Texas Beef Quality Assurance Program

For Cow-Calf and Stocker Operations

Managing Cattle for the Kind of Beef You Want Your Kids to Eat

A cooperative program by:

Texas & Southwestern Cattle Raisers Association

BEEF LOVING TEXANS
TEXAS BEEF COUNCIL

Texas A&M AgriLife Extension

texasbeefquality.com

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INTRODUCTION

As a Texas food producer, your livelihood depends on securing the trust of your consumers. Food safety, or the perception of it, plays a significant role in the buying decisions of health-conscious Americans all across the country. Fortunately for cattle producers, the public perceives beef, in general, as a safe and wholesome product. However, there is no such thing as "too" safe when it comes to the food consumers buy for themselves and their children. After all, the beef you produce is a product that somebody will eat.

Add to that reality the ever-increasing competition for the consumer's protein dollar, and you quickly see how crucial it is for cattle producers of all sizes in every segment to commit to a management strategy that inspires consumer confidence in the safety of beef products.

In addition to safety, factors affecting cattle quality and food quality are also important. At the consumer level, quality attributes such as tenderness, flavor and portion size are important. At the production level, we are concerned with things like performance, health, and predictability all through the system.

In both cases, these quality factors can be affected by management decisions throughout the production chain — including your management decisions at the cow-calf or stocker level.

Furthermore, consumers have become more environmentally conscious. They are more closely scrutinizing agricultural practices that affect air and water quality and animal welfare. Although these factors may or may not directly affect the safety and quality of beef, they impact public perceptions of the beef industry, which may alter consumer acceptance of beef products.

The beef industry is evolving into vertically coordinated (vs. integrated) production systems, which require all segments — from the cow-calf producer to the consumer — to communicate and share information to (1) assure that beef is safe and wholesome, (2) increase the efficiency of production and (3) enhance environmental quality.

Beef Quality Assurance (BQA) is a proven system of sensible management practices that will further strengthen consumer confidence in beef products. Adopting BQA principles is a proactive way to implement a philosophy of Total Quality Management (TQM) into your beef operation and address quality and safety issues.

BQA can also help you become more competitive as a producer. Your active participation in this program is beneficial to building up the world's image of the beef originating from the Lone Star State.

> ... the beef you produce is a product that somebody will eat.

This Texas Cow-Calf and Stocker Beef Safety and Quality Assurance Handbook was developed for use in the Texas Beef Quality Assurance (TBQA) program to provide a TQM framework specifically for cow-calf and stocker producers. The information in this handbook and the instruction and support you will receive throughout the training sessions will help you identify critical points in your beef production business that influence safety and quality. The TBQA guidelines are aligned with national BQA guidelines.

The program requires everyone involved with beef production to follow regulatory guidelines for product use and to use the Best Management Practices (BMPs) outlined in this handbook, which are based on accepted scientific knowledge, to ensure safety and quality from the producer to the consumer.

> Every domestic agricultural producer contributes to the safest, most wholesome food supply in the world and is obligated to share their personal story of quality assurance and stewardship.

The History of Beef Quality Assurance

In the early 1960s, Pillsbury, NASA and the U.S. Army Natick Laboratories cooperatively developed a revolutionary quality control program. Its objectives were to ensure food safety on NASA missions and to reduce the chance of product defects entering the food chain.

Their program, the Hazard Analysis Critical Control Point (HACCP) system, gained U.S. Department of Agriculture acceptance and is presently the dominant outline for safety assurance programs in processed and fresh foods. HACCP plans are simply prevention plans that identify and control potential food hazards and monitor the production process.

To take a proactive approach to managing production practices, cattle producers began investigating ways to ensure that their production practices were safe and would pass the scrutiny of the consumer. In 1982, USDA's Food Safety Inspection Service (FSIS) began working with the U.S. beef industry to develop the Pre-harvest Beef Safety Production Program.

Between 1982 and 1985, three feedlots cooperated with FSIS to evaluate production practices and assess residue risks. In 1985, after careful analysis and adjustment of production practices, these three feedlots were certified by FSIS as "Verified Production Control" feedlots. What was learned during those three years now serves as the backbone for the National Beef Quality Assurance program. (Guidelines for the program are presented in the Appendix on page 47.)

This voluntary program has clearly been successful. BQA practices have almost eliminated violations associated with chemical residues and significantly reduced injection site lesions in fed beef cattle (steers and heifers fed in a feedyard). Cull breeding cattle provide approximately 15 to 20% of total beef production. Therefore, management practices to prevent residues and injection site lesions should be adopted.

In the 1990s, USDA mandated that all packing and processing plants develop and implement HACCP programs. To date, similar mandatory regulations do not exist for pre-harvest segments of the beef industry.

Cull breeding cattle provide approximately 15 to 20 % of total beef production.

However, in order to provide a safe, nutritious, and wholesome product without government regulation, industry groups have developed voluntary safety and quality assurance programs for the production segments of the industry.

For example, in 1986, the Texas Cattle Feeders Association initiated the first state BQA program in the country. In recent years, the TCFA program has grown to incorporate HACCP principles to address safety concerns and further address quality issues by identifying quality control points within the feedyard management system. It has paved the way toward ensuring the safety and quality of fed cattle in their members' control.

With all of this in mind, the Texas Beef Quality Assurance program has been developed to assist Texas cow-calf and stocker operators with developing BQA management strategies to ensure the safety and quality of beef from cattle they produce.

To take a proactive approach to managing production practices, cattle producers began investigating ways to ensure that their production practices were safe and would pass the scrutiny of the consumer.

Why Get Involved?

Other segments of the industry, from feedyards to foodservice, have already adopted HACCP and BQA management principles. And to further ensure the safety of products leaving their operations, whether that product is fed cattle or case-ready meat products, these companies are looking to do business with cow-calf producers and stocker operators who utilize the same management philosophy.

By adopting BQA principles as a way of doing business, you are positioning your operation to take advantage of these opportunities. Making a commitment to Beef Quality Assurance is the right thing to do to continue to increase consumer confidence and beef demand.

Participating in the Texas Beef Quality Producer program is one way to show our customers, whether they are calf buyers or consumers, that Texas cattle producers take every step possible to raise beef for them responsibly. Furthermore, every aspect of a BQA program is part of good business management.

For example, the information gained from record keeping in your BQA program will help you make better business decisions and avoid making costly production mistakes. BQA may also be a valuable resource for producers who are confronted with additional government regulations and/or possible litigation.

Making a commitment to Beef Quality Assurance is the right thing to do to continue to increase consumer confidence and beef demand.

What Is Quality?

"Quality" can be defined in several ways. One definition is "providing products that meet or exceed expectations and established requirements every time." Obviously, in the beef industry, established product requirements differ among the various production segments, but there are some common expectations.

For example, the products of a commercial cow-calf operation are weaned calves and cull breeding cattle. Calves should meet the requirements for performance, health and carcass characteristics that satisfy stocker operators and cattle feeders. Cull breeding cattle must meet the requirements of non-fed beef processors for health, food safety and expectations for carcass characteristics.

As products of a stocker operation, feeder cattle should meet the requirements of finishing operations for performance, health, carcass characteristics, and food safety. Finished cattle must meet the requirements of beef processors for health, carcass characteristics, and food safety. Commodity beef products must meet the requirements of beef purveyors for fat trim, marbling, portion size, safety, and lack of defects, such as injection site blemishes and dark cutters.

The bottom line is that quality goes far beyond the parameters of food safety. Quality encompasses performance, health, carcass characteristics, and eating satisfaction, which are all affected by management decisions throughout the beef production system. Because factors other than food safety are involved in quality, the material in this handbook is oriented toward the Total Quality Management concept.

Beef products must meet expectations for both safety and eating satisfaction.

The Texas Beef Quality Assurance Program

What is the objective?

The objective of the Texas Beef Quality Assurance program is to ensure that cattle and beef products originating from Texas cow-calf and stocker operations are safe and wholesome, meet requirements for quality throughout the production system, and are produced with humane and environmentally sound production practices.

This curriculum encompasses (1) traditional BQA principles to address food safety issues (2) management decisions affecting health, performance, and carcass characteristics, and (3) issues related to beef production and environmental quality.

The Basic Ideas Behind Total Quality Management (TQM)

At the ranch level, Total Quality Management (TQM) is as simple as creating a plan to prevent problems or to deal with something that does not go according to plan, for example, a needle breaking off inside a calf while giving an injection. The principles of TQM are incorporated in the discussions throughout the handbook.

Although specific reference to these principles is not always made, the concept is implemented by identifying and monitoring control points, preventative measures, safe limits, and corrective actions.

A core concept of TQM is W. Edwards Deming's 14 points, management practices to help companies increase their quality and productivity. The following 9 concepts have been modified from Deming's list and adapted to the TBQA program:

1. Create constancy of purpose for improving management and products from the ranch
2. Adopt the Texas Beef Quality Producer TQM philosophy
3. Build quality rather than relying on the next segment to sort out problems
4. Constantly monitor and improve planning and production
5. Take advantage of educational opportunities for self-improvementa
6. Adopt and institute leadership on the ranch to implement the TQM philosophy
7. Encourage open communication (on the ranch and across the industry)
8. Encourage quality and pride of workmanship rather than focusing on speed of completion
9. Expect everybody (from the owner to contract labor) involved in ranch operations to implement the Texas Beef Quality Assurance program

Based on these 9 concepts, 5 key action steps of the TBQA program are:

1) Examine current management practices

As with any industry trying to build or improve a production system, points in the production chain where problems could arise must be anticipated; such points are called "control points." To improve our production system, we must examine what we are doing by identifying the interactions (i.e. control points) we have with an animal that might compromise beef quality or environmental integrity.

2) Implement procedures to ensure production of cattle that will result in a safe, wholesome beef product

For example, everyone who helps you work cattle should be instructed to avoid giving intramuscular (IM) injections anywhere but the neck. IM injections given in the hip at branding have been shown to cause injection site blemishes identifiable in the steaks from that animal, and it toughens the meat adjacent to the injection site. Corrective actions should also be established in the event a problem occurs. As an example, corrective actions for a drug residue violation might include improved record keeping and employee training.

3) Establish a relationship between the ranch and veterinarian

Work with your veterinarian to develop a preventative herd health plan. This preventative herd health plan should be reviewed with your veterinarian on a regular basis and updated according to any changes on your operation or with product availability.

4) Keep records to monitor and verify

Establish effective record keeping procedures that document the system is working properly. For example, using a processing map to record where each injection was given, how much was given, how it was given, and the product administered is a way to verify your treatment protocol.

5) Pursue additional BQA training and monitor ranch activities

A periodic review of your animal treatment records, production practices, critical limits, treatment protocols, etc. is a way to verify that your management strategies are being carried out according to your BQA plan.

TQM Focus

1. Food safety control points
2. Quality control points
3. Environmental control points
4. Animal handling and well-being

FOOD SAFETY

The primary concerns associated with food safety are pathogens, residues (antibiotic/chemical) and foreign materials (buckshot/broken needles). It is imperative that food safety control points are identified so preventative and corrective measures can be put in place.

These are called "food safety" control points because a legitimate food safety risk of sufficient severity exists to warrant control. Most cow-calf and stocker operations will only have a few management points that are truly food safety control points. Process control points in cow-calf and stocker production that have potential consequences for the safety of beef are:

PROCESS	CONTROL POINT	POTENTIAL FOOD SAFETY HAZARD
Prevention and treatment of health disorders	Calving Herd bull and cow working Calf working Weaning calves Receiving breeding cattle Receiving stocker cattle	Injection site lesions Antibiotic residues Broken needles
Parasite control	Deworming External parasite control	Injection site lesions Chemical residues Broken needles
Feeding/supplementation	Purchasing Receiving Storage Feeding livestock	Antibiotic residues Chemical residues Feed toxins Beef measles
Gathering cattle	Use of firearms to haze cattle	Buckshot/birdshot
Pasture/range management	Brush control Weed control	Chemical residues
Preventing exposure to hazardous materials	Storage Handling Disposal Restricting access to: Petrochemical sites Septic systems Polluted soil and water	Chemical residues Beef measles

There may be other control points in a beef operation. It is important for you to develop your own production chart or list that includes all of the management practices you employ in your operation. That chart can then be used to identify your particular control points.

Managing food safety control points

Areas of food safety addressed in the TBQA program include:

1. Injection site management
2. Residue avoidance
   a) Antibiotic residues
   b) Chemical residues
   c) Feed contamination and residues
3. Foreign object avoidance

Beef Quality Assurance
Is Everyone's Job

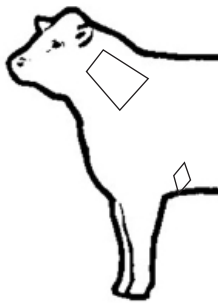
Injection Site Management

Administration of injectable animal health products can lead to food safety and food quality risks. At issue are injection site lesions and residues from injectable products. Although most injection site lesions are concerned with food quality, most consumers would perceive them as health risks. However, residues are a food safety concern. The following guidelines should be followed for both food safety control points as well as quality control points (see more about quality control points on page 19).

Figure 1

Best Management Practices — Injections

1. Choose orally or topically applied products, if efficacy is at least equal to injectable products.
2. Select injectable products that adhere to BQA recommendations: low irritant, low dose, subcutaneous.
3. Read and follow label directions when administering any animal health product.
4. Properly restrain cattle when administering injections. Improper restraint is the leading cause of broken needles and tissue damage.
5. Administer all IM injections in the NECK. When administering subcutaneous (SQ) injections, use the "tenting" technique (See Figure 1). Other acceptable SQ sites are the dewlap and the elbow pocket.
6. If possible, do not place more than one SQ injection on the same side of the neck to avoid interaction of products or severe tissue reaction.
7. Properly space injections:
   a) 3 inches between injection sites on calves and yearlings.
   b) 4 inches between injection sites on cows and bulls.
8. Never exceed label recommendation for injection sites. Most products are labeled for a maximum of 10 mL per injection site.
9. Never mix products.
10. Select the appropriate needle size, depending on product viscosity, size of animal and route of administration (IM or SQ).
    a) 16- to 18-gauge 5/8- to 1-inch needles work well for SQ injections.
    b) 16- to 18-gauge 1- to 1-1/2-inch needles work well for IM injections (See Table 1, Guidelines for Needle Selection).
11. Change your needle when it becomes contaminated or damaged. Change needles frequently (10 to 12 head per needle) to ensure minimal tissue damage from burrs and minimize the risk of carrying contaminant into the injection site. Change needles on every animal if a blood-borne pathogen (i.e., anaplasmosis) is known to exist in your herd. If a needle bends, stop immediately and replace it. Do not straighten it and use it again. Bent needles are much more likely to break off in the animal.
12. Injection sites should be free of soil and manure. Processing cattle in wet weather increases the chance of injection-site contamination.
13. Do not use chemical disinfectants to sterilize needles or syringes. To sterilize, boil syringe components and reusable needles in water for 20 minutes. Disinfectants can cause severe tissue irritation and will reduce the efficacy of products like Modified Live Virus (MLV) vaccines. It is best not to disinfect the injection site as product contamination can occur, as well as increased tissue damage.



14. Develop a record-keeping system and processing map (See Record Keeping for Beef Quality Assurance, page 16) to document individual animals or entire groups of animals that have been treated. Also, include the route of administration used (IM or SQ), product used, product lot number and serial number (in the event you encounter an episode of product or treatment failure).

Table 1. Guidelines for needle selection

Viscosity of Injectable	Route of Administration: SQ (5/8 to 1 inch needle)			IV (1 1/2 inch needle)			IM (1 to 1 1/2 inch needle)		
	< 300 lbs.	300-700 lbs.	> 700 lbs.	< 300 lbs.	300-700 lbs.	> 700 lbs.	< 300 lbs.	300-700 lbs.	> 700 lbs.
Thin Liquids Example: Saline	18 gauge	18-16 gauge	16 gauge	18-16 gauge	16 gauge	16-14 gauge	18 gauge	18-16 gauge	18-16 gauge
Thick Liquids Example: Oxytetracycline	18-16 gauge	18-16 gauge	16 gauge	16 gauge	16-14 gauge	16-14 gauge	18 gauge	16 gauge	16 gauge

Examples of Label Types

Over the Counter (OTC) Product

Name of Drug → COWBIOTIC

Active Ingredients → (hydrocillin and streptazolidin)

Directions for use: See package insert. ← Instructions for Use

Withdrawal Time → Warning: The use of this drug must be discontinued for 30 days before treated animals are slaughtered for food.
Exceeding the highest recommended dosage level may result in antibiotic residues in meat or milk.

Quantity of Contents → Net Contents: 100 ml

Distributed by Arkansas Animal Health, Inc. ← Name of Distributor

Prescription Product

BULLMYCIN 300
(Wondercine HCl)
Directions for use: See package insert.
Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian. ← Prescription Legend
Warning: The use of this drug must be discontinued for 28 days before treated animals are slaughtered for food.
Exceeding recommended dose, or number of days on treatment, or 10 ml per intramuscular injection site may result in antibiotic residues.
Net Contents: 100 ml.
Distributed by
Texas Animal Health, Inc.

Label Provided by Veterinarian

For "Extra-Label" Use

Veterinarian:_____Phone:_____
Address:_____Date:_____Exp:_____
Owner/Farm:_____Animal ID:_____ Species:_____
Active Ingredients/Concentration: _____
Quantity:_____Drug Trade Name:_____
Indications: _____
Directions: Give _____cc/bolus/oz _____times each day for _____days
Drug Withdrawal Time for Slaughter_____Days
Test for Residues: Urine_____ Blood_____

Calculation example:

A 550-pound calf is sick with respiratory disease and the veterinarian recommends that the calf be treated with "CALFBIOTIC." The directions on the bottle are as follows:

"Directions: Inject subcutaneously in cattle only. Administer a single subcutaneous dose of 10 mg/kg of body weight (1 ml per 30 kg or 1.5 ml per 100 lbs).

