

Technical Guide

Animal welfare is complex with no single parameter identified to satisfactorily evaluate well-being under all conditions. Four measurements of animal welfare are used in scientific studies: behavior, immune function, hormonal response, and production. These measurements are time consuming and expensive to quantify directly on the farm, but an inexpensive assessment of animal welfare on the dairy can be made using this program.

Continued research is essential to provide additional information about the basic needs of dairy cattle under different management systems. As new scientifically based techniques and practices are developed, management should adopt these into existing systems.

The **Dairy Welfare Evaluation Guide** has been written in general terms to be applicable to the diversity of dairy management in California. The suggested practices are often described using the verbs *must*, *should*, or *recommended*. The word *must* is used for practices that are imperative or essential. The word *should* was chosen for those practices as a strong recommendation, but where alternatives are not desirable. A *recommendation* is generally the preferred practice or policy, but for which there are acceptable alternatives. Professional judgment of producers and consultants is essential in the application of guidelines to a specific situation.

Generally, producers can provide quality animal care by:

1. Observing each animal daily for evidence of adequate care. Signs of sickness, poor hygiene, and unusual behavior should call attention to necessary improvements.
2. Observing the animals' environment; for example, slick flooring, rough fencing, and dirty bedding must be corrected.
3. Implementing basic management and handling practices that enhance animal well-being, which include a herd health plan, sound nutrition program, clean and safe environment, and proper handling and transportation protocols.
4. Communication to employees the expectations for animal care and appropriate employee training is vital to the well-being of all animals on the dairy.
5. Patronizing only those auctions, sales yards, or processing facilities where proper animal handling and care methods are used. Improper animal handling must be reported to industry or government representatives for follow-up action.

Management Policies

It is the responsibility of the manager to establish and implement standards for dairy animal care. Management must communicate expectations for animal care to employees, and monitor the care provided. All animal caretakers should be aware of their responsibilities during normal work hours and in case of emergencies. On-farm policies should be reviewed twice per year to remind employees of the importance of proper animal care, well-being, and comfort.

Training employees about animal care influences the quality of care they provide to the animals. A considerate attitude combined with sound husbandry practices will produce healthy, efficient animals. All animals should be observed daily for comfort, locomotion, and behavioral changes. All changes or deficiencies must be reported and/or corrected. Employee training should encompass care expectations for particular circumstances, such as how to move uncooperative cattle or what to do in cases of emergencies, as well as general expectations for routine handling. By adequately training and motivating staff, a producer can achieve high-quality animal care. Training provided should comply with OSHA standards for safety training (OSHA, 1995).

Emergency, weekend, and holiday care requires specific management and planning steps. The producer should arrange for personnel or temporary help to cover emergencies, and on weekends, holidays and unexpected absences of assigned caretakers. The owner and/or manager should ensure that personnel are informed of expectations in animal care routines and are qualified to perform assigned duties. Posting the names and telephone numbers of emergency contacts (e.g., herd manager, owner, and veterinarian) in a prominent place in the animal facility will expedite communication. It is also important to establish a written emergency plan and assure that facilities, labor and equipment are adequate to address animal needs arising from adverse weather conditions common to the area.

Federal and California animal laws concerning the care and handling of dairy cattle are mainly focused on cruelty, abuse and neglect, but these regulations should be communicated to employees. These include the following:

Penal Code 597: "...every person who overdrives, overloads, drives when overloaded, overworks, tortures, torments, deprives of necessary sustenance, drink or shelter, cruelly beats, mutilates, or cruelly kills an animal...is guilty of an offense punishable as a misdemeanor or felony."

Penal Code 599f: "(a) No slaughterhouse that is not inspected by the United States Department of Agriculture, stockyard, or auction shall buy, sell, or receive a nonambulatory animal.

(b) No slaughterhouse, stockyard, auction, market agency, or dealer shall hold a nonambulatory animal without taking immediate action to humanely euthanize the animal or remove the animal from the premise.

(c) While in transit or on the premise of the stockyard, auction, market agency, dealer, or slaughterhouse, a nonambulatory animal may not be dragged at any time, or pushed with equipment at any time, but shall be moved with a sling or on a stoneboat or other sled-like device or wheeled conveyance.

(d) A violation of this section is a misdemeanor."

Food and Agriculture Code 16908: Confinement of Animals in Truck Transit: Rest, Water, and Feeding: Storm or Accident. “It is unlawful for any person that owns or operates any motor truck and trailer, or semi trailer, to confine or permit to be confined, in such vehicle, any animal for a longer period than 28 consecutive hours from the time the animal was last fed and watered. Upon the written request of the owner or person in charge of the animal, the period of confinement may be extended to 36 hours. Before the expiration of the permissible period of confinement, the animal shall be unloaded in a humane manner by means of a chute or tailgate of sufficient size into properly equipped pens for rest, water, and feeding for a period of at least five consecutive hours. The failure of a person to feed and water an animal within the time limit prescribed by this section is not a violation of this section if the feeding and watering of the animal is prevented by storm or other accidental or unavoidable causes which could not be anticipated or avoided by the exercise of diligence and foresight.”

