Getting a Handle on Managing Attic Inlet Systems

It was more than five years ago that poultry growers in the Broiler Belt began using attic inlets. Their primary reason for installing the inlets was an effort to reduce fuel expenditures as gas prices during the 2000-2005 period were rising. Since their first installation, the success rate with most growers using and managing the inlets has been mixed. Some growers understand the capabilities and limitations of pulling air from the attic and value the attic inlet systems as a tool for fuel savings and moisture management; however, many growers have struggled with their attic inlet systems and pretty much do not use them, citing issues such as requiring too much management and lack of seeing much benefit.

In numerous visits and phone calls to integrators and growers, we have confirmed that that there is a steep learning curve to the proper management of attic inlets and a large percentage of growers haven't been able to execute the management necessary to render the attic inlets a valuable ventilation tool. This document will attempt to address some of the problems we have seen with attic inlet systems and attempt to better explain how to successfully manage them for better results. Attic inlet technology is still very new and we will continue to see technology improvements. The decision to install them should be made carefully. There can be benefits, but potential users must understand that the attic inlet system must be thoroughly understood and properly managed for it to be beneficial.

Basic Facts and Observations

1. Attic inlets are meant to be used during the first stage(s) of ventilation. They should be run at lower static pressures, such as 0.08". Our goal is not to throw the incoming air stream to the house side wall at high velocity. High static pressure and high velocity air is not the goal of an attic inlet ventilation system. We have observed many cases where attic inlets were being run at static pressures well above 0.10".
2. When attic air is 5° to 10° F warmer than outside air, attic inlets serve as a pre-heater for incoming ventilation air. If there is no heat in the attic, such as at night or on cold overcast days, there is no real advantage with using the attic inlet system.
3. Attic inlets are <u>never</u> a license to reduce the minimum ventilation rates. Preheating air can displace some LP/fuel usage used to heat the incoming air, but it does not remove any more moisture from the house. To remove moisture from the house and keep litter from increasing in moisture, we must have sufficient fan run time or minimum ventilation or the house will not remain dry.
4. When attic air temperatures are equal to or above the house set points, attic inlets can provide a tool for increasing ventilation rates and reducing moisture in the litter without burning additional fuel. This is accomplished by the increase in the ventilation rate; it is not that the attic air can absorb more moisture than the outside air when heated to room temperature.
5. When attic temperatures are extremely cold, below 35° to 40° F, attic inlets can become problematic. Cold air is dense and heavy, and falls quickly to the floor. We must guard against driving colder air all the way to the sidewall or allowing it to fall the floor.
6. Attic inlet systems have benefit in spring and fall as ventilation enhancers. They allow us to increase ventilation run times over those minimum requirements, thus achieving more moisture removal and drier floors and houses.
7. When growers are experiencing sunny days with moderate temperatures they often think they can get by with reduced minimum ventilation rates since the attic heats up during the day and drives the ventilation system to increased ventilation based on warmer house temperatures. As soon as they experience cold weather with several overcast days in a row they don't get the daily bump up in ventilation rate during the day and the floors slick over. Minimum ventilation rates must always be set correctly, with or without attic inlets. To avoid this scenario, examine your house every morning at 6:00AM. If the air quality is not good, humidity is up or the litter is getting tacky or damp, you need a higher ventilation rate. It doesn't matter if you are using attic inlets or side inlets.

8. A problem with many attic inlet system installations is the failure or the inability to close attic inlets in the non-brood chamber during brooding. Many people running attic inlet systems leave all the attic inlets in the non-brood end open during the brooding period. If attic inlets in the non-brood end of the house are left open, then approximately 50% of the ventilation air does not pass through the bird chamber. This results in only 50% of the expected moisture and ammonia being removed. As a result, the birds in the brood chamber are often under ventilated by 50%. To address this problem, the recommended minimum ventilation rates should be doubled to compensate for the fact that half of the air discharged from the house does not pass thru the bird chamber. It also means that we may be cooling rather than pre-heating the non-brood end of the house.
9. No matter what type of attic inlet system you have, it is a good idea to have a manual shut off latch on every inlet. This allows the greatest flexibility in the use of attic inlets and allows you to get the maximum benefit from the system.
10. If attic inlets are to be used in conjunction with perimeter inlets, it is absolutely necessary the perimeter inlets open up sufficiently to ensure good air velocity when both are being used. A sidewall or ceiling perimeter inlet that is cracked a quarter to a half an inch will not provide the air velocity necessary for mixing and can be very detrimental to house conditions. See the table below which describes how attic and perimeter inlets must be set so that they do not conflict with each other. In setting up the second stage of ventilation on a controller it is imperative that perimeter (side wall or ceiling type) inlets be managed to ensure sufficient opening for good air velocity.

