Intercooled Gas Turbine Cycle: Compressor Work and Efficiency

Compressor work, net specific work and efficiency of a gas turbine with two equal-ratio compression stages and an intercooler, against single-stage.

Method: Air-standard cycle with intercooling

Input parameters

Unit system: SI

Parameter	Value	Unit
Compressor inlet temperature	15.000	°C
Overall pressure ratio	8.0000	
Turbine inlet temperature	1,100.0	°C
Compressor isentropic efficiency	85.000	%
Turbine isentropic efficiency	88.000	%
Mean specific heat	1.1000	kJ/(kg·K)
Heat capacity ratio	1.3600	
Air temperature after the intercooler	26.850	°C

Calculated results

Parameter	Value	Unit
Compressor work, single stage	273.71	kJ/kg
Compressor work, intercooled	241.14	kJ/kg
Net specific work, intercooled	321.52	kJ/kg
Efficiency, intercooled	30.404	%
Efficiency, single stage	31.414	%
Compressor delivery, intercooled	138.67	°C

Notes for this case

• Two stages at √r_p each with cooling to T_ic between them: compressing cooler air takes less work, raising specific work substantially. Efficiency rises only at high pressure ratios or with a recuperator, because the combustor must now heat the air from a lower T_2. Aero-derivative units such as the LMS100 use intercooling for output.

Formula and method

$$w_{c,ic} = c_p \left[T_1 \frac{r_p^{k/2} - 1}{\eta_c} + T_{ic} \frac{r_p^{k/2} - 1}{\eta_c} \right], \quad k = \frac{\gamma - 1}{\gamma}$$

Variables

T_1	Compressor inlet temperature	K
r_p	Overall pressure ratio	-
T_3	Turbine inlet temperature	K
η_c	Compressor isentropic efficiency	-
η_t	Turbine isentropic efficiency	-
c_p	Mean specific heat	J/(kg·K)
γ	Heat capacity ratio	-

T_{ic}	Air temperature after the intercooler	K
$w_{c,1}$	Compressor work, single stage	J/kg
$w_{c,ic}$	Compressor work, intercooled	J/kg
w_{net}	Net specific work, intercooled	J/kg
η	Efficiency, intercooled	-
η_0	Efficiency, single stage	-
T_2	Compressor delivery, intercooled	K

Method and standards

Intercooled cycle.

Assumptions and limits

- Constant c_p and γ; equal stage ratios; no pressure losses.

References

Air-standard cycle with intercooling

Report details

Report reference	FCC-GKD6-SPEK (the same inputs always give the same reference)
Generated	23 November 2026, 17:43 UTC
Calculator	Intercooled Gas Turbine Cycle: Compressor Work and Efficiency
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/intercooled-gas-turbine-cycle

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.