550 lbs = 249 kg (550 lbs divided by 2.205 lb/kg)

then

249 kg x 1 ml/30 kg = 8.3 ml (249/30=8.3)

550 lbs x 1.5 ml/100 lbs = 8.25 ml (550/100) x 1.5 = 8.25

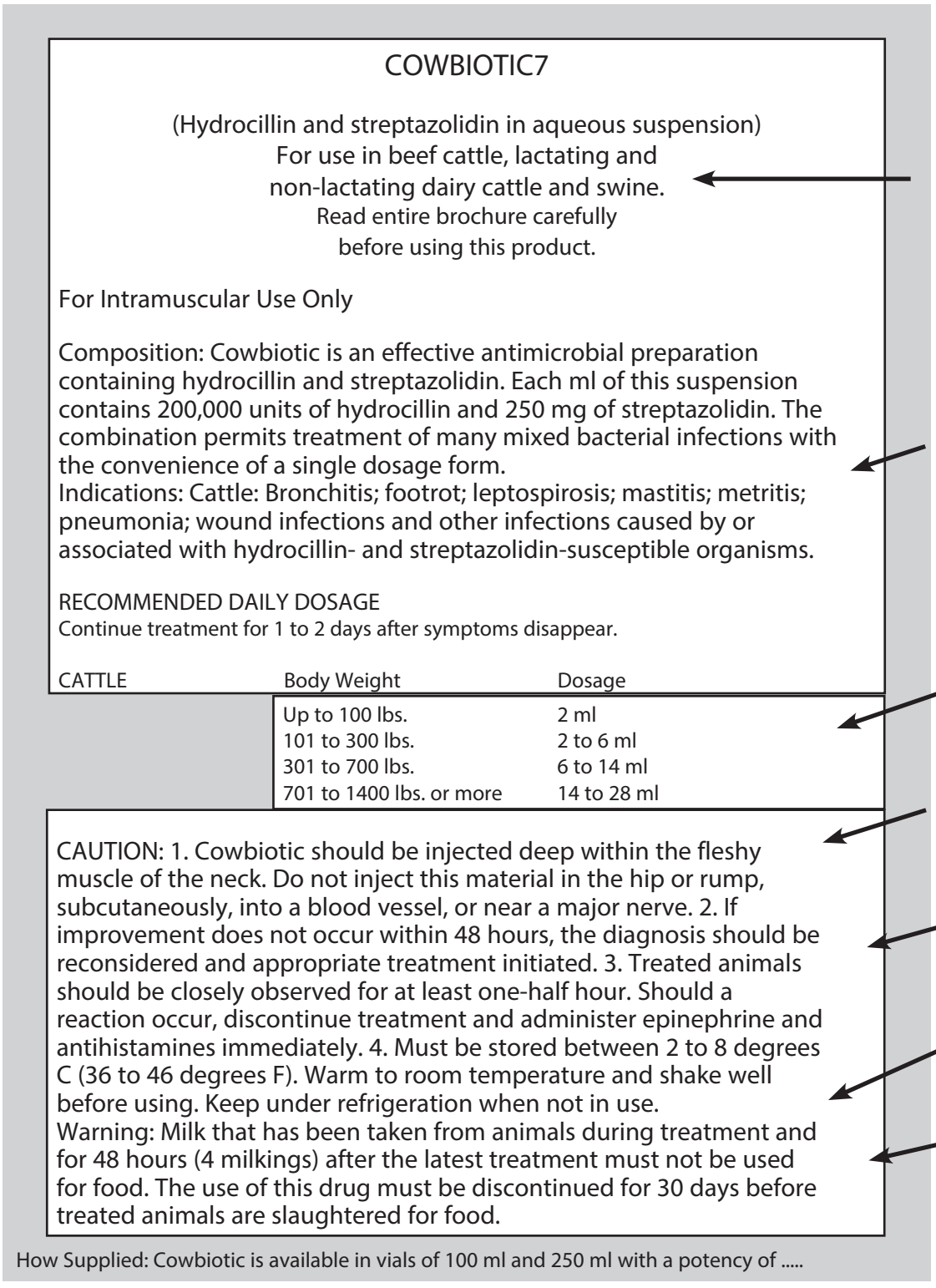
What if the calf actually weighed 400 lbs or 700 lbs?

400 lbs x 1.5 ml/100 lbs = 6 ml

700 lbs x 1.5 ml/100 lbs = 10.5 ml

In this example, if no scales were available to obtain a correct weight, then guessing the weight of an animal can lead to improper treatment. If the calf actually weighed 400 lbs and was given a dose for a 550-lb calf, then additional expense was incurred and the potential for a longer withdrawal time exists. If the calf actually weighed 700 lbs and was given the dose for a 550-lb calf, then most likely the treatment would have failed and the animal's condition may have gotten worse. It is essential that an accurate estimation of the animal's weight be taken to avoid incorrect dosages.

Example of Package Insert Information



COWBIOTIC7

(Hydrocillin and streptazolidin in aqueous suspension)
For use in beef cattle, lactating and
non-lactating dairy cattle and swine.
Read entire brochure carefully
before using this product.

Species & Animal Class

For Intramuscular Use Only

Composition: Cowbiotic is an effective antimicrobial preparation containing hydrocillin and streptazolidin. Each ml of this suspension contains 200,000 units of hydrocillin and 250 mg of streptazolidin. The combination permits treatment of many mixed bacterial infections with the convenience of a single dosage form.
Indications: Cattle: Bronchitis; footrot; leptospirosis; mastitis; metritis; pneumonia; wound infections and other infections caused by or associated with hydrocillin- and streptazolidin-susceptible organisms.

Approved Uses

RECOMMENDED DAILY DOSAGE
Continue treatment for 1 to 2 days after symptoms disappear.

CATTLE	Body Weight	Dosage
	Up to 100 lbs.	2 ml
	101 to 300 lbs.	2 to 6 ml
	301 to 700 lbs.	6 to 14 ml
	701 to 1400 lbs. or more	14 to 28 ml

Dosage

Route of Administration

CAUTION: 1. Cowbiotic should be injected deep within the fleshy muscle of the neck. Do not inject this material in the hip or rump, subcutaneously, into a blood vessel, or near a major nerve. 2. If improvement does not occur within 48 hours, the diagnosis should be reconsidered and appropriate treatment initiated. 3. Treated animals should be closely observed for at least one-half hour. Should a reaction occur, discontinue treatment and administer epinephrine and antihistamines immediately. 4. Must be stored between 2 to 8 degrees C (36 to 46 degrees F). Warm to room temperature and shake well before using. Keep under refrigeration when not in use.
Warning: Milk that has been taken from animals during treatment and for 48 hours (4 milkings) after the latest treatment must not be used for food. The use of this drug must be discontinued for 30 days before treated animals are slaughtered for food.

Additional Information

Storage Requirement

Withdrawal Time

How Supplied: Cowbiotic is available in vials of 100 ml and 250 ml with a potency of .....

Residue Avoidance

Adulteration of beef products can occur with residues from animal health products, herbicides, pesticides and chemical contaminants of feed and water. Traces of some drugs and chemicals may be allowed in certain tissues. This is known as the tolerance level.

Tolerance levels are usually discussed in terms of one part of a drug or chemical to one million or one billion parts of tissue. For some chemicals, no detectable amount is allowed (zero tolerance). The Food and Drug Administration establishes tolerance levels for residues in food products.

Residues are monitored through tissue sampling in beef processing facilities. Violations of the legal limits called violative levels can result in regulatory action, including fines, herd quarantine and possible criminal prosecution.

To date, violations have been minimal. Continual changes in inspection and monitoring may result in a higher incidence of residue detection.

The Food and Drug Administration and the Environmental Protection Agency approve and establish guidelines for the use of animal health products and agricultural chemical products used in pasture and range management, crop production, feed processing and storage.

During the approval process, withdrawal times are established for livestock treated with or exposed to regulated compounds and products. These times are explicitly defined on the labels for the products. The first step in avoiding residues is to read and follow label directions for all products used in beef and other agricultural production.

In addition to animal health products and pasture and range pesticides, contamination or residues may result from accidental or negligent exposure to feed, water or soil that has been contaminated with heavy metals, petrochemicals, PCBs, PCPs, insecticides, fungicides, herbicides, mycotoxins, or other hazardous materials. Careful management and oversight are necessary to prevent exposure to these compounds.

Traces of some drugs and chemicals may be allowed in certain tissues. This is known as the tolerance level.

Residue monitoring in non-fed cattle (cull cows/bulls)

Residues in fresh meat and poultry are monitored by the Food Safety Inspection Service through the National Residue Program (NRP). The NRP helps prevent the entry of animals containing violative residues of pesticides, drugs, or potentially hazardous chemicals into the food chain through monitoring and enforcement.

Random samples are tested for monitoring the national residue incidence. Specific samples are collected for enforcement based on clinical signs and previous herd history.

Traditionally, animals were selected for testing based on pre-harvest evaluation only (down, disabled, recent surgery). Inspectors were instructed to check for residues after harvest in animals with any of the following 11 conditions:

1. Suspects
2. Mastitis
3. Pneumonia
4. Body-cavity lining inflammation
5. Heart sac lining inflammation
6. Skin inflammation
7. Twisted stomach disease
8. Septicemia (blood poisoning)
9. Pyemia (blood poisoning)
10. Injection sites
11. Uterine infection

Violations of the legal limits called violative levels can result in regulatory action, including fines, herd quarantine and possible criminal prosecution.

In cull cows and bulls, residues are monitored and can be traced back to the owner through back tags that are applied at the auction market or packing plant. The majority of violative residues for antibiotics occur in tissue samples from dairy cows. But, violative residues are found in beef cattle as well.

Nationally there are approximately 6 million cull cows/bulls harvested (remember, that means slaughtered) every year. Relying on inspection and testing goes against the principles of TQM, which stress prevention rather than inspection. These problems can and must be solved at the producer level, and progress in reducing residues will only be accomplished if producers pay strict attention to guidelines for proper use of animal health products and other potential contaminants.

Avoiding antibiotic residues

Overall, the beef industry is doing an excellent job of controlling violative drug residues by placing emphasis on the identification and handling of individually treated cattle. This includes identifying each animal treated,

accurately recording the treatment, date, and following proper withdrawal times. It is important that beef producers establish a working relationship with a licensed veterinarian. Find and use a veterinarian who is willing to be involved with your Beef Quality Assurance program. Be cautious about cattle treatment advice from anyone who is not highly acquainted with your operation and the proper use of animal health products.

Overall, the beef industry is doing an excellent job of controlling violative residues by placing emphasis on the identification and handling of individually treated cattle.

Preventative Herd Health Plan

The most effective way to reduce the potential for antibiotic residues is to control the need to use them. Every effort should be made to prevent disease and infection in the cattle herd. To accomplish this a herd health plan needs to be developed for each individual ranch operation. One herd health plan will not fit all operations across the state.

Preventative herd health plans will consist of herd management and immunization recommendations. Work with your veterinarian to develop a herd health plan including a biosecurity program. Included in this plan should be:

- Diseases of concern
- Recommended vaccines
- Appropriate time frame to protect (vaccinate) against diseases of concern
- Recommended feed additives (if any)
- Additional management considerations to aid in the prevention or spread of diseases of concern
- Development of management protocols in the event of failed prevention efforts

Management and treatment considerations will need to be discussed and developed for each operation.

Any medication that requires a use other than as directed on the label must have revised administration procedures. Your veterinarian must supply a revised label including the veterinarian's name, address, phone number, revised directions for use, name of drug and withdrawal time.

Animal health products have specific label instructions including the period of time that must pass after the last dose is given until harvest of the animal. This period of time is known as the withdrawal period and is usually stated in hours or days. The withdrawal period allows time for elimination of the drug from the animal, or reduction of residues to below tolerance levels before harvest.

Extra-label use requires extended withdrawal periods in order to reduce the level of residues below violative levels. Any revisions to withdrawal times should be established by the authorizing veterinarian. Withdrawal times may also be extended for animals that have been severely impaired by stress, disease, malnutrition, or age.

Avoiding tissue residue of antibiotics is simple to manage; observe and follow label directions and ensure that cattle are not marketed until the appropriate withdrawal time has elapsed. Following are basic management practices necessary to ensure that no violative antibiotic residues will be present in carcass tissues.

Best Management Practices — Antibiotic Use

1. Strictly follow all recommendations and guidelines from your veterinarian for selection of products.
2. Follow label directions for use of product. Use product at recommended dosage for required time period. Treatment regimens must comply with label directions unless otherwise authorized by a veterinarian. Use of drugs in an extra-label manner must be authorized by a veterinarian under a valid veterinarian-client-patient relationship. (The requirements for a valid veterinarian-client-patient relationship (VCPR) are covered in the Appendix, page 54.) All cattle treated in an extra-label manner must comply with established withdrawal times, which have been set by your veterinarian under the guidelines of a valid VCPR. The Texas Beef Quality Assurance program does not support extra-label drug use of injectable aminoglycosides

Withdrawal period: the period of time that must pass after the last dose is given until harvest of the animal. The withdrawal period stated on the label allows time for elimination of the drug from the animal, or reduction of drug residues to below tolerance levels before harvest.

(such as neomycin, gentamicin, or kanamycin) because of the potential violative residues related to extremely long withdrawal times. Some studies have shown withdrawal times on these types of products could be as long as 18 months.

3. Calculate dose requirements based on the weight of the animal and the specific health problem being treated. Providing the same drug simultaneously by injection, feed or water may result in overdosing and, thereby, create a residue problem.
4. When administering injectable products, follow the Best Management Practices — Injections outlined on page 6.
5. All animals treated for problems unique to the individual animal should be recorded by the animal's ID, treatment date, drug and dose administered, product serial/lot number, weight of animal, route and location of administration, and the earliest date the animal would clear the withdrawal period. (See page 17 for sample treatment records). Record treatments either by individually identifying each animal and/ or individually identifying each animal when or if they are treated. The ID number should be unique to that animal and tie it to the group from which it came.
6. Identifying each animal individually is not required to participate in this program; cattle can be identified by groups. However, if treated cattle are not individually identified, then the entire group must be managed together until the appropriate withdrawal times have elapsed for every animal in the group. The withdrawal time applies to the entire group of animals. (See forms for recording group treatment history on page 18).
7. All cattle marketed from the ranch can potentially go directly to slaughter. Therefore, records for any cattle to be marketed should be checked by ranch personnel to ensure that treated animals will meet label withdrawal times for all products administered. A release slip should be signed and dated by the person who checks records prior to shipping cattle from the operation. The examination should include processing records, feeding records, treatment records and all other records that may apply.
8. Extended withdrawal times should be expected for emaciated or severely debilitated animals. Attempting to salvage value by treatment and prompt slaughter requires an accurate diagnosis and careful selection of drugs. Should there be any question about withdrawal period, the veterinarian will evaluate the treatment history against information provided by the Food Animal Residue Avoidance Databank (FARAD), and the animal may have to pass a residue screening test, such as the Live Animal Swab Test (LAST). The results will determine whether the animals can be released for shipment but cannot be used to shorten the labeled withdrawal time.
9. Make sure that all employees are aware of the proper use and administration of antibiotics and withdrawal times, and that they have the ability to check appropriate withdrawal restrictions before moving cattle to market. Use charts or software to help track withdrawal dates.

Extra-label drug use is using a drug at a dose, by a route, for a condition or indication, or in a species not on the label.

Feed additives and medications

The term "medicated feed" includes any feeds containing animal health products. This includes products that are commonly referred to as supplements (medicated mineral), concentrates (grain mixture that contains medication), premix feeds (concentrated medications mixed with additional roughage or concentrates) and base mixes, as well as complete feeds (preconditioning feed used for receiving/weaning).

For more details on FDA regulations concerning feed additives and medicated feeds, see Appendix, page 55. The following recommendations relate specifically to the use of medicated feeds.

Any animal marketed from a cow-calf or stocker operation could potentially go immediately into a meat product. You may sell an animal with no intent of it going to slaughter; however, the buyer could resell it within days to someone who sends it to slaughter. This applies to cows, bulls, calves, and yearlings. That is why it is so important to observe withdrawal times whenever you sell cattle.

Best Management Practices — Medicated Feeds

1. Only FDA-approved medicated feeds and feed additives can be used in rations.
2. Feed only at recommended rates. Exercise caution when calculating rates for medicated feeds.
3. All medicated feeds and feed additives will be used in accordance with the FDA-approved label. Extra-label use of feed additives is prohibited by federal law. No one has the authority to adjust the dose as labeled, including veterinarians. All directions for the use of a medicated feed or feed additive will be on the label attached to the bag or will be supplied with a bulk order. Medications added to water are not considered feed medications; follow label directions or directions from your veterinarian.
4. Follow withdrawal times stated on the label or provided by your veterinarian.
5. For operations formulating and mixing rations on site, medicated feed additives will be used in accordance with the FDA Good Manufacturing Practices (GMPs). These include a formula record of all medicated feed rations produced and records of all batches of feed produced that contain medicated additives. Records must include additive used, date run, ration name or number, the name of the person adding the additive or responsible for mixing the feed and amount produced. Use separate mixers for mixing medicated feeds and non-medicated feeds, or clean mixers between batches of each.
6. Pre-mixed or formulated supplements do not require FDA registration of any type. Larger operations that use certain highly concentrated medications may be required to register with the FDA via a FD-1900 permit.
7. Identify treated individuals or groups as described in the antibiotic use section, page 11.

Avoiding Chemical Residues

Pesticide or herbicide residue is not a major problem in the beef cattle industry. Areas of risk include products applied to the land, applied to the animal, or accidental or negligent exposure to hazardous materials. To avoid potential risk of residues, the following guidelines are recommended.

