Boiler Feed Pump Minimum Flow from Temperature Rise

Minimum flow through a feed pump so the water does not heat above an allowed rise, from shaft power and efficiency at low flow and IF97 specific heat.

Method: Energy balance: losses (1 − η)P heat the water; c_p from IAPWS-IF97

Input parameters

Unit system: SI

Parameter	Value	Unit
Shaft power at minimum flow	180.00	kW
Pump efficiency at minimum flow	25.000	%
Allowed temperature rise	8.0000	K
Suction pressure (absolute)	6.0000	bar
Suction temperature	105.00	°C

Calculated results

Parameter	Value	Unit
Water specific heat	4.2221	kJ/(kg·K)
Minimum flow	14.389	t/h

Notes for this case

- Take the larger of this thermal minimum and the maker's hydraulic minimum flow; set the recirculation valve to it.

Formula and method

$$\dot{m}_{min} = \frac{P(1-\eta)}{c_p \Delta T_{max}}$$

Variables

P	Shaft power at minimum flow	W
η	Pump efficiency at minimum flow	-
ΔT_{max}	Allowed temperature rise	K
p	Suction pressure (absolute)	Pa
T	Suction temperature	K
c_p	Water specific heat	J/(kg·K)
$\dot{m}_{min}$	Minimum flow	kg/s

Method and standards

Energy balance.

Assumptions and limits

- All losses $(1-\eta)P$ heat the water passing through the pump once. If the recirculated water is throttled back to the suction, the hydraulic work ηP also turns to heat in that loop, so the loop heats faster; the minimum flow here is per pass through the pump.
- A warning is given when the suction temperature plus the allowed rise reaches saturation at suction pressure.

References

- Energy balance: losses (1 − η)P heat the water; c_p from IAPWS-IF97

Report details

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Release checks	2 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/feed-pump-minimum-flow

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.