



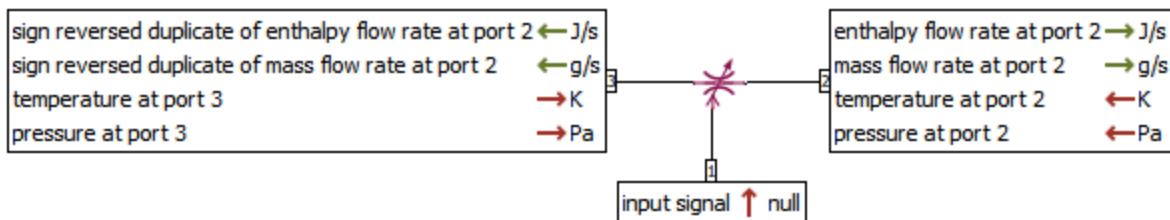
PNVO001 - modulated pneumatic orifice (constant flow coefficient)

Description

PNVO001 is a submodel of a pneumatic orifice with a variable area. A pressure in Pa and a temperature in K are input at each ports and a mass flow rate in g/s and an enthalpy flow rate in J/s are computed to be an output at both ports.

The orifice can be characterized either by a discharge coefficient $\backslash(C_q\backslash)$ and an area, or by a flow coefficient $\backslash(C_v\backslash)$ or $\backslash(K_v\backslash)$ [1].

Icon with external variables



Usage

Use PNVO001 for an orifice of variable area where you want to adjust the discharge coefficient.

Use the submodel [PNVO002](#) for a discharge coefficient given by the Perry's polynomial.

Parameter settings

The *gas type index* refers to the gas defined by the [PNGD00](#) icon put on the sketch.

The enumeration **flow coefficient setting** is used to select the characterization of the orifice between a flow coefficient $\backslash(C_q\backslash)$, $\backslash(C_v\backslash)$ or $\backslash(K_v\backslash)$:

- If the flow coefficient $\backslash(C_q\backslash)$ (or discharge coefficient) is chosen, the *orifice area at maximum opening* should be greater or equal than zero. Usually, $\backslash(C_q\backslash)$ is set to a value between 0.3 and 0.9.
- If $\backslash(C_v\backslash)$ or $\backslash(K_v\backslash)$ is chosen, the flow coefficient should be given at maximum opening of the orifice.

Physics and equations

Orifice opening

The fractional opening x_v is the input signal **res** at port 1 normalized with the function [dlimit](#) to be in range [0; 1].

The orifice area of the valve is given by:

$$area = x_v \cdot A_{\{max\}}$$

where $A_{\{max\}}$ is the area when the orifice is fully open ($x_v = 1$).

It is given as a parameter or computed from the maximum flow coefficient (C_v) with utility [orif_areafromcv](#) or (K_v) with utility [orif_areafromkv](#).

Flow rates

The flow rates through the orifice are computed using the utility [pn2rcqfix](#).

The pressures used in the calculation are absolute pressures in PaA. The atmospheric pressure is set using the pneumatic utility [pn2getatp](#) to 101300 [PaA] by default, but it can be set to another value using submodel [PNATP00](#).

Reference

[1] ISA-75.01.01-2007, Flow Equations for Sizing Control Valves, 2007.

Detailed submodel view

External variables

	Title	Variable name	Unit	Type	In/Out	Default value
Port 1						
1	input signal	res	null	basic variable	input	-
Port 2						
1	enthalpy flow rate at port 2	dh2	J/s	basic variable	output	-
2	mass flow rate at port 2	dm2	g/s	basic variable	output	-
3	temperature at port 2	temp2	K	basic variable	input	-
4	pressure at port 2	press2	Pa	basic variable	input	-
Port 3						
1	duplicate of dh2	dh3	J/s	sign reversed duplicate [hidden]	output	-
2	duplicate of dm2	dm3	g/s	sign reversed duplicate [hidden]	output	-
3	temperature at port 3	temp3	K	basic variable	input	-

4	pressure at port 3	press3	Pa	basic variable	input	-
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Internal variables

	Title	Variable name	Unit	Type	Default value
1	fractional opening	xv	null	basic variable	-
2	mass flow parameter (cm)	cm	(kg*K/J)**(1/2)	basic variable	-
3	vena contracta gas velocity	gasvel	m/s	basic variable	-

Real parameters

	Title	Variable name	Unit	Default value
1	flow coefficient (Cq)	cq	null	0.72
2	orifice area at maximum opening	area0	mm**2	5
3	maximum flow coefficient (Cv)	Cv	null	0.5
4	maximum flow coefficient (Kv)	Kv	null	0.4

Integer parameters

	Title	Variable name	Default value
1	gas type index	gi	1
2	flow coefficient setting	flowset	1: Cq

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