Flash Steam from Condensate or Blowdown

Fraction and flow of flash steam released when saturated condensate or boiler blowdown drops to a lower pressure, from IAPWS-IF97 enthalpies.

Method: IAPWS R7-97(2012) IF97

Input parameters

Unit system: SI

Parameter	Value	Unit
Upstream pressure (absolute) Pressure of the saturated condensate or blowdown before the valve.	40.000	bar
Flash pressure (absolute) Pressure in the flash vessel or return line.	2.0000	bar
Condensate or blowdown flow	2,500.0	kg/h

Calculated results

Parameter	Value	Unit
Flash steam fraction	26.470	%
Flash steam flow	661.74	kg/h
Remaining condensate flow	1,838.3	kg/h
Upstream saturation temperature	250.36	°C
Flash temperature	120.21	°C
Upstream liquid enthalpy	1,087.4	kJ/kg
Liquid enthalpy at flash pressure	504.68	kJ/kg
Latent heat at flash pressure	2,201.6	kJ/kg
Heat carried by the flash steam	404.68	kW
Flash steam volume flow	586.13	m³/h

Formula and method

$$x = \frac{h_{f1} - h_{f2}}{h_{fg2}} \qquad \dot{m}_{fs} = x\,\dot{m} \qquad \dot{m}_c = (1 - x)\,\dot{m} \qquad \dot{Q}_{fs} = \dot{m}_{fs}\,h_{fg2} \qquad \dot{V}_{fs} = \dot{m}_{fs}\,v_{g2}$$

Variables

p_1	upstream absolute pressure of the saturated liquid	Pa
p_2	absolute pressure after the drop (flash vessel)	Pa
$\dot{m}$	liquid mass flow before the drop	kg/s
x	mass fraction flashed to steam	–
$\dot{m}_{fs}$	flash steam mass flow	kg/s
$\dot{m}_c$	remaining condensate mass flow	kg/s
$T_1\$, \$T_2$	saturation temperatures at p_1 and p_2	K
h_{f1}	saturated liquid enthalpy at p_1	J/kg
h_{f2}	saturated liquid enthalpy at p_2	J/kg
h_{fg2}	latent heat of vaporisation at p_2	J/kg
$\dot{Q}_{fs}$	latent heat carried by the flash steam	W
$\dot{V}_{fs}$	volume flow of the flash steam at p_2	m³/s

Method and standards

Enthalpies from FireCAD's IAPWS-IF97 implementation on the saturation line (region 1 liquid and region 2 vapour, region 3 above about 165 bar, region 4 pressure–temperature relation). The throttling is treated as adiabatic with no kinetic energy change, the usual assumption for flash vessels and condensate receivers.

Assumptions and limits

- Saturated liquid upstream; sub-cooled liquid flashes less.
- Equilibrium at the flash pressure; real vessels carry over a little liquid.
- Both pressures absolute and below the critical pressure (220.64 bar).

References

• IAPWS R7-97(2012) IF97

Report details

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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-steam

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Reopens the calculator with the inputs of this report.