Best Management Practices — Chemical Residues

1. Use only agricultural chemicals approved for application to land grazed by livestock or on land where feedstuffs are harvested for animal consumption.
2. Follow label directions and observe grazing and harvest restrictions when applying pesticides to pastures, rangeland and crops treated with pesticides.
3. Prevent accidental exposure to agricultural chemicals by proper storage and disposal of containers. Thoroughly clean sprayers between application of agricultural chemicals and application of livestock pesticides.
4. Only use products approved for cattle to control internal and external parasites. In back rubbers or other self-treatment devices, it is preferred to use vegetable oil or mineral oil as a carrier.
5. Apply topical, oral, and/or injectable livestock pesticides at label dose rates. Overdosing constitutes extra-label usage with unknown withdrawal times. Individual animal weights can help determine appropriate calculation of doses.
6. Document usage and observe all appropriate withdrawal times before marketing cattle.
7. Prevent consumption of hazardous chemicals and heavy metals by proper storage and disposal of paint, batteries, chemical containers, used petrochemical products, and other materials. Restrict access to any site that may provide the opportunity for exposure to hazardous chemicals.
8. Prevent contamination of feedstuffs and water.

Feed Contamination

The potential for adulteration of beef from contaminated feed is greater than most producers realize. However, contamination is not common at the ranch level. Accidental contamination is much more common than any other type of problem.

EPA pesticide product registration and licensed pesticide applicator requirements provide significant protection from pesticide residues in the U.S. feed grain supply. In addition, costs associated with pesticides discourage over-application.

To make sure you do not buy a residue problem in a load of feed, grain, by-products, hay or crop residues, deal with a reputable feed commodity supplier. In addition, you may wish to ask suppliers about their use of grain protectants during storage and their monitoring procedures.

Fluid leakage and other potential contamination

The leakage of transmission and transformer fluid poses a potential problem in residue avoidance. Both types of fluid contain polychlorinated hydrocarbons (PCBs), which can leave a violative residue in cattle. While the occurrence of PCB residue from this source is small, the possibility still exists.

Another potential problem is transmission/hydraulic or radiator fluid that leaks from farm equipment and contaminates feed. Lead and other heavy metals may

be picked up through spills and leaks; batteries, paint, and other materials may inadvertently contaminate feed or be picked up elsewhere by cattle.

Products used for bird and rodent control are another potential problem. While no residues have been reported from these products, they are toxic substances. Adhering to the following guidelines can reduce the risk of residues from contaminated feed.

Best Management Practices — Feed Contaminants

1. Maintain a quality control program for incoming feed ingredients in an attempt to eliminate contamination resulting from molds, mycotoxins, chemicals, and other contaminants.
2. Store feed in a manner that prevents development of molds and mycotoxins and exposure to chemicals and other potential contaminants.
3. If contamination is suspected, submit the feed ingredient for analysis by a qualified laboratory before use.
4. To avoid accidental livestock exposure, treat all chemicals as potential hazards. Never store chemical products where leakage or breakage can contaminate feed products. For example, do not store batteries, fuel containers or paint next to feedstuffs.
5. Regularly check all feed-handling equipment for fluid leaks.
6. Clean spills to prevent potential contamination.
7. If a feed-related poisoning is suspected, it is critical for the producer or veterinarian to contact a diagnostic laboratory for assistance in confirming the suspicion.
8. If purchasing fats and vegetable oils, monitor for potential contamination. Letters of guarantee from companies supplying these materials may be requested that state these materials have been tested.

Ruminant by-products

As of 1998, federal regulations prohibit the feeding of certain mammalian protein sources. The regulations primarily impact the feeding of meat meal and bone meal, and blood products derived from ruminants. Tallow, gelatin, and milk products are excluded by the regulation and are acceptable for use in ration formulations. (More information on ruminant derived by-products and their use is available in the Appendix, page 55.)

Best Management Practice — Ruminant By-Products

1. Do not use ruminant-derived protein sources in manufacturing ruminant feeds.

Beef measles

Occasionally, feeders are notified by packers that some of their cattle have "measles." Cysticercosis, or "beef measles," refers to the immature larvae stage of the human tapeworm found in the form of cysts in the muscles of cattle. It results from cattle consuming feedstuffs contaminated with tapeworm segments or eggs, or cattle coming in contact with water or ground that has been contaminated by infected humans.

USDA regulations prohibit contaminated carcasses from being approved for human consumption.

Investigations have indicated that the majority of cattle with measles were infected prior to entering the feedyard.

Best Management Practices — Beef Measles

1. Fecal/oral contamination should be avoided regardless of the source.

Potential microbial contamination

As the beef industry strives to produce a safe and wholesome product, many areas of quality assurance take on new importance. Contamination of beef with various organisms of importance in human health is of increasingly serious concern. Recognized pathogens, such as E. coli 0157H7, Listeria spp. (all species) Salmonella spp. and Campylobacter, may enter the beef supply in a number of ways.

Attention to basic sanitation practices and proper animal health techniques can decrease the chance of microbial contamination.

Potential feed toxins

Mycotoxins are naturally occurring compounds produced by fungi. Mycotoxins can be found in grains and forages, and if present in sufficient concentration,

can cause reduced feed consumption, poor production and adverse health effects that may result in residues in meat and milk products.

Environmental conditions that are conducive to the growth of fungi and the production of mycotoxins are quite variable. Mycotoxins can be produced in feedstuffs prior to harvesting or during storage. Mycotoxins common in Texas include aflatoxin, vomitoxin, zearalenone and fumonisins. These primarily occur in grain, peanuts, and cotton by-products. Stress during critical stages of crop development often leads to aflatoxin development.

Best Management Practices — Feed Toxins

1. Store feedstuffs in a manner to prevent mold formation and avoid feeding moldy feed.
2. Maintain a quality control program for incoming feed ingredients in an attempt to eliminate contamination. It is important to keep in mind that mycotoxins can be present in feeds without visible mold growth; conversely, visibly moldy feed may not always contain detectable mycotoxins. (Texas AgriLife Extension Publication B-1279, Mycotoxins in Feed and Food-Producing Crops.)

Foreign Objects

There are two major types of foreign objects to be concerned with: (1) buckshot or birdshot and (2) broken needles. On rare occasion, rifle bullet fragments and arrow tips have also been found in carcasses.

Birdshot/buckshot

Lead cannot be detected by metal detection devices used in packing and processing facilities. Lead is considered an adulterant by the Food and Drug Administration. If the shot is detected on the slaughter floor the entire carcass is condemned or special measures must be taken to completely remove shot.

If metal is detected during ground beef production, the entire lot of ground beef must be condemned. In large slaughter and processing plants, this can be several thousand pounds in one batch! The presence of buckshot/birdshot ranks high on the list of packer concerns.

Regardless of who is at fault, this defect should be prevented with education about the consequences. To ensure that foreign objects are not found in carcasses, adhere to the following guidelines.

Best Management Practices — Birdshot/Buckshot

1. Never use firearms to gather cattle. Develop alternative methods to control and capture animals.
2. Work with hunters to prevent shooting cattle with any weapon. Educate hunters to the potential safety concerns associated with adulterated carcasses. Remove cattle from hunting areas when possible to avoid accidental shootings.

Broken needles

You and your veterinarian must determine how animals will be handled if a needle breaks off when giving an injection. A broken needle is an emergency which should be handled immediately. Broken needles migrate in tissue and, if not handled immediately, the needle fragment will be difficult to find, requiring the animal to eventually be destroyed if the broken needle is not recovered, rather than sold at market.

Under no circumstances should animals carrying broken needles be sold or sent to a packer. Refer to the following guidelines for best management practices to avoid broken needles.

Best Management Practices — Broken needles

1. Restrain animals properly and adhere to injection site management as outlined on page 6.
2. Do not straighten bent needles. Replace immediately.
3. Develop a standard operating procedure for dealing with needles broken off in cattle.
   a) If the needle remains in the animal, mark the location where the needle was inserted.
   b) If a broken needle cannot be removed at the ranch, immediately contact a veterinarian to have the needle surgically removed.
   c) If a broken needle cannot be extracted from the tissue, record the animal's ID to ensure that it is never sold or leaves the ranch. At the end of its productive life, the animal should be euthanatized and disposed of properly.

Record Keeping for Beef Quality Assurance

Record keeping is a key element of Beef Quality Assurance, and it is simply a good business practice. There are many software programs on the market, and even old-fashioned pen and paper beats no record keeping system.

The important thing is to find a method that you are comfortable with, which allows you to maintain accurate, thorough, and timely documentation of your herd health program, nutrition program and other important production factors.

To inspire consumer confidence, we must be able to document the responsible use of products and demonstrate that we have control over risk factors that have residue potential. Good records are also important if your operation is inspected (for example, if one of your cull cows is found to have a violative residue) by any state or federal agency.

Effective documentation showing appropriate training, inventory control, product use, animal identification, withdrawal and disposal is the only way to avoid liability from a residue contamination. The only way to accurately determine if you are in compliance with withdrawal times is to know exactly what was given, how much was given, where it was given, how it was given and when it was given to the animal.

Updated records also allow you to make well-informed decisions about marketing cattle without worrying whether enough time has elapsed since the last treatment. Also, as mentioned in the section on feed contamination, you should keep records on your use of pesticides, herbicides, and other chemicals. Understand the safety restrictions with regard to withdrawal times and animal types (pregnant, lactating, etc.) that should not be treated or exposed to treated areas.

Best Management Practices — Animal Treatment Records

1. Keep all records for at least two years from the date of transfer or sale of the cattle. In case a problem arises later, your records will help you track the treatment history of the animal when it was in your possession.
2. The treatment record should contain the following information:
   a) Treatment date
   b) Animal or group identification
   c) Weight of animal or group average
   d) Product administered
   e) Product lot/serial number
   f) Earliest date the animal could clear withdrawal time
   g) Dose administered
   h) Route of administration (ROA - IM, SQ, etc.)
   i) Location of injections
   j) Name of person who administered the treatment
3. If appropriate, records should be made available to the buyer or next manager of the cattle. Records should include all individual and group treatment/processing history and other information as deemed appropriate.

Best Management Practices — Feed Records

1. Keep all feed records for at least two years.
2. It is a good management practice to require that all feed products be accompanied by an invoice that includes the date, amount, and composition of any custom mixed feeds.

Best Management Practices — Chemical Records

1. If grazing/haying restrictions or withdrawal times apply, records should be maintained for non-restricted pesticides. (Full-page forms can be found in the Appendix, starting on page 63.)

GROUP PROCESSING / TREATMENT MAP

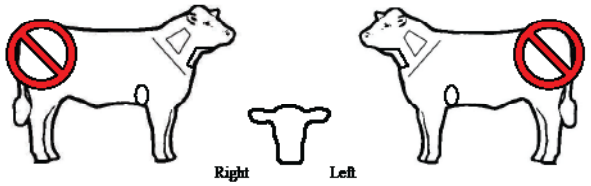
Select SQ products when possible.
Never give an injection in the rear leg or top butt.

Group:_____ Date:_____ ID: Rt. Ear/ Lft Ear: _____

Booster/Reprocess Date:_____ Pen/Pasture #: _____

Class: S / H / Bulls / Cows Age:_____ Weight:_____ Hd. Processed _____

Other Management (√): Castrate___ Dehorn ___ Other _____ Crew _____



Product and Company	Lot or Serial #	Exp. Date	ROA*	Dose	Booster Date	Withdrawal Date
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

*ROA – Route of Administration

Comments:

These sample records provide an idea of how to record information on purchased animal health products, individual and group treatment records, as well as an example of an individual animal treatment record and a group treatment record. There are also full-page sample forms that can be downloaded from the TBQA website www.texasbeefquality.com.

Animal Health Products Inventory

Date Received	Supplier/Distributor	Product Name	Quantity	Cost	Lot #	Serial #	Expiration Date

Individual Animal Health Record

I.D.	Date	Temp.	Diagnosis	Home Group Pen	Treatment	Route of Administration	Treatment Location	Date of Withdrawal	Initials of Processor

Pesticide Inventory

Name of Product	Rec by	Date	Source	Quantity Received	Special ID	Comments

Pesticide Use Record

PR=Pesticide name, WD=Withdrawal time

Date	Product	Location	Withdrawal Time	Comments
1.				
2.				
3.				
4.				

GROUP PROCESSING / TREATMENT MAP

Select SQ products when possible.
Never give an injection in the rear leg or top butt.

Group:_____ **Date:**_____ **ID: Rt. Ear/ Lft Ear:** _____

Booster/Reprocess Date:_____ **Pen/Pasture #:** _____

Class: S / H / Bulls / Cows **Age:**_____ **Weight:**_____ **Hd. Processed** _____

Other Management (√): Castrate___ **Dehorn** ___ **Other** _____ **Crew** _____

Right Left

Product and Company	Lot or Serial #	Exp. Date	ROA*	Dose	Booster Date	Withdrawal Date
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

*ROA – Route of Administration

Comments:

QUALITY CONTROL POINTS

Identifying quality control points in cow-calf and stocker operations

Eliminating the possibility of food safety risks by management of critical control points has already been outlined in detail. The same thought and management processes need to be employed in quality management. The points in your operation where management can influence health, performance, and carcass merit are called "Quality Control Points."

Many common points exist for all operations. In addition to the common points listed below, each producer should identify and manage other quality control points unique to a particular operation.

Management approaches for quality control points

Quality concerns fall under these five areas:

1. Genetic management
   (a) Progeny evaluation
   (b) Breeding system considerations
   (c) Breeding stock selection
      i. Sire selection
      ii. Replacement females
2. Utilization of animal health products and practices
   (a) Injection site management
   (b) Vaccine handling and administration
   (c) Implant utilization and recommendations
   (d) Parasite management
3. Processing/cattle handling
   (b) Calf management practices
   (c) Branding
   (d) Cattle behavior and facility design
4. Nutrition
   (a) Immune system
   (b) General health
   (c) Weaning nutritional management
   (d) Nutritional stress
5. Culling management
   (a) Cancer eye
   (b) Horns
   (c) Branding
   (d) Lameness
   (e) Inadequate muscling/excessive fat
   (f) Bruising
   (g) Body condition

Process	Control Point	Potential Quality Concerns
Genetic Management	Sire selection Replacement female selection Breed combinations/systems	Carcass characteristics Health Performance Temperament
Processing/cattle handling	Weaning calves Receiving Shipping	Bruises Hide damage Carcass characteristics Health Temperament Performance Stress
Animal health: practices and products	Injection site management Vaccine management Implant utilization Parasite management	Injection site lesions Health Hide damage Liver damage
Nutrition	Forage management Supplementation	Health Carcass characteristics
Culling management	Timely marketing Shipping culls	Carcass characteristics Bruising Condemnation Hide damage

Genetic decisions are the first step in quality control.

Processes, Control Points & Quality Concerns
Cow/Calf Production

CONTROL POINTS	QUALITY CONCERNS: Health	Uniformity	Growth/ Efficiency	Carcass Damage	Carcass Quality	Hide Damage	Behavior/ Temperament
Breeding & Genetic Selection							
Sire Selection	X	X	X		X		X
Culling/Replacement Females		X	X	X		X	X
Health Products & Practices							
Injection Site Management				X	X		
Vaccine Handling	X		X		X		X
Implant Utilization	X		X		X		
Parasite Management	X			X		X	
Processing & Handling							
Calf Management Practices	X	X	X	X	X	X	X
Branding						X	
Handling & Facility Design	X	X	X	X	X	X	X
Nutrition	X	X	X		X		X
Culling Management							
Health				X	X	X	
Body Condition				X	X	X	

X - indicates there is likely an interaction between the corresponding Process and Quality Concern

Genetic Management

Progeny evaluation

Before developing a breeding program, it is necessary to understand the expectations of the beef industry for growth, health, carcass merit, and eating quality. Progeny evaluation is then used to determine the current status of an operation's genetic management plan.

Most selection and breeding programs lack information about the performance and carcass traits of their calves and stocker cattle after they leave the ranch. Many breeding decisions are made without a knowledge of what changes, if any, are needed or which are the most beneficial to the operation. To effectively measure change, benchmarks must be established. Benchmarking is accomplished by collecting performance and carcass information on calves and stocker cattle after they leave the ranch. Information can be obtained in several ways.

Networking with calf buyers, stocker operators and feedyards that purchase your calves and feeder cattle is another way to find out how your cattle perform past the ranch gate. In recent years, carcass traits have been the focus of many information feedback programs. However, performance characteristics, such as daily weight gain, feed efficiency and health are also "quality" factors that should be included in your portfolio of information.

For example, price discrimination is increasing for Yield Grade 4 and 5 carcasses as the industry continues to emphasize red meat yield. Also, cattle producing carcasses that are too large or too small cause problems with retail portion sizes, so they are also discounted. And obviously, carcasses that grade Standard are discounted.

Fed Cattle Targets		
	Desirable	Undesirable
Carcass weight (lbs.)	650-850	<600 or >950
Quality Grade:	Select or Higher	Standard
Yield Grade	1s and 2s	4s and 5s
Ribeye area	11-16 sq. in.	<10 or >17

All cattle do not have to hit one specific target.

Genetics vs. management

Carcass traits are moderately to highly heritable. Higher heritability implies that predictable and permanent genetic change can result from selection for improved carcass traits. However, "management" influences the expression of genetic potential. And although selection can alter the genetic potential for carcass traits, management can influence expression of these traits as the calf moves from the ranch through finishing and harvest.

For instance, the genetic potential for carcass weight, red meat yield and marbling are set at conception. However, the age and weight when a beef animal is placed in a finishing program and the growth promotants used during that time can affect carcass weight. Similarly, cattle can be fed to different degrees of fatness, which affects red meat yield from the carcass.

Marbling is influenced by growth promotants, days on feed prior to harvest, health, genetics, and other factors. So, cow-calf producers determine genetic potential with their selection and breeding programs. Management of the calf from birth to harvest then influences the expression of genetic potential, but it is difficult, and in most cases impossible, to enhance desirable traits through management if cattle lack the genetic potential to do it.

Selecting breeding stock

Sire selection

With the industry's focus on carcass quality, it is easy to forget the most important characteristic of the cow herd — reproductive and production efficiency.

With the current emphasis on carcass traits, it is easy to forget that cows must match their production environment.

Emphasis should be given to sire selection because of the bull's ability to produce multiple offspring in one year. Sire selection should be based on the operation's breeding system. In a continuous system where replacement heifers are put back in the herd, balanced trait selection is important. In a terminal system (where replacement females are not saved from the herd), sires should be selected to emphasize growth and carcass characteristics. Females for terminal systems should emphasize maternal traits.

