

FAN LAWS

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. Density:

$$\rho_2 = \rho_1 \times \left(\frac{B_2}{B_1}\right) \times \left(\frac{T_1}{T_2}\right)$$

5. Sound power:

$$L_{w2} = L_{w1} + 55 \log_{10} \left(\frac{n_2}{n_1}\right)^1 + 55 \log_{10} \left(\frac{d_2}{d_1}\right)^1 + 55 \log_{10} \left(\frac{\rho_2}{\rho_1}\right)^1$$

6. Efficiency %:

$$\frac{q_v \times \rho_t F}{10 P_R}$$

7. Total pressure:

$$\rho_t F = \rho_s F + \rho_d F$$

8. Velocity pressure:

$$\rho_d = 0.6 v^2 \text{ (Standard air)}$$

Nomenclature for symbols used in this page:-

q_v = volume flow of air, m³/sec
 n = rotational speed of fan
 d = diameter of fan
 ρ = pressure developed by the fan
 ρ = density of air, kg/m³
 P_R = power absorbed by the fan, kW
 L_W = sound power level, dB

B = barometric pressure
 T = absolute temperature, K ($K = ^\circ\text{C} + 273$)
 $\rho_t F$ = fan total pressure, Pa
 $\rho_s F$ = fan static pressure, Pa
 $\rho_d F$ = fan dynamic/velocity pressure, Pa
 ρ_d = system dynamic/velocity pressure, Pa
 v = velocity of air, m/sec