

Ventilation Assessment

Dairy Barn Cooling Factsheets

Key points

- A Minimum Cooling Air Speed (MCAS) of at least 1 m/s (200 fpm) at the cow resting height is required to reduce heat stress but a target air speed of 2 m/s (400 fpm) will be more effective at higher Temperature Humidity Index (THI)
- The goal is to have 100% of the free stall resting area with the target air speed at the cow resting height of 0.5 m (1.5 ft.)
- Air speed is easily measured using a handheld anemometer

Introduction

The best method for reducing heat stress in dairy cattle is to blanket the cow resting area with fast moving air. Research has shown the minimum air speed for effective cooling is 1 m/s (200 fpm) referred to as the Minimum Cooling Air Speed (MCAS). However, a study done in the Fraser Valley during the heat dome of 2021 showed improvements in milk production with a higher air speed of 2 m/s (400 fpm).

The most effective way of providing this air speed is with some form of auxiliary fan ventilation. The spacing and angle of the fans is critical to ensure that the airflow is uniform and that the air is blowing into the stall area at resting height and not just blowing over top of the stalls.

The only way to check this is by doing a ventilation assessment which involves measuring air speeds at cow resting levels. Some targets are more relevant to mechanically ventilated barns than naturally ventilated barns. The assessment approach will vary depending on the type of barn and the type of supplemental fan.

Ventilation targets (Table 1 and 2) have been developed to check whether the ventilation system is doing its best to reduce heat stress. A ventilation assessment on your farm should meet or exceed these targets.

Ventilation Criteria	Target
% Stalls with MCAS air speeds of 1 m/s (200 fpm) at the cow resting height in the summer	>90%
% Stalls with Target air speeds of 2 m/s (400 fpm) at the cow resting height in the summer	>90%
% Cows with Heat Stress: breathing rate >60 breaths per minute (minimum ~ 20 cows)	<25%
% Cows panting: breathing rate >100 breaths per minute (minimum ~ 20 cows)	0%
History of bunching	No

Table 1. Ventilation assessment targets.

Ventilation Criteria	Target
Air changes per hour – summer	40-60
Air changes per hour – winter	4-8
Air exchange per cow	>2,550 m ³ /h (>1,500 cfm)
Measured inlet air speed	2.5-4 m/s (500-800 fpm)
Temperature increase between inlet and exhaust	< 2°C (<3.6°F)

Table 2. Ventilation assessment targets specific to negative pressure mechanically ventilated barns.

The only way to determine whether the ventilation system is performing as it should to reduce heat stress is to complete a ventilation assessment. This includes:

- Collecting information about the barn and the ventilation system
- Observing the cows for signs of heat stress
- Measuring air speeds in the cow area
- Measuring temperature and humidity levels

The [Dairyland Initiative podcast](#) on troubleshooting adult cow barn ventilation describes how to do a ventilation assessment of a variety ventilation systems. The following explains what information to collect when doing a ventilation assessment for naturally ventilated and tunnel-ventilated barns.

1. Barn Information

Collect basic barn information including length, width, height at eaves, height in centre. This information will be used in a mechanically ventilated barn to calculate air changes per hour (ACH). Describe the ventilation system. If it is naturally ventilated, record curtain wall openings size and type and size of ridge openings. If it is mechanically ventilated, record the size and type of exhaust fans and size and location of inlets. Collect information on any supplementary ventilation such as HVLS fans or panel fans as to their size, location and angle. Manufacturers may be able to supply fan capacities based on manufacturers literature, but a more accurate source is the BESS Lab [AG Ventilation Fans](#) data if it is available for a particular fan.

Sketch the stall or pen layout as that will be used to determine where air speed readings should be taken.

2. Building Observations

It is important to make note of the condition of the barn.

- Check if the barn has a ridge vent. If it does, is it big enough for the size of the barn and the number of animals inside?
- Are there supplemental fans? What is their condition? Are they located out of the reach of the cows or workers for safety?

- If it is a mechanically ventilated tunnel or cross flow barn, what is the condition of the exhaust fans? Do they have dirty shutters? Dust build up on louvers can reduce fan efficiency by 24% or more.
- If the barn doesn't have a ceiling, look for streaks along the purlins. These streaks can be a sign of condensation, which may mean there's too much moisture in the barn.

3. Cow Observations

When you first enter a barn do a ventilation assessment, the first step is to observe the cows before walking through them. Observe and note their location within the barn. Are they evenly spread out in the stalls or are they bunched together in certain spots? Are they lying down or standing?

Observe and calculate the breathing rate of the cows. Once their breathing rate exceeds 60 breaths per minute, they are experiencing heat stress. Panting occurs close to 100 breaths per minute. If panting is observed, cows are under extreme heat stress.

You can count a cow's breaths by watching its flank move in and out — that's one breath. Use a stopwatch to time it easily. Count the breaths in 15 seconds and multiply by 4. Another method is described in detail on the YouTube video [How to measure respiration rate in dairy cattle](#).

Measure about 20 cows, both standing and lying down. If more than 25% of them are breathing faster than 60 times per minute, they are likely experiencing heat stress.

