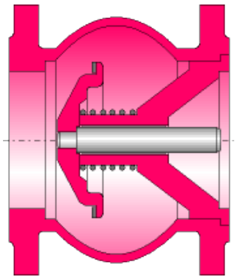
Swing Check Valve
(User defined)



Model description:

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

The swing check valve characteristics are defined by the user. 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 (m^2):

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

Mean velocity (m/s):

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

Mass flow rate (kg/s):

$$G = Q \cdot \rho$$

Reynolds number:

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

- check valve at full opening:

Local resistance coefficient:

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

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

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

Total pressure loss coefficient (based on mean velocity):

$$K = K_{turb}$$

Total pressure loss (Pa):

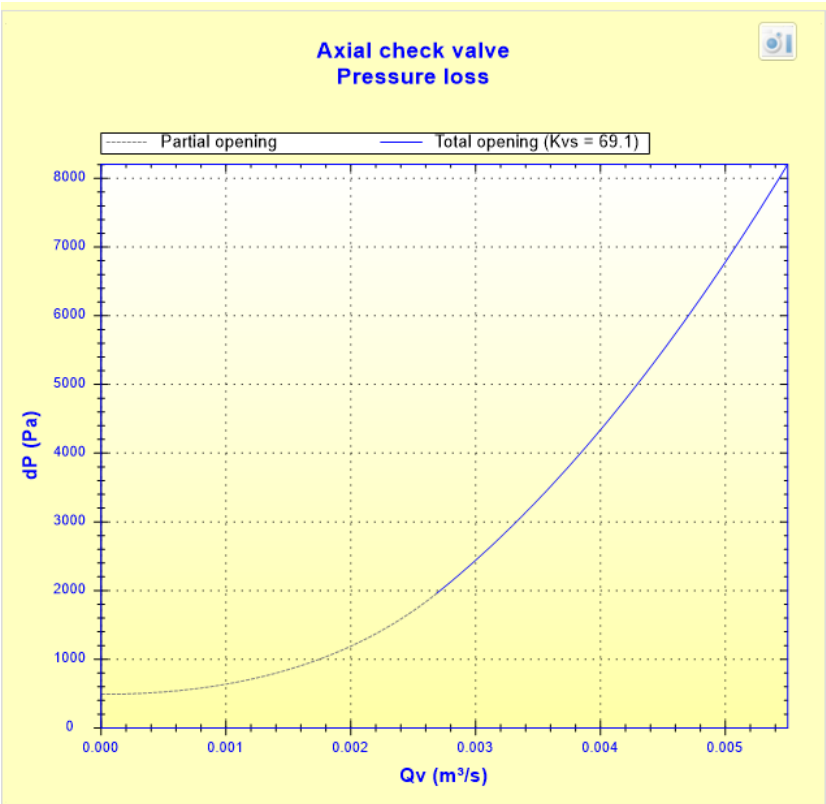
$$\Delta P = K \cdot \frac{\rho \cdot U^2}{2}$$

- 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".

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

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)
Pbo	Pressure at the begin of opening (Pa)
Pto	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: