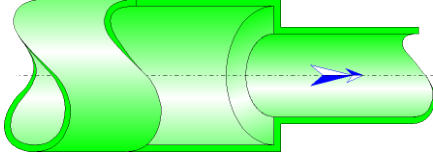




## Sudden Contraction Sharp Circular Cross-Section (MILLER)



### 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:

---

Major cross-sectional area (m<sup>2</sup>):

$$A_1 = \pi \cdot \frac{D_1^2}{4}$$

---

Minor cross-sectional area (m<sup>2</sup>):

$$A_2 = \pi \cdot \frac{D_2^2}{4}$$

---

Mean velocity in major diameter (m/s):

$$U_1 = \frac{Q}{A_1}$$

---

Mean velocity in minor diameter (m/s):

$$U_2 = \frac{Q}{A_2}$$

---

Mass flow rate (kg/s):

$$G = Q \cdot \rho$$

---

Reynolds number in major diameter:

$$Re_1 = \frac{U_1 \cdot D_1}{\nu}$$

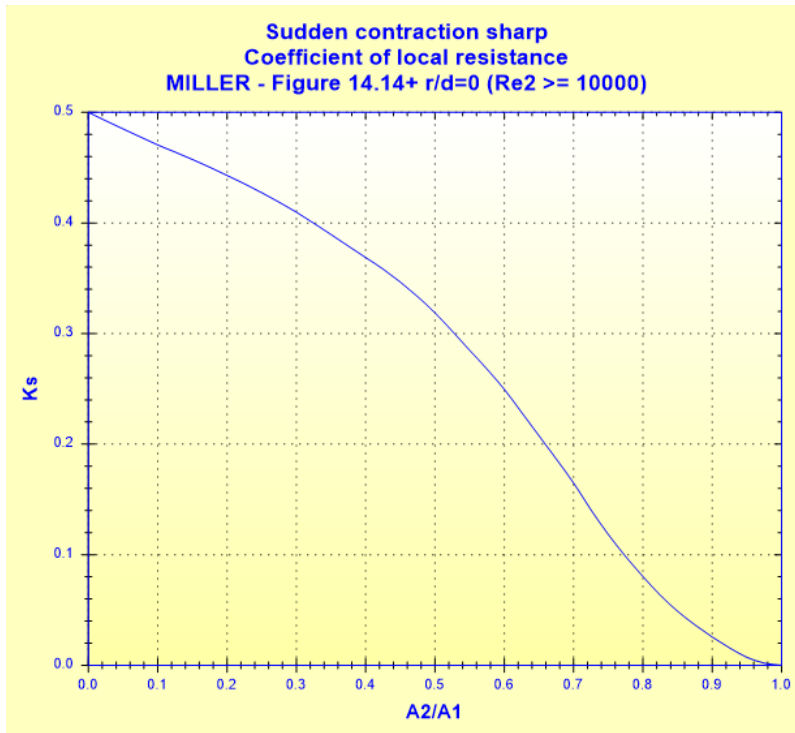
Reynolds number in minor diameter:

$$Re_2 = \frac{U_2 \cdot D_2}{\nu}$$

Local resistance coefficient :

$$K_s = f\left(\frac{A_2}{A_1}\right)$$

([1] figure 14.14+ r/d=0)



