Critical Heat Flux in Pool Boiling (Zuber–Lienhard)

Peak (critical) heat flux for pool boiling of water at a pressure from saturation properties and IAPWS surface tension, by the Zuber–Lienhard correlation.

Method: N. Zuber (1959); J.H. Lienhard and V.K. Dhir (1973); constant 0.149; Incropera; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Pressure (absolute)	1.0132	bar
Constant (0.149 Lienhard flat heater; 0.131 Zuber)	0.14900	

Calculated results

Parameter	Value	Unit
Saturation temperature	99.974	°C
Surface tension (IAPWS)	0.058917	N/m
Critical heat flux	1,260.7	kW/m²

Notes for this case

- Saturated pool boiling on a large horizontal surface; flow boiling in tubes has its own critical heat flux.

Formula and method

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

Variables

p	Pressure (absolute)	Pa
C	Constant (0.149 Lienhard flat heater; 0.131 Zuber)	-
T_{sat}	Saturation temperature	K
σ	Surface tension (IAPWS)	N/m
q''_{max}	Critical heat flux	W/m²

Method and standards

Hydrodynamic instability of the vapour columns.

Assumptions and limits

- Saturated pool boiling, large surface.

References

- N. Zuber (1959); J.H. Lienhard and V.K. Dhir (1973)
- constant 0.149; Incropera
- DeWitt
- Bergman and Lavine
- Fundamentals of Heat and Mass Transfer
- ch. 10
- IAPWS-IF97 and IAPWS R1-76(2014) surface tension

Report details

Report reference	FCC-V7MZ-7281 (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/mechanical/heat-transfer/critical-heat-flux-zuber

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.