# Cooling Water Flow for a Heat Duty

Cooling water mass and volume flow needed to remove a heat duty with a given temperature rise, using IAPWS-IF97 water enthalpy and density.

**Method:** IAPWS R7-97(2012) IF97; first law of thermodynamics

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Heat duty to remove | 500.00 | kW |
| Cooling water inlet temperature | 32.000 | °C |
| Cooling water outlet temperature | 40.000 | °C |
| Water pressure (absolute)<br>Absolute: add the barometric pressure (about 1.013 bar) to a gauge reading, or choose a gauge unit. It matters only near boiling, where it decides whether the water stays liquid. | 3.0000 | bar |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Cooling water mass flow | 53,849 | kg/h |
| Cooling water volume flow (at inlet) | 54.113 | m³/h |
| Mean specific heat of the water | 4.1784 | kJ/(kg·K) |

## Formula and method

$$\dot{m} = \frac{\dot{Q}}{h(p, T_2) - h(p, T_1)} \qquad \dot{V} = \frac{\dot{m}}{\rho(p, T_1)} \qquad \bar{c}_p = \frac{h(T_2) - h(T_1)}{T_2 - T_1}$$

### Variables

| | | |
|---|---|---|
| $\dot{Q}$ | heat duty | W |
| $T_1$ | water inlet temperature | K |
| $T_2$ | water outlet temperature | K |
| $p$ | water pressure, absolute | Pa |
| $\dot{m}$ | water mass flow | kg/s |
| $\dot{V}$ | water volume flow at inlet | m³/s |
| $\bar{c}_p$ | mean specific heat | J/(kg·K) |
| $h$ | water enthalpy | J/kg |
| $\rho$ | water density | kg/m³ |

### Method and standards

Energy balance with water enthalpy and density from FireCAD's IAPWS-IF97.

### Assumptions and limits

- Water stays liquid; no heat loss to surroundings.

### References

- IAPWS R7-97(2012) IF97
- first law of thermodynamics

## Report details

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|---|---|
| Report reference | FCC-DWWW-KRJ5 (the same inputs always give the same reference) |
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| Calculator | Cooling Water Flow for a Heat Duty |
| Method last reviewed | 11 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/boilers-power-plant/condensers-cooling/cooling-water-flow

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.