

Time-lapse Video Opens Our Eyes to Cow Behaviour and Comfort

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Marketing Images are Pastoral

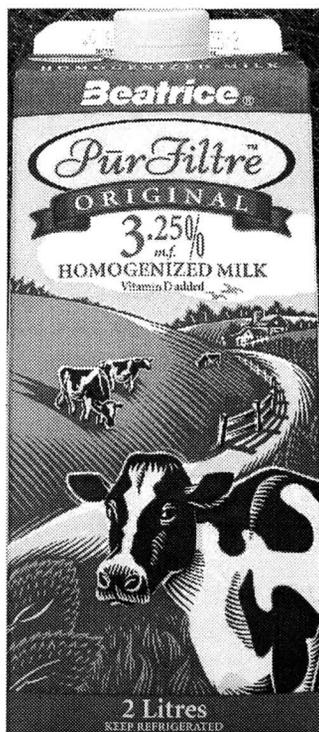
Our images for marketing milk show cows in lush green pastures, blue water in streams, and clear blue skies – pastoral images that portray the wholesomeness of the environment where cows produce milk - healthy cows, healthy environment, and a healthy food.

In Ontario, confinement housing is the norm for several months of the year. Our attention turns to the barn and its husbandry systems when looking for opportunities to enhance market access and international trade, human health and safety, animal health and dignity, residue avoidance, or to decrease the use of medicines or antimicrobial resistance.

Rather than chase bugs with drugs, dairy producers are adopting housing and management practices to reduce environmental risks and improve cattle health. In this presentation, 24-hour time-lapse video recordings and colour photographs show several examples of ways producers are using their knowledge of cow behaviour and ergonomics to improve dairy cattle health and performance.

The Ancient Cow Contract

Dairy farming includes a contract with the cattle - a barter of housing, feeding, safety and comfort in exchange for milk and meat. Dairy cattle cannot audit our performance or write a report about how well we are living up to our end of the deal. Nonetheless, cows show signs of their plea-



Marketing images are pastoral—not confinement

sure or displeasure with their situation: fear, unusual behaviour, injuries, lameness, impaired reproductive performance, metabolic diseases, infectious diseases, or poor milk production.

Savvy cattle-care professionals live up to their end of the bargain, auditing their contributions and sweetening the deal for cattle in their care. Some, however, are unaware that their actions or inaction, their design or construction of a facility, their choice of a husbandry system or their management within a system, infringes upon the contract. And occasionally, they are simply unaware that they have broken the contract.

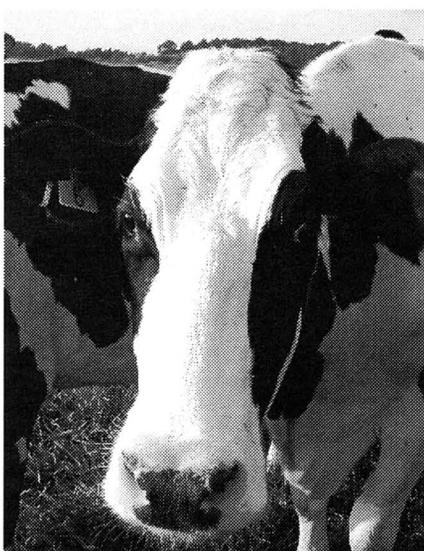
As animal care professionals, our time spent on dairy farms provides an opportunity for observation and assessment - an audit of how well we are doing with our end of the *cow contract*. For some working on a dairy farm full-time, cow behaviour may be so common as to appear normal and bias their audit. The astute know this, and often ask, “How do the cows look to you?” or similar audit-type questions of visitors to their farms. We are learning that common behaviour is not normal behaviour and that common housing may not be best for the cows.

When asked, we must realize that our cameo appearances provide only snapshots in time, an estimate of events or actions that may be occurring during a greater time period. This estimate is often weak because of the short observation times. A more accurate assessment of events is possible with a stillwatch: a close and silent inspection of dairy farm activities.

