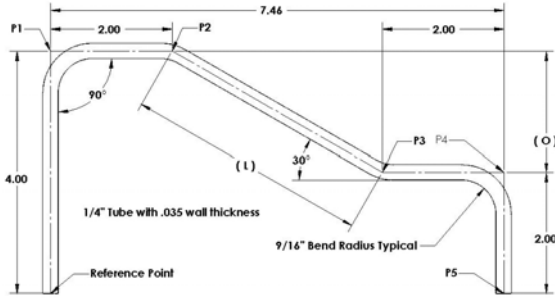


Tube Bending via the Layout Method
1/4" OD Tube, 9/16" Bend Radius



1. Start with a straight length of tube. The first mark, **P₁**, is placed 4 inches from the **REFERENCE** end of the tubing. Since no bends were made prior to this mark, no adjustment is necessary. **P₁ = 4"**

2. The second mark, **P₂**, is placed an additional 2 inches from **P₁** minus the **ADJUSTMENT** for the previous 90° bend. The **ADJUSTMENT** for a 90° bend with 1/4" tubing using a tube bender with a 9/16" bend radius, is 1/4".

$$P_2 = P_1 + 2" - \text{adjustment} \text{ or } P_2 = 4" + 2" - 1/4" = 5-3/4"$$

3. To calculate **P₃**, it is necessary to determine the length of tube or **TRAVEL** from **P₂** to **P₃**, given the offset angles shown. Using the **OFFSET** chart to the right and the 2" center-to-center **DROP (O)** and 30° bend angle shown in this example, the Length of **TRAVEL (L)** is 4". The table shows that the adjustment for a 30° bend angle is 0" so the resulting calculation is:

$$P_3 = P_2 + L - \text{adjustment} \text{ or } P_3 = 5-3/4" + 4" - 0" = 9-3/4"$$

Tube Travel can also be calculated using the following formula: **Offset (O) x Bend Constant (30° in this example) = 2" x 2.000 = 4"**

4. The fourth mark on the tubing, **P₄**, is placed an additional 2 inches from **P₃** minus the adjustment for the previous 30° bend. The resulting calculation is:

$$P_4 = P_3 + 2" - \text{adjustment} \text{ or } P_4 = 9-3/4" + 2" - 0" = 11-3/4"$$

5. The last calculation, **P₅**, determines the length of tubing needed to complete this example. **P₅** is an additional 2 inches from **P₄** minus the adjustment for the previous 90° bend. The resulting calculation is:

$$P_5 = P_4 + 2" - \text{adjustment} \text{ or } P_5 = 11-3/4" + 2" - 1/4" = 13-1/2"$$

Note: All measurement marks are measured from the reference or "zero" end of the tube. Each mark is made on the tube, and the tube is cut to length (13-1/2" in this example), prior to the start of bending. Bends are made starting at **P₁** and progressing to **P₅**.

Common Fractional Adjustments

Bend Angle	Tube OD		
	1/4"	3/8"	1/2"
	Tube Bender Radius		
	9/16"	15/16"	1-1/2"
90	1/4"	13/32"	5/8"
85	3/16"	11/32"	1/2"
80	5/32"	9/32"	7/16"
75	1/8"	7/32"	11/32"
70	3/32"	11/64"	9/32"
65	5/64"	1/8"	7/32"
60	1/16"	3/32"	5/32"
55	3/64"	5/64"	1/8"
50	1/32"	1/16"	3/32"
45	1/32"	1/32"	1/16"

Note: Adjustments on angles of less than 45° are minimal. No adjustment is necessary.

Calculating Bend Adjustments

Using the adjustment formula of **(2 TAN 1/2Ø - 0.01745 Ø) X R** Where TAN = Tangent, Ø = Bend Angle, R = Radius, the adjustment for any angle and any size of bender can be calculated.

Bend Angle	% of Bender Radius
90	43%
60	11%
45	5%

Offset "Travel" Values (L) Based on Center to Center Drop (O) (inches)

30° Offset		45° Offset		60° Offset	
(O) dim.	(L) dim.	(O) dim.	(L) dim.	(O) dim.	(L) dim.
1	2	1	1 7/16	1	1 3/16
1 1/4	2 1/2	1 1/4	13/4	1 1/4	1 7/16
1 1/2	3	1 1/2	2 1/8	1 1/2	13/4
1 3/4	3 1/2	1 3/4	2 1/2	1 3/4	2
2	4	2	2 3/4	2	2 5/16
2 1/4	4 1/2	2 1/4	3 3/16	2 1/4	2 9/16
2 1/2	5	2 1/2	3 9/16	2 1/2	2 7/8
2 3/4	5 1/2	2 3/4	3 7/8	2 3/4	3 3/16
3	6	3	4 1/4	3	3 1/2
3 1/4	6 1/2	3 1/4	4 5/8	3 1/4	3 3/4
3 1/2	7	3 1/2	5	3 1/2	4
3 3/4	7 1/2	3 3/4	5 5/16	3 3/4	4 5/16
4	8	4	5 9/16	4	4 5/8

Offset Calculations

Multiplying the value of the "Center to Center" drop (O) by the bend angle constant, equals the "Travel" or length of tube required to go from one bend to the other in an offset.

