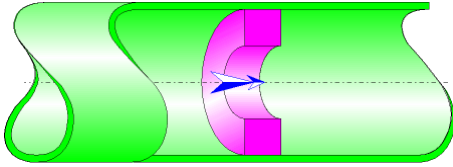




Thick-edged Orifice Circular Cross-Section (MILLER)



Model description:

This model of component calculates the minor head loss (pressure drop) generated by the flow in a thick-edged orifice.

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

Model formulation:

Pipe cross-sectional area (m²):

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

Orifice cross-sectional area (m²):

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

Mean velocity in pipe (m/s):

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

Mean velocity in orifice (m/s):

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

Mass flow rate (kg/s):

$$G = Q \cdot \rho$$

Reynolds number in pipe:

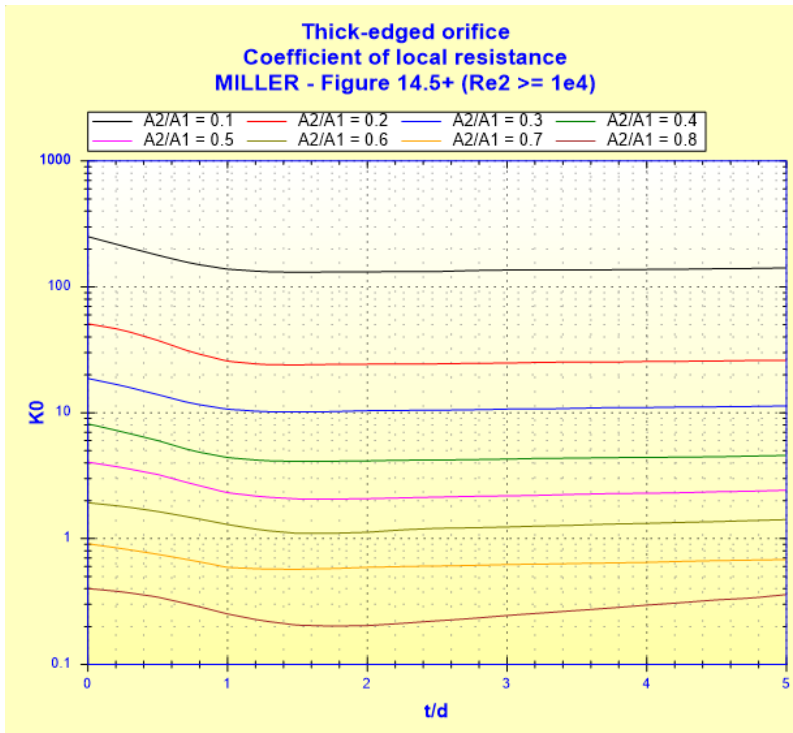
$$\text{Re}_1 = \frac{U \cdot D}{\nu}$$

Reynolds number in orifice:

$$\text{Re}_2 = \frac{u \cdot d}{\nu}$$

Local resistance coefficient:

$$K_0 = f\left(\frac{t}{d}, \frac{A_2}{A_1}\right) \quad ([1] \text{ figure 14.5+})$$



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

$$K = K_0$$

Total pressure loss (Pa):

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

Total head loss of fluid (m):

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

Hydraulic power loss (W):

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

Symbols, Definitions, SI Units:

D	Pipe internal diameter (m)
d	Orifice diameter (m)
A_1	Pipe cross-sectional area (m^2)
A_2	Orifice cross-sectional area (m^2)
Q	Volume flow rate (m^3/s)
G	Mass flow rate (kg/s)
U	Mean velocity in pipe (m/s)
u	Mean velocity in orifice (m/s)
Re_1	Reynolds number in pipe ()
Re_2	Reynolds number in orifice ()
t	Orifice thickness (m)
K_0	Local resistance coefficient ()
K	Total pressure loss coefficient (based on mean velocity in pipe) ()
ΔP	Total pressure loss (Pa)
ΔH	Total head loss of fluid (m)
Wh	Hydraulic power loss (W)
ρ	Fluid density (kg/m^3)
ν	Fluid kinematic viscosity (m^2/s)
g	Gravitational acceleration (m/s^2)

Validity range:

- turbulent flow regime in orifice ($Re_2 \geq 10^4$)
- stabilized flow upstream of the orifice

Example of application:

HydrauCalc 2018a - [Thick-edged orifice - 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. Kn. Visc.

Geometrical characteristics

Help Info Calculate

Complementary results

Designation	Symbol	Value	Unit
Pipe cross-section area	A1	0.003881508	m ²
Orifice cross-section area	A2	0.0009621127	m ²
Diameters ratio	d/D	0.4978663	
Cross-sections area ratio	A2/A1	0.2478708	
Thickness to orifice diameter ratio	t/d	0.2	
Pipe Reynolds number	Re1	90251	
Orifice Reynolds number	Re2	181275.6	
<input checked="" type="checkbox"/> Coefficient of local resistance (Fig. 14.5+)	K0	28.60365	
Pressure loss coefficient (based on the mean pipe velocity)	K	28.60365	
Hydraulic power loss	Wh	118.4461	W

References:

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