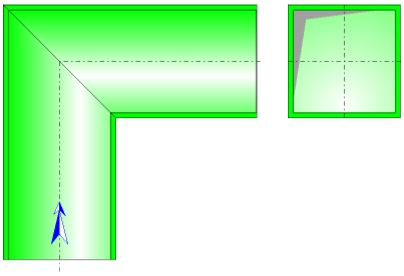
# Miter Bend
# Rectangular Cross-Section
# (MILLER)



**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:**

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Hydraulic diameter (m):

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

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Cross-section area (m²):

$$A = b \cdot W$$

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Mean velocity (m/s):

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

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Mass flow rate (kg/s):

$$m = Q \cdot \rho$$

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Reynolds number:

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

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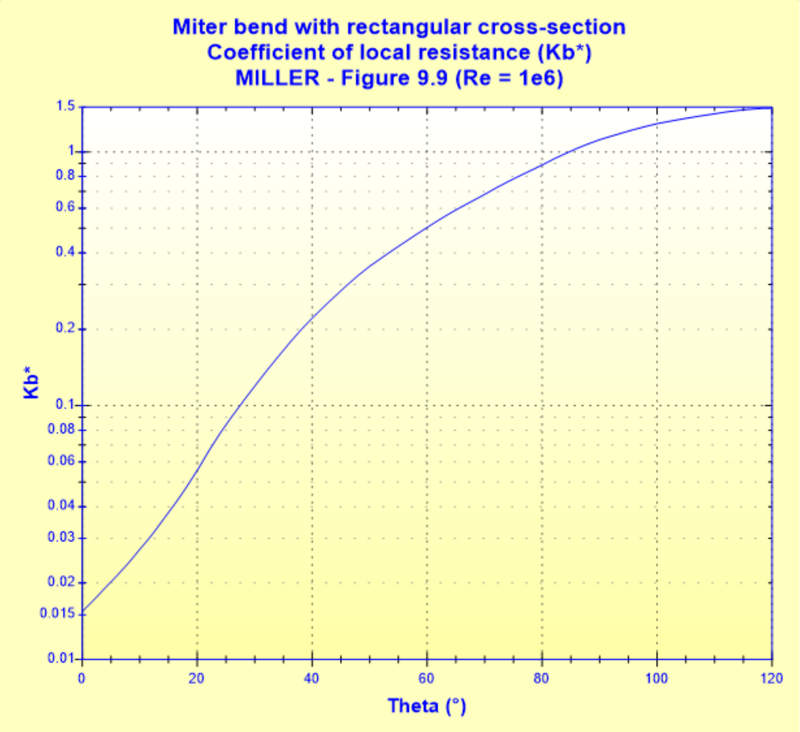
Basic resistance coefficient:

$$K_b^* = f(\theta_b)$$ ([1] figure 9.9)

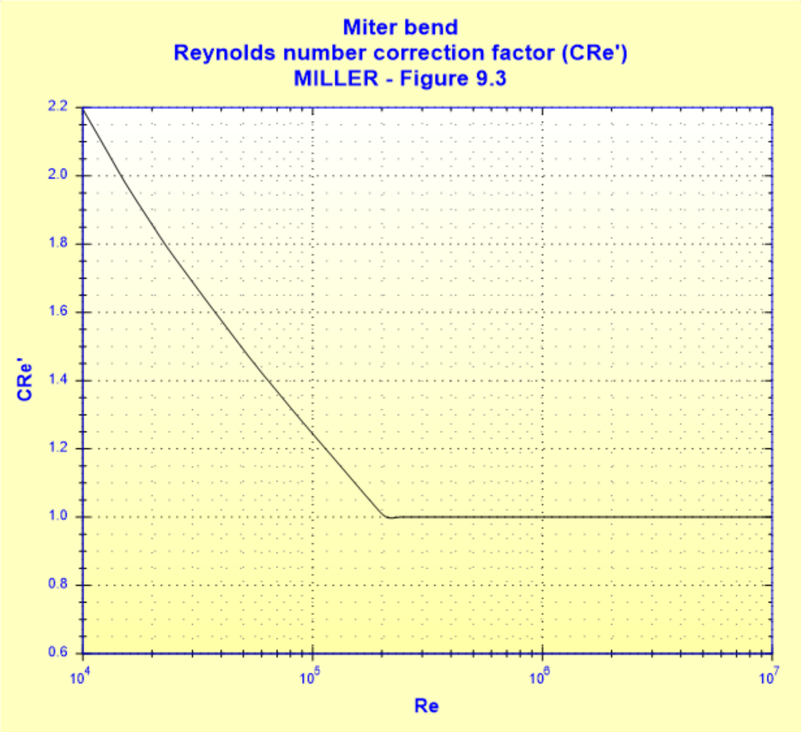



Reynolds number correction factor:

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

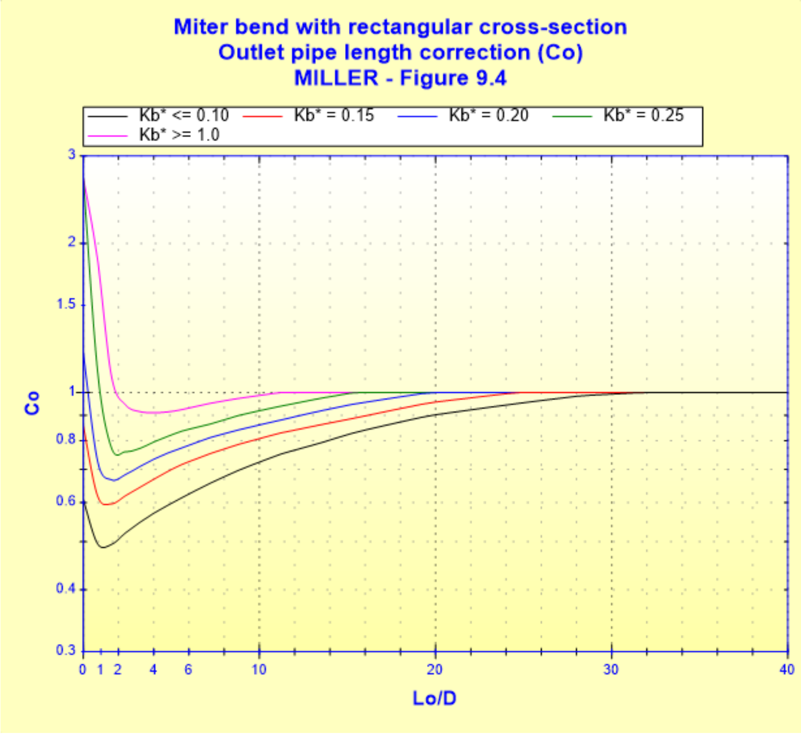
with:

$$C'_{Re} = f(\mathrm{Re})$$ ([1] 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 Co is equal to unity.

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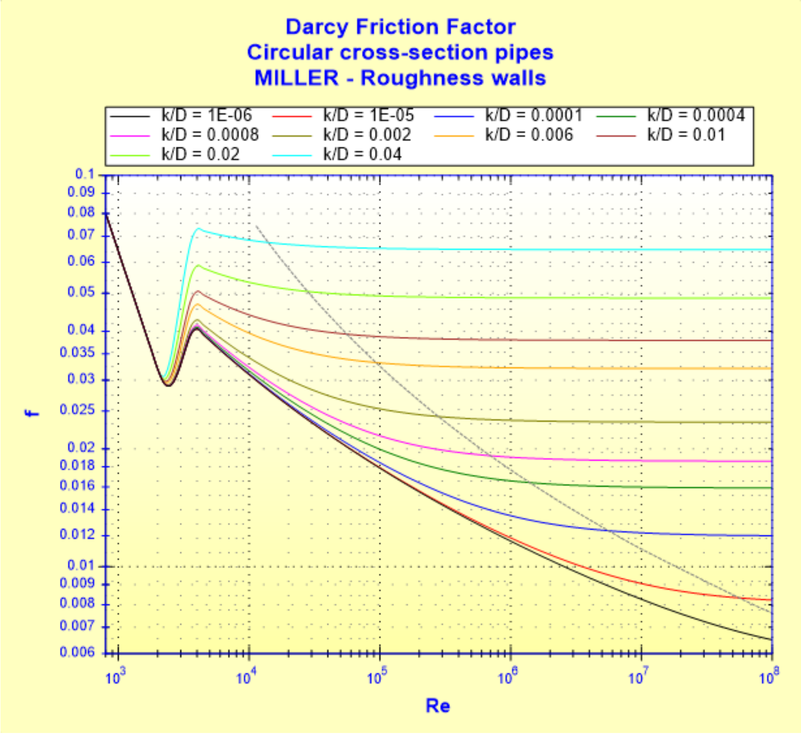
Darcy friction factor:

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

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

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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

- $\theta_b > 45$:

$$C_f = 1$$

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Corrected loss coefficient:

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

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

$$K = K_b$$

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Total pressure loss (Pa):

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

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Total head loss of fluid (m):