Offset Angle	Bend Constant
22-1/2	2.613
30	2.000
45	1.414
60	1.154

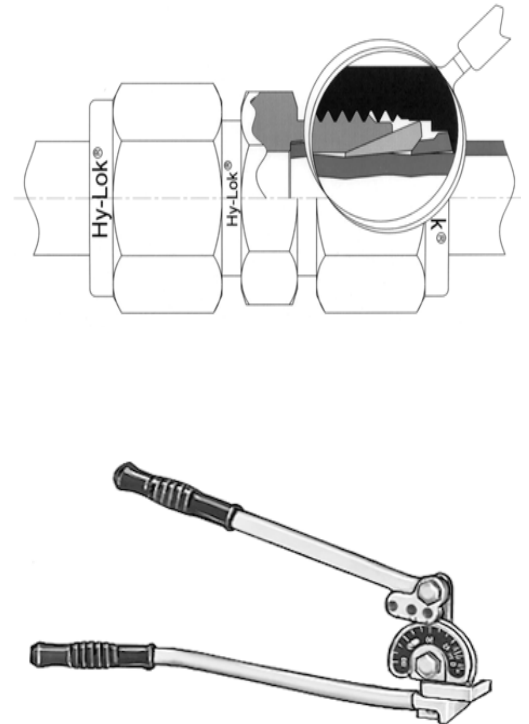
Ex. 45° Offset: (O) 1.5" x 1.414 = (L) 2.121" or 2-1/8"

Minimum Straight Length of Tube Preceding a Bend					
Tube OD	Straight Length	Tube OD	Straight Length	Tube OD	Straight Length
1/8"	23/32"	1/2"	1-3/16"	1-1/4"	2"
1/4"	13/16"	3/4"	1-1/4"	1-1/2"	2-13/32"
3/8"	15/16"	1"	1-1/2"	2"	3-1/4"

The information in this pamphlet is for reference only.



Hy-Lok
Tube Fitting Installation & Tube Bending Guide

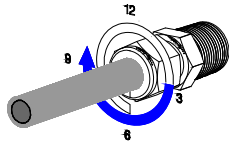


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INSTALLATION INSTRUCTIONS: HY-LOK TUBE FITTINGS 1 in. (25 mm) and Under

Hy-Lok fittings are supplied fully assembled and ready for installation. All that is required for successful assembly is to:

1. Insert the prepared tube into the Hy-Lok fitting until the tubing end is firmly seated into the shoulder of the fitting.



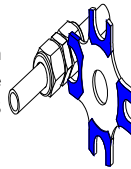
2. Mark the nut at the 6 o'clock position.

3. Tighten the nut 1-1/4 turns with a wrench while holding the fitting body steady with a backup wrench. After 1-1/4 turns the mark will be at the 9 o'clock position.

Note: Only 3/4 turn is required for 1/16", 1/8" and 3/16" (2mm, 3mm & 4mm) fittings.

Inspection

1. Insert the appropriate Gap Inspection Gauge between the leading edge of the fitting nut and body hex. If the gauge DOES NOT enter, the fitting has been tightened sufficiently.



2. If the gauge DOES enter, tighten the nut slightly until the gauge will not enter.

Note: Gauge is for use on initial installation only.

Reassembly—Two simple steps.

1. Insert the pre-swaged tube & ferrule assembly into the fitting body. Make sure the tube is fully bottomed and finger tight. The mark on the nut will return to about the 7 o'clock position.

2. Retighten the nut to the original 9 o'clock position, holding the body steady with a backup wrench, and snug slightly (approximately 1/16 to 1/8 additional turn).

INSTALLATION INSTRUCTIONS: HY-LOK TUBE FITTINGS Over 1 in. (1-1/4, 1-1/2 and 2 in.; 28, 30, 32 and 38 mm)

Hy-Lok EZY-MAT Tools must be used to install Hy-Lok Tube Fittings that are of a size larger than 1 in.

INSTALLATION INSTRUCTIONS: ADDITIONAL PRODUCTS

Plug—Thread plug onto Hy-Lok Tube Fitting Body and tighten 1/4 turn past finger tight (1/8 Turn for sizes 1/16", 1/8" & 3/16"; 2, 3, and 4mm).