Federal Registry (Vol. 69, No. 7), January 12, 2004, Department of Agriculture, Food Safety and Inspection Service, Interim Final Rule including Requirements for the Disposition of Non-Ambulatory Cattle. “Non-ambulatory disabled livestock are livestock that cannot rise from a recumbent position or that cannot walk, including, but not limited to, those with broken appendages, severed tendons or ligaments, nerve paralysis, fractured vertebral column, or metabolic conditions,” (Part 309.2). “Non-ambulatory disabled cattle presented for slaughter shall be condemned.” (Part 309.3).

Animal Health Care

Establishing a Herd Health Program

Quality dairy animal care includes a written herd health program that is comprehensive and emphasizes disease prevention. A licensed veterinarian can assist producers to develop and implement a routine herd health program. The program should include:

- Regular observation of cattle
- A valid veterinarian/client/patient relationship
- Routine herd practices including vaccine schedule, quarantine procedures for newly arrived animals, reproductive examinations, fresh cow observations, calving observations, calf care, body condition scoring, and cleanliness and hygiene scoring
- Proper administration of medication, identification of all treated animals, and observation of milk and meat withdrawal times
- Animal identification and health records
- Proper facility sanitation and waste management
- Pest and parasite control
- Husbandry practices including elective surgery protocols (i.e., castration, dehorning, extra-teat removal)
- Lameness (locomotion scoring) and hoof care evaluation

Producers should establish a valid veterinarian/client/patient relationship. The American Veterinary Medical Association defines this relationship will exist when:

(1) The veterinarian has assumed the responsibility for making medical judgments regarding the health of the animal(s) and the need for medical treatment, and the client (owner or caretaker) has agreed to follow the instructions of the veterinarian; and when (2) there is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s). This means the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s) and/or by medically appropriate and timely visits to the premises where the animal(s) are kept; and when (3) the practicing veterinarian is readily available, or has arranged for emergency coverage, for follow-up in case of adverse reactions or failure of the regimen of therapy (American Veterinary Medical Association, 2002).

Animal ID and Health Records

Animal identification and health records are critical for making important management decisions about feeding, selection, medicating, breeding, and culling an animal from the herd. Every animal should be identified in two locations by methods such as electronic transpondence, ear tags, neck chain tags, or branding.

Sanitation and Waste Management

Proper sanitation and waste management keep animals dry and clean and provide comfortable, healthy surroundings. In contrast, poor sanitation contributes to many animal health problems and compromises well-being.

- Maintain clean facilities
- Minimize generation of odors and dust
- Minimize pests and parasites

- Minimize spread of pathogens

Cattle housed in environments with wet bedding, mud, or manure are more likely to have a higher prevalence of lameness. A hygiene scoring system can accurately assess manure contamination in three main body areas including the udder, lower rear leg, and the upper leg and flank (**Appendix 1**). A color hygiene scoring chart may also be downloaded from the University of Wisconsin's web site: www.vetmed.wisc.edu/dms/fapm/forms.htm.

Parasites

Some parasitic infections, such as coccidiosis and cryptosporidiosis, can cause serious health problems. It is recommended that a regular parasite control program be developed with a veterinarian's assistance. A clean environment is the best tool for combating parasite infections.

Pest Control

Pest control is part of a herd health program because vermin transmit diseases and interfere with the animals' comfort. Producers should adopt procedures to control flies, mosquitoes, lice, mites, ticks, grubs, fleas, rodents, skunks, and pest birds (e.g., starlings, pigeons and sparrows).

Health Care Procedures

Specific elective procedures are utilized to sustain long-term welfare of the dairy animals, even though some of these practices cause short-term stress, discomfort, and/or pain. These practices include dehorning, extra teat removal, castration, vaccination, hoof trimming, and some identification methods. The protocols for these procedures should be based on available science and be performed by personnel knowledgeable and experienced, or under the supervision of experienced personnel. **Appendix 2** contains sample protocols.

Dehorning is performed to avoid injury to herd mates and dairy personnel, reduce feeder space, and increase handling ease. It is recommended that dehorning be performed when calves are 2 to 10 weeks old. Older calves are more difficult to restrain and have an increased risk of blood loss, infection, and fly infestation. A local anesthetic should be used for calves older than 10 weeks of age. A hot dehorning iron is the simplest and fastest method to kill horn-producing cells. Caustic pastes and scoops are alternatives, but generally cause more prolonged pain and discomfort. A fly repellent should be applied to the dehorned area during fly season. Newly dehorned calves should be kept out of the rain until dehorned area is scabbed and dry.

