Poultry Housing Tips

Exhaust Fan Performance Factors

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There are three performance factors to consider when purchasing an exhaust fan for a tunnel-ventilated poultry house: air moving capacity, energy efficiency, and air flow ratio. Knowing the air moving capacity of an exhaust fan, at a static pressure of 0.05", helps a grower to determine how many fans his house will require. For instance, let's say a grower is going to build a 40' X 500' dropped ceiling (7 ½' side wall) broiler house. To obtain the desired air exchange rate and air speed he will need to have a minimum of 170,000 cfm of exhaust fan capacity. If a fan he was considering purchasing moved 19,000 cfm at a static pressure of 0.05", he would need to purchase nine fans. If the fan moved 23,000 cfm, approximately eight fans would be required.

On the other hand, knowing a fan's energy efficiency rating helps a grower to select a fan that will keep his operating costs to a minimum. The higher a fan's energy efficiency rating, the lower a grower's electricity bill will be. For instance, selecting a fan with an energy efficiency rating of 22 cfm/watt will reduce fan operating cost approximately 20% over one with an energy efficiency rating of 18 cfm/watt.

The performance factor most likely to be ignored when purchasing fans is air flow ratio, which is just as important as its air moving capacity or energy efficiency rating. The amount of air a fan moves decreases as static pressure increases. The higher the static pressure, the harder it is for the fan to draw air into the house, the lower the amount of air moved by the fan. Reduced fan output results in decreased air speed and air exchange rates, leading to increased heat stress related problems. How much a fan's output decreases as static pressure increases varies significantly from fan to fan. One of the best ways to evaluate a fan's ability to move air as static pressure increases is by its air flow ratio (Figure 1). A fan's air flow ratio (A.F.R.) is determined by dividing its air moving capacity at a 0.20" by the amount of air it moves at a 0.05" static pressure:

Air Flow Ratio = cfm (0.20") / cfm (0.05")

If a fan moved the same amount of air at a static pressure of 0.20" that it does at 0.05", the air flow ratio would be equal to one. If a fan moved 20,000 cfm at a 0.05" and 15,000 at a 0.20" its air flow ratio would be 0.75 (A.F.R. = 15,000 / 20,000 = 0.75). In other words, the fan's air moving capacity decreases by 25% as the static pressure increases from a 0.05" to a 0.20". Air flow ratios for most fans range between 0.40 and 0.85, which means the output of most fans decreases somewhere between 15 and 60% as static pressure increases from 0.05" to 0.20"

Though a tunnel-ventilated house operating at a static pressure of 0.20" is rare, at times pressure may be much higher than you realize. For instance, in a tunnel-ventilated house with evaporative cooling pads a static pressure of 0.10" is fairly common. The problem is that the static pressure you are measuring is only a measure of the amount of work the fans have to do to pull the air through the pads and down the house. What it doesn't tell you

