Waste Heat Boiler Gas Outlet Temperature

Gas temperature leaving a waste heat boiler for a required steam output, from gas flow and specific heat, steam conditions and casing loss (IAPWS-IF97).

Method: IAPWS-IF97

Input parameters

Unit system: SI

Parameter	Value	Unit
Waste gas flow	54,000	kg/h
Mean specific heat of the gas	1.1500	kJ/(kg·K)
Gas temperature entering	800.00	°C
Steam required	12,000	kg/h
Steam pressure (absolute)	18.000	bar
Steam condition	Dry saturated	
Superheated steam temperature	250.00	°C
Feedwater temperature	105.00	°C
Casing heat loss, share of the heat given up by the gas	1.0000	%

Calculated results

Parameter	Value	Unit
Gas temperature leaving	340.42	°C
Heat to the steam	7.8484	MW
Gas outlet minus saturation temperature	133.30	K

Formula and method

$$\dot{Q} = \dot{m}_s\,(h_s - h_{fw}) \qquad T_{g,2} = T_{g,1} - \frac{\dot{Q}}{(1-\lambda)\,\dot{m}_g\,c_{p,g}} \qquad \Delta T = T_{g,2} - T_{sat}(p)$$

Variables

$\dot{m}_g$	gas flow	kg/s
$c_{p,g}$	gas mean specific heat	J/(kg·K)
$T_{g,1}$	gas inlet temperature	K
$\dot{m}_s$	steam required	kg/s
p	steam pressure	Pa
state	saturated or superheated	–
T_s	superheat temperature	K
T_{fw}	feedwater temperature	K
λ	casing loss, share of the heat given up by the gas	–
$T_{g,2}$	gas outlet temperature	K
$\dot{Q}$	heat to steam	W
ΔT	outlet minus saturation	K
h_s, h_{fw}	IF97 enthalpies	J/kg

Method and standards

Heat balance on the gas side with a mean specific heat; steam and feedwater enthalpies from IAPWS-IF97.

Assumptions and limits

- Single pass, no supplementary firing; pinch point not checked. For superheated steam the gas must enter hotter than the steam; the gas-to-steam profile in the superheater is not checked.
- An outlet below saturation is reported with a warning, not rejected; the boiler alone cannot then make that steam.

References

- IAPWS-IF97

Report details

Report reference	FCC-RBAH-F48R (the same inputs always give the same reference)
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Calculator	Waste Heat Boiler Gas Outlet Temperature
Method last reviewed	12 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/hrsg-waste-heat/whb-gas-outlet-temperature

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.