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Principles of Successful Wintertime Broiler House Ventilation

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The principles of successful poultry house ventilation during winter are very different from those applied during summer. Under hot weather conditions, maximum airflow through the house is normally required to directly contact birds for cooling. Ventilation is regulated on and off by thermostat or controller according to house temperature. During cold weather, cool outside air should be prevented from contacting birds. Additionally, to minimize heating costs, ventilation fans are used minimally.

Keeping birds warm enough with good air quality is the primary goal in cold weather ventilation. Wintertime ventilation also aims to remove moisture from the house to maintain good litter condition. During very cold weather, minimum ventilation fans should be controlled by a timer to ensure sufficient ventilation occurs to maintain air quality and to remove moisture.

Following are some key points outlining successful wintertime broiler house ventilation based on poultry industry experiences and university research findings.

1. Seal all house air leaks. A house with many air leaks cannot be properly ventilated.

All air must come in through inlets — not leaks and cracks. Cold air falls, so cold outside air leaking through cracks, curtains, holes and other unwanted openings drops to the floor. This results in condensation, causing wet litter, litter “cake” and poor bird performance. Test house “tightness” by measuring static pressure. If all house doors, curtains and inlets are closed and one 48-inch (122 cm), 20,000 CFM fan is turned on, you should be able to pull a negative

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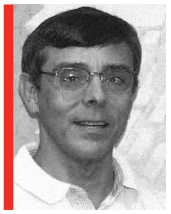
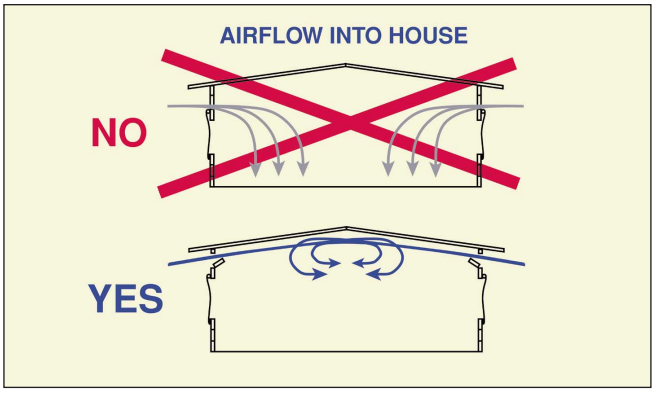


Jim Donald grew up in Athens, Georgia, and completed his undergraduate and graduate training in agricultural engineering at the University of Georgia. In 1970, Donald joined the staff of Auburn University. His present capacity is professor and extension engineer in the biosystems engineering department.

Donald’s main role in Alabama has been teaching the state’s 3,800 poultry growers techniques for managing and designing ventilation and waste management systems for use in the 10,000 poultry houses that are in production in Alabama. His areas of expertise are poultry housing, ventilation and waste management.

During the past ten years, Professor Donald has been an invited speaker for industry and scientific programs throughout the United States and the world. He serves as an advisor to several poultry companies and poultry trade organizations. Over the span of his career, he has published more than 200 papers, bulletins and videos to help poultry growers. Donald and colleagues publish the Alabama Poultry Engineering and Economics Newsletter, sent to thousands of growers six times each year. He also maintains the Auburn University Web site, featuring up-to-date information on poultry ventilation and housing, at www.poultryhouse.com.

Figure 1



The most important principle of winter ventilation is to bring air into the house high and at high velocity to get good air mixing. Cold air must not be allowed to drop onto birds.

static pressure of 0.12 inches (3.1 mm) in an older house and 0.15 inches (3.8 mm) in a newer house. If the house doesn't pass this test, too much air is coming in through leaks and cracks. In other words, the higher the number measured from the static pressure test, the tighter the house.

2. Insulate before you ventilate.

Good growing conditions cannot be maintained in a poultry house during cold weather if heat isn't kept in. Ceiling insulation should be approximately R-19 for southern USA to R-28 for Canada. Insulation should be routinely inspected for tears, holes, places where it may have shifted or areas where there is no insulation at all. Consider insulating end walls, end doors and other house areas that are not currently insulated.

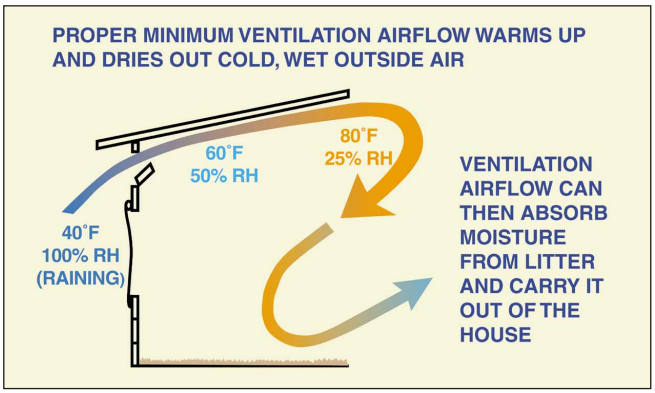
3. Set the fan timer for proper minimum ventilation rate — according to bird age.

