Positive Pressure Air Tube Ventilation for Calf Housing

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Figure 1. PPAT systems improve calf barn ventilation

Positive pressure air tube (PPAT) ventilation systems have become popular for improving the ventilation in calf barns (Figure 1). Most producers choose natural ventilation for their calf nurseries. Natural ventilation works quite well for most of the year, but during cold weather baby calves do not produce enough heat to create thermal buoyancy to draw air in through the curtains and out through chimney openings. One solution is to add fans in the chimneys to create a positive draw of air. This improves ventilation as it provides a minimum fresh air exchange, but it does not ensure an even distribution of air throughout the room. PPAT systems provide the fresh air and distribute it evenly throughout the room.

What is a PPAT system?

The PPAT system consists of a wall mounted fan blowing fresh outside air into the calf room. Attached to the fan is a distribution tube with equally spaced holes in it that runs the length of the room. The fan draws fresh air in from the outside, pressurizing the tube and blowing the air out of each of the holes to distribute it evenly throughout the room. The room is pressurized by the fan, and air finds its way out of the room through the natural ventilation system, usually through the chimneys.

How is it different from traditional systems?

The air tube system for ventilating calf barns is not new. It has been in use for over 30 years. The PPAT system developed by Dr. Ken Nordlund of the University of Wisconsin has several improvements. The original air tube system was designed to blend room air with the incoming fresh air to moderate the temperature. Dr. Nordlund found in his studies that the blending of the room air with the outside air was contaminating the fresh air and distributing contaminants throughout the room. He proposed that the system should be designed to bring in fresh air only directly from the outside no matter what the outside temperature was and not blend it with inside air. It is critical that this fresh air be slowed down to an air speed of less than 60 fpm at calf level so that the calf does not feel this fresh air movement as a draft.

How is it designed?

The fresh air fan is sized to provide the minimum fresh air requirement for the baby calves, which is 15 cfm per calf. The other consideration for determining the minimum

ventilation rate is the room volume. Four air changes per hour are required to keep the air fresh in a room. The fan is selected on the basis of which is the larger air flow. In an ideal world a single speed fan would be used where the fan capacity would match the minimum calculated ventilation rate. In practice it may be necessary to select a variable speed fan with a manually set controller. The speed should be set to provide the calculated fan capacity and left at that amount.

Tubes need to be located to best fit the size and layout of the room. Use a single tube if the room is less than 9 m (30 ft) wide, and two tubes if the room is between 9 m and 18 m (30 ft and 60 ft). The goal is to ventilate the entire room space evenly. Pen location will also dictate how many, and where the tubes should be mounted to provide uniform ventilation. Mount tubes to direct the fresh air at the fronts of individual or group pens.

The air tube itself needs to be sized to match the fan capacity. It needs to inflate evenly from end to end so that air distribution is equal end to end, and complete inflation positions the location of the holes correctly. The tube should be sized for an air speed of about 1,000 to 1,200 fpm. This usually requires the tube diameter to be larger than the fan diameter (Figure 2).

Figure 2. The air tube is sized to match the fan capacity

The most common tube material is a light weight plastic, but more permanent tubes can be made from PVC water pipe or spiral wound galvanized steel. It is also possible to obtain heavier duty plastic tubes from limited suppliers. Shallow wide rectangular boxes constructed of plywood have also been used with extremely low ceiling heights.

The hole size determines the how far the air will travel. The larger the diameter of the hole the further the air will travel. For instance a 2.5 cm (1 in.) diameter hole will jet the air about 3 m (10 ft) while a 5 cm (2 in.) diameter hole will jet the air about 6.1 m (20 ft). The air speed at the hole should be about 1,000 fpm. Hole spacing needs to be calculated to match the fan capacity to provide uniform air distribution along the length of the tube.

The hole location is important to match the shape of the room to direct the air to calf level. It will vary depending on the mounting height of the tube. Hole location is usually stated to match the numbers on a clock face. For instance, if the tube is mounted 2.4 m to 3 m (8 ft to 10 ft) above the floor, holes punched at 4 and 8 o'clock will provide a good distribution (Figure 3). If the mounting height is over 3 m (10 ft) then punching holes at 5 and 7 o'clock is better. It also may be necessary to add a row of holes at 6 o'clock in a wide room.

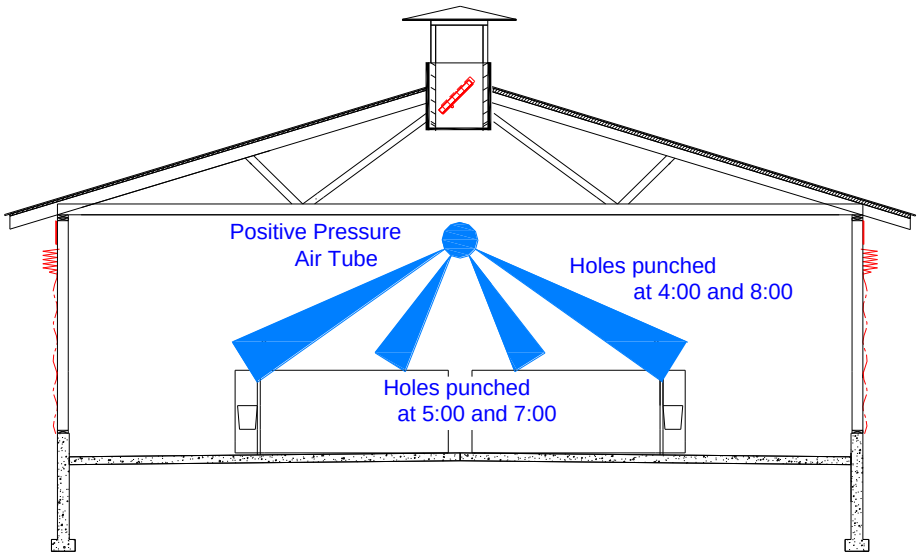

Figure 3. Holes are positioned to match room size and shape

How a PPAT system is used to ventilate a calf barn

Most calf barns are designed to ventilate naturally, and natural ventilation works well for all but the coldest months of the year. When the temperature becomes too cold to provide a good air pattern naturally, the sidewall curtains can be closed completely and the PPAT system used to provide the minimum amount of fresh air.

PPAT systems can be left running year round to provide air circulation. In hot weather they do not supply sufficient ventilation, but on still humid days when there is no wind, they will continue to circulate air.

Straw and Solid Partitions

Calves also benefit from lots of long straw bedding in cold naturally ventilated calf barns. Providing lots of long straw allows the calf to “burrow” or “nest” in the bedding to get out of any drafts.

Calves also like to lie along solid walls. In cold weather a cold outside wall will draw the heat from the calf making it more susceptible to drafts. It is best to provide a walkway around group calf pens to keep them away from an outside wall. Individual pens should be designed to be away from outside walls. Solid panels can be used in group pens to provide a lying space where a calf can get out of a draft. Large straw bales can be used to provide the same protection.

SUMMARY

Positive pressure air tube (PPAT) systems can be used to improve calf barn ventilation during cold weather when natural ventilation systems do not do well in distributing the small amounts of fresh air required. Dr. Ken Nordlund from the University of Wisconsin redesigned the original air tube concept to provide fresh air only Information is available at The Dairyland Initiative website http://thedairylandinitiative.vetmed.wisc.edu/

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