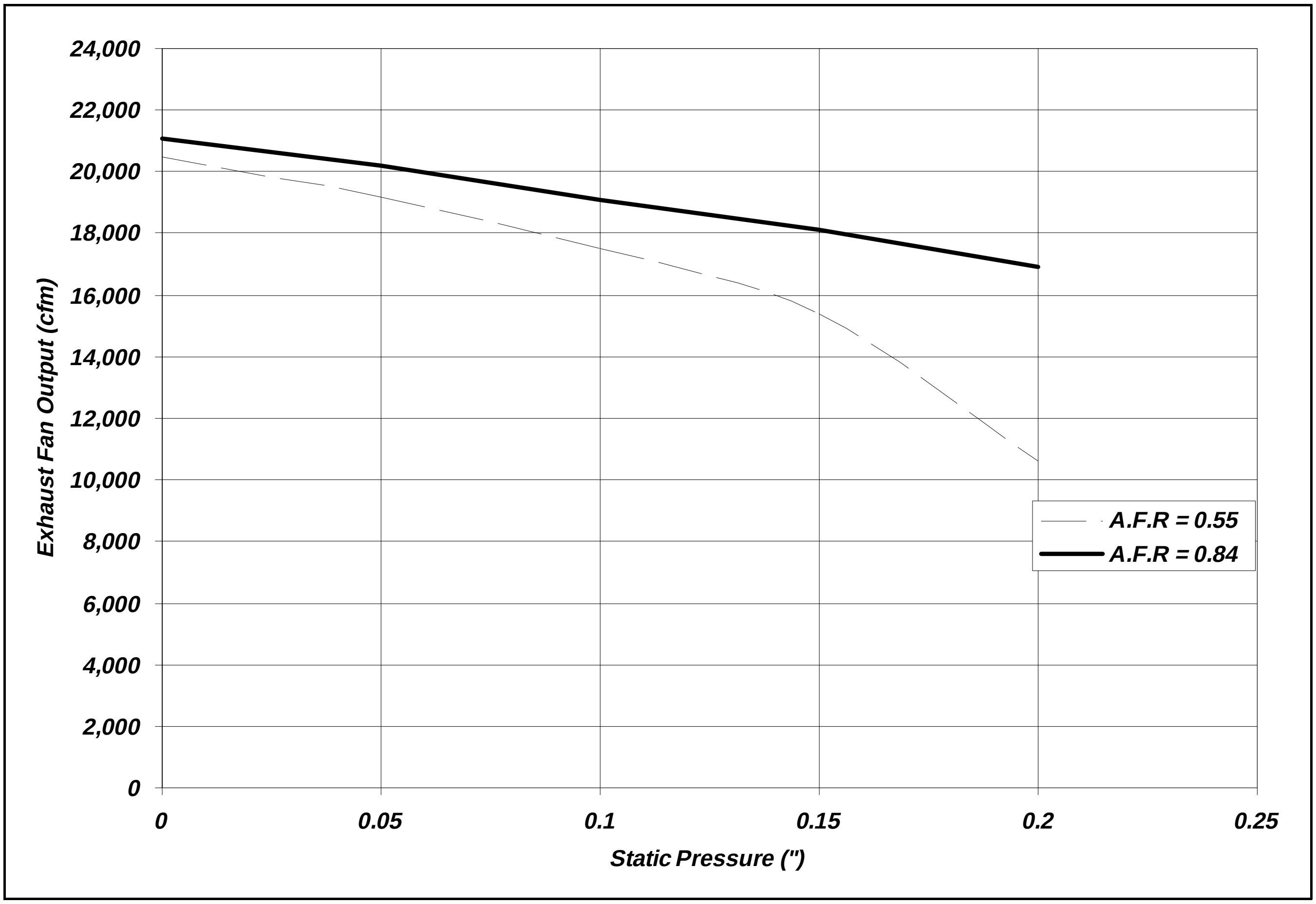

Figure1. Air flow Vs. Static Pressure

is how much work is required to pull the air through the dusty shutters. This static pressure can only be measured by placing a static pressure gauge between the shutter and the exhaust fan which is next to impossible to do. Research has shown a dusty shutter can add 0.05" or more to the static pressure you are reading, so the actual static pressure the fans are working against may be over a 0.15" at times.

Another pressure a fan has to work against at times that is very difficult to measure is wind pressure. A 25 mph wind blowing directly against fans can increase the static pressure these fans are working against by 0.28", dramatically reducing their air moving capacity. Though this strong of a wind is rare during hot weather, it is important to realize that wind speeds as low as 5 to 10 mph can significantly increase the static pressure the fans are working against. You probably have seen the effect wind can have on a fan's air moving capacity on a windy day. A strong breeze hits a tunnel fan and the shutters on the fan partially close. The wind lets up and the shutters open again.

The advantage of a fan with a high air flow ratio is that as shutters and pads get dirty or the wind starts to blow, air flow will not be affected nearly as much as with fans having a low air flow ratio. So, if you went a couple of weeks without cleaning your shutters or the wind starts to blow on a hot day, your air flow may only decrease 10% if you had a fan with a high air flow ratio, whereas air may decrease 30% of more if you had fans with a low air flow ratio.

It is important to note that there are a number of fans that have a very good air flow ratio but a poor energy efficiency rating. Conversely, there are many fans that have a good energy efficiency rating, but a poor air flow ratio. What you should be looking for in a fan is balance. At a minimum you want a fan with an energy efficiency rating of at least 19 cfm/watt and an air flow ratio of at least 0.67. But, do not set your sites too low…there are fans that have energy efficiency ratings of 23 cfm/watt and air flow ratios over 0.80.

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