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# Poultry Housing Tips

## *Minimum Ventilation Rates*

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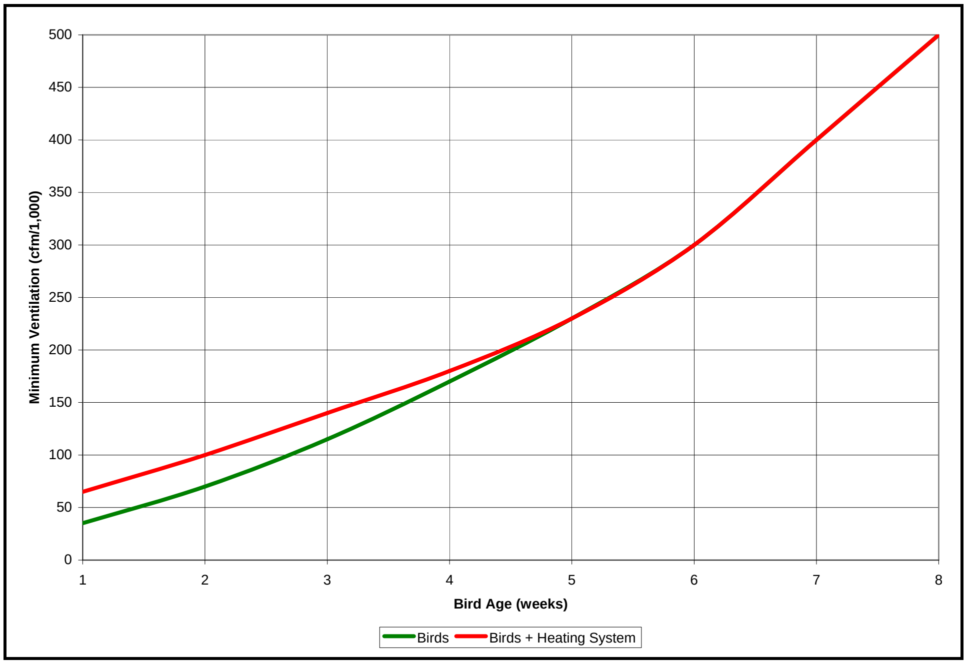


Figure 1. Minimum ventilation rates to control carbon dioxide.

Knowing how much to ventilate during cold weather is crucial to a producer's bottom line. Ventilating too little can lead to poor air/litter quality, resulting in bird health and performance issues. Ventilating too much can lead to drafty conditions and high heating costs. The first step to knowing how much you need to ventilate during cold weather is to understand which air quality variables are most likely to cause problems. In short, the three primary air quality variables poultry producers need to manage, besides temperature, in a poultry house during cold weather are carbon dioxide, humidity, and ammonia. To maximize bird performance we would ideally like to keep carbon dioxide concentrations below 5,000 ppm, relative humidity around 60%, and ammonia concentrations below 30 ppm.

Carbon dioxide is produced by the birds as well as by a house's heating system. High carbon dioxide concentrations can lead to lethargic chicks and reduced weight gain. Figure 1 illustrates the approximate minimum ventilation rate (cfm per 1,000 birds) required to maintain a carbon dioxide concentration below 5,000 ppm. The green line is the minimum ventilation rate if we assume the only source of carbon dioxide is the birds. The red line assumes the house has an unvented heating system and the combustion gases from the brooders/heaters are being added to air, thereby requiring higher minimum ventilation rates to control carbon dioxide. As you can see, the carbon dioxide produced by the heating system typically doubles the minimum ventilation required for the first few weeks. The chart is based on the assumption that after the fourth week, the amount of heat run time is minimal so additional ventilation to get rid of carbon dioxide produced by the heating system is unnecessary.