Cap— Follow the Hy-Lok Tube Fitting Installation



Port Connector—



1. Remove nut & ferrules from the Hy-Lok tube fitting.
2. Slip nut over the smaller end of port connector and assemble to a Hy-Lok fitting body. Tighten while holding fitting body with a backup wrench, 1/4 turn (1/8 turn for sizes below 1/4").
3. Insert smaller end into a Hy-Lok tube fitting and tighten 1-1/4 turns (3/4 turn for sizes below 1/4").

Tube Adapters—

1. To ease installation it is recommended the end opposite the tube end be installed first.
2. Place the Hy-Lok Tube Fitting over the adapter stub making certain the stub is inserted firmly to the shoulder of the tube fitting.
3. Mark the nut at the 6 o'clock position. While holding the Hy-Lok fitting body with a backup wrench tighten the nut 1-1/4 turns (3/4 turns for sizes below 1/4").



Reducers —



1. Insert the machined tube end into the appropriate size Hy-Lok tube fitting. Tighten Hy-Lok nut 1-1/4 turns (3/4 turn for sizes below 1/4").
2. Insert prepared bare tube end into Hy-Lok tube fitting and tighten nut 1-1/4 turns (3/4 turn for sizes below 1/4").

Proper Spacing for Tube & Pipe Supports					
Size	Pressure		Size	Pressure	
	<3000	>3000		<3000	>3000
1/4" to 5/8"	5-7 ft.	3-5 ft.	4" to 4-1/2"	10-12 ft.	8-10 ft.
3/4" to 1"	6-8 ft.	4-6 ft.	5.563" to 6.625"	11-13 ft.	8-11 ft.
1-1/4" to 1-1/2"	7-9 ft.	5-7 ft.	8.625"	12-14 ft.	9-11 ft.
1-3/4" to 2-1/2"	8-10 ft.	6-8 ft.	10.75" to 12.75"	13-15 ft.	8-10 ft.
2-3/4" to 3-1/2"	9-11 ft.	7-9 ft.	12.75" to 19.75"	14-16 ft.	10-12 ft.

Pipe Thread Comparison Chart					
Nominal Size	Threads Per Inch		Pipe OD IN.	Included Angle	Pitch IN
	NPT	ISO			
1/16"	NPT	27	0.312	60°	0.037
	ISO	28	0.312	55°	0.036
1/8"	NPT	27	0.405	60°	0.037
	ISO	28	0.398	55°	0.036
1/4"	NPT	18	0.540	60°	0.057
	ISO	19	0.535	55°	0.053
3/8"	NPT	18	0.675	60°	0.057
	ISO	19	0.672	55°	0.053
1/2"	NPT	14	0.840	60°	0.071
	ISO	14	0.843	55°	0.071
3/4"	NPT	14	1.050	60°	0.071
	ISO	14	1.060	55°	0.071
1"	NPT	11 1/2	1.315	60°	0.087
	ISO	11	1.331	55°	0.091
1 1/4"	NPT	11 1/2	1.660	60°	0.087
	ISO	11	1.669	55°	0.091
1 1/2"	NPT	11 1/2	1.900	60°	0.087
	ISO	11	1.900	55°	0.091
2"	NPT	11 1/2	2.375	60°	0.087
	ISO	11	2.374	55°	0.091

SAE Thread Size					
Nominal Tube OD	THRD Size	Nominal Tube OD	THRD Size	Nominal Tube OD	THRD Size
1/8"	5/16" -24	1/2"	3/4" -20	1-1/4"	1-5/8" -12
3/16"	3/8" -24	5/8"	7/8" -14	1-1/2"	1-7/8" -12
1/4"	7/16" -20	3/4"	1-1/16" -14	2"	2-1/2" -12
5/16"	1/2" -20	7/8"	1-3/16" -12		
3/8"	9/16" -18	1	1-5/16" -12		

Maximum Allowable Working Pressure Table*											
Stainless Steel Fractional Tubing - Fully annealed 304 or 316 high quality seamless tube to ASTM A269 or equivalent. Rb80 or less.											
Tube O.D.	Tube Wall Thickness in Inches										
	0.028	0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.134	0.156	0.188
1/8"	8500	10900									
3/16"	5400	7000	10200								
1/4"	4000	5100	7500	10200							
5/16"		4000	5800	8000							
3/8"		3300	4800	6500							
1/2"		2600	3700	5100	6700						
5/8"			2900	4000	5200	6000					
3/4"			2400	3300	4200	4900	5800				
7/8"			2000	2800	3600	4200	4800				
1"				2400	3100	3600	4200	4700			
1-1/4"	Shaded area denotes tubing is not suitable for gas service				2400	2800	3300	3600	4100	4900	
1-1/2"	Shaded area denotes tubing is not suitable for gas service					2300	2700	3000	3400	4000	4900
2"	Shaded area denotes tubing is not suitable for gas service						2000	2200	2500	2900	3600

* Working pressure calculated in accordance with ASME B31.3. Chemical Plant and Petroleum Refinery Piping Code, 1993 Edition