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Poultry Housing Tips

How Much Evaporative Cooling Pad do I Need?

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One of the advantages of having a tunnel-ventilated poultry house is that you can use evaporative cooling pads to reduce the temperature of the incoming air. Evaporative cooling pads resemble paper air filters and are placed over the large air inlets in a tunnel-ventilated house. They are wetted using fogging nozzles or by dripping water over them. As the air drawn in to the house by the tunnel fans moves through the wetted pad, water evaporates off the pad reducing the temperature of the air.

Depending on the type of pad used you can expect between 10 and 20 degrees of cooling on a hot summer day in the southeastern United States. This with the additional ten degree windchill effect produced by air movement down the house can keep birds cool and comfortable during the summer months. Evaporative cooling pad systems have the added advantage of keeping most of the water out of the house. By keeping the water on the pad instead of in the house, the litter stays drier, fans and equipment remain cleaner, maintenance is reduced, and equipment life is increased.

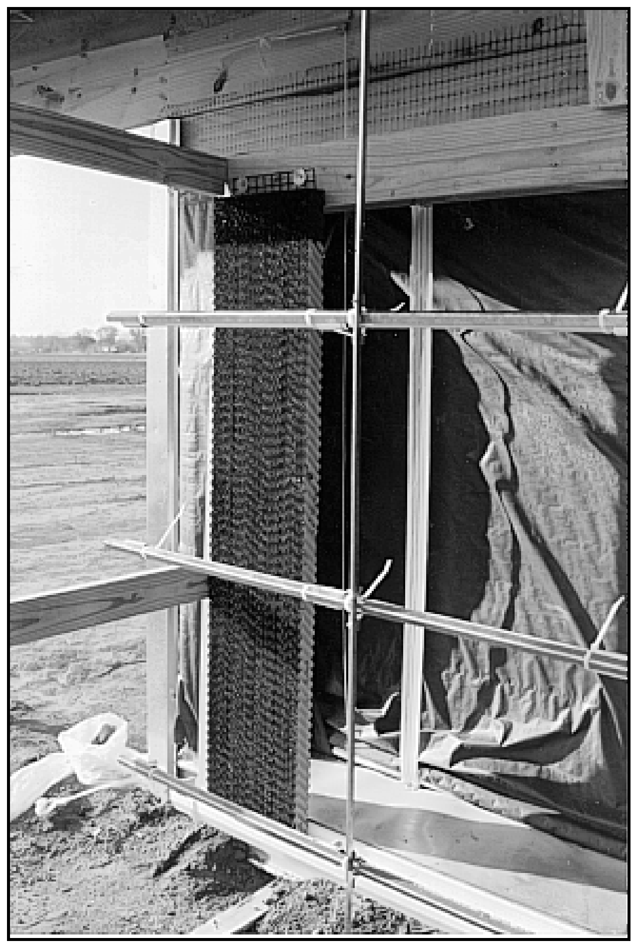

Figure 1. Installation of 2" Fogging-Pad.

There are primarily two types of evaporative cooling pad systems: fogging-pad and traditional circulating pad systems. The only real difference between the two types of systems is the way the evaporative cooling pads are wetted. Traditional circulating water evaporative cooling pad systems have been used by segments of the poultry industry for over 20 years. A PVC pipe with small holes is placed above the pads in a shroud that directs the water pumped through the holes onto the top of the pad. The water flows down the pad into a gutter. The gutter collects the water and funnels it into a storage tank. A pump in the tank pumps the water back into the PVC pipe over the pad where the process is repeated. In a fogging pad system, the pad is sprayed with nozzles located in front of the pad. Any water which is not evaporated typically runs off onto the ground.

Regardless of how you wet the pad, there are specific recommendations on the minimum amount of evaporative cooling pad a tunnel-ventilated house should have. These recommendations help to insure maximum air flow and bird cooling. Failure to follow these recommendations can seriously reduce growers' ability to cool their birds during hot weather.

