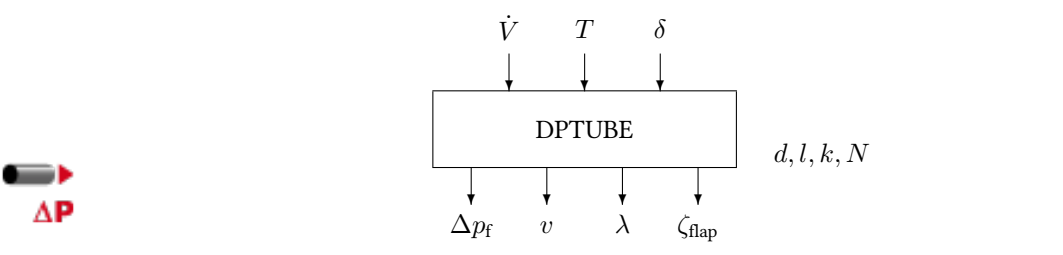


Block DPTUBE

The DPTUBE block calculates the pressure drop in a tube due to friction of an incompressible one-phase turbulent tubular flow from the empirical Colebrook-White equation. It is possible to include a flap in the tube.



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Function	st0007
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Group	S

Inputs

- 1 Volume flow $\dot{V}$ / $\text{m}^3 \text{h}^{-1}$
- 2 Air temperature T / $^{\circ}\text{C}$
- 3 Flap angle δ / $^{\circ}$ (Open: $\delta = 0^{\circ}$. Closed: $\delta = 90^{\circ}$)

Outputs

- 1 Pressure drop Δp_f / Pa
- 2 Flow velocity v / m s^{-1}
- 3 Tube friction number λ / m s^{-1}
- 4 Zeta value of flap position ζ_{flap}

Parameters

- 1 Nominal tube diameter d / m
- 2 Length l / m
- 3 Tube roughness k / mm
- 4 Number of flaps N (either zero or one)

Strings

None

Tube type	Roughness k / mm
Smooth tubes (brass etc.)	0.0015
PVC and PE tubes	0.007
Asbestos-cement tubes (new)	0.05 ... 0.1
Steel tubes	0.045
Galvanised steel tubes	0.15
Steel tubes, light rust	0.15 ... 1.0
Steel tubes, heavy rust	1.0 ... 3.0
Cast iron tubes	0.4 ... 0.6
Cast iron tubes, asphaltic	0.125
Sheet metal channel, weltet	0.15
Flexible tubes	0.6 ... 0.8 ... > 2.0
Stonewalled channels	3.0 ... 5.0
Wooden channels	0.2 ... 1.0
Concrete channels, rough	1.0 ... 3.0

Table 1: Surface roughness of different tubes according to Recknagel.

Description The empirical Colebrook-White equation is given by

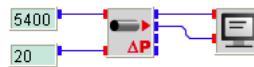
$$\frac{1}{\lambda} = -2 \log \left(\frac{2.51}{\text{Re} \sqrt{\lambda}} + \frac{k}{3.71 d} \right)$$

where λ denotes the tube friction coefficient, k the surface roughness of the tube, d the nominal tube diameter, and Re the Reynold's number $\text{Re} = vd/\nu$ with the flow velocity v and the viscosity of air ν . Hence, λ is a function of the Reynold's number and the relative surface roughness $\epsilon = k/d$. Some typical k -values are given in Table.

The pressure drop as function of tube length L and air density ρ is given by

$$\Delta p = \lambda \frac{L}{d} \rho \frac{v^2}{2}$$

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A tube with length 1 m and a diameter of 0.35 m is simulated with a tube roughness set to 0.15. No flap is assumed. The volume flow is set to 5400 m³/h at an air temperature of 20 °C as defined through two **CONST** blocks. The **SCREEN** block displays the pressure drop and the flow velocity.

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