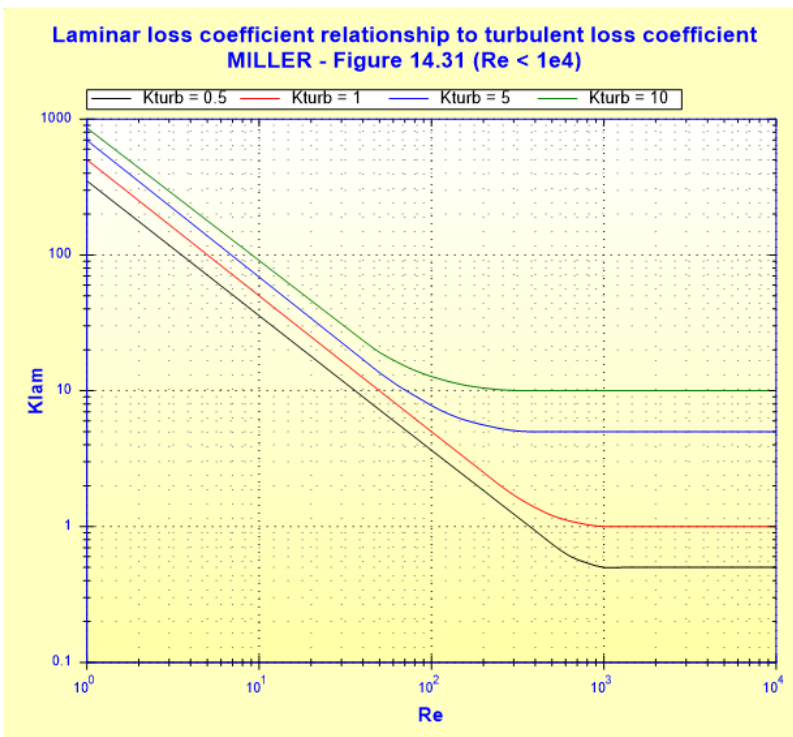
■  $Re_2 < 10^4$

$$K_{lam} = f(K_{turb}, Re_2)$$

([1] figure 14.31)

where:

$K_{turb}$  is the local resistance coefficient in turbulent regime ( $K_s$  for  $Re_2 = 10^4$  - figure 14.14+ r/d=0)



Reynolds Number Correction ( $Re_2 < 10^4$ ):

$$C_{Re} = \frac{K_{lam}}{K_{turb}}$$

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

- turbulent flow ( $Re_2 \geq 10^4$ ):

$$K = K_s$$

- laminar flow ( $Re_2 < 10^4$ ):

$$K = K_{lam}$$

Total pressure loss (Pa):

$$\Delta P = K \cdot \frac{\rho \cdot U_2^2}{2}$$

Total head loss of fluid (m):

$$\Delta H = K \cdot \frac{U_2^2}{2 \cdot g}$$

Hydraulic power loss (W):

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

**Symbols, Definitions, SI Units:**

$D_1$	Major diameter (m)
$D_2$	Minor diameter (m)
$A_1$	Major cross-sectional area (m <sup>2</sup> )

$A_2$	Minor cross-sectional area ( $m^2$ )
$Q$	Volume flow rate ( $m^3/s$ )
$G$	Mass flow rate ( $kg/s$ )
$U_1$	Mean velocity in major diameter ( $m/s$ )
$U_2$	Mean velocity in minor diameter ( $m/s$ )
$Re_1$	Reynolds number in major diameter ( )
$Re_2$	Reynolds number in minor diameter ( )
$K_s$	Local resistance coefficient for $Re_2 \geq 10^4$ ( )
$K_{turb}$	Local resistance coefficient for $Re_2 = 10^4$ ( )
$K_{lam}$	Local resistance coefficient for $Re_2 < 10^4$ ( )
$C_{Re}$	Reynolds number correction for $Re_2 < 10^4$ ( )
$K$	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)
$W_h$	Hydraulic power loss (W)
$\rho$	Fluid density ( $kg/m^3$ )
$\nu$	Fluid kinematic viscosity ( $m^2/s$ )
$g$	Gravitational acceleration ( $m/s^2$ )

---

#### Validity range:

- any flow regime: laminar and turbulent

note: for Reynolds number " $Re_2$ " lower than  $10^4$ , and coefficients " $K_{turb}$ " lower than 0.5 or greater than 10, the laminar pressure loss coefficient is extrapolated

---

#### Example of application:

HydrauCalc 2018a - [Sudden contraction sharp - 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:  $\rho$  998.2061 kg/m<sup>3</sup>  
Dynamic Viscosity:  $\mu$  0.00100159 N.s/m<sup>2</sup>  
Kinematic Viscosity:  $\nu$  1.00340E-06 m<sup>2</sup>/s

Density  Dyn. Visc.  Kn. Visc.

Geometrical characteristics

Help Info Calculate

Pressure loss  $\Delta P$  0.02220181 bar  
 $\Delta H$  0.2268 m of fluid

Complementary results

Designation	Symbol	Value	Unit
Diameters ratio	D2/D1	0.6130868	
Major diameter cross-section area	A1	0.003881508	m <sup>2</sup>
Minor diameter cross-section area	A2	0.001458963	m <sup>2</sup>
Cross-sections area ratio	A2/A1	0.3758754	
Major diameter Reynolds number	Re1	90251	
Minor diameter Reynolds number	Re2	147207.5	
Coefficient of local resistance (Fig. 14.14+ r/d=0)	Ks	0.3787451	
Pressure loss coefficient (based on velocity in minor diameter)	K	0.3787451	
Hydraulic power loss	Wh	11.1009	W

## References:

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