Fan Laws

The Fan Laws are the basic proportional relationships between fan speed, flow, pressure, and power. They are most useful for determining the impact of extrapolating from a known fan performance to a desired performance.

The most common change made to a fan is that of altering its rotational speed. For a given speed change percentage:

- Flow change is directly proportional.
- Pressure changes by the square of the proportion.
- Power changes by the cube of the proportion.

A detailed explanation follows:

The Fan Laws are frequently used to estimate air moving device requirements in both of the above situations. Additionally the Fan Laws can be used to calculate the performances of air movers of different sizes and speeds, assuming proportionality regarding linear and angular dimensions, fluid velocities, and internal fluid forces. The basic relations for air movers are:

VARIABLE IN FAN SPEED

$$CFM2/CFM1=RPM2/RPM1$$

$$P2/P1=(RPM2/RPM1)^2$$

$$N2-N1=50\log10(RPM2/RPM1)$$

CFM: Air Flow (m3/min or ft3/mm)
SP: Air Pressure (mm-H2O;inch-H2O)
N: Noise (dB)

For identical fans in parallel,

$$P_{max}=P_{max,single}\ ;\ Q_{max}=Q_{max,single}$$ **x no. of fans**

For identical fans in serial,

$$Q_{max}=Q_{max,single};\ P_{max}=P_{max,single}$$ **x no. of fans**

In all of the Fan Law equations, the fan or fans are assumed to have the same efficiencies at the various operating points under consideration.

The above formulae and discussion provide the basic tools by which the potential air mover user can approximate the device that he requires. In some instances, because of availability or allowable space, the user may elect to specify multiple air movers for series or parallel operation.