Extra teat removal is performed since extra teats may interfere with milking and increase the risk of mastitis. Teat removal should occur as soon as possible after birth to ensure a quick recovery. A qualified person may use a scalpel or scissors in a hygienic manner.

Castration may be performed on most young male calves. Castration reduces aggression against other male herd mates and dairy personnel. Castration should generally be performed at the earliest possible age, and certainly less than 4 months of age. After 4 months of age, a licensed veterinarian should perform the castration using a local anesthetic. Different techniques can be used including surgical removal of the testicles or crushing the spermatic cord with an emasculator.

Tail docking (removal of the lower portion of the tail including the switch) must not be routinely performed on the dairy herd. If performed due to tail injury, docking should be under the direction of a licensed veterinarian on an individual cow basis. There is no benefit to tail docking normal, healthy tails in dairy cattle based on peer-reviewed scientific studies and governmental

sponsored research. Commercial dairies may have high fly densities especially during the warm season. The tail serves as a “fly-swatter”, so tail docking is detrimental to welfare and comfort.

The available scientific data do not support claims that docking improves the dairy personnel’s comfort during milking procedures or lowers their risk of leptospirosis. Additionally, while docked cows may be cleaner, their udders were not cleaner nor did cows have lower somatic cell counts or frequency of mastitis than undocked cows. Switch trimming may provide a compromise to milking personnel’s comfort by trimming the switch in the winter when the tail is most likely to be dirty, and allowing the switch to grow back during the spring and summer when fly predation is greatest.

Lameness and Hoof Care

Hoof care is important to the well-being of all cows. Lameness will interfere with movement to the milking, feeding and watering area; limit the exhibition of estrus; and decrease general health. Routine examination and trimming of hooves, when needed, can help prevent foot problems and infections. Avoid exposing animals to sharp rocks, muddy ground, broken concrete, or concrete with exposed rocks. Antiseptic footbaths that are properly maintained and located may prevent infectious foot diseases.

Locomotion scoring on a regular basis is recommended. A locomotion scoring guide developed by the University of California puts special emphasis upon the cow’s back posture (**Appendix 3**). Locomotion scoring is based on the observation of cows standing and walking (gait), with special emphasis on their back posture. This system is easy to learn and implement. Use of locomotion scoring is effective for early detection of claw (hoof) disorders, monitoring prevalence of lameness, comparing the incidence and severity of lameness between herds and identifying individual cows for functional claw (hoof) trimming.

Visually observe the cows standing and walking on a flat surface with good footing. Those cows that walk and stand with a level back are given a score of 1. Cows scoring 2 or 3 should be examined and trimmed, if necessary, to prevent more serious problems. Trimming should be done by a competent trimmer with the goal of returning the claws to functional weight bearing and conformation.

Rear feet posture offers clues. Research indicates that 92% of lameness involves the rear feet, of which 68% affects the outside claw. Often viewed as weak conformation, the “cow hock” posture is the result of overburdening of the outside rear claw because it has been allowed to grow too long. When cows walk, the outside claw is vulnerable to irritation that stimulates increased horn formation and increases damage to the horn producing tissue (corium). Cows stand “cow-hocked” to put more weight on the sound inner claw. This can be corrected with proper claw trimming. If the condition persists, lameness will result.

Other rear feet postures to look for include feet that are “camped back” or held well back. Often confused with “post leg” conformation, this posture indicates that animal has pain in the heels. Conversely, when rear feet are “camped under” or held well forward, often confused with “sickle hock” conformation, the posture indicates pain in the toe. Knowledge and awareness are the first lines of defense. Hoof trimming is essential to herd health. It helps correct the unbalanced growth and wear created by walking on unyielding surfaces.

Sick and Injured Animals

Sick and injured animals should be segregated from the herd and observed carefully at least twice daily. In cases of isolation or quarantine, appropriate biosecurity measures should be employed.

A hospital or sick pen isolates the animal(s) from the herd and makes treatment easier. Because sick or injured animals are distressed, it is important that the pen be equipped to maximize animal comfort. It should provide adequate shade, bedding, air movement, and accessibility to feed and water. Be sure to observe sick animals after caring for healthy animals to minimize the transfer of pathogens to the healthy animals.

Nonambulatory Animals

Nonambulatory animals (animals that are unable to stand and/or walk unassisted) are often in extreme discomfort, and must not be moved to market channels. Prevention and prompt action are keys to their proper handling. Weak and emaciated animals often become nonambulatory. Conditions that increase an animal's susceptibility to injury – slippery floors, improperly designed loading ramps, excessive loading densities on trucks – are preventable. Animal injuries can be prevented if clearly defined policies requiring appropriate handling practices are set and followed, caretakers are trained and supervised in proper animal handling, mishandling of animals is not tolerated, and animals are shipped before they become weak.