Close study, for 24 hours or more, provides a better estimation of events influencing cow behaviour, health, comfort or performance - the opportunity for improved diagnosis and provision of superior advice. Using time-lapse video recordings, we can conduct an audit of the cow contract with relative ease. Video gives us the opportunity to observe cow behaviour and interpret how barn designs, construction, husbandry systems and practices affect our cows. Video also allows us to critically assess current practices and dogma, increase awareness and knowledge, reject compromises, and enable change.

Cow Ergonomics

Cow ergonomics concern the improvement of cow health and performance through the careful design of her work environment. We see examples of human ergonomics being built into milk parlors – heated, cushioned floors and floors that are adjustable for height – and some tie-stall barns – tracks for the milking machines. One objective of these innovations is to increase the longevity of the workers. Similarly, ergonomic innovations in dairy barn design and construction aim to increase the health, safety and longevity of our cows.



The careful design of her work environment.

In the United Kingdom, W.B. Faull and J.W. Hughes observed cows freely lying and rising in a field to establish the space requirements for Friesian-Holstein cattle. Their data for typical cows appear in Table 1.

Table 1. Measurements of cow length, width, and rising space for UK Friesian-Holsteins.

Length - nose to tail head	240 cm (94 in)
Imprint length	180 cm (71 in)
Imprint width	120 cm (47 in)
Length of head lunging space	60 cm (24 in)
Length of front-leg stride to rise	45 cm (18 in)

They concluded that Friesian/Holstein cows at pasture required about 240 cm (94 in) x 120 cm (47 in) living space and a further 60 cm (24 in) of lunging space for rising. By these standards, they found 87% of cubicles were too short, 50% were too wide or too narrow, and that only 12% of the cubicles permitted real freedom of movement. Fully 10% of cows appeared moderately or severely restricted when lying down, 33% when rising and 55% when standing.

In Switzerland, animal welfare legislation includes guidelines for positioning of brisket boards to define the resting area of freestalls. Brisket boards must be positioned 185 cm (73 inches) from the rear curb and they

must not extend more than 10 cm (4 inches) above the lying surface. These measurements are for cows with a withers height of 135±5 cm (53±2 inches). (Katharina Friedli, Personal Communication, 2001) Our Ontario codes of practice do not include specific measurements.

According to Faull, total lunging space should be 240 cm plus 60 cm, or 300 cm (118 in) for UK Friesian-Holsteins. Mature Canadian Holstein-Friesians have a nose-to-tail length of 235-245 cm (92.5 - 96.5 in) (Haley, DB et al, 2000) that is similar to the cattle in Faull's study. Nonetheless, barns in Ontario are commonly built with 244-cm (96-in) long stalls, 117-cm (46-in) wide platforms, and 15 - 25-cm (6-10-in) high brisket boards located 168 - 173 cm (66-68-in) from the rear curb. Time-lapse video recordings show that several of these features in our free-stall barns do not allow cows to rest comfortably (see below - restlessness and stall sores).

Similarly in tie-stall barns, short platforms, narrow stalls, high manger curbs, low tie rails, and short tie chains alter normal cow behaviour and rest. The video portion of this presentation includes before and after time-lapse recordings in John's new tie-stall barn. The histogram below shows the increase in resting time (11 hr to 14.3 hr) after two simple changes - longer tie chains and more straw on the rubber mats. The data from the video convinced John that lying times could be increased with some minor husbandry changes. There are reports of associations of reduced lying times with lameness (Colam-Ainsworth, 1989; Leonard, 1996). John is monitoring his herd for improvements in hoof health following his changes.

Safety

The housing and feeding parts of the contract are usually at the forefront of dairy herd management. Nonetheless, our contract includes responsibility for *safety* - freedom from danger, risk or injury. A careful

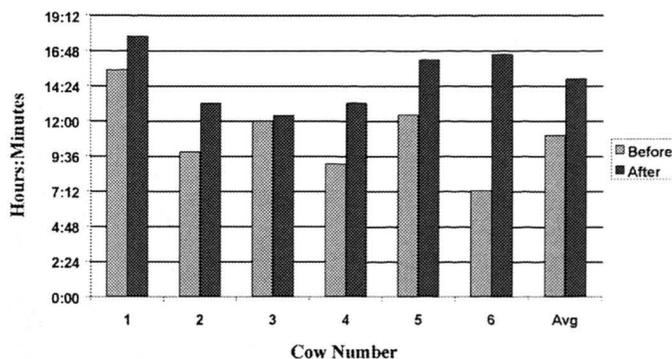


Figure 1. Lying times for John's six cows increased from 11 hours to 14.3 hours after adding more straw on the rubber mats for all cows and lengthening the chains for cows 4, 5 and 6.

