Electric (Electrode) Boiler kW and Current

Electrical power and three-phase line current an electric resistance or electrode steam boiler needs for a steam output, from the steam conditions (IAPWS-IF97).

Method: IAPWS R7-97 IF97; Three-phase power P = √3 V I cos φ

Input parameters

Unit system: SI

Parameter	Value	Unit
Steam output	2,000.0	kg/h
Steam pressure (absolute)	10.500	bar
Steam condition	Dry saturated	
Superheated steam temperature	250.00	°C
Feedwater temperature	80.000	°C
Boiler efficiency (heat loss from the shell)	98.000	%
Supply line voltage	415.00	V
Power factor	100.00	%

Calculated results

Parameter	Value	Unit
Electrical power	1,385.0	kW
Line current (three-phase)	1,926.9	A
Heat to the steam	1,357.3	kW

Notes for this case

- Blowdown is not included: electrode boilers control conductivity by blowdown, which takes heat too; add it to the steam output if it is significant.

Formula and method

$$\dot{Q} = \dot{m}_s(h_s - h_{fw}) \qquad P = \frac{\dot{Q}}{\eta} \qquad I = \frac{P}{\sqrt{3}\,V\cos\varphi}$$

Variables

$\dot{m}_s$	steam output	kg/s
p	steam pressure	Pa
state	saturated or superheated	–
T_s	steam temperature	K
T_{fw}	feedwater temperature	K
η	boiler efficiency	–
V	line voltage	V
$\cos\varphi$	power factor	–
P	electrical power	W
I	line current	A
$\dot{Q}$	heat to steam	W
h_s, h_{fw}	enthalpies (IF97)	J/kg

Method and standards

Steam heat from FireCAD's IAPWS-IF97; three-phase balanced load.

Assumptions and limits

- Balanced three-phase load; steady output.
- Blowdown heat is not included. Electrode boilers hold the water conductivity by blowdown, which carries saturated water away; add its share to the output if significant.

References

- IAPWS R7-97 IF97
- Three-phase power P = √3 V I cos φ

Report details

Report reference	FCC-KD90-Z165 (the same inputs always give the same reference)
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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/electric-boiler-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.