Venturi Tube Flow Rate (ISO 5167-4)

Mass and volume flow through a classical venturi tube from throat and pipe diameters, differential pressure and density, with expansibility for gases.

Method: ISO 5167-4 classical venturi tubes (method)

Input parameters

Unit system: SI

Parameter	Value	Unit
Fluid	Liquid (incompressible)	
Throat diameter	100.00	mm
Pipe (inlet) diameter	200.00	mm
Differential pressure	25.000	kPa
Density at the inlet tapping	998.00	kg/m³
Inlet pressure, absolute (gas)	5.0000	bar
Isentropic exponent (gas)	1.4000	
Discharge coefficient From ISO 5167-4 for your venturi construction, or from its calibration certificate.	0.99500	

Calculated results

Parameter	Value	Unit
Diameter ratio d/D	0.50000	
Velocity of approach factor 1/√(1 − β⁴)	1.0328	
Expansibility factor	1.0000	
Mass flow	205,249	kg/h
Volume flow at inlet conditions	205.66	m³/h

Notes for this case

- The Reynolds number is not checked (no viscosity input): make sure the flow lies in the ISO 5167-4 Reynolds range for your venturi construction, for which the discharge coefficient entered applies.

Formula and method

$$q_m = \frac{C\varepsilon}{\sqrt{1-\beta^4}}\frac{\pi}{4}d^2\sqrt{2\,\Delta p\,\rho_1}, \quad \beta = d/D$$

$$\varepsilon = \sqrt{\frac{\kappa\tau^{2/\kappa}}{\kappa-1}\cdot\frac{1-\beta^4}{1-\beta^4\tau^{2/\kappa}}\cdot\frac{1-\tau^{(\kappa-1)/\kappa}}{1-\tau}}, \quad \tau = \frac{p_1-\Delta p}{p_1}$$

Variables

fluid	Fluid	-
d	Throat diameter	m
D	Pipe (inlet) diameter	m
Δp	Differential pressure	Pa
ρ_1	Density at the inlet tapping	kg/m³
p_1	Inlet pressure, absolute (gas)	Pa
κ	Isentropic exponent (gas)	-
C	Discharge coefficient	-

β	Diameter ratio d/D	-
E	Velocity of approach factor $1/\sqrt{(1 - \beta^4)}$	-
ε	Expansibility factor	-
q_m	Mass flow	kg/s
q_V	Volume flow at inlet conditions	m^3/s
τ	Pressure ratio $(p_1 - \Delta p)/p_1$	-

Method and standards

The differential-pressure flow equation of ISO 5167 with the isentropic expansibility used for venturi tubes and nozzles; the discharge coefficient is entered for your construction or from calibration.

Assumptions and limits

- Full pipe, steady flow; ISO 5167-4 limits on β and Reynolds number.
- The discharge coefficient is entered, not computed, and there is no viscosity input, so the Reynolds number is not checked: confirm that the pipe Reynolds number lies in the range ISO 5167-4 gives for your construction (or in the calibration range), otherwise the entered C does not apply. β and the gas pressure ratio are checked.

References

• ISO 5167-4 classical venturi tubes (method)

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/instrumentation/flow/venturi-flow

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Reopens the calculator with the inputs of this report.