

## Calf Housing and Environments Series

### VIII. Assessment Tool to Evaluate the Calf Environment

When problem-solving dairy calf health and performance problems or bottlenecks, *in addition to assessing or evaluating overall calving management, colostrum management, nutrition and feeding systems, and disease detection and treatment protocols*, the calf-management advisor can help evaluate the calf environment. There are several areas to assess, based on the literature review:

- Housing systems and space requirements,
- Ventilation or air quality around the calf,
- Housing hygiene and sanitation, and
- Calf comfort and welfare (associated with housing).

It is very important to evaluate housing needs for winter and summer months. Providing for sufficient airflow without draft is essential in winter, but maximizing heat and humidity removal from calf environments in summer requires a different set of recommendations and farm management protocols. The housing areas need to be evaluated for both cold and hot weather!

The following list is a guideline for the kinds of items an environments assessor might want to have on hand:

1. Checklist/Form and Guidelines + Clipboard
2. Tape measure or laser measuring device
3. Graph paper
4. Anemometer (new models will also measure temperature and humidity)
5. Calculator
6. CO<sub>2</sub> sampler and sticks
7. Smoke sticks
8. Temperature/humidity data loggers (2)
9. Sterile culture swabs and blood agar plates
10. Sterile whirlpaks for bedding samples
11. Ruler to measure bedding depth or evaluate nesting score

# Calf Environment and Housing Assessment

## MATERNITY PEN

### 1. Space:

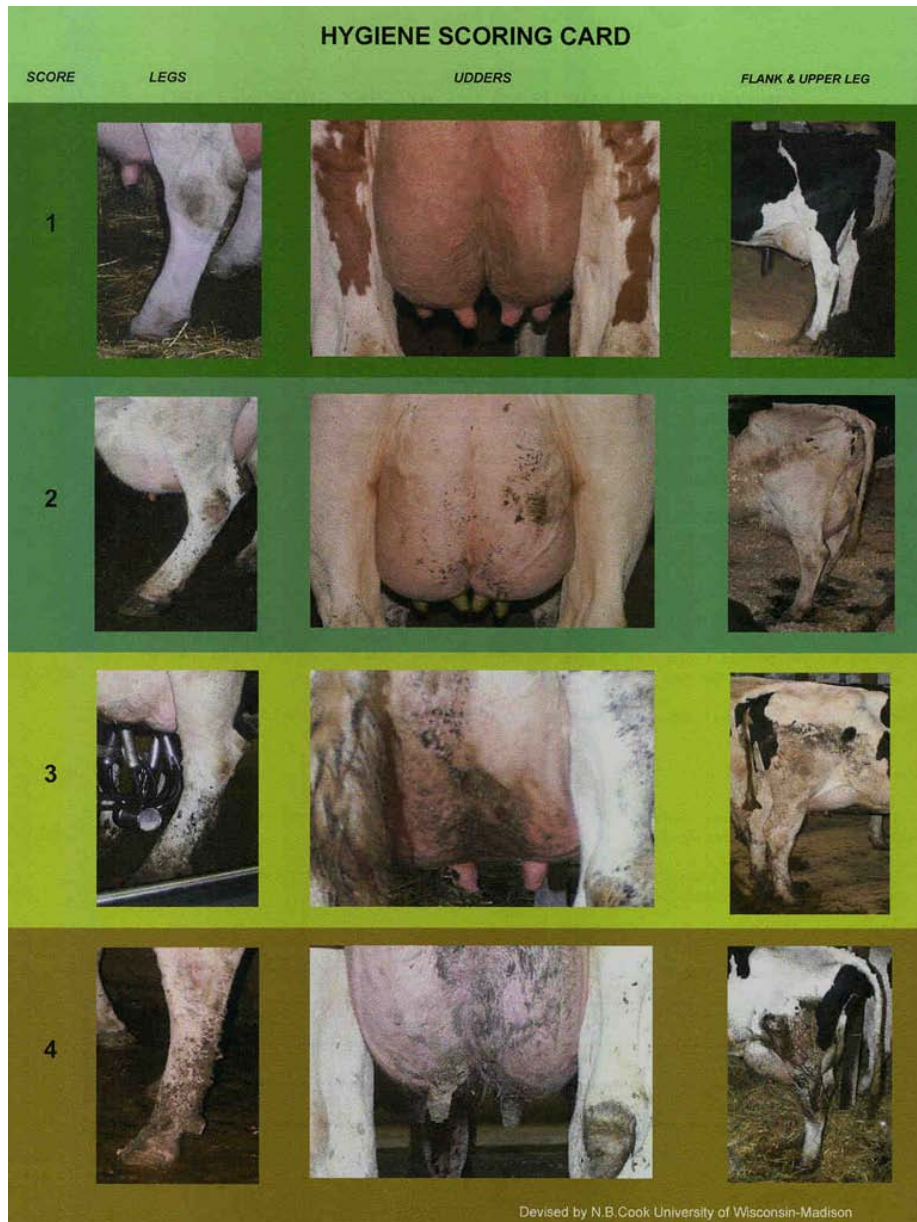
- Individual pen dimensions (12X12 or 10X14 ft)
- Group calving pen dimensions (need 120 ft<sup>2</sup> per cow)
- Stocking density (# cows/pen area)
- Bedding:
  - Dry matter %
  - [www.extension.org/pages/Dry\\_Matter\\_Determination](http://www.extension.org/pages/Dry_Matter_Determination)
  - Bacteria count cfu/ml of bedding
- From the dairy herd records, plot weekly or monthly calvings for the last two years. What is the maternity capacity? Does it match the times with the largest number of fresh cows? Does the maternity area have the capacity to handle this many cows?