Ensure all fans are controlled by a single timer. Proper ventilation rate usually ranges from 0.10 CFM/bird in week 1 to 0.90 CFM/bird by week 8.

EXAMPLE: During week 1, with 24,000 birds, you would need 0.10 CFM x 24,000 = 2,400 CFM on average. We say "on average," because you can't run a 2,400 CFM fan. Use a timer, for example, to run two 10,000 CFM 36-inch (91 cm) fans for the percentage of time needed to average 2,400 CFM. Find the percentage of time needed by dividing the CFMs needed by the CFM capacity of the fans you will be running. In this example, 2,400 CFM/ 20,000 fan CFMs = 0.12. Multiply this number x 5 minutes (timer cycle) = 0.6 minutes or 36 seconds run-time out of a 5 minute cycle (36 seconds on-time out of 300 seconds = 0.12).

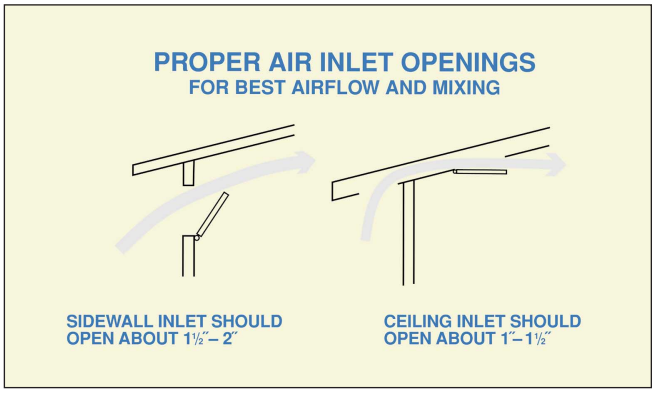
Never ventilate with less than two 36-inch (91 cm) fans. Single 36-inch (91 cm) fan ventilation will not typically yield sufficient static pressure to ventilate properly. Heat moves toward fans, so ventilating with a single 48-inch (122 cm) fan concentrates heat at that end of the house. Running two or more minimum ventilation fans helps maintain temperature uniformity. This in turn will boost flock performance.

Figure 2



Warm air can hold a lot more moisture than cold air. This explains how proper minimum ventilation airflow can help remove moisture from the house even when a cold rain is falling outside.

Figure 3

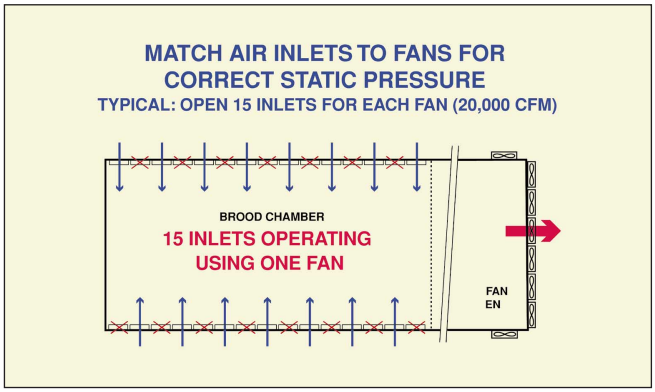


Good static pressure is critical for proper airflow. Too wide air inlet openings cause static pressure to drop and allow air to drop onto birds. Too narrow openings cause static pressure to rise too high and choke off airflow.

4. Increase fan timer settings (minimum ventilation rate) each week.

Fan run-time must be increased weekly to handle the increased moisture that birds respire as they grow. As noted in point 3, the rate needed typically increases from 0.10 CFM/bird to 0.90 CFM/ bird over an eight-week period. Note that having a properly set minimum ventilation timer is as important at the end of the growing period as it is in the beginning. During the latter part of the growing period, the thermostat control usually overrides the timer. However, the minimum ventilation timer must remain properly set to maintain air quality when higher temperatures no longer trigger the thermostat control.

Figure 4

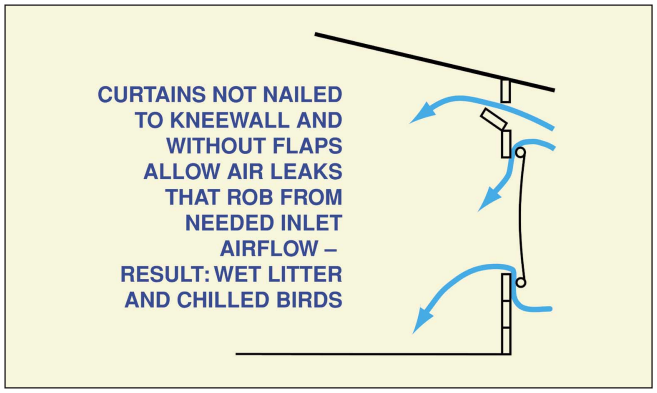


A rule of thumb is to unlatch about 15 air inlets for every 48-inch fan that will be brought on. At the beginning of a growout, half of the inlets in the brood chamber and all inlets in the growout end may be latched closed.

