Steam Volume after Throttling to a Vent or Silencer

Temperature, specific volume and volume flow of steam blown down through a safety valve or vent to near-atmospheric pressure, by isenthalpic throttling with IF97.

Method: Ganapathy; Steam Plant Calculations Manual; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Steam flow	27,216	kg/h
Upstream pressure (absolute)	44.800	bar
Upstream steam condition	Superheated at the temperature below	
Upstream temperature (superheated only) Used only for superheated steam; it must be above the saturation temperature at the upstream pressure.	426.67	°C
Pressure after throttling (absolute)	1.0342	bar

Calculated results

Parameter	Value	Unit
Enthalpy (constant)	3,269.5	kJ/kg
Temperature after throttling	395.66	°C
Specific volume after throttling	2.9805	m³/kg
Volume flow after throttling	81,116	m³/h

Notes for this case

- Size silencers and vent pipes on this volume; the velocity in the vent outlet should stay well below sonic.
- Kinetic energy is taken as recovered: where the outlet velocity is high, the static temperature and the volume at the outlet differ from these values.

Formula and method

$$h_2(p_2, T_2) = h_1(p_1, T_1), \quad \dot{V}_2 = \dot{m}\, v_2(p_2, h_1)$$

Variables

$\dot{m}$	Steam flow	kg/s
p_1	Upstream pressure (absolute)	Pa
state	Upstream steam condition: dry saturated, or superheated at T_1	–
T_1	Upstream temperature (superheated only; above the saturation temperature at p_1)	K
p_2	Pressure after throttling (absolute)	Pa
h	Enthalpy (constant)	J/kg
T_2	Temperature after throttling	K
v_2	Specific volume after throttling	m³/kg
$\dot{V}_2$	Volume flow after throttling	m³/s

Method and standards

Isenthalpic throttling with IF97.

Assumptions and limits

- Adiabatic valve; kinetic energy recovered. At high outlet velocity the static temperature is lower and the volume different; keep the vent velocity well below sonic for the results to hold.
- Temperatures follow the unit system (°F in US units, as in Ganapathy's example).

- The upstream steam is dry saturated or superheated; a temperature at or below the saturation temperature is rejected (it would be water, not steam).

References

- Ganapathy
- Steam Plant Calculations Manual
- 2nd ed. (Marcel Dekker, 1993)
- Q1.16 (steam volume after throttling)
- IAPWS-IF97 (isenthalpic throttling)

Report details

Report reference	FCC-6BYK-45WQ (the same inputs always give the same reference)
Generated	17 November 2026, 19:37 UTC
Calculator	Steam Volume after Throttling to a Vent or Silencer
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 reference cases of this calculator, computed independently, are checked on every release

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

This calculator online

https://calc.firecad.com/boilers-power-plant/steam/safety-valve-vent-steam-volume

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.