4. Air Speed Measurement

Air speed measurement is the most important indicator of how well the ventilation system is performing to reduce heat stress. The location for taking measurements will vary depending on the layout of the barn and the type of ventilation system. Air speed measurements should be taken at a height of 0.5 m (1.5 ft.) off the ground to determine conditions at the resting height of the cow. Each measurement should take 30 to 60 seconds at a location for the air speed to be stable.

5. Measuring Equipment

There are three pieces of equipment commonly used to do a ventilation assessment (Figure 1):

- A propeller anemometer or air speed meter
- An insect fogger (optional)
- Temperature and humidity sensors (optional for determining THI)




Propeller Anemometer	Propeller Anemometer capable of recording measurements every 2 seconds (i.e. Kestrel 5000AG with LINK)	
Insect Fogger	Portable Insect Fogger with Light Mineral Oil (i.e. Burgess 1433 Insect Fogger)	
Temperature & Relative Humidity (T & RH) Sensors (at least 2)	Temperature & Relative Humidity Sensor (i.e. Kestrel DROP D2AG)	

Figure 1. Equipment for ventilation assessment.

- A.** The propeller anemometer is used to measure the air speed within the cow area. Measurements should be taken 0.5 m (1.5 ft.) off the ground to determine conditions for the resting height of the cow.
- B.** You don't need an insect fogger or smoker to assess ventilation, but it can help you see how air moves through the barn. Light mineral oil is used to make the smoke. With a bit of practice, you can produce a steady stream of white smoke. The smoke will indicate areas of fast-moving air or dead spots where there is no air movement.

C. The temperature and humidity sensors are used to determine the Temperature Humidity Index (THI), which is an indicator of heat stress.

6. Measuring Temperature and %RH

Temperature and humidity can be measured and recorded using a Kestrel Drop or similar device. In a naturally ventilated barn hang one in the middle of the pen where you are sampling air speeds. The temperature and humidity readings can be used to calculate the Temperature Humidity Index (THI) which is an indicator of heat stress.

In a mechanically ventilated barn hang two sensors at the inlet and two at the outlet where the exhaust fans are. Air shouldn't stay in the barn long enough for the temperature to rise more than 2°C (3.6°F) between the intake and exhaust points.

Ventilation assessment of a naturally ventilated barn with panel fans

Air speeds should be measured in every row of stalls and ideally in every second stall in that row (Figure 2). Try to do measurements between at least three fans. In a naturally ventilated barn choose the side away from the prevailing wind, as you want to be measuring the fan effect, and not the wind effect. If there are stalls where the air speed is less than the MCAS then the spacing and the angle of the fans must be adjusted.

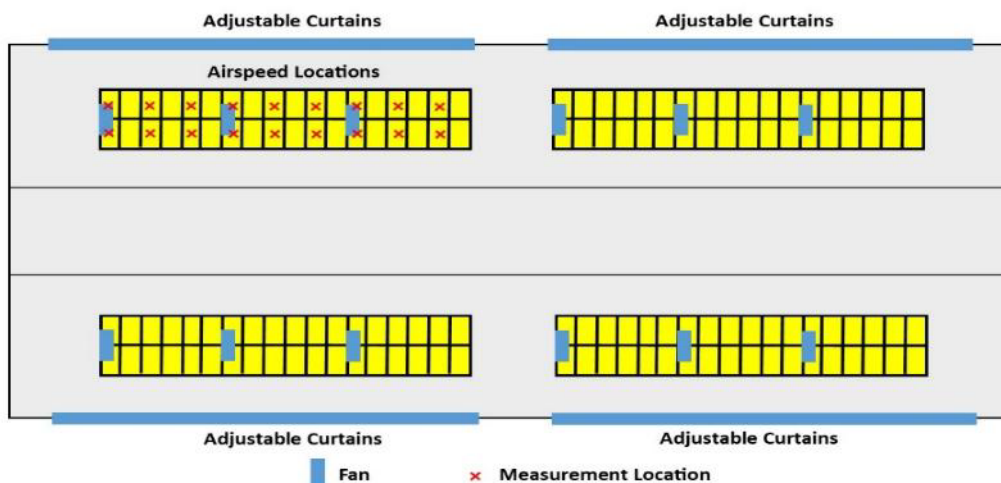


Figure 2. Measurement locations in a naturally ventilated barn with fans.

Ventilation Assessment of Tunnel Ventilated

Similar to a naturally ventilated barn, air speeds should be measured in every row of stalls and ideally in every second stall in that row (Figure 3). Measure the air speed at the air inlet. It should be 2.5 to 4 m/s (500 to 800 fpm). Hang two sensors at the inlet and two at the outlet where the exhaust fans are. Air shouldn't stay in the barn long enough for the temperature to rise more than 2°C (3.6°F) between the intake and exhaust points. Using the barn dimensions calculate the air exchange rate. There should be 4 to 8 air changes per hour (AC/h) for the winter, and 40 to 50 AC/h for the summer. There also should be at least 2,550 m³/hr. (1,500 cfm per cow) of exhaust capacity.

