

3. Temperature Difference

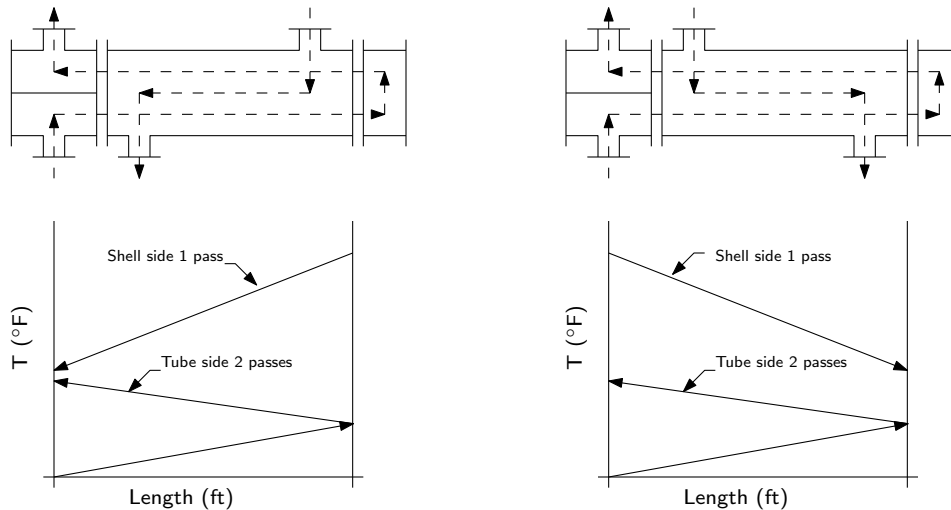
- For true countercurrent exchangers (such as double pipes, Packinox and VCFE):

$$\frac{\Delta T_M}{F_T} = LMTD$$

$$F_T = 1$$

- For typical shell and tube exchangers with multiple tube passes, $F_T < 1$.

1:2 S&T Exchanger Layout (mathematically identical)



- The LMTD correction factor, F_T , is determined from the graphs in TEMA Section 7. Alternatively, for S&T exchangers the equation of Bowman et al. can be used (Trans ASME, 1940):

$$F_T = \frac{2^{0.5} \times S}{(1 - S) \times \ln((2/S - 2 + 2^{0.5})/(2/S - 2 - 2^{0.5}))} \text{ if } R = 1$$

$$= \frac{\sqrt{(R^2 + 1)}/(R - 1) \times \ln[(1 - S)/(1 - SR)]}{\ln[(2/S - 1 - R + \sqrt{(R^2 + 1)})/(2/S - 1 - R - \sqrt{(R^2 + 1)})]} \text{ if } R \ll 1$$

$$S = \frac{P}{P + N - NP} \text{ if } R = 1$$

$$= \frac{1 - ((1 - PR)/(1 - P))^{(1/N)}}{R - ((1 - PR)/(1 - P))^{(1/N)}} \text{ if } R \ll 1$$

$$P = (T_{co} - T_{ci})/(T_{hi} - T_{ci})$$

$$R = (T_{hi} - T_{ho})/(T_{co} - T_{ci})$$

$$N = \text{Number of shells in series}$$