



Severity of Service	Description	Design Factor	Derating Factor
A (Normal)	Moderate mechanical and hydraulic shocks.	4.00	1.00
B (Severe)	Severe hydraulic shocks and mechanical strain.	6.00	0.67
C (Hazardous)	Hazardous application with severe service conditions.	8.00	0.50

Table U10 — Severity of Service Design and Derating Factors

The design factor is generally applied to ultimate strength of material (or burst pressure of tubing) to provide a measure of safety against the unknowns in material and operating conditions. The derating factors listed here should be applied directly to the design pressure values in Tables U15 and U16 to arrive at maximum recommended working pressures (i.e., multiply values in Tables U15 and U16 by these derating factors).

Besides severity of service, high operating temperature also reduces allowable working pressure of the tubing. Temperature derating factors for various tube materials are given in Table U11. Where applicable, derating factors for severity of service and temperature should be applied to the design pressure values in Tables U15 and U16 to arrive at the maximum recommended working pressure.

Example:

Combined derating factor for 316SS tubing for B (severe) service and 500° F. operation is .67 x .9 = .603

Tube Selection Example:

Maximum Operating Temperature (degrees F)	Steel C-1010 and C-4130	Stainless Steel		Copper	Aluminum 6061-T6	Monel Type 400
		304	316			
100	1.00	1.00	1.00	1.00	1.00	1.00
150	1.00	0.91	1.00	0.85	1.00	0.97
200	1.00	0.84	1.00	0.80	1.00	0.94
250	1.00	0.79	1.00	0.80	0.94	0.91
300	1.00	0.75	1.00	0.78	0.80	0.88
350	0.99	0.72	0.99	0.67	0.60	0.86
400	0.98	0.69	0.97	0.50	0.43	0.85
500	0.96	0.65	0.90			0.84
600		0.61	0.85			0.84
700		0.59	0.82			0.84
800		0.57	0.80			0.83
900		0.54	0.78			
1000		0.52	0.77			
1100		0.47	0.62			
1200		0.32	0.37			

Table U11 — Temperature Derating Factors* for Tubes

* The derating factors are based on allowable design stress values at various temperatures per ASME B31.1 code for pressure piping (1986).

To select tube material and tube sizes for pressure, return and suction lines for a hydraulic power unit with the following operating parameters known:

- Type of fluid: Petroleum base hydraulic fluid
- Operating temperature range: -20°F to +140°F.
- Maximum operating pressure: 3500 psi
- Maximum flow rate through each line: 10 GPM
- Severity of service: A (normal)

1. **Selecting Tube Material:** Table U7 indicates that carbon steel, C-1010, tubing would meet the media, operating temperature range, and maximum operating pressure (high) requirements.

2. **Sizing the Tube:** From Table U13, the recommended flow diameters for various lines for 10 GPM flow rate are: 0.405 for pressure line, 0.639 for return line, and 1.012 for suction line.

Now, using Tables U15 and U16, we need to find tubes with inside diameters (I.D.) equal to or larger than the above flow diameters, and wall thicknesses appropriate for design pressures of 3500 psi minimum for the pressure line and about 500 psi for return and suction lines. Since derating factors for Severity of Service (Table U10) and Max. Operating Temperature (Table U11) are both 1, design pressure values in Tables U15 and U16 do not need to be reduced.

Matching tube I.D.s and design pressures in Tables U15 and U16 for above conditions, we find:

- A) For the pressure line, we would choose 5/8" O.D. x .083" wall tubing. The .095" and .109" wall tubes would also be satisfactory if .083" wall is not readily available.
- B) For the return line, either 3/4" x .035" or 3/4" x .049" would meet the requirements. If Ferulok fittings are being used, we will need to go to 3/4" x .065" because .065" is the smallest wall thickness recommended for 3/4" O.D. tubing used with Ferulok fittings in Table U14. This reduces the flow diameter about 3% below the recommended value, but is still in the acceptable range. The alternative is to go to 7/8" O.D. x .072" wall tubing, which is way too large.

Tube Material			Steel St. Steel Copper Aluminum	Steel St. Steel Monel	Steel Alloy Steel St. Steel Copper Monel	Copper Aluminum Plastics	Steel St. Steel
Size			SAE 37° Flare Triple-Lok	SAE Flareless Ferulok	SAE O-ring Face Seal Seal-Lok ¹⁾	Intru-Lok	Metric Flareless
O.D. (in.)	O.D. (mm)	Dash Number					
1/8	4	-2	.010 - .035	.010 - .035	—	.012 - .028	0.5 - 1
3/16	6	-3	.010 - .035	.020 - .049	—	.012 - .035	1 - 2
1/4	8	-4	.020 - .065	.028 - .065	.020 - .083	.020 - .049	1 - 2.5
5/16	10	-5	.020 - .065	.028 - .065	.020 - .095	.020 - .065	1 - 3
3/8	12	-6	.020 - .065	.035 - .095	.020 - .109	.028 - .065	1.5 - 3.5
1/2	14	-8	.028 - .083	.049 - .120	.028 - .148	.035 - .083	1.5 - 4
5/8	15	-10	.035 - .095	.058 - .120	.035 - .134	.035 - .083	1.5 - 4
3/4	16	-12	.035 - .109	.065 - .120	.035 - .148	.035 - .095	2 - 4
7/8	18	-14	.035 - .109	.072 - .120	—	.049 - .095	2 - 4
1	20	-16	.035 - .120	.083 - .148	.035 - .188	.049 - .120	2.5 - 4
1 1/4	22	-20	.049 - .120	.095 - .188	.049 - .220		2.5 - 4
1 1/2	25	-24	.049 - .120	.095 - .220	.049 - .250		2.5 - 4.5
2	28	-32	.058 - .134	.095 - .220	.065 - .220		2.5 - 4.5
	30						2.5 - 5
	35						3 - 5
	38						3 - 6
	42						3.5 - 7

1) Brazing to attach sleeve can be used for all wall thicknesses. For flanging tool availability, see page S26.

Table U12 — Recommended "Min./Max" Tube Wall Thickness for Common Fittings

- C) For the suction line, we can use any one of the following tubes: 1-1/4" O.D. x .049" to .083" wall tube for Triple-Lok or Seal-Lok fittings and 1-1/4" O.D. x .095" wall tube for Ferulok fittings.

One final consideration in choosing the right wall thickness for tubing is bending. If bending without the use of a mandrel is desired, then wall thickness of less than 7% of tube O.D. should not be used.

Dimensions and pressures for reference only, subject to change.