White Paper

Flow and Conversion Formulas

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VAL-MATIC COMMON FORMULAS

Darcy-Weisbach Formula for headloss in a pipe:

$\Delta H = f (L / D) \times (v^2 / 2g)$ $\Delta H = K (v^2 / 2g)$

Flow equation using Cv Flow Coefficient:

$Q = Cv (\Delta P / S_g)^{1/2}$ $\Delta P = (Q / Cv)^2 S_g$

Collapse pressure of thin walled steel pipe for Air/Vacuum valve sizing:

$P= 16{,}250{,}000 (T/d)^3$

Annual pumping costs for a given headloss and flow rate:

$A = (1.65 Q \Delta H S_g C U) / E$

Where:

A	= annual energy cost, $
C	= cost of electricity, $/kW-hr
CFS	= flow rate, cu-ft/sec
Cv	= flow coefficient defined as gpm of 60F water with 1 psi pressure drop
d	= diameter of pipe or valve, in
D	= diameter of pipe or valve, ft
E	= efficiency of pump and motor set, percent /100 (0.80 typical)
f	= pipe friction factor (.019 for 12 in iron)
g	= acceleration due to gravity, 32.2 ft/sec2
ΔH	= head loss, ft of water
K	= resistance coefficient, dimensionless
L	= length of pipe, ft
P	= collapse pressure, psi
ΔP	= pressure drop, psi
Q	= flow rate, gpm
S_g	= specific gravity, dimensionless (water = 1.0)
T	= wall thickness, in
U	= usage, percent / 100 (1.0 equals 24 hrs per day)
v	= flow velocity, ft/sec

VAL-MATIC CONVERSION FORMULAS

LIQUID FLOW:

GPM = FPS x 2.448 x d^2
GPM = CFS x 448.83
GPM = MGD x 694.4
GPM = Bbl/day x .02917
GPM = L/SEC x 15.853
FPS = GPM x .4085 ÷ d^2
FPS = M/SEC x 3.2808
FPS = CFS x 183.35 ÷ d^2
LPS = CFM x .4719
CFS = CMS x 35.315
CFS = L/MIN ÷ 1699.3
CFS = GPM x .002228
CFS = MGD x 1.5472
C_v = 29.82 x d^2 √ ÷K
K = 889.2 x d^4 ÷ $(C_v)^2$
K_v = C_v x .865

PRESSURE:

FT(W) = PSI x 2.3106
PSI = FT(W) x.43278
PSI = IN(Hg) x .49115
PSI = KPa x .14504
PSI = MPa x 145.04
PSI = BAR x 14.504
PSI = Kg/cm^2 x 14.223
BAR = MPa x 10

TEMPERATURE:

°F = 9/5 x °C +32
°F = °R - 459.69
°C = 5/9 x (°F - 32)
°C = °K - 273.16

LENGTH:

IN = M x 39.37
IN = CM÷2.54
IN = MM÷25.4
IN = MICRON ÷ 25400
MIL = IN x1000
MIL = MICRON ÷ 25.4
FT = CM x .03281
FT = M x 3.281
FT = KM x 3281

VOLUME:

FL OZ = ML x 0.0338
FL OZ = GAL x 128
FL OZ = 100 DROPS
CU IN = GAL x 231
CU IN = L x 61.025
CU FT = GAL x .13368
CU FT = CU M x 35.315
CU FT = L x .035315
GAL = L x .2642
ML = CC

WEIGHT:

LB = KG x 2.2046
LB = GRAMS ÷ 453.59
LB = TON x 2000
LB = METRIC TON x 2205
LB = N x 0.2248
LB(W) = GAL x 8.3453
LB(W) = CU FT x 62.425
LB(W) = CU IN x .0361
MG/L = PPM
OZ = LB x 16

VAL-MATIC CONVERSION FORMULAS

TORQUE:

FT-LB = N-M x 0.7376

WHERE:

Bbl = Barrels

CFM = Cubic feet per minute

CFS = Cubic feet per second

°C = Degrees Celsius

CC = Cubic centimeter

CM = Centimeter

CMS = Cubic meter per second

C_v = Flow coefficient, GPM @ 1 Psi

d = diameter of pipe or valve, in

°F = Degrees Fahrenheit

FL OZ = Fluid ounce

FPS = Feet per second

FT = Feet

FT(W) = Feet of Water

GAL = Gallon

GPM = Gallons per minute

IN = Inch

IN(Hg) = Inches of Mercury

K = Flow coefficient dimensionless

K_v = Flow coefficient, M^3/hr @ I Bar

KG = Kilogram

KM = Kilometer

KPA = Kilopascal

°K = Degrees Kelvin

L = Liter

LB = Pound

LB(W) = Pounds of Water at 60F

LPS = Liters per second

M = Meter

MG = Milligram

MGD = Million gallons per day

MIL = mil (1000th of an inch)

ML = Milliliter

MM = Millimeter

MPA = Megapascal

N = Newton

PPM = Parts per million

°R = Degrees Rankin

OZ = Ounce, weight

PSI = Pounds per square inch

SEC = Seconds