Jacketed Reactor: Duty and Jacket Fluid Flow (Isothermal Batch)

Heat transfer through a reactor jacket or coil to an isothermal batch from U, area and jacket fluid inlet and outlet temperatures, and the jacket fluid flow.

Method: Q = U A ΔT_lm with the batch at uniform temperature; jacket flow from its temperature change

Input parameters

Unit system: SI

Parameter	Value	Unit
Overall coefficient	350.00	W/(m²·K)
Jacket or coil area	12.000	m²
Batch temperature	80.000	°C
Jacket fluid in	30.000	°C
Jacket fluid out	40.000	°C
Jacket fluid specific heat	4.1800	kJ/(kg·K)

Calculated results

Parameter	Value	Unit
Log mean temperature difference	44.814	K
Heat transfer (positive: batch cooled)	188.22	kW
Jacket fluid flow	16.210	t/h

Formula and method

$$\Delta T_{lm} = \frac{(T_r - t_1) - (T_r - t_2)}{\ln \frac{T_r - t_1}{T_r - t_2}}, \quad \dot{Q} = UA\Delta T_{lm}, \quad \dot{m} = \frac{\dot{Q}}{c(t_2 - t_1)}$$

Variables

U	Overall coefficient	W/(m²·K)
A	Jacket or coil area	m²
T_r	Batch temperature	K
t_1	Jacket fluid in	K
t_2	Jacket fluid out	K
c	Jacket fluid specific heat	J/(kg·K)
ΔT_{lm}	Log mean temperature difference	K
$\dot{Q}$	Heat transfer (positive: batch cooled)	W
$\dot{m}$	Jacket fluid flow	kg/s

Method and standards

LMTD.

Assumptions and limits

- Well-mixed batch at constant temperature.
- The jacket fluid must warm when it cools the batch and cool when it heats it; other combinations are rejected.

References

- Q = U A ΔT_lm with the batch at uniform temperature; jacket flow from its temperature change

Report details

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Release checks	2 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/chemical/process-heat-exchangers/reactor-jacket-duty

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.