



1210 Washington Ave. Racine, WI 53403  
(800)822-6122 (262)634-5534  
FAX (262)634-2127  
www.hfluidpowerproducts.com  
sales@hfluidpowerproducts.com

• MANUFACTURER, DISTRIBUTOR, AND FABRICATOR OF FLUID POWER COMPONENTS •

---

## **BEST PRACTICES IN DESIGNING A HYDRAULIC TUBE ASSEMBLY**

### **General Design Considerations**

Do not specify metric tubing (not readily available). For metric drawings convert the inch equivalent of the O .D. and wall thickness to metric.

Design all bends as simple bends. A simple bend is a bend with all of its parts in a single plane. A compound bend is a bend within a bend and cannot not occur within a single plane.

Use a single bend radius for a part, whenever possible.

Do not specify two radii with less than two times the outside diameter's length of straight portion between them. If you must use less straight length, consult the supplier.

To enable ends to be square within the standard 2° requires sufficient straight length from the tube end to the tangent of the nearest radius. This sufficient straight length is two times the outside diameter's length for an unflared end to the tangent spot, or for flared ends it applies to the exposed tube beyond the end fitting to the tangent spot.

Practically all tube assemblies are now formed after the assembly of fittings and flaring. To do otherwise will result in higher cost. If the bend starts too near the end, stretching of the metal distorts the end to become outside of standard squareness and an expensive machining operation after forming is then required to resquare the end. Inability to hold the tube for forming is another result of too short a straight length.

Use 2 bends with a radius in the range of 2 to 4 times the tubes outside diameter rather than one larger radius. Large radii are costly due to tools plus difficulty in forming.

Design other than flared ends for tubes over 3/4" outside diameter.

A tube whose ends are to be inserted into housing holes must not require deforming for assembly. For example, ends must be parallel and pointing the same direction and the housing holes must be parallel (such as for permanent attachment by roll expanding to housing hole wall).

A pictorial presentation of only tube centerline with 2 or more views is preferred. An alternate is to use a partly pictorial and partly X, Y, Z tabulation if this makes the drawing easier to read. Tabulation only is not acceptable. The reduced flow areas formed in bending the tubing are not to be illustrated.

Dimension to the tube centerline, including radii of bends, and in three coordinate directions. Illustrate and dimension the imaginary centerline apexes. Do not dimension to the radii centers, nor tangent points, nor angles of change planes, nor angles included in a bend.

### Fabrication Tolerance Ranges for Formed Tubes

NOMINAL TUBE OUTSIDE DIAMETER	APPROXIMATE STRAIGHT TUBE LENGTH				
	1" TO 11.99"	12" TO 23.99"	24" TO 35.99"	36" TO 47.99"	48" AND UP
1/8" to 1/2"	0.06	0.06	0.08	0.08	0.12
1/2" to 1-1/4"	0.06	0.06	0.06	0.09	0.12
1-1/4" to 2"		0.09	0.09	0.09	0.12
2" to 3.5"		0.12	0.12	0.12	0.12

## Acceptable Bend Radii

TUBE OD	STANDARD CENTERLINE RADII				
	PREFERENCE	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
1/8"	0.25	0.375	0.75	1.00	
1/4"	0.50	0.75	1.00	1.25	1.50
5/16"	.625	1.00	1.25	1.50	2.00
3/8"	.75	1.00	1.50	2.00	2.75
1/2"	1.00	1.50	2.50	3.00	4.00
5/8"	1.25	2.00	2.75	3.75	5.00
3/4"	1.50	2.25	3.00	3.75	4.00
7/8"	1.75	2.50	3.25		
1"	2.00	3.00	4.00	5.75	6.75
1-1/4"	2.5	4.00	5.00	6.00	7.50
1-1/2"	3.00	3.50	4.00	5.00	6.00
2"	4.00	4.50	6.00		

## **Application Suggestions**

Select the heavier wall thickness recommended to obtain maximum fatigue life. Excessive wall thickness may introduce assembly cracking (during rolling-in-place or flaring) and too light a wall may be so flexible as to vibrate excessively under forces of splash oil, pressure pulsations or vehicle bouncing.

Certain quality grades of tubing are desirable for particular assembly procedures.

Surface treatment to resist rust is available. Zinc plating followed with a clear chromate finish is recommended.

If painting tubes, phosphate coating is available, and you should obtain the manufacturers recommendation. Phosphate coating plus oiling is available for storage problems.

Metals other than zinc can be applied by electroplating also. Again, contact the tube supplier for recommendations. Do not specify cadmium plating.

Sizing of tube ends for brazing needs consultation with the tube supplier. If the supplier furnishes all parts plus doing the brazing, permit the supplier to follow their standards and only specify joint integrity desired.

Tubing with excessive weld flash on either O.D. or I.D. and the lap of double walled tubing are to be avoided because of high leakage risk at the housing fit.

**Many tube suppliers, and certainly HFI FLUID POWER PRODUCTS, have engineers on staff to assist with design and best practice advice. When in doubt, contact the tube supplier's engineering or sales department before creating prototype prints.**