If moving a nonambulatory animal becomes necessary on the dairy facility, proper equipment and trained personnel must be used. Use equipment and handling devices that are appropriate to the animal's size. Recommended procedures for moving a nonambulatory animal are presented in **Appendix 4**. If these techniques are not practical, euthanasia is recommended. Euthanasia is strongly recommended if an animal goes down in the belly compartment of a semi-trailer that does not have side doors, because humane removal is nearly impossible.

Prompt decisions and action are necessary if an animal becomes nonambulatory. The person in charge must determine immediately whether it is likely that the injured animal is otherwise healthy and can recover. If the nonambulatory animal can recover, then protect it from further injury and provide shelter, feed, and water. Veterinary care can minimize pain and discomfort during the recovery process. If the animal appears to be experiencing severe pain or distress, has a poor prognosis for recovery, or has been chronically ill, the nonambulatory animal must not be transported from the dairy, but should be euthanized immediately by a trained person using a humane procedure.

Euthanasia (Humane Killing)

Personnel who routinely work with livestock should be trained to carry out emergency euthanasia. Personnel transporting livestock also should be trained and have the ability to euthanize animals in an emergency. Protocols should be developed for different ages of animals on the dairy (**Appendix 5**).

One recommended method of euthanasia is to shoot the dairy animal in the center of the forehead (not between the eyes) with a penetrating captive bolt stunner or a firearm. A *penetrating* captive bolt stunner is the preferred method because it does not fire a free bullet. It can be obtained from a packing plant supply company. The stunner fires a blank cartridge that propels a steel bolt into the animal's brain, producing immediate brain tissue destruction, causing stunning of the animal. The point of entry in cattle should be in the center of the forehead, at the intersection of two lines drawn from the inside corner of the eye to the base of the opposite horn – not between the eyes. Animals may be exsanguinated (bled out) after use of a penetrating captive bolt stunner to insure death.

If gunshot is the method of choice, a .22 caliber hollow or soft point bullet is sufficient for young animals, however, larger mature animals require at least a .22 magnum solid point bullet or preferably a 9 mm or .357 caliber bullet. The point of entry in cattle is the same as the penetrating captive bolt. The firearm should be held perpendicular to the skull and within 2-10 inches from the point of intended impact. Do not place the firearm directly against the head. There is potential for ricochet with the use of firearms, and some laws or regulations may prohibit the discharge of firearms in certain locations.

A veterinarian may euthanize an animal using an injectable euthanasia solution. Some local rendering services may not accept carcasses containing euthanasia solution. Limit access of the carcass to scavengers, since residues of the euthanasia solution may remain. **Appendix 6** provides detailed information on the various options for euthanasia. Additional information on performing on-farm, euthanasia using a penetrating captive bolt method is provided on a CD-ROM format (Reynolds, et al., 2004).

Facilities and Management

Facilities should be designed, constructed and maintained to promote animals' comfort, safety, and health and to facilitate easy and safe handling. Natural or constructed shelter should offer adequate protection from adverse weather conditions. All facilities including fencing and gates should be properly maintained.

Flooring

Floors must not be slippery. Slipping can result in broken legs or crippling injuries. Skid-resistant working surfaces reduce injuries, increase mobility to water and feed, and are easily cleaned and maintained. Floors must keep their non-slip characteristic after cleaning, scraping, or wear.

When concrete flooring is used, it should be grooved. The dairy industry standard is to score concrete with grooves 3/8 inch deep, 1/2 inch wide, and approximately three to four inches apart. The grooves should be designed in a pattern to prevent slipping; a diamond pattern is recommended for high-traffic areas. In freestall alleys, grooving should be parallel to the flow of flushing water.

There are limited data on long-term effects of keeping dairy cattle continuously on concrete floors. It is common practice to move cows from concrete to dirt lots or pasture at least during their non-lactating period. The rates of detection and duration of estrus are higher for cows on dirt lots than for those on concrete. Lameness incidence is usually lower on dirt than concrete surfaces. Rubber flooring can provide a slip-resistant surface that decreases concussion to the hoof.

Floor Space

The floor space available to a dairy cow affects her comfort. Producers should assure that each animal has enough room to stand, lie down, stretch its legs, eat, drink, and eliminate comfortably. When animals lie down, their hind legs should not extend into common traffic areas, curbs, or gutters. Facilities should be sized so timid cows may avoid dominant cows and still have access to feed, water, and resting areas.

Determination of area requirements for dairy cows should be based on breed, body size, stage of life, behavior, health, weather conditions and the planned frequency of cleaning and bedding practices. There must be a freestall for every cow in the pen. Cows should be provided with an exercise area when weather permits. Providing daily exercise and freedom of movement for dairy cows will help improve estrus detection and thus improve reproductive efficiency.

Non-lactating cows are usually housed in groups. Corral space, resting area size, and protection from weather vary, depending on cow numbers, climate, and waste management considerations. Animals must always have the opportunity to rest in the shade and avoid muddy areas.