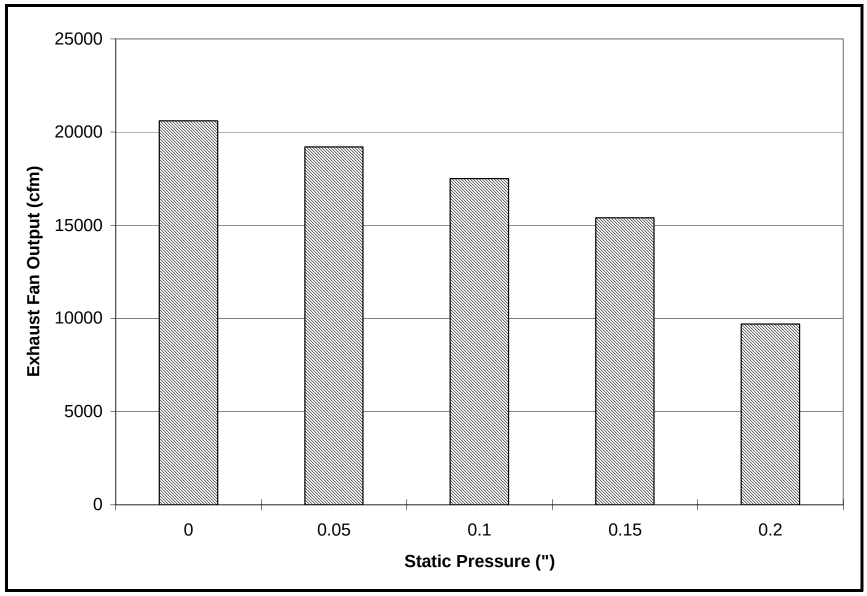

Figure 2. Exhaust Fan Performance and Static Pressure

Air movement is crucial in a tunnel-ventilated house. Without it we lose our windchill effect and the house temperatures will rise (especially near the tunnel fans). When we put an evaporative cooling pad on a house, it is very easy to reduce our air flow if we are not careful. This is because an evaporative cooling pad is essentially an air filter. And as you might expect, it is more difficult for the exhaust fans to pull air through an opening with a filter than through an opening without a filter. If insufficient pad is placed on a house, the exhaust fans' ability to draw fresh air into a house will be reduced. With reduced air flow, the windchill effect will be lessened and the air will stay in the house too long, leading to large temperature differences between the pad and exhaust fan ends of the house.

Static pressure is one way to measure how hard it is for the exhaust fans to pull air into a house. The higher the static pressure (or vacuum) the harder the fans are working to pull air into the house. If the pressure is too high, the amount of air the fans draw into the house will be reduced. Figure 2 illustrates to what degree exhaust fan output is affected by static pressure. At 0.05" static pressure the fans do not have to work very hard to draw air into the house and as a result will move nearly 20,000 cubic feet of air each minute. But, if the static pressure is 0.20", it is so difficult for fans to pull air into the house that fan output is reduced by approximately 50%.

If fan performance were decreased by 50% because of insufficient pad area, the effect would be dramatic. First, the air velocity in the average tunnel-ventilated house would decrease from 400 ft/min to about 200 ft/min, reducing windchill effect by 30 percent or more. Since the air is staying in the house twice as long, the air would heat up twice as much as it travels from the inlet to the fan end of the house. So instead of the exhaust fan end of the house being about five degrees hotter than the inlet end, the difference would increase to ten degrees or more. Furthermore, there would be more pressure on the drop ceiling and fan power usage would increase three to five percent. Power usage would be further increased on days when you should only need seven fans but because of reduced fan performance, eight or nine may be needed to move the required amount of air.

When considering how much pad you should put on a house, you have to decide how high of a static pressure you are willing to tolerate. If you put a lot of pad on a house, the static pressure will be low, but the cost will be high. Conversely, if you put too little pad on a house, the static pressure will be high and air flow will be low, but the initial cost will be relatively low. In general, most engineers find that putting enough pad on a house so that the static pressure does not exceed 0.075" provides a happy medium.

