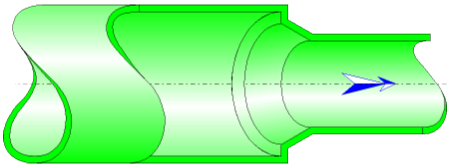
# Sudden Contraction Bevelled
# Circular Cross-Section
# (Pipe Flow - Guide)



**Model description:**

This model of component calculates the minor head loss (pressure drop) generated by the flow in a sudden contraction bevelled.

The head loss by friction in the inlet and outlet piping is not taken into account in this component.

**Model formulation:**

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Ratio of small to large diameter:

$$\beta = \frac{d_2}{d_1}$$

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Top angle of cone (°):

$$\alpha = 2 \cdot \tan^{-1}\left(\frac{d_0 - d_2}{2 \cdot l}\right)$$

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Major cross-sectional area (m²):

$$A_1 = \pi \cdot \frac{d_1^2}{4}$$

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Minor cross-sectional area (m²):

$$A_2 = \pi \cdot \frac{d_2^2}{4}$$

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Mean velocity in major diameter (m/s):

$$V_1 = \frac{Q}{A_1}$$

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Mean velocity in minor diameter (m/s):

$$V_2 = \frac{Q}{A_2}$$

Mass flow rate (kg/s):

$$G = Q \cdot \rho$$

Reynolds number in major diameter:

$$N_{Re_1} = \frac{V_1 \cdot d_1}{\nu}$$

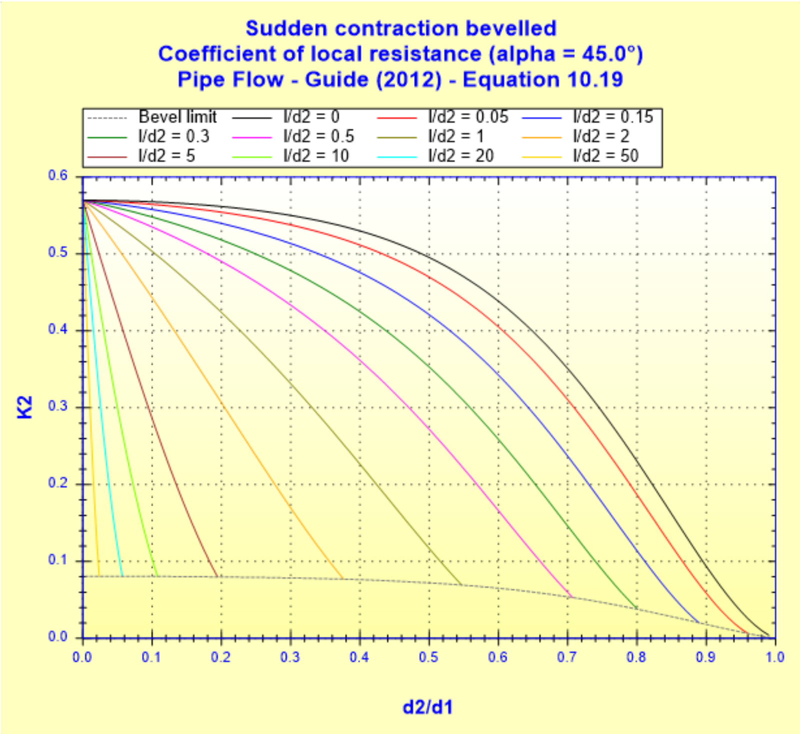
Reynolds number in minor diameter:

$$N_{Re_2} = \frac{V_2 \cdot d_2}{\nu}$$

Local resistance coefficient ($N_{Re} \geq 10^4$):

$$K_2 = 0.0696 \cdot \left[1 + C_B \cdot \left(\sin\left(\frac{\alpha}{2}\right) - 1\right)\right] \cdot \left(1 - \beta^5\right) \cdot \lambda^2 + (\lambda - 1)^2$$

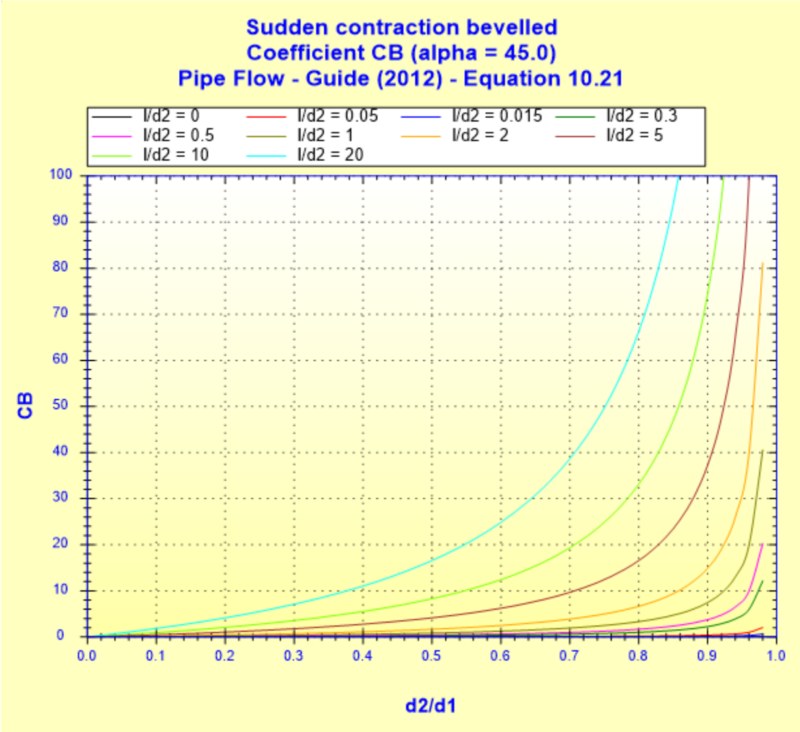
([1] equation 10.19)




With:

$$C_B = \frac{l}{d_2} \cdot \frac{2 \cdot \beta \cdot \tan\left(\frac{\alpha}{2}\right)}{1 - \beta}$$

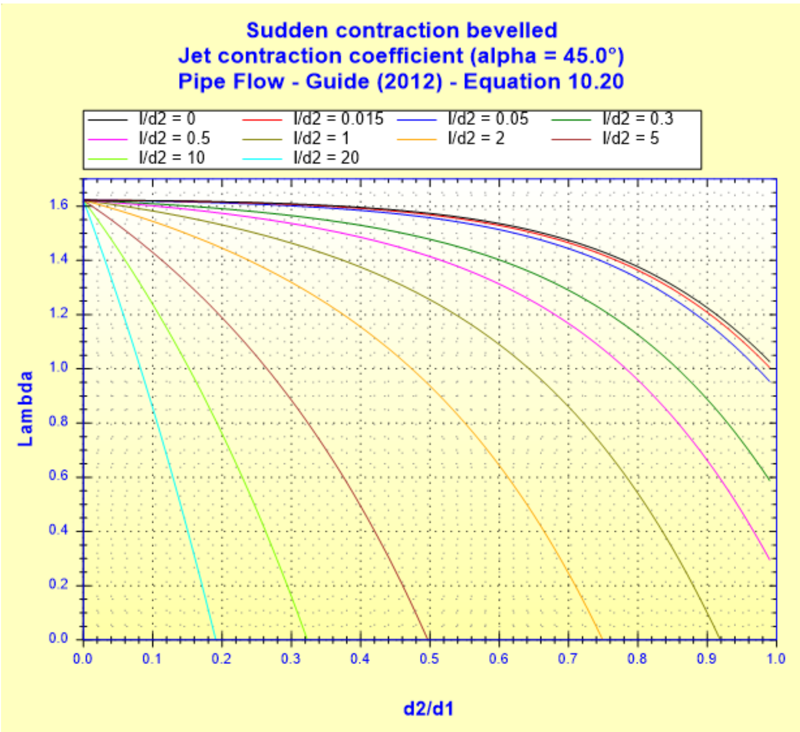
([1] equation 10.21)




And:

$$\lambda = 1 + 0.622 \cdot \left[ 1 + C_B \cdot \left( \left( \frac{\alpha}{180} \right)^{4/5} - 1 \right) \right] \cdot \left( 1 - 0.215 \cdot \beta^2 - 0.785 \cdot \beta^5 \right)$$

([1] equation 10.20)

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

$$K = K_2$$

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Total pressure loss (Pa):

$$\Delta P = K \cdot \frac{\rho_m \cdot v_2^{\,2}}{2}$$

Total head loss of fluid (m):

$$\Delta H = K \cdot \frac{v_2^2}{2 \cdot g}$$

Hydraulic power loss (W):

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

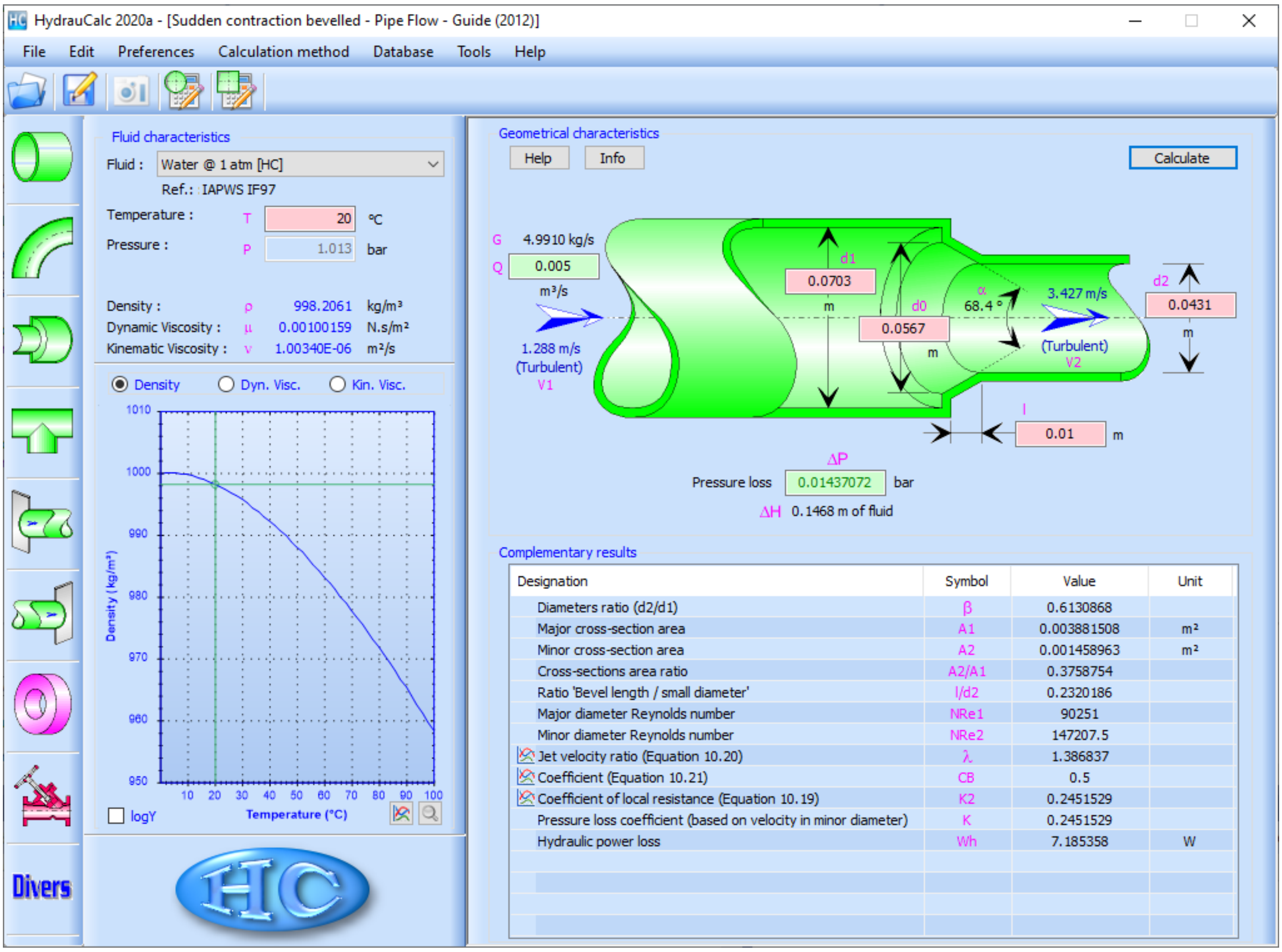
**Symbols, Definitions, SI Units:**

| | |
|---|---|
| $d_1$ | Major diameter (m) |
| $d_2$ | Minor diameter (m) |
| $d_0$ | Base diameter of the cone (m) |
| $\beta$ | Ratio of small to large diameter () |
| $A_1$ | Major cross-sectional area (m²) |
| $A_2$ | Minor cross-sectional area (m²) |
| Q | Volume flow rate (m³/s) |
| G | Mass flow rate (kg/s) |
| $V_1$ | Mean velocity in major diameter (m/s) |
| $V_2$ | Mean velocity in minor diameter (m/s) |
| $NRe_1$ | Reynolds number in major diameter () |
| $NRe_2$ | Reynolds number in minor diameter () |
| $K_2$ | Local resistance coefficient () |
| $C_B$ | Ratio of bevel length l to the length of a conical contraction of corresponding diameter ratio and included angle () |
| $\lambda$ | Jet contraction coefficient () |
| K | Total pressure loss coefficient (based on mean velocity in minor diameter) () |
| $\Delta P$ | Total pressure loss (Pa) |
| $\Delta H$ | Total head loss of fluid (m) |
| Wh | Hydraulic power loss (W) |
| $\rho_m$ | Fluid density (kg/m³) |
| $\nu$ | Fluid kinematic viscosity (m²/s) |
| g | Gravitational acceleration (m/s²) |

**Validity range:**

- turbulent flow regime in minor diameter ($NRe_2 \geq 10^4$)

**Example of application:**




**References:**

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