Poultry Ventilation Pointers

ALABAMA COOPERATIVE **Extension** SYSTEM

Auburn University

Choosing Fans for Tunnel Ventilation

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If you are buying new fans for a broiler house, or refitting an old one, you're really buying *air flow*, and you want to make sure you get adequate fan capacity. Other factors, including initial cost, operating cost, durability and reliability, warranties, and ease of maintenance are also important. The prime factor, however, is getting fans that will move air at the rate you need.

Fans must produce high air velocity and change house air at least once per minute

How much fan capacity do you need? For tunnel ventilation, you need enough to *exchange house air at least once every minute*. For a 400-foot house, that means fan capacity to move air at least 400 feet per minute. For a 500-foot house, the fans have to move air at 500 feet per minute. This rate of exchange gets rid of house heat, and the high air velocity produces the wind-chill cooling effect on the birds. If your fans don't have the air-moving capacity needed, bird performance is going to be hurt.

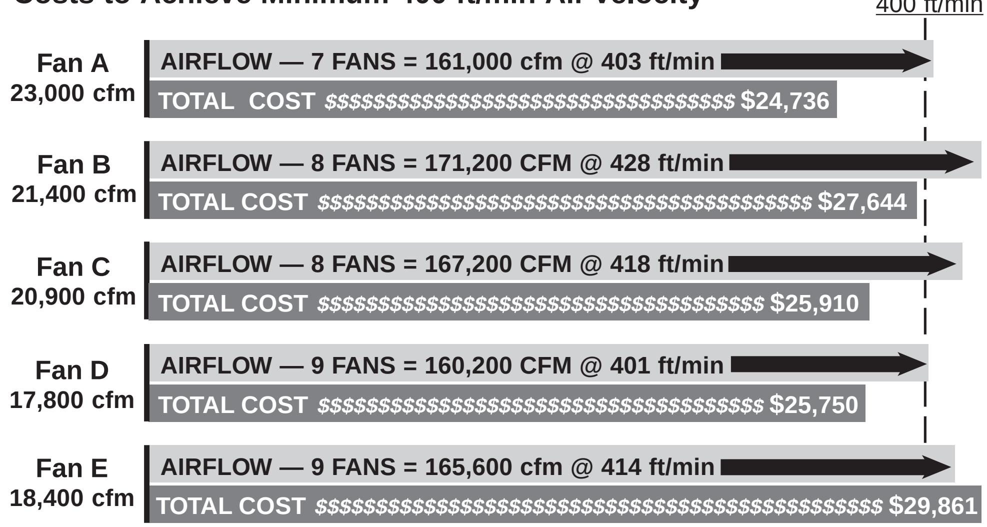
Number of fans needed depends on fan capacities; *efficiency* affects costs

How many fans will you need to accomplish this rate of airflow? Since not all fans are created equal, that will depend on the air-moving capacity (cubic feet per minute) of the fans you select. Operating cost is another factor to consider, and that will depend to a large extent on the efficiency of the fans you choose. A fan's efficiency rating (cfm/watt) tells you how many cubic feet per minute the fan can pump on one watt of electric power. Higher numbers are better.

To make the best fan decision, it's a very good idea to consider all the factors involved over the expected life of the fans. The chart below gives you a ten-year performance and cost comparison for five typical broiler house exhaust fans. For each fan, the figure shows how many are needed to meet or exceed the 400 feet per minute requirement (for a 400-foot house), what the total fan capacity and air velocity will be, and estimated total ten-year costs. As you can see, getting adequate airflow isn't cheap; but choosing the right fan can save big bucks down the road. And here's a surprise: Fan A, the ten-year least-cost leader, has the highest list price; Fan D has the lowest list price.

Choosing the right fan can make a BIG difference in long-term costs

Ten-Year Comparison: Number of Fans, Airflow and Total Costs to Achieve Minimum 400 ft/min Air Velocity



Note: Total cost is fan price times number of fans needed, plus ten-year operating costs, based on $0.10 per Kwh. Airflow based on 400-foot house operating at 0.05 static pressure.

Now, let's sort the factors out one at a time.

How Many Fans Will Be Needed?

The old rule of thumb ain't necessarily so!

The figure shows you that the old rule of thumb, "Eight fans for a 400-foot house, ten fans for a 500-foot house," isn't necessarily so. A typical 400-foot broiler house will have a volume somewhere around 160,000 cubic feet (40 ft x 400 ft x 10 ft). Most of this volume is empty space, that is, air. So it takes eight 20,000 cfm fans to exhaust that amount of air in one minute.

