

# 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 %:-

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

7. Fan Total pressure:-

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

or Fan Static pressure:-

$$\rho_s F = \rho_t F - \rho_d F$$

8. Velocity pressure:-

$$\rho_d = 0.5 \rho V^2$$

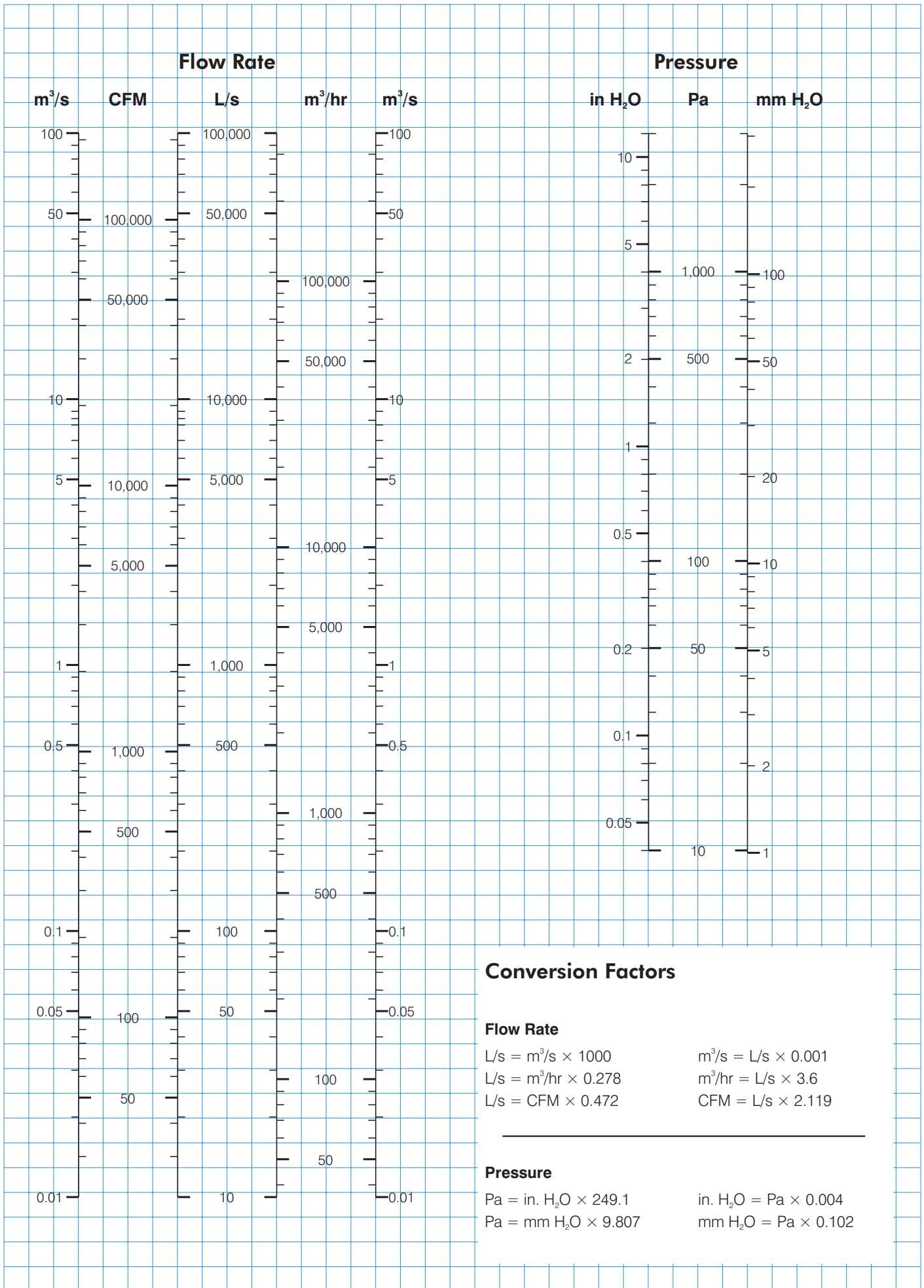
$$\rho_d = 0.6 V^2 \text{ (Standard air, where } \rho = 1.2 \text{ kg/m}^3 \text{)}$$

Nomenclature for symbols used in this page:-

$q_v$	=	volume flow of air, m <sup>3</sup> /sec
$n$	=	rotational speed of fan
$d$	=	diameter of fan
$p$	=	pressure developed by the fan
$\rho$	=	density of air, kg/m <sup>3</sup>
$P_R$	=	power absorbed by the fan, kW
$B$	=	barometric pressure (millibars)
$T$	=	absolute temperature, K (K = °C + 273)
$\rho_t F$	=	fan total pressure, Pa
$\rho_s F$	=	fan static pressure, Pa
$\rho_d F$	=	fan dynamic/velocity pressure, Pa
$\rho_d$	=	system dynamic/velocity pressure, Pa
$V$	=	velocity of air, m/sec
$PWL$	=	sound power level

	Symbol	Definition
Area	$m^2$	square metre
Density	$\rho$	density of air $kg/m^3$
Dimensions	mm	millimetre
	cm	centimetre
	m	metre
	$\square$	square
	$\emptyset$	diameter
Electricity	Amps	amperes
	D.I.P.	dust and ignition proof motor
	Ex d	flame-proof motor
	Ex e	explosion-proof motor
	Ex n	non-sparking motor
	kW	kilowatt
	ph	phase
	$\emptyset$	phase
Power	$P_R$	impeller absorbed power, kW
Pressure	$kg/m^2$	kilogram per square metre
	Pa	pascal
	kPa	kilopascals
	$\rho_d F$	fan dynamic/velocity pressure
	$\rho_s F$	fan static pressure
Sound	$\rho_t F$	fan total pressure
	dB	decibel
	dB(A)	decibel, A weighted
	dBW	sound power level, $L_w$
	Hz	frequency, Hertz
	$L_p$	sound pressure level, dB
	$L_w$	sound power level, dB
	NC	noise criteria
	NR	noise rating
	PNC	Preferred Noise Criterion
	pW	picowatt
	$\mu pa$	micropascal
Speed of rotation	r/s	revolutions per second
	rev/sec	revolutions per second
Temperature	$^{\circ}C$	degrees celcius
	K	Kelvin, absolute temp.
Time	sec or s	seconds
Velocity	m/s	metres per second
Volumetric flow	L/s	litres per second
	$m^3/s$	cubic metres per second
	$q_v$	volume flow
Volume	$m^3$	cubic metres
Weights	wt	weight
	kg	kilogram

# NOMOGRAMS & CONVERSION FACTORS



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