A general rule of freestall floor space is that the width should be at least twice the hip-width of the animal, and stall length should be approximately 1.25 times the stall width.

Freestall Dimensions (Midwest Plan Service, 2000)

Animal Weight (lbs)	Freestall Width (in)	Freestall Length (in)		Neck Rail Height ^b (in)	Curb to Neck Rail and Brisket Board (in)
		Side Lunge	Forward Lunge ^a		
800-1200	42-44	78	90-96	41-43	62
1,200-1,500	45-48	84	96-102	44-46	66
Over 1,500	48-52	90	102-108	46-48	71

^a An additional 12” to 18” in stall length (compared to side lunge stalls) is required to allow the cow to thrust her head forward during the lunge process.

^b Above top of curb or top of mattress.

Bedding

Appropriate use of bedding materials and manure removal help prevent mastitis. Bedding should be of sufficient quantity and changed often enough to prevent animal waste from creating wet, unsanitary conditions. Bedding material should be absorbent or well drained, free of toxic chemicals or residues, and of a type not readily eaten by the animals. Any permanent stall surfaces, including rubber-filled mats, should be cushioned with dry bedding.

Mud

Producers who make an effort to keep cows out of mud will increase the animals’ productivity and comfort. Mud decreases the animals’ ability to obtain feed and water. It also increases the animals’ nutritional needs, because when animals move through mud, they use more energy. Loss of body heat is increased in environments that are cold and muddy. Cows housed in mud may have nutritional needs for body maintenance increased by 20 to 50%. Animals must not continuously stand in mud over their dewclaws. Muddy corrals will increase hoof problems and lameness. All animals must have the opportunity to lie down on dry, comfortable areas.

Hospital Facilities

A hospital pen is recommended for isolation and treatment of sick animals. The hospital pen should be separate from calving, fresh cow, and calf areas. Locking stanchions make observation and treatment easier. Animals should not be restrained for more than one hour in a locking stall, with two hours as an absolute maximum. All animals should be observed at least once daily, and any sick or injured animals should be promptly treated.

Breeding Facilities

Breeding facilities should enable a caretaker to restrain a cow with minimal effort. When natural service is used, the facility should have dry and secure flooring to prevent the cow and bull from slipping.

Before acceptance into an artificial insemination program, bulls are often housed individually in pens. The pens should provide adequate space for the bull to move freely (rise, stand, walk, and lie down) and provide protection from mud and rain. The interior should be safe for the animal and attendants, with no protruding pipes or sharp edges. As a safety factor, the facility design should allow attendants to feed and water the animal without entering the bullpen.

Milking Parlors

The pre-milking holding area is the place of highest animal density on the farm and poses the greatest likelihood for injury. Injury prevention should be considered in the design of the holding area’s flooring, space, sidewalls, and entrance to the milking parlor.

The milking area should have clean floors with good traction and proper illumination. Grooved floors will help to prevent cows from slipping. Milking facilities should be designed so cows are standing on concrete for less than 2 hours at each milking.

Reducing stress to the cows, particularly at milking time, helps to maximize milk yield. An effective preparation routine will help overcome any negative effects of stress experienced by the cows before or during milking. When dairy cows are frightened, excited, or experience pain, they release hormones into the bloodstream that interfere with milk letdown and decrease resistance to mastitis and other diseases. Therefore, a consistent routine for milking is essential. Gates and restraining equipment should operate smoothly, quietly, and safely. Milking equipment should be routinely tested and maintained to prevent injury or discomfort to the cows.

Waiting time should be consistent for each milking and kept as short as possible. The preparation routine that signals the beginning of milking should be pleasant and consistent for the cows. The routine should include checking for abnormal milk, and thorough cleaning and drying of the teats. Teat ends should be inspected and scored frequently. Prevent unpleasant experiences from being associated with the place of milking. Do not conduct medical exams or treat sick cows in the parlor.

Gates and Fences

Properly designed and maintained facilities operated by trained personnel greatly facilitate efficient movement of animals. Fences and gates should be made of strong, smooth material and be devoid of sharp objects that can cut, puncture, or bruise an animal. Their design should prevent animals from attempting to go over or under them.

Animals should easily pass through gates. It is beneficial to locate gates in the corners of pens. Install them to swing inward and outward so that the animals can easily enter or leave the pen. The latching mechanism on gates should be designed so that animals cannot open the gate. The latching mechanism on a stationary post must not create a sharp point when the gate is open, because this could injure passing animals.

Environmental Temperature

Proper management of the environment enhances animal comfort and production performance, while minimizing animal disease, death loss, and behavioral problems. Dairy cattle are adaptable; they grow, produce milk, and reproduce in a variety of environments. Cattle can be raised outdoors on pastures, dry lots and hutches, or indoors in stalls, pens, and free stalls. Environmental temperature affects animals' comfort, behavior, metabolism and performance. The temperature the animals experience and the effects on them is the net result of air temperature, insulating effects of the surroundings, and animals' age, sex, weight, adaptation status, activity level, posture, stage of lactation, body condition, cleanliness, and diet.