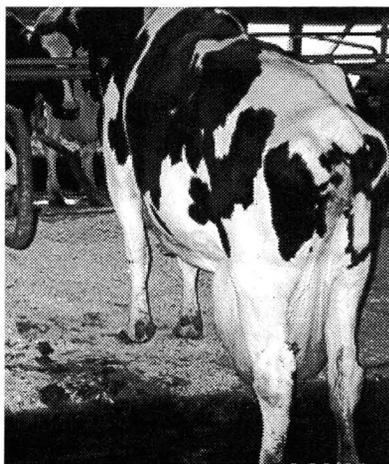
inspection of our cows for injuries to hocks, stifles and knees, or bumps or bruises over the top line or rib cage, will reveal how well we are living up to this part of our contract. Their reluctance to use stalls, to move quickly in or out of the parlor, or their actions at feed bunks or waterers may also alert us to issues of safety.

Fear or Apprehension

Cows in unsafe facilities exhibit fear - feelings of alarm or disquiet caused by the expectation of danger, pain, or disaster. Signs of apprehension include abnormal, unexpected or unwanted behaviour, such as:

1. Increased defecation or urination.
2. Standing with front feet in the stalls and rear feet in the alleys.
3. Increased standing and less lying.
4. Increased lying time and less frequent standing and re-positioning.
5. Refusal to use stalls and lying in alleys or partially in stalls.
6. The *hesitation waltz* - intention behaviour before lying in stalls.
7. Unusual actions when rising or trying to rest in stalls.
8. Lapping at water.
9. Reaching over walls to drink rather than stand in passageways where waterers are located.
10. Unusual and unexpected approaches to eating or drinking.
11. Unusual walking gait in dark places.
12. Reluctance to cross gutters or enter some areas of a barn.

I n t e n t i o n behaviour, or *hesitation waltz*, can last for several minutes before a cow lies in an uncomfortable stall. This is an extremely long time when compared to the few seconds taken by cows on pasture. Intention time should be considered one of several surrogate measures of stall comfort.



Stall refusal and shifting weight associated with lameness.

Avoidance or Learned Behaviour from Sources of Pain or Discomfort

Cows show some behaviour because of experiencing pain or discomfort while using a facility. The discomfort can originate from several sources:

1. Needles or injections given in the milk parlor or at lockups at the feed manger.
2. Neck rails that are too low or too close to the back of a stall.
3. Poorly positioned or designed stall partitions.
4. Hard stall surfaces.
5. Wide slots in slatted floors.
6. Flooring surface - too rough or too smooth.
7. Obstacles - alley scrapers, return pulleys in high traffic walkways.
8. Automatic gates.
9. Electric crowd gates.
10. Body contact with parts of the milking parlor.
11. Feed bunk barriers.
12. Electric cow trainers.
13. Sunshine into stalls.
14. Manure gasses.
15. Lack of ventilation, or cooling problems.

On some farms, cows that receive treatments or injections while in the parlor show their apprehension about entering by urination or defecation. Injuries sustained in milk parlors make cows apprehensive about entering, and thus slow the milking time. Electric cow trainers alter behaviour and aid in keeping cows clean. Moreover, electric trainers are a risk factor for silent heat, clinical mastitis, ketosis and culling relative to cows in herds not using cow trainers (Oltenuacu, 1998). Short tie chains prevent cows from lying in the short resting position. They also restrict cows from exhibiting normal estral behaviour and thus contribute to silent heats and challenges for heat detection. With some stall designs, cows prefer to stand rather than experience the pain associated with lying or rising. Cows cluster around the wet areas of waterers to take advantage of evaporative cooling. They refuse to use stalls bathed in sunlight, and instead—to avoid the heat—choose to rest in shaded stalls first or stand in clusters in shaded areas of the barn. Similarly, cows will cluster near open doors or the downwind side of barns to avoid areas with airflow problems or areas subjected to manure gasses from adjacent storage facilities.

