The *Poultry Engineering, Economics & Management*
NEWSLETTER

Critical Information for Improved Bird Performance Through Better House and Ventilation System Design, Operation and Management

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Evaluating Costs of Tunnel Ventilation Fans

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Growers continue to ask us for help in selecting fans for both new and retrofit poultry housing. We can make no specific brand name recommendations, but we do try to provide the most up to date information on fan engineering and economics and to explain the criteria that enable growers to make sound fan decisions.

The tunnel fans are the engine of a tunnel ventilated broiler house. They run thousands of hours per year and consume a great deal of electric power. So, when making a fan purchase decision, a grower must consider not just initial costs but long-term or lifecycle costs, including total purchase price, interest and operating costs.

Finding Good Information on Fan Performance

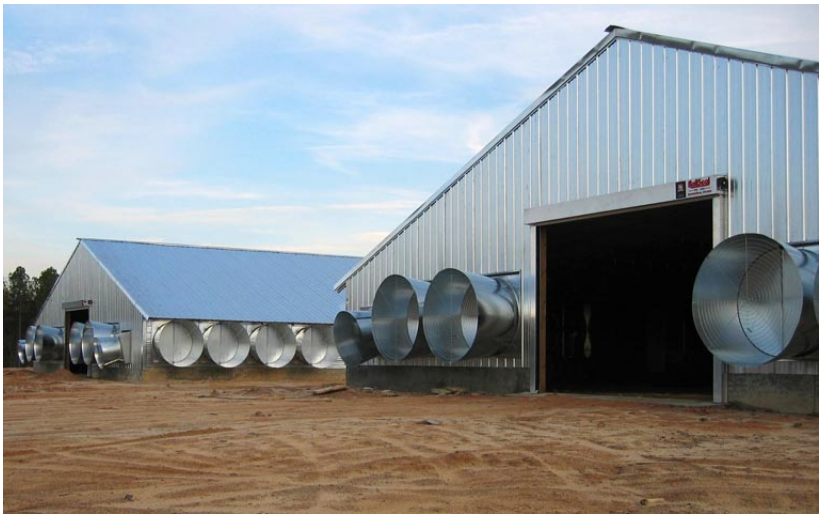
One of the best places to get unbiased fan performance information is the BESS lab at the University of Illinois (the website is www.bess.uiuc.edu). All fans that have been tested by the BESS lab are posted on the website. All fans are tested in exactly the same way, which allows you compare apples to apples. Go to the main page, select performance tests, choose a manufacturer, size and airflow rating and you can look at a multitude of unbiased test information.

However, while the BESS lab fan tests provide the essential (and unbiased) data you need to make good fan decisions, the lab tests are probably not the best place from which to start the decision-making process. The reason is simply that there are so many fans listed that the amount of data available can be overwhelming. Some might be for poultry, some for swine. Some are steel housing and some are fiberglass. Just about every type of fan you can imagine that has been tested is on a manufacturer's section of the web site with the BESS test results.

We suggest narrowing down some of the choices before going to the BESS website. First, of course, you must have a good idea of what your minimum acceptable performance criteria are before you start looking at individual fan models and tests. Determining the fan size, airflow rating, type of shutter and minimum energy efficiency rating first allows a grower to more quickly focus only on the specific fan models and manufacturers that meet your performance needs.

The second important consideration is that working with a good local installer who will service what he sells can

With today's larger poultry houses, often larger and more numerous fans are being installed to meet tunnel ventilation needs. Under these conditions, and especially in view of rising energy prices, it has become even more important for growers to consider fan energy efficiency and long-term operating costs in making fan buying decisions. This newsletter suggests a process for making sound fan buying decisions and introduces a spreadsheet tool to make it easier for growers to compare fan performance and true lifecycle costs.



be very important when retrofitting or building, and there may be only one or two local equipment installers who can do a good job furnishing, installing, and servicing fans. So, looking at all of the test data on the web site would not be the best use of your time. You need to be looking at fan models and manufacturers that you have access to and would feel good making a purchase from, and getting the local distributors to provide their fan recommendations to you. After this information is in hand, you can visit the BESS lab website to evaluate the different fans and decide if they meet your criteria. Note: It is also very important when making the final buying decision to tell your supplier very specifically that you want to purchase XYZ fan equipped with shutter, motor, etc. as tested in BESS test No. 123456.

Determining Fan Selection Criteria

Fan selection can become a very complex issue and a lot has been written by experts on this topic. However, the most important factors are fairly easy to understand and if you do your homework on these points that matter the most, you should be able to make buying decisions with confidence. The overall most important point to keep in mind is that while we must be looking at the initial costs and performance specifications for individual fans, it is how the total house fan package performs, including lifespan operating costs, that must make up the final criteria.

