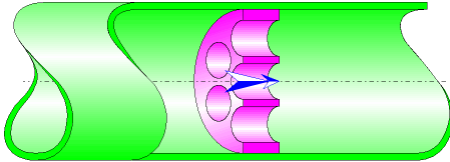




## Thick-edged Grid Circular Cross-Section (MILLER)



### Model description:

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

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 (m<sup>2</sup>):

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

---

Cross-section area of one hole (m<sup>2</sup>):

$$a_2 = \pi \cdot \frac{d^2}{4}$$

---

Clear cross-sectional area of the grid (m<sup>2</sup>):

$$A_2 = a_2 \cdot N$$

---

Equivalent section orifice diameter (m):

$$d' = \sqrt{\frac{4 \cdot A_2}{\pi}} \quad ([1] \text{ figure 5.72})$$

---

Equivalent section orifice thickness (m):

$$t' = t \cdot \frac{d'}{d} \quad ([1] \text{ figure 5.72})$$

---

Mean velocity in pipe (m/s):

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

Mean velocity in holes (m/s):

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

Mass flow rate (kg/s):

$$G = Q \cdot \rho$$

Reynolds number in pipe:

$$Re_1 = \frac{U \cdot D}{\nu}$$

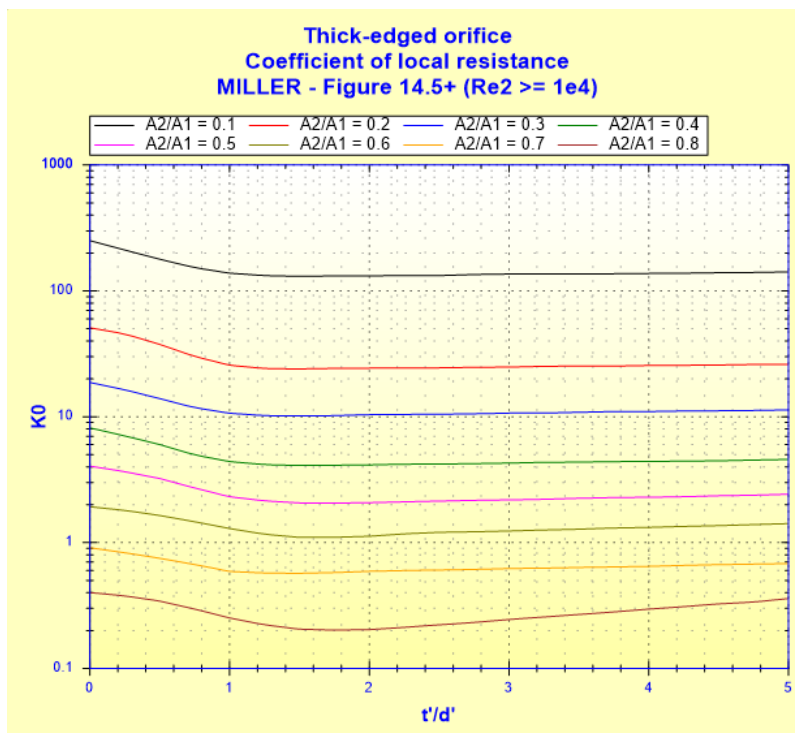
Reynolds number in holes:

$$Re_2 = \frac{u \cdot d}{\nu}$$

Local resistance coefficient:

$$K_0 = f\left(\frac{t'}{d'}, \frac{A_2}{A_1}\right)$$

([1] 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)
A <sub>1</sub>	Pipe cross-sectional area (m <sup>2</sup> )
d	Hole diameter (m)
a <sub>2</sub>	Cross-section area of one hole (m <sup>2</sup> )
N	Holes number ( )
A <sub>2</sub>	Clear cross-sectional area of the grid (m <sup>2</sup> )
d'	Equivalent section orifice diameter (m)
t	Grid thickness (m)
t'	Equivalent section orifice thickness (m)
Q	Volume flow rate (m <sup>3</sup> /s)
G	Mass flow rate (kg/s)
U	Mean velocity in pipe (m/s)
u	Mean velocity in holes (m/s)
Re <sub>1</sub>	Reynolds number in pipe ( )
Re <sub>2</sub>	Reynolds number in holes ( )
K <sub>0</sub>	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 <sup>3</sup> )
ν	Fluid kinematic viscosity (m <sup>2</sup> /s)
g	Gravitational acceleration (m/s <sup>2</sup> )

---

**Validity range:**

- turbulent flow regime in holes (Re<sub>2</sub> ≥ 10<sup>4</sup>)
- stabilized flow upstream of the grid

---

**Example of application:**

HydrauCalc 2019a - [Thick-edged grid - 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.  Kin. Visc.

Geometrical characteristics

Help Info Grid plot Calculate

Pressure loss  $\Delta P$  0.1206315 bar  
 $\Delta H$  1.2323 m of fluid

Complementary results

Designation	Symbol	Value	Unit
Pipe cross-section area	A1	0.003881508	m <sup>2</sup>
One hole cross-section area	a2	0.0001767146	m <sup>2</sup>
Total holes cross-section area	A2	0.001237002	m <sup>2</sup>
Diameters ratio	d/D	0.2133713	
Cross-sections area ratio	A2/A1	0.3186911	
Equivalent section orifice diameter	d'	0.03968627	
Equivalent section orifice thickness	t'	0.01852026	
Thickness to equivalent orifice diameter ratio	t'/d'	0.4666667	
Pipe Reynolds number	Re1	90251	
Holes Reynolds number	Re2	60425.19	
<input checked="" type="checkbox"/> Coefficient of local resistance (Fig. 14.5+)	K0	14.56571	
Pressure loss coefficient (based on the mean pipe velocity)	K	14.56571	
Hydraulic power loss	Wh	60.31575	W

## References:

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