Reheat (Sequential Combustion) Gas Turbine Cycle

Specific work, fuel/air ratio, efficiency and exhaust temperature of a single-shaft gas turbine with reheat, from polytropic efficiencies and the reheat pressure.

Input parameters

Unit system: SI

Parameter	Value	Unit
Compressor pressure ratio	20.000	
Compressor polytropic efficiency	88.000	%
Turbine polytropic efficiency (both turbines)	87.000	%
HP turbine inlet temperature	1,176.8	°C
LP turbine inlet temperature (after reheat)	1,126.8	°C
First combustor pressure loss	3.0000	%
Reheat combustor pressure loss	4.0000	%
Ambient (compressor inlet) pressure	1.0130	bar
Ambient temperature	29.850	°C
Turbine exhaust pressure	1.0400	bar
HP turbine pressure ratio (sets the reheat pressure)	3.5000	
Mechanical efficiency	98.500	%
Combustion efficiency	99.500	%
Air specific heat	1.0050	kJ/(kg·K)
Air ratio of specific heats	1.4000	
Gas specific heat	1.1480	kJ/(kg·K)
Gas ratio of specific heats	1.3333	
Fuel net calorific value	43,100	kJ/kg
Fuel H/C atom ratio (kerosene about 1.92, methane 4)	1.9200	
Power required (for the air flow)	240.00	MW

Calculated results

Parameter	Value	Unit
Compressor delivery temperature	801.41	K
Compressor work per kg air	500.90	kJ/kg
HP turbine inlet pressure	19.652	bar
Reheat pressure (HP turbine exit)	5.6149	bar
HP turbine exit temperature	1,104.2	K
LP turbine inlet pressure	5.3903	bar
LP turbine pressure ratio	5.1830	
Equal-split HP ratio (ignoring the reheat loss)	4.3470	
Exhaust temperature (EGT)	978.83	K
Net specific work	366.42	kJ/kg
Total fuel/air ratio	0.027742	

Parameter	Value	Unit
Specific fuel consumption	0.27257	kg/kWh
Cycle efficiency (LHV)	30.644	%
Air flow for the power required	654.99	kg/s

Notes for this case

• Constant mass flow, no cooling bleeds, constant c_p and γ for air and for gas as in the textbook method. The fuel/air ratio of each combustor comes from an enthalpy balance with NIST Shomate data for a CH_y fuel. Equal turbine ratios give the most work; a higher reheat pressure lowers the exhaust temperature and raises efficiency.

Formula and method

$$\frac{T_{02}}{T_{01}} = r_c^{(\gamma_a - 1)/(\gamma_a \eta_{\infty c})}, \quad \frac{T_{03}}{T_{04}} = \left(\frac{p_{03}}{p_{04}}\right)^{\eta_{\infty t}(\gamma_g - 1)/\gamma_g}$$

$$W = \eta_m c_{pg}\left[(T_{03} - T_{04}) + (T_{05} - T_{06})\right] - c_{pa}(T_{02} - T_{01}), \quad \eta = \frac{W}{f Q_{net}}$$

Variables

r_c	Compressor pressure ratio	-
$\eta_{\infty c}$	Compressor polytropic efficiency	-
$\eta_{\infty t}$	Turbine polytropic efficiency (both turbines)	-
T_{03}	HP turbine inlet temperature	K
T_{05}	LP turbine inlet temperature (after reheat)	K
$\Delta p/p_{02}$	First combustor pressure loss	-
$\Delta p/p_{04}$	Reheat combustor pressure loss	-
p_a	Ambient (compressor inlet) pressure	Pa
T_a	Ambient temperature	K
p_{06}	Turbine exhaust pressure	Pa
p_{03}/p_{04}	HP turbine pressure ratio (sets the reheat pressure)	-
η_m	Mechanical efficiency	-
η_b	Combustion efficiency	-
c_{pa}	Air specific heat	J/(kg·K)
γ_a	Air ratio of specific heats	-
c_{pg}	Gas specific heat	J/(kg·K)
γ_g	Gas ratio of specific heats	-
Q_{net}	Fuel net calorific value	J/kg
y	Fuel H/C atom ratio (kerosene about 1.92, methane 4)	-
P	Power required (for the air flow)	W
T_{02}	Compressor delivery temperature	K
W_c	Compressor work per kg air	J/kg
p_{03}	HP turbine inlet pressure	Pa
p_{04}	Reheat pressure (HP turbine exit)	Pa
T_{04}	HP turbine exit temperature	K
p_{05}	LP turbine inlet pressure	Pa
p_{05}/p_{06}	LP turbine pressure ratio	-

$\sqrt{p_{03}/p_{06}}$	Equal-split HP ratio (ignoring the reheat loss)	-
T_{06}	Exhaust temperature (EGT)	K
W	Net specific work	J/kg
f	Total fuel/air ratio	-
SFC	Specific fuel consumption	kg/J
η	Cycle efficiency (LHV)	-
$\dot{m}$	Air flow for the power required	kg/s

Method and standards

Textbook reheat cycle with polytropic efficiencies and enthalpy-balance fuel/air ratios.

Assumptions and limits

- Constant flow; no cooling air; constant c_p and γ.

Report details

Report reference	FCC-CTZF-8WEX (the same inputs always give the same reference)
Generated	23 November 2026, 17:43 UTC
Calculator	Reheat (Sequential Combustion) Gas Turbine Cycle
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 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/gas-turbines-combined-cycle/gas-turbine-reheat-cycle

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.