### 2. Ventilation:

- Positive pressure                       Negative pressure                       Natural ventilation
- Other \_\_\_\_\_
- Evaluate ventilation, if needed, using calf barn ventilation assessment below.

### 3. Hygiene/Sanitation:

- Hygiene-score 12-14 cows in maternity pens. Score in each of three zones - lower leg, udder and upper leg, and flank zones. Score each zone separately. Scores 3 and 4 show a level of poor hygiene which is unacceptable.
- **Scoring Guide**
  - Lower Leg: *Score 1* - little or no manure above the coronary band. *Score 2* - minor splashing above the coronary band. *Score 3* - distinct plaques of manure above the coronary band, but with leg hair visible. *Score 4* - solid plaque of manure extending high up the leg.
  - Udder: Observe the udder from the rear and the side if possible. *Score 1* - no manure present. *Score 2* - minor splashing of manure near the teats. *Score 3* - distinct plaques of manure on the lower half of the udder. *Score 4* - confluent plaques of manure encrusted on/around the teats.
  - Upper leg and Flank: *Score 1* - no manure. *Score 2* - minor splashing of manure. *Score 3* - distinct plaques of manure with hair showing through. *Score 4* - confluent plaques of manure.



(Provided with permission, Dr. NB Cook, University of Wisconsin, Madison)

