Air-Standard Otto and Diesel Cycle Efficiency

Air-standard efficiency of the Otto and Diesel cycles from compression ratio, cut-off ratio and the ratio of specific heats.

Method: Air-standard cycles: η_Otto = 1 − r^(1−γ); η_Diesel = 1 − r^(1−γ)(r_c^γ − 1)/(γ(r_c − 1))

Input parameters

Unit system: SI

Parameter	Value	Unit
Compression ratio	16.000	
Cut-off ratio (Diesel)	2.0000	
Ratio of specific heats	1.4000	

Calculated results

Parameter	Value	Unit
Otto efficiency at r	67.012	%
Diesel efficiency at r and r_c	61.380	%

Notes for this case

- Ideal cycles with cold air; real engines reach well under these values.

Formula and method

$$\eta_{Otto} = 1 - \frac{1}{r^{\gamma-1}}, \quad \eta_{Diesel} = 1 - \frac{1}{r^{\gamma-1}} \cdot \frac{r_c^{\gamma} - 1}{\gamma(r_c - 1)}$$

Variables

r	Compression ratio	-
r_c	Cut-off ratio (Diesel)	-
γ	Ratio of specific heats	-
η_{Otto}	Otto efficiency at r	-
η_{Diesel}	Diesel efficiency at r and r_c	-

Method and standards

Air-standard analysis.

Assumptions and limits

- Ideal gas, reversible processes.

References

- Air-standard cycles: η_Otto = 1 − r^(1−γ); η_Diesel = 1 − r^(1−γ)(r_c^γ − 1)/(γ(r_c − 1))

Report details

Report reference	FCC-RNWQ-V446 (the same inputs always give the same reference)
Generated	17 November 2026, 19:45 UTC
Calculator	Air-Standard Otto and Diesel Cycle Efficiency
Method last reviewed	12 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 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/automotive/engine/air-standard-cycle-efficiency

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.