Boiler Efficiency Quick Formula (Gas or Oil)

Boiler or heater efficiency on HHV and LHV basis from excess air and the exit-gas-to-ambient temperature difference for natural gas or fuel oil (Ganapathy Eq. 16).

Method: Ganapathy; Steam Plant Calculations Manual; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Fuel	Natural gas	
Excess air	15.000	%
Exit gas temperature	137.78	°C
Ambient temperature	26.670	°C

Calculated results

Parameter	Value	Unit
Efficiency, HHV basis	84.690	%
Efficiency, LHV basis	93.783	%

Notes for this case

- The expressions include 1 % for radiation and unaccounted losses and assume complete combustion.

Formula and method

$$\eta_{HHV} = 89.4 - (0.001123 + 0.0195\,f)\,\Delta T, \quad \eta_{LHV} = 99.0 - (0.001244 + 0.0216\,f)\,\Delta T$$

$$\eta_{HHV} = 92.9 - (0.001298 + 0.01905\,f)\,\Delta T, \quad \eta_{LHV} = 99.0 - (0.001383 + 0.0203\,f)\,\Delta T$$

$$f = 1 + EA, \quad \Delta T = 1.8\,(t_g - t_a) \text{ in °F}, \quad \eta \text{ in per cent}$$

Variables

fuel	Fuel	-
EA	Excess air, fraction (15 % = 0.15)	-
f	excess air factor, $1 + EA$	-
ΔT	exit gas minus ambient temperature, in °F	°F
t_g	Exit gas temperature	K
t_a	Ambient temperature	K
η_{HHV}	Efficiency, HHV basis	-
η_{LHV}	Efficiency, LHV basis	-

Method and standards

Ganapathy's Eqs. (16a–b), derived from combustion calculations for typical gas and oil; the HHV and LHV forms are both from the same source.

Assumptions and limits

- Natural gas or fuel oil; 1 % other losses.
- A warning appears above 60 % excess air or 300 K gas-to-ambient difference, where the linear fit is extrapolated.

References

- Ganapathy
- Steam Plant Calculations Manual
- 2nd ed. (Marcel Dekker, 1993)
- Q2.22
- Eqs. (16a) and (16b)

Report details

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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-efficiency-quick-formula

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Reopens the calculator with the inputs of this report.