Steam Dryness by Throttling Calorimeter

Dryness fraction of wet steam in a main from a throttling calorimeter's pressure and temperature, by the constant-enthalpy (throttling) principle (IAPWS-IF97).

Method: Throttling at constant enthalpy; IAPWS R7-97 IF97

Input parameters

Unit system: SI

Parameter	Value	Unit
Pressure in the main (absolute)	10.000	bar
Pressure in the calorimeter after throttling (absolute)	1.0132	bar
Temperature in the calorimeter	120.00	°C

Calculated results

Parameter	Value	Unit
Dryness fraction in the main	96.989	%
Superheat in the calorimeter	20.026	K
Steam enthalpy (constant through the throttle)	2,716.5	kJ/kg

Formula and method

$$h = h(p_2, T_2) \qquad x_1 = \frac{h - h_f(p_1)}{h_{fg}(p_1)} \qquad \Delta T_{sh} = T_2 - T_{sat}(p_2)$$

Variables

p_1	main pressure	Pa
p_2	calorimeter pressure	Pa
T_2	calorimeter temperature	K
x_1	dryness in the main	–
ΔT_{sh}	superheat in the calorimeter	K
h	steam enthalpy	J/kg
h_f, h_{fg}	saturated liquid enthalpy and latent heat at p_1 (IF97)	J/kg

Method and standards

Throttling is isenthalpic; enthalpies from FireCAD's IAPWS-IF97.

Assumptions and limits

- Adiabatic throttling; representative sample.
- A result above 100 % dry means the main steam is superheated; no dryness is shown then.
- A calorimeter superheat below about 2 K is flagged: the thermometer error then dominates.

References

- Throttling at constant enthalpy
- IAPWS R7-97 IF97

Report details

Report reference	FCC-AB2K-X4HD (the same inputs always give the same reference)
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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/steam-quality-from-throttling

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.