Fan Static, Velocity and Total Pressure

Fan total pressure and fan static pressure from the static pressures and flow areas at the fan inlet and outlet, with velocities and velocity pressures (ISO 5801).

Method: ISO 5801 (fan performance, pressure definitions); AMCA 210

Input parameters

Unit system: SI

Parameter	Value	Unit
Volume flow	72,000	m³/h
Gas density	1.1500	kg/m³
Flow area at the inlet measuring plane	1.8000	m²
Flow area at the outlet measuring plane	1.2000	m²
Static pressure at the inlet (gauge, negative for suction)	-5.0986	mmWC
Static pressure at the outlet (gauge)	295.72	mmWC

Calculated results

Parameter	Value	Unit
Fan total pressure	309.86	mmWC
Fan static pressure	293.58	mmWC
Air power on fan total pressure	60.775	kW
Inlet velocity	11.111	m/s
Outlet velocity	16.667	m/s
Inlet velocity pressure	7.2387	mmWC
Outlet velocity pressure	16.287	mmWC
Inlet total pressure (gauge)	2.1401	mmWC
Outlet total pressure (gauge)	312.00	mmWC

Formula and method

$$v_1 = \frac{\dot{V}}{A_1} \qquad v_2 = \frac{\dot{V}}{A_2} \qquad p_{d1} = \frac{\rho v_1^2}{2} \qquad p_{d2} = \frac{\rho v_2^2}{2} \qquad p_{t1} = p_{s1} + p_{d1} \qquad p_{t2} = p_{s2} + p_{d2}$$

$$p_F = p_{t2} - p_{t1} \qquad p_{sF} = p_{s2} - p_{t1} \qquad P_a = \dot{V} p_F$$

Variables

$\dot{V}$	volume flow	m³/s
ρ	gas density	kg/m³
A_1	flow area at the inlet measuring plane	m²
A_2	flow area at the outlet measuring plane	m²
p_{s1}	static pressure at the inlet, gauge	Pa
p_{s2}	static pressure at the outlet, gauge	Pa
p_F	fan total pressure	Pa
p_{sF}	fan static pressure	Pa
P_a	air power on fan total pressure	W
v_1	inlet velocity	m/s
v_2	outlet velocity	m/s

p_{d1}	inlet velocity pressure	Pa
p_{d2}	outlet velocity pressure	Pa
p_{t1}	inlet total pressure, gauge	Pa
p_{t2}	outlet total pressure, gauge	Pa

Method and standards

Fan pressure definitions of ISO 5801 (and AMCA 210) for incompressible flow, with mean velocities at the measuring planes.

Assumptions and limits

- Uniform velocity in each plane; with a distorted profile the true velocity pressure is higher.
- Incompressible; below about 2.5 kPa the error is negligible.
- Gauge pressures at both planes referred to the same atmosphere.

References

• ISO 5801 (fan performance, pressure 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-static-total-pressure

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Reopens the calculator with the inputs of this report.