DCHA

DAIRY CALF & HEIFER ASSOCIATION

GOLD STANDARDS

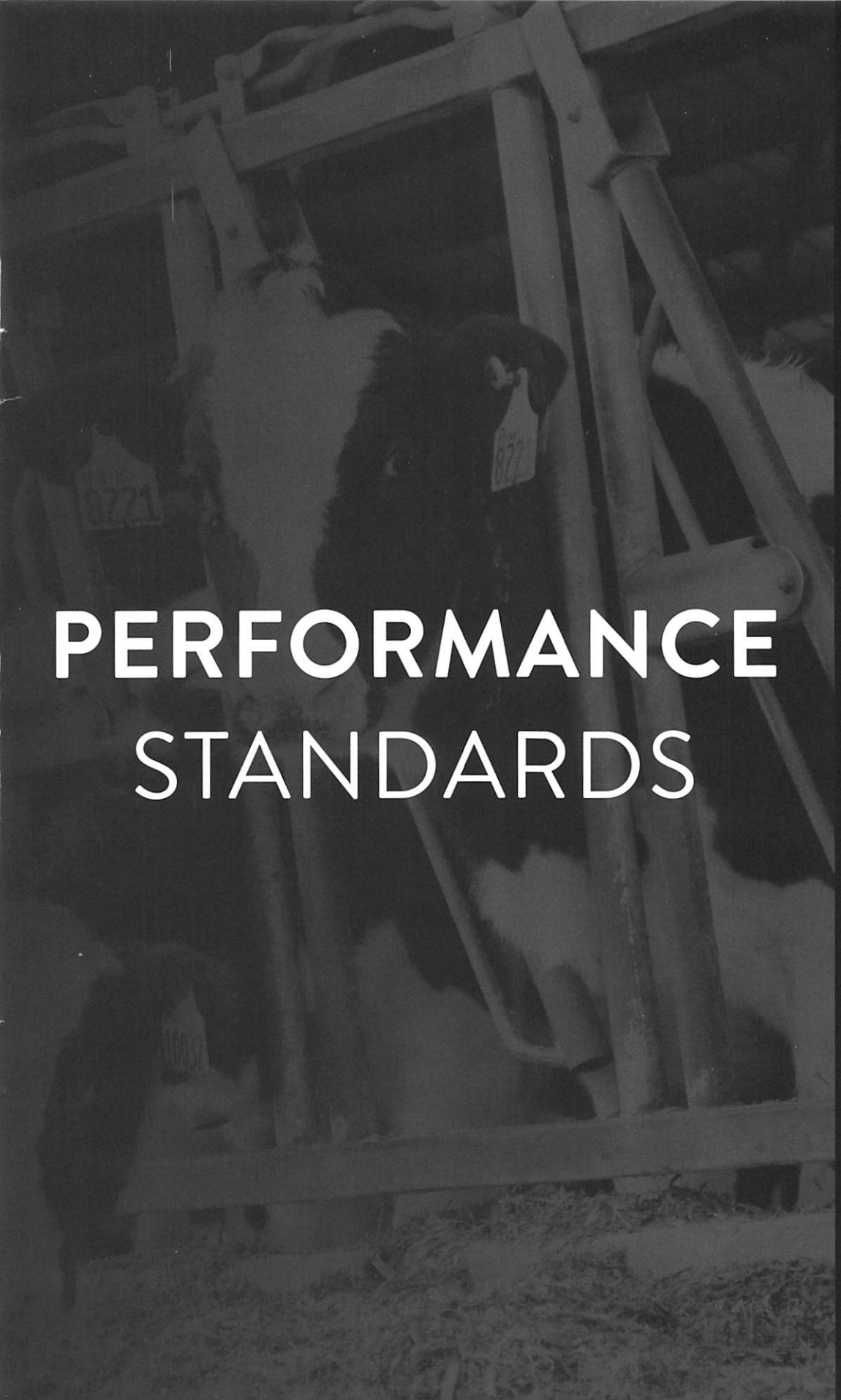
Setting the benchmarks for your herd's future.

DCHA GOLD STANDARDS | SECOND EDITION

Performance and production standards for dairy calves and heifers, from birth to freshening

The Dairy Calf and Heifer Association Gold Standards are industry benchmarks and best management practices intended to guide dairy calf and heifer raisers in growing the most efficient, healthy and profitable dairy replacements possible. The Gold Standards have been developed using published data and input from DCHA leaders and advisors. While individual herd goals, current level of attainment and geography may vary, the Gold Standards are meant to provide a framework for successful dairy replacement raising. Utilize this information to identify areas for improvement, conduct training and implement plans that support the performance targets you want to attain.

DCHA would like to recognize the expertise and collaboration of the Gold Standards Committee in bringing forward this edition. Committee members: Dr. Sam Barringer, Dr. Rob Farrugio, Marcie Feine, Jamie Franken, Gary Geisler, Katie Grinstead, Dr. Stuart Hall, Dr. Doug Hammon, Maureen Hanson, Dr. Bob James, Dr. Sam Leadley, Jim Leick, David Mathes, Amber Mirabal, Larry Van Roekel, Brian Wesemann.