Selection emphasis for specific traits should be based upon progeny data collected by producers and the market for which cattle are targeted. If carcass traits need to be changed, information is available to help select suitable herd sires. For example, most breed associations are collecting EPDs (Expected Progeny Differences) for carcass traits, such as carcass weight, marbling, ribeye area and fat thickness.

Replacement female considerations

Although most carcass merit improvement results from sire selection, female selection and management also contribute significantly to uniformity and carcass traits in your calf crop.

Uniformity in a calf crop becomes increasingly important when you can market your calves in multiple-head lots and take advantage of higher prices that are typically paid for load lots.

Narrowing the breeding season, culling extremes in cow size and breed type, and selecting for a consistent color pattern can improve your calf-crop uniformity.

Breeding system considerations

All breeds have relative strengths and weaknesses. More rapid genetic change can be made by choosing a breed type that, in general, excels in traits of importance to an operation, as opposed to selection within a breed for the same traits. For instance, if you desire to increase the marbling ability of your calves, utilize sires from a high-marbling breed instead of searching for high-marbling sires in a breed that is not noted for marbling.

As a general rule, the following (documented) breed type characteristics allow producers to combine breeds to best suit their operation. British breeds, on average, will produce calves with a greater propensity to marble.

Brahman-influenced breeds are more heat tolerant and have greater longevity. Continental breeds produce leaner carcasses.

In much of Texas, a calf that is produced by a combination of two or three of these breed types can hit carcass and production targets. The most appropriate combinations of breed type vary across the state.

Again, as a general rule, logical breed combinations for market calves would include a minimum of 1/4 British, maximum 1/2 Continental, no more than 1/4 Brahman-influenced and no more than 1/4 Dairy. Calves with these breed specifications provide an acceptable mix of growth, muscling, and marbling. These proportions can be varied for different beef markets.

How To Hit an Example Target

Ribeye area	14 sq in
Carcass wt.	775 lb
Live Wt.	1225 lb
Fat thickness	0.4 in
Yield Grade	2.0
Quality Grade	Ch

14 in2 REA/1.8 in2 per cwt carcass = 778 lb

778 lb carcass/63.5 (Dressing Percent) = 1225 lb live wt.

FRAME SCORE		MATURE WEIGHT[1]		CH HARVEST WT.[2]		CARCASS WT.	
		Cows	Bulls	Steer	Heifer	Steer	Heifer
4	45″	1110	1775	1105	945	705	605
5	47″	1200	1920	1200	1020	762	662
6	49″	1295	2070	1295	1100	822	722
7	51″	1400	2240	1390	1190	889	789

1- Estimated @ BCS of 5. Bulls = 160% of cow weight

2 - Determined by 0.5 in. backfat.

Numbers to right of frame score are hip height (in.) for heifers @ 12 mos. of age

Injection site management

The administration of most injectable animal health products can cause tissue irritation and result in an injection site lesion. Lesion types include active fluid-filled, woody callus and discoloration.

Although the scar tissue looks like fat and can be removed by trimming, research has documented that tenderness of the surrounding muscle tissue is reduced significantly.

While the actual lesion may be small, tenderness will be affected in a 3-4-inch radius around the lesion. A single injection can negatively affect the tenderness of several retail portions. Concerns with injection site lesions are not limited to fed cattle; lesions are also a significant problem in cull bulls and cows. Annual health management programs for breeding animals expose them to numerous injections. However, proper injection site location can eliminate lesions in areas other than the neck.

Vaccine handling and administration

Illness requires treatment and increases the probability of poor performance, injection site lesions, residues and death loss. Proper handling and administration of vaccines is an integral part of a preventative herd health program. Improper storage, exposure to heat, sunlight, or freezing temperature, or improper reconstitution can compromise efficacy of the vaccine. Maintaining a high level of efficacy is critical to establishing immunity in a majority of vaccinated cattle. The success of a vaccination program also depends on having an animal capable of responding to the vaccine. Plane of nutrition, stress level, current health status, and timing of vaccination all impact the immune response of an animal.

Vaccine protection

Refrigerate vaccine and protect it from ultraviolet (UV) light until administered to an animal. Use cold packs during transport and chuteside storage of vaccine.

Never reconstitute vaccine before it is needed because mixed vaccine begins to lose effectiveness in a relatively short period of time. Reconstitute only the amount of vaccine that can be administered in less than 1 hour. On small operations, it is advisable to purchase vaccines in smaller containers (5- to 10- dose bottles) and mix as needed. Although larger-dose bottles are usually less expensive per dose, their use often results in leftover product. Partially used bottles should not be saved.

Always cool syringes before the initial draw of vaccine. Transporting syringes in the cooler while going to the working facilities will allow sufficient time for the syringe to cool. Do not leave syringes on top of working tables, barrels or tailgates while performing other processing chores at the chute. Figure 2 illustrates one method to keep syringes cool and out of direct sunlight while maintaining easy access to them. A cooler, as shown, keeps syringes from prolonged exposure to UV light throughout processing. If any delay occurs in processing, place syringes back in a cooler immediately.

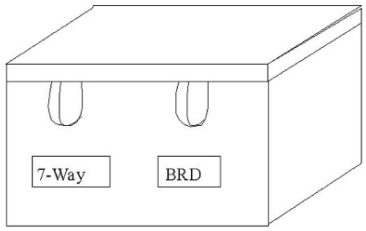
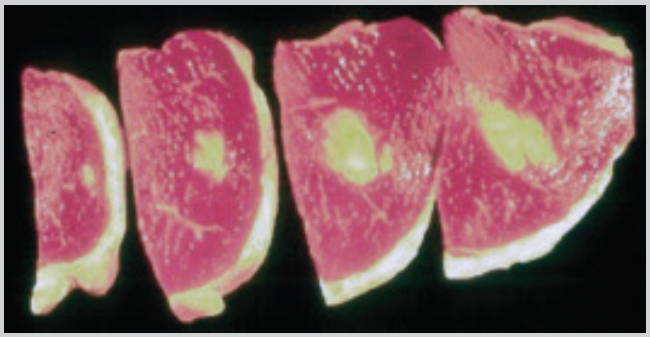


Figure 2. "Working Cooler" for holding syringes and vaccine.

Do NOT clean/disinfect syringes or needles with disinfectants. Many of these products will kill MLV vaccines and cause damage to Killed vaccines. Do NOT use products like alcohol, soap, Lysol®, Betadine®, Nolvasan® or Clorox® to clean or disinfect the syringe.

Any disinfectant other than boiling water can leave a residue in the syringe, altering the effectiveness of the vaccine. Although this contamination predominately

A lesion can impact tenderness up to 4 inches away from the injection site.



Series of woody or callus lesions

Active fluid filled lesions

Discoloration lesion

affects the first draw, it could impact the immunization of several animals.

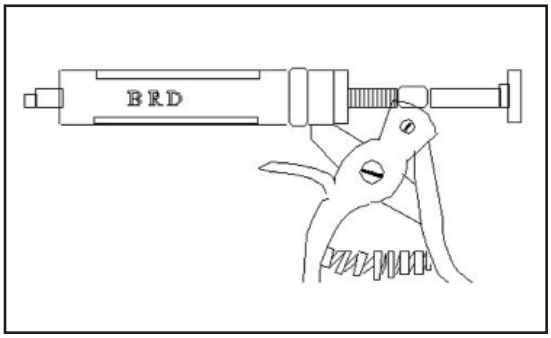
Disinfect syringe components in boiling water. Multiple-dose syringes need to be completely disassembled and cleaned after each working. After cleaning, reassemble syringes and store in a clean, dry environment until needed. If not, clean prior to next use.

Syringe selection, utilization and cleaning

Selecting the appropriate syringe is important for development of a sound vaccination program. Multiple-dose syringes, such as shown in Figure 3, or sterile, disposable syringes, are appropriate for administering vaccines.

To help prevent contamination of the remaining vaccine in your working bottle, never enter a bottle with a used needle. The needles should be changed each time the syringe is refilled. Plastic syringes are an accurate single-dose delivery system. It is best to utilize a syringe size that closely matches the dose and draw a single dose for each individual animal. Disposable syringes should not be used for multiple-dose delivery because this practice can result in inaccurate dose delivery.

Figure 3. Multiple-dose syringe



Lubricate with first vaccine draw (No petroleum-based products)

Use the first draw of vaccine to lubricate the syringe. Do not lubricate syringes with silicone, mineral oil, Vaseline® or any other lubricant. All of these lubricants may impact vaccine efficacy. If the plunger and stopper are difficult to move without lubricant, replace the syringe, or at least the stopper.

Inspect and maintain equipment

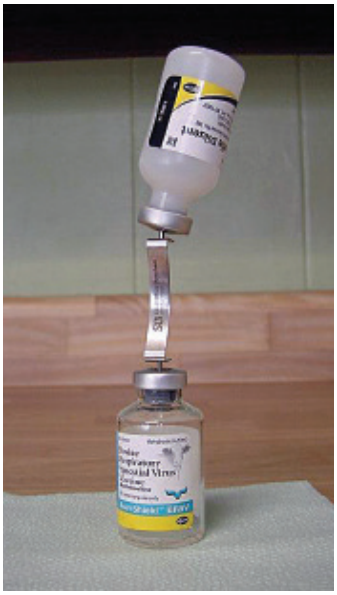
Always inspect syringes prior to processing. Check the barrels for chips or cracks that would lead to leakage and under-dosing. Check calibration and dosage setting prior to — and continuously throughout — the process. Some multi-dose syringes are not accurate enough for low-dose products.

Even slight changes in working components change dose rates. Dosage gauges on some multi-dose syringes can accidentally change volume settings, leading to under- or over-dosing. Adjust the tension on the plunger to prevent leakage. Always keep spare parts available in case something happens to the working syringe. Keep a supply of extra disposable syringes as a backup delivery system.

Adopt the practice of changing needles before filling a syringe to keep needles sharp and prevent contamination of the vaccine.

Mixing and drawing vaccines

Use a clean transfer needle when reconstituting vaccines. Transfer needles can be cleaned and reused. If a transfer needle is not available, use a clean syringe to draw the diluent out of the plastic bottle and then place it in the vial with the dry material.



When using a transfer needle, always place the transfer needle in the stopper of the plastic bottle first, then invert the needle and diluent as the other end of the transfer needle is placed in the stopper of the glass vial containing the freeze-dried fraction. After proper mixing, vaccine can be drawn from the glass vial into the dosing gun.

Label syringes and the cooler box prior to processing to prevent accidental mixing of vaccine when refilling syringes. Accidental mixing will result in under-dosing and may render one or both of the vaccines ineffective. Mixing MLV product with a Killed product destroys the MLV product immediately.

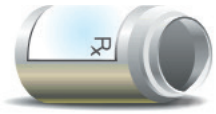
Never use one syringe to administer antibiotics or dewormers one time, and then MLV, CA or Killed products the next time. Any residue can potentially affect the product.

Read labels

Always read label and dosing instructions prior to processing to ensure proper product administration.

Revaccinate (boost) vaccines as outlined on the label. If a booster is required, one initial dose will not achieve immunity; it will only provide a brief increase in resistance. If the initial program is carried out properly, only an annual booster will be required after the first year.

Take time to become familiar with your products. Also, check for side effects and treatment should they occur.



Best Management Practices — Vaccination

1. Select the most effective vaccine for the disease(s) of concern.
2. Prevent exposure of vaccine to heat and sunlight.
3. Draw from bottle with sterile needle.
4. Use quality syringes; inspect and maintain all working components.
5. Use proper needle size.
6. Administer proper dose.
7. Administer via the recommended route (IM or SQ).
8. Administer in recommended site (neck region).
9. Change needles often.
10. Revaccinate according to label directions.

Implant utilization and recommendations

When used properly, growth-stimulating implants have been proven safe and effective through both research and actual use in the beef industry.

Always check label directions for sex, age, and weight recommendations for the use of specific implants.

Research has shown that there are no benefits to implanting heifers to be kept as replacements. However, there are no detrimental effects of implanting replacement heifers with a single calfhood implant after 60 days of age and before they are 6 months old.

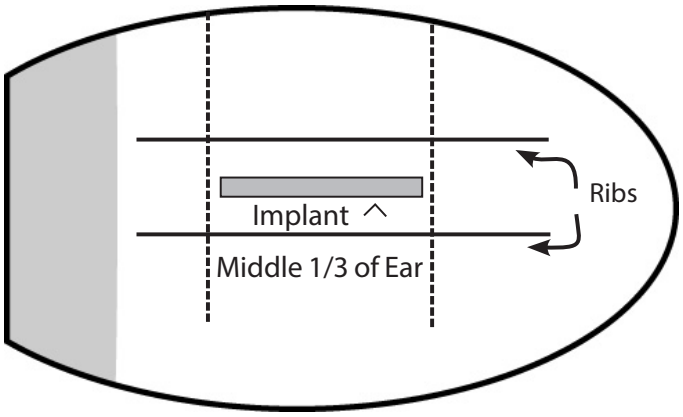
Implants are placed under the skin on the back of the ear (see Figure 4 for proper implant placement). The full benefit cannot be realized if the implant is administered improperly.

The implant needle should be disinfected between animals. Sanitation is important for product effectiveness.

Potential causes of implant failures:

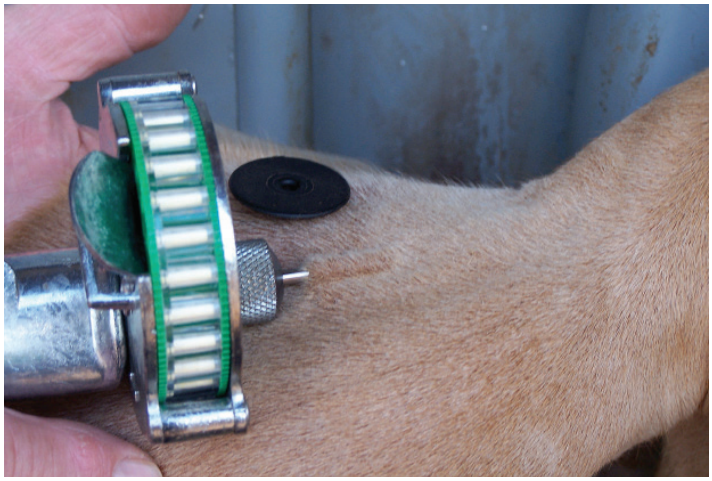
- Improper site (in the cartilage)
- Abscess due to poor sanitation
- Missing implant (through the ear)
- Partial implant due to technique or implant gun failure
- Bunched or crushed pellets
- Improper implant storage

Figure 4.



Best Management Practices — Implant Use

1. Review all instructions carefully before implanting.
2. Properly restrain the animal. If proper restraint is not possible with head gate, use a halter.
3. Select the proper implant site. Place the implant between the skin and cartilage on the back of the ear.
4. Clean the needle with a disinfectant. Use only sharp needles; burrs increase the chance of tissue trauma and infection.
5. Utilize disinfectant to clean the implant site when the site is contaminated with feces, urine, or mud. Contamination increases the chance of abscessed implant sites.
6. When possible, implant all calves in the same ear to minimize confusion. Avoid placing implants in the same ear used for ear tags, tattoos, or ear notching.
7. Palpate the ear to determine if the implant was inserted properly.
8. Never sacrifice careful implantation technique for speed.
9. Proper training is essential.
10. Record the date and type (brand name) of implant administered.



Parasite management

Internal parasites, such as stomach worms, can cause extensive damage to the digestive tract of cattle. The damage can result in impaired digestive function and suppressed absorption of nutrients, leading to deficiencies in energy and protein. Nutrient deficiencies can lead to suppression of the immune system, resulting in poor animal performance and health.

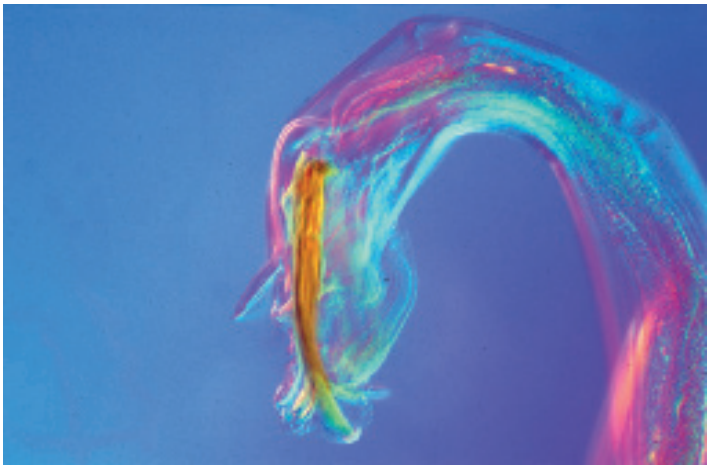
Liver flukes are another internal parasite in Texas. In general, infection is limited to cattle produced in areas where it is common to have standing water, such as river bottom pastures and alkaline soils. Additionally, the presence of an aquatic snail is necessary to serve as the intermediary host for the liver fluke.

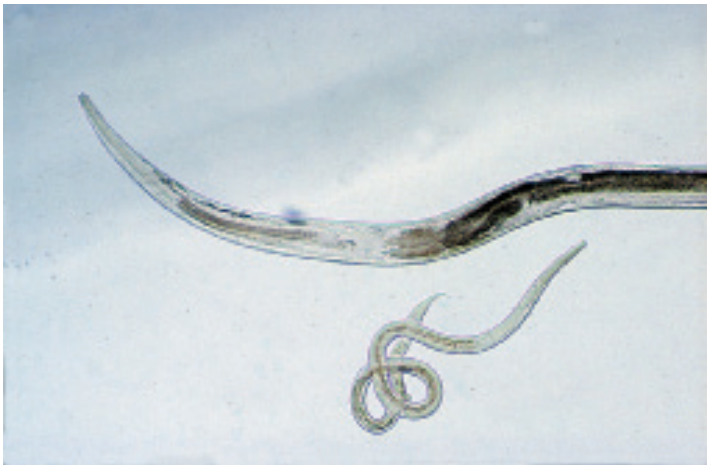
Many of the major river/flood areas in the southeastern United States are habitat for such snails, and pastures adjacent to these waters are sources of potential infection. A large number of the stocker and feeder cattle managed in Texas originate from fluke-infected areas. A liver fluke infection can reduce animal performance and cause liver condemnation in fed cattle, cull cows and bulls.

