Nucleate Pool Boiling Heat Flux (Rohsenow)

Nucleate pool boiling heat flux and coefficient of water from the wall superheat (Rohsenow), with IF97 properties and IAPWS surface tension.

Method: Rohsenow (1952) q = μ_l h_fg [g(ρ_l − ρ_v)/σ]^½ [c_p ΔT/(C_sf h_fg Pr^n)]³ (Incropera); properties from IAPWS-IF97; IAPWS 2008/2011 and IAPWS R1-76 surface tension

Input parameters

Unit system: SI

Parameter	Value	Unit
Pressure (absolute)	1.0132	bar
Wall superheat T_w − T_sat	10.000	K
Surface–fluid constant 0.013 for water on polished copper or stainless; others from tables.	0.013000	
Prandtl exponent (1 for water)	1.0000	

Calculated results

Parameter	Value	Unit
Heat flux	139.72	kW/m²
Boiling coefficient	13,972	W/(m²·K)
Critical heat flux, Zuber–Lienhard (C = 0.149)	1,260.7	kW/m²

Notes for this case

- Valid in nucleate boiling below the critical heat flux; errors of ±100 % in q are typical of the correlation.

Formula and method

$$q = \mu_l h_{fg} \left[\frac{g(\rho_l - \rho_v)}{\sigma}\right]^{1/2} \left(\frac{c_{p,l}\Delta T_e}{C_{sf} h_{fg} Pr_l^n}\right)^3, \quad h = \frac{q}{\Delta T_e}$$

$$q_{max} = 0.149\, h_{fg}\, \rho_v \left[\frac{\sigma g(\rho_l - \rho_v)}{\rho_v^2}\right]^{1/4}$$

Variables

p	Pressure (absolute)	Pa
ΔT_e	Wall superheat T_w − T_sat	K
C_{sf}	Surface–fluid constant	-
n	Prandtl exponent (1 for water)	-
q	Heat flux	W/m²
h	Boiling coefficient	W/(m²·K)
q_{max}	Critical heat flux, Zuber–Lienhard	W/m²
μ_l	Saturated liquid viscosity (IAPWS 2008)	Pa·s
h_{fg}	Enthalpy of evaporation (IF97)	J/kg
ρ_l	Saturated liquid density (IF97)	kg/m³
ρ_v	Saturated vapour density (IF97)	kg/m³
σ	Surface tension (IAPWS R1-76)	N/m
$c_{p,l}$	Saturated liquid specific heat (IF97)	J/(kg·K)
Pr_l	Saturated liquid Prandtl number	-

g	Standard gravity, 9.806 65	m/s²

Method and standards

Rohsenow's nucleate boiling correlation with saturation properties at the pressure; critical heat flux by Zuber with Lienhard's constant 0.149 (as in the critical heat flux calculator).

Assumptions and limits

- Nucleate regime only: the page gives the critical heat flux (Zuber–Lienhard, C = 0.149, for a large flat heater) and warns when q exceeds it; above it the correlation does not apply.

References

- Rohsenow (1952) q = μ_l h_fg [g(ρ_l − ρ_v)/σ]^½ [c_p ΔT/(C_sf h_fg Pr^n)]³ (Incropera); properties from IAPWS-IF97
- IAPWS 2008/2011 and IAPWS R1-76 surface tension

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/mechanical/heat-transfer/rohsenow-pool-boiling

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Reopens the calculator with the inputs of this report.