



**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 =  $VG = V \times 0.004329$

**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 =  $W_{PVC} = .632 \times A$

**Weight of CPVC pipe**, lb. per ft. length =  $W_{CPVC} = .705 \times A$

**Weight of water in pipe**, lb. per ft. length =  $W_W = 0.433 A_F$

**Weight of water filled pipe**, lb. per ft. length =  $W_{WFP} = W_{PVC} \text{ (or } W_{CPVC}) + W_W$

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

**Moment of inertia**, inches fourth =  $I = Ar_g^2 = .0491(D^4 - d^4)$

**Section modulus**, inches cube =  $Z = \frac{2I}{D} = 0.0982 \times \frac{(D^4 - d^4)}{D}$

**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

(see PVC or CPVC material Thermal properties) 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)



## Pipe & Hangers Technical Industry Piping Formulas

### Friction Loss (Hazen-Williams equations)

$$f = .2083 \times (100/C)^{1.852} \times \frac{G^{1.852}}{d^{4.8655}}$$

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

$$V = .3208 \times \frac{G}{A}$$

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 x Pipe Diameter Inches<sup>2</sup> x 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<sub>g</sub> = Specific gravity of liquid

C<sub>v</sub> = 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

1 pound water = 27.7 cubic inches

1 cubic foot water = 7.5 gallon = 62.5

pounds (salt water = 64.3 pounds)

1 miner's inch = 9 to 12 gallons per minute

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