PERFORMANCE STANDARDS

HEALTH STATUS

PNEUMONIA

Defining pneumonia as a case of respiratory disease which requires individual animal treatment, target morbidity rates are:

AGE	%
Preweaning	< 10
Postweaning – 120 days	< 10
121 – 180 days	< 2

SCOURS

Defining scours as a case of diarrhea which requires any intervention for more than 24 hours, target morbidity rates are:

AGE	%
Preweaning	< 15
Postweaning – 120 days	< 2
121 – 180 days	< 1

SURVIVAL RATE

TARGET SURVIVAL RATE

Given that some calves are born with a heartbeat and breathing, yet die not long after birth, the age of 24 hours shall be used to distinguish between "dead-on-arrival" (stillbirth) and "live birth."

AGE	%
After live birth	
24 hours – 60 days	≥ 97
61 – 180 days	≥ 98
6 months – freshening	≥ 99
*Live birth – freshening**	
Live birth – freshening	≥ 90

*Including reproductive culls, does not include genetic culling

GROWTH RATE

TARGET GROWTH RATE

- 24 hours to weaning (56 days of age):
  - **At least double birth weight**
  - **At least 4 – 5 inches** (10 – 12.7 cm) of height growth **(see fig. 1)**
- Target growth rate beyond weaning depends on herd's mature size, which is influenced by breed and herd genetic goals. An individual herd's mature size is defined as the average weight of third-lactation animals, in mid-lactation. Nutritional management should focus on heifers reaching breeding bodyweight at the desired age. **(see fig. 2)**
- Stature is highly variable and depends on breed, genetics and herd goals. Stature growth rate is dependent on nutrition – especially protein – fed.
- Developing a herd-specific growth curve is recommended, based on the herd's mature animals.

FIGURES

fig. 1

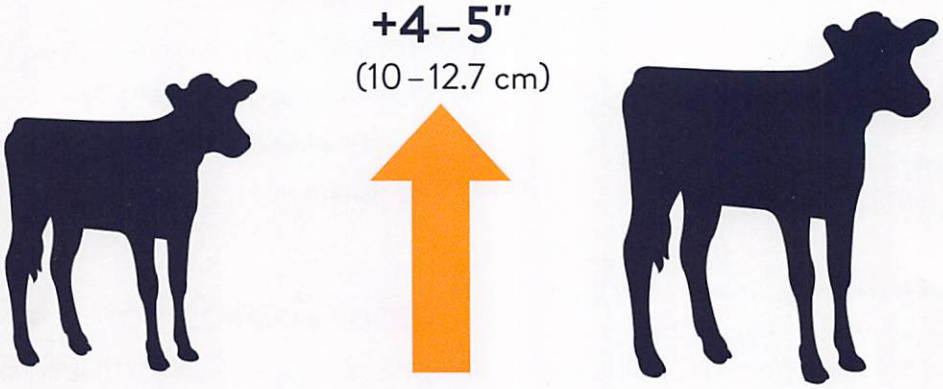


fig. 2

HEIFER GROWTH STAGE AND % MATURE WT.	MATURE BODYWEIGHT					
	1,000[1] 454		1,400[2] 635		1,800[3] 817	
	TARGET WT. LBS. KG.	APPROX. ADG TO NEXT TARGET LBS. KG.	TARGET WT. LBS. KG.	APPROX. ADG TO NEXT TARGET LBS. KG.	TARGET WT. LBS. KG.	APPROX. ADG TO NEXT TARGET LBS. KG.
Birth	60 27	1.1 0.50	80 36	1.4 0.64	90 41	1.6 0.73
Weaning 56 days	120 54	1.7 0.77	160 73	2.0 0.91	180 82	2.4 1.09
First breeding 55%	550 250	1.0 0.45	770 349	1.4 0.64	990 449	1.8 0.82
Post-calving, 1st calf 85%	850 386	0.3 1.4	1,190 540	0.3 0.14	1,530 694	0.4 0.18

1 Assumes birthweight of 60 lbs., first breeding at 10 months of age (30.5 days/month), and 10 months between first breeding and first calving. Does not include weight of the pregnancy.

2 Assumes birthweight of 80 lbs., first breeding at 12 months of age (30.5 days/month), and 10 months between first breeding and first calving. Does not include weight of the pregnancy.

3 Assumes birthweight of 90 lbs., first breeding at 13 months of age (30.5 days/month), and 10 months between first breeding and first calving. Does not include weight of the pregnancy.

REPRODUCTION

Begin breeding when heifers are 55% of the herd's mature bodyweight.

APPROXIMATE AGE TARGETS

- **Holsteins**: 12 – 13 months **(see fig. 3)**
- **Jerseys:** 10 – 12 months **(see fig. 3)**

If the heifers are achieving this bodyweight before the target age, then physiologically they are mature enough to be pregnant. Heifers that calve earlier are more productive, assuming they meet the benchmark for post-calving bodyweight.