Apprehension from Intrusion on the Comfort Zone

Cows may show apprehension from dominance behaviour or intrusion on their comfort zone by

herdmates. This apprehension can also originate from several sources:

1. Lack of an escape route - position of water troughs in narrow alleys, lockups at bunks.
2. Depth perception - deep gutters in tie stall barns, dark alleys and entrances.
3. Frightening objects - the same apron or clothes used while milking and while administering painful treatments.

Cows adopt avoidance behaviour rather than risk injury. They move away from drinking or eating when approached by a dominant cow. In tie-stall barns, dominant cows often prevent submissive first-calf heifers from drinking at their shared water bowl. In some free-stall barns, cows step into the end stall and drink over a concrete partition rather than stand facing the water trough. Often, cows just drink from the ends of water troughs placed in eight-foot walkways, leading some producers to conclude that they should have saved money and only bought the ends. For a comparison, look at what store designers do to prevent “refusals to buy” by shoppers. They give us ample “butt space” so we are undisturbed by store traffic. Some dairy producers know this. Their barns have 12-foot walkways where the water troughs are located, and they place them on the outside of the traffic curve.

Apprehension from Design or Construction

Apprehension may arise from the design of equipment or facilities that is beyond the ability of the cow to cope comfortably. Examples include:

1. Watering devices that are too difficult to operate, too high, with poor flow or access.
2. Elevated feed bunks.
3. Noise from air operated gates.
4. Lack of lighting.
5. Slippery floor surfaces.
6. Stall features that contribute to entrapment.

In some barns, we see cows lying partially in the stall and partially in the alley, rising like horses, back-



Cows in short resting position in an open-front freestall with PolyPillow®.

ing into stalls, choosing the alley to lie, or pawing bedding out of stalls. In tie-stall barns, we see frustrated cows lapping at water or chewing on water bowls because the stabling and bowl position prevent them from getting their head in to drink comfortably. Feed tossing is more common when cows must eat from elevated feed bunks. The “water-flinging” behaviour seen when cows must drink from four-foot high water troughs could be similar to the feed-tossing behaviour at high feed bunks. Cows show their displeasure with unwanted behaviour. Sometimes, in barns with slippery floors or those with short tie chains and electric trainers, they protest silently by not showing signs of estrus.

Design or Construction Features Leading to Disease

Design or construction features of the facility, or characteristics of the husbandry system, can lead to diseases in cattle that are not associated with fear. Examples are traumatic injuries, sore feet, mastitis, or metabolic diseases.

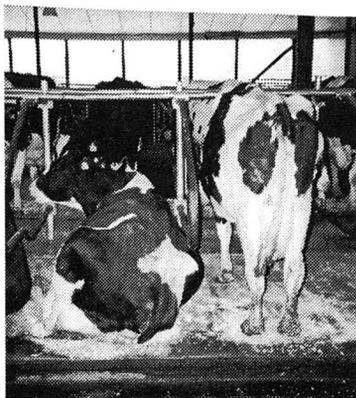
Sore feet (laminitis, sole ulcers, strawberry foot rot, or heel horn erosion) often have predisposing causes related to housing, environment or husbandry (Philipot, 1994; Leonard, 1996), such as:

1. Shifting of weight to hind feet: steps or sanitary curbs at feed bunks or water troughs, steps into parlors, solid or vertical feeding barriers at mangers, mangers built with bottoms level with the walk alley or stall platform.
2. Wet conditions: manure systems that leave wet floors, wet stalls, or ventilation systems with inadequate air flow or air exchange.
3. Hazards: wide slots, slippery floors or obstacles.
4. Overcrowding, leading to reduced lying times and foot lesions.