Fan CFM and other basics: Most fans installed in modern broiler houses have galvanized steel cones. Fiberglass is great but to keep costs down most growers go with steel housings. The type of shutter must also be decided. Plastic, aluminum or the newer butterfly type shutters are all available. A newsletter could be written just on the different types of shutters. The most basic requirement is airflow, the cfm rating. Fans must be able to deliver the air exchange rate and the tunnel air velocity needed. Note that fan cfm ratings depend on the static pressure. Most manufacturers will rate fans at 0.05 inches SP; however, the more realistic working pressure to assume in a modern tunnel house is 0.10 inches. So all fan comparisons should be based on their cfm's at 0.10 SP.

Ten years ago 48-inch fans were the choice hands down. Today with larger houses and increasing airflow needs, larger diameter fans are being installed and there are more choices to make among fans of different diameters and horsepower ratings. This means if we are doing a retrofit we also need to look at how well fans will fit into our existing structure.

The grower must realize also that it may be a mistake to jump on a fan just because it's big and will mean fewer fans to buy, install and maintain. That is certainly a benefit of having the larger fan choices, but it should be balanced against the possible advantage of getting lower lifespan operating and total costs with, say a package of ten smaller but more efficient fans rather than eight or nine of the larger fans. This can easily happen because long-term operating costs of tunnel fans can be three to four times their initial purchase price. Installing fewer, larger diameter and/or higher horsepower fans might turn out to be the right thing to do, but the point is you need to be aware of total long-term costs for the entire building package, not just initial cost and convenience.

CFM/Watt: This is the energy efficiency ratio of the fan. The higher the cfm per watt number the less electricity it takes to move the air. A fan with a 20 cfm per watt rating will cost 20% less to operate than a fan with a 16 cfm per watt rating. Many ten year-old fans have very low cfm per watt numbers. Some are less than 16. Some of these old fans are also direct drive. A tremendous energy savings could be made by replacing these fans with higher efficiency models.

On the average a good rule of thumb is that your tunnel fans in the broiler belt will run about 3000 operating hours per year. So if we had ten fans that moved 22,000 cfm at 16 cfm per watt the total yearly power bill would be $4125 based on electricity at $0.10/kwh. The formula for determining the cost to run a fan for 3000 hours at $.10 /Kwhr at 0.10 static pressure using the Bess data is:

Operating Cost = (cfm at 0.10SP/cfm/watt)/1000 x 3000 hrs x $.10 /Kwhr

If new fans were chosen that delivered 20 cfm per watt the yearly power bill would be $3300. This is a 20% reduction in the power bill. Fans can be bought with energy efficiency ratios in the mid to high 20's. But the extremely high energy efficiency ratios are often much more expensive. The point is each time you improve cfm/watt by 1, the operating cost of the fan goes down by about 5%. The above example is an over simplification but it does illustrate the need to evaluate cfm/watt for tunnel ventilation fans.

Airflow Ratio: As static pressure increases in a broiler house, the fans must work harder to draw the air into the house and the amount of air they are able to draw into the house decreases. So wind speed, wind chill and bird cooling decrease as the fans have to operate under higher static pressures. In essence the airflow ratio is a number that describes how well the fan keeps pumping air as the amount of restriction increases. It is a ratio

Tunnel Fan Lifecycle Value Comparison – Same size fans with different airflows and efficiencies

	Annual Interest Rate	8.00%	Length of Loan (yrs)	10
Fan Specifications & Performance				
	Example Fan #1	Example Fan #2	Example Fan #3	Example Fan #4
Bess Labs Test Number	-----	-----	-----	-----
Manufacturer	-----	-----	-----	-----
Model	-----	-----	-----	-----
Catalog No.	-----	-----	-----	-----
Horse Power	1.0	1.5	1.0	1.5
Size / Drive	50” / Belt	50” / Belt	54” / Belt	54” / Belt
Shutter	Plastic	Plastic	Aluminum	Aluminum
Housing / Cone	Galvanized	Galvanized	Galvanized	Galvanized
Assumed Grower Cost Each:	$740.00	$765.00	$965.00	$975.00
Static Pressure Used	0.10	0.10	0.10	0.10
CFM	22,400	25,800	23,500	27,500
CFM/Watt	20.1	16.4	24.5	18.1
Building Ventilation Performance				
Width (ft)	40	40	40	40
Length (ft)	500	500	500	500
Eave height (ft)	7.50	7.50	7.50	7.50
Peak height (ft)	10.50	10.50	10.50	10.50
Number Fans Used	10.0	9.0	10.0	8.0
Total Building CFM =	224,000	232,200	235,000	220,000
Air Exchange (sec) =	48	47	46	49
Tunnel Velocity (FPM) =	622	645	653	611
Yearly Electrical Cost				
Power Cost ($/kWh) =	$0.100	$0.100	$0.100	$0.100
Operation (hrs/year) =	3000	3000	3000	3000
Yearly Power Cost =	$3,343.28	$4,247.56	$2,877.55	$3,646.41
Fan Purchase Cost				
Fan System Cost =	$7,400.00	$6,885.00	$9,650.00	$7,800.00
Yearly Payment =	$1,102.82	$1,026.07	$1,438.13	$1,162.43
Total Purchase and Operation Cost				
Total Yearly Cost =	$4,446.10	$5,273.63	$4,315.69	$4,808.84
Total Cost Over Loan =	$44,461.02	$52,736.29	$43,156.86	$48,088.39

