# EV Battery Pack Heat and Coolant Flow

Heat generated by a battery pack from its current and internal resistance, plus other loads, and the coolant mass and volume flow for a chosen temperature rise.

**Method:** Joule heating and coolant heat balance

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Pack current (RMS over the duty) | 250.00 | A |
| Pack internal resistance | 0.080000 | Ω |
| Other heat into the loop (charger, electronics) | 1.5000 | kW |
| Coolant specific heat | 3.5000 | kJ/(kg·K) |
| Coolant density | 1,060.0 | kg/m³ |
| Coolant temperature rise | 4.0000 | K |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Battery Joule heat | 5.0000 | kW |
| Total heat to remove | 6.5000 | kW |
| Coolant mass flow | 0.46429 | kg/s |
| Coolant volume flow | 26.280 | L/min |

### Notes for this case

• Joule heat in the cells is I²R with the pack's DC internal resistance (rising at low temperature and with ageing); entropic (reversible) heat is neglected, which is reasonable at high rates. The coolant flow follows from Q = ṁc_pΔT. A 50 % ethylene glycol–water mix has c_p ≈ 3.5 kJ/kg·K and ρ ≈ 1,060 kg/m³. Keep ΔT across the pack small (3–5 K) so cells age evenly.

## Formula and method

$$\dot{Q} = I^2 R_{pack} + \dot{Q}_x, \quad \dot{m} = \frac{\dot{Q}}{c_p \Delta T}, \quad \dot{V} = \frac{\dot{m}}{\rho}$$

### Variables

| | | |
|---|---|---|
| $I$ | Pack current (RMS over the duty) | A |
| $R_{pack}$ | Pack internal resistance | Ω |
| $\dot{Q}_x$ | Other heat into the loop (charger, electronics) | W |
| $c_p$ | Coolant specific heat | J/(kg·K) |
| $\rho$ | Coolant density | kg/m³ |
| $\Delta T$ | Coolant temperature rise | K |
| $\dot{Q}_b$ | Battery Joule heat | W |
| $\dot{Q}$ | Total heat to remove | W |
| $\dot{m}$ | Coolant mass flow | kg/s |
| $\dot{V}$ | Coolant volume flow | m³/s |

### Method and standards

Coolant flow.

### Assumptions and limits

- Steady state; reversible heat neglected; uniform resistance.

### References

Joule heating and coolant heat balance

## Report details

| | |
|---|---|
| Report reference | FCC-S03E-NB6H (the same inputs always give the same reference) |
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| Calculator | EV Battery Pack Heat and Coolant Flow |
| Method last reviewed | 17 November 2026 |
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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/automotive/electric-vehicles/ev-battery-coolant-flow

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.