Hard lying surfaces on stall platforms, and stall characteristics that hinder the ability to rise, predispose to abrasions leading to swellings or ulcerations on legs. Also, cows may spend considerably more time lying on hard surfaces without rising to change positions because they find the hard surface painful when they are rising. This behaviour poses another challenge to interpretation of stall use and lying time.

Floor plans or building layouts also affect our ability to manage feeding strategies for dry cows and fresh cows. Compromises in the floor plan can lead to metabolic diseases, because we cannot group cows separately and implement feeding programs to prevent the diseases. Over time, the initial investment in a housing system for optimal feeding strategies could be less expensive than the veterinary, culling or labour costs associated with the metabolic diseases.

Three housing goals have been clean stalls, clean cows and reduced labour. To achieve these goals in free-stall barns, we position a neck rail, a brisket board and loops to locate the cow towards the alley curb and to keep her relatively straight in the allotted space. Cows will naturally stand sideways to get more unobstructed room when the neck rail is too low and too close



In open-front, high-neckrail freestalls cows stand and lie straight with tail, legs and udder on platform.

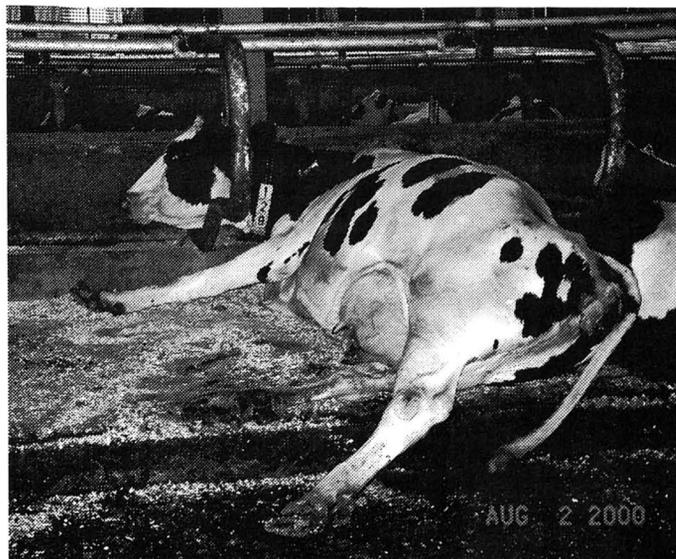
to the rear of the stall or when they have short stalls designed specifically for side-lunging when lying or rising. When they lie in these stalls, they are sideways and when they defecate, the manure is on the corners. When observing this husbandry problem, some diagnose the cause as stalls that are too wide. They narrow the loops to 117 cm (46 in) (or less) centres to correct the dirty-stall problem.

For sure, the narrower stall forces cows to lie straight so they will defecate off the stall platform. Although this “fix” appears to work, it creates more problems – the cows cannot keep their tails or legs on the platform and they are restless in the narrow and short stalls. Their tails become dirty from resting in the walkways. Their feet also become soiled while dropping off the platform (15-30 times per hour of lying) and these soiled feet drag manure back onto their bed. The latter is often viewed as an increased risk of environmental mastitis.

Some have chosen to treat these signs of sick barns by amputating tails or building narrower stalls. On the other hand, producers leading the way in cow ergonomics and rest are choosing to build open front freestalls, raising and repositioning the neckrails, making stalls wider, and changing the position and style of brisket restraint. For similar cow-comfort concerns in tie-stall barns, producers are building stalls with longer and wider platforms, tie rails higher above the bed and forward of the manger curb, open-front stalls, and longer tie chains. These changes to tie-stall barns virtually eliminate “stupid heifer syndrome” and the difficulties of rising previously experienced by some older cows.

Restlessness and Stall Sores

Dairy cows assume four common resting positions - wide, narrow, short or long (see below). On occasion, they will stretch out and rest completely on their sides – the “dead-cow” position. In some of our barns, our cows



Trying to fit a square peg into a round hole: brisket boards obstruct resting positions.

cannot assume normal resting, lying or rising positions because of interference from brisket boards, supporting pipes, narrow stalls or manger curbs.

Restrictive stalls lead to unusual resting behaviour – restlessness. In the adjacent photograph, notice that the brisket board prevents the cow from extending her front legs forward. Nonetheless, she can extend her upper front leg laterally – an unnatural position unless she rests on her side. The brisket board positions her towards the curb, her leg and tail hang in the gutter.

