Gas Turbine Exhaust Flow from Heat Rate

Gas turbine exhaust mass flow and exhaust heat from its power output, heat rate and exhaust temperature, by an energy balance, for HRSG design.

Method: Energy balance of the gas turbine

Input parameters

Unit system: SI

Parameter	Value	Unit
Gas turbine power output	30.000	MW
Gas turbine heat rate (on NCV)	10,500	kJ/kWh
Exhaust temperature	540.00	°C
Ambient (compressor inlet) temperature	30.000	°C
Mean specific heat of the exhaust	1.1200	kJ/(kg·K)
Other losses (generator, lube oil, casing), share of fuel heat	2.0000	%

Calculated results

Parameter	Value	Unit
Exhaust gas flow	351,366	kg/h
Heat in the exhaust above ambient	55.750	MW
Fuel heat input	87.500	MW
Gas turbine efficiency	34.286	%

Notes for this case

- An estimate: use the gas turbine maker's exhaust flow at site conditions for design.

Formula and method

$$\dot{Q}_f = PHR \qquad \dot{Q}_{exh} = \dot{Q}_f(1-\lambda) - P \qquad \dot{m}_{exh} = \frac{\dot{Q}_{exh}}{\bar{c}_p\,(T_{exh} - T_a)} \qquad \eta = \frac{1}{HR}$$

Variables

P	power output	W
HR	heat rate on NCV	J/J
T_{exh}	exhaust temperature	K
T_a	ambient temperature	K
$\bar{c}_p$	mean exhaust specific heat	J/(kg·K)
λ	other losses, share of fuel heat	–
$\dot{m}_{exh}$	exhaust flow	kg/s
$\dot{Q}_{exh}$	exhaust heat above ambient	W
$\dot{Q}_f$	fuel heat input	W
η	efficiency	–

Method and standards

Energy balance: fuel heat leaves as power, other losses and exhaust heat above ambient.

Assumptions and limits

- Steady state; mean specific heat. The flow is inversely proportional to the c̄_p entered (5 % error in c̄_p gives about 5 % in flow).

The default 1120 J/(kg·K) is a round figure for gas turbine exhaust; for a better value compute the mean c_p of your exhaust composition over the temperature range with the gas properties calculator.

References

Energy balance of the gas turbine

Report details

Report reference	FCC-Q6VV-8WR6 (the same inputs always give the same reference)
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Calculator	Gas Turbine Exhaust Flow from Heat Rate
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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/gas-turbines-combined-cycle/gas-turbine-exhaust-flow

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.