4. What is the Cleaning protocol for maternity pens?

5. Bedding:

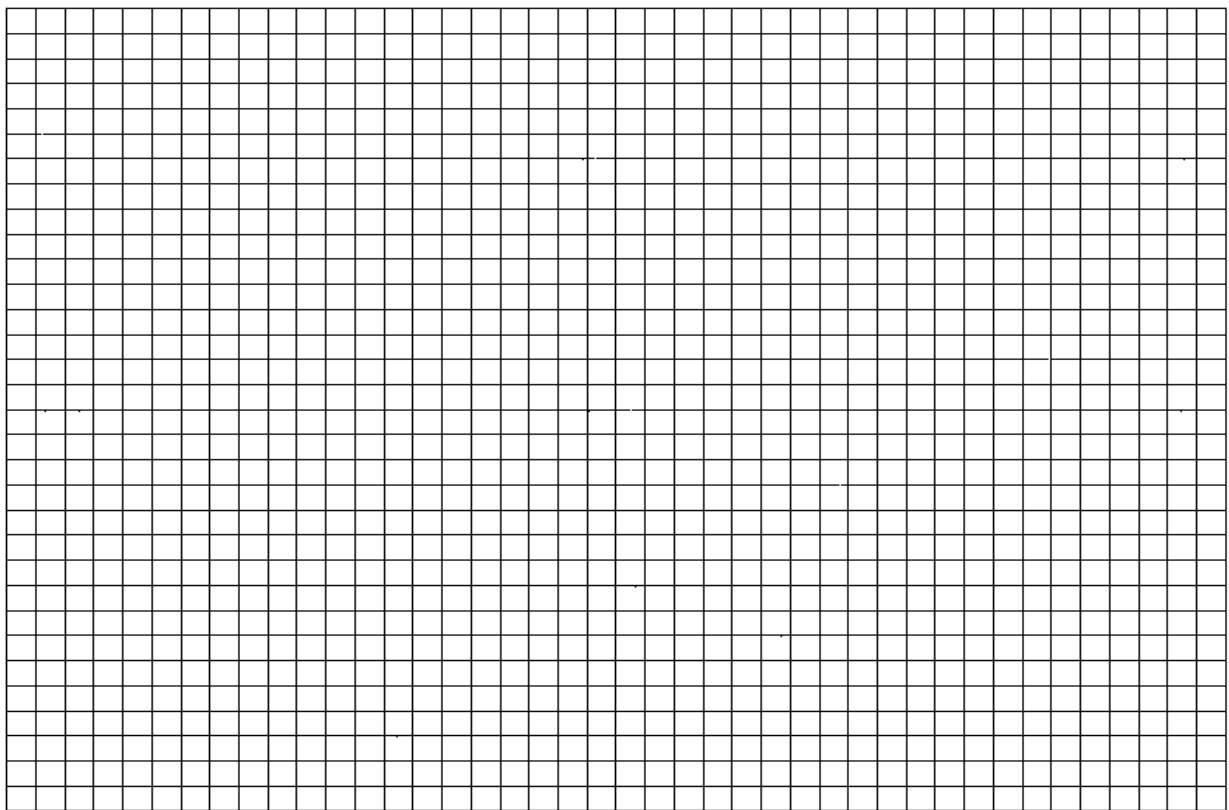
- Bedding bacterial counts: clean environment ready for a newborn calf, total bacterial count should be < 5,000 colonies/ml. During occupancy < 2,000,000 colonies/ml (S. McGuirk, 2003 AABP). *Similar recommendations from University of Minnesota indicate that fresh bedding should be <5000 cfu/g and counts should stay below 1,000,000 cfu/g.*
- Bedding samples - Dry Matter % estimates as surrogate for dampness (compare "fresh" bedding DM% with used bedding material DM%). Fresh dry bedding should have about 85 to 90% dry matter. Based on recommendations from some research, bedding should not be less than 60% dry matter.

**CALF TRANSPORT FROM MATERNITY**

- 1. Calves receive colostrum before transport?     Yes             No
- 2. What is the method of transport?
- 3. Observations of the transport vehicles:
  
- 4. Livestock Trailer Space (One linear foot per calf):     Yes             No
- 5. Ventilation:     Poor             Fair             Good             Excellent
- 6. Hygiene/Sanitation:     Poor             Fair             Good             Excellent
- 7. Bedding - Quantity, Quality - Dry Matter%:

**Hutch Housing Evaluation**

- 1. Layout of rows of hutches: Draw out a plot plan of the calf raising area and note compass directions, prevailing winds in summer and winter, other structures (wind block distance and height); The calf rearing area should be upwind from cow housing with no windblocks to impede airflow.



2. Distance between hutches:
3. Distance between hutch rows:
4. Windspeed at the front of each hutch, measure air speed across the front of hutches in each row and at each end of the rows with anemometer. Note: Are there different windspeeds in different areas of the calf rearing area?
5. Venting of air in the hutch -- design should provide for upward air venting; body heat will make air rise in winter, and moisture will accumulate unless roof is single-sloped upward toward opening or unless a vent is located at the highest point of hutch ceiling.
6. Space : Assess the space available for each calf (areas given based on fact that most dairy calves are Holsteins)(2010)
  - Hutches / Bedded pen - 24 to 32 ft<sup>2</sup>/calf (allow the animals to comfortably turn around, stand up, and lie down fully - legs stretched -- without touching the enclosure)
7. Assess ability of calves to stand up and move around hutches for calves about to be weaned (Is their back touching the roof?)
8. Can calves see other calves?  Yes  No
9. In cold weather, are hutches tight to the ground -- no slats or cracks through which wind can blow onto calf from underneath during winter?  Yes  No
10. Open end of hutches should be south- or south-east facing during cold months, and the other three walls should be solid with no openings.
11. Hutch Orientation -- During summer, hutch orientation should be to the north, to maximize shade. In winter, hutches should open to the south to maximize sun.
12. Substrate should provide for adequate liquid (urine, etc) drainage from the hutch; 4 inches or more of crushed rock is an ideal substrate.
13. Bedding should provide for adequate thermal insulation -- straw is preferred over shavings in winter. Additional bedding should be added weekly; old bedding should be removed only after calves are weaned and moved out. (No bare concrete.)
  - Nesting score - evaluate how much of the calf is covered by bedding when reclining (Lago et al., 2006).
    - 1 - lying on top of bedding
    - 2 - legs are partially covered
    - 3 - legs are completely covered by bedding
  - Bedding samples - Dry Matter % estimates for dampness
  - Hair loss on the calf's hindquarters?  Yes  No

