

# The Importance of Monitoring Carbon Dioxide (CO<sub>2</sub>) in Turkey Production



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**With respect to turkey production, flock performance is dependent upon many factors; including the environment we place them into. As such, environmental control has become increasingly more important in recent years.**

Finished flock performance can be influenced early in the production cycle—and it should be a priority to ensure that this happens. When poults get off to a good start (low mortality, good uniformity and morbidity), they develop good gut health through regular feeding and drinking patterns. This allows the bird to realize the improved genetic gains that a Hybrid Turkey can offer each year.

Good flock performance can be achieved, whether you have the most innovative and up-to-date equipment or have an older barn that is managed well. However, if you don't monitor the environmental conditions to know what is really happening to air quality, you can compromise bird health and performance very easily.

All turkey operations measure, and some monitor, temperature levels to help manage ventilation requirements. Some growers have realized that measuring humidity levels as well, can make a large difference in air and litter quality. Very few operators monitor and measure Carbon Dioxide (CO<sub>2</sub>) and Carbon Monoxide (CO) levels in turkey barns. This info sheet will examine the effects of excessive carbon dioxide and outline the benefits of monitoring it.

## Effects of Excessive Carbon Dioxide Levels

Various studies have been conducted to show that elevated carbon dioxide levels can negatively impact bird performance.<sup>1,2</sup> Levels as high as 2 500 ppm of carbon dioxide are known to increase the incidence of roundheart disease. Excessive carbon dioxide can cause inactivity in birds, such as reduced feed intake and altered metabolism. Carbon dioxide, at these high levels, can also have a negative impact on gut health and overall flock performance.

### Roundheart Disease

Dr. David Frame, an Extension Poultry Specialist with Utah State University, studied the effects of carbon dioxide on roundheart disease. It was demonstrated that levels above 2 500 ppm of carbon dioxide were linked to significant spontaneous turkey cardiomyopathy (STC). Carbon dioxide is formed through the normal combustion of fuel in brooder stoves and heaters as well as through the respiration of the birds. Low ventilation rates, due to poor air mixing and distribution, can result in elevated levels as well as pockets of carbon dioxide, thus increasing the risk for high carbon dioxide levels.<sup>1</sup>

### Inactivity in Birds



Birds at all ages are affected by elevated levels of carbon dioxide; however poults show significant effects. High levels of carbon dioxide cause poults to become lethargic and inactive. They begin to huddle as metabolism and feed intake are reduced. They become chilled, even though barn temperatures are adequate.

## Gut Health and Overall Flock Performance

An article in the Journal of Applied Poultry Research<sup>2</sup> evaluated exposure to excessive carbon dioxide as it relates to early poult mortality. It was found that levels of 4 000 ppm of carbon dioxide caused reduced thyroid activity, which led to decreased metabolism of the bird. When this happens, birds become lethargic, reducing their feed and water consumption. This can lead to poor gut development and an imbalance of gut microflora leading to cecal destabilization and, eventually, enteritis. When cecal destabilization occurs, litter becomes wet and environmental conditions can deteriorate. This can lead to poor flock performance, including low weight, poor skeletal development and poor uniformity.

Exposure to 4 000 ppm of carbon dioxide can result in altered metabolism, depleted glycogen reserves, lowered liver glucose levels and lowered blood oxygen levels. A study by Dr. Christensen<sup>2</sup> noted that all poults exposed to 4 000 ppm of carbon dioxide fell asleep; indicating that carbon dioxide levels must be kept well below 4 000 ppm. This is consistent with the findings of Dr. Frame<sup>1</sup>.

## Measurement

Measuring carbon dioxide and humidity levels can be done easily and is relatively inexpensive. Commercial monitors, such as the Extech SD800 plug-in model or Amprobe CO2-100, are available to monitor and record carbon dioxide, temperature, and humidity levels.

