BASIC FAN LAWS

VARIABLE	CHANGE IN RPM	CHANGE IN DIAM.	CHANGE IN DENSITY
VOLUME	$CFM_2 = CFM_1 \left(\frac{RPM_2}{RPM_1}\right)$	$CFM_2 = CFM_1 \left(\frac{DIAM_2}{DIAM_1}\right)^3$	DOES NOT CHANGE
PRESSURE	$P_2 = P_1 \left(\frac{RPM_2}{RPM_1}\right)^2$	$P_2 = P_1 \left(\frac{DIAM_2}{DIAM_1}\right)^2$	$P_2 = P_1 \left(\frac{D_2}{D_1}\right)$
HORSEPOWER	$HP_2 = HP_1 \left(\frac{RPM_2}{RPM_1}\right)^3$	$HP_2 = HP_1 \left(\frac{DIAM_2}{DIAM_1}\right)^5$	$HP_2 = HP_1 \left(\frac{D_2}{D_1}\right)$

Formulae for Determining the Spread and Throw of a Fan

By using the following formulae, information can be obtained on the velocity from a fan and also the width of the stream at a specific distance. While these values are influenced greatly by the presence or absence of walls, floors and obstructions, the following formulae will give a good approximation for most cases.

SPREAD: $W = .36L + \frac{d}{12}$

W = Maximum width in feet of airstream perpendicular to axis of rotation of the fan.

L = Distance from fan in feet.

d = Fan diameter in inches.

VELOCITY (Not less than 10 feet from fan):

(1) $k = 5\left(\frac{2.5 \times CFM}{d}\right)^2$ (2) $V_{La} = 1.15\sqrt{\frac{k}{L}}$

(3) $V_{max} = \left(\frac{d}{73} + 1\right)V_{La}$

k = Fan constant.

V_{La} = Average velocity across the width of the spread. L feet from the fan (feet per minute).

V_{max} = Maximum velocity L feet from the fan (feet per minute).

CFM = Free Air Deliverv of fan.

ALTITUDE & TEMPERATURE CORRECTION FACTORS

Temperature (°F) \ Altitude (feet)	0	1000	2000	3000	4000	5000	6000	7000	8000
-50	0.77	0.80	0.83	0.86	0.89	0.92	0.96	1.00	1.04
-25	0.82	0.85	0.89	0.92	0.95	0.98	1.03	1.07	1.11
0	0.87	0.90	0.94	0.97	1.01	1.04	1.09	1.13	1.17
25	0.91	0.95	0.98	1.02	1.06	1.08	1.14	1.18	1.23
50	0.96	1.00	1.04	1.08	1.11	1.15	1.20	1.25	1.30
70	1.00	1.04	1.08	1.12	1.16	1.20	1.25	1.30	1.35
100	1.06	1.10	1.14	1.19	1.23	1.27	1.33	1.38	1.43
150	1.15	1.20	1.24	1.29	1.33	1.38	1.44	1.50	1.55
200	1.25	1.30	1.35	1.40	1.45	1.50	1.56	1.63	1.69
250	1.34	1.39	1.45	1.50	1.55	1.61	1.68	1.74	1.81
300	1.43	1.49	1.54	1.60	1.66	1.72	1.79	1.86	1.93
350	1.53	1.59	1.65	1.71	1.77	1.84	1.91	1.99	2.07
400	1.62	1.69	1.75	1.82	1.89	1.96	2.03	2.10	2.18
500	1.81	1.88	1.96	2.03	2.11	2.19	2.27	2.35	2.43

Example : Assume the required performance for a tubeaxial fan to be : 5000 CFM, .375" S.P.@ 150 ° F., & 4000 ft altitude, and 24" dia.

1. The table above gives a factor of 1.33
2. .375 X 1.33 = .49875 or about .5" S.P. for 70 ° F. at sea level
3. A B24-1 fan selected from the rating tables for the new conditions will meet the required performance rating at 1725 RPM.

TO CALCULATE:

Velocity = CFM ÷ Duct Area (in Sq. Ft.)

ALTERNATE METHOD:

$$\text{Velocity} = \frac{\text{CFM} \times 144}{\text{Duct area (in sq. in.)}}$$

CFM = Velocity x duct area (in sq. ft.)

ALTERNATE METHOD:

$$\text{CFM} = \frac{\text{Velocity} \times \text{duct area (in sq. in.)}}{144}$$

Tip Speed = Circumference x RPM

$$\text{BHP} = \frac{\text{Total Watts input} \times \text{motor eff.}}{746}$$

$$\text{Mechanical Efficiency} = \frac{\text{TP} \times \text{CFM}}{6356 \times \text{BHP}} \times 100\%$$

$$\text{Static Efficiency} = \frac{\text{SP} \times \text{CFM}}{6356 \times \text{BHP}} \times 100\%$$