TARGET AGE

Target age at first calving (AFC), if grown to appropriate body size **(see fig. 4)**

- **Holsteins:** 21 – 24 months
- **Jerseys:** 20 – 22 months

BODY COMPOSITION

Body composition goals AFC **(see fig. 4)**

- **Weight after calving:** 85% of the herd's mature bodyweight
- **Body condition score (BCS)**: 3.25 – 3.50

SEMEN TYPE	TARGET FIRST-SERVICE CONCEPTION RATE	TARGET PREGNANCY RATE *
Conventional semen	70%	47%
Sexed semen	60%	37%

*Percent of heifers that become pregnant out of the total number of heifers eligible to become pregnant in a given 21-day period

RESOURCES

"Customized Dairy Heifer Growth Chart" by Pennsylvania State University Dairy Extension, http://extension.psu.edu/animals/dairy/nutrition/heifers/monitoring-heifer-growth/customized-dairy-heifer-growth-chart

"Universal Heifer Growth Chart" by University of Wisconsin-Extension, http://fyi.uwex.edu/heifermgmt/growth-charts/

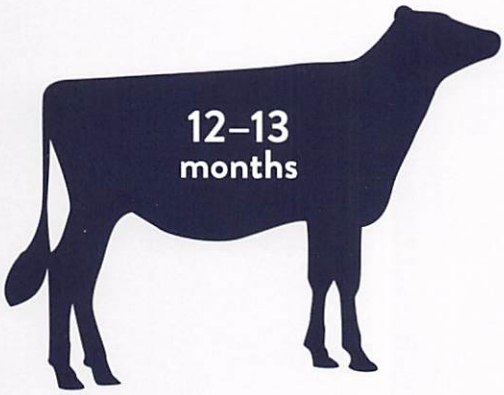
"Heifer Growth and Economics: Target Growth" by the Bovine Alliance on Management and Nutrition, https://www.aphis.usda.gov/animal_health/nahms/dairy/downloads/bamn/BAMN07_HeiferGrowth.pdf

"Focus on Heifer Sized to Determine Age at Breeding" by the Dairy Cattle Reproduction Council, http://www.dcrcouncil.org/media/Public/Focus%20on%20Heifer%20Size%20to%20Determine%20Age%20at%20Breeding.pdf

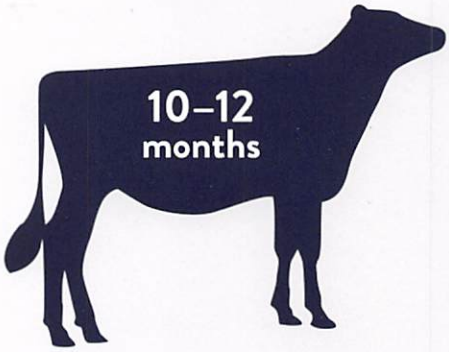
"Taking Heifer Reproduction to the Next Level" by the Dairy Cattle Reproduction Council, http://www.dcrcouncil.org/media/Public/Taking%20Heifer%20Reproduction%20to%20the%20Next%20Level.pdf

