Steam Turbine Heat Rate (kJ/kWh)

Turbine (cycle) heat rate in kJ/kWh and kcal/kWh from main steam flow and conditions, feedwater temperature and generator output, with the cycle efficiency.

Method: IAPWS R7-97(2012) IF97; ASME PTC 6 (turbine heat rate definition)

Input parameters

Unit system: SI

Parameter	Value	Unit
Main steam flow	60,000	kg/h
Inlet steam pressure (absolute)	66.000	bar
Inlet steam condition	Superheated at the temperature below	
Inlet steam temperature (superheated only)	485.00	°C
Final feedwater temperature (boiler inlet)	150.00	°C
Generator output	15.000	MW

Calculated results

Parameter	Value	Unit
Turbine heat rate	10,975	kJ/kWh
Turbine cycle efficiency	32.803	%
Heat added to the steam	45.728	MW

Formula and method

$$\dot{Q} = \dot{m}_s (h_1 - h_{fw}) \qquad HR = \frac{\dot{Q}}{P_{el}} \qquad \eta_c = \frac{P_{el}}{\dot{Q}} = \frac{1}{HR}$$

Variables

$\dot{m}_s$	main steam flow	kg/s
p_1	main steam pressure, absolute	Pa
state	dry saturated or superheated steam	–
T_1	main steam temperature	K
T_{fw}	final feedwater temperature	K
P_{el}	generator output	W
HR	turbine heat rate	J/J
η_c	turbine cycle efficiency	–
$\dot{Q}$	heat added to the steam	W
h_1	main steam enthalpy	J/kg
h_{fw}	feedwater enthalpy	J/kg

Method and standards

Turbine heat rate as heat added to the working fluid per unit of generator output, the definition used in ASME PTC 6 for non-reheat units, with enthalpies from FireCAD's IAPWS-IF97. Shown in kJ/kWh; 3600 kJ/kWh is 100 % efficiency.

Assumptions and limits

- Non-reheat cycle; feedwater enthalpy at main steam pressure (the real feed pressure is higher; small effect); output measured at the generator terminals.
- For back-pressure (cogeneration) sets all the heat is charged to power, with no credit for the process steam: the heat rate is then very high and not a measure of the turbine's quality.

- Output above the heat added is rejected.

References

• IAPWS R7-97(2012) IF97
• ASME PTC 6 (turbine heat rate definition)

Report details

Report reference	FCC-0JMC-3CJV (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/turbines-cycles/turbine-heat-rate

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.