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

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Hydraulic power loss (W):

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

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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

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**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 () |
| $\theta_b$ | 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) () |
| $\Delta P$ | Total pressure loss (Pa) |
| $\Delta H$ | Total head loss of fluid (m) |
| Wh | Hydraulic power loss (W) |
| $L_{eq}$ | Straight length of equivalent pressure loss (m) |
| | |
| $\rho$ | Fluid density ($kg/m^3$) |
| $\nu$ | Fluid kinematic viscosity ($m^2/s$) |
| g | Gravitational acceleration ($m/s^2$) |

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**Validity range:**

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

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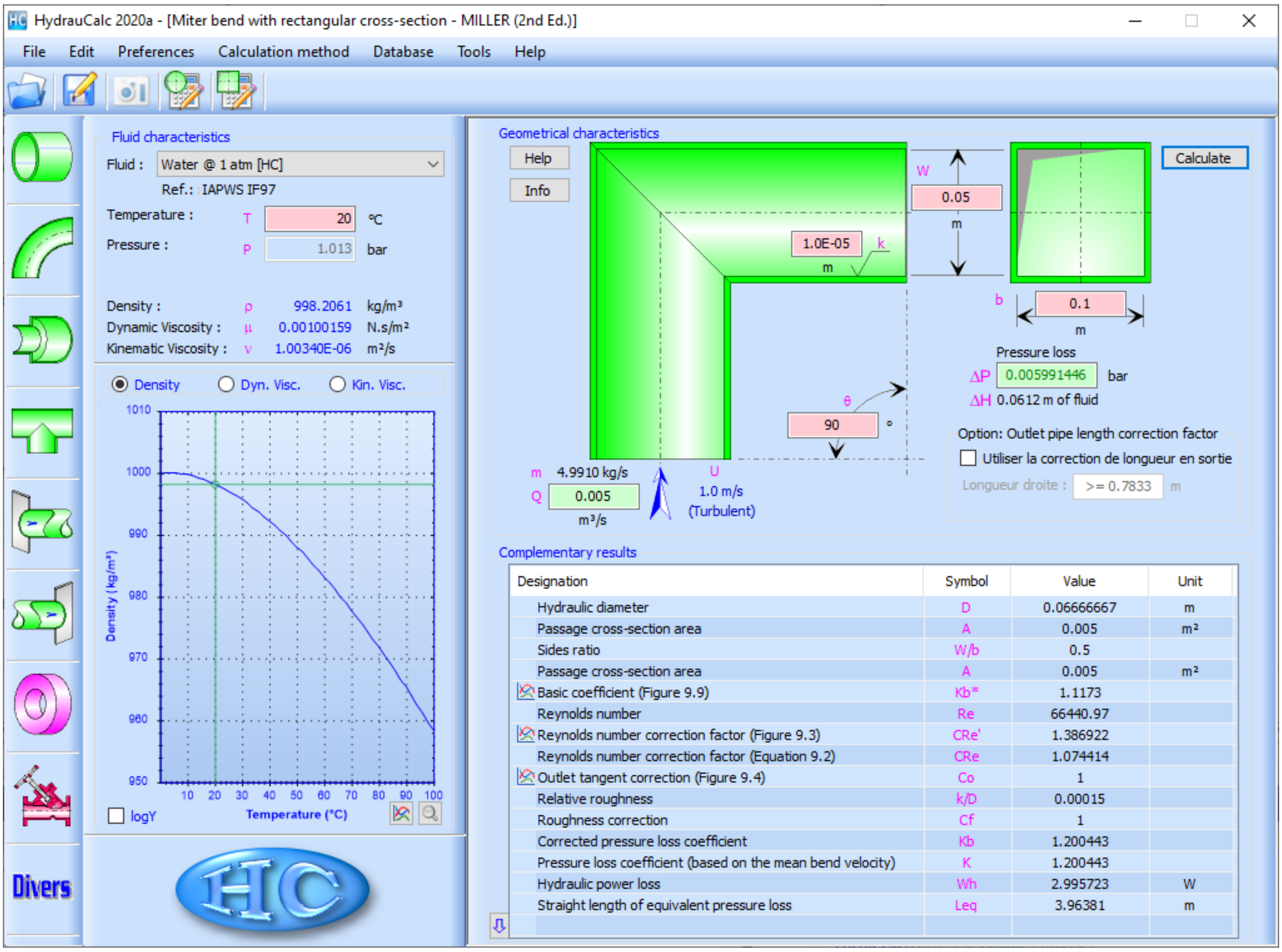
**Example of application:**




## References:

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