That is, the rule of thumb is right only if the fans have the capacity to move at least 20,000 cubic feet of air per minute. Higher fan capacities will give you a "cushion" over the minimum requirements, turning over house air quicker and producing higher air velocities. Lower fan capacities result in slower house air exchange and air velocities below 400 feet per minute.

Fan ratings are based on static pressure

Important: Fan capacities are rated for a specific static pressure. Typically, fan cfm drops as static pressure increases. Fan selection should be based on the fan's cfm rating at 0.05 inches sp, which is typical for tunnel ventilation.

The rule of high bird performance

The 0.05 sp cfm capacities of broiler house fans on the market and being installed in broiler houses range from around 16,000 to over 24,000 cfm. If the rule of thumb (that only counts fans) is used, some of these houses are seriously under-ventilated. Some may have more fan capacity than needed, but this is not usually the case. The best rule to follow could be called the *rule of high bird performance*, which means buying whatever number of fans it takes to get *at least one air exchange per minute*.

How Can I Tell What the Air Velocity Will Be?

Changing air in a 400-foot house in one minute automatically results in an air velocity of 400 feet per minute. To calculate actual air velocity, you divide the total fan capacity by the cross-sectional area of the house (width times average ceiling height). In the above example with a total fan capacity of 162,000 cfm, if cross-sectional area is 400 square feet (10 ft x 40 ft), you will get 405 feet per minute (162,000 divided by 400).

House cross-section is critical for air velocity

For a given total fan capacity, cross-sectional area can make a big difference in air velocity and the air exchange rate. For example, if you don't have a drop ceiling (or at least diverters or baffles), and average ceiling height is 12 feet, cross-sectional area will be 480 square feet and that 162,000 cfm total fan capacity gives an air velocity of only 337 feet per minute. And since the house's actual volume is 192,000 cubic feet, that fan capacity totaling 162,000 cfm will not give a one-minute air exchange rate. On the other hand, if ceiling height is only 9.5 feet, air velocity will be 426 feet per minute, and the air exchange rate will be well over one per minute.

What Will Fans Cost to Run?

High efficiency fans mean low operating costs

Like fan capacity, fan efficiencv also varies with static pressure, and the number you want to pay attention to is efficiency at 0.05 sp. Cfm/watt ratings at this pressure typically range between 16 and 30. Higher numbers mean lower operating costs. For example, a 20,000 cfm fan with a 16 cfm/watt rating will cost 12.5 cents per hour to run if power costs ten cents a Kwh. A 20,000 cfm fan rated at 20 cfm/watt will cost 10.0 cents an hour to run, saving 20 percent over the less efficient 16 cfm/watt fan. The more efficient fans usually come with higher price tags, but often these fans more than pay for themselves over time by cutting the electric bills. In comparing fans, it makes sense to do the arithmetic to make sure you not only get adequate airflow, you get it at the lowest long-run cost.

Putting the Numbers Together –

Table 1 is the kind of chart you might put together to compare fans on the basis of list price and airflow achieved. The five fans are the same ones given in the chart on page 1, again listed in order of manufacturer's list prices. This kind of table shows how many fans you would need for a house, the resulting air velocity and exchange rate, and the capital outlay required (installation not included). Based on this comparison, Fan E looks like an obvious choice.

Table 1. Example Airflow and Fan Cost Comparison for Typical 400-foot House, Selected Fans

	list price	cfm @ 0.05 sp	fans needed for 400 fpm or better	house total fan capacity	air exchanges per minute	total fan cost for house
Fan A	$1,208	23,000	7 fans – 403 fpm	161,000 cfm	1.01	$8,456
Fan B	$1,008	21,400	8 fans – 428 fpm	171,200 cfm	1.05	$8,064
Fan C	$840	20,900	8 fans – 418 fpm	167,200 cfm	1.04	$6,720
Fan D	$780	17,800	9 fans – 401 fpm	160,200 cfm	1.01	$7,020
Fan E	$699	18,400	9 fans – 414 fpm	165,600 cfm	1.03	$6,291

Although nine would be needed, Fan D does the job at lowest capital cost

Table 2 displays the operating costs, based on efficiency ratings at 0.05 sp, projecting the costs for a year's operation, then adding fan prices for the overall ten-year cost shown in the chart on page 1. This comparison shows that Fan A's high efficiency yields the lowest estimated ten-year total cost, even though this fan carries the highest list price. Factoring efficiency and operating costs into the comparison shows how important it is to ask not just what fans cost but how many fans are needed to get the required airflow, and what the long-term total costs will be.