### Recommended Levels

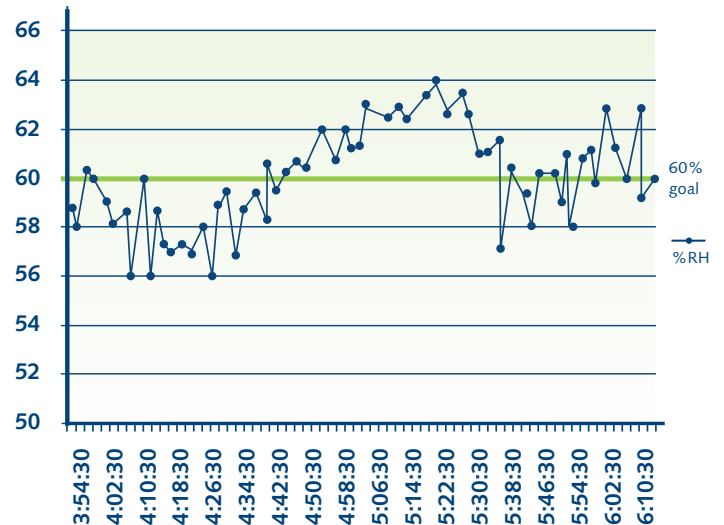
**Carbon Dioxide:** Hybrid Turkeys recommends maintaining a goal of 2 500 ppm.

**Humidity:** Hybrid Turkeys recommends maintaining a goal of less than 60% relative humidity. This will help ensure air maintains low levels of ammonia and aid in maintaining drier litter.

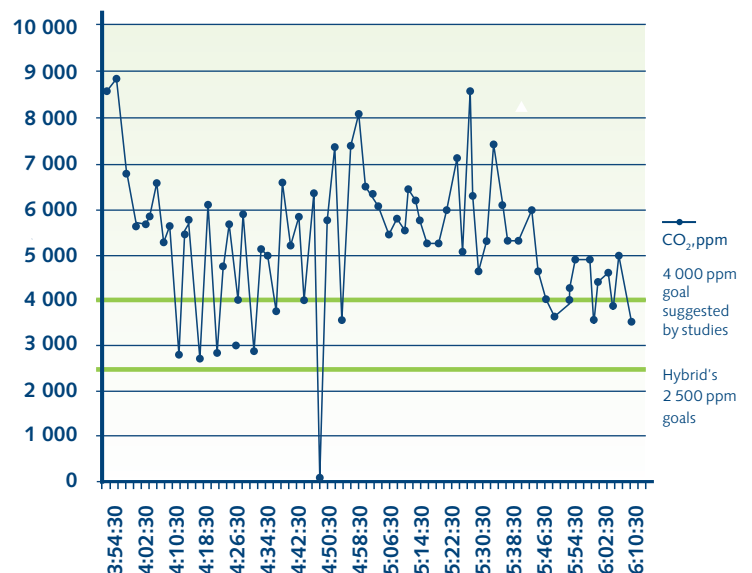
### Example 1

The graphs below show an example where the relative humidity was in check for most of the time period monitored; however the carbon dioxide level was in excess of our recommended goals. This is an example where potential growth issues can occur.

