ENHANCED MANAGEMENT

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Key considerations in fan cooling

Keeping cows comfortable and healthy is essential to sustain production of high quality, high volume milk. Elevated air temperatures and humidity, intense solar radiation, and/or little or no natural air movement contribute to stressful conditions for dairy cows. Effects are seen in reduced milk production, decreased feed efficiency, reduced conception rates, and compromised growth rates of neonatal calves. Losses combine to cause huge economic impacts, even in the Northeast.

Maximize benefits from cooling fans by targeting high airflow rates at cow level in beneficial areas of the barn.

While the economic nature of the dairy business does not allow the capital and operating base to house cows in environments that totally mitigate the effects of heat stress, the effects of heat stress can be significantly reduced. A heat stress abatement system: ensures all cows always have free access to clean, fresh water; provides shade from the sun's solar energy; increases barn ventilation (air exchange) rate; provides air speed directly on cows in strategic locations; increases evaporative heat loss by intermittently soaking cows' hair coats; and adjusts feed ration composition. Focus is on two general areas in fan cooling: 1. attributes of fans and 2. installation and maintenance of fans.

There are many considerations for each area:

Locating Fans: Provide targeted air speeds in areas where cows perform beneficial activities. Fans should be strategically located over cow feeding, resting, and watering areas, and in the milking center holding area. In freestall barns, this means rows of fans should be centered over feeding cows and over cows lying in each row of freestalls (**Figure 1**). Fans not centered over feeding or resting cows can result in significant air flow in nonproductive areas. Cows may stand in these areas during stressful conditions to increase heat loss.

Figure 1. Lateral positioning of cooling fans over feeding and lying cows in a freestall barn.

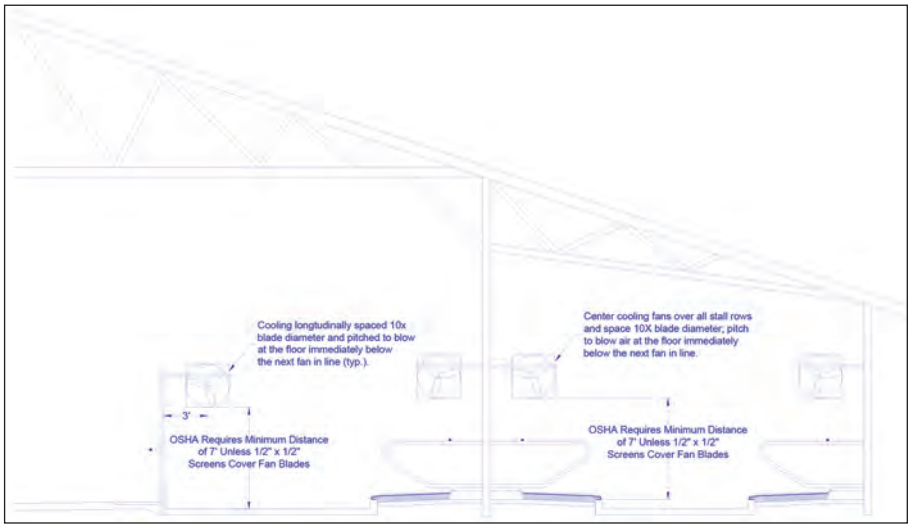
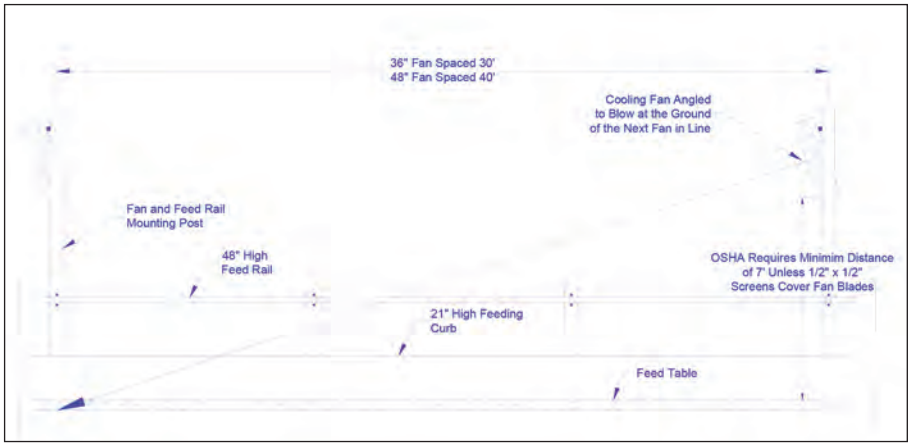


Figure 2. Longitudinal positioning of cooling fans over feeding cows in a freestall barn.



Target Air Speed at Cow Level: Research shows that target air speed over cows' bodies should be 400 to 600 fpm. Most fans marketed to cool cows easily exceed this velocity, even at many feet away. However, cows are like boulders in a river; water flow in the river is impacted by the boulders and air flow in a barn is impacted by cows. Moving air that strikes a cow is slowed down and its flow direction is changed.

Fan Spacing within a Row of Fans: Cooling fans need to have a good 'throw,' meaning airflow should be maintained a good distance away from a fan. This implies that air must be expelled in a fairly tight cone. Fans in rows spaced longitudinally about 10 blade diameters (30' for 3' diameter fan, 40' for 4' diameter fan) maintain effective velocity when blowing on cows. The fans can easily move air further, but the initial cows cooled by the fan discharge air sufficiently interrupt the flow so cows further away do not benefit.

