Physical Fan Laws

General

To plot a curve of any size and speed fan from the reference curves, apply the physical fan laws as follows: using $K = \left(\frac{\text{NEW RPM}}{\text{REF RPM}}\right)$

Vol. of any size at any speed (CFM) = CFM of ref fan $\times \left(\frac{\text{New dia}}{\text{ref dia}}\right)^3 \times (K)$

Static pressure of any size at any speed (SP) = SP of ref fan $\times \left(\frac{\text{New dia}}{\text{ref dia}}\right)^2 \times (K)^2$

BHP of any size at any speed = BHP of ref fan $\times \left(\frac{\text{New dia}}{\text{ref dia}}\right)^5 \times (K)^3$

Physical Fan Laws for Speed Change (RPM)

When the speed of the Ref. Fan is changed:

1. CFM varies directly as the rpm or the speed ratio (K)
2. SP varies directly as the speed ratio squared. $(K)^2$
3. BHP varies directly as the speed ratio cubed. $(K)^3$

Physical Fan Laws for Speed Change (RPM) and Size Change (DIA.)

1. CFM varies as the size ratio cubed x speed ratio. (K)
2. SP varies as the size ratio squared x speed ratio squared. $(K)^2$
3. BHP varies as size ratio to the fifth power x speed ratio cubed. $(K)^3$

Examples:

Prepare curve on a 42″ tubeaxial @ 1036 RPM from a curve on a 42″ tubeaxial @ 1750 RPM.

NEW CFM = (REF. CFM) x (K) $K = \frac{1036}{1750} = .592$

NEW CFM = 19150 x .592
NEW CFM = 11340

NEW SP = (REF. SP) x $(K)^2$
NEW SP = (.4) x (.35)
NEW SP = .14

NEW BHP = (REF BHP) x $(K)^3$
NEW BHP = (6.4) x (.207)
NEW BHP = 1.325

These physical "Fan Law" Equations can only be applied to Geometrically proportional fans and does not compensate for a change in air density (Temperature, Altitude, Humidity, or Gases).

Correction Factors for temperature and altitude can be obtained from Page 15.

Prepare curve on a 42″ tubeaxial @ 1036 RPM from a 30″ tubeaxial @ 1750 RPM curve.

$K = \frac{1036}{1750} = .592$

The CFM, SP and BHP factors are:

CFM factor = $(42/30)^3 \times (K) = 2.74 \times .592 = 1.62$
SP factor = $(42/30)^2 \times (K)^2 = 1.96 \times .35 = .69$
BHP factor = $(42/30)^5 \times (K)^3 = 5.378 \times .207 = 1.11$

Thus the CFM of the reference fan is to be multiplied by the CFM factor of 1.63; SP by .69; BHP by 1.11

Below is a tabulation of a number of points on the reference curve and the corresponding points on the new curve for the 42″ fan running at 1036 RPM.

30″ @ 1750 RPM			42″ @ 1036 RPM		
CFM	SP	BHP	(CFM)x(1.62)	(SP)x(.69)	(BHP)x(1.11)
19800	0	6.4	32300	0	7.1
19150	.4	6.8	31250	.276	7.55
18400	.8	7.15	30000	.552	7.94
17550	1.2	7.5	28600	.816	8.32
16500	1.6	7.9	26900	1.1	8.77
15150	2.0	8.5	24700	1.38	9.43
13000	2.22	9.1	21200	1.53	10.1