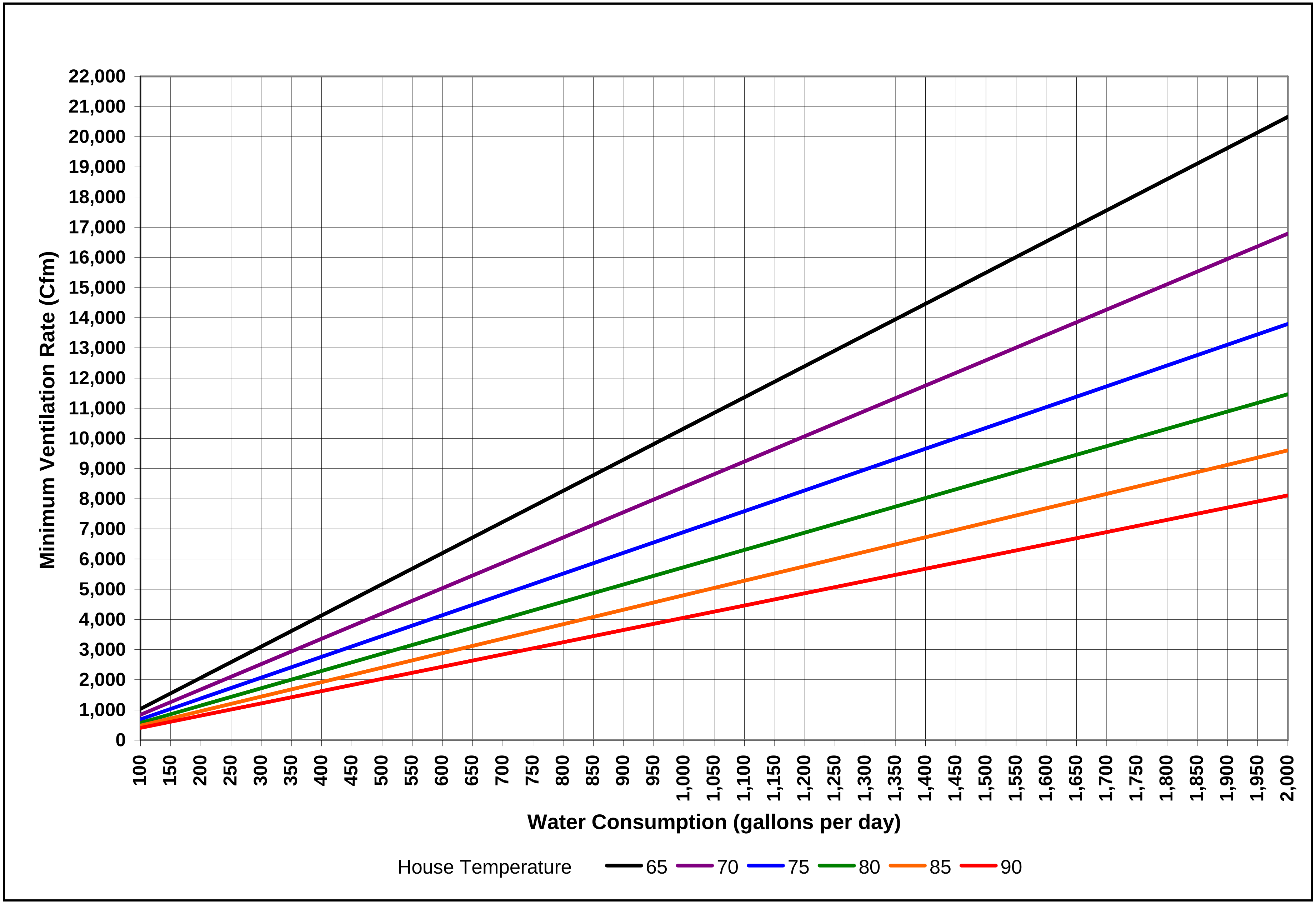


Figure 2. Minimum ventilation rates required to manage house moisture based on bird water usage and inside temperature.

Insufficient ventilation during cold weather can also lead to a buildup of moisture in a house, resulting in damp litter and all the associated problems. But, if a producer ventilates too much not only will it result in high heating costs but the resulting low relative humidity can lead to dusty house conditions. The chart in Figure 2 provides a way to determine minimum ventilation rates to control house humidity from daily water consumption and house temperature. For every pound of feed, a bird will drink approximately a quart of water. The older the birds get, the more feed they eat, the more water going into the house that we have to get rid of through ventilation. If we know how much water is going into a house, inside and outside temperature, and have a target for inside relative humidity we can calculate how much we need to ventilate to rid the house of the moisture the birds are adding. What about outside relative humidity? The fact is that when it is cold, outside relative humidity really doesn't have a large effect on how much we need to ventilate to control moisture in the house because cold air, whether at 40% or 100% relative humidity actually contains very little moisture.

For instance, if during brooding it is 90°F and 60% Rh there would be approximately 20 ounces of water in every 1,000 cubic feet of air in the house. If outside it were 40°F and 50% Rh there would be 3 ounces of water in every 1,000 cubic feet of air. When the timer fans come on, for every 1,000 cubic feet of air we bring in, we are bringing in 3 ounces of water. The good news is though we are bringing in 3 ounces of water we are at the same time exhausting 20 ounces of water. So, even though when we are ventilated we are bringing in some moisture, the fact is we are exhausting air with significantly more moisture, which results in an overall reduction in house moisture levels.