Cattle should be protected from heat and cold stress caused by extreme weather events. Windbreaks, sunshades, or solid-roofed shelters are needed if trees or other landscape features do not provide adequate protection from winter storms and extremely cold or hot temperatures. Cattle lose heat mainly through respiration and panting, not through sweating. Sunshades, sprinklers, misting, fans and other methods of cooling, as well as dietary alterations, will reduce heat stress and reduce a decrease in milk production during hot weather.

Air Temperature, Humidity, Quality, and Movement

Air temperature, humidity, quality, and movement are important to ensure animal comfort and prevent diseases. Humidity influences animals' ability to maintain their thermal balance. Air quality affects the health and well-being of animals and their caretakers. Quality is typically defined in terms of the air's content of certain gases, particulate matter, and liquid aerosols. Five primary pollutants are found in animal facilities—ammonia, hydrogen sulfide, carbon monoxide, methane, and airborne dust. Government standards for these pollutants have not been established for many agricultural animals, but they have been established for human worker exposure. Allowable levels for eight hours of exposure daily for humans are as follows (Occupational Safety and Health Administration, 1997):

Ammonia	Less than 25 ppm and ideally less than 10 ppm
Hydrogen sulfide	Less than 15 ppm and ideally less than 10 ppm
Carbon monoxide	Less than 150 ppm
Methane	Less than 150 ppm
Airborne dust	5 mg/m ³ for respirable dust (partial size ≤ 5 um); 15 mg/m ³ for total dust

Ventilation

Adequate ventilation helps to prevent respiratory and other diseases by removing heat, water vapor, air pollutants, and odors from an animal facility. Ventilation also modifies the indoor air temperature, but supplemental heating and cooling may be needed when temperature control is critical. The increase in temperature in a building can be controlled by the rate of air movement (i.e., the ventilation rate). Dairy barns with open sides and open ridges help expedite air movement, and eliminate moisture, heat, and gases.

Lighting

Lighting should allow inspection of animals and provide safe working conditions. In facilities where animals are routinely observed or handled, such as for milking or estrus observation, lighting should be diffused evenly. An outdoor light attached to a corral or building where animals congregate provides sufficient illumination for safety purposes.

Noise

Noise ordinarily experienced in agricultural facilities has little permanent effect on the production performance of dairy animals. Loud or alarming sounds can startle cows, causing erratic behavior. In contrast, music in the cows' environment may produce a calming effect and stimulate milk let-down.

Nutritional Care: Feeding and Watering

Feed Quality

Feed considerations include nutritional quality and quantity, feed bunk design, and proper feed storage. Qualified nutritional consultants normally assist in formulating rations that meet nutritional requirements of animals. Rations should meet the NRC recommendations (2001) for each class of animal, such as growing, lactating, or pregnant dairy cattle. All animals should have consistent access to feed and free access to water on a daily basis.

Feeders or Feed Bunks

Fence line feeding or feed bunks should provide the animals an easy, comfortable access to the feed. The daily removal of feed not consumed ensures freshness of feed, prevents mold and spoilage, and aids in insect control. A smooth feeding surface facilitates cleaning and enhances dry matter intake. Feeding at floor level reduces feed tossing behavior and feed wastage. Feeding with the cow's head down increases saliva produced, which aids in digestion. Feeders should be located away from waterers to minimize contamination of water. Feeders should provide 24 to 30 inches of bunk space per cow to allow all animals, including timid cows uninterrupted feeding. Feed should be pushed up several times daily. Corrals should not contain more cows than the number of stanchions.

Water and Waterers

Fresh, clean water is essential. Non-lactating cows consume 3 to 15 pounds of water per pound of dry matter consumed, depending on environmental temperature. Lactating cows consume an extra 2 to 3 pounds of water per pound of milk produced. High-producing, lactating cows need continuous access to clean, fresh water.

Water access should be available at all times. Waterers should be convenient for the animals to reach on demand. There should be sufficient waterers to accommodate the number of animals in the pens and prevent dominant cows from limiting water to others. Waterers should be kept clean and protected from freezing. Situating waterers under shade keeps water cooler, which encourages more water consumption during hot weather.

Body Condition Scoring

Achieving growth targets for heifers and monitoring change in body condition during gestation and lactation is very important. Body condition can change rapidly around calving and should be used to adjust ration changes. Body condition scoring on a regular basis is recommended (**Appendix 7**).

Emergencies

During emergency situations such as extreme weather or power outage, water should be available to all animals on the dairy. The lack of feed may stop milk production in lactating cows, but lack of feed for 48 hours should not irreversibly jeopardize the health of well nourished adult cattle. Calves should not be deprived of feed for more than 24 hours.

