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Poultry Housing Tips

Static Pressure and Inlet System Performance

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A house tightness test is conducted on a 40' X 500' broiler house using a 54" tunnel fan that moves 25,900 cfm @ 0.10". With everything closed, the 54" fan generates a static pressure of 0.20", which would be considered a relatively tight house by most. Using the Poultry411 Poultry House Leakage Area Calculator it was determined that the house had a total of approximately 12 ft² of cracks in the end and side walls, tunnel doors, and fan shutters. The producer decides to use the 54" tunnel fan for minimum ventilation and closes half of the house's 40 air inlets. The environmental controller is set to maintain an inlet static pressure of 0.10". As expected, when the tunnel fan operated, the air inlets opened approximately two inches. 65% of the air brought in by the exhaust fan entered through the house's 20 air inlets and 35% entered through cracks scattered throughout the house (Figure 1).

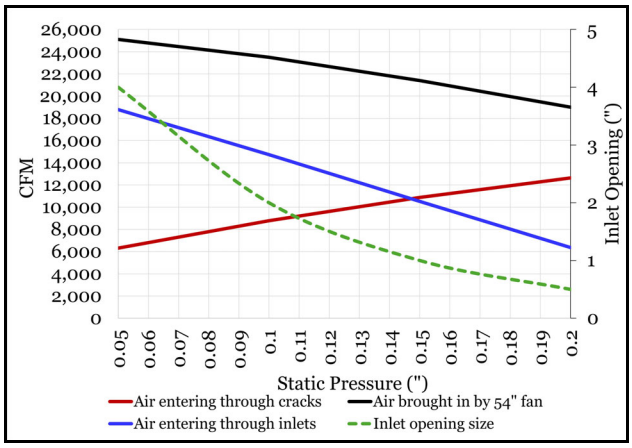

Figure 1. Inlet system performance vs Pressure

Changing the controller's static pressure setting will change the inlet opening size as well as the speed at which the air will enter the house. If the controller's static pressure setting is decreased, inlet openings will increase, and the speed at which the air enters the house will be reduced. If the controller's static pressure setting is increased, inlet openings will reduced, and air will enter the house at a higher speed. For all practical purposes, the total volume of air brought into a house will not change significantly by increasing/decreasing static pressure settings a few points.

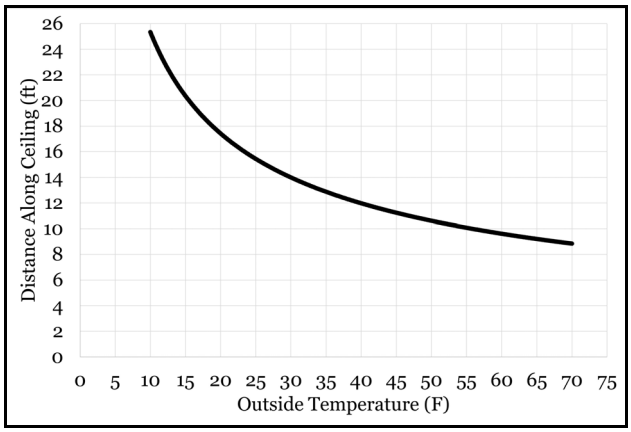

Figure 2. Theoretical distance air will move across a ceiling from a 2" inlet opening (Inside air temperature = 80°F)

Generally, static pressure settings are increased during cold weather because the outside air is heavier than the warmer air inside the house. The heavier the air, the more likely it will drop to the floor before it is fully warmed by the air collecting near the ceiling (Figure 2). By maintaining a higher static pressure, the higher inlet air speed will tend to keep the air next to the ceiling longer maximizing the warming of the incoming air. Higher static pressures are also often sought in wider houses due to the increased distance the incoming air must travel to make it the center of the house. It is essential to remember that static pressure is not the only factor determining how long an air jet will stay attached to a ceiling before moving down to floor level. Inlet opening size plays just as important a role as static pressure.

Care must be taken when increasing inlet static pressure settings because although reducing the inlet opening size results in the air entering the house faster, which can increase how far it moves across the ceiling, as the inlet opening size is decreased, a smaller air jet is created which tends to reduce the distance the air travel across the ceiling (Table 1). So, though the thinner air jet may warm faster than a

thicker air jet and may be warmed sufficiently during its reduced travel distance along the ceiling, it may not travel far enough into the house to ensure that the fresh air brought in by exhaust fans is evenly distributed throughout the house.

Pressure	1" opening	2" opening
0.05"	5'	9'
0.07"	6'	10'
0.09"	7'	12'
0.11"	8'	13'
0.13"	8.5'	14'
0.15"	9'	15'

Table 1. Theoretical distance an air jet will travel across the ceiling (inside = 80°F, outside = 40°F) at various levels of negative pressure

Farm managers often discover they can improve environmental conditions within a house during cold weather, not by increasing the static pressure by reducing the size of the inlet openings, but rather by latching closed half to two-thirds of the inlets in the house. By reducing the number of inlets being used, the static pressure can be increased without reducing the opening size of those remaining in use: same opening size, higher pressure, improved fresh air distribution.

Another potential problem with increasing the operating static pressure is that as static pressure increases, the proportion of the air entering through the cracks increases. This is because as the static pressure increases by reducing the side wall air inlet opening size, the leakage area will remain the same. The more the inlets are closed, the lower the percentage of the total opening area (cracks + inlet openings) the inlets represent. As a result, in the example above, if the static pressure is increased to 0.15", roughly half the air will enter through the cracks and half will enter through the side wall inlets (Figure 1). Since in the typical tunnel-ventilated house most of the leakage occurs near the ends of the house due to poor sealing of the tunnel door/curtains, tunnel fan shutters, and end wall doors, a grower ends up with half the air brought in by exhaust fans ending up near the end walls of a house. Not only will this result in low air temperatures, wet litter, and excessive heater runtime near the ends of the house, but also poor air quality for those birds near the center of the house because they are not receiving a fair share of fresh air. If the static pressure is increased above 0.15", more air will end up entering through the cracks than the air inlets, making matters even worse.

No single combination of pressure and inlet opening will work in all situations. In most cases an inlet opening of approximately two inches and a static pressure of 0.10" is a good place to start. The performance of the inlet system can be evaluated visually by attaching 12" pieces of surveying tape to the ceiling five feet in front of a few inlets in the house, as well as 1/4, 1/2 and 3/4 of the way to the center of the ceiling. Ideally, the surveying tape 3/4 of the way between the side wall and the center of the house barely flickers when the exhaust fans operate. Suppose the air is not making it 3/4's of the way to the center of the house. In that case, the controller static pressure can be adjusted up and down a few points to see if the distance the air travels along the ceiling increases. Keep in mind that increasing the static pressure to above 0.15" is not advised. Suppose the surveying tape at half the distance between the inlet and the center of the house is not moving. In that case, most likely, a portion of the side wall inlets will need to be latched closed to obtain a large enough air jet with sufficient pressure to get the incoming air to the center of the house.

In some cases, additional exhaust fan capacity will be required to obtain the optimal inlet air flow pattern. Ideally, a house is tight enough that a grower can obtain a good inlet air flow pattern by operating 1 cfm per square foot of floor space on a timer the first week or two of a flock (40' X 500' house = 20,000 cfm, i.e., two 36" fans or one tunnel fan). If it is impossible to obtain proper inlet performance, this can be increased to 1.5 cfm per square foot of floor space. It is important to keep in mind that the greater the timer fan capacity, the greater the variation in house temperature and air quality will be every time the minimum ventilation fans cycle.

In summary, effectively managing static pressure and inlet openings is vital for optimal fresh air distribution in a broiler house. By adjusting inlet system static pressure settings, closely monitoring inlet opening size, and strategically closing a portion of house's inlets, producers can maximize the amount of fresh air they can bring into a house during cold weather with a minimum of fuel usage.

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