



Application of Time Integrated Value (TIV) Environmental Control Technology to Dairy Barns

This state-of-the-art controller helps improve cow comfort and improves energy usage

By

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Proper barn ventilation and supplemental cooling are key components to successful cow comfort and well-being during summertime conditions. Poor ventilation and/or the lack of cow cooling will result in heat stress and unhealthy cows. Heat stress is well known to, among other things, reduce feed intake, which leads to declined milk yields. Without supplemental cooling, milk production in high-producing herds can drop several percentage points after the onset of hot weather, and even more with high humidities.

Simple thermostats or conventional stage controllers are traditionally used to automatically control barn ventilation and/or cow cooling equipment.

Conventional staging environmental controllers use the current value of the inside temperature and a user defined target value for the inside barn temperature to determine which stage of ventilating and/or cooling equipment to activate. As the difference between the barn air temperature and the target temperature increases, additional ventilating and/or cooling equipment is activated. The problem with conventional controls is they do not recognize accumulated heat stress and merely react to changing air temperature. Just because barn air cools off at night does not mean that the cows' core body temperature is also cooled down.

What is a TIV controller?

A Time Integrated Variable (TIV) controller is a micro-controller based staging temperature controller designed to interface with ventilation and cooling equipment.

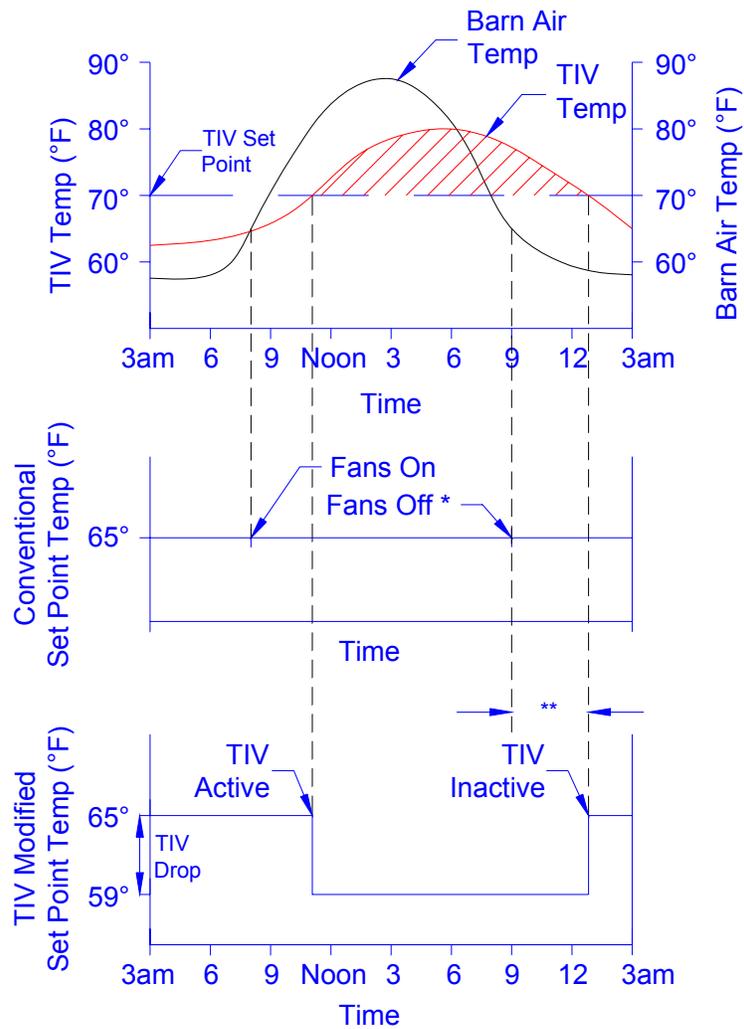
Like a conventional staging controller, the TIV controller also makes decisions based on the barn air temperature and the target temperature set by the barn manager. The unique characteristic of the TIV controller is that it uses a variable referred to as the inside temperature TIV to slightly modify its control decisions when cow heat stress is perceived. The TIV value is the average inside temperature for the last 12 hours, or a 12-hour rolling temperature average. TIV can be thought of as degree-hours as an analogy to cooling-degree days for air conditioning systems. If the temperature were 60°F for the last 12 hours, then there would be 720 degree hours (60°F x 12 hours).

How does TIV work?

A TIV controller calculates and maintains a running record of the average inside temperature for the last 24 hours of operation. The TIV controller compares an



instantaneous 12-hour TIV value to a user selected target TIV value (based on our field research, it is recommended to start with a setting of about 65°F for your barns). If the instantaneous 12 hour TIV value is greater than the TIV set point temperature, TIV controller switches to the TIV active mode. When TIV is active, the staging controller operates as if the target temperature was 6°F lower than the value actually selected by the barn manager. This increases the time period that each bank of fans and evaporative cooling equipment will operate before they turn off, allowing additional cow cooling to occur and removal of accumulated heat load. Figure 1 contrasts environmental equipment controlled by TIV vs. conventional control technology.