When viewed on video, cows in similar stalls changed positions several times per hour. Their top hindlegs moved into and out of the alley 15 to 30 times per hour and their bottom hindleg moved across the mattress 6 to 10 times per hour (Anderson, Pace & Douglas, 2000).

After viewing the video taken at his farm, one owner removed the brisket boards and raised the neckrail to 127 cm (50 in) above the mattress. Stall usage and cow behaviour changed immediately. Within six months, the majority of the hock lesions had healed. Several researchers have reported on hock lesions and the stall surface or bedding (e.g. Weary, 2000; Wechsler, 2000). Often these reports do not include the confounding influence of other stall features. If stall features cause restlessness, and if restlessness leads to excessive leg movements, stall characteristics that lead to a more restful lying experience could prevent hock sores in mattress barns.

Six Freedoms for Stall Design

With free stalls, cows have the freedom to choose a stall. Perhaps a new name - freedom stall – would focus

our attention on normal resting positions and the freedom to express them. At the same time, adhering to six freedoms for stall design would help define the space needed for dairy cows to express normal resting behaviour. The adjacent four photographs show normal resting positions – wide, narrow, short and long.

To achieve the four positions, the resting area must provide cows:

1. Freedom to stretch their front legs forward.
2. Freedom to lie on their sides, with unobstructed space for their neck and head.
3. Freedom to rest their heads against their sides without hindrance from a partition.
4. Freedom to rest with their legs, udders and tails on the platform.
5. Freedom to stand or lie without fear or pain from neck rails, partitions, or supports.
6. Freedom to rest on a clean, dry and soft bed.

Recently, manufacturers and contractors introduced several stall features that provide these freedoms. Many are using PolyPillows® rather than brisket boards. Some producers have chosen not to have any form of brisket restraint. New stalls have open fronts with loops supported independently so there are no obstructions at the



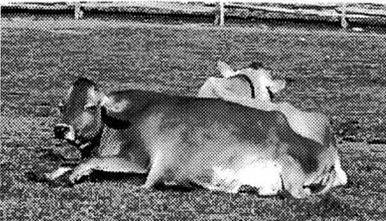
wide



narrow



short



long

front of the stall. Neck rails are 122 - 127 cm (48 - 50 in) above the mattress and positioned 160 - 167 cm (63 - 66 in) from the rear curb, according to cow size. For retrofitting in barns where side-lunging is unavoidable, we recognize that the top bar of the loop becomes the neckrail in these side-lunging stalls. For this application, there is a special loop with a wider opening between the top and bottom bar, with the top bar at neckrail height - 122 - 127 cm. New free stalls are also wider - 121 cm (48 in) and longer - 503 cm (198 in) when head-to-head, and 305 cm (120 in) when a wall is at the front.

Better nights. Better days. That's the message on the home page of "The Sleep Council." Through their website, they give advice about getting a good sleep – one that leads to a better day tomorrow. For many, the remedy for restless nights is a new mattress. That was the case for Janice and Bob. At five feet tall, she fits the new 80-inch mattress better than he fit the old 74-inch one with his height of six feet.

This bedroom example also applies to the beds we build for our cows. For producers building only one size stall, the choice is the size for the largest 25% of the cows in the herd. Under ideal conditions, cows often lie for greater than 14 hours in day. Recent innovations in stall designs show that producers will no longer tolerate deprivation of resting positions and rest for their cows. They know that cows cannot perform well without adequate resting time. They also know that the level of health and performance increases significantly in freedom stalls.

Stall Choices: Revelations Lead to an Epidemic of Change

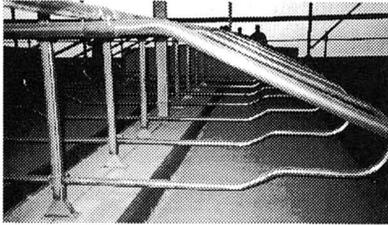
This past year, several Ontario dairy producers chose significantly different stabling for their new free stall or tie-stall barns than that commonly used in the past—stabling that allows cows to assume more normal resting, lying and rising positions. They are at the leading edge of an epidemic of change – an epidemic that changed their beliefs about cow comfort.

