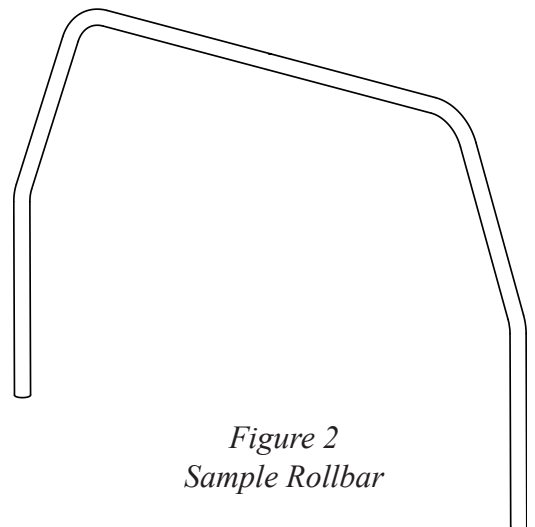


Figure 1 - Sample Template Bend



*Figure 2
Sample Rollbar*

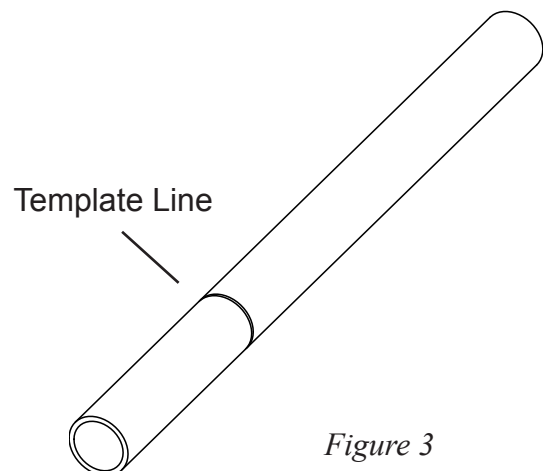


Figure 3

Load this tube into your bender as shown in Figure 4. Note that only the die set and tubing are visible in the figure. The actual bender and the die set's u-strap are not shown so that you can see what we're trying to achieve. Place the scribed line at the flat edge of the forming die. Never use the followbar as a reference. If the forming die has a lock bolt on it, use it to securely tighten the tubing in place. It's very important that this mark stays in line with the die's flat edge during the bending process or template will not give you accurate results later.

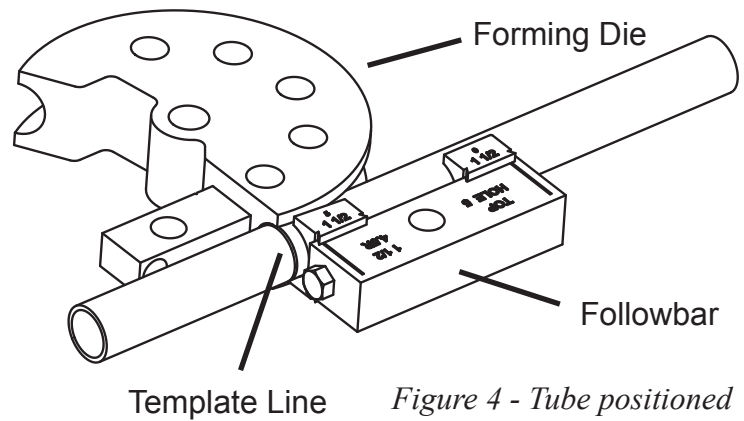


Figure 4 - Tube positioned in forming die

Bend the tube to a finished bend of exactly 90 degrees. On this example, I had to bend to 94 degrees to achieve a true 90 degree bend after the tubing relaxed. Cut the straight length of tubing that is not scribed to 6" long so that it matches the scribed side. This is not really necessary but it does look nice. Deburr both ends and then paint the template an easily visible color. Why does it need paint? It doesn't. But after losing this thing a few times you'll get the idea. The template is finished.

If you work with different types of tubing that are of the same size but differ in the amount of springback they produce, possibly because of a different material or wall thickness, you may need to make a separate template for each one. You can decide later if this necessary depending on the accuracy that you require.

Figure 5 shows a finished template bend still in the die. Note the position of the scribed line on the tube.

