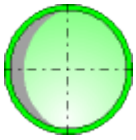
General Head Drop Formulations for Steady State and Incompressible Fluid Circular Cross-Section



Model description:

This component model brings together the main formulas relating to the calculation of pressure drops for incompressible fluids. These formulas apply to pipes of circular section and for stabilized flows.

Model formulation:

Cross-section area (m^2):

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

Mean velocity (m/s):

$$V = \frac{Qv}{S}$$

Mass flow rate (kg/s):

$$Qm = Qv \cdot \rho$$

Reynolds number:

$$Re = \frac{V \cdot d}{\nu}$$

Flow coefficient Av (m^2):

$$Av = Qv \cdot \sqrt{\frac{\rho}{\Delta P}}$$

or:

$$Av = S \cdot \sqrt{\frac{2}{\zeta}}$$

Flow coefficient Cv (gal/min US):

$$Cv = 41650 \cdot Av$$

or:

$$Cv = Qv_{[gpm\ US]} \cdot \sqrt{\frac{G_{[-]}}{\Delta P_{[psi]}}}$$

where:

Qv	Volume flow rate (gal/min US)
ΔP	Pressure loss (psi)
G	Specific gravity of fluid (1 for water at 60°F)

Flow coefficient Kv (m³/h):

$$Kv = 36023 \cdot Av$$

or:

$$Kv = Qv_{[m^3/h]} \cdot \sqrt{\frac{G_{[-]}}{\Delta P_{[bar]}}}$$

where:

Qv	Volume flow rate (m³/h)
ΔP	Pressure loss (bar)
G	Specific gravity of fluid (1 for water at 15°C)

Pressure loss coefficient ():

$$\zeta = \lambda \cdot \frac{L}{d}$$

Pressure loss (Pa):

$$\Delta P = \zeta \cdot \frac{\rho \cdot V^2}{2}$$

Head loss of fluid (m):

$$\Delta h = \zeta \cdot \frac{V^2}{2 \cdot g}$$

Hydraulic power loss (W):

$$Wh = \Delta P \cdot Qv$$

Symbols, Definitions, SI Units:

d	Pipe internal diameter (m)
S	Cross-sectional area (m²)
Qv	Volume flow rate (m³/s)
Qm	Mass flow rate (kg/s)
V	Mean velocity (m/s)
Re	Reynolds number ()
Av	Flow coefficient (m²)
Cv	Flow coefficient (USG/min)

Kv	Flow coefficient (m^3/h)
ζ	Pressure loss coefficient ()
λ	Friction coefficient ()
L	Straight length (m)
ΔP	Pressure loss (Pa)
Δh	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:

- Equations for the flow coefficients Av, Cv and Kv are valid only for turbulent flows.

Example of input data and results: