Boiler Feed Pump Sizing (Flow, Head, Motor)

Design flow, total head, power and motor of a boiler feed water pump from the boiler MCR, drum pressure, pressure drops and deaerator conditions.

Method: ANSI/HI 1.6 (head and power definitions); IAPWS R7-97(2012) IF97 (feedwater density); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Boiler steam output at MCR	50,000	kg/h
Blowdown, as a share of steam	2.0000	%
Flow margin 20 % covers peak load (110 % of rating) and wear. Default from FireCAD design practice; enter your specification's value.	20.000	%
Pumps sharing the duty (1 = each pump 100 %)	1.0000	
Drum pressure for pump sizing (absolute) Usually the highest safety-valve set pressure on the drum, so the pump can feed the boiler while the valves lift. Absolute; choose a gauge unit to enter gauge readings.	70.000	bar
Economiser pressure drop	200.00	kPa
Feed control valve pressure drop	400.00	kPa
Discharge piping, fittings and check-valve losses	150.00	kPa
Drum water level above the pump centreline	25.000	m
Deaerator pressure (absolute)	1.2000	bar
Deaerator water level above the pump centreline	12.000	m
Suction line friction loss	0.60000	m
Head margin Enter your specification's head margin, if any; the flow margin above already raises the duty.	0	%
Pump efficiency From the pump maker's curve at the duty point. 68 % is a typical maker's value for this size; some makers offer better. Default from FireCAD design practice; enter your specification's value.	68.000	%
Motor margin over the power absorbed 18 % for pump motors. Default from FireCAD design practice; enter your specification's value.	18.000	%

Calculated results

Parameter	Value	Unit
Design flow per pump	64.093	m^3/h
Design total head	828.42	m
Standard motor rating (IEC 60072-1)	250.00	kW
Minimum motor rating (absorbed + margin)	239.66	kW
Power absorbed at the design point	203.10	kW
Design mass flow per pump	61,200	kg/h
Pump discharge pressure (absolute)	79.841	bar
Pump suction pressure (absolute)	2.2675	bar
Feedwater density at deaerator saturation	954.87	kg/m^3

Formula and method

$$\dot{m} = \frac{\dot{m}_{MCR}\,(1+b)\,(1+m_Q)}{n} \qquad Q = \frac{\dot{m}}{\rho}$$

$$p_1 = p_{da} + \rho g\,(z_{da} - h_{fs}) \qquad p_{req} = p_{dr} + \Delta p_{eco} + \Delta p_v + \Delta p_l + \rho g\, z_{dr}$$

$$H = \frac{p_{req} - p_1}{\rho g}\,(1+m_H) \qquad p_2 = p_1 + \rho g H \qquad P_s = \frac{\dot{m}\, g\, H}{\eta_p} \qquad P_{m,min} = P_s\,(1+m_m)$$

Variables

$\dot{m}_{MCR}$	boiler steam output at MCR	kg/s
b	blowdown as a share of steam	–
m_Q	flow margin	–
n	pumps sharing the duty	–
p_{dr}	drum pressure for sizing, absolute	Pa
Δp_{eco}	economiser pressure drop	Pa
Δp_v	feed control valve pressure drop	Pa
Δp_l	discharge piping and fitting losses	Pa
z_{dr}	drum level above the pump centreline	m
p_{da}	deaerator pressure, absolute	Pa
z_{da}	deaerator water level above the pump centreline	m
h_{fs}	suction line friction loss	m
m_H	head margin	–
η_p	pump efficiency	–
m_m	motor margin	–
Q	design flow per pump	m³/s
H	design total head	m
P_{std}	standard motor rating	W
$P_{m,min}$	minimum motor rating	W
P_s	power absorbed	W
$\dot{m}$	design mass flow per pump	kg/s
p_2	pump discharge pressure	Pa
p_1	pump suction pressure	Pa
ρ	feedwater density, saturated at the deaerator pressure	kg/m³
p_{req}	pressure needed at the pump discharge	Pa
g	standard gravity, 9.806 65	m/s²

Method and standards

Pressure balance from the deaerator to the drum, with head and power as defined in ANSI/HI 1.6. Feedwater density from FireCAD's IAPWS-IF97 for saturated water at the deaerator pressure. Motor ratings from the IEC 60072-1 series. Default efficiency, margins and flow allowance are FireCAD design practice (owner, 2026-11-10); all are inputs.

Assumptions and limits

- Feedwater saturated at the deaerator pressure; the density change through the pump is neglected.
- The discharge pressure drops are at the design flow; enter them at that flow.
- Minimum-flow recirculation, balancing-device leak-off and attemperator spray taken from the pump discharge add to the flow: include them in the margin or the MCR.
- Check NPSH separately with the deaerator elevation calculator.

References

• ANSI/HI 1.6 (head and power definitions)

- IAPWS R7-97(2012) IF97 (feedwater density)
- IEC 60072-1 (motor ratings)

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/boiler-feed-pump-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.