Indexing Tube Bender Pocket Guide

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WARNING

IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE PERSONAL INJURY AND PROPERTY DAMAGE.

It is the sole responsibility of the system designers and users to properly select and use products for their specific applications. This document has been printed for users with technical expertise as a reference for further investigation to determine specific product needs relative to design requirements.

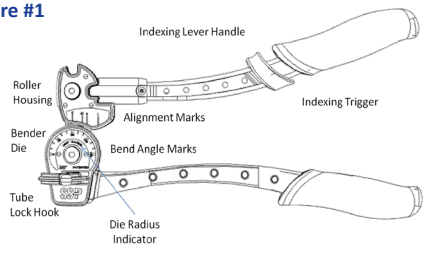
Table of Contents

Read this manual before using the TurnPro Tube Bender.

Tube Bender Components

TurnPro Indexing Handle Tube Benders provide consistent, high-quality bends in stainless steel, carbon steel, nickel alloys, and other tubing materials used with SSP tube fittings. The components of the tube bender are named in Figure #1.

Figure #1



TurnPro indexing tube benders are available in sizes to bend 1/4, 3/8, and 1/2 in. and 6, 8, 10, and 12 mm OD tubing. The size of the tube bender is indicated on the face of the tube bender near the alignment marks.

Selecting Tubing

Leak-tight connections require high-quality tubing which meets requirements for material hardness, roundness/ovality, and wall thickness. The tables #1, 2, and 3 contain suggested specifications for fractional and metric tubing.

Tubing Hardness

Table #1

Description	Material	Hardness	Standard
Carbon Steel	Soft Annealed, Seamless	72 HRB (130 HV) or less	ASTM A179
304 Stainless Steel	Fully-annealed, seamless or welded and drawn	90 HRB (200 HV) or less	ASTM 269 or A213
316 Stainless Steel	Fully-annealed, seamless or welded and drawn	90 HRB (200 HV) or less	ASTM 269 or A213

Fractional Tubing Wall Thickness

Table #2

Tube OD	Approx Bend Radius	Carbon Steel Wall Thickness Min/Max	Stainless Steel Wall Thickness Min/Max
¼	9/16	0.028/0.065	
	¾	0.028/0.065	
5/16	15/16	0.035/0.065	
3/8	15/16	0.035/0.065	0.035/0.083
1/2	1 1/2	0.035/0.083	

Metric Tubing Wall Thickness

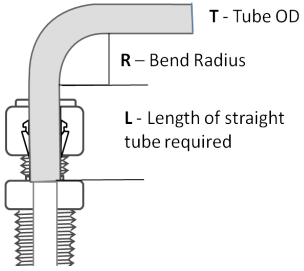
Table #3

Tube OD	Approx Bend Radius	Carbon Steel Wall Thickness Min/Max	Stainless Steel Wall Thickness Min/Max
6	15	0.8/1.5	
8	24	1.0/1.5	
10	24	1.0/1.5	1.0/2.0
12	38	1.0/2.2	1.0/2.0

Tubing Installation

When bending tubing, it is important to allow a sufficient length of straight tubing between the shoulder of the tube fitting and the bend. (See Figure 2)

Figure #2



Tables #4 and #5 specify the minimum required lengths for straight tubing leading into a tube fitting for each tubing OD and bend radius.

Bend Allowance Tables

Table #4

Fractional (in.)		
T Tube OD	**R Bend Radius**	**L**
1/4	9/16	13/16
	3/4	
5/16	15/16	7/8
3/8	15/16	15/16
1/2	1 1/2	1 3/16

Table #5

Metric (mm)		
Tube OD	**R Bend Radius**	**L**
6	15	21
8	24	23
10	24	25
12	38	31

Bend Layouts

In this section, you will learn methods to plan, measure, and mark tubing.

Sequential Bending Method

In this method, users measure, mark, then bend each leg of the fabrication in a sequence until the project is completed. The steps are:

1. Add the lengths or all section together to calculate the overall length of tubing required for the job.
2. Mark the starting point (reference mark) for your project. Hint: Remember to make all marks completely around the tube.
3. Measure from the reference mark to the vertex of the first bend. The vertex is the point where the center lines of the two legs of the angle meet. (See Figure 3)
4. Bend the tube using the directions on page 9.

