Boiler Fuel Firing Rate

Fuel a boiler burns for a heat output or a steam flow, from the efficiency and the gross calorific value, with heat input and steam-to-fuel ratio.

Method: ASME PTC 4-2013 (efficiency on GCV); IAPWS R7-97(2012) IF97

Input parameters

Unit system: SI

Parameter	Value	Unit
Heat output from	Steam flow and conditions	
Heat output to steam	10,000	kW
Steam generated	10,000	kg/h
Steam pressure (absolute) At the boiler outlet. Absolute; choose a gauge unit to enter gauge readings.	10.500	bar
Steam condition	Dry saturated	
Steam temperature (superheated only)	250.00	°C
Feedwater temperature	105.00	°C
Boiler efficiency (on GCV) Gross efficiency, on the gross (higher) calorific value, as ASME PTC 4 states it.	80.000	%
Gross calorific value of the fuel, as fired	18,600	kJ/kg

Calculated results

Parameter	Value	Unit
Fuel firing rate	1,571.3	kg/h
Heat input from fuel (on GCV)	8,118.2	kW
Heat output to steam	6,494.6	kW
Steam to fuel ratio	6.3643	kg/kg
Steam enthalpy	2,779.0	kJ/kg
Feedwater enthalpy	440.90	kJ/kg

Formula and method

$$\dot{Q} = \dot{m}_s (h_s - h_{fw}) \quad \text{or} \quad \dot{Q} = \dot{Q}_{out}$$

$$\dot{Q}_{in} = \frac{\dot{Q}}{\eta} \qquad \dot{m}_f = \frac{\dot{Q}}{\eta\, GCV} \qquad \text{steam to fuel ratio} = \frac{\dot{m}_s}{\dot{m}_f}$$

Variables

basis	heat output entered, or from the steam flow and conditions	–
$\dot{Q}_{out}$	heat output to steam, entered	W
$\dot{m}_s$	steam generated	kg/s
p	steam pressure at the boiler outlet, absolute	Pa
state	dry saturated or superheated steam	–
T_s	steam temperature (superheated)	K
T_{fw}	feedwater temperature	K
η	boiler efficiency on GCV	–
GCV	gross calorific value of the fuel as fired	J/kg

$\dot{Q}$	heat output to steam used	W
$\dot{Q}_{in}$	heat input from fuel, on GCV	W
$\dot{m}_f$	fuel firing rate	kg/s
$\dot{m}_s/\dot{m}_f$	steam to fuel ratio	kg/kg
h_s	steam enthalpy	J/kg
h_{fw}	feedwater enthalpy at the steam pressure	J/kg

Method and standards

Energy balance on the boiler: the heat absorbed by the water and steam equals the fuel's heat input times the efficiency. Efficiency and calorific value are on the gross (higher) basis, as ASME PTC 4-2013 defines boiler efficiency. Steam and feedwater enthalpies come from FireCAD's IAPWS-IF97 implementation; blowdown is not included in the heat output (add it with the blowdown rate calculator if it is significant).

Assumptions and limits

- Steady load; the efficiency entered applies at this load.
- Heat output is the steam leaving the boiler minus the feedwater entering it; blowdown, soot-blowing steam and auxiliary steam are not included.
- Feedwater enthalpy is taken at the steam pressure.
- GCV as fired, on the same moisture basis as the fuel flow.

References

• ASME PTC 4-2013 (efficiency on GCV)
• IAPWS R7-97(2012) IF97

Report details

Report reference	FCC-12FS-S5G1 (the same inputs always give the same reference)
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Calculator	Boiler Fuel Firing Rate
Method last reviewed	10 November 2026
Software release	FireCAD Calc, release of 17 November 2026
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/fuel-firing-rate

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.