Note

Air Changes per hour = Exhaust Fan Capacity (m³/h) / Volume of Barn (m³)

Air Changes per hour = Exhaust Fan Capacity (cfm) x 60 / Volume of Barn (ft³)

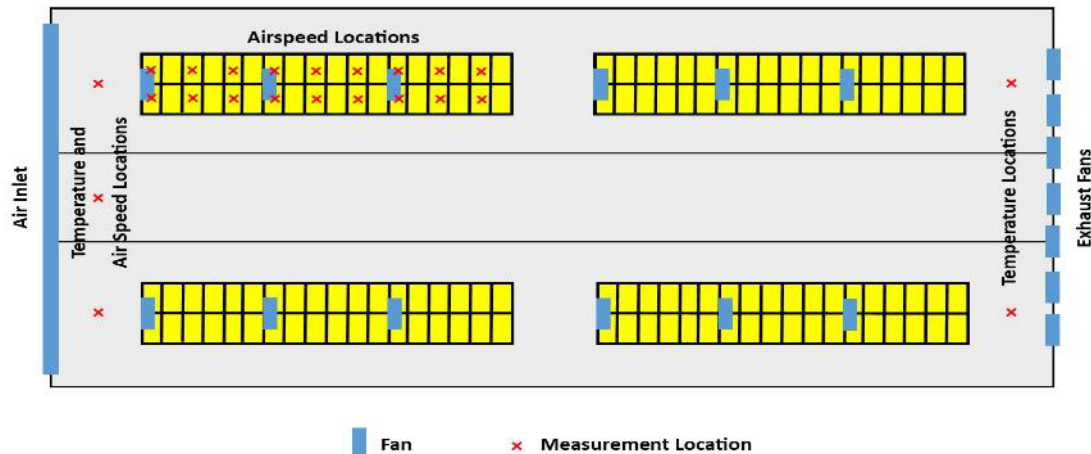


Figure 3. Measurement locations in a tunnel ventilated barn.

Ventilation assessment of cross ventilated barns

Measure the air speed across the barn and then move over and measure back since the air is flowing parallel to the stall dividers (Figure 4). Measure the air speed in a row of stalls with a baffle and measure in every second stall. Measure the air speed at the air inlet. It should be 2.5 to 4 m/s (500 to 800 fpm). Hang two sensors at the inlet and two at the outlet where the exhaust fans are. Air shouldn't stay in the barn long enough for the temperature to rise more than 2°C (3.6°F) between the intake and exhaust points. Using the barn dimensions calculate the air exchange rate. There should be 4 to 8 air changes per hour (AC/h) for the winter, and 40 to 50 AC/h for the summer. There also should be at least 2,550 m³/hr. (1,500 cfm per cow) of exhaust capacity.

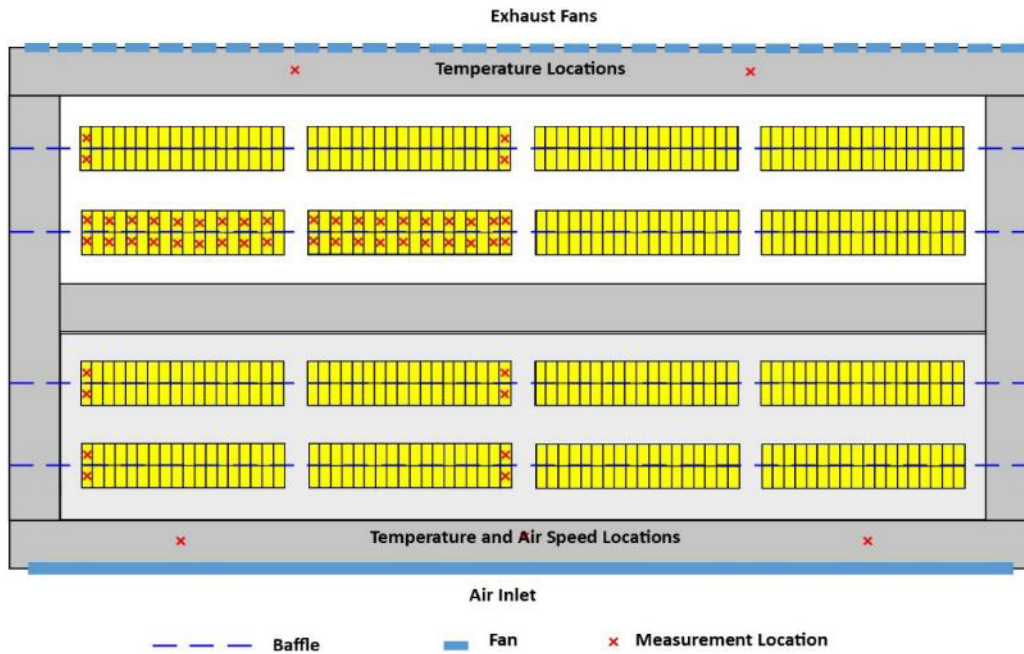


Figure 4. Measure locations in a cross ventilated barn with baffles

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For more information, please contact AgriServiceBC:

Email: AgriServiceBC@gov.bc.ca

Phone: (+1) 888-221-7141