Tables 1 and 2* illustrate how static pressure changes with the pad area for two of the most popular types of pads (assuming 19,000 cfm per 48"fan). As you might expect, it is easier for the fans to pull air through a two-inch pad than a four-inch pad. For instance, if we installed 60 ft^2 of two-inch pad per 48"fan the static pressure would be approximately 0.06". But, if we installed 60 ft^2 of four-inch pad per 48" fan the static pressure would be almost 0.10". Because of the higher static pressure experienced with the four-inch pad, fan output would be decreased from 19,200 cfm to approximately 17,500 cfm, a 13% decrease (Figure 2). That's the same as turning off one 48" fan in most tunnel-ventilated houses. The static pressure experienced using the four-inch pad can be reduced to the same level experienced using a two-inch pad simply by increasing the pad area to approximately 80 ft^2 per 48" fan.

Another benefit associated with increasing pad area is that the amount of temperature reduction produced by the pad increases (Tables 3 and 4). In most cases, the increase in temperature reduction is relatively minimal, but bottom line, more pad equals more cooling.

2" Paper Pad (45º X 45º flutes)	
Pad Area (ft^2 per 48" fan)	**Static Pressure**
40	0.125"
45	0.105"
50	0.085"
55	***0.07"***
60	***0.06"***
65	***0.05"***
70	0.045"
75	0.038"
80	0.035"

Table 1. Static Pressure vs. Pad Area (2" Pad)

4" Paper Pad (45º X 45º flutes)	
Pad Area (ft^2 per 48" fan)	**Static Pressure**
40	0.20"
45	0.165"
50	0.135"
55	0.115"
60	0.095"
65	0.082"
70	0.075"
75	***0.07"***
80	***0.065"***

Table 2. Static Pressure vs. Pad Area (4" Pad)

The italicized pad areas in Tables 1, 2, and 5 are what are generally recommended for most tunnel-ventilated houses. Since a 2" fogging-pad is relatively inexpensive and no expensive distribution system is required, producers would be wise to consider installing 60 to 65 square feet per 48" fan to give themselves a little safety margin. With a four-inch pad, it is advisable not to go much above the minimum recommended amount of pad because of the cost of the pad and distribution system. In most cases 75 to 80 square feet per fan will prove sufficient. If your fans move more or less than 19,000 cfm (@0.05" static pressure), you will have to adjust the amount of pad area per fan accordingly (more cfm's will require more pad).

2" Paper Pad (45° X 45° flutes)	
Pad Area (ft^2 per 48" fan)	**Max. Cooling (°F)**
40	9.4
50	10.6
60	***11.9***
70	12.8
80	13.3

Table 3. Cooling vs. Pad Area (2" Pad)

4" Paper Pad (45° X 45° flutes)	
Pad Area (ft^2 per 48" fan)	**Max. Cooling (°F)**
40	14
50	14.8
60	15.4
70	16
80	***17***

Table 4. Cooling vs. Pad Area (4" Pad)

It is important to realize that a thicker pad does not always result in higher static pressure than a thinner pad. This is because static pressure is affected not only by thickness but also by flute angles. If you look closely at a paper evaporative cooling pad, you will see that it is made up of sheets of paper with quarter- to half-inch angular folds (Figure 3). The pieces of paper are glued together so that the folds form channels going down and up (Figure 4). The angle of these channels or flutes affects static pressure. The steeper the angle, the harder it is to pull air through the pad, and the higher the static pressure. Conversely, the flatter the flute angles, the lower the static pressure. Most pads have flute angles of 45° by 45°. But some pads have flute angles such as 45° by 15°. These 45° by 15° pads would produce a lower static pressure if the same amount (same thickness) of pad is used as a 45° by 45° pad. The only downside of flatter flute angles is that the amount of cooling produced by the pad is reduced.