5. Maintain minimum ventilation settings regardless of outside or inside conditions.

Without minimum ventilation, inside air quality will deteriorate and create litter moisture and ammonia problems. The amount of house heat loss with minimum ventilation is small, and economically justifiable to avoid moisture problems. Remember, minimum ventilation must be practiced even if a cold rain is falling outside. Heating cold air increases its moisture holding capacity. When air is heated 20°F (11°C), its relative humidity will be reduced by about one half; therefore, its ability to pick up water roughly doubles. Cold air entering the house in wintertime gets warmed and dried. Thus, this "conditioned" air is able to carry excess moisture out of the house through ventilation fans.Ventilation is the only way to remove moisture from poultry house litter.

Figure 5



Air leaks around top and bottom of curtains lower static pressure and allow cold, wet air to contact birds and litter.

6. Bring cool outside air into the house high above the birds, with enough velocity to mix with warm inside air before contacting birds.

Achieving this goal requires a tight house operating at a static pressure of around 0.10 inches (2.5 mm), and properly designed and adjusted air inlets. A static pressure of approximately 0.10 inches (2.5 mm) moves air 20 feet (6.1 m) toward the center of the house. Static pressure controlled vent boxes do the best job. A good "jetstream" of incoming air

Figure 6

Curtains nailed to kneewall and with flaps at top prevent air leakage into house.

along the ceiling avoids chilling birds. In addition, the mixing action improves heating fuel usage efficiency by preventing warm air produced by birds, furnaces and brooders from rising to the ceiling and staying there. Mixing fans can also help promote temperature uniformity and reduce fuel usage.

7. If wet litter and/or ammonia become a problem, increase the minimum ventilation rate (fan timer settings).

This means increasing the fan run-time. Birds deposit about 2 pounds (0.9 kg) of water into the house per 1 pound (0.45 kg) of feed eaten. Thus, a lot of water is deposited into a poultry house during the growing period. Fecal material plus excessive moisture causes ammonia, and this worsens when litter moisture is high. Proper ventilation is the only way to remove moisture from litter. Growers who have tried to operate minimum ventilation fans by using a humidistat to turn fans on and off have found this does not work. Humidistats can't hold accuracy in the environment of today's poultry houses. A practical measure of litter moisture content is to squeeze a handful of litter. If it sticks

Figure 7

If a squeezed handful of litter sticks together in a lump or ball, it's too wet.

together tightly and remains in a ball, it is too wet. If it sticks together only slightly, it has the proper moisture content. If it doesn't hold together at all, it is too dry.

8. If increased minimum ventilation rate does not solve a wet litter problem, add a small amount of heat.

Sometimes when a house has "slick" litter, more fan run-time may not solve the problem. This usually means the house needs a little more furnace or brooder heat to help lower humidity and facilitate moisture removal. It may be possible to dry out a house by slightly increasing fan run-time during the warmest part of the day when humidity is low. If this doesn't work, heat must be added.

Figure 8

In new construction, foam sealing strips can be used to stop air leaks; in existing houses, use smoke bombs to find leaks and seal them with caulking or expandable foam sprays.

9. If the house gets too dusty and litter is too dry, reduce the minimum ventilation rate.

This situation usually signals over-ventilation, and calls for lowering the fan on-time setting.

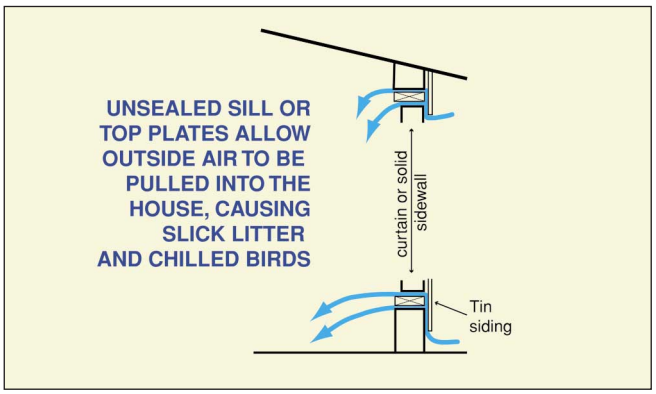
Figure 9

Wet kneewall (left picture) indicates air leaks, usually through unsealed sill plate and/or curtains not nailed to kneewall. Properly sealed and caulked house will have dry kneewall and litter, as in right picture.