Table 2. Example Operating and Ten-Year Cost Comparison for Typical 400-foot House

	list price	cfm @ 0.05 sp	efficiency cfm/watt	operating cost per hour/fan	house operating cost/hour	house operating cost/year	ten-year total cost
Fan A	$1,208	23,000	24.3	9.5 cents	$0.67 – 7 fans	$1,628	$24,736
Fan B	$1,008	21,400	21.4	10 cents	$0.80 – 8 fans	$1,958	$27,644
Fan C	$840	20,900	21.3	9.8 cents	$0.78 – 8 fans	$1,919	$25,910
Fan D	$780	17,800	20.9	8.5 cents	$0.77 – 9 fans	$1,873	$25,750
Fan E	$699	18,400	17.2	10.7 cents	$0.97 – 9 fans	$2,357	$29,861

Note: One-year operating costs assume an electric rate of $0.10/Kwh and are based on all fans running 50% of the time in summer (4 months), 25% in spring and fall (4 months), and 10% in winter (4 months). This is necessarily a rough estimate, since actual operating hours vary widely, but serves for purposes of comparison. Ten-year costs are sum of total fan initial costs (Table 1) and ten years' operating costs.

High-efficiency, high-capacity fans can be cheaper in the long run

All cfm and efficiency numbers presented above are drawn from independent BESS lab tests (see page 4). It should be noted that such laboratory test data give only one-time performance information on new fans. Since fans are usually expected to last at least ten years, factors such as reliability and durability should also be considered, but have to be judged by means other than laboratory tests. Installation, maintenance and interest costs could also be factored into the decision process. These costs are not considered here since they are highly variable and also usually small compared with initial and long-run operating costs. In addition, there are some good reasons to consider buying at least a bit more than the minimum requirements for house airflow, as we'll see next–

Other factors should also be considered

Reasons for Buying an Airflow Cushion

Three good reasons for buying *more than* minimum fan capacity

So far, we've explained how to judge fan airflow delivery and costs, based on a minimum requirement for house air exchange and air velocity. Since fan capacity numbers rarely work out to exactly match the house requirement numbers, you almost always end up with your given number of fans not just meeting but exceeding the minimum. There are good reasons to be happy about this, good reasons to deliberately buy a *cushion of fan capacity* over the minimum requirement for hot-weather ventilation:

First, having a cushion allows for the loss in air-moving capacity that inevitably happens over time from dust build-up, belt slippage, or just ordinary fan wear.

Second, having an average house air velocity well over 400 feet per minute compensates for the slightly lower velocity usually found at bird level, and allows you to better cope with extreme heat waves and the added heat involved in growing larger birds.

Third, fan capacities decrease with increasing static pressure, so that if the house is operated at higher static pressure, air velocity will drop. Evaporative cooling pads, for example, usually increase static pressure slightly. While properly designed air inlets for cooling pads result in only a small increase, a set of fans that meets only the minimum requirement at 0.05 sp might be inadequate for evaporative cooling.

Good bird performance in hot weather depends to a great extent on the adequacy of your ventilation system. Here are the main points to keep in mind:

Buy fan capacity to give good airflow and low costs over time, and do the maintenance!

✔ Above all, if you're buying new fans, buy adequate capacity to achieve at least 400 feet per minute air velocity and at least one air exchange per minute.

✔ Consider buying a cushion of fan capacity above the minimum to insure against the inevitable airflow losses that come with an aging house and fans.

✔ Look at fan efficiency ratings and operating costs, not just fan prices, and look long and hard before buying any fan with a cfm/watt efficiency rating less than 20. Electric power rates are more likely to go up than down, and holding down long-term operating costs is the key to long-term profits.

✔ Do the regular maintenance to make sure you keep on getting the fan performance you paid for – keep belts in good condition and not slipping, check shutter operation, and keep fan blades, shutters and cooling pads clean.

Base fan purchase decisions on good information

Note: In choosing fans, it is best to get data from an independent testing lab in addition to the manufacturer's literature. Test results will specify how the fan is equipped (belt vs direct drive, shutters, cones, etc.) and list fan speed, airflow (cfm), and efficiency (cfm/watt) at various static pressures. The most important numbers are the ones for cfm and efficiency at a static pressure of 0.05 inches, which is typical for tunnel ventilation. Two sources for independent testing results are:

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