14. Body cleanliness score of calf's coat (1 = very little manure through 5 = caked-on manure) Observe forequarters, belly, hindquarters, and overall body appearance (Terosky et al., 1997).  1  2  3  4  5

15. Assess "hutch comfort" for calves just leaving the hutches:

Ambulation scores:

- 1 - moves normally
- 2 - slight staggering or stiffness of leg joints
- 3 - modest staggering, stiffness of leg joints
- 4 - moderate staggering or stiffness, needs assistance
- 5 - needs assistance to stay erect and move
- 6 - falls frequently, must be partially carried
- 7 - must be carried, non-ambulatory

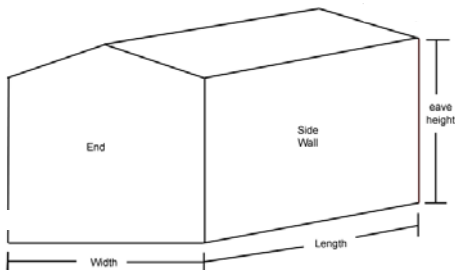
Knee or hock swelling scores:

- 1 - no swelling
- 2 - slight swelling
- 3 - modest swelling
- 4 - moderate swelling
- 5 - severely swollen

16. Hutch capacity for surges in animal numbers? (e.g. many more calves might be born in June in hot western climates because it took until October to get many cows pregnant because of summer heat stress effects on reproduction).

**Calf Barn Assessment**

*Barn layout*



1. Dimensions: (Measure)

a. Barn: Total area and volume of the barn (*Refer to Table 1. for pitched roof calculations*)

\_\_\_\_\_

b. Ridge:

\_\_\_\_\_

c. Sidewall & curtain opening:

\_\_\_\_\_

d. Alleys:

\_\_\_\_\_

e. Calf pens:

\_\_\_\_\_

2. Proportion of pen area within the barn: Total pen area ÷ total barn interior area =

3. Stocking density: \_\_\_\_Width x \_\_\_\_Length = \_\_\_\_\_ ÷ \_\_\_\_# of calves = \_\_\_\_\_

- a. Number of calves in barn:
- b. Number of calves per row:
- c. Number of rows in barn:

4. Box factor pen scores:

- Score 1 (1-3 solid planes: floor, 3 mesh sides; or floor, 2 solid sides, 2 mesh ends)
- Score 2 (4 solid planes: solid floor, 3 solid sides, mesh front, open top)
- Score 3 (5 solid planes: floor, 4 solid sides, open top; or floor, 3 solid sides, solid cover, mesh front)

5. Bedding:

- a. Type:
- b. Quantity:

6. Nesting score:

- Score 1 - Most of calves appear to lie on top of bedding with legs exposed.
- Score 2 - Nestled slightly into bedding, part of legs visible above bedding.
- Score 3 - Nestled deeply, legs not visible.

7. Temperature & humidity data logger data

- a. Place one outside of barn under shade, and another one in calf barn
- b. Start date & time:

End date & time:

*(Record data in 2 hour increments)*

8. Wind measurement: (Naturally ventilated barn)

- a. Anemometer → Measure prevailing wind speed.
- b. Note wind direction:
- c. Calculate barn ventilation rate:
- d. How close is the nearest building?