* Fans off based on conventional controller
** Additional fan on-time to remove accumulated heat stress

Figure 1. Graphic representation of TIV vs. conventional control technology.



TIV is an indication of the cumulative heat stress that the animals have been subjected to, and TIV based control allows the controller to modify its control decisions based on heat stress. When time integrated temperatures indicate cows may have experienced cumulative heat stress, the ventilation and cooling systems will operate for a longer period to cool the cows as compared to the conventional stage controller. In effect, the TIV controller tries to over-cool the animals once heat stress has occurred to compensate for periodic heat stress.

How can I use a TIV controller in my barns?

A TIV controller can be used in both freestall and tie stall barns with mechanical (tunnel) ventilation systems and/or supplemental cooling (fans, misters, sprinkler) systems. A TIV stage controller will provide several stages for use with user determined temperature differential between stages. TIV controllers can be used to control both natural (curtain) and tunnel ventilation systems – switching between natural and tunnel system as needed to ensure a quality environment in the barn at the most efficient energy costs!

Is it applicable in the Northeast?

In the summer of 2001 we collected data from a six-row tunnel-ventilated barn in central New York. A TIV controller was used to control the tunnel system. A conventional controller was also installed and operational, but did not control the tunnel fans. Timers were attached to each stage of each controller and the “on-time” was recorded for the summer as shown in Figure 2. The chart clearly shows that the tunnel fans would have been turned off prematurely a large percentage of the time (before the cows were fully cooled) if the conventional controller was employed.

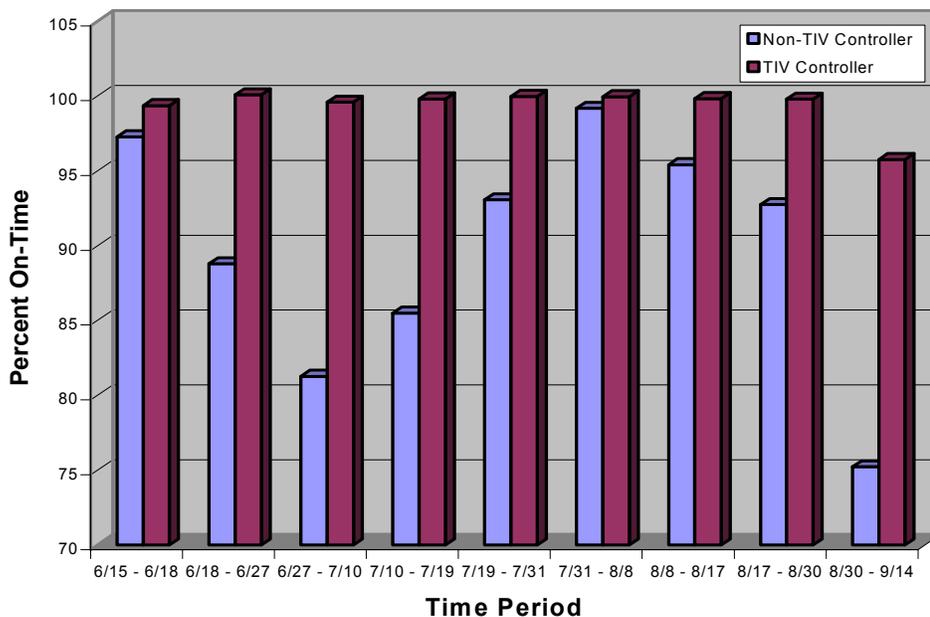


Figure 2. TIV vs. Non-TIV for stage No. 1 of a six-row tunnel-ventilated freestall barn in central NY during summer of 2001.



TIV technology is new, innovative, and here for producers to use. The cost of a TIV controller is only slightly more than a conventional stage controller but offers better management of the cow environment during summer-time conditions and can reduce energy consumption.

Where can I get one?

Thevco Electronics, Quebec, Canada has licensed the rights for manufacturing TIV controllers. Contact them at:

Thevco Electronics
Quebec, Canada
450-926-2780

Their equipment is available through local distributors in the Northeast, such as Aerotech, Inc. Their contact information is below:

Aerotech
800-227-2376
www.aerotech-inc.com

Where can I find out more about TIV technology as applied to ventilation and cow cooling?

Go to the **NEW** PRO-DAIRY Facilities Program web page at www.prodairyfacilities.cornell.edu and check out:

- *Time Integrated Value Environmental Control Technology: Step Up to the Times*
- *Tunnel Ventilation for Freestall Barns*
- *Economics of Tunnel Ventilation for Freestall Barns*
- *Heat Stress Relief for Dairy Cows*