Relative Humidity Data



CO<sub>2</sub> Data



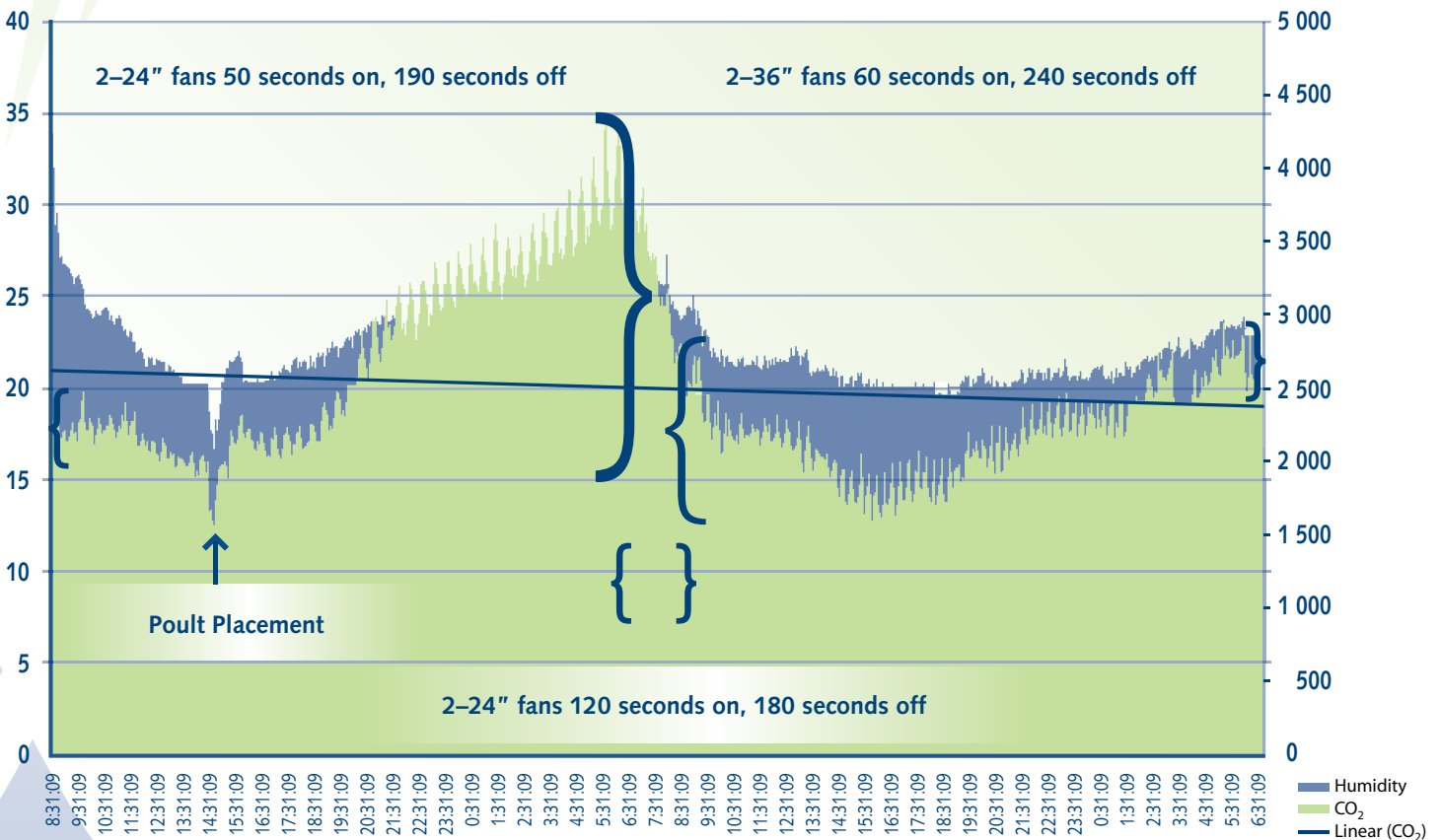
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## Example 2

This next graph displays the effects of varying levels of ventilation on humidity and carbon dioxide readings. You will notice on the left hand side of the graph, where two 24" fans were operating, that there is extreme variation in the humidity and carbon dioxide levels. Where two 36" fans were operating, shown in the far right of the graph, this allowed for proper air volume and static pressure, which mixed the air efficiently at the ceiling and throughout the barn.

It is evident that improving the ventilation rate and air distribution will improve both carbon dioxide and humidity levels. It is important to note that during the period using two 36" fans, less propane was used compared to the period which was using two 24" fans. Therefore, proper ventilation in the hatchery, poult trucks and brooding barns is critical. Examination of proper ventilation requires monitoring carbon dioxide levels.

