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Poultry Housing Tips

Air Moving Capacity of Galvanized Door Inlets (Part 2)

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It is well known that the higher the static pressure, the faster the air will enter through an air inlet and therefore the greater the amount of air which will enter through the inlet. But how precisely does velocity change with pressure and similarly how does the amount of air entering through an inlet change with static pressure? To answer these questions, the performance of typical 44" X 7" (42.75" X 5.75" actual opening) and 44" X 14" (42" X 10.75" actual opening) galvanized door inlets were evaluated in a fan/inlet test chamber*. The inlet openings of both inlets were varied from one inch to fully opened and the capacity of the inlets was determined at static pressures of 0.05", 0.10", 0.15" and 0.20"(Figures 1 and 2).

As expected, the air moving capacity of the inlets increased with pressure. For both inlets, regardless of inlet opening size, increasing the static pressure from 0.05" to 0.10" increased the amount of air flowing through the inlet by 41% (Figures 1 and 2). Increasing the pressure from 0.10" to 0.15" only increased the amount of air flowing through the inlet by 22%. This was expected due to the nonlinear relationship between static pressure and air speed established by Daniel Bernoulli in the early 1700's (Figure 3). Bernoulli found that the air velocity is equal to 4005 times the square root of static pressure (Eq 1).

$$\text{Velocity} = 4005 \times (\text{Static pressure})^{0.5} \qquad \text{(Eq. 1)}$$

Where:
Velocity = ft/min
Static pressure= inches of water column

Because of the nonlinear relationship between pressure and air velocity, the higher the pressure, the less difference a point or two in pressure will make in inlet air velocity or inlet capacity. As a result, there is no real advantage of operating inlets at a pressure above 0.15". The primary disadvantage of operating inlets at very high pressures (0.15"+) is that the air-moving capacity of a fan is greatly reduced which

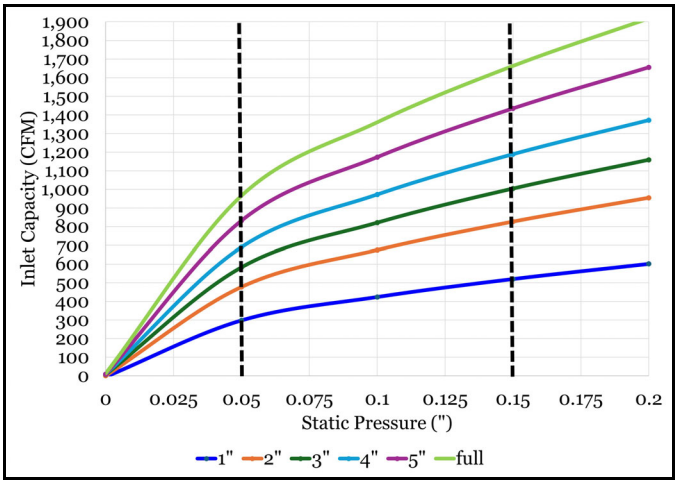

Figure 1. Air-moving capacity of 7" X 44" galvanized inlet as a function of inlet opening and static pressure

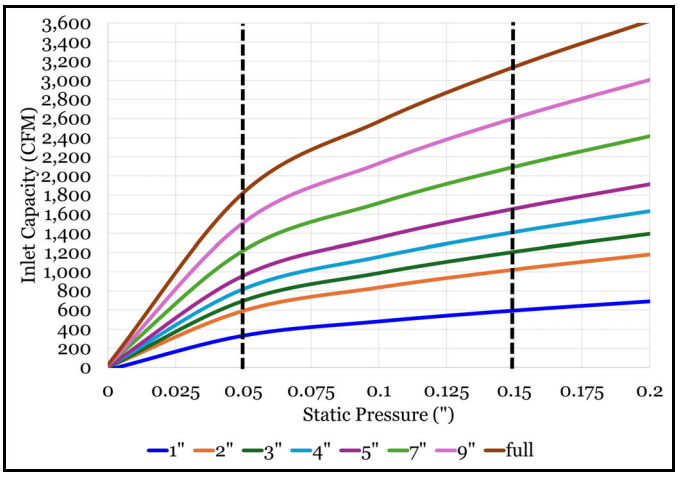

Figure 2. Air-moving capacity of 14" X 44" galvanized inlet as a function of inlet opening and static pressure