9. Crude airflow: (Measure fan capacity both dirty & clean)(Mechanically ventilated barn)

- a. Measure exit fans with anemometer (ft/min)

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- b. \*Measure exit fan diameter \_\_\_\_\_
- c. Measure inlet fans with anemometer (ft/min)

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\*Measure inlet fan diameter \_\_\_\_\_

d. Air exchange in ft<sup>3</sup>/ head/min for calves: (Calculate) (area=3.14\*r<sup>2</sup>)

Vol / time = airflow velocity x size of fan opening

Vol / time = \_\_\_\_\_ft/min x \_\_\_\_\_ft<sup>2</sup> = \_\_\_\_\_ ft<sup>3</sup>/min ÷ \_\_\_\_\_# of calves  
= \_\_\_\_\_ ft<sup>3</sup>/calf/minute

Age range	Cold Weather	Mild weather	Hot weather
0-2 months	15 ft <sup>3</sup> /hd/min (~10 ft <sup>3</sup> /100lb/min)	50 ft <sup>3</sup> /hd/min (~33 ft <sup>3</sup> /100lb/min)	100 ft <sup>3</sup> /hd/min (~66 ft <sup>3</sup> /100lb/min)
2-12 months	20 ft <sup>3</sup> /hd/min (~5 ft <sup>3</sup> /100lb/min)	60 ft <sup>3</sup> /hd/min (~15 ft <sup>3</sup> /100lb/min)	130 ft <sup>3</sup> /hd/min (~33 ft <sup>3</sup> /100lb/min)

*(Recommended air exchange in ft<sup>3</sup>/head/min for calves. (Midwest Plan Service, Iowa State University, Ames, IA 50011, Structures and Environment Handbook, 1983). Estimates of ft<sup>3</sup>/100lb/min have been added based on avg weights of 150 lbs at 0-2 mos and 400 lb at 2-12 mos). Note: Minimum airspace for Calf up to 200 lbs = 10 cubic meters per calf)*

10. Air flow patterns:

a. Dead Spots: (Use smoke sticks to see patterns of airflow)

\_\_\_\_\_  
\_\_\_\_\_

b. Drafts: (Any air striking a calf at 88ft/min or 1mph)

\_\_\_\_\_  
\_\_\_\_\_

11. Effective airflow:

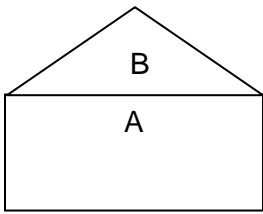
a. Measure CO<sub>2</sub> level at calf's nose in several areas of the barn.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Standards: Hot weather below 350 ppm. Mild weather below 600 ppm. Cold weather below 1400 ppm.



How to calculate the approximate volume of a pitched roof:



**Calculate A volume:**

$$\text{Volume} = \text{_____ width} \times \text{_____ length} \times \text{_____ height}$$

$$= \text{_____ ft}^3$$

**Calculate B volume:**

$$\text{Volume} = \text{_____ width} \times \text{_____ length} \times \text{_____ height}$$