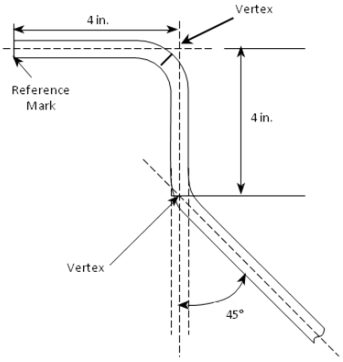
5. Using the vertex of this bend as the reference market for the next bend, repeat steps 3 and 4 to complete the next bend.

6. For additional bends, use the vertex of the previous bend as the reference mark, repeat steps 3 and 4 for the next bend.

Example

A 90° bend 4 inches from the reference mark followed by a 45° bend with 4 inches between bends .

Figure #3



Example Steps (see Figure #3 above)

1. Place a reference mark at the start of the tube.
2. Make the bend mark 4 inches from the reference mark.
3. Bend the tube 90° (See the instructions on page 9).
4. Make a second bend mark 4 in . from the center line of the first leg.
5. Mark a point on the reference mark indicating the outside of the bend. (See Figure #4)
6. Using the directions on page 11, bend the tubing 45°.

Figure #4

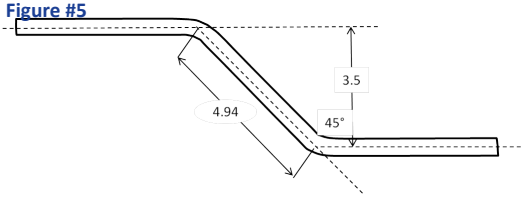
Tip

Mark the outside of the bend to make the next bend easier to align.

Laying Out Offset Bends

Offset bends change the centerline of the tubing run to avoid an obstruction.

Figure #5



To determine the distand between bend marks in an offset:

1. Determine the offset angle and locate it in table #6.
2. Multiply the offset bend allowance from table #6 by the offset amount.
3. Use the offset calculation as the distance between the marks.

Table #6

Offset Bend Allowance Table	
Offset Bend Angle	**Offset Bend Allowance**
22 ½	2.613
30	2.000
45	1.414
60	1.154

Example

Offset bend angle (E) 45°

Offset Dimension (O) 3.50 in .

3.5 x1 .414 = 4.94 in. or approximately 5 in.

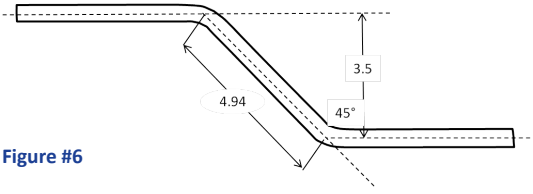


Figure #6

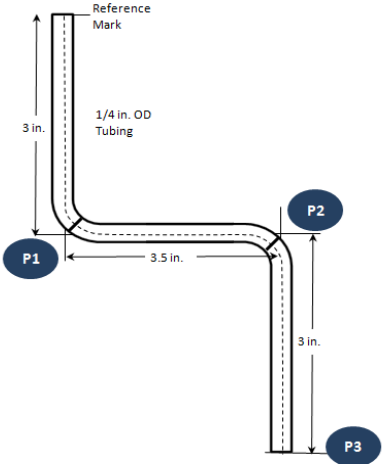
Adjustment (Gain) Method

The Adjustment or Gain Method measures and marks the entire layout for a project prior to bending using adjustment or gain factors. Gain is the amount that tubing stretches as it bends. See the adjustment tables to determine the amount of gain for each tube OD, bend radius and bend angle.

Example

Calucate the vertexes for the diagram below for 1/4 in. tube bender with a 9/16 in. bend radius.

Figure #7



Adjust Method Example Steps (refer to Figure #7)

1. Mark the tubing for the first vertex

   P1= 3 in.

2. Calculate the second vertex mark by adding the second leg to the first then subtracting gain factor for the first bend. Use Table #7 and 8 to find the gain factor. At the top of the table locate the tube OD and bend radius, then read down to the bend angle to find the gain factor.

   P2 = P1 + 3.5 in. – 5/16 in. adjustment = 6 3/16 in.

3. Follow the same procedure to caluclate and mark the second bend.

   P3 = P2 + 3 in. – 5/16 in. adjustment = 8 7/8 in.

   8 7/8 in. is the total length of tube needed.

