Pressure Rating
\[ P = \frac{2St}{D-t} \quad S = \frac{P(D-t)}{2t} \]

P is the pressure rating in psi.
S is the Hydrostatic Design Basis (usually 4000 psi) divided by the safety factor (which is 2 for the three standards).
DR is the Dimension Ratio for D2241 and C905 but is OD/t for D1785

Where:
P = pressure, psi
S = circumferential stress, psi
D = outside diameter of pipe, inches
d = inside diameter of pipe, inches (average based on mean wall)
t = average wall thickness, inches

Volume capacity-gallons per ft. length = \( VG = \frac{V}{0.004329} \)
Volume capacity-cubic inches per ft. length = \( V = 0.7854 \times d^2 \times 12 \)

Outside pipe surface, sq. ft per ft. length = \( AO = \frac{D^2 \pi}{12} \)

Inside pipe surface, sq. ft. per ft. length = \( A_I = \frac{d \pi}{12} \)

Cross-sectional plastic area, sq. in. = \( A = \frac{(D^2 - d^2) \pi}{4} \)

Cross sectional flow area, sq. in. = \( A_F = \frac{d^2 \pi}{4} \)

Weight of PVC pipe, lb. per ft. length = \( W_{PVC} = 0.632 \times A \)
Weight of CPVC pipe, lb. per ft. length = \( W_{CPVC} = 0.705 \times A \)
Weight of water in pipe, lb. per ft. length = \( W_W = 0.433 \times A_F \)
Weight of water filled pipe, lb. per ft. length = \( W_{WFP} = W_{PVC} + W_W \)

Radius of gyration, inches = \( r_g = \sqrt{\frac{D^2 + d^2}{4}} \)

Moment of inertia, inches fourth = \( I = \frac{A r_g^2}{2} \times 0.0491 \times (D^4 - d^4) \)
Section modulus, inches cube = \( Z = \frac{A}{D} \times 0.0982 \times (D^4 - d^4) \)

Thermal Expansion and Contraction
\[ \Delta L = 12 yL (\Delta T) \]

Where:
\( \Delta L \) = expansion or contraction of pipe in inches
\( y \) = Coefficient of thermal expansion
\( L \) = Length of pipe run in feet
\( \Delta T \) = Temperature change °F (Maximum temperature – Temperature @ Installation or maximum system temperature – lowest system temperature, whichever is greater)
Friction Loss (Hazen-Williams equations)

\[ f = 0.2083 \times (100/C)^{1.852} \times G^{1.852} \times d^{4.8655} \]

Where:
- \( f \) = friction head of feet of water per 100' for the specific pipe size and I.D.
- \( C \) = a constant for internal pipe roughness (=150 for thermoplastic pipe)
- \( G \) = flow rate of U.S. gallons per minute
- \( d \) = inside diameter of pipe in inches

Water Velocities

\[ V = 0.3208 \times \frac{G}{A} \]

Where:
- \( V \) = velocity in feet per second
- \( G \) = gallons per minute
- \( A \) = inside cross sectional area in square inches

Gallons Per Minute Through Pipe

\[ GPM = 0.0408 \times \text{Pipe Diameter Inches}^2 \times \text{Feet Per Minute Velocity} \]

Pressure Drop in Valves

\[ P = \frac{G^2 \times S_g}{C_V^2} \]

Where:
- \( P \) = Pressure drop in PSI; feet of water = PSI/.4332
- \( G \) = Gallons per minute
- \( S_g \) = Specific gravity of liquid
- \( C_V \) = Gallons per minute per 1 PSI pressure drop (see Valve product Cv from manufacturer)

Water Conversions

- 1 foot of head = 0.434 PSI
- 1 gallon = 231 cubic inch = 8.333 pounds (salt water = 64.3 pounds)
- 1 pound water = 27.7 cubic inches
- 1 miner’s inch = 9 to 12 gallons per minute

Horsepower to Raise Water = \( \frac{\text{Gallons Per Minute} \times \text{Total Head in Feet}}{3960} \)