FAN LAWS

Formulae 1 to 4 can be applied to any fan provided the diameter does not change. If the diameter does not change the fans must be geometrically similar. The units of density, fan rotational speed and diameter are not important as long as both are the same.

In formulae 5 to 8 the units shown in the nomenclature must be used to satisfy the formulae.

1. Volume flow:- $$q_{v2} = q_{v1} \times \left(\frac{n_2}{n_1}\right)^1 \times \left(\frac{d_2}{d_1}\right)^3$$

2. Pressure:- $$p_2 = p_1 \times \left(\frac{n_2}{n_1}\right)^2 \times \left(\frac{d_2}{d_1}\right)^2 \times \left(\frac{\rho_2}{\rho_1}\right)^1$$

3. Absorbed power:- $$P_{R2} = P_{R1} \times \left(\frac{n_2}{n_1}\right)^3 \times \left(\frac{d_2}{d_1}\right)^5 \times \left(\frac{\rho_2}{\rho_1}\right)^1$$

4. Sound Power Level:- $$PWL_2 = PWL_1 + 70 \log_{10}\left(\frac{d_2}{d_1}\right) + 55 \log_{10}\left(\frac{n_2}{n_1}\right) + 20 \log_{10}\left(\frac{c_2}{c_1}\right)$$

5. Density:- $$\rho_2 = \rho_1 \times \left(\frac{B_2}{B_1}\right) \times \left(\frac{T_1}{T_2}\right)$$

6. Fan Total Efficiency %:- $$\frac{q_v \times p_t F}{10\, P_R}$$

7. Fan Total pressure:- $$p_t F = p_s F + p_d F$$

or Fan Static pressure:- $$p_s F = p_t F - p_d F$$

8. Velocity pressure:- $$p_d = 0.5\, \rho\, V^2$$
$$p_d = 0.6\, V^2 \text{ (Standard air, where } \rho = 1.2 \text{ kg/m}^3\text{)}$$

Nomenclature for symbols used in this page:-

q_V	=	volume flow of air, m³/sec
n	=	rotational speed of fan
d	=	diameter of fan
p	=	pressure developed by the fan
ρ	=	density of air, kg/m³
P_R	=	power absorbed by the fan, kW
B	=	barometric pressure (millibars)
T	=	absolute temperature, K (K = °C + 273)
$p_t F$	=	fan total pressure, Pa
$p_S F$	=	fan static pressure, Pa
$p_d F$	=	fan dynamic/velocity pressure, Pa
p_d	=	system dynamic/velocity pressure, Pa
V	=	velocity of air, m/sec
PWL	=	sound power level

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