Ventilation Stage	Fan CFM required	Air Source	Approx Operating SP
1st Stage	20,000 CFM	Attic	.08
2nd Stage	30,000-40,000 CFM	Blend Attic and Perimeter	.10 -.13
3rd Stage	40,000-50,000 CFM	Perimeter	.10 -.13

Commonly Asked Questions Regarding Attic Inlets

How many attic inlets should be placed in a house? A good rule of thumb for the number of attic inlets to install in a house is at least 1 CFM per square foot of floor space, or enough capacity to handle the timer fan volume you plan to operate during your first stage of ventilation. Attic inlet systems are meant for low air flow and relatively low static pressure. More is not better when it comes to figuring the number of attic inlets needed in a house. Having too few is also a major problem. So the number of needed inlets will be based on the airflow of the brand of inlet chosen and its rating at a certain static pressure. Some inlets are rated at 1,500 CFM at a 0.10" pressure others rate their inlet at 1,800 CFM at a 0.10" pressure. You want enough inlets to handle the timer fans. That would normally be 2-36 inch fans. If you know you want to run 3-36 inch fans through the attic inlets, you have to plan for that. Some brands will require 12 inlets for a 40' x 500' house, while other brands will require 14. Check with a technical representative who knows something about the inlet you are considering. It is very important to figure the number of inlets per house correctly.

How should attic inlet systems be managed for half house brooding? The first decision that must be made is whether or not you are going to open the attic inlets in the non-brood end of the house or close them. If the attic inlets are left open in the non-brood end, then the air coming into the non-brood end does not ventilate the birds, it only ventilates the empty portion of the house. This could be a good or bad situation depending on the weather. Some growers would make the decision to close all or some of the attic inlets in the non-brood end of the house and only ventilate the brood chamber. Check the static pressure and be sure the inlets are open enough to give good airflow. If you elect to open all the attic inlets in the non-brood chamber, remember that only the fresh air that enters the brood chamber can be counted for minimum ventilation. So even though you are running 2-36 inch fans, only half of the air being moved is benefitting the chickens in the brood chamber.

Setting Inlets up for Operation

Start with closing up the house tight just like you were getting ready for birds. Make sure the tunnel inlet and side inlets are fully closed. Use the manual switches on your controller to lock the tunnel inlet and vents closed to make sure these do not try to open while you are setting the attic inlets.

Gravity Attic Inlets (Manual Shut Off For Each Inlet)

1. Manually lock on the fans you plan to use as first stage timer fans. The static pressure should go pretty high in the building at this point. If static pressure is low, some of the attic inlets will need to be closed in the non-brood chamber to reach a desired pressure of about 0.08".
2. Check the static pressure of the building with the timer fans on. Then set the static pressure limits for the side vents slightly higher than where you are operating the attic inlets. For example, if you are operating the attic inlets at 0.08", set the limits for the vents at approximately low limit 0.09" / high limit 0.12". You don't want the side vents to open when the first stage of ventilation comes on.
3. When stage 2 fans come on the pressure will go up and the side vents should start working off static pressure. You now have air coming through the attic inlets and side vents. Be sure that when your stage 2 fans come on and your side vents open, they open wide enough to get good air throw. It will likely be necessary to tab closed most or all of the side vents in the non-brood end of the house and perhaps tab closed every other side inlet in the brood chamber to get the side vents that are left open to open to the desired opening to get good air throw. This is <u>critical</u> for maintaining dry floors.

