Heat Exchanger Area (Q = U·A·F·LMTD)

Heat transfer area a heat exchanger needs for a duty, from the overall coefficient U, the terminal temperatures (LMTD) and the correction factor F.

Method: Incropera; Fundamentals of Heat and Mass Transfer; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Heat duty	500.00	kW
Overall heat transfer coefficient Clean or fouled, on the area basis you want the result in (usually the tube outside area).	300.00	W/(m²·K)
Hot stream inlet	150.00	°C
Hot stream outlet	90.000	°C
Cold stream inlet	30.000	°C
Cold stream outlet	70.000	°C
Flow arrangement	Counterflow	
LMTD correction factor (1 for pure counterflow) For shell-and-tube exchangers with more than one tube pass, and for cross-flow, read F from the TEMA or textbook charts; 1 for true counterflow or a condensing or boiling stream.	1.0000	

Calculated results

Parameter	Value	Unit
Heat transfer area required	23.974	m²
Conductance required	7.1921	kW/K
Log mean temperature difference	69.521	K
Corrected mean temperature difference	69.521	K

Formula and method

$$A = \frac{Q}{U F \Delta T_{lm}} \qquad UA = \frac{Q}{F \Delta T_{lm}} \qquad \Delta T_{lm} = \frac{\Delta T_1 - \Delta T_2}{\ln(\Delta T_1 / \Delta T_2)}$$

Variables

Q	heat duty	W
U	overall heat transfer coefficient	W/(m²·K)
$T_{h,in}$	hot stream inlet temperature	K
$T_{h,out}$	hot stream outlet temperature	K
$T_{c,in}$	cold stream inlet temperature	K
$T_{c,out}$	cold stream outlet temperature	K
flow	counterflow or parallel flow	–
F	LMTD correction factor	–
A	heat transfer area required	m²
UA	conductance required	W/K
ΔT_{lm}	log mean temperature difference	K
$F\Delta T_{lm}$	corrected mean temperature difference	K
$\Delta T_1\$, \$\Delta T_2$	terminal temperature differences	K

Method and standards

The rate equation of a heat exchanger with the log mean temperature difference (Incropera, ch. 11). F for multi-pass and cross-flow arrangements comes from the charts for the exchanger type (TEMA, textbooks).

Assumptions and limits

- Constant U along the exchanger. For a condensing or desuperheating section, split the exchanger into zones and add the areas.
- The duty must agree with both streams' heat balances; check them with the steam or gas property calculators.
- No allowance for plugged tubes or extra surface margin; add the design margin you need.
- F applies to the counterflow LMTD; F below 1 with parallel flow, and F below 0.75, are flagged.

References

• Incropera
• Fundamentals of Heat and Mass Transfer
• ch. 11; TEMA (F factor charts)

Report details

Report reference	FCC-AZH5-NCVB (the same inputs always give the same reference)
Generated	17 November 2026, 19:46 UTC
Calculator	Heat Exchanger Area (Q = U·A·F·LMTD)
Method last reviewed	10 November 2026
Software release	FireCAD Calc, release of 17 November 2026
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/heat-exchanger-area

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Reopens the calculator with the inputs of this report.