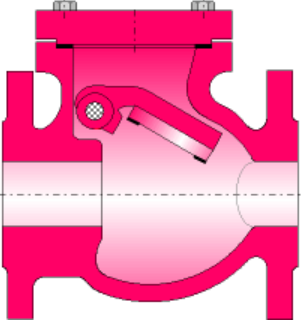




Swing Check Valve (Manufacturer defined)



Model description:

This model of component calculates the minor head loss (pressure drop) generated by the flow in a swing check valve installed in a straight pipe.

The swing check valve characteristics are defined by valves manufacturers. The pressure drop of the valve is characterized by a flow coefficient "Kvs", "Cvs" or "Avs" at full opening. The model also takes into account the partial opening of the valve, the opening is partial when the pressure at the inlet of the valve is between the pressure at the begin of opening and the minimum pressure for full opening.

Model formulation:

Cross-sectional area (m²):

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

Mean velocity (m/s):

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

Mass flow rate (kg/s):

$$G = Q \cdot \rho$$

Reynolds number:

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

● check valve at full opening:

Local resistance coefficient:

$$K_{turb} = \frac{2 \cdot A^2}{\left(\frac{Kvs}{36023}\right)^2}$$

$$K_{turb} = \frac{2 \cdot A^2}{\left(\frac{Cvs}{41650}\right)^2}$$

$$K_{turb} = \frac{2 \cdot A^2}{Avs^2}$$

Total pressure loss coefficient (based on mean velocity):

$$K = K_{turb}$$

Total pressure loss (Pa):

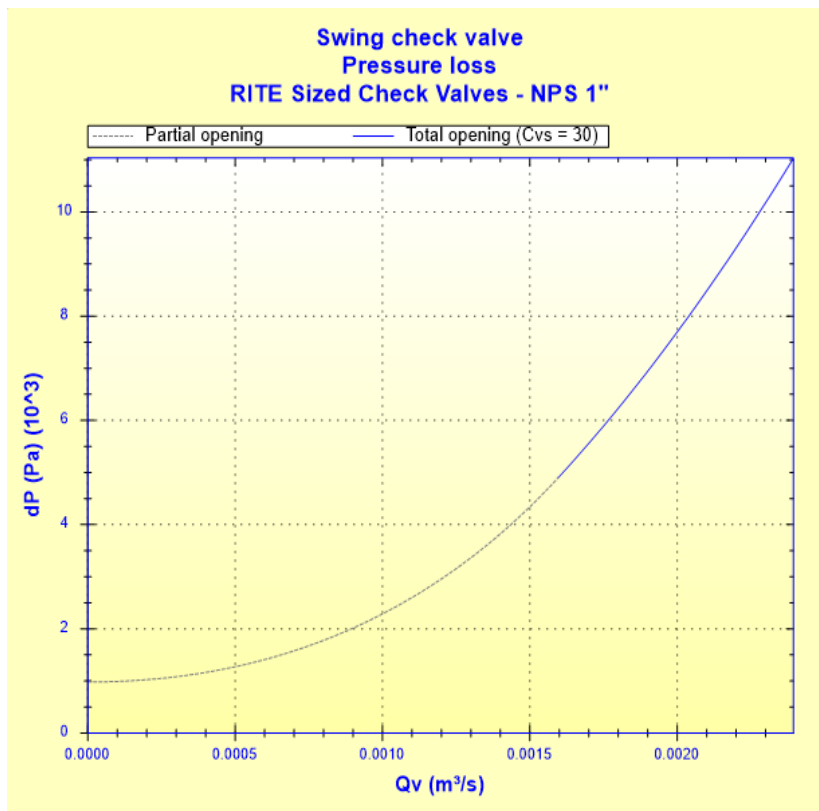
$$\Delta P = K \cdot \frac{\rho \cdot U^2}{2}$$

-
- check valve at partial opening:

The pressure drop at partial opening is estimated by curvilinear interpolation between the pressure at the begin of opening "Pbo" and the minimum pressure for full opening "Pto".

$$\Delta P = f(Qv, Pbo, Pto)$$

The figure below shows an example of the pressure drop of a check valve with partial opening.



Flow coefficient:

$$Kv = 36023 \cdot Q \cdot \sqrt{\frac{\rho}{\Delta P}}$$

$$Cv = 41650 \cdot Q \cdot \sqrt{\frac{\rho}{\Delta P}}$$

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

Total pressure loss coefficient (based on mean velocity):

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

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	Internal diameter (m)
A	Cross-sectional area (m ²)
Q	Volume flow rate (m ³ /s)
U	Mean velocity (m/s)

G	Mass flow rate (kg/s)
Re	Reynolds number ()
α	Opening angle (°)
Kvs	Full opening flow coefficient (m ³ /h)
Cvs	Full opening flow coefficient (USG/min)
Avs	Full opening flow coefficient (m ²)
K_{turb}	Local resistance coefficient for $Re \geq 10^4$ ()
K	Total pressure loss coefficient (based on mean velocity) ()
ΔP	Total pressure loss (Pa)
Kv	Partial opening flow coefficient (m ³ /h)
Cv	Partial opening flow coefficient (USG/min)
Av	Partial opening flow coefficient (m ²)
P_{bo}	Pressure at the begin of opening (Pa)
P_{to}	Minimum pressure for full opening (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:

- flow regime: turbulent

note: for laminar flow regime ($Re < 10^4$) and for operation in partial opening, the pressure loss coefficient "K" is estimated

Example of application:

HydrauCalc 2021b - [Swing check valve - Manufacturer - RITE - Check Valves (NPS 1"-60")]

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. Kin. Visc.

logY

Geometrical characteristics

RITE - Check Valves (NPS 1"-60")
NPS 1" - DN 25

Calculate
Help
Info

G 4.9910 kg/s
Q 0.005 m³/s
9.868 m/s (Turbulent)

Definition of partial opening

Define opening pressures

Begin of opening 0.00981 bar
Total opening 0.04903 bar

Pressure loss 0.4810068 bar
4.9137 m of fluid

Complementary results

Designation	Symbol	Value	Unit
Pipe cross-section area	A	0.0005067075	m ²
Reynolds number	Re	249789.2	
Fully open flow coefficient 'Cvs	Cvs	30	
Flow coefficient 'Cv	Cv	30	
Coefficient of local resistance	K _{turb}	0.9897732	
Pressure loss coefficient (based on the mean valve velocity)	K	0.9897732	
<input checked="" type="checkbox"/> Pressure loss	ΔP	0.4810068	bar
Hydraulic power loss	Wh	240.5034	W

References:

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