results in a reduction in the amount of fresh air brought into a house. Though inlets can be operated at pressures as high as 0.15", it is generally recommended that the number of inlets installed in a poultry house is based on their air-moving capacity when fully opened at a static pressure of 0.10", which would be approximately 1,400 cfm and 2,600 cfm for the 7" and 14" tall inlets, respectively. This means if a producer wanted to operate four, 54" fans (100,000

cfm) through side wall air inlets before transistioning to tunnel ventilation, approximately 70 of the 7" X 44" and 38 of the 14" X 44" inlets would be required. If the operating pressure were to be increased to 0.15", the air moving capacity of the inlets would increase approximately 15% to approximately 115,000 cfm.

It is important to keep in mind that when it comes to operating an inlet system we are actually more interested in the velocity of the air entering a house than static pressure. We are simply using static pressure as an indirect measure of the velocity of the air entering a house's air inlets.

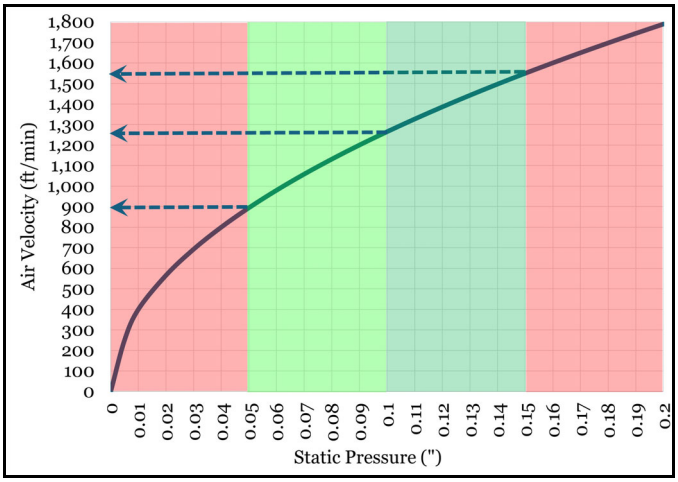

Figure 3. Inlet Air Velocity vs. Static Pressure

Inlet systems are generally managed to produce an inlet velocity of between 900 and 1,550 ft/min, which corresponds to a static pressure range of 0.05" and 0.15" (Figure 3). During colder weather higher velocities are required (1,250 to 1,550 ft/min - 0.10" and 0.15") because the air is heavier and more velocity is required to insure the air will make it to the center of the house before moving down to floor level. When it is warmer outside, the air is lighter so it takes less speed (900 to 1,250 ft/min - 0.05" to 0.10") to get the air to the center of the house. The optimal velocity/static pressure will vary according to inlet design, inlet opening, house width, inlet installation, etc.

During minimum ventilation it is generally recommended that an inlet opening of approximately two inches be used. At a static pressure of 0.10", approximately 700 cfm will enter through each 7" X 44" air inlet and approximately 800 cfm through the larger 14" X 44" inlet. More air will enter through the taller inlet because there is more opening along the sides of the inlet for the incoming air to move through. If the inlet opening is increased to four inches the capacity of the 7" X 44" inlet increases to approximately 1,000 cfm and 1,200 cfm for the taller 14" X 44" inlet. Though the taller inlet has a greater overall capacity, the weakness is that a higher percentage of the air enters a house through the sides of the inlet and not front of the inlet (Figure 4). The problem is that air exiting through the sides of the inlet will be deposited near the side wall where it will tend to cause drafts. For this reason, it is important that the taller inlets have side "flaps" to minimize the amount of air exiting the sides of the inlet, thereby maximizing the amount of air that will be delivered to the center of the house (Figure 5).


Figure 4. Opening alongside of galvanized inlet opened three inches


Figure 5. Side "flaps" to prevent air from exiting sides of a galvanized inlet

In conclusion, the study highlights the critical relationship between static pressure and air flow in galvanized door inlets, emphasizing that while higher static pressures increase air capacity, the benefits diminish at pressures above 0.15". Operating inlets at around 0.10" is advisable to optimize fan efficiency and fresh air intake in poultry houses. Additionally, achieving the right inlet velocity is essential, varying with temperature and house conditions. Taller inlets may provide greater capacity but must be designed with features like side flaps to minimize drafts and ensure effective air distribution throughout the space.

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