

Fan Laws



FM 00701

Fan laws can apply to any range of fans of geometric similarity

FOR CONSTANT FAN SIZE AND DENSITY:

I. Volume varies directly as the speed ratio: -	$V_2 = V_1 \left(\frac{N_2}{N_1} \right)$
II. Pressure varies as the square of the speed ratio: -	$P_2 = P_1 \left(\frac{N_2}{N_1} \right)^2$
III. Power Varies as the cube of the speed ratio: -	$kW_2 = kW_1 \left(\frac{N_2}{N_1} \right)^3$

FOR CONSTANT FAN SPEED AND DENSITY:

I. Volume varies as the cube of the ratio of fan sizes: -	$V_2 = V_1 \left(\frac{D_2}{D_1} \right)^3$
II. Pressure varies as the square of the ratio of fan sizes: -	$P_2 = P_1 \left(\frac{D_2}{D_1} \right)^2$
III. Power varies as the fifth power of the ratio of fan sizes: -	$kW_2 = kW_1 \left(\frac{D_2}{D_1} \right)^5$

FOR CONSTANT SIZE, SPEED & VOLUME:

I. Pressure varies directly as the ratio of densities: -	$P_2 = P_1 \left(\frac{\rho_2}{\rho_1} \right)$
II. Power varies directly as the ratio of densities: -	$kW_2 = kW_1 \left(\frac{\rho_2}{\rho_1} \right)$

DENSITY CONVERSION FOR A GIVEN TEMPERATURE: -
Where: ρ_1 is density at $t_1^\circ\text{C}$ and ρ_2 is density at $t_2^\circ\text{C}$

$$\rho_2 = \rho_1 \left(\frac{273 + t_1}{273 + t_2} \right)$$

KEY:

Volume =	V	Fan size =	D	Power absorbed =	kW	Standard air temp./Density =	20°C / 1.2kg/m ³
Pressure =	P	Air density =	ρ	Fan speed =	N	Standard atmospheric pressure =	1.01325 bar
Temperature =	t						