American Society of Plumbing Engineers

Plumbing Engineering & Design Handbook of Tables

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Darcy-Weisbach Formula

Equation

$$h_f = f\left(\frac{L}{D}\right)\left(\frac{V^2}{2g}\right)$$

$$p = h_f \times \left(\frac{\phi}{144}\right)$$

where

h_f = friction head loss, ft of fluid
p = friction head loss, psi
f = coefficient of friction or friction factor, dimensionless (from Colebrook equation or Moody diagram)
L = length of pipe, ft
D = inside diameter of pipe, ft
V = average velocity of flow, fps
g = gravitational acceleration, 32.2 ft/sec/sec
ϕ = lbs/ft^3

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For turbulent flow, "f" can be determined by the C.F. Colebrook Formula, Moody diagrams, or from manufacturers' data or various handbooks.

Colebrook Formula

Equation

$$\frac{1}{\sqrt{f}} = -2\log_{10}\left[\left(\frac{\varepsilon}{3.7D}\right) + \left(\frac{2.51}{R\sqrt{f}}\right)\right]$$

$$\text{also, } R = \frac{VD}{v}$$

where

R = Reynolds number (Figure 5-9)
f = Friction Factor (dimensionless)
ε = Absolute roughness, in ft
D = Inside diameter of pipe, ft
V = Average pipe velocity, ft/sec
v = Kinematic Viscosity, ft^2/sec

Pressure Loss in Pipe Fittings and Valves

Equation

$$\Delta h = \frac{kV^2}{2g}$$

$$\Delta P = \left(\frac{Q}{C_v}\right)^2 \text{ S.G.}$$

where

Δh = Fluid head (ft)
V = Velocity (ft/sec)
g = Acceleration of gravity (ft/sec2)
P = psi
Q = gpm
SG = Specific gravity (water = 1.0); for water, $\Delta h \times 0.43$ = psi
C_v = Flow through a valve where pressure loss of 1 psi occurs