HRSG Supplementary (Duct Burner) Firing Fuel

Fuel a duct burner needs to raise gas turbine exhaust from one temperature to another in a supplementary-fired HRSG, from the exhaust flow and NCV.

Method: Energy balance of the exhaust gas

Input parameters

Unit system: SI

Parameter	Value	Unit
Exhaust gas flow	360,000	kg/h
Mean specific heat of the gas between T_1 and T_2	1.1800	kJ/(kg·K)
Gas temperature before the burner	550.00	°C
Gas temperature after firing	750.00	°C
Net calorific value of the fuel	47,000	kJ/kg
Burner (combustion) efficiency	99.000	%

Calculated results

Parameter	Value	Unit
Fuel needed	1,825.9	kg/h
Heat added to the gas	23.600	MW

Notes for this case

- Gas turbine exhaust holds about 13–16 % O_2, enough for supplementary firing; check the O_2 left after firing and the duct and liner temperature limits with the burner maker.

Formula and method

$$\dot{Q} = \dot{m}_g c_{p,g} (T_2 - T_1) \qquad \dot{m}_f = \frac{\dot{Q}}{NCV \eta_b}$$

Variables

$\dot{m}_g$	exhaust gas flow	kg/s
$c_{p,g}$	mean gas specific heat between T_1 and T_2	J/(kg·K)
T_1	temperature before firing	K
T_2	temperature after firing	K
NCV	net calorific value of the fuel	J/kg
η_b	burner efficiency	–
$\dot{m}_f$	fuel needed	kg/s
$\dot{Q}$	heat added	W

Method and standards

Energy balance of the exhaust with a mean specific heat; the small mass of fuel added is neglected.

Assumptions and limits

- Constant gas specific heat (the mean between T_1 and T_2); fuel mass neglected.
- The O_2 left after firing is not calculated (the exhaust analysis and fuel are not inputs): check with the combustion or flue gas calculators, and with the burner maker, that enough O_2 remains for the fired temperature.

References

- Energy balance of the exhaust gas

Report details

Report reference	FCC-Y2AR-XGQ7 (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/hrsg-waste-heat/hrsg-supplementary-firing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.