Gravity Attic Inlets on a Hand Winch

1. The most desirable setup would be to have the brood chamber and the non-brood chamber on separate hand winches.
2. Winch closed all attic inlets, then lock on manually the fans you plan to use as first stage timer fans. The static pressure should go pretty high in the building at this point.
3. Back off the hand winch to allow the attic inlets to open. Continue opening the attic inlets until you reach the static pressure you want to operate at when the timer fans run. Around 0.08 s.p. is a good number to shoot for. It is a good idea to in some way mark the main cable so you can return to this point without having to keep checking the pressure on the controller. A cable clamp or ribbon tie on the main cable aligned with a mark on the wall can work.
4. Set the static pressure limits for the vent doors slightly higher than where you are operating the attic inlets. For example, if you are operating the attic inlets at 0.08", set the limits for the side vents at something like low limit 0.09" / high limit 0.12". You don't want the side vents to open when the first stage of ventilation comes on.
5. Return the controller switches for vents and tunnel inlet to automatic.
6. The inlet system should respond as follows through the staging:
    a. Timer fans cycling on/off - attic inlets should open/close with fan cycles and the building should operate at the pressure you chose when they are on.
    b. Timer fans on continuously – attic inlets open and building is operating at the pressure you chose.
    c. When stage 2 fans come on the pressure will go up and the side vents should start working off static pressure. You now have air coming through both the attic inlets and side vents. Be sure that when your stage 2 fans come on and your side vents open, they open wide enough to get good air throw. It will likely be necessary to tab closed most or all of the side vents in the non-brood end of the house and perhaps tab closed every other side inlet in the brood chamber to get the side vents that are left open to open to the desire opening to get good air throw. This is very important for maintaining dry floors.

d. Stage 3 and higher – attic inlets stay in the same position and more air is drawn in through the side vents as fans continue to stage up. When you decide you do not want any more hot air from the attic (hot weather with big birds, system is running in tunnel, etc.), close the attic inlets. Using the hand winch, you can go back and forth using or not using the attic inlet as the weather and bird size dictate.

Attic Inlets on a Machine (Operated by Controller)

Most of the controllers on the market now have attic inlets built into the control logic. Just set the static pressure limits where you want the attic inlets and side vents to operate. A static pressure of 0.08" is a good starting point. You will also need to set up how you want to control the transition from attic inlets to sidewall vents.

There are a lot of opinions on how best to set up the transition. Whenever you need heat or whenever slightly warmer incoming air would be beneficial, run the attic inlets. When the building warms up and you go into a cooling mode you don't need heat any more so you can shut them off. If your control programming allows one stage where you are bringing air from both the attic inlets and side vents (blending) during the transition, this will help keep the system from bouncing back and forth between attic and vent door inlets.

For reference, a typical transition set up would look something like the following:

1. Minimum ventilation-Timer fans cycling or running full time – All the air through the attic inlets at approximately 0.08"
2. As house temp increases, add fan(s) – Transition stage – attic inlets stay in the same position they were when just the timer fans were running. The side inlets open to the correct position to satisfy the additional airflow (pressure) created by adding fan(s). It is very important that the side inlets open to the proper position and not just open to a crack. Again, it may be necessary to tab shut every other vent door in the house during the set up so that when the next fan(s) come on, the doors will open sufficiently to get good air throw into the house. This is very important to maintain a dry floor.
3. Power ventilation for cooling – Attic inlets close and side vents operate off static pressure

Do I Use Stir-Circulation Fans With Attic Inlets?