Table #7
Fractional Gain Adjustments

Bend Angle	Tube OD, in.				
	1/4	1/4	5/16	3/8	1/2
	Bend Radius, in.				
	9/16	3/4	15/16	15/16	1 1/2
30°	0	0	0	0	1/16
45°	1/16	1/16	1/16	1/16	1/16
50°	1/16	1/16	1/16	1/16	1/8
55°	1/16	1/16	1/8	1/8	1/8
60°	1/8	1/16	1/8	1/8	3/16
65°	1/8	1/8	3/16	1/8	1/4
70°	1/8	1/8	3/16	3/16	5/16
75°	3/16	3/16	1/4	1/4	3/8
80°	3/16	3/16	5/16	5/16	7/16
85°	1/4	1/4	3/8	3/8	9/16
90°	5/16	5/16	7/16	7/16	11/16

Metric Adjustment Calculations

Table #8

Bend Angle	Tube OD, mm			
	6	8	10	12
	Bend Radius, mm			
	15	24	24	38
30°	1	1	1	1
45°	1	2	2	3
50°	2	2	2	3
55°	2	3	3	4
60°	3	3	4	5
65°	3	4	4	7
70°	4	5	5	8
75°	5	6	7	10
80°	6	8	8	12
85°	7	10	10	15
90°	8	12	12	18

Using the Tube Bender

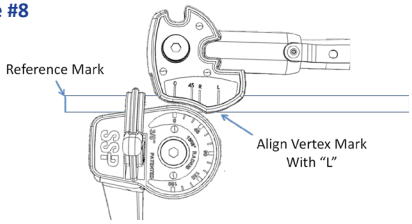
Left Reference Bends

90° Bends

1. Swing the indexing handle up so it is above the die.
2. Open the tube lock hook.
3. Place the tube in the groove of the bender die with the reference mark to the left of the tube lock hook.
4. Close the tube lock hook over the tube just enough to hold the tube in place. This restricts movement of the tube during initial positioning, but allows for additional alignment
5. Carefully lower the indexing handle until the rollers rest gently on the tube.
6. Align the zero alignment mark with the zero angle mark.

7. Align the vertex mark with the alignment mark that corresponds to the bend angle. For 90° bends align the vertex mark under the "L" as shown in Figure #8.

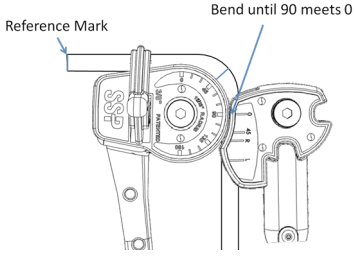
Figure #8



8. Push the tube latch firmly over the tube to secure the tube in the bender die. Note: Excessive pressure on the tube latch may damage soft tubing.

9. Pull the indexing handle down until the 0 reaches the desired bend angle. Relax the pressure on the handle and check the angle. In many cases, the tubing will spring back 2-3 degrees. It might be necessary to bend the tube slightly past the planned angle to compensate for spring back.

Figure #9

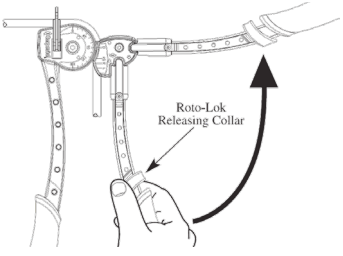


Bend Angles Greater Than 90°

1. Follow the procedure above to create a 90° bend.

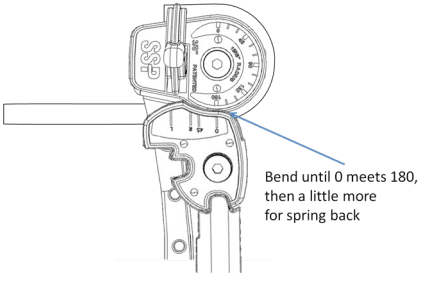
2. Pull the red indexing trigger toward the grip until the handle releases then swing the handle up until it locks into the new position. (See Figure# 11)

Figure #10



3. Pull the handle down until the 0 alignment mark meets the desired angle mark. Note: You might have to press 2 or 3 degrees past your target angle to compensate for spring back. (See Figure# 12)

