

Estimating Wall Thicknesses for Vessels and Piping

D. A. Crowl, 1/9/2003

Problem: Given temperature, pressure and dimension of vessel or pipe, estimate the wall thickness.

1. From temperature, determine allowable stress for the material of construction from figure on next page, or from Table 10-49 on page 10-110 of Perry's 7th edition.
2. Given the pressure and characteristic dimension of the pipe or vessel, determine the wall thickness:

For cylindrical vessels:
$$t = \frac{PR}{0.9S - 0.6P} + C$$

For spherical vessels:
$$t = \frac{PR}{1.8S - 0.2P} + C$$

For pipes:
$$t = \frac{PD_o}{2(SE + PY)} + C$$
 Equation 10-92 on page 10-103 of Perry's 7th.

Where:

- t is the wall thickness
- P is the design pressure
- R inside vessel radius for vessels
- S allowable stress - see attached figure
- D_o outside diameter of pipe
- Y coefficient from Table 10-50 of Perry's for ductile ferrous materials(see below), 0.4 for ductile non-ferrous materials, and zero for brittle materials such as cast iron.
- E quality factor - see Table 10-164 on page 10-109 of Perry's. This accounts for various types of joint welds. For ideal case, use 1.0.
- C sum of allowances for corrosion, erosion, and any thread or groove depth. For standard corrosion, use $C = 3\text{mm}$.

TABLE 10-50 Values of Coefficient Y When t Is Less Than $D/6$ *

Materials	Temperature, °C (°F)					
	485 (900) and lower	510 (950)	540 (1000)	560 (1050)	595 (1100)	620 (1150) and higher
Ferritic steels	0.4	0.5	0.7	0.7	0.7	0.7
Austenitic steels	0.4	0.4	0.4	0.4	0.5	0.7
Other ductile metals	0.4	0.4	0.4	0.4	0.4	0.4
Cast iron	0.0					

*Extracted from ANSI B31.3—1980, with permission of the publisher, the American Society of Mechanical Engineers, New York.

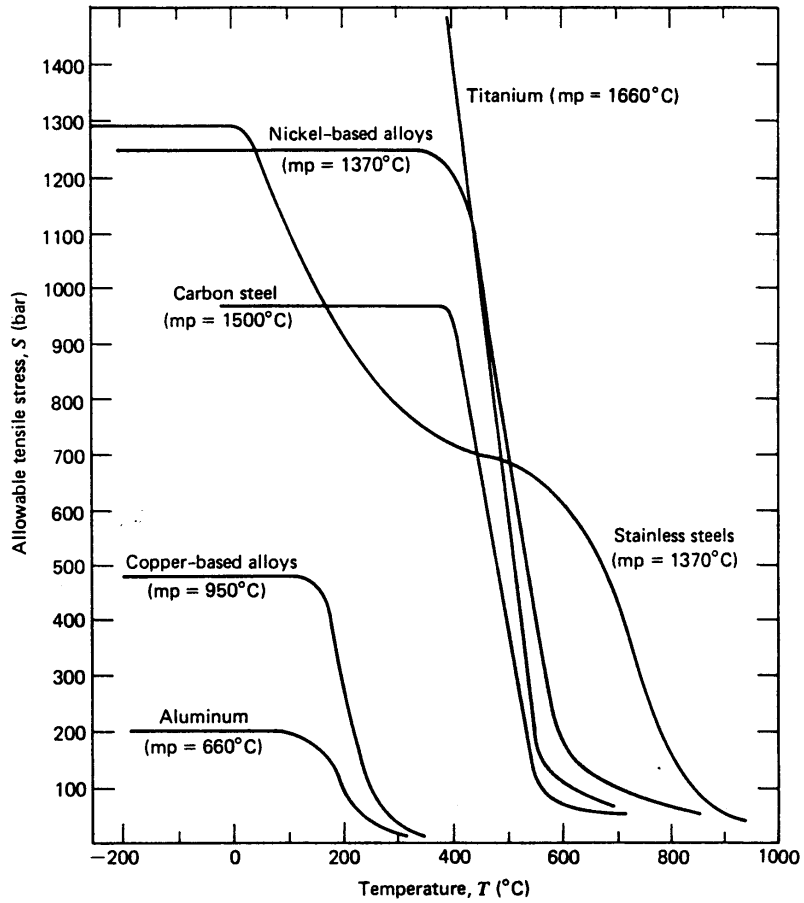


Figure 4-45 Stress-temperature relationships for important process metals and alloys.

Above figure from G. A. Ulrich, *A Guide to Chemical Engineering Process Design and Economics*, Wiley, New York, 1984.