

## POULTRY HOUSES: ATTIC INLETS

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Lately there seems to be a buzz in the broiler industry about “**attic inlets**.” So let’s take a quick look at an idea that might save some heating fuel and perhaps provide drier litter and better air quality as additional benefits.

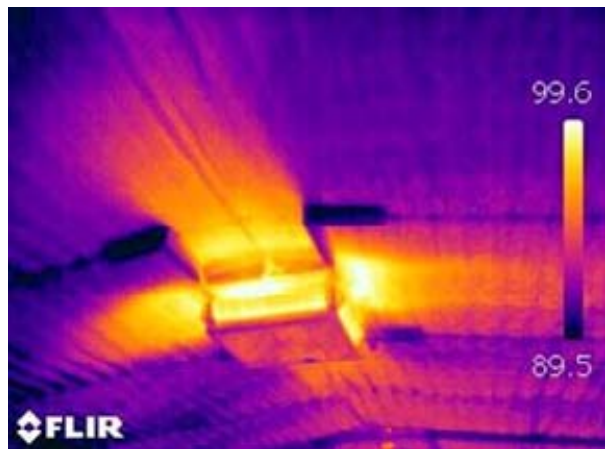
Although new to the broiler industry, attic inlets are a ventilation concept that has been around for quite a while in livestock housing. Rapidly escalating fuel costs have prompted a serious look at attic inlets in broiler houses.

Attic inlets (see figure below) are used to **recover solar heat from the attic** of poultry houses. The large roof areas of dropped ceiling poultry houses make very good solar collectors, so there is a large amount of heat readily available in the attic (see the thermal image below). On sunny winter days, the attic can be 20 - 30 °F warmer than outside air for a few hours and may average about 15°F warmer over a 9-hour day. Attic inlets are used change the winter air inlet system so that minimum winter ventilation air is pulled out of the attic in the center of the building instead of directly from outside over the eaves.

This free solar heat can also help to lower the relative humidity in the house and reduce litter moisture. So in addition to reducing fuel costs, attic inlets also have the potential to improve in-house conditions because of the reduced litter moisture. Of course, there is little or no heat in the attic at night or on cloudy days, so attic inlets provide no substantial benefit at those times.



Attic inlet in the ceiling of a broiler house



Thermal image showing heating entering a broiler house from the ceiling via an attic inlet

Note: In thermal images, blue/purple areas are cool surfaces and yellow areas are warm surfaces

Some producers have already installed attic inlets even though many questions remain to be answered before we know if they are really cost effective. The amount of fuel that may be saved by using attic inlets is strongly dependent on the condition of the poultry houses, the time of year and the weather conditions.

Addition of attic inlets in the houses evaluated as part of the Kentucky Poultry House Evaluation Service can **save an average of 400 – 800 gal LP/house/yr**. The payback period depends on the type of attic inlets installed. The less expensive option is the **gravity inlet** and has a payback period of 2 to 4 years. This type of inlet is more dependent on having a tight house in order to be functional as designed. The gravity inlet is manually operated which can be time consuming when it is necessary to close all the inlets. The **controlled inlets** are more expensive but house tightness is not as critical for proper functioning. There may be more energy savings than with the gravity inlets, but because of the higher cost of installation, the payback period is increased to 5 to 10 years.

## Basic principles

Four fundamental rules apply to attic inlets:

1. Attic air is heated only when the sun shines.
2. Attic air enters the bird space only when the fans operate.
3. **Attic inlets will not operate properly in a house with a lot of air leakage.**
4. Attic inlets are not a year around system. At certain times they can actually supply too much heat and can not be used.

## Installation

An inlet commonly used is a four sided box, about 2 feet square, with a counter-weighted blade (similar to a shutter blade) that covers a 3-inch wide opening on each side of the box. The blades open and close with fan operation and direct air outward in all four directions.

Inlets are usually installed at or near the center of the barn and spaced evenly along its length. If mixing fans are installed along the centerline, move them 2 feet off center. Where fans can not be moved, place inlets 2 feet off center on alternating sides of the centerline.

