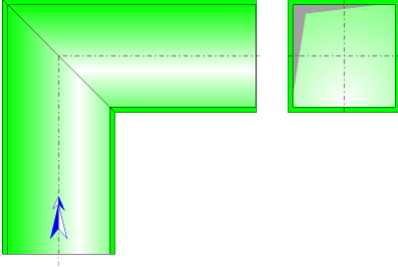




Miter Bend Rectangular Cross-Section (MILLER)



Model description:

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

An option allows to take into account the effect of the straight length at the exit of the bend.

Model formulation:

Hydraulic diameter (m):

$$D = \frac{2 \cdot b \cdot W}{b + W}$$

Cross-section area (m²):

$$A = b \cdot W$$

Mean velocity (m/s):

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

Mass flow rate (kg/s):

$$m = Q \cdot \rho$$

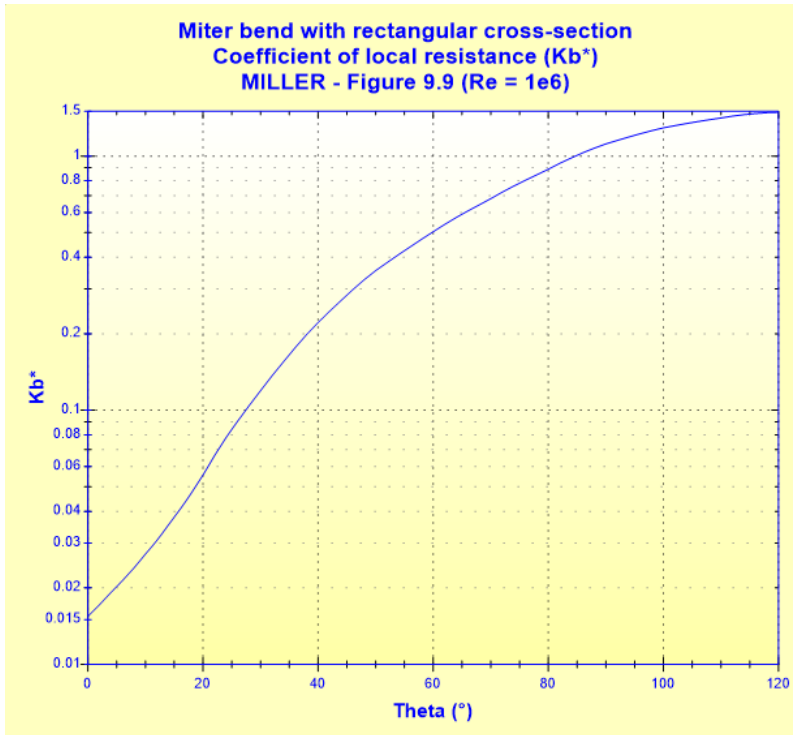
Reynolds number:

$$Re = \frac{U \cdot D}{\nu}$$

Basic resistance coefficient:

$$K_b^* = f(\theta_b)$$

([1] figure 9.9)

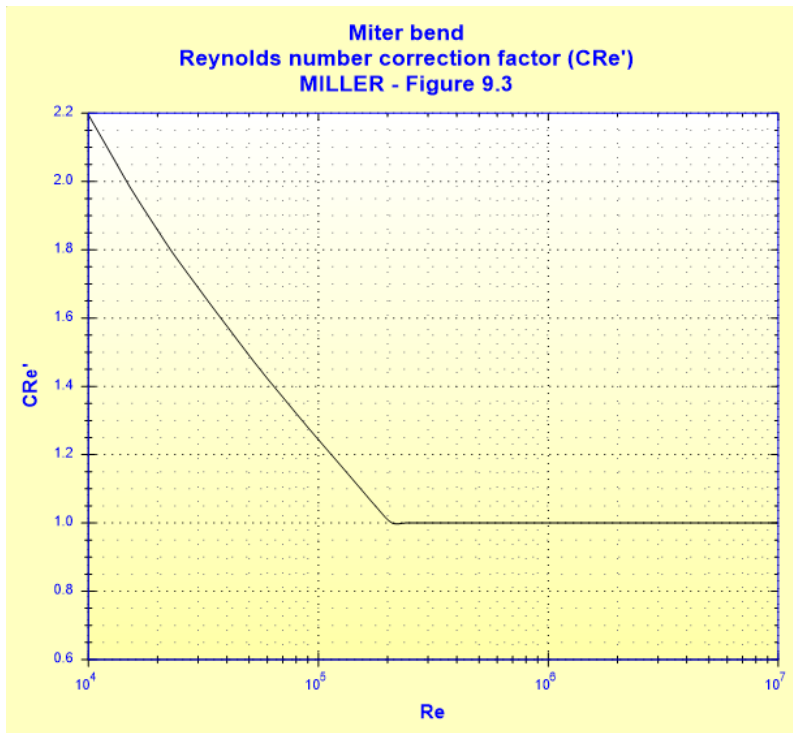


Reynolds number correction factor:

$$C_{Re} = \frac{K_b^*}{K_b^* - 0.2C'_{Re} + 0.2} \quad ([1] \text{ equation 9.2})$$

with:

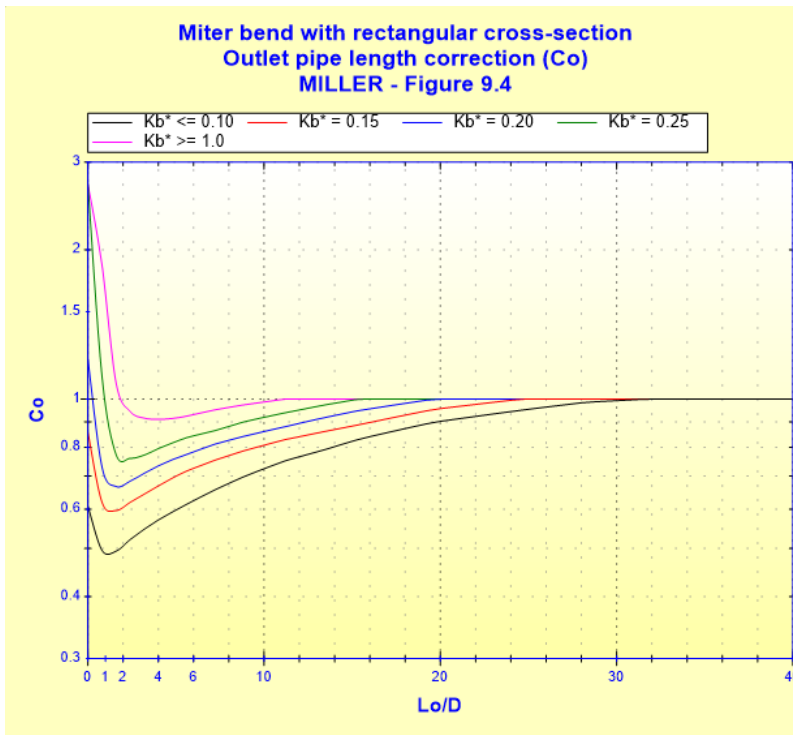
$$C'_{Re} = f(Re) \quad ([1] \text{ figure 9.3 with } r/d=1)$$



Outlet pipe length correction factor (optional):

$$C_o = f\left(\frac{L_o}{D}, K_b^*\right)$$

([1] figure 9.4)

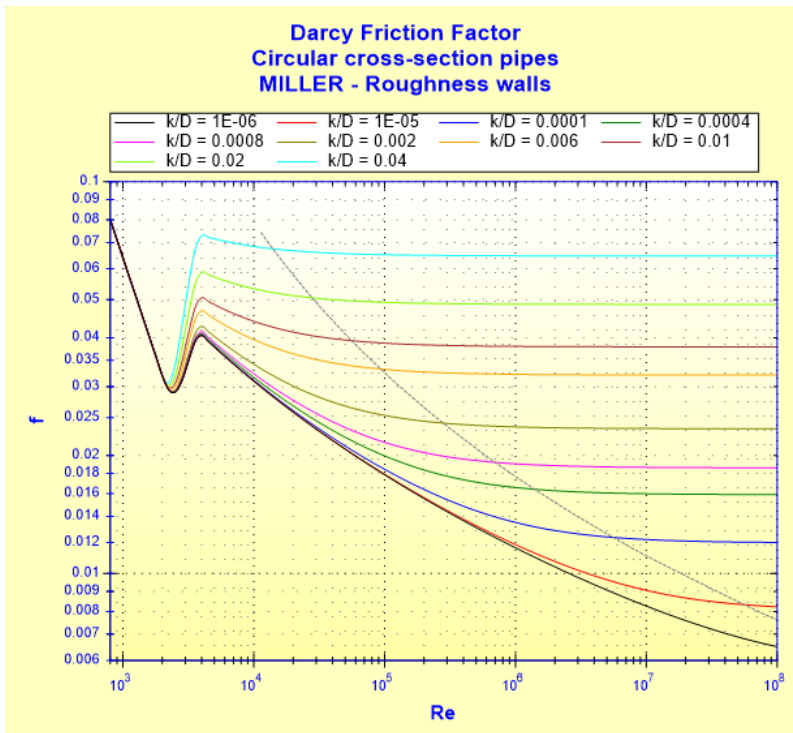


If this option is not activated, the factor C_o is equal to unity.