FIGURES

fig. 3

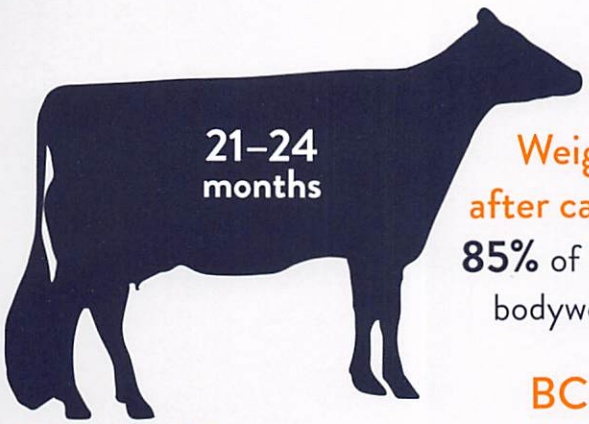


Holsteins



Jerseys

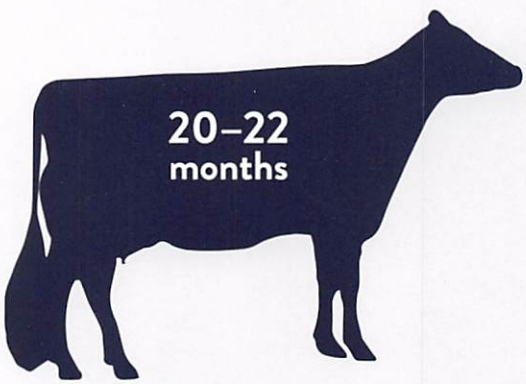
fig. 4



Holsteins

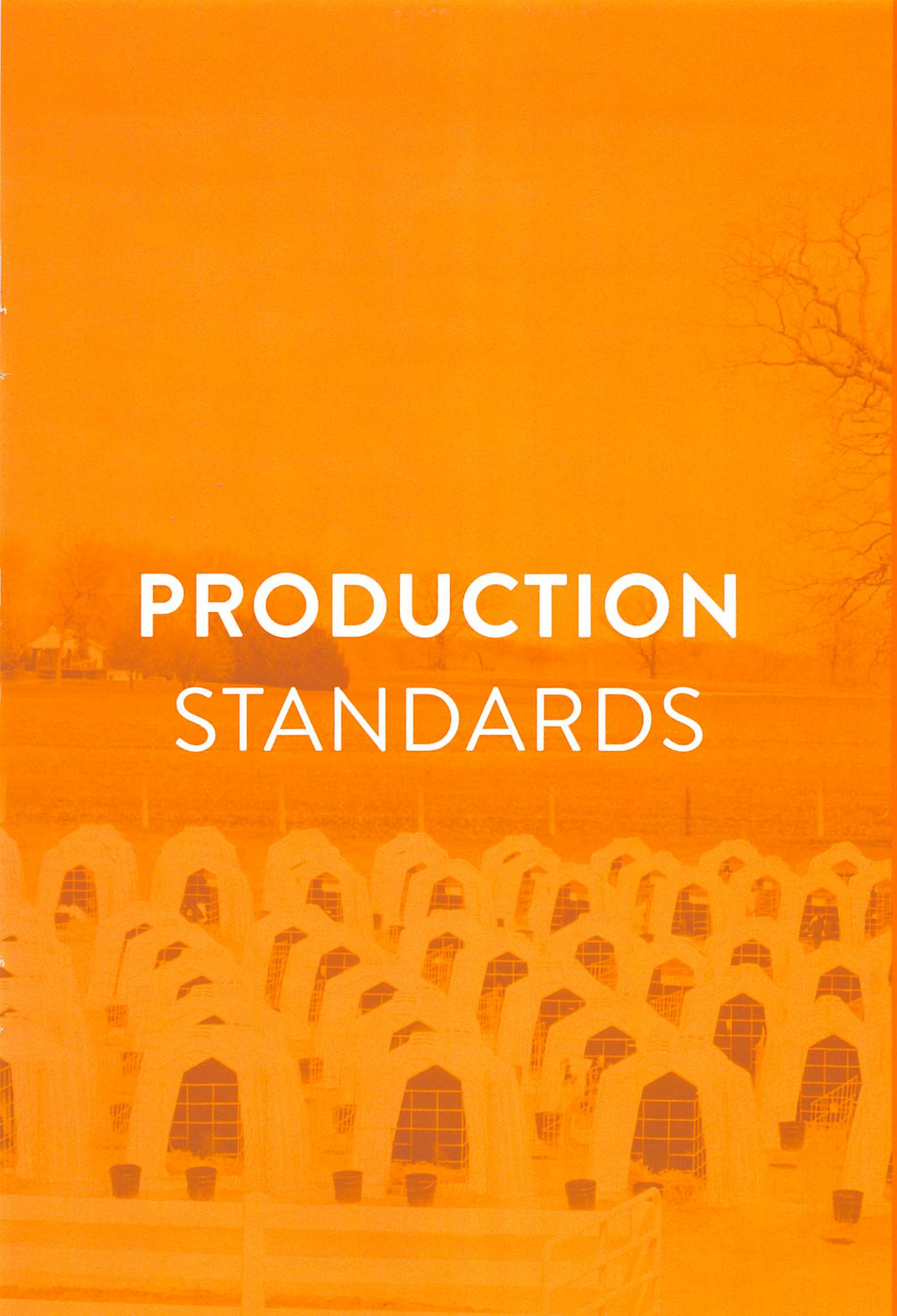
Weight after calving:
85% of mature bodyweight

BCS:
3.25 - 3.50



Jerseys

PRODUCTION STANDARDS



PRODUCTION STANDARDS

NEWBORN CARE

REMOVAL FROM MATERNITY

Remove calves from maternity pen as soon as possible to prevent injury and illness

NAVEL DISINFECTION

Thoroughly disinfect navel with 7% tincture of iodine or 1:1 chlorhexidine/70% alcohol mixture within 30 minutes of birth

DEHORNING

- Work with herd veterinarian to develop pain-management protocols using anesthetic and/or analgesic therapy
- Preferred method: Apply dehorning paste within the first day after birth

IDENTIFICATION

- Tag every calf as soon as practical after birth with a radio-frequency identification (RFID) tag; or
- Tattoo within the first month of life

MEASUREMENT

Measure and record birth weight and height

BVDV SCREENING

- Ear notch or blood-PCR test all calves for persistently infected (PI) carriers of Bovine Viral Diarrhea Virus (BVDV) within 1 week of birth
- Euthanize or quarantine positive animals as soon as possible; continue quarantine until confirmed with a second test

COLOSTRUM ADMINISTRATION

COLOSTRUM HARVEST

- Work with herd veterinarian to develop a herd vaccination protocol to enhance colostrum quality for both mature cows and heifers
- Collect first-milking colostrum within 4 hours of calving
- Follow strict hygiene protocols for cow preparation, milking equipment and collection vessels to minimize bacterial contamination of colostrum

COLOSTRUM DELIVERY

- Hand-feed colostrum equal to 10% of calf's bodyweight* within the first 2 hours of life. **(see fig. 1 + 2)**
- When practical, continue to feed second- and third-milking, pasteurized transition milk for the next 3 – 4 feedings