External parasites, such as the horn fly and heel fly, are pests that can impact performance and hide quality. Horn fly irritation reduces gains in calves and yearlings and body condition in cows. Horn flies are biting insects that not only affect performance but can also reduce hide quality due to scar tissue on the surface of the skin.

Heel flies also cause annoyance during the spring fly season. Heel fly eggs laid on lower legs of cattle hatch into larvae that burrow through the skin. Larvae then migrate through the body and, ultimately, become encapsulated just beneath the hide, along the back.

The larvae cause tissue damage, resulting in trim loss and reduced carcass value. The holes in the hides eventually heal, but the scar tissue devalues the hide. Treating cattle one to two months after heel fly activity ceases can control larvae from heel flies.





Ostertagia ostertagi can make for a pretty picture under a microscope. However, the damage this parasite can cause to your cattle gets ugly before you can see the outward signs. The photo at right shows how the worm can grow inside of a cow's gastric gland between day 3 and day ± 15. Photos provided by Dr. Tom Craig, Department of Veterinary Pathobiology, Texas A&M University.

Nutritional Management

Nutrition is a broad category involving management of energy, protein, vitamins, minerals, and water. Nutritional status of the cow herd has a direct impact on production efficiency, immunity, and carcass characteristics of calves.

General health and immune system function

Proper nutritional management includes utilizing Body Condition Scores (BCS) to monitor nutritional status. Target a BCS 5 or higher at calving for optimum production and for cow and calf health. Cows calving below a BCS 5 produce less volume of colostrum, lower-quality colostrum, and decreased milk production.

Additionally, calves born to cows in a BCS less than 5 are slower to stand and nurse and are more susceptible to cold stress. This results in decreased colostrum consumption, reduced antibody absorption, and reduced passive immunity. For maximum passive transfer, calves should nurse within four hours. Although some absorption can occur during the first 24 hours, efficiency of antibody absorption decreases after the first two hours.

Lower body condition will affect passive transfer, resulting in lower maternal antibody protection and decreased neonatal calf resistance to disease. Calves born to thin cows have increased susceptibility to calf scours and lower stores of brown adipose tissue, resulting in higher morbidity and mortality during the first two weeks of life. Immunocompromised calves have an increased risk of sickness when exposed to stress and pathogens throughout their life.

Nutritional stress can and will mask the expression of

immunity in cattle exposed to infectious pathogens. The most critical nutritional consideration is the protein and energy balance. When adequate protein and energy are available, digestion is enhanced, and mineral digestion and absorption is adequate in most instances. Adequate levels of most B vitamins are synthesized when microbial activity is high.

Deficiencies in protein intake affect total forage intake, energy digestion, microbial protein synthesis and vitamin synthesis by rumen microflora. It is important to stress that protein and energy requirements must be met before the impact of minerals or vitamins can be determined.

Minerals are necessary for microbial synthesis of protein and energy, maintenance of forage digestibility and electrolyte fluid balance in the animal. Minerals also play an important role in metabolic pathways and immune system function. Imbalances in mineral intake interfere with the development and function of the immune system, even when adequate levels of protein and energy are supplied.

Trace minerals are known to be involved in immune function. Producers cannot afford to wait until clinical symptoms are expressed before initiating changes in nutritional management.

Vitamins that appear to be the most critical in immune system function are vitamin A (beta-carotene) and vitamin E. Selenium and vitamin E function as antioxidants and reduce the accumulation of compounds produced as cells in the immune system response to invasive organisms.

Weaning nutritional management

Stress suppresses the immune system. Removal from the cow, introduction to a new environment, and commingling with cattle of different origins are all stressful events for a calf.

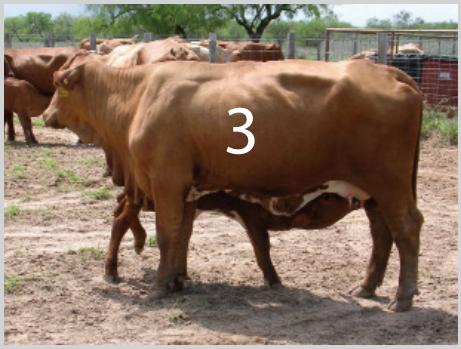
This stress is accompanied by reduced feed and water intake and exposure to pathogens. These stressors can result in a high percentage of freshly weaned calves requiring treatment for respiratory disease. These problems can be managed if calves are weaned and held at the ranch for a minimum of 45 days.

Ranch-to-Rail and other steer feed-out programs have documented that calves requiring treatment not only have higher medical costs, but also reduced performance, increased death loss and decreased carcass quality (See Table 2).

In an effort to enhance immunity, and thereby performance, of stocker and feeder cattle, vaccination and nutritional management programs were designed for weaning programs on the ranch. Preconditioning programs with a 45-day post-weaning period have been accepted by the industry to improve animal performance, health, and carcass quality.

Preconditioning can mean many different things to different people. It is important that everyone has the same program in mind as this topic is addressed.

Preconditioning is the process by which calves are weaned and "conditioned" before moving them to grass or a backgrounding yard for growing or sending them



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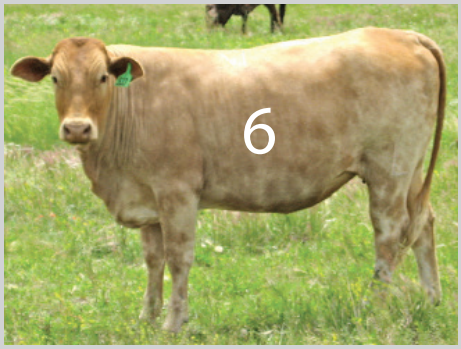

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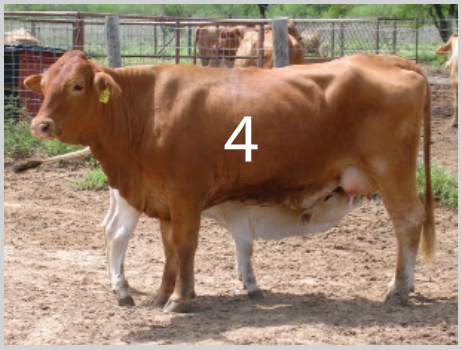

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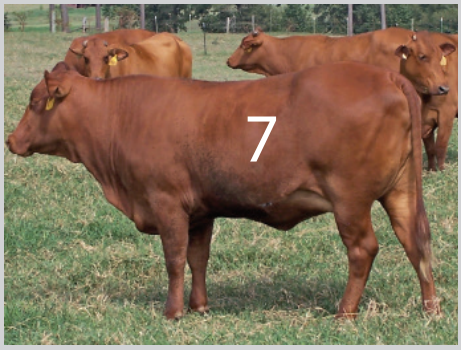

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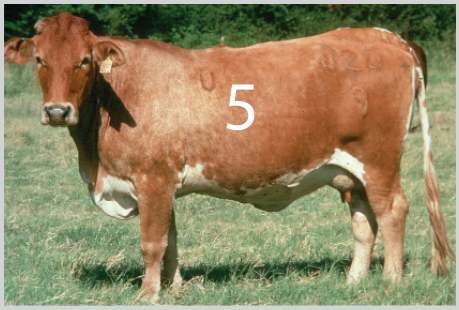
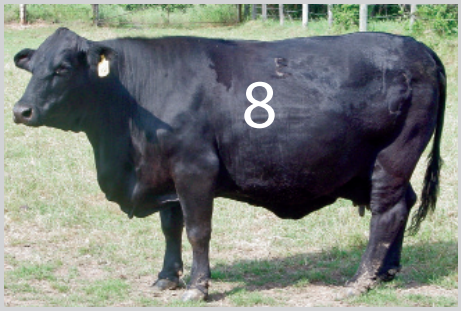


Condition score 5



Condition score 8

straight to a feedyard for finishing. Preconditioning can be done at the ranch or at preconditioning facilities that specialize in managing fresh-weaned calves. We will focus on the preconditioning of weaned calves before they leave the ranch of origin.

The preconditioning process improves the likelihood that a calf can deal with future stressors and exposure to pathogens without health complications. Bridging the management gap from suckling calf to weaned calf is not that difficult when it is done at the ranch. It involves enhancing and managing the immune system, controlling stress, and preventing overexposure to pathogens during this brief period of time.

Calves that have fewer health problems after they leave the ranch will (1) require less medication, which reduces costs but also lowers the potential for injection site lesions and residues; (2) suffer less death loss; (3) perform more efficiently; and (4) potentially have higher-valued carcasses.

So, preconditioning is a value-added management practice. In the past, it has been difficult for a calf producer to realize the added value in the preconditioned calves they have sold. There are opportunities through both direct sales and auction markets for calf producers to market preconditioned calves. The following are just a few of the things to consider about preconditioning calves.

It is not uncommon for 25 to 50 percent of non-preconditioned weaned calves to require treatment.

Plan ahead

Locating markets, allocating pasture, shopping for feed and health products, scheduling other farm and ranch activities, and finally the preconditioning process itself, takes time. So, allow adequate time to plan, evaluate and implement your program.

Identify your market

Producers often fall short with their marketing efforts. A key to realizing the added value is finding the outlets that have buyers seeking preconditioned calves and pursuing those markets. These may be auction venues or direct sales to buyers. This effort must start well in advance of the time calves are weaned.

What does the market require?

Once market outlets have been identified, determine the buyers' expectations in those outlets. These may include specifications for vaccination, parasite control practices, nutritional management, number of days weaned, weight, cattle type, and individual animal identification. Know what is expected and plan to deliver.

Evaluate the economics

Just because it seems easy to do and it is beneficial to the calves and the industry, that does not mean preconditioning will automatically be profitable to your ranch. If cattle are being prepared for retained ownership, then preconditioning should be considered.

However, if cattle are being preconditioned for sale, the economics must be carefully considered. The ranch

Table 2. Ranch to Rail Cattle - Healthy vs. Sick

Year	92-93		93-94		94-95		95-96		96-97		97-98		98-99	
	Sick	Healthy	Sick	Healthy	Sick	Healthy	Sick	Healthy	Sick	Healthy	Sick	Healthy	Sick	Healthy
# head	347	1235	1133	2155	667	2206	857	2017	298	1774	507	1394	159	978
Death loss	2.9%	0.5%	2.2%	0.8%	1.7%	0.5%	3.5%	0.3%	7.7%	0.6%	4%	0.6%	5.7%	1.8%
ADG (lbs)	2.68	2.88	2.69	2.9	2.99	3.02	2.91	3.01	2.4	2.96	2.54	2.84	2.64	3.07
Medicine	$27.36	0	$37.9	0	$20.76	0	$34.05	0	$23.36	0	$22.73	0	$21.39	0
Quality Grade														
Choice +	28%	40%	19%	26%	33%	39%	32%	38%	26%	40%	23%	42%	24%	41%
Select	70%	55%	73%	67%	63%	59%	56%	54%	60%	55%	60%	51%	65%	54%
Standard	2%	4%	8%	7%	4%	2%	12%	8%	14%	5%	17%	7%	11%	5%
Value Difference* $/cwt (arrival)	$16.00		$15.70		$8.65		$10.33		$19.87		$10.58		$13.42	
Avg. Profit/Loss	$155.56		($27.47)		$64.66		($28.32)		$96.28		($54.44)		$71.10	

*Difference in net return + medicine divided by initial weight
15,727 calves involved in the TAMU Ranch to Rail program

should be ready and willing to retain ownership in the cattle if they cannot receive adequate compensation for their preconditioning efforts. Likewise, suffering a loss at the end of preconditioning might be the best alternative if retained ownership does not appear to be profitable.

Feed and opportunity costs account for the larger part of the preconditioning costs.

Identify your costs

It is critical for producers to take time to evaluate the costs of preconditioning. Many producers fail to adequately project the costs of a program and then are disappointed when they do not recoup their costs at marketing. Buyers' requirements dictate a portion of the costs. Feed (purchased feed, raised feed and grazing) and opportunity costs account for the larger part of the preconditioning costs.

Be certain to charge interest against the value of the calves the day they are weaned. If you borrow operating money, this interest is the cost of not paying down the loan when the calves were weaned. If you do not borrow operating money, the interest represents income you could have realized by putting the money in savings.

If you graze your own pasture, charge the preconditioning program a reasonable rate for use of the pasture. Some may question this expense; but this ensures that money is being set aside to pay land rent or payments. If your stocking rate has to be lowered to support preconditioning, it will add expense to the enterprise.

If the land is owned and debt-free, this charge represents income for the ranch enterprise. If the preconditioning program breaks even, the ranch still pockets some income. Some may prefer to leave this cost in the cow herd expenses. Likewise, account for use of equipment and facilities, fuel, labor, utilities, and other costs.

One simple accounting method is to assign a daily yardage charge for each calf in the program. Again, some may question this expense and prefer to allocate the expense to the cow herd. Do not forget to add in marketing costs like commissions, freight, and other expenses, as well.

What will the preconditioned calves be worth?

In order to evaluate a preconditioning program, it will be necessary to project the weight and sale price of the calves at the end of the preconditioning program. Many producers are concerned with the premiums they will receive for their preconditioned calves. This is a factor to consider, but an equally important consideration is seasonal market fluctuation. Does the market typically go up or down during the period of time the calves are being preconditioned?

The difference between the calf's value the day it is weaned and at the end of the preconditioning period is the money available to pay for the preconditioning program and provide some extra income to the ranch. Projecting this margin allows you to determine if the program is feasible.

Control your costs

Shop for animal health products. Check with the market outlets to see if they have purchase arrangements for the required products. As mentioned, feed is one of the major costs of preconditioning. So, it is important to utilize on-site forage and feed resources as much as possible.

This means utilizing excess forage and feed resources to add value to calves. If pastures can be managed to provide good-quality forage to weaned calves, then preconditioning becomes a viable option. Quality can be supplemented, but quantity of available feed resources is important to the success of your program.

Although it will vary from region to region, the most economical way to manage calves during the preconditioning period will involve forage and supplement. In some areas, raw feed commodities and by-products are relatively inexpensive and fit well in a preconditioning program.

In other areas, manufactured feeds are the only option and a relatively higher cost. If harvest forage has to be purchased for feeding any time other than the first five days post-weaning, carefully evaluate the profit potential. Minimize feed purchases and scrutinize the cost of these purchases closely.

The objective of preconditioning is not to get cattle on feed; it is to prepare them for the stresses to come. There are some real economic limitations as to the amount of feed that can be purchased and fed to ranch-weaned calves. Weaning on the ranch is different from preconditioning purchased and stressed calves in a preconditioning yard. If forage resources are managed properly, ranch calves will not need mixed feed to maintain a positive plane of nutrition or to maintain their health.

Use Best Management Practices and do not cut corners

Always follow Beef Quality Assurance guidelines. Do not cut corners on the nutrition and health programs or

In order to evaluate a preconditioning program, it will be necessary to project the weight and sale price of the calves at the end of the preconditioning program.

the calves may still have problems once they leave the ranch. This will reflect badly on the ranch and the whole concept of preconditioning.

Preconditioning has routinely been done over a period of 14 to 45 days. There are instances where shorter programs may work effectively but keeping the calves for 45 days offers additional opportunities for weight gain and immune response.

Do not expect too much from the calves

Be realistic in estimating the performance of your calves during preconditioning. Weight change can vary from a loss to gains of more than 2 lbs./day, depending on feed resources and how the calves respond to weaning. In most preconditioning programs, achieving an average daily gain of 1 to 1.5 pounds per day during the 45 days will be optimum.

This rate of gain can be achieved economically with a wide range of nutritional programs. Higher rates of gain can be achieved but the cost of gain may not be economical. If calves are contracted, calculate the desired rate of gain to meet the target and always make sure the target is realistic.

Maximize immune response

Strengthen passive transfer and antibody response in the calf through supplementation of the cow in late gestation and early lactation. Passive transfer can also be enhanced through proper vaccination programs targeted at the cow in late gestation. Develop your heifers, stockers and/or feeders by maintaining a positive plane of nutrition throughout the weaning and growing phases.

Maximum immune response will be achieved when proper vaccinations are administered in conjunction with proper nutritional management. Nutrition is not what makes the immune system work but deficiencies can prevent the immune system from working properly.

Market Cow and Bull Management

Regardless of herd size, all beef cow operations produce some market animals (i.e. cull cows and bulls). Many times, these are older cows past their prime producing years. Other market cows may result from failure to reproduce in a given breeding season. Market cows and bulls represent 15-20% of a cow-calf producers' cash flow. With proper management and timely marketing, the value of market cows and bulls can be increased.

Market cows and bulls (non-fed beef and dairy) supply between 15% and 20% (depending on market conditions) of total U.S. beef production. Most producers assume that the major product from market cattle is ground beef merchandised through fast-food restaurants.

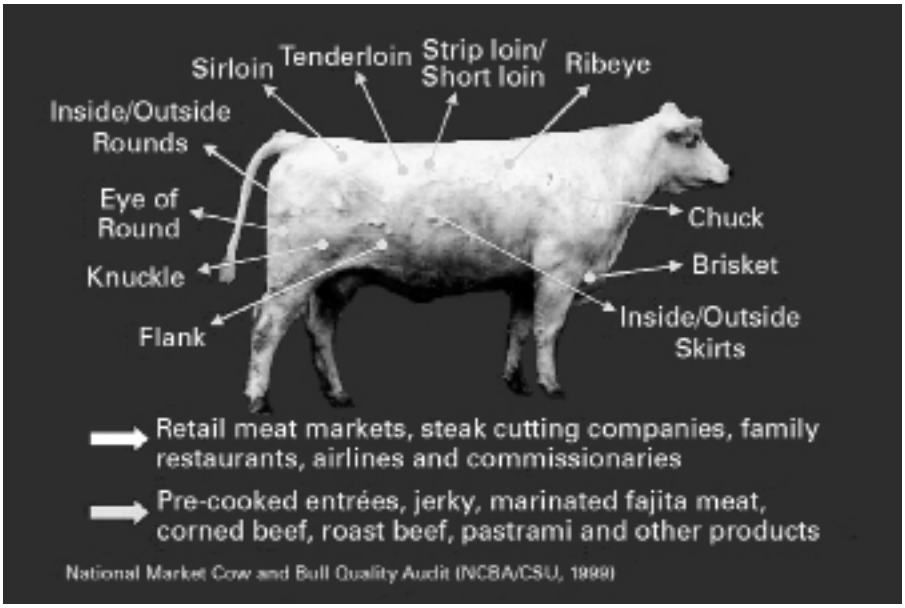
While ground beef is a very important product of market cattle, it is only one of many beef products from market animals. Cow packers utilize tenderloins, ribeyes and strip loins, particularly from younger cows. These cuts are merchandised as lower-priced steaks.

