Plate & Frame Heat Exchanger (PFHX)

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ME 307: Heat Transfer Equipment Design

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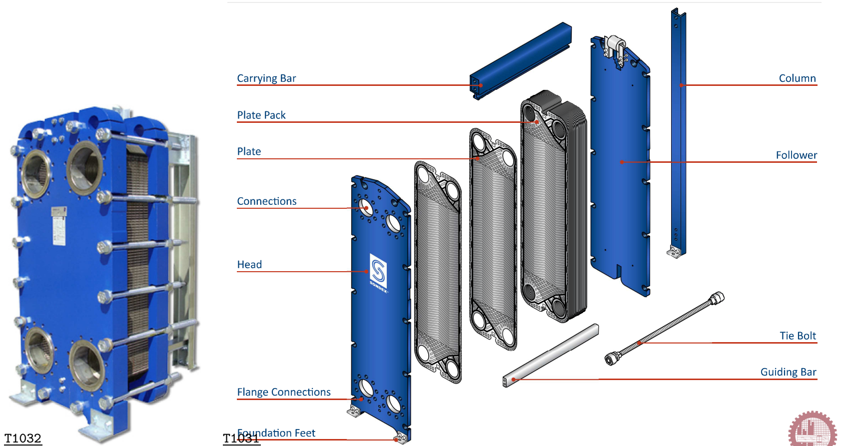
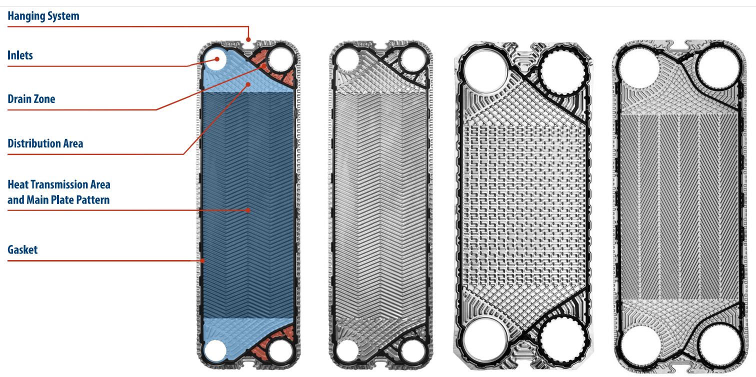
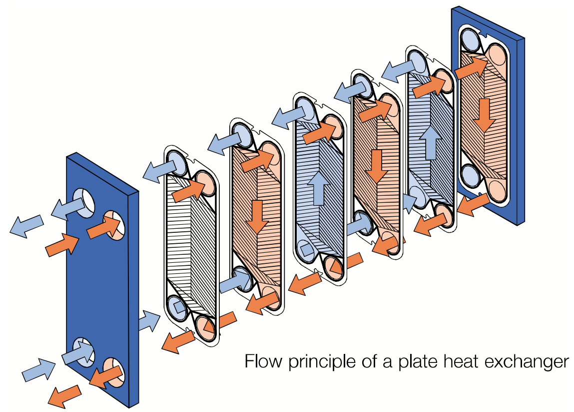


T1032 T1031

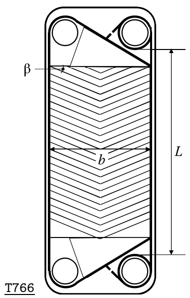


T1033



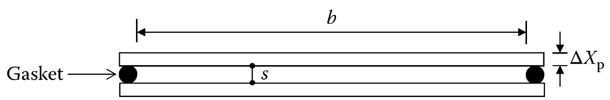
Flow principle of a plate heat exchanger

T765



T766

- $NTU = \frac{U_o A_o N_s}{(\dot{m} C_p)_{min}}$, $A_o = bl$
- Effective $NTU = F_{corr} NTU$, $F_{corr} = 1 - 0.0166 NTU$
- Heat transfer & pressure loss correlations are based on the hydraulic diameter, D_h of the passage formed by the two plates.



T767

- $\frac{1}{U_o} = \frac{1}{h_h} + \frac{1}{h_c} + \frac{\Delta X_p}{k} + R_{di} + R_{do}$
- Flow velocity, $V = \begin{cases} \frac{2\dot{m}}{\rho sb(N_s+1)} & : \text{odd number of plates} \\ \frac{2\dot{m}}{\rho sb N_s}, \ \frac{2\dot{m}}{\rho sb(N_s+2)} & : \text{even number of plates} \end{cases}$
- $D_h = \frac{4(cross-sectional\ \ area)}{wetted\ \ perimeter} = \frac{4sb}{2s+2b} \simeq \frac{4sb}{2b} = 2s, \quad Re = \frac{VD_h}{\nu}$
- Laminar flow: $Nu = 1.86(Gz)^{1/3}\left(\frac{\mu_b}{\mu_w}\right)^{0.14}; \quad Gz = \frac{RePr}{L/D} \qquad Re < 100$
- Turbulent flow: $Nu = 0.374Re^{0.668}Pr^{1/3}; \qquad Re > 100$
- Friction factor, $f = \begin{cases} \frac{280}{Re} & : 1 < Re < 10 \\ \frac{100}{Re^{0.589}} & : 10 < Re < 100 \\ \frac{12}{Re^{0.183}} & : Re > 100 \end{cases}$
- Pressure drop, $\Delta P = \frac{fL}{D_h}(\frac{1}{2}\rho V^2) + 1.3(\frac{1}{2}\rho V_p^2) \simeq \frac{fL}{D_h}(\frac{1}{2}\rho V^2)$

- Flexibility of design through a variety of plate sizes and pass arrangements
- Easily accessible heat transfer area, permitting changes in configuration to suit changes in processes requirements through changes in the number of plates
- Efficient heat transfer; high heat transfer coefficients for both fluids because of turbulence and a small hydraulic diameter
- Very compact, and low in weight; in spite of their compactness, 1500 m^2 of surface area is available in a single unit
- Only the plate edges are exposed to the atmosphere; the heat losses are negligible and no insulation is required

PFHX Rating ▷ 0.975 kg/s water at 25°C is to be cooled using 1.0 kg/s water available at 7°C. If b = 457 mm, L = 914 mm, s = 5.08 mm, t = 1.016 mm, k = 14.3 W/mK, Ns = 11, fouling coefficients for both fluids = 3.52 x 10^{-6}, rate the heat-exchanger.