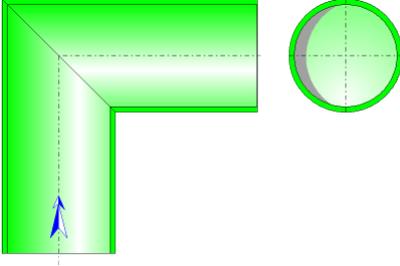




Miter Bend Circular Cross-Section (Pipe Flow - Guide)



Model description:

This model of component calculates the head loss (pressure drop) of a miter bend whose cross-section is circular and constant. In addition, the flow is assumed fully developed and stabilized upstream of the bend.

Model formulation:

Cross-section area (m²):

$$A = \pi \cdot \frac{d^2}{4}$$

Mean velocity (m/s):

$$V = \frac{Q}{A}$$

Mass flow rate (kg/s):

$$G = Q \cdot \rho_m$$

Reynolds number:

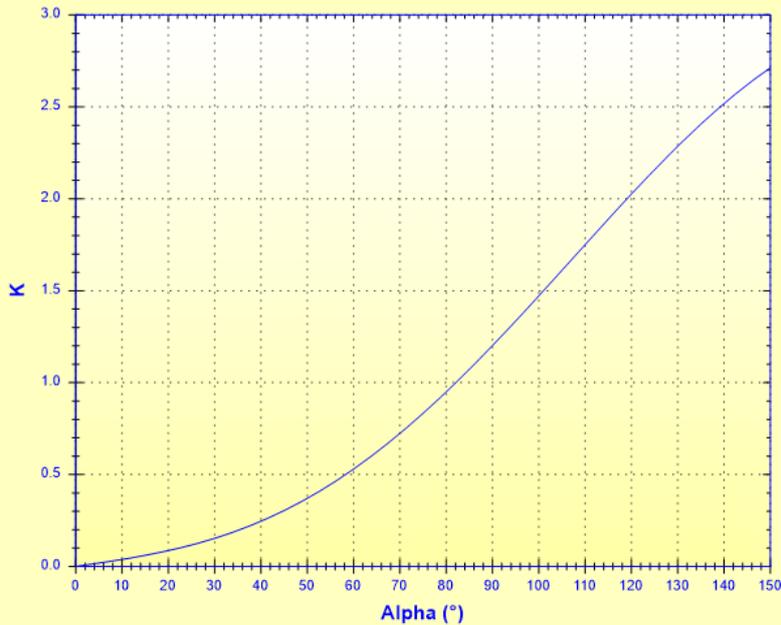
$$N_{Re} = \frac{V \cdot d}{\nu}$$

Total pressure loss coefficient (based on mean velocity in bend):

$$K = 0.42 \cdot \sin(\alpha/2) + 2.56 \cdot (\sin(\alpha/2))^3$$

([1] equation 15.5)

Miter bend with circular cross-section
Coefficient of local resistance
Pipe Flow - Guide (2012) - Equation 15.5



Total pressure loss (Pa):

$$\Delta P = K \cdot \frac{\rho \cdot V^2}{2}$$

Total head loss of fluid (m):