Leaders in cow ergonomics have been blessed with two important revelations:

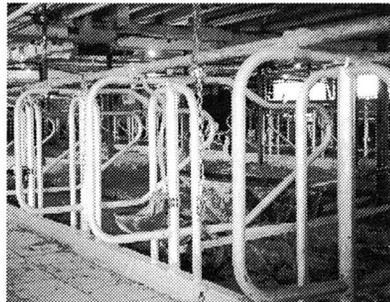
1. Building barns to house cows is costly – and often just plain foolish; and
2. Building barns to make money is best for their cows and for them.

Barns built to make money have all the features essential for cow comfort as standard features – they are not options.

The new forward-lunging freestalls allow cows to stand straight in the stall, to lie straight, and to have their tails rest on the platform while lying. Producers



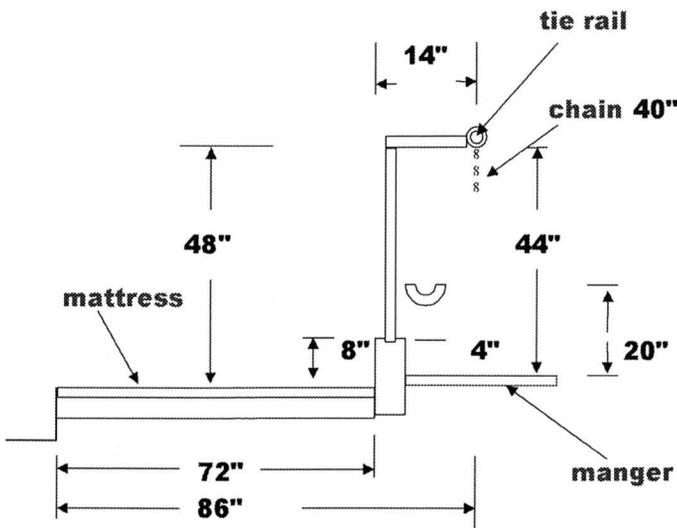
An example of wide-loop, open-front freestalls.



Tie stalls with suspended loops with 30-inch opening and tie rail 48 inches above mattress.

are choosing stalls for her comfort and compromising by investing more labour in stall maintenance.

For their tie-stall barns, owners are installing the single tie rail 121 cm (48 in) above the mattress and 35 cm (14 in) forward of the manger curb in barns with 183-cm (72-in) platforms. Several producers built stalls for their biggest cows with the tie rail 127 cm (50 in) above the mattress and 25 cm (10 in) forward of the manger curb. Stall widths and platform lengths vary from 137 cm (54 in) wide and 178 cm (70 in) long for first-lactation heifers, to 152 cm (60 in) wide and 183 cm long for the largest cows. The new stalls provide 56 - 61 cm (22 - 24 in) unobstructed access to water bowls. Tie chains need to be 102 cm (40 in) long for stalls with 121-cm tie rails.



Tie stall measurements for medium-sized Holstein-Friesians.

Expectations from Safe Dairy Facilities: Benefits of Change

Cow comfort is difficult to measure in business terms. Indeed, it's often difficult to measure in scientific experiments by researchers. Dairy producers, sensitive to injuries and disease, and observant of cow behaviour, do not wait for research results - they lead the way with innovations. They are unwilling to accept compromises in cow safety that appear as sore feet, injuries, lower reproductive performance, greater culling, reduced feed intakes, lower milk production, increased health care costs, or increased labour for management.

Self-regulated, Self-audited, Moral Obligation: The Cow Contract

In some countries, dairy producers must be responsive to consumer priorities for ergonomics, health and welfare in dairy cattle housing. In addition to meeting stringent standards for milk quality, producers must meet standards for cattle husbandry and pass an audit to qualify for a milk contract. Both marketing and market access prompted the requirements.