Now, let's say that it is 40°F and 80% Rh outside. Under these conditions there would be 5 ounces of water in every 1,000 cubic feet of air we brought into a house. But again, since the inside air has 20 ounces of moisture for every 1,000 cubic feet we would be removing 15 ounces (20 ounces - 5 ounces) of moisture for every 1,000 cubic feet of air we moved into and out of the house. As you can see, even though the humidity is much higher outside than in the first example it only reduced the amount of moisture we removed from the house by a little over 10%. So even though technically a minimum ventilation chart should take into account outside relative hmidity for the most part you can obtain fairly accurate results with just using a chart that assumes an outside relative humidity of 50%.

Outside temperature has more of an effect on minimum ventilation settings than does outside relative humidity. The minimum ventilation rates provided in Figure 2 are based on an outside temperature of 30°F. The minimum ventilation rates indicated can be adjusted for very cold or moderate conditions. For instance, if the minimum outside temperature is 50°F (20°F warmer) minimum ventilation settings should be increased by approximately 25%. If the minimum outside temperature is 10°F (20°F colder) the minimum ventilation rates can be decreased 25%.

Last but not least, we need to ventilate enough during cold weather to control ammonia. High ammonia concentrations can lead to reduced bird weights, increased feed conversions, and increased incidence of respiratory problems. The problem is that there isn't a minimum ventilation chart to provide a minimum ventilation rate to control ammonia. This is because though the moisture and carbon dioxide produced by the birds doesn't change much from farm to farm, ammonia production is very hard to accurately predict. The amount of ammonia produced is a function of factors such as age of litter, litter moisture, amount of caked litter, length of downtime between flocks, etc. At this time the best way to determine how much you need to ventilate to control ammonia is to simply set a couple of 36" fans to run a minute or so out of five and measure the ammonia concentration right after the fans shut off. If you want to cut the ammonia concentration in half, double your timer setting. If it is very low, and you think it would be okay to double the concentration, then cut your timer fan settings in half.

Which method should be used to determine timer fan settings? Actually, all three. Ideally, you should determine minimum ventilation rates using all three methods and then use whichever one requires the highest minimum ventilation rate. For instance, if you have a house with built-up litter and you are not using a litter treatment, you will probably find that the minimum ventilation rate to control ammonia concentration will be the highest. But, if you have a freshly cleaned out house you will find that relative humidity will be the controlling air quality variable. If you have a house with very dry fresh litter you may find that carbon dioxide will be the controlling air quality variable.

In an ideal situation we wouldn't use any charts. Producers would have meters to measure ammonia, relative humidity, and carbon dioxide and then make adjustments to minimum ventilation fan settings accordingly. But, in most cases this is not possible. To date, there hasn't been an ammonia meter that has been proven to accurately measure ammonia in a poultry house on a continuous basis. Yes, there are some meters that can be taken into a house for a short period to measure ammonia, but they tend to be expensive ($1,000+), require frequent calibration, and the meter's sensor typically has to be replaced once a year at significant expense (over $400), putting them out of the reach of most producers. Carbon dioxide meters cost around $500, though typically less problematic than ammonia meters, they are not that useful because for the most part carbon dioxide is not very likely to be a significant problem on most farms.

This brings us to relative humidity meters/sensors. Relative humidity meters/sensors are for the most part very reliable and relatively inexpensive. Furthermore, relative humidity is what we are most interested in controlling during cold weather. The fact is that if we properly manage humidity in our houses we will keep ammonia and dust from becoming problems in the first place. If we use a litter treatment in a house with built-up litter we will not have to worry about ammonia the first week or so and if we properly manage relative humidity we should be able to keep our litter in good shape, minimizing the likelihood that ammonia will be a problem later on in the growout. If a house has fresh shavings and it is ventilated to control relative humidity from day one, then litter caking will be kept to a minimum and therefore keep ammonia from being a major problem. Basically, a relative humidity meter/sensor is a ventilation tool that no poultry house should be without.

Trying to determine how much to ventilate a house is always going to be a challenge. Balancing the well being of the birds and heating costs is difficult at best. But, the better you understand the goals of minimum ventilation rates during cold weather, the more likely you will have optimal bird health and performance and the less likely you will be to over ventilate your houses, which of course will lead to high heating costs.

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