Nucleate Pool Boiling by Forster–Zuber with Zuber Critical Flux

Nucleate pool boiling coefficient and heat flux of any liquid by Forster–Zuber from fluid properties and wall superheat, checked against Zuber's critical flux.

Input parameters

Unit system: SI

Parameter	Value	Unit
Liquid conductivity	0.67900	W/(m·K)
Liquid specific heat	4.2160	kJ/(kg·K)
Liquid density	958.40	kg/m³
Vapour density	0.59800	kg/m³
Surface tension	58.900	mN/m
Liquid viscosity	0.28200	mPa·s
Latent heat	2,257.0	kJ/kg
Wall temperature	110.00	°C
Saturation temperature	99.970	°C
Saturation pressure at the wall temperature	1.4327	bar
System pressure	1.0132	bar

Calculated results

Parameter	Value	Unit
Nucleate boiling coefficient	8,436.0	W/(m²·K)
Heat flux	84.613	kW/m²
Zuber critical heat flux	1,108.9	kW/m²
Share of the critical flux	7.6306	%

Notes for this case

• Forster and Zuber (1955) in SI units; the saturation pressure at the wall temperature comes from steam tables (or the fluid's vapour-pressure curve). Pool boiling coefficients depend on the surface; treat the result as an estimate within about ±50 %.

Formula and method

$$h_{nb} = 0.00122 \left[\frac{k_L^{0.79} c_{pL}^{0.45} \rho_L^{0.49}}{\sigma^{0.5} \mu_L^{0.29} \lambda^{0.24} \rho_v^{0.24}} \right] (T_w - T_s)^{0.24} (p_w - p_s)^{0.75}$$

$$q_c = 0.131 \lambda [\sigma g (\rho_L - \rho_v) \rho_v^2]^{1/4}$$

Variables

k_L	Liquid conductivity	W/(m·K)
c_{pL}	Liquid specific heat	J/(kg·K)
ρ_L	Liquid density	kg/m³
ρ_v	Vapour density	kg/m³
σ	Surface tension	N/m
μ_L	Liquid viscosity	Pa·s

λ	Latent heat	J/kg
T_w	Wall temperature	K
T_s	Saturation temperature	K
p_w	Saturation pressure at the wall temperature	Pa
p_s	System pressure	Pa
h_{nb}	Nucleate boiling coefficient	W/(m²·K)
q	Heat flux	W/m²
q_c	Zuber critical heat flux	W/m²
q/q_c	Share of the critical flux	-

Method and standards

Forster–Zuber nucleate boiling and Zuber hydrodynamic CHF.

Assumptions and limits

- Clean surfaces, pure liquids, nucleate regime.

Report details

Report reference	FCC-YHV1-5Y7Q (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/forster-zuber-nucleate-boiling

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Reopens the calculator with the inputs of this report.