Handling and Transporting

Animal Handling

Producers must ensure that animal caretakers are trained and qualified in proper handling techniques and in the use of restraint equipment. Routine contact with humans from birth through production, including regular, gentle handling will reduce fear and flight distances, make observation and treatment easier, and enhance animal well-being and productivity. Animals should be handled quietly but firmly at all times. Do not force animals to move faster than a walk. Excited animals have increased levels of stress hormones, which can reduce the quality of milk and meat, and increase susceptibility to disease. It is particularly important to allow the cows to walk at their own speed in lanes and alleyways to prevent crowding or crushing at corners, gates, and other narrow places in a facility, as well as to prevent lameness.

Use of flags, plastic paddles, or sorting sticks with ribbon attached are appropriate for handling animals that refuse to move through facilities, but only if minimal force is applied. Any force used must be applied calmly. Dairy animals are creatures of habit and can sense differences in their environment or routine procedure. In all cases, use the least amount of force necessary to control the animal and still ensure the safety of herd mates and caretakers. Electric prods should not be used on dairy cattle unless animal or human safety is in jeopardy. If used, electric prods should be used as a last resort.

Young Stock

Calves should be handled gently. Never pull or force the animals to move by grabbing ears, tail, or one leg. Young calves should be moved on the dairy by walking or lifting them. Electric prods and whips must not be used.

Animal Restraint Equipment

Animals should be restrained by equipment appropriate for the procedure. Cows should not be restrained for more than two hours for routine care and management procedures.

Loading and Unloading Animals

Animals should be loaded and unloaded for transit in a manner that minimizes stress and anxiety. The process of being moved, especially if it involves a loading chute, is frightening to most animals. The following will minimize stress and loading problems: (1) Caretakers trained in proper loading and unloading practices, (2) properly located and designed loading areas, and (3) minimal number of directional changes an animal must take.

Caretakers should not overcrowd animals, and loading or unloading should be at the time of day that is best for moving the animals. Sufficient labor and appropriate equipment should be available for loading or unloading animals.

Loading areas should be located near hospital pens and roads, and should be accessible in all kinds of weather. Loading ramps should not exceed a twenty-five degree slope. Ramps should provide non-slip flooring for proper footing. Ramps should be designed to prevent animals from stepping between the ramp and the truck, or from getting trapped between the side of a chute and the truck.

Animals should not be forced to walk toward bright lights or other things that are likely to cause fear. Cattle have difficulty discriminating between a shadow and a hole in the ground because of

poor depth perception and will balk at shadows. Cattle have wide-angle, panoramic vision and poor depth perception; therefore, facilities should have curved paths, be uniformly illuminated, and be a uniform color and texture to avoid sharp contrasts and shadows that may impede cattle flow. Single-file chutes, crowding pens, and other areas where cattle are crowded should have high, solid fences to prevent the animals from observing people, vehicles, and other distracting objects outside the facility.

Nonambulatory Animals

Nonambulatory animals are often in extreme discomfort or pain and must not be loaded or transported from the dairy to marketing channels or processing facilities. The position statement of the American Veterinary Medical Association on nonambulatory animals states, “If the animal is in extreme distress and the condition is obviously irreversible, the animal should be immediately euthanatized or humanely slaughtered on the farm.” **Appendix 4** provides information on recommended methods of moving nonambulatory animals on the dairy, if necessary.

Vehicles

Transport vehicles should have safety and comfort features including (1) sides high enough to prevent animals from jumping over, (2) non-slip flooring that provides secure footing (avoid abrasive floor and wall surfaces), (3) ventilation adequate for the weather conditions, (4) proper bedding (to protect animals from weather extremes), and (5) adequate (vehicle) covering to protect animals from adverse weather.

Providing shade, wetting animals, and bedding trucks with damp sand will protect animals in transit from heat stress. Truck flooring should be clean and covered with sand to prevent slipping, and then may be covered with clean, dry bedding.

To protect animals from cold stress, provide wind protection from the front of the truck and use bedding material with high thermal insulative properties, such as chopped straw, to prevent body heat loss to the truck floor. Animals should not be exposed to exhaust fumes during transport.

In-Transit Care

In-transit care will prevent injuries, bruises, and carcass damage, which ultimately discount market value as well as impair animal well-being. Transport crews should be trained in animal care and handling. Chances for injuries are reduced when animals on a truck are confined in several smaller groups. Animals should be shipped in groups of uniform weight and class when possible. Pregnant cows showing signs of imminent labor or parturition must not be shipped to avoid the possibility of calves being born during transport or in market channels.

Adequate time should be allotted for the trip to include periodic checking of the animals' condition. Drivers should start and stop the vehicle smoothly and slow down for curves and corners. If an animal falls in transit, it should be helped to its feet and possibly segregated from the other animals for the remainder of the trip. Provisions for feed and water must be made if the trip takes more than 24 hours.

