

Positive Pressure Air Tube Ventilation for Calf Housing

H. House

Factsheet

FACTSHEET 15-009

AGDEX 420/721

MAY 2015

This Factsheet is written using common units used by ventilation designers and equipment manufacturers for sizing and designing ventilation systems. The units are a combination of imperial and metric. Imperial is common usage in the ventilation industry. For example, temperature is normally stated in Celsius, while air flow measurements are listed in cubic feet per minute (CFM).

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 the thermal buoyancy required 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.



Figure 1. PPAT systems improve calf barn ventilation.

HOW IS PPAT DIFFERENT FROM TRADITIONAL SYSTEMS?

The air tube system for ventilating calf barns 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 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 (feet per minute) at calf level, so that the calf does not feel this fresh air movement as a draft.

PPAT DESIGN

The fresh air fan is sized to provide the minimum fresh air requirement for the baby calves, which is 15 CFM (cubic feet per minute) 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: 15 CFM/calf or four air changes per hour. 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. Set the speed to provide the calculated fan capacity and leave it at that setting.

Locate tubes 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. The location of the pens 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.

Size the air tube to match the fan capacity. To ensure equal air distribution, the tube must inflate evenly, end to end, with the holes positioned correctly in the fully inflated position. Size the tube for an air speed of about 1,000–1,200 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 lightweight plastic, but more permanent tubes can be made from PVC water pipe or drainage tile. It is also possible to obtain heavier-duty plastic tubes from ventilation suppliers. Shallow, wide rectangular boxes constructed of plywood have also been used in rooms with extremely low ceilings.

The hole size determines 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. Calculate hole spacing to match the fan capacity to provide uniform air distribution along the length of the tube.

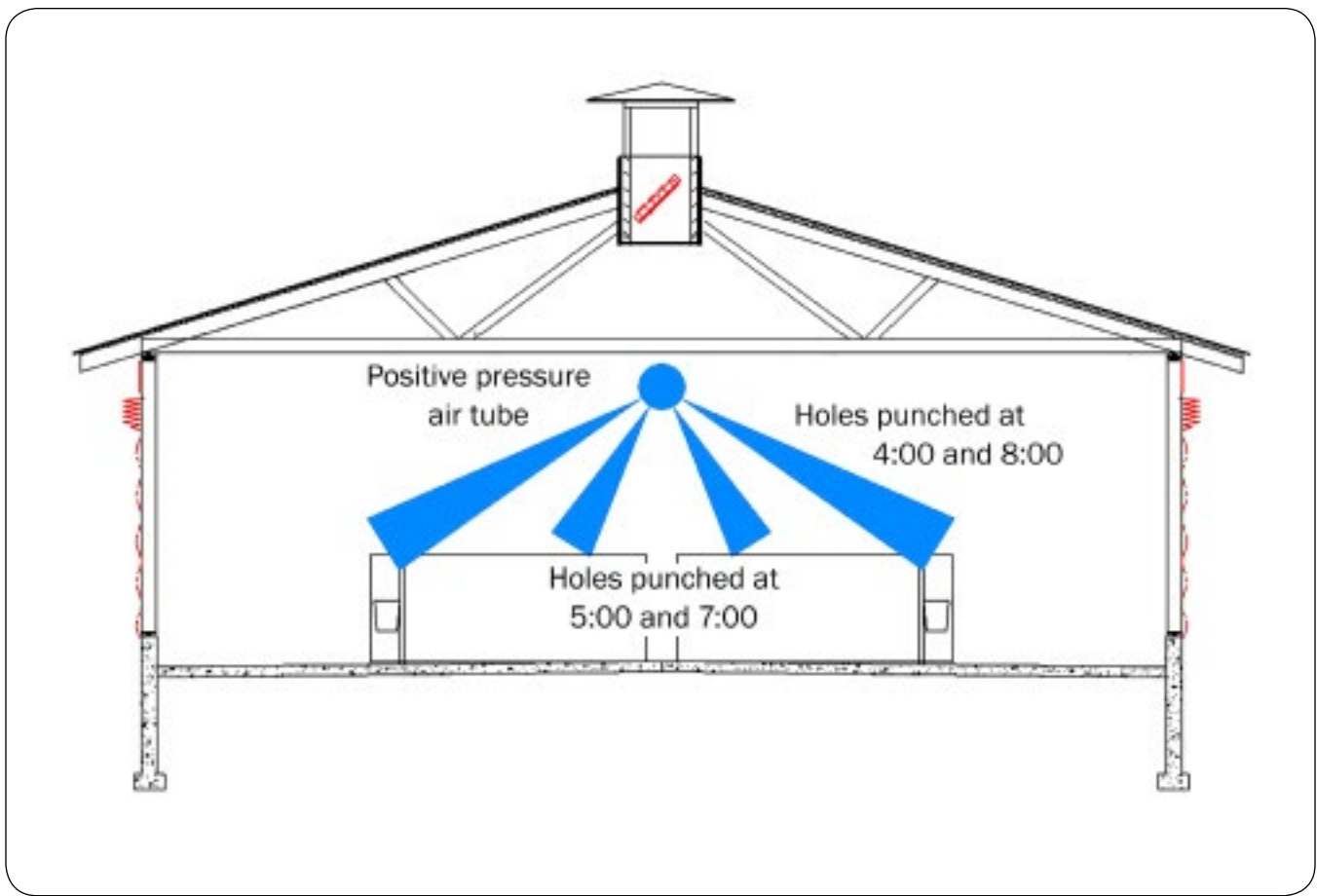


Figure 3. Hole location to match room size and pen layout.

Match the hole location to the shape of the room and the pen layout (Figure 3). The goal is to distribute the air evenly across the width of the room. If this is not possible, direct it towards the front of the pens.

The hole location will vary, depending on the mounting height of the tube. Hole location is usually described as positions on a clock face. For instance, if the tube is mounted 2.4–3 m (8–10 ft) above the floor, holes punched at 4 o’clock and 8 o’clock will provide a good distribution. If the mounting height is over 3 m (10 ft), punching holes at 5 o’clock and 7 o’clock is better. It may also be necessary to add a row of holes at 6 o’clock in a wide room.

VENTILATING CALF BARN WITH PPAT SYSTEMS

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 humid days when there is no wind, they will continue to circulate air.

STRAW AND SOLID PARTITIONS

In cold, naturally ventilated calf barns, calves also benefit from lots of long straw bedding, which 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. Design individual pens to be away from outside walls. Use solid panels 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 improve calf barn ventilation during cold weather when natural ventilation systems do not do well 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/>.

REFERENCES

Lago, A., S.M. McGuirk, T.B. Bennett, N.B. Cook, and K.V. Nordlund. 2006. Calf Respiratory Disease and Pen Microenvironments in Naturally Ventilated Calf Barns in Winter. *J. Dairy Sci.* 89:4,014–4,025.

The Dairyland Initiative 2012.
<http://thedairylandinitiative.vetmed.wisc.edu/>.

Ventilation for Livestock and Poultry Facilities. 2010. Publication 833. Ontario Ministry of Agriculture, Food and Rural Affairs. Guelph, Ontario.

This Factsheet was written by Harold K. House, P.Eng., Engineer, Dairy and Beef Housing and Equipment, OMAFRA, Clinton.



Published by the Ontario Ministry of Agriculture, Food and Rural Affairs

© Queen's Printer for Ontario, 2015, Toronto, Canada
ISSN 1198-712X

Également disponible en français (Fiche technique 15-010)

Agricultural Information Contact Centre:

1-877-424-1300

E-mail: ag.info.omafra@ontario.ca

www.ontario.ca/omafra