Ventilation Comparison



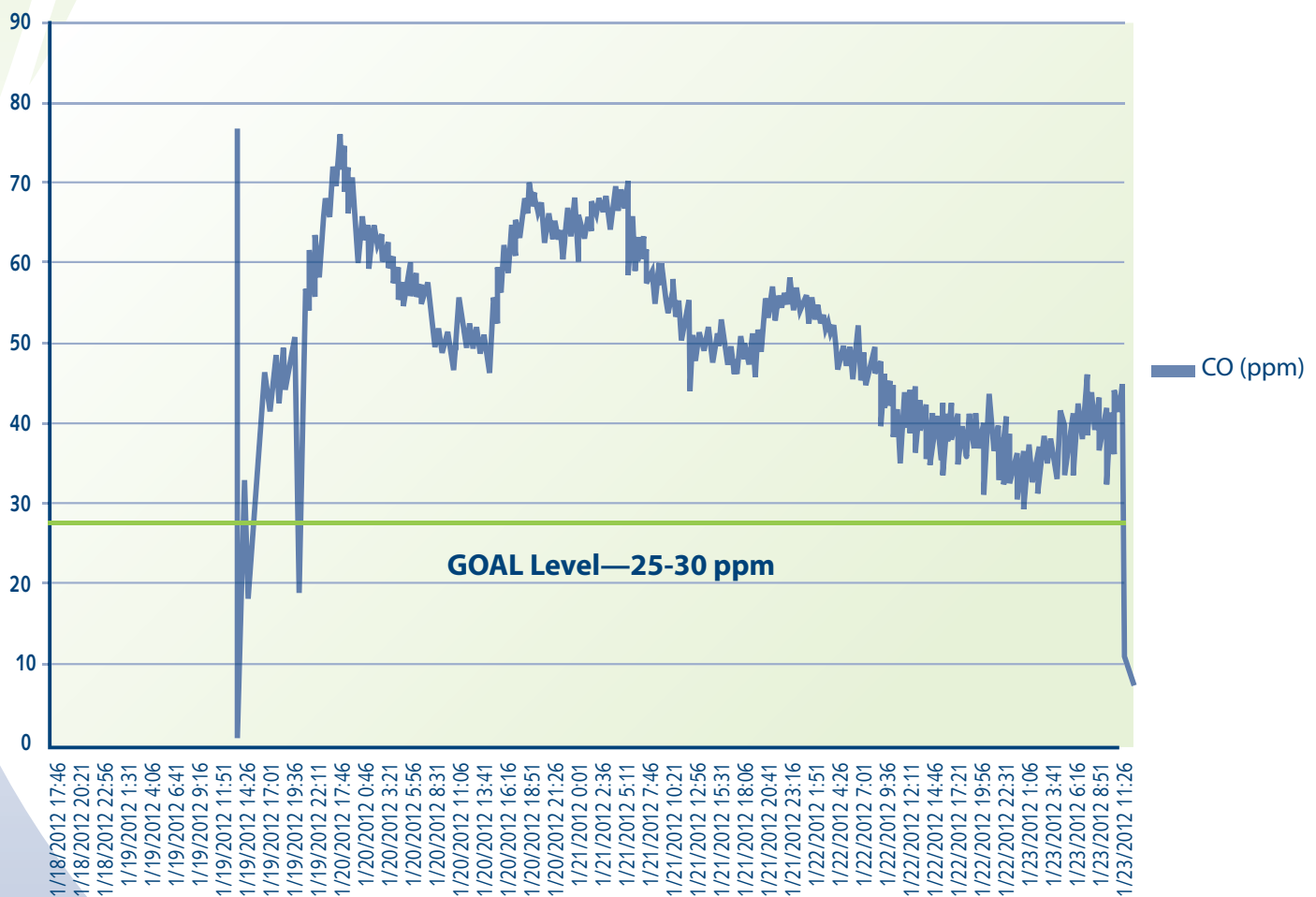
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### The Future of Environmental Monitoring

Studies have been conducted to evaluate elevated carbon dioxide levels in hot weather; such as one by C. Bennett which found a correlation between elevated carbon dioxide levels and heat stress.<sup>3</sup> More studies need to be conducted to understand the effects of high carbon dioxide in commercial housing in cold weather. Carbon monoxide levels also need to be evaluated to better understand their effects on the environment around our birds.

It is important to monitor and log carbon monoxide levels to be certain they are not elevated for extended periods. It has been reported<sup>1</sup> that levels above 25 ppm of carbon monoxide, for extended periods, can cause roundheart disease and poor performance. Using a data logger such as the LASCAR CO<sub>2</sub> logger can track levels over time. You can see in the example below that levels can be elevated well above the recommended 25 ppm of carbon monoxide yet many barn operators are not aware of this.

### Carbon Monoxide Tracking



### Conclusions

Today's commercial turkeys are growing heavier at younger ages and with improved feed conversions. Understanding the impact of the environment surrounding the birds, including carbon dioxide, is critical to enabling the turkey to reach its full genetic potential.

### References

1. David D. Frame, Robert E. Buckner, Gary L. Anderson, Causes and Control of Spontaneous Cardiomyopathy or Roundheart Disease in Utah, [http://extension.usu.edu/files/publications/publication/AG\\_506.pdf](http://extension.usu.edu/files/publications/publication/AG_506.pdf)
2. V.L. Christensen et al., "Exposure to Excessive Carbon Dioxide: A Risk Factor for Early Poult Mortality," *Journal of Applied Poultry Research* 4:3 (Fall 1995): 249-253.
3. C. Bennett, "How to use a Hand-held Carbon Dioxide Monitor to Evaluate Summer Ventilation in Poultry Houses," *Zootecnica International, World's Poultry Journal* (May 2008).

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Environmental monitors such as Extech SD800, Amprobe CO2-100 and LASCAR CO<sub>2</sub> mentioned here in are as examples and are not endorsed in any way by Hybrid Turkeys.

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