The main reason we started using stir fans in our houses was to break up temperature stratification - hot air pooling or stratifying at the peak of the house and not getting down to bird level. Stir fans do a good job of moving this hot air down and mixing it with cooler air below, creating a more homogeneous environment. Properly managed perimeter vents help do the same good job of breaking up stratification during their run cycles if they are managed properly. Stir fans can then be used to further mix hot and cold air together. Attic inlets typically installed in or around the peak of a house and having all or at least half of their air flow being directed laterally toward the sidewalls, do not do a good job of breaking up this stratification. This is particularly a problem if you are pulling extremely cold air out of the attic, such as at night or on cloudy, cold days. When cold air is being pulled through attic inlets, stir fans become even more important. The cold air from the attic vents gets either thrown to the sidewalls where it rolls onto the floor, or it simply falls, typically along the feed/water lines, and never mixes well with the hot air at the peak of the house. This can contribute to wet litter problems along the wall and feed/water lines. In either situation, mixing fans can be very helpful in breaking up this stratification. Hence, stir fans in an attic inlet house are very important. When it is cold and there is no heat in the attic, stir fans become even more valuable.

Attic Inlets In Loose Houses

If your house is very loose, you will continue to pull the majority of your minimum ventilation air through the leaks and cracks in the house rather than the attic inlets, just as you were doing with sidewall vents before the

attic inlets were installed. With a small portion of the air being preheated by the attic you will realize little benefit from the installation. The tighter the house the more heating benefit you will see from the attic inlet installation.

Do I Have Sufficient Opening from Outside to Feed the Attic With Fresh Air?

As a rule of thumb, approximately 1 square foot of inlet area from outside into the attic is required to supply 500 CFM of air to the attic inlets. For a 1,500 to 1,800 CFM rated inlet, that works out to about 4 sq ft /inlet. This inlet area is required to prevent the roofline from becoming a restriction to the airflow into the attic. If the available opening into the attic area is too small, the pressure the timer fans realize will run high, thus reducing their airflow. It will also increase the proportion of air entering the building through leaks and cracks, thus reducing the effectiveness of the attic inlets for heating purposes. For example, a house with 12 1,500-1,800 CFM inlets would require a minimum of about 48 sq ft of opening into the attic from outside. This area would be made up of inlets at the ridge, eaves, and any gable vents. Typically there is a 1/2" crack at the ridge line where the ridge cover overlaps the roof metal on both sides. On a 500' house this alone would give about 0.5 x (500 x 12) x 2 sides / (144 sq in/ sq ft) = 41.6 sq ft. The other 6-7 sq ft is easily made up by cracks at the eave or any gable vents that might be installed. If you had more attic inlets in the house (or a shorter house) you would need more open area into the attic which would require additional openings at the eaves or gable. It is always a good idea to run through the numbers to make sure the open area into the attic is adequate. And on larger houses, such as 54, 60 and 66 ft. wide houses, provisions must be made to have enough clear area to allow unrestricted airflow into the attic.

Can I Have Too Much Opening From Outside To Feed the Attic With Fresh Air

Some buildings, in particular many of the steel truss - dropped ceiling style houses, have very large openings at the eaves into the attic. There is often an 8-10" opening covered with bird wire or hardware cloth under both eaves and the ridge cap opening. If you calculate the open area into the attic, it might be in the order of 700 – 800 sq. ft. With this large opening into the attic from outside, even a very light breeze can quickly exchange the air in the attic, keeping it cool. Without the attic heating up during the day, attic inlets would offer only a marginal benefit in this style house. In general, reducing the attic inlet to around 1 square foot / 350-400 CFM of attic inlet airflow will greatly enhance the performance of attic inlets in this style building. For a 1,500 -1,800 CFM inlet we would like to see a maximum attic inlet of around 5 – 6 sq. ft. / inlet. Closing off some of the eave inlet to get to into the 5 - 6 sq. ft. of opening for each inlet would greatly improve attic inlet performance.

Summary

Attic inlets are still a fairly new technology in the broiler industry. There is still a lot to learn and a lot of research is being done to maximize the heat capture from the attic, while streamlining management. Typical installations yield a reduction in heating cost that varies greatly depending on the management by the grower and weather conditions. In addition, drawing warm air out of the attic during the day allows longer run times and the opportunity for more ventilation and more moisture removal with no additional fuel being burned. This leads to drier litter and a fresher environment for the birds over a larger portion of the day, both of which contribute to better bird health and overall performance. However, like any new technology, attic inlets are not a silver bullet by themselves. If they are applied incorrectly and/or mismanaged, the producer will not see the expected benefit.

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