Unlike natural ventilation and negative pressure mechanical systems, tubes can place an exact amount of fresh air exactly where wanted at a defined speed.

Used to supplement natural ventilation in nursing calf and weaned heifer barns.

Retrofits of traditional closed calf barns, with additional mechanical ventilation for summer.

Holding area cooling for adult cows.

They are becoming common.

Supplemental positive pressure ventilation tube.

Very healthy calves!

Natural ventilation with curtain sidewalls and open ridge.

Topics
- Field study of calf barn respiratory disease risk factors
- Limitations of natural ventilation
- Features of “New Generation” tubes
- Current trends in modern calf barns
- Other applications for positive pressure tubes

Naturally ventilated calf barns.

World Dairy Expo “New Holland” pavilions.
Individual pens  
Solid or mesh sides  
Pen covers?  
Variable bedding  
Respiratory disease

Field study of risk factors for respiratory disease in naturally ventilated calf barns  

Typical values  
- Outdoor air: 100 – 1,000 cfu/m³  
- Clean office air: 1,000 - 2,000 cfu/m³  
- Well-ventilated barn: 10-15,000 cfu/m³  
- Calf barn microenvironments: 25,000 – 3 million cfu/m³

Finding:  
Total airborne bacterial cfu/m³ in PEN associated with prevalence of respiratory disease  
P ≤ 0.003  
Association is not causation...

Key factors for respiratory health

1) Low pen airborne bacteria counts  
P<0.003  
Total bacterial counts significant  
Coliforms (EMB) not significant
2) Nesting in deep bedding  
P<0.002
3) Solid panel between calves  
P<0.003

Nesting score = 1  
Legs entirely visible when lying down

Lago et.al., J Dairy Sci 89:4014, 2006
Nordlund - Positive pressure tube ventilation
Topics

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Why supplement natural ventilation?

- We estimate several thousand calf barns in North America have been fitted with positive pressure tubes during past 5 years. Why?
- The adoption driven by dairy farmer testimonials leading to demand by others
- Typical comment is that they will reduce calf pneumonia treatments by ½ to ¾
- Widespread adoption suggests that “natural” ventilation insufficient for optimal calf health

A Primer in Natural Ventilation

- Prevailing winds
  - Move directly into eave (and sidewall) openings
  - Travel over an open ridge and create a negative pressure or “lift”
- Thermal buoyancy as animals heat surrounding air, which causes it to rise out ridge opening

Natural ventilation by wind

Outside air colder than inside

![Temperature Chart Outside and Inside Two Calf Barns Over 4 Days](chart.png)
GPS Dairy Forum, Dubuque, IA  
Nov. 19, 2014

Outside air warmer than inside

Wind becomes still

Wind rose:
Wind in Eau Claire, WI in January
“Calm” 10% of time


Fog to demonstrate air jets

Supplemental tubes systems NEVER shut down & cover for some of the deficits of natural ventilation

“Still” winds

Topics
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Other applications for positive pressure tubes
“New Generation” Tubes

- Not the tubes of the 1980’s!
- Supplemental to natural ventilation, not recirculation
- Non-stop and deal with cold through ample bedding, etc.
- Technical differences in tube design
  - Uniform discharge along the length
  - “Throw” distance to avoid drafts

This is NOT what we are talking about!

- Oversized holes will create “drafts” on calves
- Tube sized for uneven distribution of air along length
- Fan positioned to recirculate every pathogen in the barn

Designing the systems

- Size the fan(s) to change the air in the barn ~4 times per hour
- Appropriate diameter of the tube to assure uniform discharge along the length of the tube
- Size and number of discharge holes to deliver air to calf without a draft

PPTC 6.0 Spreadsheet
Tubes require “custom” fitting

- Diameter of tube and sum of discharge hole area MUST be appropriate for capacity of fan
- Height of tube affects required “throw” distance, i.e., lower tube requires more and smaller discharge holes
- Width of coverage area affects the needed “throw” distance, i.e., clock position and sizing of holes
Approximate costs

- Fan – range from $250-800
- Tube, cable, and clamps –
  - range from $7-50 per linear meter
- Power cost (USA)
  - Example: 20-inch fan consumes 500 watts or 0.5 kWh = 12 kWh per day = 4,380 kWh per year.
  - Annual electrical costs = $438 per year at $0.10 per kWh

Topics

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Key features of preferred calf barns

1. Spatial allowances of approximately 30 ft² or more of bedded space per calf not including service alleys
2. Deeply bedded surfaces in weather less than 50° F
3. Drainage below the bedding
4. Multiple “all-in, all-out” barns with “down” time for cleaning
5. Natural ventilation with positive pressure supplemental ventilation
6. Minimal solid sidewalls, limited to ~24” height

Individual pen nurseries

Four separate “all-in, all-out” barns, serviced from a utility room separate from nurseries
Separation panels alternate solid and mesh

Barn base of “screenings”, sand summer bedding

Barn base of “screenings”, straw winter bedding

Natural ventilation supplemented with PP tubes

Originally constructed for natural ventilation only, positive pressure tubes added after a year

Automatic feeder nursery
One entrance to barn (except for bedding/cleaning)

Footbaths at entrance to room plus all four calf pens

Floors sloped to central drainage trough with 25 cm pea gravel over tile drain to outside storage

Newborn calves in individual pens 5-7 days, then move to group pen. Individual pens removed as group pen fills.

Natural ventilation with continuous central winter tube plus two warm weather tubes

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Application to “Holding Areas”

- Traditional holding areas use recirculating fans to create velocity, and depend on natural ventilation for fresh air.
- If natural ventilation minimal, recirculation results in increasing temperature & humidity.
- Positive pressure tubes can bring fresh air in from outside and deliver high-speed air to cow for evaporation of water from cow skin.

Challenges in holding areas

- Access and distance to “outside” fresh air.
- Height of the crowd gate (best <10 ft).
  - If >11 ft high, difficult to generate sufficient air speed at level of cow’s back.
- Sufficient space (~4 ft) above crowd gate for large capacity tubes.
Are you soon done?

Rotary Parlor

Summary

- Need to get beyond ventilating buildings and to ventilating the microenvironment around the animal
- Positive pressure tubes can place specific quantities of air where needed at specific speeds
- Positive pressure tubes have been effective and low-cost supplements to naturally ventilated calf barns
- Other potential applications for improved cooling in holding areas and parlors

http://TheDairylandInitiative.vetmed.wisc.edu