$$\Delta H = K \cdot \frac{V^2}{2 \cdot g} \quad ([1] \text{ equation 3.7})$$

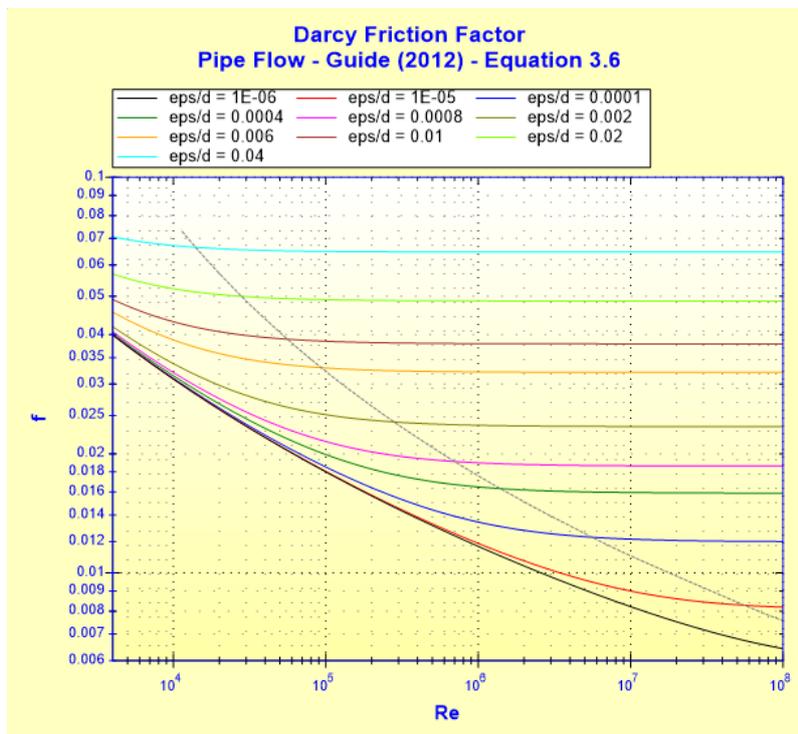
Hydraulic power loss (W):

$$W_h = \Delta P \cdot Q$$

Darcy friction factor:

$$f = \frac{1}{\left[2 \cdot \log \left(\frac{\varepsilon}{3.7 \cdot d} + \frac{2.51}{N_{Re} \cdot \sqrt{f}} \right) \right]^2}$$

Colebrook-White equation ([1] equation 3.6)



Straight length of equivalent pressure loss (m):

$$L_{eq} = \zeta \cdot \frac{D_0}{\lambda}$$

Symbols, Definitions, SI Units:

d	Pipe internal diameter (m)
A	Cross-section area (m ²)
Q	Volume flow rate (m ³ /s)
V	Mean velocity (m/s)
α	Angle (°)
G	Mass flow rate (kg/s)
N _{Re}	Reynolds number ()
K	Total pressure loss coefficient (based on mean velocity in bend) ()
ΔP	Total pressure loss (Pa)
ΔH	Total head loss of fluid (m)
Wh	Hydraulic power loss (W)
f	Darcy friction coefficient ()
L _{eq}	Straight length of equivalent pressure loss (m)
ρ_m	Fluid density (kg/m ³)
ν	Fluid kinematic viscosity (m ² /s)
g	Gravitational acceleration (m/s ²)

Validity range:

- turbulent flow regime (N_{Re} ≥ 10⁴)
- stabilized flow upstream of the bend
- angle between 0° and 150°

Example of application:

HydrauCalc 2018b - [Miter bend with circular cross-section - Pipe Flow - Guide (2012)]

File Edit Preferences Calculation method Database Tools Help

Fluid characteristics

Fluid : Water @ 1 atm [HC]
Ref.: IAPWS IF97

Temperature : T 20 °C
Pressure : P 1.013 bar

Density : ρ 998.2061 kg/m³
Dynamic Viscosity : μ 0.00100159 N.s/m²
Kinematic Viscosity : ν 1.00340E-06 m²/s

Density Dyn. Visc. Kn. Visc.

Density (kg/m³)

Temperature (°C)

logY

Geometrical characteristics

Help Info

Calculate

Pressure loss
 ΔP 0.0099555 bar
 ΔH 0.1017 m of fluid

90°

G 4.9910 kg/s
q 0.005 m³/s
V 1.288 m/s (Turbulent)

Complementary results

Designation	Symbol	Value	Unit
Cross-sectional area	A	0.003881508	m ²
Reynolds number	Re	90251	
<input checked="" type="checkbox"/> Coefficient of local resistance (Equation 15.5)	K	1.202082	
Pressure loss coefficient (based on the mean bend velocity)	K	1.202082	
Hydraulic power loss	Wh	4.97775	W
<input checked="" type="checkbox"/> Darcy Friction Factor (Equation 3.6)	f	0.01907611	
Straight length of equivalent pressure loss	Leq	4.429957	m

References:

[1] Pipe Flow: A Practical and Comprehensive Guide. Donald C. Rennels and Hobart M. Hudson. (2012)