

# FAN LAWS

There are many occasions when your customers will have an air-moving application such as a belt drive ventilator, and for one reason or another it becomes necessary to increase the amount of air flow being produced in the application. The following article describes some basic guidelines to offer your customer when it is time to select the new motor horsepower to do the job. Always suggest your customer review the change with the OEM first, before any changes are done.

Air flow is measured in cubic feet per minute (CFM). The pressure that develops when the moving air encounters restrictions such as a filter, is called static pressure (SP) and is measured in inches of water column. These two values along with required horsepower, change as the speed of the blower wheel or fan blade is changed. The relationships that describe the amount of change in CFM, SP and Horsepower when the speed changes are called Fan Laws.

Three of the laws are:

1. New CFM/Old CFM = New speed/Old speed
2. New SP/Old SP = (New speed/Old speed)<sup>2</sup>
3. New HP/Old HP = (New speed/Old speed)<sup>3</sup>

For example, your customer needs to change the pulley sizes on a belt drive fan currently running at 450 RPM to increase air flow from 5000 CFM to 9000 CFM. Existing SP happens to be 0.5" and the motor horsepower is 1/2.

1. What new fan speed is needed?

Using the first Fan Law, and solving for New speed, you have the following:

$$\begin{aligned}\text{New speed} &= \text{Old speed}/(\text{New CFM}/\text{Old CFM}) \\ &= 450(9000/5000) \\ &= 810 \text{ RPM}\end{aligned}$$

2. What new static pressure will be generated?

Using the second Fan Law, and solving for New SP, you have the following:



$$\begin{aligned}\text{New SP} &= \text{Old SP} (\text{New speed}/\text{Old speed})^2 \\ &= 0.5(810/450)^2 \\ &= 1.62'' \text{ water column}\end{aligned}$$

3. What new HP will be needed?

Using the third Fan Law, and solving for New HP, you have the following:

$$\begin{aligned}\text{New HP} &= \text{Old HP} (\text{New speed}/\text{Old speed})^3 \\ &= 0.5(810/450)^3 \\ &= 2.9 \text{ HP}\end{aligned}$$

Your customer will need to use a 3 HP motor!

This example shows that an 80% increase in air flow requires a 480% increase in HP. Careful consideration should be given to any changes in air-moving equipment to assure results are accurate and practical.