

FAN LAWS

Rotational Speed	Fan Size Air Density Duct System	1. Flow is directly proportional to speed	$q_1 = N_1$ $q_2 = N_2$
		2. Pressure is directly proportional to speed ²	$P_1 = N_1^2$ $P_2 = N_2^2$
		3. Air Power is directly proportional to speed ³	$A_1 = N_1^3$ $A_2 = N_2^3$
Fan Size & Rotational Speed	Tip Speed Air Density	4. Flow and air power are directly proportional to diameter ²	$q_1 = A_1 D_1^2$ $q_2 = A_2 D_2^2$
		5. Speed is inversely proportional to diameter	$N_1 = D_2$ $N_2 = D_1$
		6. Pressure remains constant	$P_1 = P_2$
Fan Size	Rotational Speed Air Density	7. Flow is directly proportional to diameter ³	$q_1 = D_1^3$ $q_2 = D_2^3$
		8. Pressure is directly proportional to diameter ²	$P_1 = D_1^2$ $P_2 = D_2^2$
		9. Air power is directly proportional to diameter ⁵	$A_1 = D_1^5$ $A_2 = D_2^5$
Rotational Speed & Air Density	Fan Size Pressure	10. Speed, flow and air power are inversely proportional to 0 density	$N_1=q_1=A_1=p_2^{1/2}$ $N_2 q_2 A_2 p_1$
Air Density	Rotational Speed Fan Size	11. Pressure and air power are directly proportional to density	$P_1 = A_1 = p_1$ $P_2 = A_2 = p_2$
		Duct System	12. Flow remains constant

SYMBOLS

A = Air Power in watts
D = Impeller diameter in metres
N = Number of revolutions per second
P = Total pressure in pascals
q = Volume flow in m³/s
p = Density in kg/m³

NOTES

- Total Pressure = Static Pressure + Velocity Pressure
- $A = P \times q$
- Shaft Power = A + Efficiency
(Fan efficiencies usually range between 0.45 and 0.8)
- System resistance usually varies as the square of velocity
- Fan laws apply accurately only to geometrically similar fans operating at the same point on the characteristic curve