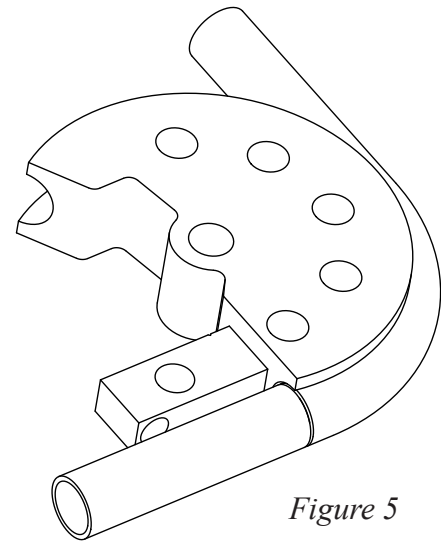


Figure 5

Time To Start Bending...

As shown in Figure 6, the rollbar will be 40" tall from the floor to its UPPER side. It will be 62" wide, outside to outside. The top two bends have been determined to be 70° each and the two lower bends will be 20° each. I recommend that you purchase an adjustable carpenters' protractor to help determine the degree of bend for your specific job. They are made of clear plastic and have legs approximately 12" long.

To determine the total length of tubing needed, you could sit down and calculate it. However, for this application, I think it's a waste of time. Time usually cost more than tubing, so here's the fast way: Take the total width of the rollbar (62") and add it to twice the height (40") which gives us a length of 142" (62" + 40" + 40"). This is slightly too long, maybe a foot or so, but there's a popular rule in fabricating: It is easier to remove material than to add it. Through experience you will learn how much extra tubing you must leave to complete the part.

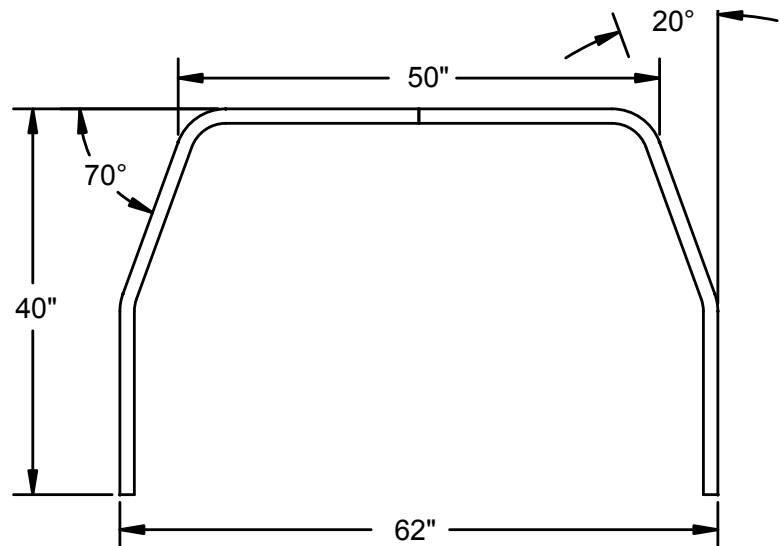


Figure 6

An important rule of bending is to, if possible, always make the bends closest to the center first and work your way out. This allows you to make measurement corrections between bends. Based on this rule, place a mark at the center of the rollbar tube. This is shown Figure 7.

BEND 1:

The first bend will be the upper right side bend. Referring to Figure 6, the upper dimension of the rollbar is 50". From the center of the rollbar to the outside of the bend is 25" (50" divided by 2). Lay the tubing to be bent on the floor and hold the template with the scribed side parallel to the rollbar tubing and directly above it, as shown in Figure 7 . The scribed side of the template will always face towards the center of the tubing being bent. Using a tape measure, slide the template left or right until it is 25" from its outside edge, shown by the right arrow in Figure 7, to the rollbar's center mark. Using a marker, draw a small line on the rollbar directly below the scribed line. Take note of what side of this mark the bend needs to be and draw an 'X' there so that when you load the tube into the bender you'll be bending on the correct side. Since the desired bend is only 70° and the template is 90°, you will have to use your best judgement of when the template is 25" out. This gets easier with experience. Now, load the tube into the bender and make the first bend. Don't forget to over bend a little to account for tube springback. For this material 3 to 4 degrees should be sufficient. Since all J D Squared benders are equipped with degree of bend indicators this is easily accomplished. Once you know the correct over bend required, you may want to record it for future reference.

