Liquid Friction Factor K And Flow Coefficients Av Cv And Kv From Flowrate And Delta Pressure

This example should be used with the Pipeng Toolbox :
http://pipeng.com/index.php/ts/itdmotflow001a : Pipeng Pipe Fitting calculators

Data Values

$ID := 0.2984 \cdot m$		Nominal Inside Diameter
$Pi := 3 \cdot MPa$	$Pi = 30\,bar$	Inlet Pressure
$Po := 2.9 \cdot MPa$	$Po = 29\,bar$	Outlet Pressure
$DP := Pi - Po$	$DP = 1\,bar$	Delta Pressure
$W := 800 \cdot kg \cdot m^{-3}$		Fluid Density
$q := 0.553 \cdot \frac{m^3}{s}$	$q = 5.53 \times 10^{-1} \frac{m^3}{s}$	Volume Flow Rate
$maf := W \cdot q$	$maf = 4.424 \times 10^{2} \frac{kg}{s}$	Mass Flow Rate

Water Density Table 2-28 Perrys Chemical Engineers Handbook

Flowrate is calculated at 1 bar delta pressure and fluid density 800 kg/m^3

Note delta pressure is used as a positive value.

Conversion Factors to Av

$W60F := 999.0140 \cdot kg \cdot m^{-3}$		STD Water Density (60 F)
$W16C := 998.943 \cdot kg \cdot m^{-3}$		STD Water Density (16 C)
$S60F := \frac{W}{W60F}$	$S60F = 0.80079$	Specific Gravity WRT Water (60 F)
$S16C := \frac{W}{W16C}$	$S16C = 0.80085$	Specific Gravity WRT Water (16 C)
$cvusx := \frac{gal}{min} \cdot \left(\frac{W60F}{psi}\right)^{0.5} \cdot \frac{1}{m^2}$	$cvusx = 2.40153088 \times 10^{-5}$	CV-US to Av Conversion Factor
$cvukx := \frac{galUK}{min} \cdot \left(\frac{W60F}{psi}\right)^{0.5} \cdot \frac{1}{m^2}$	$cvukx = 2.88411833 \times 10^{-5}$	Cv-UK to Av Conversion Factor
$cvmetx := \frac{liter}{min} \cdot \left(\frac{W16C}{bar}\right)^{0.5} \cdot \frac{1}{m^2}$	$cvmetx = 1.6657856 \times 10^{-6}$	Cv-Metric to Av Conversion Factor
$kvx := \frac{m^3}{hr} \cdot \left(\frac{W16C}{bar}\right)^{0.5} \cdot \frac{1}{m^2}$	$kvx = 2.77630933 \times 10^{-5}$	Kv to Av Conversion Factor
$kvz := \frac{1}{kvx} \cdot \frac{1}{m^2}$	$kvz = 3.60190411 \times 10^{4} \frac{1}{m^2}$	Av To Kv Flow Factor
$cvdy := \frac{in^2}{cvusx}$	$cvdy = 2.68645307 \times 10^{1} m^2$	Av to Cvd Conversion Factor
$cvdx := \frac{cvusx}{in^2}$	$cvdx = 3.72238031 \times 10^{-2} \frac{1}{m^2}$	Cvd to Av Conversion Factor
$cvdz := \frac{\pi}{\sqrt{8} \cdot cvdx}$	$cvdz = 2.983899 \times 10^{1} m^2$	K Factor to Cv* Conversion

K Friction Factor

$k := \frac{\pi^2 \cdot ID^4}{q^2} \cdot \frac{DP}{8 \cdot W}$ — $k = 3.998202 \times 10^{0}$ — Friction Factor

$q := \pi \cdot ID^2 \cdot \sqrt{\frac{DP}{8 \cdot k \cdot W}}$ — $q = 5.53 \times 10^{-1} \frac{m^3}{s}$ — Flow Rate

Cd Discharge Coefficient

$cd := \frac{q}{\pi \cdot ID^2} \cdot \sqrt{\frac{8 \cdot W}{DP}}$ — $cd = 5.001124 \times 10^{-1}$ — Discharge Coefficient

$cd := \frac{1}{\sqrt{k}}$ — $cd = 5.001124 \times 10^{-1}$ — Discharge Coefficient

$q := \pi \cdot cd \cdot ID^2 \cdot \sqrt{\frac{DP}{8 \cdot W}}$ — $q = 5.53 \times 10^{-1} \frac{m^3}{s}$ — Flow Rate

Av Flow Coefficient

$av := q \cdot \sqrt{\frac{W}{DP}}$ — $av = 4.946182 \times 10^{-2} m^2$ — Av Flow Coefficient

