Fan Power (Air, Shaft and Motor)

Air power, shaft power and motor input power of a fan or blower from volume flow, pressure rise and the fan, drive and motor efficiencies.

Method: ISO 5801 (fan power and efficiency definitions); AMCA 210

Input parameters

Unit system: SI

Parameter	Value	Unit
Volume flow at the fan inlet	72,000	m³/h
Fan pressure rise (total, or static with a static efficiency) Use the static pressure rise with a static efficiency, or the total rise with a total efficiency.	300.00	mmWC
Fan efficiency	80.000	%
Drive efficiency (coupling, belt, gearbox) 100 % for a direct-coupled fan; about 95 % for a V-belt; 96–98 % for a fluid coupling at full speed.	100.00	%
Motor efficiency	95.000	%

Calculated results

Parameter	Value	Unit
Fan shaft power	73.550	kW
Motor output power (at the motor shaft)	73.550	kW
Electrical input power	77.421	kW
Air power	58.840	kW
Overall efficiency, wire to air	76.000	%

Notes for this case

- Pressure rise above about 2.5 kPa: air compression is no longer negligible; the true shaft power is about 1 % lower at 2.5 kPa and 2 % or more lower above 5 kPa (ISO 5801 compressibility coefficient).

Formula and method

$$P_a = \dot{V}\Delta p_t \qquad P_s = \frac{P_a}{\eta_f} \qquad P_m = \frac{P_s}{\eta_d} \qquad P_e = \frac{P_m}{\eta_m} \qquad \eta = \eta_f \eta_d \eta_m$$

Variables

$\dot{V}$	volume flow at the fan inlet	m³/s
Δp_t	fan pressure rise (total or static, matching the efficiency)	Pa
η_f	fan efficiency	–
η_d	drive efficiency (coupling, belt, gearbox)	–
η_m	motor efficiency	–
P_a	air power	W
P_s	fan shaft power	W
P_m	motor output power	W
P_e	electrical input power	W
η	overall efficiency, wire to air	–

Method and standards

Definitions of fan air power and fan efficiency of ISO 5801 (and AMCA 210), for incompressible flow: the air power is the product of the inlet volume flow and the fan pressure. Shaft, motor and electrical power follow by dividing by the efficiencies in turn.

Assumptions and limits

- Incompressible: below about 2.5 kPa pressure rise the error is under 1 %; above it ISO 5801's compressibility coefficient lowers the power by a few per cent.
- Volume flow at the fan inlet temperature and pressure, not normal volume.
- The result is the power absorbed at this duty; the motor rating needs the margin your standard or the fan maker requires.

References

• ISO 5801 (fan power and efficiency definitions)
• AMCA 210

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/mechanical/fans/fan-power

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Reopens the calculator with the inputs of this report.