The number of inlets suggested for a 40' x 500' house ranges from 10 to 14, assuming that two 36-inch or one 48-inch fan is used for minimum ventilation. Unless the house is extremely tight, it is probably best to use 10 or 12 inlets. Too many inlets reduce static pressure below that needed for good air distribution and mixing. For this purpose, a house should be tight enough to produce a static pressure of around 0.15 inches of water (or more) when the barn is completely closed and two good quality 36-inch fans are running. **If a house does not meet that criterion, place priority on sealing air leaks before adding attic inlets.**

## **What to expect**

One potential benefit from attic inlets is fuel savings. Some early reports suggest savings of 5 to 35% may be possible but few, if any, side by side comparisons have been made to measure actual fuel savings. Until more definitive information is available, it would be wise to expect fuel savings at the low end of that range. Remember, nights and cloudy days don't count for collecting heat.

Drier litter and less caking, especially near the sidewalls, also appears to be emerging as an important secondary benefit. Air from the attic inlets enters at the peak of the ceiling and begins mixing with the warmest air in the barn. Thus, the air is relatively warm and dry when it reaches the base of the wall and may have some enhanced drying capacity as it moves across the litter near the wall.

A third potential benefit is better house air quality. At various times, depending on temperatures outside and inside the poultry house, more heat may be drawn in through the attic inlets than is required to heat the barn. At those times, poultry house temperature will rise and fans will begin to operate on temperature control. It is even possible that additional fans will run and sidewall inlets will need to open until the barn is cooled below the control temperature set point. During the time of additional fan operation, both ammonia and humidity in the barn will be reduced, thus freshening the air and drying the litter without requiring any additional heating fuel.

## **Future**

Some other potential benefits, primarily in the summer, remain to be evaluated. Between flocks, heat from the attic might be used to heat the empty barn as an aid in driving some ammonia out of the litter. Likewise, heat from the attic may help pre-heat the barn before placing a new flock. With potential for both fuel savings and improved house conditions, it seems likely that more and better attic inlet systems will be developed. Additional testing and experience will better define the costs, benefits, and operation thus giving growers a sound basis for future decisions and management.

## **Cautions**

It's easy to get excited about potential benefits of a new idea, but there are always two sides to any story.

⇒ First, let's look at the number of inlets to install. Several unknowns in regard to building leakage make it difficult to calculate precisely how many inlets are needed in a particular building. Basically, attic inlets are just holes in the building envelope and there is a bit of guesswork about how big those holes can be without losing static pressure in the barn.

- ⇒ Attic inlets must close when the fans are off. ***Under no circumstances should warm, moist, ammonia laden air be allowed to migrate into the attic.*** This can seriously damage insulation, roofing, and structural framing. Counter weighted blades are self-closing but they must be checked regularly to verify proper operation. Inlets must be manually closed to stop drawing hot air from the attic. This is accomplished by pulling a closure flap down over the counter-weighted blade. In mild weather that changes frequently between warm and cold, manually opening and closing inlets in several barns can be a challenging management chore.
- ⇒ Under some conditions, excess attic heat could prematurely force the ventilation system into tunnel operation. **Such a condition would increase electricity costs and could chill the birds at certain growth stages.** This can be avoided by careful adjustment of control temperature set points and by closing the attic inlets at critical times. Attic inlets installed as described are generally adequate to handle two 36-inch or one 48-inch fan (approximately 18,000 cfm at 0.08 inch W.C.). When additional fans operate, sidewall vents also need to open. The static pressure controller will need adjusting to ensure that sidewall vents open when needed.
- ⇒ If for any reason moist air from the broiler house comes into contact with cold roof surfaces and insulation, condensation will occur. Over time this will cause serious damage to the insulation and the house structure. Attic inlets should always be shut and sealed when no air is being pulled by the fans. This can be a very labor-intensive activity when manual inlet controls are used.