10. If a house gets too warm, look at the thermostat setting, not the fan timer setting.

The minimum ventilation timer setting is for moisture removal and air quality, not temperature control. To make the house cooler, a thermostat or controller temperature set-point is used to override the ventilation timer and add more ventilation. In this mode, we are now ventilating at a higher rate for temperature control purposes and fan operation is determined by the thermostat or controller set-point. Do not confuse this with minimum ventilation, which is timer-operated.

Figure 10



Unsealed carpentry joints are another source of air leaks that spoil ventilation airflow and cause wet litter.

11. Adjust and reset backup thermostat settings, curtain drops and alarms from day 1 to catch.

It is possible, even in wintertime, to lose birds due to high heat and high humidity if the power fails or fans fail to operate. With larger birds, just a few minutes in a totally enclosed house with no ventilation can elevate temperatures as much as 20°F (11°C), causing suffocation and death. Protection from this situation can be achieved by maintaining recommended backup settings throughout the grow-out. A good rule to follow is to set backups and alarms at 10°F (5.5°C) above and below target temperature.

Figure 11

Paddle-type "Casablanca" fans can help mix warm air near the ceiling with cooler air at bird level, which can save fuel the costs and help ventilation air remove moisture. Paddle fans are most useful in high-ceiling houses.

Recirculating Fans Can Assist Ventilation and Save Fuel

In addition to the principles outlined above, growers might also consider using stirring or paddle fans as a way of improving wintertime in-house conditions and saving on heating costs. Field studies over the last two years have shown that recirculating fans can significantly help prevent temperature stratification (i.e., warm air staying near the ceiling and cold air collecting at bird level).

Figure 12

Vane axial stirring fans can be pulled up to the ceiling to allow space for machinery operation in low-ceiling houses. Although these fans blow air horizontally, they will assist in-house air mixing just as paddle fans do, with the same potential for fuel savings and moisture control. .

One analogy that helps us understand the idea of temperature stratification is to think of taking a leisurely warm bath. After a while the water cools off, so you turn on the hot water at the front of the tub to warm things up. The rear of the tub still remains cold while the water at your feet can be very warm or even scalding hot. The only way to make the water uniformly warm is to stir it. Similarly, mixing or stirring the air in the broiler house produces less of a temperature difference from ceiling to floor and more uniformity from wall to wall. The result: lower fuel usage, drier litter, less

cake under waterers, less cake removal between flocks and a better environment for growing birds.

Even with the best minimum ventilation management and vent boxes to provide good air mixing in a house, minimum ventilation fans will be running only a fraction of the time. Recirculating fans provide a continuous way of mixing air in the house without running an exhaust fan and without chilling birds.

Many years ago, an attempt to recirculate air was made by hanging 36-inch (91 cm) fans up high in houses and blowing them horizontally in a racetrack pattern. There were problems with this concept in that 36-inch (91 cm) fans move a lot of air which chills young birds. Running several 36-inch (91 cm) fans in a house provides more air velocity than needed for mixing during cold weather or brooding.

Paddle-type recirculating fans for cooling and recirculating air were also tried, but with mixed results. When paddle fans were used for recirculating air, they were commonly used in the down-draft mode — resulting in too much air being blown down. When this occurs, young birds scatter and move away from areas under fans. With the advent of tunnel ventilation, interest in paddle or recirculating fans subsided. However, during the last four years, new approaches to achieving air-mixing with recirculating fans have been developed.

One new approach is the use of 18- to 24-inch (46-61 cm) vane axial fans. These run horizontally in the house in much the same way as 36-inch (91 cm) fans, but provide a better air-mixing pattern. Chicks aren't chilled since they don't move as much air. These fans are also available in variable speed models. Being able to vary fan speed can be useful, especially for 24-inch (61 cm) models, ensuring fans do not create cold drafts on young birds. A second approach now becoming popular is using paddle fans in the updraft mode, as has been practiced for some time in very cold or mountainous areas. A couple of years ago, Auburn University and some integrators began experimenting with paddle type agricultural ceiling fans used in the updraft mode. Pulling air up through the fan directs ceiling air out toward the house sidewall, instead of blowing air directly down on birds. Air velocity measurements on the floor should be minimal (less than 50 ft/min; 15.2 m/min). Application of the results of these field studies has led to significant fuel savings and represents a tool that improves house environmental quality.

In summary, both new approaches have proven effective. Since both approaches work well, deciding whether to go paddle or vane axial is up to the broiler grower.

For more information on poultry housing and ventilation management, please contact Aviagen North America's technical service department at 1-800-826-9685 or www.aviagen.com. You may also visit Auburn University's Poultry Housing and Ventilation Web site: www.poultryhouse.com.

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