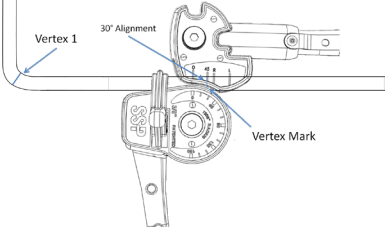
Figure #11



Bend Angles Less than 90°

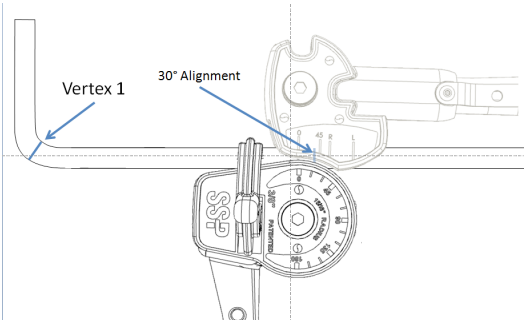
Making bends less than 90° is smililar to making 90° bends except for the setup. For example, when making a 45° bend, the vertex is aligned under the 45° alignment mark.

Figure #12



For other angles less than 90° estimate where the alignment mark should be then align the vertex mark on the tubing under that alignment mark. For example, an arrow in Figure 13 indicate where the vertex is aligned for a 30° bend.

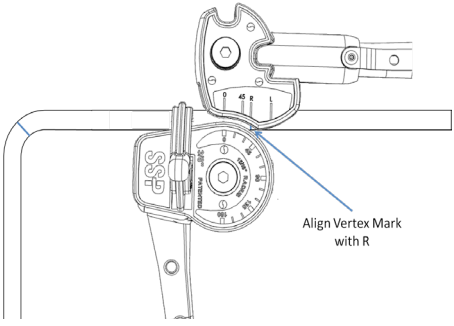
Figure #13



Right Reference Bends

Right reference bend are made with the reference mark to the right of the bender die. The process is similar to making left reference bends, except that the "R" alignment mark is used instead of the "L" for 90° bends. (Figure #14)

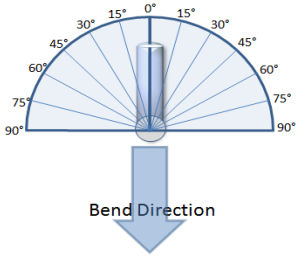
Figure #14



Changes In Plane and Direction

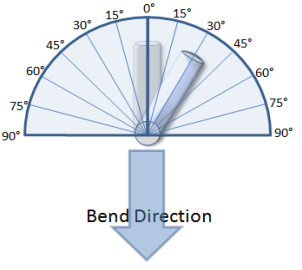
When making a bend on a new plane or a new direction, it is helpful to think of a protractor mounted on the tube bender with the 0° at the straight up position as shown. To make our bend, set the tube in the bender such that the previous leg is at the 0° position. (Figure #15)

Figure #15



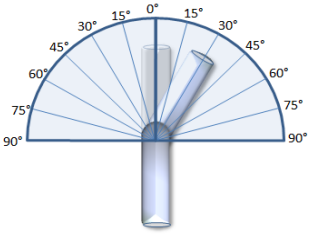
To make the bend on a new plane, rotate the tubing to angle for the new plane. (Figure #16)

Figure #16

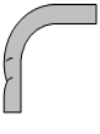


Once it is aligned, bend the tube to the desired angle. (Figure #17)

Figure #17



Troubleshooting

Tube Bending Defect	Cause	Solution
Wrinkled Bend 	Undersized bend radius	Increase bend radius
	Tube wall thickness too thin	Increase wall thickness
Flattened Bend 	Bender is intended for use with a larger tubing diameter	Use the correct size bender for the tubing being bent
	Tubing is collapsing during bending	Increase wall thickness
	Pressure die is flattening the tubing during the bending operation	Use a bender equipped with rollers instead of a pressure die
Kinked Bend 	Bender is intended for use with a larger tubing diameter	Use the correct size bender for the tubing being bent
Scored Tubing 	Bender is intended for use with a smaller tubing diameter	Use the correct size bender for the tubing being bent
	Damaged bender die	Repair or replace bender/die
	Dirt or foreign matter in bender die/shoe or roller	Clean bender die/ shoe or roller
	Frozen roller	Replace damaged roller or bender
Excessive Tubing Deformation 	Improper alignment	Make sure that the bender die and rollers are aligned
	Excessive pressure on the tube latch (generally visible on softer tubing only)	Reduce latch pressure

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