$$= \text{_____ ft}^3 \div 2$$

$$= \text{_____ ft}^3$$

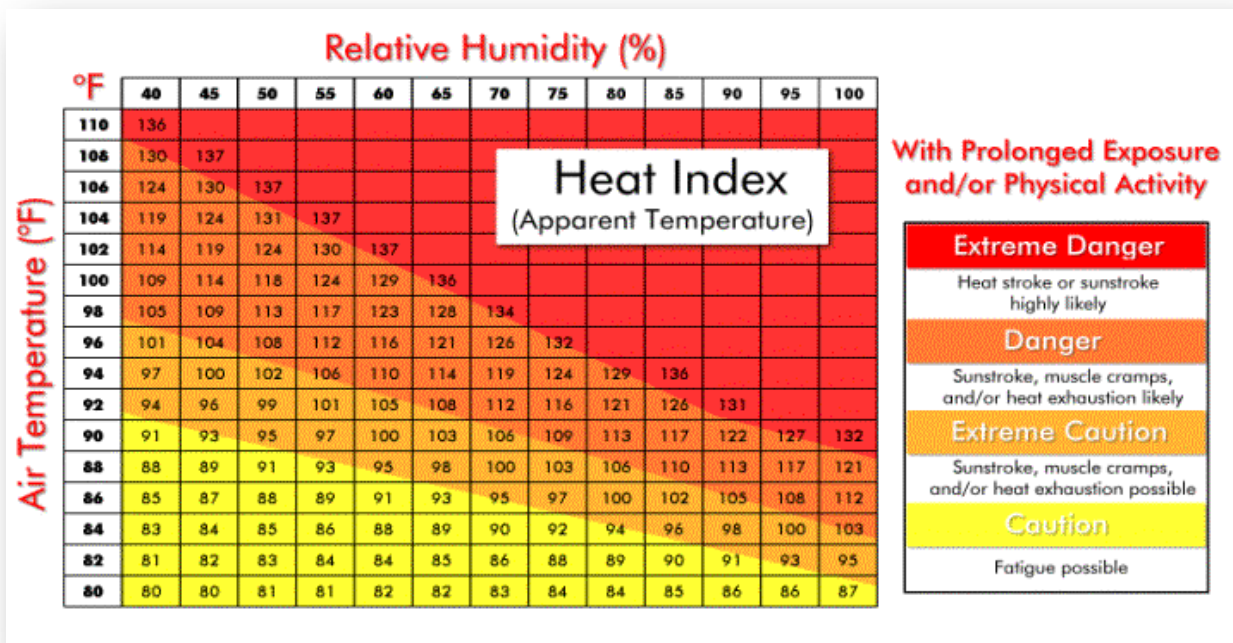
**Add for Total Barn Volume:**

**Weaned Calf Environment, 2 to 4 Months of Age:**

1. Super hutch - 34 ft<sup>2</sup>/calf of space required (DCHA 2010)
2. Transition groups - (5-12 calves); 34 ft<sup>2</sup>/head of space required
3. Dry lot Corrals - 200 ft<sup>2</sup> / calf, 18 inches bunk space/head; 20 ft<sup>2</sup> of shade/head
4. Bedding samples - Dry Matter % estimate as surrogate for dampness
5. Enough total calf raising space/facilities for surge capacity?
6. Are calves kept in stable groups and not mixed?  Yes  No
7. Are calf groups sorted by age, size, and behaviorally? (No more than 2 months age difference?)
8. Are all facilities, equipment, fittings, and pasture used by the animals free of debris?
  - a.  Yes  No
9. Assess respiratory rates in summer for heat stress. For neonates, 50 breaths per minute is normal. Respiratory rate is used clinically to detect pneumonia. However, under heat stress, panting occurs and caretakers will need to differentiate heat stressed calves from those with pneumonia. The following table shows average respiratory rates of calves at different environmental temperatures (Eigenberg et al., 2005; Findlay, 1957). *\*\*An unvalidated rule of thumb is that if they are breathing faster than 90 breaths per minute, heat stress remediation is necessary.*

Dry Bulb Temperature °F (°C)	Breaths per Minute
41 (5)	60
50 (10)	70
59 (15)	80
68 (20)	70-90
77 (25)	100
86 (30)	110-120
104 (40)	130-140

Skin temperature measurements can be used to measure skin temperature in cattle. (If the skin temperature is less than 95°F (35°C), the animals can effectively use all four routes of heat exchange (conduction, convection, radiation, and evaporation)(Collier et al., 2006)). Infrared skin temperature is highly correlated with respiratory rate in dairy cows. Can also use a Heat Index Chart to assess potential for heat stress within the calf environment. (From [www.ersh.noaa.gov/rah/heat/heatindexchart.gif](http://www.ersh.noaa.gov/rah/heat/heatindexchart.gif))



**Resources:**

Hancock, D. 1998. Assessing ventilation in livestock housing. Field Disease Investigation Unit, Washington State University.

Holmes BJ. Mechanical Ventilation for Individual Pen Calf Barns Calculator. University of Wisconsin. <http://www.uwex.edu/ces/heifermgmt/links.cfm>

**References**

Dairy cattle. (2010). In Federation of Animal Science Societies (Ed.), Guide for the Care and Use of Agricultural Animals in Research and Teaching (3rd ed., Champaign, IL: Federation of Animal Science Societies.

Collier, R. J., Dahl, G. E., & VanBaale, M. J. (2006). Major advances associated with environmental effects on dairy cattle. J Dairy Sci, 89, 1244-1253.

Lago, A., McGuirk, S. M., Bennett, T. B., Cook, N. B., & Nordlund, K. V. (2006). Calf respiratory disease and pen microenvironments in naturally ventilated calf barns in winter. J.Dairy Sci 89[10], 4014-4025.

Terosky, T. L., Wilson, L. L., Stull, C. L., & Stricklin, W. R. (1997). Effects of individual housing design and size on special-fed Holstein veal calf growth performance, hematology, and carcass characteristics. J Anim Sci, 75, 1703.

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**Funded by USDA: National Integrated Food Safety Initiative # 2007-01877**

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