In Ontario, our *cow contract* is self-regulated and self-audited: a moral obligation to deliver care, safety, comfort and food in exchange for milk and meat. Living up to our end of the deal requires consideration of both biosecurity and safety issues in dairy herd management. Biosecurity strategies minimize the risk of infectious diseases. Safety strategies minimize the risk of fear, apprehension and abnormal behaviour that lead to traumatic injuries, loss of comfort or welfare, and loss of cow performance.

Rather than accept compromises in facilities or husbandry systems, and chase bugs with drugs, let's follow our industry leaders. Let's speed the adoption of housing and management practices to reduce environmental risk factors for disease, and improve cattle health. By doing so, we enhance the image of milk and contribute to market access, animal health and dignity, human health and safety, a reduction in drug use, residue avoidance, or antimicrobial resistance issues. Time-lapse video is a very useful tool for diagnosis and enabling change.

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EXCENEL RTU Sterile Suspension is indicated for treatment of bovine respiratory disease (BRD, shipping fever, pneumonia) associated with *Pasteurella haemolytica*, *Pasteurella multocida* and *Haemophilus somnus*. EXCENEL RTU Sterile Suspension is also indicated for treatment of acute bovine interdigital necrobacillosis (foot rot, pododermatitis) associated with *Fusobacterium necrophorum* and *Bacteroides melaninogenicus*.

CONTRAINDICATIONS

As with all drugs, the use of EXCENEL RTU Sterile Suspension is contraindicated in animals previously found to be hypersensitive to the drug.

DOSAGE AND ADMINISTRATION

Administer by intramuscular or subcutaneous administration at the dosage of 0.5 to 1.0 mg ceftiofur equivalents/lb (1.1 to 2.2 mg/kg) BW (1 to 2 mL sterile suspension per 100 lb BW). Administer daily at 24 h intervals for a total of three consecutive days. Additional treatments may be administered on Days 4 and 5 for animals which do not show a satisfactory response (not recovered) after the initial three treatments. In addition, for BRD only, administer intramuscularly or subcutaneously 1.0 mg ceftiofur equivalents/lb (2.2 mg/kg) BW every other day on Days 1 and 3 (48 h interval). Do not inject more than 15 mL per intramuscular injection site.

Selection of dosage level (0.5 to 1.0 mg/lb) and regimen/duration (daily or every other day for BRD only) should be based on an assessment of the severity of disease, pathogen susceptibility and clinical response.

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WARNINGS

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Penicillins and cephalosporins can cause allergic reactions in sensitized individuals. Topical exposures to such antimicrobials, including ceftiofur, may elicit mild to severe allergic reactions in some individuals. Repeated or prolonged exposure may lead to sensitization. Avoid direct contact of the product with the skin, eyes, mouth, and clothing.

Persons with a known hypersensitivity to penicillin or cephalosporins should avoid exposure to this product.

In case of accidental eye exposure, flush with water for 15 minutes. In case of accidental skin exposure, wash with soap and water. Remove contaminated clothing. If allergic reaction occurs (e.g., skin rash, hives, difficult breathing), seek medical attention.

The material safety data sheet contains more detailed occupational safety information. To report adverse effects in users, to obtain more information or obtain a material safety data sheet, call 1-800-253-8600.

RESIDUE WARNINGS: No pre-slaughter drug withdrawal interval is required when this product is used in swine. Treated cattle must not be slaughtered for 48 hours (2 days) following last treatment because unsafe levels of drug remain at the injection sites. No milk discard time is required when this product is used according to label directions. Use of dosages in excess of those indicated or by unapproved routes of administration, such as intramammary, may result in illegal residues in edible tissues and/or in milk. A withdrawal period has not been established in pre-ruminating calves. Do not use in calves to be processed for veal.

PRECAUTIONS

Following intramuscular or subcutaneous administration in the neck, areas of discoloration at the site may persist beyond 11 days resulting in trim loss of edible tissues at slaughter. Following intramuscular administration in the rear leg, areas of discoloration at the injection site may persist beyond 28 days resulting in trim loss of edible tissues at slaughter.

STORAGE CONDITIONS

Store at controlled room temperature 20° to 25° C (68° to 77° F) [see USP]. Shake well before using. Protect from freezing.

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