FORMULE EMPIRICHE ATTRITO PERDITE DISTRIBUITE

Haaland equation

The *Haaland equation* was proposed in 1983 by Professor S.E. Haaland of the Norwegian Institute of Technology
It is used to solve directly for the Darcy–Weisbach friction factor *f* for a full-flowing circular pipe. It is an approximation of the implicit Colebrook–White equation, but the discrepancy from experimental data is well within the accuracy of the data.

$$\frac{1}{\sqrt{\lambda}} = -1{,}8\log\left[\left(\frac{\varepsilon/D}{3{,}7}\right)^{1{,}11} + \frac{6{,}9}{Re}\right]$$

Swamee–Jain equation

The Swamee–Jain equation is used to solve directly for the Darcy–Weisbach friction factor *f* for a full-flowing circular pipe. It is an approximation of the implicit Colebrook–White equation

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{\varepsilon/D}{3.7} + \frac{5.74}{\mathrm{Re}^{0.9}}\right)$$

Barr equation (1981)

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{\varepsilon/D}{3.7} + \frac{5.158\log\left(\frac{\mathrm{Re}}{7}\right)}{\mathrm{Re}\left(1+\frac{\mathrm{Re}^{0.52}}{29}(\varepsilon/D)^{0.7}\right)}\right)$$

Evangelides, Papaevangelou, Tzimopoulos equation (2010)

$$f = \frac{0.2479 - 0.0000947(7-\log\mathrm{Re})^4}{(\log\left(\frac{\varepsilon/D}{3.615} + \frac{7.366}{\mathrm{Re}^{0.9142}}\right))^2}$$

Table of Fluid Properties (Liquids and Gases)

Fluid	**T (°F)**	**Density ($slug/ft^3$)**	***v* (ft^2/s)**	**T (°C)**	**Density (kg/m^3)**	***v* (m^2/s)**
Liquids:						
Water	70	1.936	1.05e-5	20	998.2	1.00e-6
Water	40	1.94	1.66e-5	5	1000	1.52e-6
Seawater	60	1.99	1.26e-5	16	1030	1.17e-6
SAE 30 oil	60	1.77	0.0045	16	912	4.2e-4
Gasoline	60	1.32	4.9e-6	16	680	4.6e-7
Mercury	68	26.3	1.25e-6	20	13600	1.15e-7
Gases (at standard atmospheric pressure, i.e. 1 atm):						
Air	70	0.00233	1.64e-4	20	1.204	1.51e-5
Carbon Dioxide	68	0.00355	8.65e-5	20	1.83	8.03e-6
Nitrogen	68	0.00226	1.63e-4	20	1.16	1.52e-5
Helium	68	3.23e-4	1.27e-3	20	0.166	1.17e-4

Symbols:
p (greek letter rho) = Density (units are mass/volume). The English (U.S. Customary Unit) for mass is the slug. The SI (metric) unit for mass is the kg.
v (greek letter nu) = kinematic viscosity (units are length squared/time). If you're more familiar with dynamic viscosity μ (greek letter mu), then it may help to know that $v = \mu/p$.