$av := \frac{\pi \cdot ID^2}{\sqrt{8 \cdot k}}$ — $av = 4.946182 \times 10^{-2} m^2$ — Av Flow Coefficient

$q := av \cdot \sqrt{\frac{DP}{W}}$ — $q = 5.53 \times 10^{-1} \frac{m^3}{s}$ — Flow Rate

Cv US Flow Coefficient

$cvus := q \cdot \frac{min}{gal} \cdot \sqrt{\frac{S60F \cdot psi}{DP}}$ — $cvus = 2.059596 \times 10^{3}$ — Cv US Flow Coefficient

$cvus := \frac{av}{cvusx}$ — $cvus = 2.059596 \times 10^{3} m^2$ — Cv US Flow Coefficient

$q := \frac{cvus}{m^2} \cdot \frac{gal}{min} \cdot \sqrt{\frac{DP}{W} \cdot \frac{W60F}{psi}}$ — $q = 5.53 \times 10^{-1} \frac{m^3}{s}$ — Flow Rate

$q = 8.76523 \times 10^{3} \frac{gal}{min}$

Cv UK Flow Coefficient

$cvuk := q \cdot \frac{min}{galUK} \cdot \sqrt{\frac{S60F \cdot psi}{DP}}$ $\quad cvuk = 1.714972 \times 10^{3}$ $\quad$ Cv UK Flow Coefficient

$cvuk := \frac{av}{cvukx}$ $\quad cvuk = 1.714972 \times 10^{3}\, m^{2}$ $\quad$ Cv UK Flow Coefficient

$q := \frac{cvuk}{m^{2}} \cdot \frac{galUK}{min} \cdot \sqrt{\frac{DP}{W} \cdot \frac{W60F}{psi}}$ $\quad q = 5.53 \times 10^{-1} \frac{m^{3}}{s}$ $\quad$ Flow Rate

$q = 7.29858 \times 10^{3} \frac{galUK}{min}$

Cv Metric Flow Coefficient

$cvmet := q \cdot \frac{min}{liter} \cdot \sqrt{\frac{S16C \cdot bar}{DP}}$ $\quad cvmet = 2.969279 \times 10^{4}$ $\quad$ Cv Metric Flow Coefficient

$cvmet := \frac{av}{cvmetx}$ $\quad cvmet = 2.969279 \times 10^{4}\, m^{2}$ $\quad$ Cv Metric Flow Coefficient

$q := cvmet \cdot \frac{liter}{min} \cdot \sqrt{\frac{DP}{W} \cdot \frac{W16C}{bar}}$ $\quad q = 5.53 \times 10^{-1} \frac{m^{5}}{s}$ $\quad$ Volume Flow Rate

$q = 3.318 \times 10^{4}\, m^{2} \frac{liter}{min}$

Kv Flow Coefficient

$kv := q \cdot \frac{hr}{m^{3}} \cdot \sqrt{\frac{S16C \cdot bar}{DP}}$ $\quad kv = 1.781567 \times 10^{3}\, m^{2}$ $\quad$ Kv Flow Coefficient

$kv := \frac{av}{kvx}$ $\quad kv = 1.781567 \times 10^{3}\, m^{2}$ $\quad$ Kv Flow Coefficient

$q := \frac{kv}{m^{2}} \cdot \frac{m^{3}}{hr} \cdot \sqrt{\frac{DP}{W} \cdot \frac{W16C}{bar}}$ $\quad q = 5.53 \times 10^{-1} \frac{m^{3}}{s}$ $\quad$ Flow Rate

$q = 1.9908 \times 10^{3} \frac{m^{3}}{hr}$

Cv* Dimensionless Flow Coefficient

$cvd := \frac{cvus}{ID^2} \cdot \frac{in^2}{m^2}$ $cvd = 1.492285 \times 10^{1}$ Cv* Flow Coefficient

$cvd := \frac{q}{ID^2} \cdot \frac{min}{gal} \cdot \frac{in^2}{m^2} \cdot \sqrt{\frac{S60F \cdot psi}{DP}}$ $cvd = 1.492285 \times 10^{1} \frac{1}{m^2}$ Cv US Flow Coefficient

$cvd := \frac{av}{cvdx \cdot ID^2}$ $cvd = 1.492285 \times 10^{1} m^2$ Cv* Flow Coefficient

$q := \frac{cvd}{m^2} \cdot ID^2 \cdot \frac{1}{in^2} \cdot \frac{gal}{min} \cdot \sqrt{\frac{DP}{W} \cdot \frac{W60F}{psi}}$ $q = 5.53 \times 10^{-1} \frac{m^3}{s}$ Flow Rate

$q = 8.76523 \times 10^{3} \frac{gal}{min}$