

Tube Fan Ventilation for Pre-Weaned Calf Barns

Part 1: System Overview and Practical Information

Description

In general, positive pressure air ventilation systems consist of wall-mounted fans blowing fresh outside air into the calf barn. With tube fan systems, flexible or even ridged tubes with a series of discharge holes are attached to a fan to distribute air. The fan draws fresh air in from the outside to pressurize the tube and a small amount of air exits from each hole along the length of the tube (Figure 1). Without a mechanical exhaust system to make tubes a part of a neutral pressure system, the room is slightly pressurized, and air finds its way out through openings in the structure; usually through chimneys, open eave lines, or open curtain walls.

Design

Tube fan ventilation systems need to be designed individually for each barn to account for inherent differences in the facility and calf management style. The systems are generally designed with three factors in mind: rate, distribution, and speed. Rate determines the amount of air exchange that will need to take place in the barn. Two methods exist as a basis for determining the system rate, one based on volumes of air to exchange proportionate to building size, and the other based on rates required per animal housed. Once the rate is determined distribution ensures that air exchange takes place at key points in the shelter, for instance, the calf pen microenvironment. Finally, speed is considered to safeguard that the calf's temperature isn't negatively affected by the ventilation. Too much air velocity in cold seasons can cause a draft, while too little speed during high temperatures will fail to keep the calves cool. A detailed description of what a designer may require in the production of a successful tube fan ventilation design can be found in part 4 of



Figure 1. Polyethylene ventilation tubes in a greenhouse calf barn introduce air in mild and hot seasons. Blue arrows represent air streams introduced by the tube fan ventilation system.

this fact sheet series “What is needed to design a tube fan system for existing barns”.

Common Uses

Tube fan ventilation systems are most commonly utilized in two conditions. The first is a barn where doors are required to be left open so that animals can enter and exit, or to provide natural air exchange. This is an advantage with positive pressure systems, as barn doors, windows, and curtains inadvertently left don't negatively affect system performance. The second common situation includes barns where there are so many cracks and openings into the barn that a negative or neutral pressure ventilation system would source air from non-targeted locations compromising system performance. Consequently, tube fan systems have become popular in retrofitting existing inadequate ventilation systems. One of the most common applications of positive pressure tube fan

systems is in assisting natural ventilation. The tubes are designed to provide air exchange through the calf pen where natural ventilation alone can't always reach to provide consistent, reliable air exchange when winds calm or to supplement seasonal ventilation needs.

Ventilation Seasons

Different seasons present different ventilation requirements. From one extreme to another, colder seasons present the challenge of ventilating a calf barn without creating a draft, while hot seasons ventilation rate and airspeed must increase so that the calf experiences minimal heat stress. Tube fan ventilation can be designed to supplement either of these temperature extremes individually or provide year-round ventilation by implementing multiple ventilation seasons. Multi-stage designs are made to match five identified ventilation seasons: cold-cold, cold, transition, warm, and hot^[1]. The coldest of the seasons, or the first stage of the ventilation system is controlled to continuously operate in all seasons providing a minimal amount of air exchange. Each consecutive stage turns on as the barn air temperature increases, building on one another to create the correct amount of air exchange for that condition. Table 1 outlines

Table 1

Season	Temperature (°F)
Cold – Cold	$T < 10$
Cold	$10 < T < 35$
Transition	$35 < T < 60$
Warm	$60 < T < 75$
Hot	$T > 75$

the initial set points of these seasons. These temperature ranges are only initial controller set points and can be altered to fit each barns calf needs and management style.

System Maintenance^[2]

Developing and implementing a regular maintenance schedule goes a long way to not only extend the life of the system but to ensure ideal system function. Regular maintenance allows fans to operate efficiently and ensures that the distributed air remains clean and fresh. Cleaning of the fans is an important part of maintaining the system that should be completed at least annually or more frequently if the system is exposed to dust and other particle contaminate inputs. Suggested preventative maintenance for ventilation fans includes: regular examination of belts and belt replacement on belt-drive fans; 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. During winter, hot weather fans should be covered to stop the possibility of chilled air entering the barn and creating drafty conditions. Just be sure to uncover the fans again as the weather warms. Tubes do not frequently accumulate dust or moisture, but in some circumstances have been seen to collect dirt and water when unused for long durations with no barrier (such as a shutter on the fan). Therefore, tubes and ducts should be checked as a part of a regular maintenance routine to ensure that the air being distributed is clean and fresh.

FACT SHEET SERIES

Tube Fan Ventilation for Pre-Weaned Calf Barns

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Part 3: Tube Options Overview

Part 4: What is needed to Design a Tube Fan System for Existing Barns?

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References

[1] Gooch, C.A. (2018). A Novel Approach to all-Season ventilation for pre-weaned calf barns. [video] Spring Seminar Series 2018 Cornell Dairy Center of Excellence. [2] Mechanical Ventilating Systems for livestock Housing. MWPS-32 (1990) ISBN 0-89373-075-0

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