Heat Exchanger Duty and Outlet Temperature Balance

Heat duty of a heat exchanger from one stream's flow and temperatures, and the other stream's outlet temperature or flow needed, by energy balance.

Method: Steady-flow energy balance Q = ṁ c_p ΔT

Input parameters

Unit system: SI

Parameter	Value	Unit
Flow of stream 1	18,000	kg/h
Specific heat of stream 1	4.1800	kJ/(kg·K)
Stream 1 inlet	80.000	°C
Stream 1 outlet	50.000	°C
Flow of stream 2	28,800	kg/h
Specific heat of stream 2	4.1800	kJ/(kg·K)
Stream 2 inlet	25.000	°C
Stream 2 outlet wanted (for the flow needed)	45.000	°C
Heat loss as a share of the duty	0	%

Calculated results

Parameter	Value	Unit
Duty from stream 1	627.00	kW
Stream 2 outlet at its flow	43.750	°C
Stream 2 flow for the outlet wanted	27,000	kg/h

Formula and method

$$\dot{Q} = \dot{m}_1 c_{p1}(T_{1,in} - T_{1,out}),\quad \dot{Q}_2 = \dot{Q}(1-\epsilon_l)\ (\dot{Q} \geq 0),\quad \frac{\dot{Q}}{1-\epsilon_l}\ (\dot{Q} < 0),\quad T_{2,out} = T_{2,in} + \frac{\dot{Q}_2}{\dot{m}_2 c_{p2}},\quad \dot{m}_{2,req} = \frac{\dot{Q}_2}{c_{p2}(T_{2,out,w} - T_{2,in})}$$

Variables

$\dot{m}_1$	Flow of stream 1	kg/s
c_{p1}	Specific heat of stream 1	J/(kg·K)
$T_{1,in}$	Stream 1 inlet	K
$T_{1,out}$	Stream 1 outlet	K
$\dot{m}_2$	Flow of stream 2	kg/s
c_{p2}	Specific heat of stream 2	J/(kg·K)
$T_{2,in}$	Stream 2 inlet	K
$T_{2,out,w}$	Stream 2 outlet wanted (for the flow needed)	K
ϵ_l	Heat loss as a share of the duty	-
$\dot{Q}$	Duty from stream 1	W
$T_{2,out}$	Stream 2 outlet at its flow	K
$\dot{m}_{2,req}$	Stream 2 flow for the outlet wanted	kg/s

Method and standards

Energy balance.

Assumptions and limits

- No phase change, constant c_p.

- The heat loss is taken from the hot side: when stream 1 is hot, stream 2 receives Q(1 − ε_l); when stream 1 is cold, stream 2 must give |Q|/(1 − ε_l).
- A stream 2 outlet beyond stream 1's inlet (impossible) is flagged.

References

- Steady-flow energy balance Q = ṁ c_p ΔT

Report details

Report reference	FCC-QH7A-PVYH (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/heat-exchanger-duty-balance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.