*For example, a 90-lb. calf should receive 4 quarts (3.8 liters) of colostrum

FIGURES

fig. 1

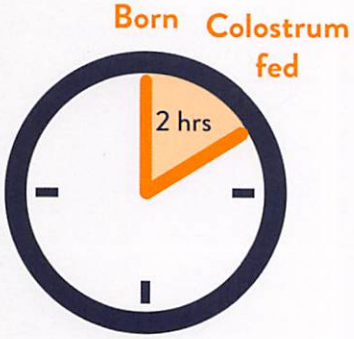
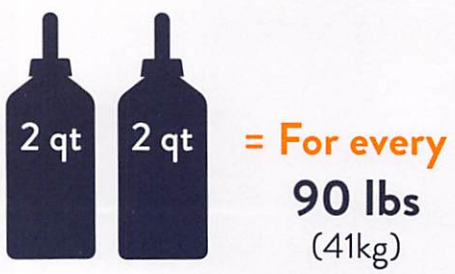


fig. 2



COLOSTRUM MANAGEMENT

- Feed colostrum within 30 minutes of harvest, or chill to 60°F (15.5°C) within 30 minutes before refrigerating or freezing **(see fig.3)**
- Store and feed refrigerated, fresh colostrum for no more than 48 hours
- Test for quality with an on-farm tool such as a Brix refractometer or colostrum tester
- Extra colostrum can be stored frozen for up to one year in a frost-free freezer. One-time-use, zipper-closure bags or commercial colostrum storage products are convenient for storing and thawing
- Colostrum should be free of blood, debris, mastitis and signs of disease

TESTER TYPE	TARGET COLOSTRUM LEVELS	
	Holstein	Jersey
Brix refractometer	≥ 22	≥ 18
Colostrum tester	≥ 50g/L	

- Pasteurize colostrum for optimum disease prevention
- Pooled colostrum represents a higher risk of disease transmission than individual-cow colostrum, unless pasteurized
- Periodically measure bacteria count of colostrum as it is fed to calves. Target counts as fed:

  Standard plate count: <50,000 CFU/mL
  Coliforms: <5,000 CFU/mL

FIGURES

fig. 3

- In situations in which timely harvesting of high-quality, low-bacteria colostrum is not possible, commercial colostrum replacers are a viable alternative. Use a colostrum replacer (not supplement) to deliver 150 – 200g IgG at first feeding.

MILK TYPE	TARGET IMMUNITY LEVEL*+ *Calves 2–7 days of age*	
	80%	90%
Maternal colostrum fed calves	5.5 g/dL	5.2 g/dL
Colostrum replacer fed calves	5.3 g/dL	5.0 g/dL

*Blood serum total protein, measured via clinical refractometer

+For routine monitoring, sample a minimum of 12 calves from each source farm before interpretation

NUTRTION & WATER

- Structure your nutrition program to achieve health and growth standards defined in the Growth Rate section, and monitor performance regularly. Consult your nutritionist and veterinarian routinely.
- Adjust diets according to growth and energy demands imposed by the environment. Recognize that preweaned calves require more than 1.25 pounds (.57 kg) (4 quarts (3.8 liters)) of milk or milk replacer solids per day to meet maintenance requirements during many days of the year
- Offer clean, warm water and starter grain to calves with continuous availability starting at Day 1 of life, and refresh or replenish daily
- Deliver fresh water within 20 minutes after feeding milk or milk replacer
- Use separate pails for water, milk and starter grain
- Establish routine cleaning and sanitation protocols for milk-feeding equipment. Because biofilm accumulation is common, periodically check equipment cleanliness via either bacteria culturing or adenosine triphosphate (ATP) testing
- As possible, space out time between milk feedings equally, with at least 6 hours between feedings if fed 3 times daily (preferred), at least 8 hours if fed twice daily
- Utilize water suitability tests every 6 months to ensure water quality and safety. Target levels:
  - **Total dissolved solids (TDS):** <1,000 ppm
  - **Sodium level for water used to reconstitute milk replacer:** 100 ppm
  - **Standard plate count:** <1,000 CFU/mL
  - **Coliform count:** <0.5 CFU/mL
  - **Range of pH:** 6.0-8.5
- Intake of calf starter will depend upon the weaning strategy. Early weaned calves (~6 weeks) will be smaller with smaller appetites and should be consuming 2.0 – 3.0 pounds (0.9 – 1.4 kg) of starter grain per head per day for 3 consecutive days before weaning. Calves weaned at 8 weeks or more have larger appetites and would expect them to consume 4 – 5 pounds (1.8 – 2.3 kg) of starter grain per head per day for 3 consecutive days before fully weaned
- Total protein (dry matter basis) for starter grain:
  - At least 20%; *and*
  - Proportionate to the percentage of protein in the milk portion of the ration

TOTAL RATION PROTEIN TARGETS FOR WEANED HEIFERS (DRY MATTER BASIS)

AGE	%
2 – 4 months	18–20
4 – 9 months	15–16
9 – 13 months	14–15
13 months – freshening	13.5–14

- Balance diet energy levels to meet daily gain needs without excessive body condition gain. The addition of low-energy, high-fiber forages (straw, stover), or more mature alfalfa or grass forage may be needed to control gains when feeding high corn silage diets

HEALTH MANAGEMENT

Work with your veterinarian to establish a valid veterinary-client-patient relationship (VCPR), and to develop and maintain current health-management protocols. The basic principles of a VCPR include:

- Maintain written agreements for working relationships
- Have a Veterinarian of Record
- Clarify any and all relationships with consultants and other veterinarians
- Provide written protocols
- Ensure written or electronic treatments are maintained
- Provide drugs or prescriptions for specific timeframes and specific protocols

VACCINATIONS

- Develop a vaccination program in collaboration with your veterinarian to create protocols addressing the unique characteristics of your dairy's environment
- Every farm's vaccination protocols should be built around the needs of the animals specific to that operation
- Growers with multiple source farms may need different protocols based on challenges and disease-prevention goals of each client's herd

DEHORNING

- Work with herd veterinarian to develop pain-management protocols using anesthetic and/or analgesic therapy
- Disbud horns before 8 weeks of age using hot-iron cauterization*

*If not removed with preferred method of dehorning paste within first day after birth

SUPERNUMERARY TEAT REMOVAL

- Surgically remove extra teats around 4 months of age
- Work with herd veterinarian to develop appropriate pain-management protocol

PARASITE CONTROL

- Collaborate with your veterinarian to develop a protocol for preventing parasitic diseases and issues
- Manage the farm environment to discourage population of parasites and pests, including regularly hauling manure, cleaning up spilled milk and preventing standing water

CLINICAL DISEASE PREVENTION AND MANAGEMENT

- Prevention can be cost-effective. Prevention depends on reaching optimum high levels of immunity and low levels of pathogen exposure
- Optimum immunity can be reached following practices outlined in Production Standards under Colostrum Management, Nutrition and Health Management — Vaccinations
- Optimum low levels of pathogen exposure can be achieved by following the practices outlined in the Production Standards section
- When animals are clinically ill, follow these guidelines:

1. Document all cases of clinical illness; at a minimum, record:
   - **Date**
   - **Disease**
   - **Treatment**
   - **Who administered treatment**
   - **Withholding period for meat/milk**
2. Treatment of a group at risk for a specific disease should be recorded separately so accurate disease incidence can be calculated
3. Work with herd veterinarian to develop treatment protocols that clearly define progression from one treatment to the next, including treatment interval and assessment for retreatment

4. Select treatment protocols based on the veterinarian's recommendation for the condition and follow the full course of therapy (versus the "drug of the day" or each employee's "favorite" treatment)
5. Use properly mixed electrolytes liberally with enteric disease (scours) and continue to offer milk/milk replacer
6. Administer antibiotics only according to their prescribed dose, frequency and route of administration
7. Follow the herd veterinarian's advice, monitor treatment outcomes and determine if additional treatments are needed **(see fig. 4)**

- Use feed-grade antibiotics in accordance with the Veterinary Feed Directive (VFD) and only under the prescription of your herd veterinarian with whom you have a valid veterinarian-client-patient relationship (VCPR)
- Use water-soluble antibiotics only under the prescription of your herd veterinarian with whom you have a valid VCPR
- Consider incorporating nutraceutical products with proven research results into a sound clinical disease prevention and management protocol. These alternatives can be used with or without antibiotics to target disease-causing pathogens, improve digestive health and enhance immune response

EMPLOYEE TRAINING

- Establish an employee education and training program with the help of your veterinarian
- Provide all employees with:
  1. Current protocols that clearly detail how they are to perform their jobs
  2. Education on the basic knowledge needed to understand the importance of following established protocols
- Train new employees at hiring and provide continuing education 1-2 times a year for current employees **(see fig. 5)**
- Routinely monitor protocol compliance and provide employee feedback

FIGURES

fig. 4

fig. 5

HOUSING & ENVIRONMENT

HOUSING FOR CALVES AND HEIFERS OF ALL AGES SHOULD BE:

- Clean
- Dry, well-drained
- Ventilated appropriately for environmental conditions regarding temperature, humidity and air speed
- Well-bedded (6-10 inches (15-25 cm) of dry bedding) with nesting scores appropriate for calf size and environmental conditions
- Sheltered from inclement weather
- Equipped with shade in outdoor housing settings

SPECIFIC HOUSING AND ENVIRONMENT STANDARDS

Newborn calves

- Environment should be clean and protected from other animals for physical safety and biosecurity
- In addition to providing dry bedding, work to ensure the calf's hair coat is dry and fluffed, particularly when ambient temperature is <60°F (<16°C)

Preweaned calves

- Size individual pens so the calf can turn around
- For group housing, provide at least 35 square feet (3.3 square meters) of resting space per calf
- If calves are housed individually, situate pens or hutches so calves can see one another
- Thoroughly clean and disinfect preweaned calf housing areas between calves
- Manage bedding and the floor or base to allow for the removal of urine in an effort to reduce ammonia production and accumulation
- Minimize heat stress in outdoor-housed calves by:
  1. Providing shade (80% shade cloth suspended at least 7 feet (2.1 meters) above hutches)
  2. Orienting hutch rows east to west to maximize shade
  3. Improve ventilation by elevating backs of hutches

