Fan Density Correction (Site to Standard Air)

Converts a fan duty at site temperature and altitude to standard air and back: pressure and power scale with density at the same speed and volume flow.

Method: AMCA 99 (fan laws); AMCA 210 (standard air 1.2 kg/m³); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Volume flow at the fan inlet	72,000	m³/h
Fan pressure at site conditions	305.91	mmWC
Shaft power at site conditions	75.000	kW
Gas temperature at the fan inlet	40.000	°C
Molar mass of the gas Dry air 28.97; flue gas about 30 (coal, oil) or 27.5–28.5 (natural gas).	28.965	kg/kmol
Site pressure from	Altitude (ISO 2533 standard atmosphere)	
Site altitude above sea level	0	m
Barometric pressure at the site (absolute)	1.0132	bar
Standard (test) density 1.2 kg/m³ is standard air in AMCA 210 and fan catalogues (20 °C, 101.325 kPa, 50 % humidity).	1.2000	kg/m³

Calculated results

Parameter	Value	Unit
Fan pressure at standard density	325.67	mmWC
Shaft power at standard density	79.843	kW
Density ratio standard / site	1.0646	
Gas density at site conditions	1.1272	kg/m³
Mass flow of standard air at the same volume	86,400	kg/h
Barometric pressure used	1.0132	bar

Formula and method

$$\rho = \frac{p\,M}{R\,T} \qquad k = \frac{\rho_0}{\rho} \qquad \Delta p_0 = k\,\Delta p \qquad P_0 = k\,P \qquad \dot{m}_0 = \rho_0\,\dot{V}$$

Variables

$\dot{V}$	volume flow at the fan inlet	m³/s
Δp	fan pressure at site conditions	Pa
P	shaft power at site conditions	W
T	gas temperature at the fan inlet	K
M	molar mass of the gas	kg/kmol
site	site pressure from altitude or entered	–
z	site altitude	m
p_s	barometric pressure entered	Pa
ρ_0	standard (test) density	kg/m³
Δp_0	fan pressure at standard density	Pa

P_0	shaft power at standard density	W
ρ_0/ρ	density ratio	–
ρ	gas density at site	kg/m³
$\dot{m}_0$	mass flow of standard air at the same volume	kg/s
p	barometric pressure used	Pa
R	universal gas constant	J/(mol·K)

Method and standards

Fan laws of AMCA Publication 99 at constant speed and size: pressure and power in proportion to density, volume flow unchanged. Standard air of 1.2 kg/m³ as in AMCA 210; site pressure from ISO 2533; ideal-gas density.

Assumptions and limits

- Same fan, same speed, same point of rating.
- Inlet suction is neglected in the density; for an ID fan with a large suction, enter the inlet absolute pressure as the barometric pressure.
- Compressibility neglected.

References

• AMCA 99 (fan laws)
• AMCA 210 (standard air 1.2 kg/m³)
• ISO 2533 (site pressure)

Report details

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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/mechanical/fans/fan-density-correction

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.