Electric Water Heater Power and Heating Time

Heater power to warm a volume of water through a temperature rise in a given time, the energy used, and the heating time with a given heater.

Method: Q = m (h₂ − h₁); IAPWS-IF97 water at 1 atm

Input parameters

Unit system: SI

Parameter	Value	Unit
Volume of water	200.00	L
Starting temperature	25.000	°C
Final temperature	60.000	°C
Time allowed	60.000	min
Heater efficiency (heat into the water)	95.000	%
Heater available (to find the time)	3.0000	kW

Calculated results

Parameter	Value	Unit
Mass of water	199.41	kg
Heat needed	8.1034	kWh
Electrical energy used	8.5299	kWh
Heater power for the time allowed	8.5299	kW
Heating time with the heater available	170.60	min

Notes for this case

- Tank heat loss during heating is inside the efficiency; for long heating times allow for standing losses.

Formula and method

$$Q = m\,(h_2 - h_1) \approx m\,c_p\,\Delta T, \quad P = \frac{Q}{\eta\,t}$$

Variables

V	Volume of water	m³
T_1	Starting temperature	K
T_2	Final temperature	K
t	Time allowed	s
η	Heater efficiency (heat into the water)	-
P_a	Heater available (to find the time)	W
m	Mass of water	kg
Q	Heat needed	J
E	Electrical energy used	J
P	Heater power for the time allowed	W
t_h	Heating time with the heater available	s

Method and standards

Energy balance on the water with IF97 enthalpies.

Assumptions and limits

- Open tank at atmospheric pressure, below boiling.

References

- $Q = m\,(h_2 - h_1)$
- IAPWS-IF97 water at 1 atm

Report details

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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/electrical/power/electric-water-heater-rating

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.