Darcy friction factor:

$$f = f\left(\text{Re}, \frac{k}{D}\right)$$

See [Straight Pipe - Rectangular Cross-Section and Roughness Walls \(MILLER\)](#)



Roughness correction factor:

- $\theta_b \leq 45$:

$$C_f = \frac{f_{rough}}{f_{smooth}}$$

([1] equation 9.3)

with:

f_{rough} : Darcy friction factor for rough pipe at Re

f_{smooth} : Darcy friction factor for smooth pipe ($k = 0$) at Re

■ $\theta_b > 45^\circ$:

$$C_f = 1$$

Corrected loss coefficient:

$$K_b = K_b^* \cdot C_{Re} \cdot C_o \cdot C_f \quad ([1] \text{ equation 9.4})$$

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

$$K = K_b$$

Total pressure loss (Pa):

$$\Delta P = K_b \cdot \frac{\rho \cdot U^2}{2} \quad ([1] \text{ equation 8.1b})$$

Total head loss of fluid (m):

$$\Delta H = K_b \cdot \frac{U^2}{2 \cdot g} \quad ([1] \text{ equation 8.1a})$$

Hydraulic power loss (W):

$$Wh = \Delta P \cdot Q$$

Straight length of equivalent pressure loss (m):

$$L_{eq} = K_b \cdot \frac{D}{f_{rough}}$$

with:

f_{rough} : Darcy friction factor for rough pipe at Re

Symbols, Definitions, SI Units:

W	Cross-section height (m)
b	Cross-section width (m)
D	Hydraulic diameter (m)
A	Cross-section area (m ²)
Q	Volume flow rate (m ³ /s)
U	Mean velocity (m/s)
m	Mass flow rate (kg/s)
Re	Reynolds number ()
θ_b	Angle of the bend (°)

K_b^*	Basic loss coefficient ()
C_{Re}	Reynolds number correction factor ()
L_0	Length of the straight section downstream of the bend (m)
C_o	Outlet pipe length correction factor ()
k	Absolute roughness of walls (m)
f	Darcy friction factor for ()
C_f	Roughness correction factor ()
K_b	Corrected loss coefficient ()
K	Total pressure loss coefficient (based on the mean velocity in the bend) ()
ΔP	Total pressure loss (Pa)
ΔH	Total head loss of fluid (m)
Wh	Hydraulic power loss (W)
L_{eq}	Straight length of equivalent pressure loss (m)
ρ	Fluid density (kg/m^3)
ν	Fluid kinematic viscosity (m^2/s)
g	Gravitational acceleration (m/s^2)

Validity range:

- turbulent flow regime ($Re \geq 10^4$)
- stabilized flow upstream bend
- curvature angle: 0 - 120°

Example of application:

HydrauCalc 2020a - [Miter bend with rectangular cross-section - MILLER (2nd Ed.)]

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. Kin. Visc.

Geometrical characteristics
 Help Info Calculate
 W 0.05 m
 k 1.0E-05 m
 b 0.1 m
 Pressure loss
 ΔP 0.005991446 bar
 ΔH 0.0612 m of fluid
 Option: Outlet pipe length correction factor
 Utiliser la correction de longueur en sortie
 Longueur droite : >= 0.7833 m

m 4.9910 kg/s
 Q 0.005 m³/s
 U 1.0 m/s (Turbulent)
 90°

Complementary results

Designation	Symbol	Value	Unit
Hydraulic diameter	D	0.06666667	m
Passage cross-section area	A	0.005	m²
Sides ratio	W/b	0.5	
Passage cross-section area	A	0.005	m²
Basic coefficient (Figure 9.9)	k_b^*	1.1173	
Reynolds number	Re	66440.97	
Reynolds number correction factor (Figure 9.3)	$CR_{e'}$	1.386922	
Reynolds number correction factor (Equation 9.2)	CR_e	1.074414	
Outlet tangent correction (Figure 9.4)	C_o	1	
Relative roughness	k/D	0.00015	
Roughness correction	C_f	1	
Corrected pressure loss coefficient	K_b	1.200443	
Pressure loss coefficient (based on the mean bend velocity)	K	1.200443	
Hydraulic power loss	Wh	2.995723	W
Straight length of equivalent pressure loss	Leq	3.96381	m

References:

[1] Internal Flow System, Second Edition, D.S. Miller