Four-Stroke Engine Volumetric Efficiency

Volumetric efficiency of a four-stroke engine from measured air flow, air density, bore, stroke, cylinders and speed.

Method: η_v = ṁ_a/(ρ_a V_s N/2) for four-stroke engines

Input parameters

Unit system: SI

Parameter	Value	Unit
Measured air flow	648.00	kg/h
Intake air density (ambient or manifold)	1.1800	kg/m³
Bore	105.00	mm
Stroke	120.00	mm
Cylinders	6.0000	
Speed	1,500.0	rpm

Calculated results

Parameter	Value	Unit
Swept volume rate V_s N/2	280.55	m³/h
Volumetric efficiency	195.74	%

Notes for this case

- Above 100 %: with ambient density this means boost (turbo- or supercharging); with manifold density a boosted engine normally reads below 100 %, so recheck the density basis.
- Four-stroke only: one intake stroke every two revolutions. A two-stroke engine draws once per revolution, so its swept volume rate is V_s N.

Formula and method

$$\eta_v = \frac{\dot{m}_a}{\rho_a V_s N/2}$$

Variables

$\dot{m}_a$	Measured air flow	kg/s
ρ_a	Intake air density (ambient or manifold)	kg/m³
B	Bore	m
S	Stroke	m
$\mathcal{Z}$	Cylinders	-
N	Speed	1/s
$\dot{V}_s$	Swept volume rate V_s N/2	m³/s
η_v	Volumetric efficiency	-

Method and standards

Definition.

Assumptions and limits

- Four-stroke engine (two-stroke engines are not covered: their swept volume rate is V_s N).
- With ambient density a value above 100 % shows boost; with manifold density a boosted engine normally reads below 100 %.

References

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Report details

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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/engine-volumetric-efficiency

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.