The outside round is often pressed into deli-style meats and inside rounds are routinely used for beef jerky. Many of the individual muscles are utilized for specific manufactured products.

Not all market cows and bulls are suitable for processing into higher-value products. Some are condemned, resulting in losses to the industry that are ultimately passed back to the producer. Quality defects and sources of condemnation in mature cows and bulls include things like inadequate muscling, excessive fat trim, lightweight or heavyweight carcasses, lameness, "cancer eye" and "downer" animals.

In 1994, the National Cattlemen's Association (now NCBA) conducted a study to look at quality shortcomings in market cows and bulls. This study was repeated in 1999 and, most recently, in 2007.

Table 3 summarizes some of the quality defects and the potential number of cattle that would be affected based on the 2007 slaughter figures. The 2007 Non-Fed Quality Audit revealed that 97% of market cows



Transportation Traits and Quality Defects

2007 National Market Cow and Bull Beef Quality Audit — Table 3

Quality Consideration	Category	Cattle Group	Incidence Rate	Head Affected
Transportation	Avg Distance Traveled, Miles	All Loads	289	
	Maximum Distance Traveled, Miles		1,250	
	Mix Grnder Loads not separated, %		11.60	
Brands	Brands, %	Beef Cows	31.1	1,034,075
		Beef Bulls	37.6	160,796
Horns	Horns, %	Beef Cows	19.2	638,400
		Beef Bulls	20.7	88,524
Cancer Eye	Advanced (3 or greater), %	Beef Cows	1.3	43,225
		Beef Bulls	0.6	2,566
Lameness	Moderately Lame or Greater, %	Beef Cows	3.6	119,700
		Beef Bulls	15.4	65,858
Body Condition Score	Too Thin BCS 1 or 2, %	Beef Cows	10	332,500
		Beef Bulls	2.1	8,981
	Too Fat BCS 8 or 9, %	Beef Cows	4.2	139,650
		Beef Bulls	3.3	14,112
Udder	Teat and Mammary Defects	Beef Cows	10.5	349,125
Bruise	At least One Bruise, %	Beef Cows	65.8	2,187,850
		Beef Bulls	50.8	217,246
Arthritic joints		Beef Cows	4.6	152,950
		Beef Bulls	8.7	37,206
Liver	Condemnation, %	Beef Cows	48.7	1,619,275
		Beef Bulls	32.3	138,131
Carcass Condemnation	Antemortem and Postmortem %	All Cattle	1.1	73,816
Dental Defect	Gummer (Old Cattle), %	Beef Cows	17.1	568,575
		Beef Bulls	6.3	26,942
Injection site lesion defects	Active lesions	Beef Cattle	4.1	153,867
Sirloin Cap	Woody callus	Beef Cattle	2.3	86,316
	Fibrous scarc	Beef Cattle	2.4	90,068
Injection site lesion defects	Active lesions	Beef Cattle	0.6	22,517
Sirloin Center-cut	Woody callus	Beef Cattle	0.1	3,753
	Fibrous scarc	Beef Cattle	0.4	15,011
Injection site lesion defects	Active lesions	Beef Cattle	9.6	360,274
Outside Round	Woody callus	Beef Cattle	2	75,057
	Fibrous scarc	Beef Cattle	2.3	86,316

Head Affected - According to the USDA-NASS Livestock Slaughter 2009 Summary the following number of Market Cows and Bulls were harvested in 2009

2009 Beef Cows	3,325,000	
	Dairy Cows	2,815,300
	Bulls	570,200
	Total	6,710,500

In the 2007 Audit approximately 75% of the bulls were beef bulls and 25% of the bulls were dairy bulls

Assume 75% Bulls Beef	
Beef Bulls	427,650

and bulls have clear eyes; 96% are sound or have only minor structural problems; and 86% of beef cows had a Body Condition Score between 3 and 7.

In general, producers do a fair job of managing and marketing surplus animals. But the 2007 audit also identified specific areas where the quality of market cows and bulls could be improved. Realizing that some of these defects are impossible to avoid completely, producers should pay close attention to marketing in order to return maximum value from their cull livestock.

Cancer eye

Cancer eye cannot always be avoided but proper marketing avoids loss of value. The 2007 audit revealed that 1.3% of beef cows and 0.6% of beef bulls had advanced stages of cancer eye. Cows with advanced stages of cancer eye are a primary cause of whole carcass condemnation. As such, packers are unwilling to purchase these cows at times. When cancer eye is detected, the eye should be surgically removed by a veterinarian, or the animal should be marketed as quickly as possible.

Horns

Horns were identified as a quality defect in the 2007 audit for two reasons: horns are a major cause of carcass bruising, and horns must be removed prior to the removal of the hide. This leaves the sinus cavities exposed to hair or foreign material contamination. If the inspector suspects contamination of the sinus cavities, the head must be condemned, resulting in a loss of value.

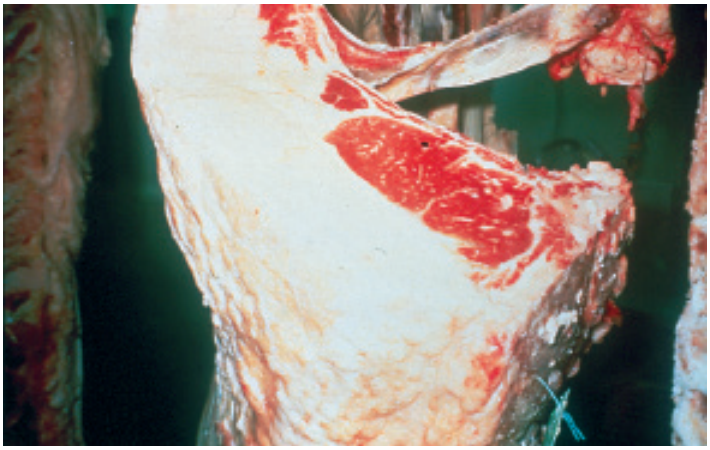
Dehorning cattle when they are young is a good animal husbandry practice that should be routine on all operations.

Brands

Brands continue to be a quality concern relating to hide value of market animals. Branding is the only permanent, easily readable means of identification that is currently available. Placement of the brand is an important decision that affects hide value. When considering placement of brands, the optimum place is high up on the hip, close to the tail head.

Lameness

Lame and disabled cattle are a perception problem for the industry. The 2007 audit showed that 30% of all market cows and bulls had signs of lameness; 4% of all cattle received scores of 4 and 5, classifying these cattle as very disabled. Some of these problems are unavoidable, particularly with bulls. However, many problems with lame cattle are easily avoidable if producers will market animals before they age excessively and develop feet and leg problems.



The audit results projected that 139,650 head (4.2%) of beef cows were overly fat, producing carcasses like the one shown here with 2.0 inches of external fat. On the other hand, 332,500 head (10%) of beef cows were too thin, generating poor meat yield relative to pounds of product. Cattle exhibiting an arthritic or stifled condition are a major concern to the packer. Estimates show that 152,950 beef cows and 37,206 beef bulls were affected by one or more arthritic joints in 2007.

The packer is required to remove all tissue associated with an arthritic joint. In the 1999 audit, 11% of market cows and bulls had at least one arthritic joint removed; this was improved to 6% in 2007, indicating that producers have done a better job of marketing cattle in a timely manner.

Inadequate muscling/excessive fat

Lean beef products are the principal end products of market cattle. It is important that market cows and bulls have adequate muscling without excessive amounts of fat. The 2007 audit suggested that 21% of beef cows had inadequate muscling. Poor muscling is often a result of emaciation. As Body Condition Score drops below 5 (on a scale of 1 to 9), losses are comprised of both lean and fat.

The 2007 audit revealed that more than 51.1% of beef cows were at or below a BCS 4, suggesting that some of the "inadequate muscling" was actually due to thin condition. Extremely thin cows (BCS 1 to 2) accounted for 10% of beef cows surveyed. These cows produce a product that is greater than 90% lean, but their lean yield is extremely low, which limits the salvage potential.

Emaciated cows are also more prone to bruising because they have no fat to serve as padding, and they are more likely to be disabled upon arrival at the packing plant. Thin cows will not make a long trip prior to harvest. Consequently, the number of buyers for emaciated cattle is limited.

At the other extreme, excessively fat cows (BCS 8 to 9) are also a problem. These cows often yield cuts that can be salvaged and merchandised for a higher value (strips, ribs, tenderloins), but there is an excessive amount of waste fat. The 2007 audit revealed that 4.2% of beef cows were excessively fat.

The ideal condition to merchandise market cows would be somewhere between BCS 4 and 5. And because these cows have optimal red meat yield, they usually bring the highest price per pound at the auction market.

Bruising

The 2007 audit found fewer carcasses with bruises than in the 1994 and 1999 audits. However, 65.8% of beef cows and 50% of beef bulls exhibited at least one bruise. These bruises must be trimmed from the carcass, resulting in millions of pounds of product loss annually.

Unfortunately, the bruises do not just occur on the lower-valued portions of the carcass. The 2007 audit revealed that 14% of bruises were observed in the round and 7% in the loin of beef cow carcasses.

Handling practices at the ranch are important in minimizing bruises. An estimated one-third of bruises occur on the ranch, and the other two-thirds occur in transport and marketing. Close scrutiny of handling facilities to eliminate sharp, protruding corners and employee training can help reduce bruising. Producers should also merchandise market cattle before they become emaciated and are more susceptible to bruises.

Best Management Practices - Culling Management

1. Merchandise market cows and bulls in a timely manner to reduce quality defects.
2. Be certain that ALL animals shipped to market have cleared proper withdrawal times.
3. Do not merchandise market animals that have a terminal condition.
4. Do not send market animals to auction that are disabled.
5. Merchandise market cows and bulls BEFORE they become severely emaciated.
6. Do not merchandise animals with advanced eye lesions.

Beef quality and consistency begins on the ranch. Everyone involved in the production system, from the producer to the packer, bears a responsibility for ensuring that market bulls and cows are not handled in a rough manner on trucks, at auction markets and in other sales facilities, as well as in packing plant premises.

ENVIRONMENTAL QUALITY CONTROL POINTS

Beef cattle production in Texas depends upon our state's bountiful natural resources. Caring for these resources ensures that cattle production is ecologically and socially sustainable. Natural resources must be monitored to learn whether or not current management needs to be adjusted.

Information collected from natural resource monitoring will usually identify problems before damage occurs, thus allowing time for preventative measures to be put in place. Monitoring information may also confirm that current management practices are appropriate. That information can then be used to defend current management when questioned by critics.

The most important resources for ranchers to manage are vegetation and streambanks/riparian area soil and water quality. Each of these areas has specific environmental control points that can be managed and monitored.

Management Approaches for Environmental Control Points

Environmental concerns fall under these five areas:

1. Forage management
   a. Stocking rate
      i. Forage conservation
      ii. Water quality and conservation
      iii. Soil conservation/erosion
   b. Grazing management
2. Soil fertility
3. Pesticide use
   a) Safe application of pesticides
   b) Safe storage of pesticides
   c) Safe disposal of pesticides and containers
4. Water Quality
5. Dead animal disposal

Forage Management

Cattle have been produced for centuries around the world. This fact alone demonstrates that cattle can be produced in an environmentally sound and sustainable manner. Both rangeland and introduced pastures are utilized in cattle production systems.

Generally speaking, management strategies are different between the two systems due to environment, soil type, topography, and the fact that fertilizer is a common input associated with introduced forage production systems. Rangelands are natural systems managed by ecological principles. Other systems can be made up of introduced forage species. These are usually managed according to agronomic principles with cultural inputs.

While abuses have occurred in the past that degraded both forage and soil resources, current Best Management Practices seek to optimize animal production in a manner that protects and/or enhances the environment.

Adequate, permanent ground cover, maintained by appropriate stocking rates and fertility programs on

Process	Control Point	Potential Environmental Concerns
Forage management	Stocking rate	Deteriorating range/pasture Riparian areas Water quality Air quality Soil erosion
Soil fertility	Fertilizer application Animal waste application	Water quality Transfer of disease
Pasture chemical use	Herbicide application Pesticide application Container disposal	Water quality Soil contamination
Disposal of dead animals	Composting Burial Burning	Water quality Air quality Transfer of disease

introduced forage species, is essential. The results are higher soil organic matter content, better soil structure, and a barrier that prevents detachment of the soil and capture and infiltration of rainfall.

Roots also act as binding agents that reduce the potential for soil detachment. Properly stocked rangeland and properly stocked and/or fertilized introduced forage pastures contain higher root numbers, which help maintain or enhance site integrity. Thus, a vigorous stand of permanent ground cover stabilizes and maintains site integrity and improves air quality.

Photo by Russell Graves

The following brief discussion illustrates those aspects of forage management and production that can have the greatest negative impact on the environment, as well as Best Management Practices for minimizing those impacts.

Stocking Rate: the number of acres required per animal unit for the grazing season that can be sustained on a long-term basis without forage resource degradation.

Stocking rate

Stocking rate is defined as the relationship between the number of animals and the grazing management unit utilized over a specified time period. Stated more simply, it is the number of acres required per animal unit for the grazing season that can be sustained on a long-term basis without forage resource degradation.

A useful term in helping to define stocking rates based on forage demand is the animal unit. An animal unit is a 1,000-pound cow and calf with an average dry matter forage requirement of 26 pounds per day through the production cycle.

Of all the aspects associated with forage-based livestock production (under the control of the manager), stocking rate is the most important. Using appropriate

stocking rates for the system being managed is related to the following aspects of environmental quality.

Forage conservation

Excessive stocking rate results in unsustainable grazing pressure on forage resources. On either rangeland or introduced forage pastures, heavy grazing pressure on desirable plants reduces animal performance but more importantly, it decreases forage plant vigor.

A reduction in plant vigor reduces frequency and abundance of desirable plants. Plant species composition shifts with an invasion of less desirable or unpalatable species. Overgrazing results in range degradation and change in species composition, which can last for decades or longer.

Under these conditions, carrying capacity is diminished, animal performance is reduced and the potential for profit is reduced. Input costs (such as increased herbicide use and increased feeding costs) associated with the livestock production enterprise are increased.

Water quality and conservation

As a result of overstocking, permanent ground cover is reduced. On properly stocked pastures, healthy stands of forage significantly reduce runoff, allowing water to infiltrate the soil for use by plants or for recharge of groundwater aquifers.

On overstocked sites, there is little forage to impede runoff of precipitation. Subsequently, much of the precipitation is lost from the site, thus reducing forage production potential. Overstocked pastures can also experience soil compaction of more clay-type soils. This can lead to further reduction in infiltration rates and increased runoff.

Runoff of sediment from overstocked pastures

On properly stocked pastures, healthy stands of forage significantly reduce runoff, allowing water to infiltrate the soil for use by plants or for recharge of groundwater aquifers.

Animal Unit Equivalency Table

Kind and class of livestock	Approximate animal unit equivalent*
(1,000-lb) Cow with calf	1.0
(1,000-lb) Dry cow	0.77
(600- to 900-lb) Heifer	0.6 - 0.8
(1,500-lb) Bull	1.2 - 1.4
(800-lb yearling) Horse	0.75
(1,000-lb 2-yr.-old) Horse	1.0
(1,100-lb 3-yr.-old and older) Horse	1.25
(130-lb) Ewe	0.20
(75-lb) Weaned lamb	0.12
(175-lb) Ram	0.25
(70-lb) Nanny	0.17
(35-lb) Weaned kid	0.10
(125-lb) Billy	0.25
Whitetail deer	0.17
Mule deer	0.25

*Animal unit equivalents will vary significantly depending on the weight and physiological stage of the animal.

From the Rancher's Reference Guide at www.texnat.tamu.edu.

decreases water quality and reduces the capacity of surface water storage reservoirs. The use of proper stocking rates on rangeland and the use of appropriate stocking and fertility programs in introduced forage pastures helps to maintain adequate, permanent ground cover and reduces erosion potential. This serves to maintain water quality and reservoir capacity.

Soil conservation

Loss of topsoil, either as a result of rain or wind, is known as erosion. Bare soil exposed to raindrop impact (splash) dislodges topsoil particles, which are lost from the site as sediment trapped in the runoff. In other words, the more bare soil you have, the larger the impact of the "splash" and the more erosion your land will experience.

Likewise, bare soil exposed to wind reduces air quality as soil particles are detached and transported away by wind currents. Topsoil forms at extremely slow rates, often requiring hundreds of years. Thus, the loss of topsoil due to erosion can affect site productivity for several generations. Additionally, important soil nutrients, such as nitrogen, phosphorus, and potassium, are also removed.

Grazing management

Profitable beef cattle ranches in Texas depend upon healthy, productive, grazing lands. Well-managed grazing is compatible with a healthy environment; but improper grazing can increase soil erosion, encourage weeds, degrade water quality, and decrease plant yield and diversity.

Whether environmental impacts from cattle grazing are beneficial, harmful, or benign depends entirely upon how the grazing is managed: its timing (when grazing occurs), frequency (how often grazing occurs), and stocking rate (how much vegetation is removed).

Every grazing land situation is unique, so every grazing management plan should be site-specific. The following guidelines are starting points for developing grazing plans that will sustain the plant and water resources of Texas.

