

SPRINKLER SYSTEM FORMULAS

Simple Flow Rate

$$Q = K \cdot P^{0.5}, \text{ where}$$

Q = flow rate (GPM)

K = discharge coefficient of pipe

P = pressure (PSI)

General Volumetric Flow Rate

$$Q = 29.8 \cdot D^2 Cd \cdot P^{0.5}, \text{ where}$$

Q = flow rate (GPM)

D = outlet diameter (Inches)

Cd = discharge coefficient based on outlet geometry

P = pressure (PSI)

Pressure Tank Sizing (Tank above sprinklers)

$$P = (30/A) - 15, \text{ where}$$

P = air pressure in tank (PSI)

A = proportion of air in the tank

Pressure Tank Sizing (Tank below sprinklers)

$$P = (30/A) - 15 + (0.43 \cdot H/A), \text{ where}$$

P = air pressure carried in tank (PSI)

A = proportion of air in the tank

H = height of highest sprinkler above tank bottom (Ft)

Pressure Tank Sizing (Hydraulically calculated)

$$P_i = [(P_f + 15)/A] - 15, \text{ where}$$

P_i = tank air pressure to use (PSI)

A = proportion of air in the tank

P_f = system pressure req'd per hydraulic calc. (PSI)

Darcy-Weisbach Formula for Friction Loss

$$HL = f \cdot (L/D) \cdot (v^2/2g), \text{ where}$$

HL = friction loss (Ft)

Re = Reynolds number (pVd / μ)

f = friction factor ($f=64/Re$)

v = water velocity (Ft/Sec)

g = gravitational constant (32.174ft/sec²)

D = pipe diameter (Ft)

L = pipe length (Ft)

PRESSURE VELOCITY

$$P_v = 0.001123 \cdot Q^2 / D^4, \text{ where}$$

P_v = pressure velocity (PSI)

Q = flow rate (GPM)

D = internal dia. of pipe (Inches)

Hazen-Williams Formula for Pressure Loss

$$P = (4.52 \cdot Q^{1.85}) / (C^{1.85} \cdot d^{4.87}), \text{ where:}$$

P = pressure loss (PSI) per lineal ft.

Q = flow rate (GPM)

C = friction factor of pipe (constant)

d = internal diameter of pipe (Inches)

Typical "C" values:

Unlined cast or ductile iron 100

Black steel (dry sys.incl.preaction) . . 100

Black steel (wet sys.incl.deluge) . . . 120

Galvanized (all) 120

Plastic (listed)– all 150

Cement lined cast or ductile iron . . 140

Copper tube or stainless steel 150

Hazen-Williams Formula for Pressure Loss

(in SI units)

$$P = 6.05 \cdot 10^5 \cdot Q^{1.85} / (C^{1.85} \cdot d^{4.87}),$$

where

P = pressure loss (Bars) per lineal meter

Q = flow rate (Litre/Min)

C = friction factor of pipe (constant)

d = internal diameter of pipe (mm)