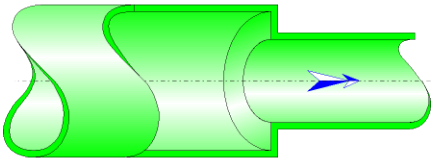
# Sudden Contraction Sharp
# Circular Cross-Section
# (Pipe Flow - Guide)



**Model description:**

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

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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Major cross-sectional area ($m^2$):

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

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Minor cross-sectional area ($m^2$):

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

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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):

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

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Mass flow rate (kg/s):

$$G = Q \cdot \rho$$

Reynolds number in major diameter:

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

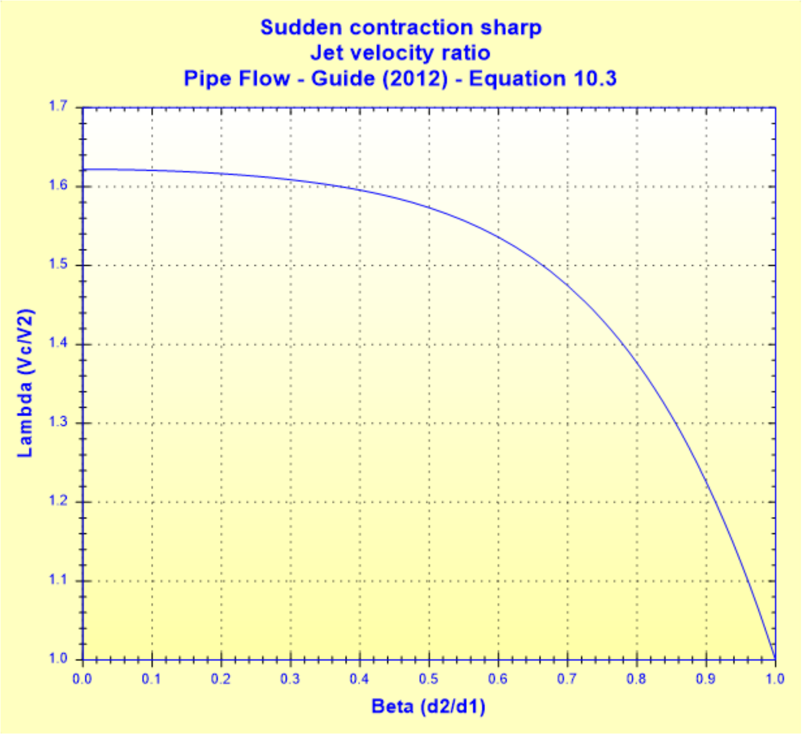
Reynolds number in minor diameter:

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

Jet velocity ratio:

$$\lambda = 1 + 0.622 \cdot \left(1 - 0.215\beta^2 - 0.785\beta^5\right)$$

([1] equation 10.3)



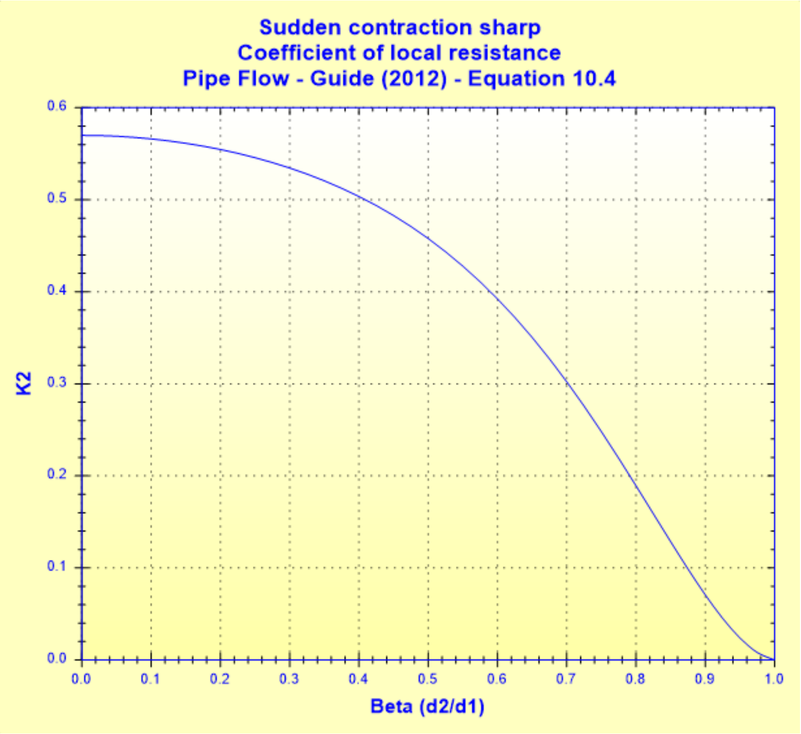

Velocity in vena contracta:

$$V_c = V_2 \cdot \lambda$$

Local resistance coefficient ($NRe_2 \geq 10^4$):

$$K_2 = 0.0696 \cdot \left(1 - \beta^5\right) \cdot \lambda^2 + (\lambda - 1)^2$$

([1] equation 10.4)