Best Management Practices — Grazing

1. More pastures and smaller pastures increase management flexibility and provide greater opportunity to control the timing, frequency, and intensity of grazing.
2. Sustainable levels of grass utilization depend upon when and how often grazing in relation to opportunity for regrowth occurs. Rotational grazing systems allow increased utilization.

	Proper Use
Season-long grazing	40-50%
Deferred rotation	55-60%
Rest rotation	65-70%

3. An adequate stubble height (3 to 12 inches depending on forage species) at the end of the growing season is necessary to sustain most grasses.
4. When more leaf area remains after grazing, plants recover faster and produce more forage the following growing season.
5. Grazing an area more often and for shorter periods (i.e. 3 weeks at a time or less) is preferable to fewer and longer grazing periods.
6. When environmental damage from cattle grazing occurs, it is often a result of poor cattle distribution or too many animals.
7. Prevent cattle from congregating near water. Fencing, alternative water sources, supplemental feeding and salt and mineral placement can promote dispersion of cattle away from water sources.

Every grazing land situation is unique, so every grazing management plan should be site-specific.

Soil Fertility

Many forage species used in livestock production systems are introduced from other parts of the world and have been selected for improvements in dry matter production, tolerance to grazing, cold tolerance, drought tolerance, insect and/or disease tolerance, etc.

Generally speaking, these introduced forage species offer these improved characteristics only when fertilized appropriately. Fertilizers can be expensive production system inputs and can prove to be water pollutants if not applied appropriately.

Best Management Practices — Soil Fertility

1. Use soil testing to determine nutrients required for the optimum production of the target forage species.
2. Apply fertilizer materials based only on soil test recommendations. The use of soil testing to determine fertilizer requirements reduces the potential for both soil and surface water contamination due to over-application of fertilizer. Animal wastes, such as poultry litter or manure, have been shown to be effective fertilizers. Many of the same concerns relating to nutrient overload and potential effects on water quality apply when using manure, as well as commercial fertilizers. Soil testing and fertilizing according to recommendations is critical when using animal waste as fertilizer. (Also, spreading raw manure on pastures can create potential sources of cattle disease problems.)
3. Routinely record all applications (rate and nutrient composition) of fertilizer, regardless of source, and the area to which it was applied.

Pesticide Use

An Integrated Pest Management (IPM) approach seeks to use routine management practices to minimize the use of pesticides on a regular basis. These routine strategies include:

1. The use of an appropriate stocking rate. This minimizes the number of unwanted weed species in the pasture and, thus, the routine application of herbicides.
2. The use of relevant grazing systems that allow for biological control of weed species. Again, this minimizes the routine application of herbicides.
3. The use of appropriate fertility programs on introduced forage pastures. This encourages the growth and vigor of desirable forage species that can challenge less desirable species.
4. The use of prescribed burning programs. Prescribed fire can safely and efficiently reduce competition from many invading species, especially those that are woody in nature.
5. Close adherence to label directions. When pesticides are required, Best Management Practices include following label directions carefully to optimize target species control and eliminate negative effects to the environment.

To use pesticides in a manner not consistent with label directions is a violation of state and federal laws.

Best Management Practices — Pesticide storage and disposal

1. Do not stockpile; control pesticide inventory to avoid accumulation of materials with expired dates or that are no longer labeled for use.
2. Always store pesticides in their original containers.
3. Store pesticides out of the reach of children and pets.
4. When disposing of pesticides, check with your local landfill, solid waste management authority, local health department or the Texas Department of Agriculture to find out whether your community has a hazardous waste collection program for disposal of unwanted pesticides.
5. If you have any doubt about proper pesticide use and disposal, contact the Texas Department of Agriculture at 800-835-5832.
6. Water that is used to rinse pesticide containers should never be dumped on the ground or down a drain. It must be added to the sprayer tank and used on the site for which the pesticide is labeled.
7. Do not pour leftover pesticides down the sink, into the toilet, or down a sewer or street drain. Pesticides may interfere with the operation of wastewater treatment systems or pollute waterways. Many municipal systems are not equipped to remove pesticide residues. If pesticides reach waterways, they can harm aquatic life (fish, plants, etc.).

Steps for triple rinsing pesticide containers:

1. Remove the cap or lid from the pesticide container, measure the pesticide as you empty the container into the sprayer tank and let the container drain into the sprayer tank for 30 seconds.
2. Fill the container 10-20% full of water.
3. Secure the cap or lid on the container and shake to rinse the inside.
4. Remove the cap or lid and add the rinse water from the container to the sprayer tank. Let the container drain into the sprayer tank for 30 seconds or more.
5. Repeat steps 2-4 two more times.
6. Put the cap or lid back on the pesticide container and dispose of the container according to label directions.
7. Do not reuse empty containers.

Water Quality

Water quality can be thought of in three categories: biological, physical and chemical.

1. Biological — bacteria, viruses, protozoa, etc.
2. Physical — color, turbidity, sediment, temperature, odor, algae (blue-green can produce toxic effects).
3. Chemical — pH, total dissolved solids (TDS), nitrates/nitrites, phosphates, sodium, sulphates.

If water quality is in question, conduct a complete water quality analysis.

Best Management Practices — Water Quality

1. Develop water sources using gravity, solar, wind or electric power to prevent cattle from watering in streams.
2. Limit cattle access to streams and sensitive riparian areas. Fence critical management areas, either with temporary or permanent fence. Electric fence works well.
3. Provide vegetative filter/buffer strips between corrals and streams. The width of the strip is dependent on soil type and slope.
4. Install runoff diversions above livestock holding areas or corrals to keep up-slope runoff from mixing with runoff from corrals.
5. Install dikes and/or sediment ponds below livestock holding areas or corrals and streams.
6. Seal all old and abandoned wells and protect active wells from being a source of contamination to groundwater.
7. Portable windbreaks will draw animals out of riparian areas and are especially good in winter.

Dead Animal Disposal

The disappearance of rendering plants is a concern and has become a national trend in recent years. High disposal costs, combined with the disappearance of rendering plants, have resulted in some producers improperly burying or simply dumping carcasses into wooded areas, creeks, or other inconspicuous areas.

These practices have created concerns about:

1. Solid waste management
2. Water quality
3. Air quality
4. Public perceptions
5. Sources of animal disease

For livestock, several options for carcass disposal are available, including burial, incineration, and composting. Incineration of large animals requires special facilities, which may be impractical for cow-calf and stocker producers.

Researchers are studying the feasibility of on-site composting of carcasses as a means of environmentally sound disposal. Composting is routinely done in the poultry and swine industries and is being adopted by feedlot/backgrounding operations to economically dispose of dead animals. Guidelines are available to aid producers in developing composting facilities.

Disposal of dead animals is not a major concern for cow-calf producers, who usually deal with minimal

numbers of dead livestock. However, for larger backgrounding and stocker operations, timely disposal of carcasses becomes an environmental concern.

On-site burial of carcasses may be the best disposal option for cow-calf producers. (For more information on relevant state laws and regulations, contact the Texas Commission on Environmental Quality at 512-239-1000 and www.tceq.state.tx.us.)

Some municipal solid waste landfills will accept dead animals provided that they can be covered immediately with 3 feet of other solid waste or at least 2 feet of soil. Producers should contact the local waste disposal facility to determine if carcasses are accepted.

Best Management Practice — Dead Animal Disposal

1. Under no circumstances should dead animals be disposed of by dumping in a creek, on a public road, abandoned wells or other areas where water and air quality might be jeopardized.

ANIMAL HANDLING AND WELL-BEING

Cattle behavior and facilities design

Cattle handling and facilities design can impact beef quality. Many bruises, dark cutters and other damage to the meat product can be reduced if cattle are handled properly. Proper handling is easier to accomplish in facilities designed to take advantage of the natural instincts and tendencies of cattle.

Understanding cattle behavior facilitates handling, improves handler safety, animal welfare, reduces stress and bruising. Bruising due to improper cattle handling costs the industry millions of dollars each year in carcass trim at the packing house.

Low-stress handling decreases shrink and improves the immune system and rumen function, resulting in decreased respiratory disease and lower cost. Mishandling can also develop temperament and behavior problems that are retained throughout the animal's life.

Communicating with cattle

To achieve the desired level of proper handling, a clear understanding of cattle behavior and their response to stimuli is needed. Communication to and with cattle is accomplished through sight, sound, or touch. Cattle prefer sight as a means of communication. Loud sounds or noise are stressful and distracting to cattle and counterproductive to proper or low-stress handling. Touch can only be utilized effectively when working cattle in confinement. Proper application of touch can help avoid the need to apply the use of other driving aids when working cattle.

Vision

The primary means of communicating with cattle should be through vision as cattle have a visual field in excess of 300 degrees. Because of their vision field it becomes important to recognize the importance of line-of-sight in handling cattle. When distractions cannot be minimized, it is generally recommended that more confined areas such as loading ramps and handling chutes have solid walls to prevent animals from seeing distractions. Movement seen through the sides of corral facilities can cause balking or even frighten livestock if it is in too close a proximity. Solid sides on the crowd pen and alley can be helpful if animals are not tame or are unaccustomed to the facility. While solid sides can help keep down distractions, they can also make it more difficult to get cattle moved. Cattle do not like to be driven toward a closed end alley or tub.

Corrals should be designed to allow cattle to move toward open sided fences as much as possible. Only when distractions cannot be eliminated by the proper placement of people and equipment should solid sides be used. In close confinement situations, such as crowd tubs and alleyways, solid sides that cover the lower portion of the structure will aid in preventing an animal from getting a leg extended through the fence.

Cattle have a tendency to move from a dimly illuminated area to a more brightly illuminated area. However, light (natural or artificial) should not glare in their eyes. Lighting can be useful in handling cattle that are unaccustomed to their surroundings. A spotlight directed onto a loading chute can be used to improve cattle movement. General soft lighting inside the processing barn/shed will often facilitate entry.

Bruising due to improper cattle handling costs the industry literally millions of dollars each year in carcass trim at the packing house.

In areas where animals are handled, illumination should be uniform and diffuse. Shadows and bright spots should be minimized. Livestock are sensitive to harsh contrasts of light and dark around loading chutes, scales, and work areas. A zebra-stripe pattern cast by slatted roof and fences can cause balking.

Cattle have poor depth perception. To see depth on the ground, the animal must stop and lower its head. The pattern of alternating light and dark caused by shadows can have the same effect as building a cattle guard in the middle of the facility. Cattle are also more likely to

balk at sudden changes in color, which can also affect depth perception. Handling facilities should be painted one uniform color.

It should be mentioned that most of these responses to contrasting light and dark are a result of animals being stressed and looking for distractions. Cattle walk across contrasts and shadows in the pasture all day long without hesitation. In those conditions, however, the cattle are not looking for something to frighten them. As handlers, it is always in the best interest of safety and handling to have cattle that are not looking for something to frighten them. Reducing stress in cattle takes patience and practice.

Hearing

The second means of communicating with cattle is through sound. It is always better to rely on vision to communicate with cattle than to rely on sound. Sound can be stressful to cattle and should be kept to an absolute minimum. Cattle can be handled calmly and moved successfully with minimal amounts of noise. In facilities where cattle are handled, loud noises and other distractions should be avoided. Rubber stops on gates and squeeze chutes reduce noise. The pump and motor on a hydraulic squeeze chute should be located away from the chute. Employees should be encouraged not to vocalize.

Touch

The third means of communicating with cattle is through touch. It should normally be reserved as a last resort. If touch is reserved for the areas of most resistance, it is much more effective when used. For example, if an animal balks in the chute or alley, approaching from the front and simply running a hand down their back as the handler passes by is effective in starting movement. In this category is also the use of driving aids such as sorting sticks, paddles, whips, ropes, and hotshots. None of these tools are bad but when misused, all can be detrimental to improved cattle handling.

Proper use of a sorting stick relies on using it for its intended purpose. Use it to direct cattle movement, not as a means of striking an animal. Often times sticks, paddles, whips, and ropes are overused just because they are in the handler's hand. The same can be said of hotshots.

The use of a hotshot should be reserved for use when all other proper handling techniques have failed. Never let anyone carry a hotshot in their hand at all times, as it will lead to overuse. A properly-used hotshot is a much more humane way to encourage an animal to move forward than any other available driving aid. However, there is a proper way to use them, and employees should know and adhere to those guidelines. Never apply a hotshot to the sensitive areas of an animal such as the eyes, muzzle, genitalia, or udder. When used, apply only as much stimulus as needed to establish desired movement.

Flight zone

An important concept of livestock handling is the "flight zone." The flight zone is the animal's "personal space." Managing where the handler is in relation to the flight zone is what allows the movement of cattle. Being able to read, gauge and adjust to the flight zone of an individual animal or a herd is important in managing the speed of cattle movement and reducing the stress placed on cattle.

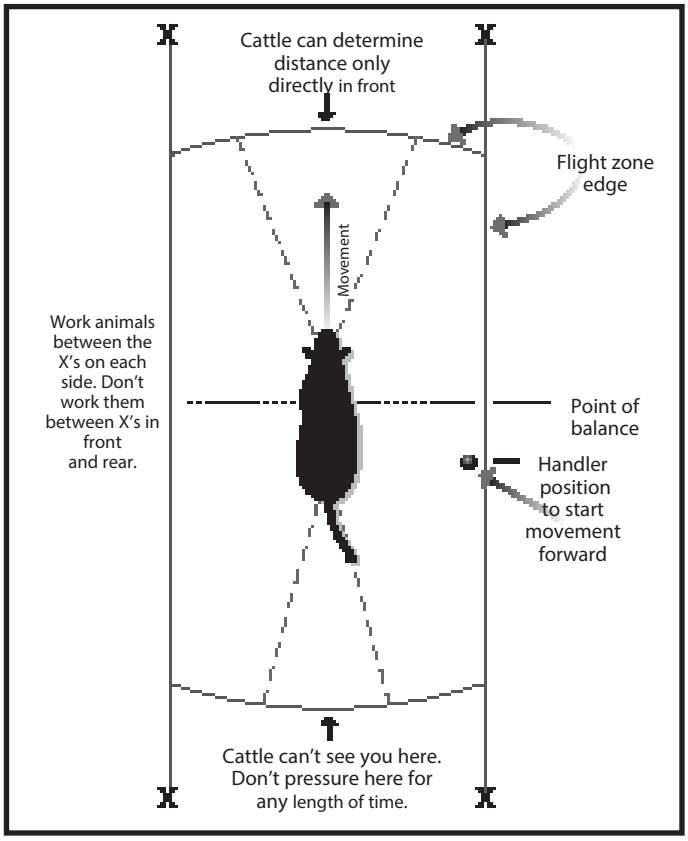
The size of the flight zone depends on cattle disposition and prior handling. Handling of cattle can be used to alter the flight zone of cattle. Cattle need to be able to accept pressure without bolting, and if they know that small responses will release the pressure the handler put on them, they will learn to respond with a measured, controlled response. Cattle accustomed to frequent calm handling may have a small flight zone. Extremely tame cattle are often difficult to move because they no longer have a flight zone.

The flight zone of range cows varies greatly. Regardless of the size/range of the flight zone, however, when a person enters the flight zone, animals move away. To develop proper handling skills, it is important to learn how to read cattle and anticipate the edge of the flight zone. The flight zone is not as important as the area right before the flight zone. How cattle are approached just prior to their flight zone dictates the direction and speed of their departure. Understanding the flight zone can reduce stress, prevent accidents and injury to handlers, and ease cattle movement and flow (See Figure 5).

The edge of the flight zone can be determined by slowly walking up to the animal. When the handler penetrates the flight zone, the animal will move away. The best place for a person to work cattle is on the edge of the flight zone. Movement can be started and stopped by movement into and out of the flight zone. Staying out of the flight zone becomes more difficult as cattle move toward and through a working facility. Cattle with a large flight zone may benefit from closed sides on the working facility. The solid sides shield pressure exerted on the animal just through their proximity to people.

One example of this is expressed in working facilities when cattle sometimes become agitated and rear up while waiting in a single-file crowd alley. This often happens because a person is in too close proximity or they lean over the crowd alley, invading the animal's flight zone. That behavior is dangerous to both people and cattle and, if observed, the person working the crowd alley or standing too close should simply back away from the crowd alley. Never approach the animal that is rearing, as it will only put more pressure on them

Figure 5



and make the problem worse, last longer, and become more dangerous.

One of the most misunderstood and misused characteristics of behavior is what is referred to as the "point of balance." The common misconception is that the point of balance is the shoulder of the animal (Figure 5) and as such to cause animal to back up, the handler should stand in front of the point of balance (the shoulder). Therefore, to get an animal to move forward the handler must be behind the shoulder. There are several differences in opinion related to the point of balance and how best to use it when moving cattle.

The focus has always been on the shoulder as the reference point on cattle. There is nothing on or about the shoulder that would cause an animal to move forward or backwards. What needs to be keyed on to move cattle is the eye. It just so happens that on many cattle, when you pass the shoulder, your position in relationship to the eye changes such that most untrained animals will move forward.

Because the eye controls the point of balance, and not the shoulder, this point of balance can be managed and changed through proper handling and training of cattle. In fact, to easily sort cattle and manage their movement through a corral system, the point of balance needs to be shifted forward. If the only way to get an animal to move forward is to pass behind its shoulder, controlling movement and sorting cattle will be extremely difficult.

Handlers should always strive to teach animals to move past by drawing them forward, rather than through getting behind and driving them out of the herd. Shifting the point of balance forward improves cattle handling and reduces stress on cattle and handlers.

Herd instinct

Properly designed facilities and effective cattle handling take advantage of the natural herding instinct of cattle. Unfortunately, many cattle are handled by trying to push the animals through a system because of the way facilities are designed. The more cattle are pushed from behind, the more resistant they become to being moved.

This herding instinct helps establish flow through a corral system. It is difficult to push a large number of cattle anywhere, much less through the confinement of a working facility. However, if movement can be created in the animals in the front, the draw of that movement can easily send cattle through the working facilities. Allow livestock to follow the leader and do not rush them. If animals bunch up, handlers should concentrate on moving the leaders instead of pushing a group of animals from the rear.