Fan Mounting Height and Safety: Operating fans can be dangerous to cows and workers. In recognition of this, OSHA section 1910.212(a)(5) states: "When the periphery of the blades of a fan is less than seven feet above the floor or working level, the blades shall be guarded. The guard shall have openings no larger than one-half inch."

For optimum cow cooling, the lowest point of the fan blade (6 o'clock) should be no more than 7' above the floor or the working level (freestall base). Fans along the feed

bunk or over the stalls may need to be mounted higher than 7' to provide required clearance for stall bedding delivery or manure gathering/removal equipment. In this case, mount fans just high enough to provide the necessary clearance.

Fans Mounting Angle: Fans should be tilted from the vertical so they are aimed at the bottom of the next fan down the line as shown in **Figure 2**. The higher the fan is mounted above the floor, the greater the angle from vertical needed.

Fan Maintenance: Developing and implementing a regular maintenance schedule goes a long way to sustain fan operation when cows need it the most. Suggested maintenance includes: regular examination of belts and belt replacement on belt-drive fans; quick repair of bent or broken fan blades and fan housings; cleaning of fan blades and housings before dirt sufficiently accumulates; and intermittent monitoring of thermostats and cleaning of sensors.

If I cannot afford to install all fans, where should I start? Order of importance when incrementally installing fans includes: 1. Calving area; 2. Close up dry cows; 3. Holding area; 4. Milking area; 5. Fresh cows; 6. High producers; and 7. Low producers.

Priority of fan locations when incrementally installed in a lactating cow barn is: 1. Over the inner rows of stalls; 2. Over the feed alley; and 3. Over the outer row of stalls.

Return on Investment: Calculating the net return on investment for a heat stress mitigation system is not easily accomplished. Consider some of the effects of heat stress: depressed appetite, slug feeding - acidosis, laminitis, decreased nutrient absorption, reproductive problems, compromised unborn calf growth, future milk production, and calving difficulties.

It is difficult to put a complete economic value on heat stress effects, but it should be given consideration. When cows continue to lie down because of air movement at cow lying level, and continue to produce pre-environmental stress levels of milk, this is sustained production. Dr. Rick Grant, President, Miner Institute, showed that an hour of cow lying time means about 2.5 to 3.5 lbs. of milk per cow for every hour over 10 hours of lying time. So, if the fan cooling system contributes to sustained cow lying time and milk production, the economic impacts of cooling fans can be evaluated from a milk production-only perspective. ❐

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Fan attributes

Size: Any size fan providing target air speed at cow level is much better than a possible alternative of no cooling fans at all. Key considerations to maximize cow level cooling are: blade diameter, motor size, and target air speed. In general, 3' diameter fans with a 1/2-hp motor meet the goals. Fans are closer together (due to the 10 blade diameter rule) and cows are less likely to affect the fan's discharge airflow pattern and speed. Thus they have a better chance of providing the target air velocity on more cows than less, but larger fans, do. Larger fans require ¾-hp or larger electrical motors and cost more to operate than 3' fans with ½-hp motors. Four-foot diameter fans may be a good choice when barns are overstocked so the wider 'swath' of air movement will impact cows that are not able to lie down or make it to the feed bunk.

Electrical Supply: If the farm has three-phase power, in almost all cases it is best to purchase fans with three-phase motors. Three-phase motors last longer and are generally more efficient than single phase motors. And, in cases where a "soft start" may be needed due to electrical service size limitations, three-phase fans can more easily be started than single phase motors.

Belt-drive or Direct-drive: In most cases, direct-drive fans are preferred for fan cooling cows primarily because the desired performance of these fans is more easily maintained over extended use periods than belt-driven fans. Belt-drive fans have excellent airflow capacities and operate with comparatively little noise when first installed. However, their performance falls off with time as the belts wear. Producers who are committed to regular fan maintenance can choose either fan.

Performance: Contrary to barn ventilation fans that provide barn air exchange, where fan efficiency (fan air output per unit of energy input (cfm/Watt)) is an important consideration, cow cooling fans are harder to evaluate as the goal is air speed at cow level. An ideal efficiency measure for cooling fans is beneficial area covered at the meaningful velocity per Watt (sq. ft./Watt). In this case, beneficial area is an area in the barn where cows are productive, i.e. lying in stalls, at the feed bunk, and at the water stations. Fan shrouds assist in focusing air velocity and therefore improve performance. Fans with ½-hp motors can have good cow cooling performance. Selection of energy efficient motors is also an important consideration with cooling fans. If it is good under some static pressure, it will be better at 0" of sp. OSHA requires that fans be covered with a guard that has openings no larger than one-half (1/2) inch. While guards are required for safety, they also are notorious for accumulating debris that significantly affects performance. If fans are not cleaned at least a few times during a summer, it is likely better to mount them so the guards are not required under OSHA.

Controls: Fans are best controlled by a dedicated fan controller or by an overall barn environmental management controller. Automated controllers, with proper settings selected, will provide cows with cooling air when they needed it, and turn the fans off when they don't. Since the East, especially the Northeast, is subject to significant swings in daytime/nighttime temperatures, it is important to consider a controller that makes decisions based on accumulated heat loading a cow may have experienced over a given period of time. Controllers that merely make decisions based on instantaneous barn air temperature only will result in cooling fans turned off before the cows are cooled on many summer days. A Time Integrated Variable (TIV) controller will make control decisions based on duration of cow heat stress and instantaneous barn air temperature, and therefore, is a very appropriate control technology for fan cooling. Consider setting the threshold temperature for fans to come on at 65 to 70°F and adjust to a lower temperature if cows show signs of heat stress, including labored or excessive breathing and/or standing in stalls when they are otherwise laying down.