Hot Water Boiler Circulation Flow

Water circulation flow through a hot water boiler or heater for its heat output and the supply and return temperatures, with IAPWS-IF97 enthalpies.

Method: IAPWS-IF97

Input parameters

Unit system: SI

Parameter	Value	Unit
Boiler heat output	2,000.0	kW
Supply (flow) temperature	90.000	°C
Return temperature	70.000	°C
Water pressure (absolute) Used for both enthalpies and the boiling margin: enter the lowest pressure the hot supply water sees (boiler outlet or pump suction).	4.0000	bar

Calculated results

Parameter	Value	Unit
Water mass flow	85,812	kg/h
Water volume flow at the return temperature	87.751	m³/h
Mean specific heat (enthalpy difference over ΔT)	4.1952	kJ/(kg·K)
Margin of the supply below boiling	53.613	K

Formula and method

$$\dot{m} = \frac{\dot{Q}}{h(T_s) - h(T_r)} \qquad \dot{V} = \frac{\dot{m}}{\rho(T_r)} \qquad \bar{c}_p = \frac{h(T_s) - h(T_r)}{T_s - T_r} \qquad \Delta T_{sub} = T_{sat}(p) - T_s$$

Variables

$\dot{Q}$	heat output	W
T_s	supply temperature	K
T_r	return temperature	K
p	water pressure	Pa
$\dot{m}$	mass flow	kg/s
$\dot{V}$	volume flow	m³/s
$\bar{c}_p$	mean specific heat	J/(kg·K)
ΔT_{sub}	margin below boiling	K

Method and standards

Energy balance with IAPWS-IF97 liquid enthalpies.

Assumptions and limits

- Liquid water; boiler output as heat to the water.
- One pressure is used for both enthalpies and the boiling margin; enter the lowest pressure at the hot supply (boiler outlet or pump suction).
- The 15 K warning margin is a FireCAD rule of thumb, not a code value; follow the boiler maker's or the code's required margin.

References

- IAPWS-IF97

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/boilers-power-plant/boilers/hot-water-boiler-flow

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.