Reference Booklet
for

CORE
COMPETENCY
EXAM

Department of Chemical Engineering
Brigham Young University

Heat Transfer Correlations

Correlation	Conditions
$Nu_D = 4.36$	Circular tube, Laminar, fully developed, uniform q''_s, $Pr \geq 0.6$
$Nu_D = 3.66$	Circular tube, Laminar, fully developed, uniform T_s, $Pr \geq 0.6$
$Nu_D = 0.023 Re_D^{4/5} Pr^{1/3}$	Circular tube, turbulent, fully developed, $0.6 \leq Pr \leq 160$ $Re_D \geq 10{,}000$, $(L/D) \geq 10$
$Nu_x = 0.0296 Re_x^{4/5} Pr^{1/3}$	Flat plate, turbulent, local, T_f, $Re_x \leq 10^8$, $0.6 \leq Pr \leq 60$
$\overline{Nu}_L = (0.037 Re_L^{4/5} - 871) Pr^{1/3}$	Flat plate, mixed, average, T_f, $Re_{x,c} = 5 \times 10^5$, $Re_L \leq 10^8$, $0.6 < Pr < 60$
$\overline{Nu}_D = 2 + 0.6 Re_D^{1/2} Pr^{1/3}$	Falling drop or flow over a sphere, average, T_∞
$Nu_D = 0.027 Re_D^{.805} Pr^{1/3}$	External flow (cross flow) over a cylinder, average, T_f, $4 \times 10^4 < Re_D < 4 \times 10^5$, $Pr \geq 0.7$

Useful equations

$$\text{Friction Head Loss} = h_L = f \frac{L}{D} \frac{V^2}{2g}$$

$$\frac{V}{F_{A0}} = \frac{X_A}{-r_A}$$ CSTR performance equation

$$\frac{\Delta P}{\rho} + \frac{\Delta V^2}{2} + g\Delta z = w_s - g h_L$$

$$x_i P_i^{sat} = y_i P$$

$$q'' = -k \nabla T$$

$$J_A^* = -c D_{AB} \nabla x_A$$

$\Delta T_{lm} = [(\Delta T)_1 - (\Delta T)_2] / \ln [(\Delta T)_1/(\Delta T)_2]$

Dimensionless variables/groups

$$Sc = \frac{\nu}{D}$$

$$Pr = \frac{\nu}{\alpha} = \frac{C_P \mu}{k}$$

$$Nu_D = \frac{hD}{k}$$

$$Sh_D = \frac{h_m D}{D_{AB}}$$

Other Information Available in the Printed Booklet

1. Conversion Factors (e.g. inside the cover of many textbooks)
2. Values of the gas constant
3. Moody friction factor diagram
4. Antoine Equation Constants (e.g. Table B.4, Felder and Rousseau)
5. Steam tables (e.g. Tables B.5-B.7, Felder and Rousseau)