This table is generated by a spreadsheet tool designed to help growers compare and choose tunnel fans, based on total house ventilation needs and total lifecycle costs. Table cells shaded yellow are filled in by the user, based on house ventilation needs and information from fan suppliers and/or BESS lab tests. The spreadsheet generates the rest of the numbers, providing yearly and total lifecycle costs. This Excel spreadsheet has been posted on www.poultryhouse.com in an easy-to-use format. Feel free to download this tool and modify it with your specific house and fan information.

The example shown here is for a poultry house requiring at least 600 fpm tunnel air velocity and house air exchange under one minute. Two 50-inch and two 54-inch fans are being compared, each pair being nearly identical except for one having higher energy efficiency (cfm/watt) and being equipped with a smaller, 1-horsepower motor, and the other a larger 1.5-horsepower motor but lower energy efficiency. Note that all four fans satisfy the air velocity and air exchange requirements, but with different numbers of fans being required – and with very different cost outcomes. The bottom-line “Total cost over loan” numbers show how great an impact energy efficiency can have. For each pair of fans compared, it takes more of the higher cfm/watt model fans (#1 and #3) to meet the ventilation needs, but total costs are thousands of dollars less over the life of the loan. And fan #3, with the highest energy efficiency (cfm/watt), has the best airflow numbers and the lowest long-term cost.

Disclaimer: This table is intended as an example for teaching purposes only. Cost numbers may vary by manufacturer and local suppliers. Framing and installation costs are not included in the table, nor are costs for installation of additional electrical circuits. No recommendations are intended or implied.

of the air moved at a 0.20 pressure divided by the air moved at a 0.05 pressure. In general fans with higher airflow ratios cost more than fans with low airflow ratios. Buying fans with higher airflow ratios, say 0.75 or higher, is basically buying insurance that the ventilation system will maintain needed airflow under conditions of heavier than normal load, such as when shutters and evaporative cooling pads are allowed to get dirty. Fans with airflow ratios below 0.70 won't perform very well when shutters and pads are dirty and we are operating at pressures above 0.10 inches in a modern broiler house. Fans running in pullet houses or where the inlets are restricted by light traps should be chosen with higher airflow ratios. Fans with constant exposure to windy conditions also need a higher airflow ratio. Windy conditions are not as prevalent in the broiler belt during hot weather as they are in other parts of the country.

Making the Decision

In choosing tunnel fans, the basic task is to determine the fan package that will produce the needed airflow under the conditions of operation for your house, and do the job needed at the lowest cost. Initial purchase price is important, but higher-priced fans with better energy efficiency may yield lower total long-term costs. This can happen even when more fans are required to meet the airflow needs, because tunnel fans typically cost up 3 to 4 times the initial purchase cost in electricity over their useful life. Key points to keep in mind in buying tunnel fans:

- ✓ For broiler houses, evaluate fans based on airflow produced at 0.10 inches house static pressure.
- ✓ Look at airflow ratio – fans with airflow ratio below 0.70 won't perform well under full tunnel load or with dirty pads and shutters.
- ✓ In evaluating fan cost/performance specifications, judge on the basis of the fan package required to meet house airflow needs, not just on individual fan specs.
- ✓ Balance likely higher initial costs for high-efficiency fan packages with lower long-term total costs.
- ✓ Buy from a dealer you trust who will provide good service over the life of the equipment. Buy fans equipped as tested by BESS Labs.

As an aid to growers, we have developed an Excel spreadsheet that is now available on the www.poultryhouse.com website. On page 3 of this newsletter we reproduce comparisons of two pairs of fans using this spreadsheet tool with inputs from actual BESS Lab fan test data. As you can see, the long-term total cost figures generated show just how important energy efficiency can be.

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