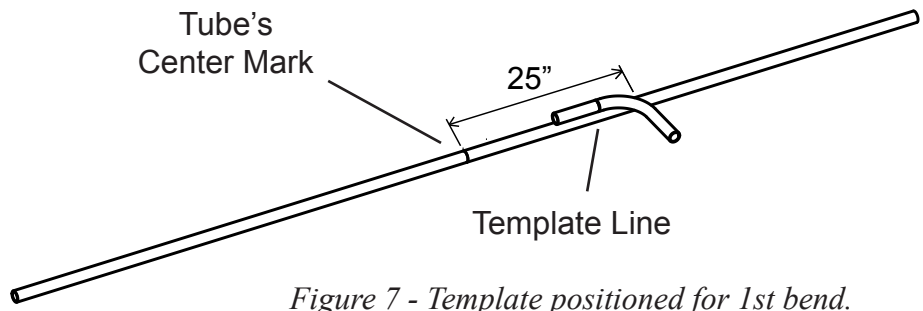


Figure 7 - Template positioned for 1st bend.

Using a tape measure, slide the template left or right until it is 25" from its outside edge, shown by the right arrow in Figure 7, to the rollbar's center mark. Using a marker, draw a small line on the rollbar directly below the scribed line. Take note of what side of this mark the bend needs to be and draw an 'X' there so that when you load the tube into the bender you'll be bending on the correct side. Since the desired bend is only 70° and the template is 90°, you will have to use your best judgement of when the template is 25" out. This gets easier with experience. Now, load the tube into the bender and make the first bend. Don't forget to over bend a little to account for tube springback. For this material 3 to 4 degrees should be sufficient. Since all J D Squared benders are equipped with degree of bend indicators this is easily accomplished. Once you know the correct over bend required, you may want to record it for future reference.

BEND 2:

Place the template above the rollbar tube with the template line facing bend 1 as shown in figure 8. Using a tape measure, position it for the desired 50" outside to outside of the two top rollbar bends. DO NOT use the tube's center mark as a reference and place the template 25" left of center. The reason for this is that if the first bend was not made at the exact right spot to achieve 25" from center you can correct for the error in the second bend's position. Once again, since the bend will be 70° and the template is 90° you must use your judgement as to where to position the template. Place a mark on the rollbar tube exactly underneath the template line. Load the tube in the bender so that the bend will be made on the CORRECT side of the tube and make the 70° bend.

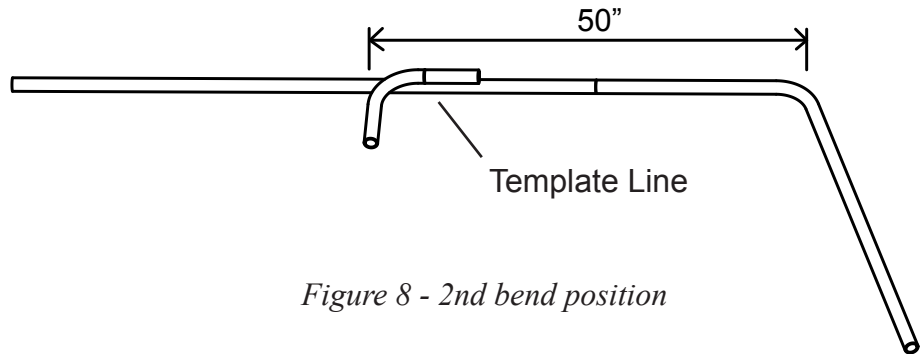


Figure 8 - 2nd bend position

Once again, since the bend will be 70° and the template is 90° you must use your judgement as to where to position the template. Place a mark on the rollbar tube exactly underneath the template line. Load the tube in the bender so that the bend will be made on the CORRECT side of the tube and make the 70° bend.

Erase the center mark on the rollbar tube. Using the tape measure, place a new center mark exactly midway between the outside of the two bends. Why? Let's say your measurement shows the two top bends are really 50 1/4" wide instead of the desired 50". In that case, your old center mark could be off by as much as a 1/4". The NEW center mark corrects this error. That's the cool part about template bending. Your errors can generally be fixed with the next bend. Also note that if you had not started your bending from the center of the rollbar you would not have been able to make the correction. Every bend adds a little more error and you end up with a rollbar that does not fit.

BEND 3:

At this step you may want to use a large 90° square to help position the template. Position the template above the rollbar tube with the template line facing up towards the top of the rollbar as shown in figure 9. Slide the template up or down the rollbar tube until its outside is 31" from the rollbar's center. Mark your tube and make the bend.