Recommended Area Allowance in Transportation Accommodations (Grandin, 1992):

Body Weight (lb)	Number of animals per linear foot of truck floor (7.7 feet wide)
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200	2.2
300	1.6
400	1.2
600	0.9
800	0.7
1,000	0.6
1,200	0.5
1,400	0.4

For example: In a truck with a length of 12 feet, there is proper space allowance for 14 animals weighing 400 lb each ($12 \times 1.2 = 14.4$ animals). Greater or lesser density increases the possibility of injury.

Birth and Management of Calves

Bull Selection

Calving-ease sires should be used when breeding heifers. To decrease the possibility of calving difficulty, ensure that heifers are of adequate size prior to breeding (750 to 800 pounds by 13 to 15 months of age for Holstein heifers; 550 to 600 pounds by 13 to 15 months for Jersey heifers).

Calving Area

The calving area should be clean, dry, well lit, and well ventilated. Wet, dirty calving areas foster the growth of bacteria that can invade newborn calves' navels or mouths and transmit disease. A separate calving area (maternity pen or paddock) that is comfortable, functional, and hygienic allows for close observation of the cows and easier, more effective assistance at calving. Calves should not be allowed to suckle and should be removed from the cow immediately to prevent transmission of diseases such as Johne's. Pens, corrals, or paddocks should be cleaned between calvings.

Calves should be housed in clean, dry environments, which are protected from extreme temperatures, wind, drafts, and precipitation. During cold weather, ventilation in houses for newborn calves should maintain acceptable air quality in terms of water vapor and pollutants without chilling the animal (See section "Air Temperature, Humidity, Quality, and Movement"). Avoid drafts or direct breezes on young animals. Dry calves protected from wind can endure lower temperatures.

Calves should be moved immediately from maternity pens and placed in individual pens or hutches until they are approximately 5 weeks of age. Calves should then be moved to larger pens holding small groups or to super hutches (these are portable pens normally located in a pasture area, which provide feed, water and shelter). Calves should be grouped by age and weight. Calves 90 to 150 days of age can be housed in larger groups.

Navel Care

Dip navels in disinfectant as soon as possible after birth. If the umbilical cord is not severed immediately after birth, it may be tied or cut with clean scissors or knife two to three inches from the calf's body. Wet cords are entry points for pathogens into the calf's body. The most effective preventive treatment is to dip the navel repeatedly into a solution of chlorhexidine or 2% iodine (use 7% iodine to cauterize the navel).

Nutritional Care: Colostrum and Feed

Providing an adequate volume of high-quality colostrum is critical to calf health because calves depend on antibodies in the colostrum for immune protection. Colostrum collected within the first six hours after calving contains antibodies to protect the calf from certain diseases. This is the single most important factor to prevent illness of young calves.

Colostrum also increases a calf's tolerance to cold temperatures. A calf housed in dry, individual shelter with protection from wind and drafts (e.g., pens or hutches) and fed colostrum can tolerate temperatures as low as -9° F (as opposed to about 50° F in the absence of colostrum).

To achieve these benefits, calves (bulls and heifers) must be fed high-quality colostrum (2 to 4 quarts). If quality of colostrum is known to be high, two quarts should be sufficient. If quality is

uncertain, feed four quarts of colostrum. The first feeding should occur as soon as possible after birth, preferably within one hour. Use an esophageal tube feeder if necessary.

Colostrum quality should be determined prior to feeding it to calves. High-quality colostrum contains high levels of specific proteins, including antibodies. Older cows should be the source of colostrum used for hand feeding calves. Colostrum should not be pooled or used from known Johne's disease positive cows. The amount of immunoglobulin in colostrum tends to increase with the lactation number of the cow. The amount of protein can be estimated with a hygrometer, an instrument that measures the specific gravity (e.g. protein and immunoglobulins) in a liquid.

Within a week after birth, young calves should be offered a palatable, high-quality starter ration (no forage). At six to eight weeks of age, the calves, in addition to the concentrate mix, should be given small offerings of high-quality alfalfa or grass hay. Calves will undergo digestive system changes as they switch from a milk/liquid diet to become fully developed ruminant animals utilizing dry feed. Calves must have continuous access to fresh clean water after 1 to 2 days of age.

Marketing and Handling

Calves should have a dry navel and should be able to walk without assistance before they are transported off the dairy. The transportation of calves should be safe, humane, and comfortable in order to ensure their health, quality, and welfare. Workers should be trained to handle and restrain a calf with a minimum of stress to the animal. Calves should be moved on the dairy, onto a truck, or in the auction market by walking or lifting them. Calves should never be thrown, dragged, pulled, lifted, or caught by the neck, ears, limbs, tail or any other extremity.