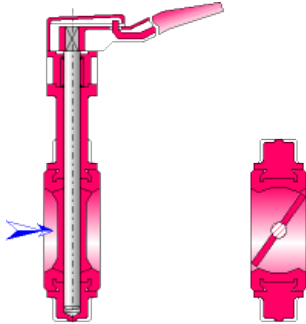# Butterfly valve
(MILLER)
Type C

Model description:

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

Model formulation:

Cross-sectional area (m²):

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

Mean velocity (m/s):

$$U = \frac{Q}{A}$$
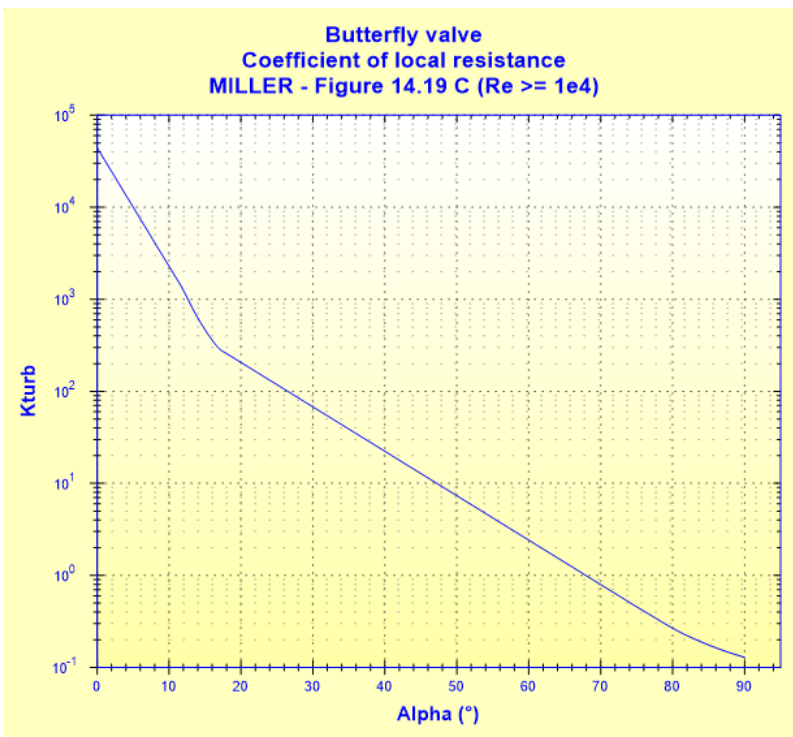
Mass flow rate (kg/s):

$$G = Q \cdot \rho$$

Reynolds number:

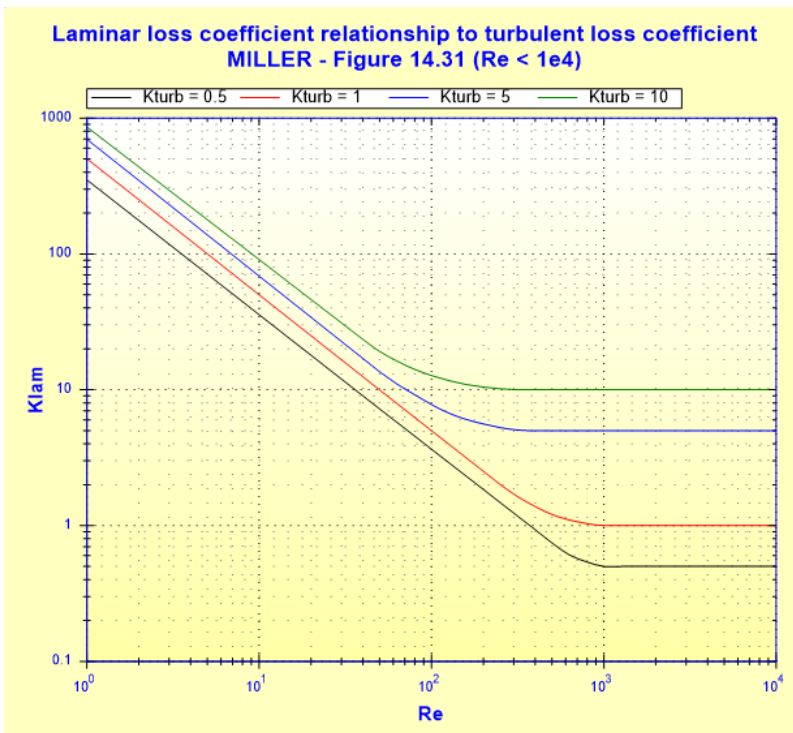$$Re = \frac{U \cdot D}{v}$$

Local resistance coefficient:

- Re ≥ 10⁴ (turbulent flow)

$$K_{turb} = f(\alpha)$$ ([1] figure 14.19 C)

Butterfly valve
Coefficient of local resistance
MILLER - Figure 14.19 C (Re >= 1e4)

- Re $< 10^4$ (laminar flow)

$$K_{lam} = f(K_{turb}, \text{Re})$$

([1] figure 14.31)

Laminar loss coefficient relationship to turbulent loss coefficient
MILLER - Figure 14.31 (Re < 1e4)

Kturb = 0.5   Kturb = 1   Kturb = 5   Kturb = 10

Reynolds Number Correction (Re $< 10^4$):

$$C_{\text{Re}} = \frac{K_{lam}}{K_{turb}}$$

Total pressure loss coefficient (based on mean velocity):

- turbulent flow (Re $\geq 10^4$):

$$K = K_{turb}$$

■ laminar flow (Re < 10^4):

$$K = K_{lam}$$

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	Internal diameter (m)
A	Cross-sectional area (m²)
Q	Volume flow rate (m³/s)
G	Mass flow rate (kg/s)
U	Mean velocity (m/s)
Re	Reynolds number ()
α	Opening angle (°)
K_{turb}	Local resistance coefficient for Re ≥ 10^4 ()
K_{lam}	Local resistance coefficient for Re < 10^4 ()
C_{Re}	Reynolds number correction for Re < 10^4 ()
K	Total pressure loss coefficient (based on mean velocity) ()
ΔP	Total pressure loss (Pa)
ΔH	Total head loss of fluid (m)
Wh	Hydraulic power loss (W)
ρ	Fluid density (kg/m³)
ν	Fluid kinematic viscosity (m²/s)
g	Gravitational acceleration (m/s²)

Validity range:

- any flow regime: laminar and turbulent

    note: for laminar flow regime (Re < 10^4), the pressure loss coefficient "K_{lam}" is estimated

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Example of application:

References:

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