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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):

$$\Delta P = K \cdot \frac{\rho_m \cdot V_2^{\,2}}{2}$$

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Total head loss of fluid (m):

$$\Delta H = K \cdot \frac{V_2^{\,2}}{2 \cdot g}$$

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Hydraulic power loss (W):

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

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**Symbols, Definitions, SI Units:**

| | |
|---|---|
| $d_1$ | Major diameter (m) |
| $d_2$ | Minor diameter (m) |
| $\beta$ | Ratio of small to large diameter () |
| $A_1$ | Major cross-sectional area ($m^2$) |
| $A_2$ | Minor cross-sectional area ($m^2$) |
| $Q$ | Volume flow rate ($m^3/s$) |
| $G$ | 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 () |
| $V_c$ | Mean velocity in vena contracta (m/s) |

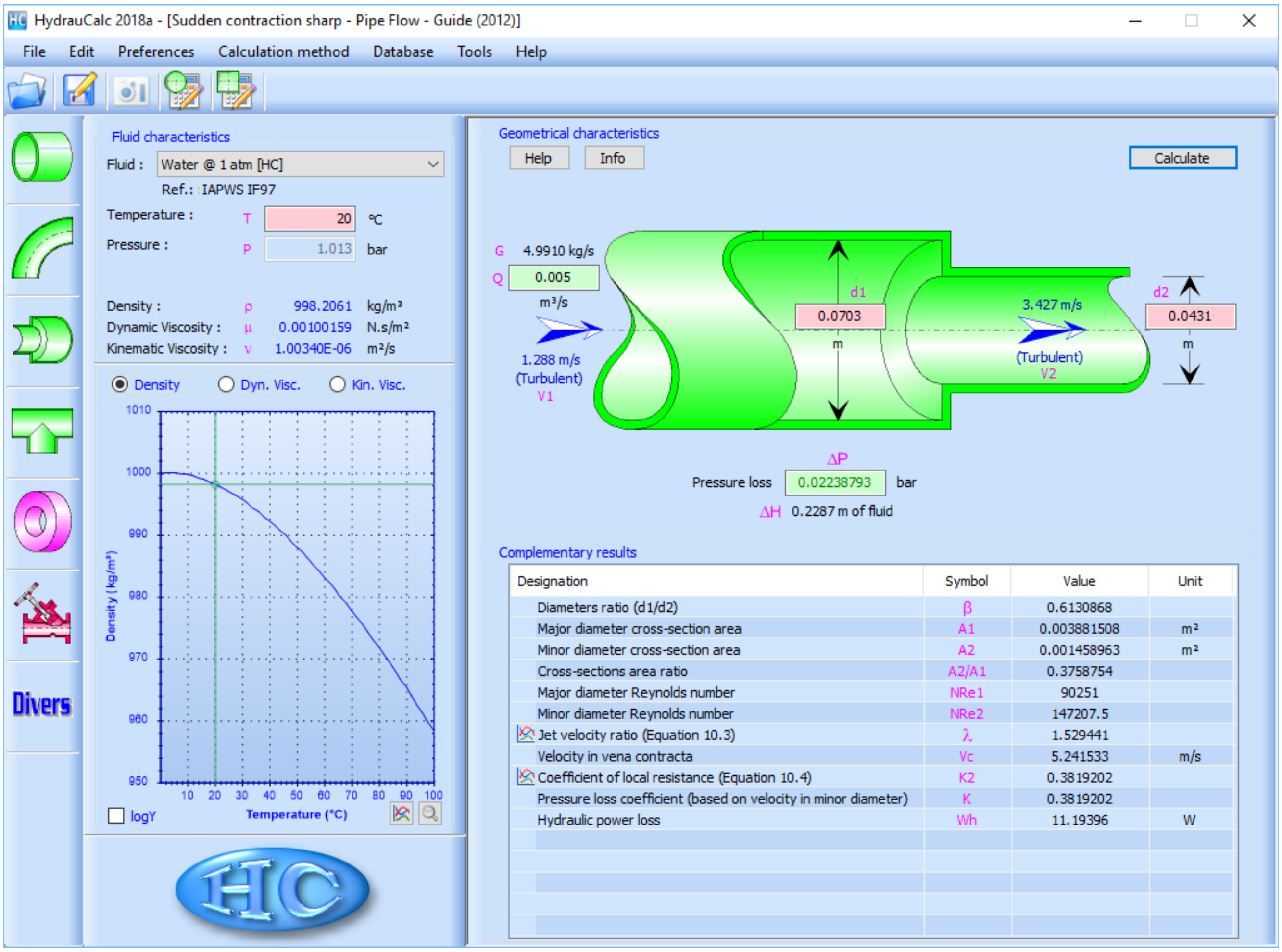
$\lambda$ Jet velocity ratio ()
$K_2$ Local resistance coefficient ()
$K$ Total pressure loss coefficient (based on mean velocity in minor diameter) ()
$\Delta P$ Total pressure loss (Pa)
$\Delta H$ Total head loss of fluid (m)
$Wh$ Hydraulic power loss (W)

$\rho_m$ Fluid density ($kg/m^3$)
$\nu$ Fluid kinematic viscosity ($m^2/s$)
$g$ Gravitational acceleration ($m/s^2$)

**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)