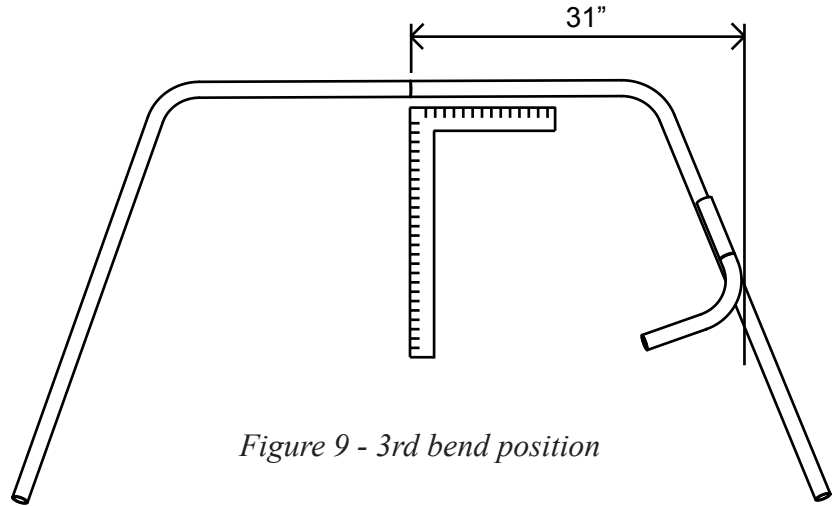


Figure 9 - 3rd bend position

BEND 4:

Position the template with the template line facing up towards the top of the rollbar as shown in figure 10. Slide the template up or down the rollbar tube until its outside is 62" from the outside of the 3rd bend. Also, verify the bend is the same distance down the tube from the top of the rollbar. If all is correct mark the tube and make the bend.

Lastly, cut the ends of the tube to make the rollbar 40" tall and your done.

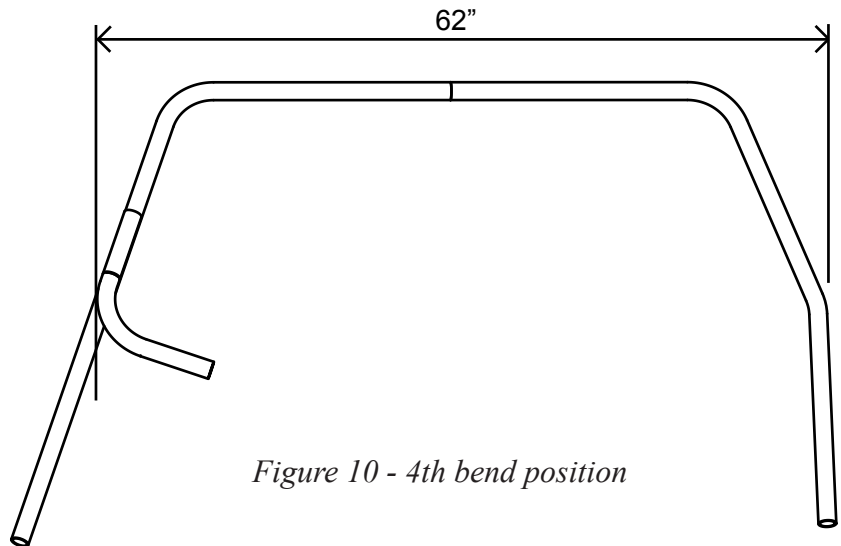


Figure 10 - 4th bend position

Finished!

PROCEDURE FOR SETTING UP A PRODUCTION BENDER USING THE TEMPLATE METHOD

As I stated earlier, this method can be used for production bending. The idea of making the bends from the center out doesn't usually work well in production. Most production bending is done by feeding the tube through the bender and making each bend as needed, thereby eliminating the need to remove the tube from the bender and flip it around. For this you would want a setup sheet with the locations of where to place the marks on the tubing for each bend location. The problem with template bending is that the template has the tube stretch and springback already in it. Since the tubing will grow in length as you make bends in it, how can you measure it accurately once it's bent? Unfortunately, you can't. What you must do is place marks down the tube, for example 10" apart, starting at the one end before you start bending. Now whenever you transfer the mark from the template to the tube being bent you can easily measure the distance from one of the 10" marks to determine where the mark would of been placed on an unbent piece of tube.

Good luck with your projects and if you liked what you read please feel free to share it with your friends. Even with those poor souls who don't have a JD Squared bender.

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