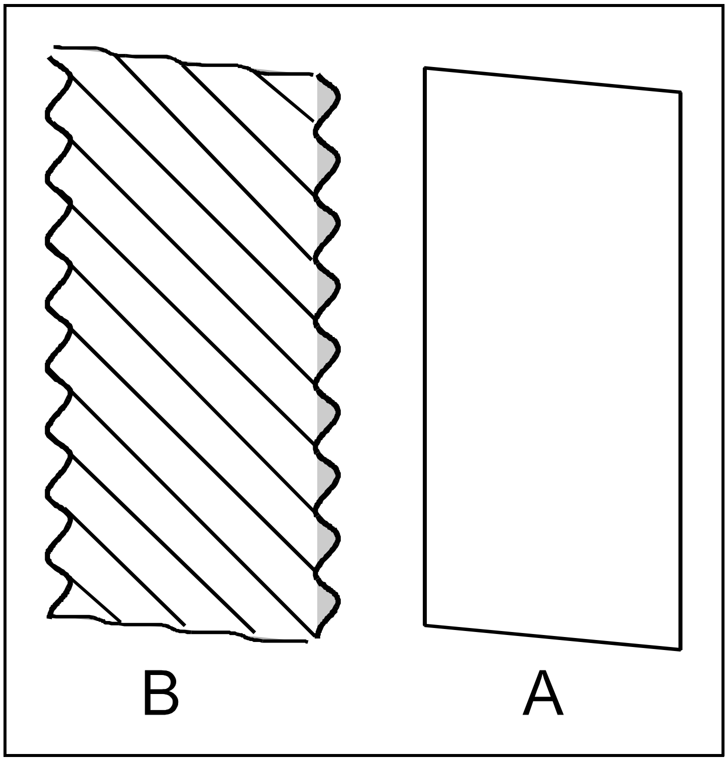

Figure 3. Folded Paper for Evaporative Cooling Pad

A (high efficiency) six-inch 45° X 15° is an example of how static pressure is affected by different flute angles. If you were to install 45 square feet of four-inch (45° X 45°) pad per 48" fan the static pressure would be about 0.165". But, if 45 square feet of six-inch, 45° X 15°, angle pad were installed, the static pressure would only be 0.078" (Table 5). The cooling would be about the same as a four-inch pad, because the reduced cooling due to the flatter flute angle is offset by the fact that the pad is two inches thicker.

Because of variations in pad thickness, flute angles, and flute hole size affect both static pressure and cooling, it is best to contact the pad manufacturer to determine how much pad area you need to make sure that the static pressure does not

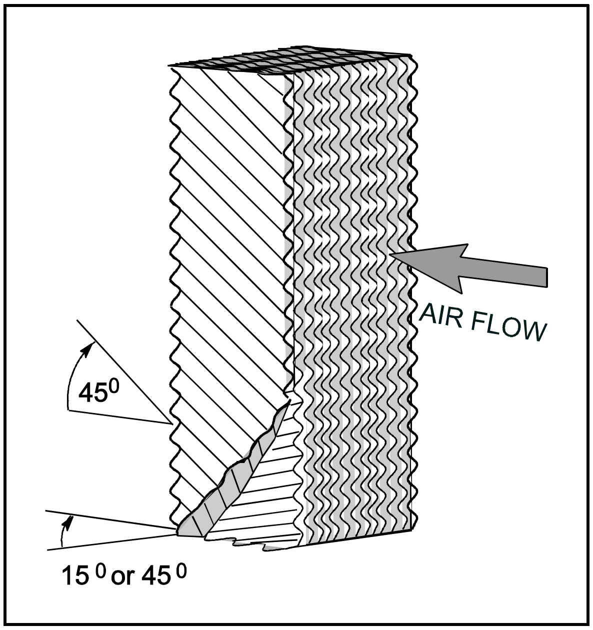

Figure 4. Paper Pad Construction

6" Paper Pad (45º X 15º flutes)	
Pad Area (ft² per 48" fan)	**Static Pressure**
40	0.095"
45	***0.078"***
50	***0.065"***
55	0.055"
60	0.047"
65	0.04"
70	0.035"
75	0.03"
80	0.028"

Table 5. Static Pressure vs. Pad Area (High Efficiency 6" Pad)

exceed 0.075". They can also furnish information on how to best wet their pad using fogging nozzles or drip systems.

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Provided to you by:

*Tables 1 - 4 approximations of the static pressure produced and cooling ability (in the southeastern U.S.) of different types of pads. Cooling and static pressure will vary due to a number of different factors. These include: outside temperature and humidity, house tightness, pad installation, fogging vs. drip, water pressure, type of fogging nozzle etc.

Other *Poultry Housing Tips* newsletters on evaporative cooling pads:

Fogging-Pad Cooling Systems. A First Look. May/June, 1993
Fogging-Pad Installation. August, 1994
Using Cold Water in Evaporative Cooling Systems. September, 1994