Flash Vessel Sizing (Blowdown and Condensate)

Diameter of a vertical flash vessel for blowdown or condensate from the flash steam flow and the allowable vapour velocity by the Souders–Brown equation.

Method: Souders and Brown (1934); GPSA Engineering Data Book (separator K values); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Blowdown or condensate entering	2,000.0	kg/h
Pressure before flashing (absolute) The water is taken as saturated at this pressure (boiler drum or steam trap inlet).	45.000	bar
Flash vessel pressure (absolute)	2.0000	bar
Souders–Brown velocity factor Sets how much liquid carry-over is accepted. The GPSA Engineering Data Book gives about 0.1 m/s for vertical separators with a wire-mesh demister; without one about half is usual. Enter your design value.	0.050000	m/s

Calculated results

Parameter	Value	Unit
Minimum inside diameter of the vessel	348.83	mm
Allowable vapour velocity	1.4441	m/s
Flash steam	560.93	kg/h
Flash fraction	28.046	%
Flash steam volume flow	496.83	m³/h
Steam density in the vessel	1.1290	kg/m³
Water density in the vessel	942.94	kg/m³

Formula and method

$$x = \frac{h_{f,1} - h_{f,f}}{h_{fg,f}} \qquad \dot{m}_{fs} = x\,\dot{m} \qquad \dot{V}_v = \frac{\dot{m}_{fs}}{\rho_v}$$

$$u_{max} = K\sqrt{\frac{\rho_l - \rho_v}{\rho_v}} \qquad D = \sqrt{\frac{4\,\dot{V}_v}{\pi\,u_{max}}}$$

Variables

$\dot{m}$	blowdown or condensate entering	kg/s
p_1	pressure before flashing, absolute	Pa
p_f	flash vessel pressure, absolute	Pa
K	Souders–Brown velocity factor	m/s
D	minimum inside diameter	m
u_{max}	allowable vapour velocity	m/s
$\dot{m}_{fs}$	flash steam	kg/s
x	flash fraction	–
$\dot{V}_v$	flash steam volume flow	m³/s
ρ_v	steam density in the vessel	kg/m³
ρ_l	water density in the vessel	kg/m³

$h_{f,1}$	saturated water enthalpy before flashing	J/kg
$h_{f,f}$	saturated water enthalpy at vessel pressure	J/kg
$h_{fg,f}$	latent heat at vessel pressure	J/kg

Method and standards

Flash fraction from the energy balance with FireCAD's IAPWS-IF97 saturation properties; allowable vapour velocity by the Souders–Brown equation (Souders and Brown, 1934), as used for vertical vapour–liquid separators in the GPSA Engineering Data Book.

Assumptions and limits

- Water saturated at the upstream pressure; subcooled condensate flashes less.
- Vertical vessel, vapour flowing upward over the full cross-section.
- The K factor is your design choice; the calculator does not check carry-over (a note appears above 0.15 m/s).
- The diameter is the bare minimum: no design margin, inlet momentum or droplet-loading allowance is added.

References

• Souders and Brown (1934)
• GPSA Engineering Data Book (separator K values)
• IAPWS R7-97(2012) IF97

Report details

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Calculator	Flash Vessel Sizing (Blowdown and Condensate)
Method last reviewed	10 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	3 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/flash-vessel-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.