Weaned heifers

- Housing conditions
  1. Skid-free walking surface
  2. Adequate feeding space for all animals to eat at the same time
  3. In freestall housing, at least one freestall per heifer
  4. Abundant supply of clean water available at all times
- Per-head square footage requirements for resting space in bedded-pack housing:
- Freestall space for Holstein heifers 400 pounds (181 kilograms) and heavier **(see fig. 4)**

RESTING SPACE REQUIREMENTS – BEDDED PACK

AREA PER ANIMAL		WEIGHT LBS. KG.						
		132 60	220 100	331 150	441 200	661 300	882 400	1100 500
Bedded resting area per animal	SQ. FT	28	28	28	29	36	41	46
	SQ. M	2.6	2.6	2.6	2.7	3.3	3.8	4.3
Total area per animal	SQ. FT	35	35	35	37	45	52	58
	SQ. M	3.3	3.3	3.3	3.4	4.2	4.8	5.4

FIGURES

fig.6

RESTING SPACE REQUIREMENTS – FREESTALL				
APPROXIMATE AGE	**BODY WEIGHT LBS. KG.**			
	400–600 181–272	600–800 272–363	800–1000 363–454	1000–1200 454–544
LARGE-SIZE HOLSTEINS | MONTHS	~6 – 10	~11 – 13	~14 – 16	~17 – 21
SMALL-SIZE HOLSTEINS | MONTHS	~6 – 10	~11 – 14	~15 – 18	~19 – 22
STALL FEATURE	**STALL DIMENSIONS INCHES METERS**			
Stall width (on center)	34 0.86	38 0.97	42 1.07	45 1.14
Total stall length facing a wall	80 2.03	88 2.24	96 2.44	108 2.74
Outside curb to outside curb for head-to-head platform	Not Recommended		180 4.60	192 4.90
Distance of the rear curb to the brisket locator (maximum height 3 inches)	Not Recommended		64 1.63	66 1.68
Width of rear curb	6–8 0.15–0.20	6–8 0.15–0.20	6–8 0.15–0.20	6–8 0.15–0.20
Horizontal distance of the neck rail from the rear point of the curb for mattress stalls	46 1.17	55 1.40	64 1.63	66 1.70
Horizontal distance of the neck rail from the rear point of the curb for deep bedded stalls	40 1.02	49 1.25	58 1.47	60 1.52
Distance from rear edge of divider loop to point of curb	9 0.23	9 0.23	9 0.23	9 0.23
Height of brisket locator above top of curb loose bedded stall or mat/mattress surface	Not Recommended		3 0.08	3 0.08
Height of upper edge of bottom stall divider rail above top of curb (loose bedded stall for matmattress surface)	8 0.20	8 0.20	10 0.25	10 0.25
Interior diameter of the stall divider loop	24 0.61	28 0.71	30 0.76	33 0.84
Height of neck rail above top of curb loose bedded stall or mat/mattress surface	34 0.86	38 0.97	42 1.07	45 1.14
Horizontal distance from brisket locator to loop angle	Not Recommended		20–22 0.51–0.56	20–22 0.51–0.56
Rear curb height	6 0.15	8 0.20	8 0.20	8 0.20

PREGNANT HEIFER MANAGEMENT

- Check heifers for pregnancy 35 – 45 days post-breeding to identify open heifers and quickly return them to breeding program
- Reconfirm pregnancies before 200 days pregnant
- Coordinate with your veterinarian to create a pre-fresh vaccination protocol

HANDLING & TRANSPORTATION

HANDLING

- Handle cattle gently to help keep them calm
- Maintain a calm, quiet, stress-free environment for animals
- Provide employee training on stockmanship and humane animal handling
- When moving animals, use stockmanship techniques that accommodate the natural instincts of cattle and do not involve striking or force
- Calves must never be handled using only their tails, neck, ears, hide or a single leg
- Establish a zero-tolerance policy for animal abuse
- Take extra care when handling sick or immobile animals
- Establish quarantine facilities for sick or injured animals

TRANSPORTATION

- Wash and disinfect vehicles used to transport animals between trips to reduce pathogen exposure
- Equip transportation vehicles with flooring that ensures secure footing and absorbs urine and manure
- Calves should be dry, well-hydrated and able to stand and walk on their own before long-haul transportation
- Help animals avoid additional stress from transfer by vaccinating and dehorning more than one week before a major move

TRIP PREPARATION

- Minimize the length of the trip as much as possible
- Haul during cooler periods of the day, such as at night, when temperatures are high
- When hauling young calves in ambient temperatures <50°F (<10°C), provide deep bedding and/or calf jackets
- Cover 1/2 - 2/3 of the holes in a trailer if transporting in colder temperatures
- If a trip is longer than 24 hours, stop for fresh water and feed for at least 5 total hours

RECOMMENDED TRAILER STOCKING SPACE PER DAIRY ANIMAL

LBS KGS	SQ. FT. SQ. M
Up to 100 lbs 45.5 kg	4 sq. ft 0.37 sq. m
Up to 240 lbs 109 kg	6 sq. ft 0.55 sq. m
Up to 440 lbs 200 kg	9 sq. ft 0.83 sq. m
Up to 1,200 lbs 545.5 kg	13 sq. ft 1.2 sq. m
Over 1,200 lbs >545.5 kg	16 sq. ft 1.5 sq. m

BIOSECURITY

- Put biosecurity measures in place to help reduce the exposure to disease from the outside and support biocontainment actions when disease breaks in the current population
- Enlist the help of your veterinarian to outline the goals for your biosecurity protocol
- Work with your veterinarian to conduct a risk assessment of the operation to determine where disease introduction or transfer between animal threats may occur. Establish low risk, medium risk and high risk areas/practices. Key areas to focus on (not all-inclusive):
    1. Farm perimeter control
    2. Employee and visitor traffic
    3. Sanitation
    4. Animal sourcing
    5. On-farm animal and employee movement
    6. Preventative health programs
- Create documented risk management protocols to target all identified threats
    1. Include animal movement, employee access and external visitor records
    2. Establish biocontainment actions for on-farm disease outbreaks
- Conduct employee and frequent visitor training
    1. Initially – all team members and frequent visitors
    2. Ongoing
        - **New hires**
        - **New visitors**
        - **Refresher and update training as needed**
- Review protocols regularly and make adjustments where needed to improve biosecurity level and execution

EUTHANASIA

There are instances in which euthanasia is the most humane option for a convalescing animal

- If an animal is in pain and suffering with no possibility of recovery, perform euthanasia using American Association of Bovine Practitioners (AABP) guidelines
- DCHA supports and endorses the cattle euthanasia guidelines established by the AABP

RESOURCES

"Castration and Dehorning Guidelines" by the American Association of Bovine Practitioners, http://www.aabp.org/resources/AABP_Guidelines/Castration_and_Dehorning_Guidelines_app3.2014_03.17.2014.pdf

"Dehorn calves with paste" by the Pacific Northwest Extension Publication, https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw626.pdf

"Pasteurizing Milk and Colostrum" by Sandra Godden, DVM, DVSc, http://articles.extension.org/pages/21323/pasteurizing-milk-and-colostrum

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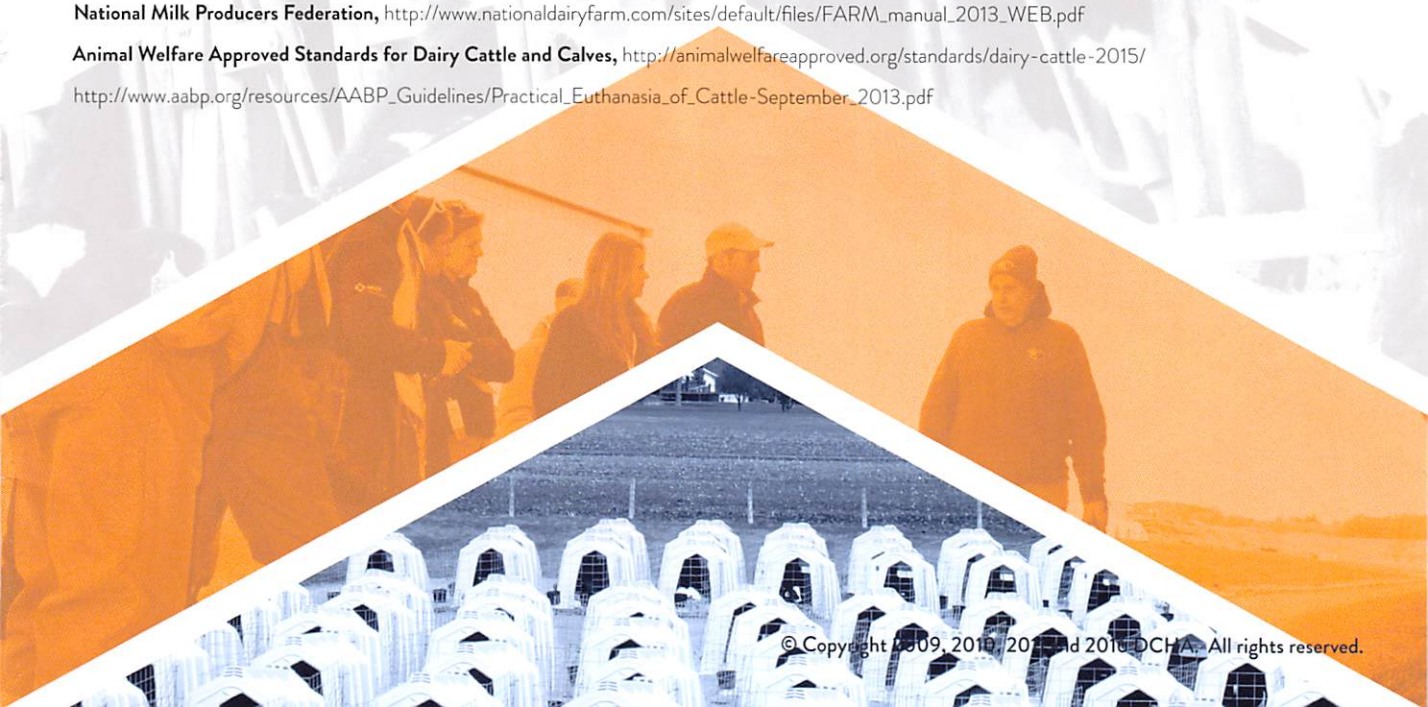

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