The same use of the herding instinct should be used in gathering cattle. Handlers start the flow and movement of the leaders, and then help in maintaining flow through the pasture or corrals.

While the herding instinct is particularly useful in managing the movement of cattle, it can also cause stress in cattle that must be sorted from the herd. Cattle are herd animals and they are likely to become stressed and possibly highly agitated when they are separated from their herd mates. Try not to isolate an animal, but if an isolated animal becomes agitated, other animals should be placed with it. This will calm agitated animals as well as facilitate movement.

Crowd alleys and loading chutes

Single-file crowd alleys are recommended for moving cattle onto a truck or squeeze chute. These can be either straight or curved, and there are advantages and disadvantages to both. A curved crowd alley might be more efficient for two reasons. First, it prevents the animal from seeing what is at the other end of the chute until it is almost there. Second, it takes advantage of the natural tendency to circle around a handler, moving along the inner radius. However, there are a couple of concerns with curved crowd alleys. Where they leave the crowding pen, whether it be a crowd tub, V-shaped box, or Bud box, it should be straight for at least 16 feet before starting a curve. This prevents the solid sides of a curved crowd alley from looking like a dead end as they approach.

While some believe a curved crowd alley is absolutely necessary, many facilities utilize straight systems. Both

will work equally well if cattle are loaded into them correctly and worked correctly by those taking the cattle to the squeeze or loading chute. Livestock will often balk when they have to move from an outdoor pen into a building. Animals will enter a building more easily if they are lined up in a single-file chute before they enter.

A curved chute with an inside radius of 13-16 feet will work well for handling cattle. The absolute minimum length for a crowd alley is 16 feet, with 20 to 24 feet being a better minimum. Regardless of shape, the success or difficulty associated with moving cattle to the squeeze or loadout is dictated by how the cattle are moved from the crowd pen into the crowd alley, and then how they are moved up the crowd alley. Always work from the front of the animals toward the back of the alley. Once the handler has started movement, they need to step away from the alley and move back to the front. Do not walk back up the side of the alley from back to front. That will stop movement of cattle. This is where a curved system has an advantage. Once the handler reaches the back of the alley, they can cut across the diameter of the circle back to the front of the cattle without stopping flow.

Solid sides are routinely recommended for both the crowd alley and the crowd pen, which leads to a squeeze chute or loading ramp. While solid sides may keep distractions to a minimum, it also will prohibit cattle from being able to see the handlers and respond to their movements. Solid sides are usually not necessary if cattle handling skills are adequate. Open-sided and straight-sided systems are much more economical to build and can be utilized just as effectively as curved and solid-sided handling facilities.

Facilities should also be designed to optimize cattle traction. Alleyways, crowd pens, crowd alleys, squeeze chutes, loading chutes, and the exit area in front of a squeeze chute are all areas that need excellent traction. Cattle remain calmer when they are able to obtain solid footing. Slipping upon exiting a squeeze chute is a common cause of bruising and injury to cattle.

Crowd pen

The crowding pen can represent the most stressful portion of a working facility. If stress occurs in this area, it is because the handlers are not working the area correctly. Regardless of design, the crowding pen is a pass-through part of the facility. Only bring the number of cattle to the crowd pen that will fit in the crowd alley. Never hold cattle in the crowd pen. The loss of movement will require excessive force be used on the cattle to reestablish flow, causing stress and risk of injury.

The most common designs for crowding pens today are tubs, Vs, or Bud boxes. Of those three, only the tubs are truly a component of the working facility that can crowd animals through use of a crowd gate. Bud boxes and Vs require that pressure be put on the animals through body position and driving aids to direct the cattle out of the enclosure. The common denominator to all of them is that they work only as well as the handlers putting cattle through them.

It also needs to be said that all tubs, Vs, and boxes are not created equal and it requires an understanding of cattle behavior and proper use of the flight zone and point of balance to make them work properly. This is a complicated area of discussion and cannot be covered in-depth in this publication. Additional information can be obtained through http://www.ranchtv.org or http://beef.tamu.edu.

Handling Facility Dimensions for Corral and Working Facilities

Holding Area (sq. ft. per head)	
Cows	20
Calves	14
Crowding Pen (sq. ft. per head)	
Cows	12
Calves	6
Crowd Alley with Fixed Sides	
Width	28 to 30 inches
Length (minimum)	20 feet
Crowd Alley with Adjustable Sides (recommended)	
Adjustable Width	18 to 32 inches
Length (minimum)	20 feet
Crowd Alley	
Recommended height (minimum)	50 inches
Depth of post in the ground (minimum)	30 inches
Corral Fence	
Recommended height	60 to 66 inches
Depth of post in the ground (minimum)	36 inches
Ramp Height for:	
Stock trailer	15 inches
Semi tractor-trailer	48 inches
Double-deck trailer	100 inches
Loading Chute	
Width	26 to 30 inches
Length (minimum)	12 feet
Rise, inches per foot	3 1/2

Best Management Practices — Cattle Handling

1. Develop a complete understanding of cattle behavior, flight zone and point of balance.
2. Work as quietly as possible, using body position and line of sight to move cattle. Keep noise, such as yelling, whistling and machinery to an absolute minimum.
3. Facilities do not have to be elaborate in design but should be constructed out of durable materials and with a good understanding of cattle behavior.
4. Handling facilities should be inspected prior to each working for broken gates, latches and anything that could be dangerous to people or cattle.
5. Have adequate holding and sorting pens to accommodate routine management of cattle.
6. Minimize the use of cattle prods (hotshots, sticks, pipe, etc.) that can cause stress and bruising. Do not allow anyone to carry a hotshot with them at all times. Reserve its use as a last resort in getting cattle to move.
7. Use driving aids, such as sorting sticks, paddles, whips, or flags for their intended purpose. They should never be used to strike an animal.
8. Use a crowding pen as a pass-through part of the facility. Cattle should never be stored in the crowding pen.

Processing/Cattle Handling

Processing involves management decisions when working cows or calves, receiving stocker cattle, weaning calves, and shipping cattle. Castration, dehorning, immunization, branding, injections, and cattle movement are all control points for management. Management practices performed early in life will reduce the chance of stress-related sickness, carcass damage and carcass devaluation.

Calf management practices

Castration and dehorning are management practices that should be performed by cow-calf producers prior to the times calves are marketed. In Texas, it is estimated that only 20% of the male calves are castrated prior to being sold off the ranch where they were born.

Intact bull calves are undesirable because their management is difficult, due to aggressive behavior. Furthermore, beef from intact bulls has a coarser texture, lower marbling scores, and more variable tenderness. For these reasons they are always castrated prior to grazing or feeding. Intact bull calves may gain faster than non-implanted steers; however, implanted steer calves will gain at the same rate or faster than intact bulls.

All bulls that are not herd sire prospects should be castrated as early in life as possible. Early castration is less stressful on bull calves. Preferably, castration should occur between birth and four months of age. Castration of older, heavier animals causes greater stress and increases the chances for surgical complications and bacterial infections. The additional stress can also suppress immune function and increase susceptibility to other diseases.

There are also economic incentives to castrating bull calves prior to marketing. Analyses of auction sales show that lightweight bull calves (under 400 pounds) are discounted less than heavier bull calves and yearlings.

Research in Texas and Kansas has demonstrated that

Early castration is less stressful on bull calves. Preferably, castration should occur between birth and four months of age.

Not only do horns cause substantial bruise damage (that has to be trimmed from the carcass) to other cattle in the pen, they often cause the head to be condemned during inspection by USDA-FSIS, thus resulting in a decreased value of the animal.

castration of a 550-pound bull calf reduces weight and increases morbidity (sickness), mortality (death rate) and treatment costs. Based on research, "cutter bulls" should be discounted $6 to $7 per cwt. as compared to the same weight steers, due to lost production efficiency. Heavier (600 pound) or older (yearling) cutter bulls will, in general, receive price discounts of $6 to $12 per cwt.

Dehorning is as stressful as castration. Horn buds should be removed sometime between birth and four months of age. Cattle with horns are the cause of a significant amount of bruising in fed and non-fed cattle. Groups of horned cattle have twice as many bruises as groups of non-horned cattle. Bruises from horns are trimmed out, resulting in lost carcass weight, devalued primal cuts and reduced carcass value.

Obviously, the use of polled genetics is the easiest and least stressful way to dehorn cattle. Does that imply all producers should breed polled cattle? No. It means that if calves are born with horns, electric or surgical dehorners should be used to prevent horn growth (before the calves are four months old).

The younger the animal is when these procedures are done, the less it is stressed. Research has shown that dehorning or tipping the horns of older calves and yearlings is one of the most stressful management practices.

It is also commonly believed that horned cattle do not receive a discount when marketed. Actually, auction market results indicate that horned heifers and steers are discounted $2 to $3 per cwt. As with bull calves, discounts for horns increase with age and weight.

Branding

For centuries, fire branding has been utilized as a method of animal identification. It remains the preferred method of identification to establish proof of ownership. Placement of your brand is important because it affects

the value of the hide. Ideally, brand placement (freeze brand or hot iron) should be located high up on the hip, close to the tailhead.

Preferred brand locations include forearm, shoulder, high on the hip near the tailhead, or lower rear leg. This allows the brand to be cut away from the hide without a significant loss of the most valuable portions. In many instances, butt-branded hides sell at prices similar to native (nonbranded) hides. Rib brands and multiple brands devalue cattle $5 to $25 per head.

Freeze branding can also be used to identify cattle. However, improper freeze branding can scar, similar to a hot iron, which lowers the value of the hide. Improper branding procedures can also create beef quality problems. Brands that are too hot or held too long can result in scar tissue that toughens the underlying muscle tissue. In extreme cases, the brand is visible on the muscle tissue below the hide.

If you choose to brand your cattle, it is mandatory that you register your brand with the county clerk in each county where you run cattle. Also, all brands must be re-registered every 10 years (most recently in Aug. 31, 2011 through Feb. 29, 2012). For more information, contact Texas and Southwestern Cattle Raisers Association at (800) 242-7820.

APPENDIX

Beef Quality Assurance Guidelines

Feedstuffs

- Maintain records of any pesticide/herbicide use on pasture or crops that could potentially lead to violative residues in grazing cattle or feedlot cattle.
- Adequate quality control program(s) are in place for incoming feedstuffs. Program(s) should be designed to eliminate contamination from molds, mycotoxins, or chemicals of incoming feed ingredients. Supplier assurance of feed ingredient quality is recommended.
- Suspect feedstuffs should be analyzed prior to use.
- Ruminant-derived protein sources cannot be fed per FDA regulations.
- Feeding by-product ingredients should be supported with sound science.

Feed Additives and Medications

- Only FDA approved medicated feed additives will be used in rations.
- Medicated feed additives will be used in accordance with the FDA Good Manufacturing Practices (GMP) regulation.
- Follow 'Judicious Antibiotic Use Guidelines'.
- Extra-label use of feed additives is illegal and strictly prohibited.
- To avoid violative residues, withdrawal times must be strictly adhered to.
- Where applicable, complete records must be kept when formulating or feeding medicated feed rations.
- Records are to be kept a minimum of two years.
- Operator will ensure that all additives are withdrawn at the proper time to avoid violative residues.

Injectable Animal Health Products

- Products labeled for subcutaneous (SQ) administration should be administered SQ in the neck region (ahead of the shoulders).
- All products labeled for intra-muscular (IM) use shall be given in the neck region only (no exceptions, regardless of age).
- All products cause tissue damage when injected IM. Therefore, all IM use should be avoided if possible.
- Products cleared for SQ, IV or oral administration are recommended.
- Products with low dosage rates are recommended and proper spacing should be followed.
- No more than 10 cc of product is administered per IM injection site.

Care and Husbandry Practices

- Follow the 'Quality Assurance Herd Health Plan' that conforms to good veterinary and husbandry practices.
- All cattle will be handled/transported in such a fashion as to minimize stress, injury and/or bruising.
- Facilities (fences, corrals, load-outs, etc.) should be inspected regularly to ensure proper care and ease of handling.
- Strive to keep feed and water handling equipment clean.
- Provide appropriate nutritional and feedstuffs management.
- Strive to maintain an environment appropriate to the production setting.
- Bio-security should be evaluated.
- Records should be kept for a minimum of 2 years (3 for Restricted Use Pesticides)

Beef Quality Grades

A quality grade is a composite evaluation of factors that affect palatability of meat (tenderness, juiciness, and flavor). These factors include carcass maturity, firmness, texture, and color of lean, and the amount and distribution of marbling within the lean. Beef carcass quality grading is based on (1) degree of marbling and (2) degree of maturity.

Marbling

Marbling (intramuscular fat) is the intermingling or dispersion of fat within the lean. Graders evaluate the amount and distribution of marbling in the ribeye muscle at the cut surface after the carcass has been ribbed between the 12th and 13th ribs. Degree of marbling is the primary determination of quality grade.

Degrees of Marbling

Each degree of marbling is divided into 100 subunits. In general, however, marbling scores are discussed in tenths within each degree of marbling (e.g., Slight 90, Small 00, Small 10).

In addition to marbling, there are other ways to evaluate muscle for quality. Firmness of muscle is desirable, as is proper color and texture. Desirable ribeyes will exhibit

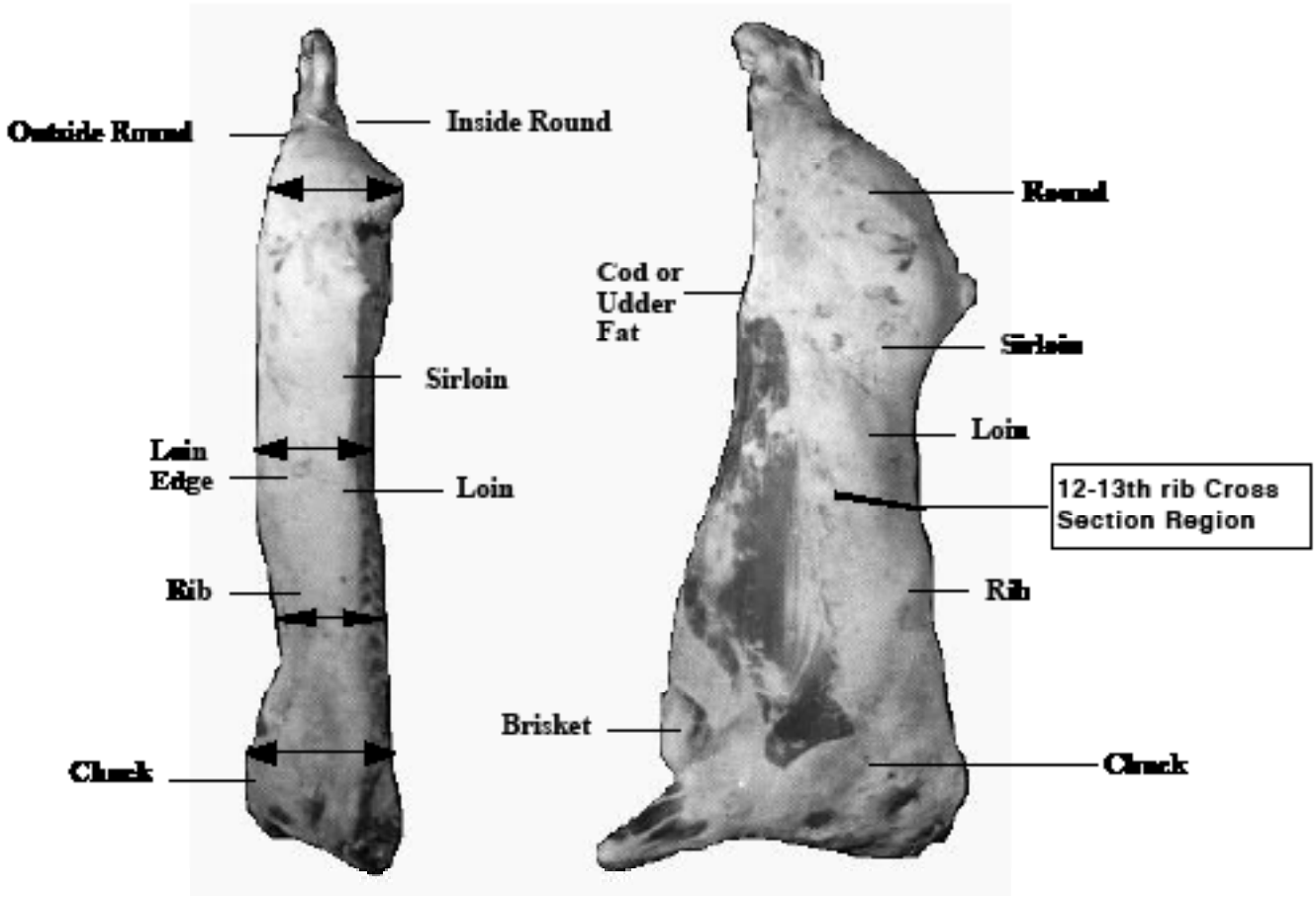
an adequate amount of finely dispersed marbling in a firm, fine textured, bright, cherry-red colored lean. As an animal matures, the characteristics of muscle change, and muscle color becomes darker and muscle texture becomes coarser.

Quality Grade	Marbling Score
Prime $^{+}$	Abundant 00-100
Prime ^{0}	Moderately Abundant 00-100
Prime $^{-}$	Slightly Abundant 00-100
Choice $^{+}$	Moderate 00-100
Choice ^{0}	Modest 00-100
Choice $^{-}$	Small 00-100
Select $^{+}$	Slight 50-100
Select $^{-}$	Slight 00-49
Standard $^{\pm}$	Traces 34-100
Standard ^{0}	Practically Devoid 67-100 to Traces 00-33
Standard –	Practically Devoid 00-66

Maturity

Maturity refers to the physiological age of the animal rather than the chronological age. Because the chronological age is rarely known, physiological maturity is used; and the indicators are bone characteristics, ossification of cartilage, and color and texture of ribeye muscle. Cartilage becomes bone, lean color darkens, and texture becomes coarser with increasing age. Cartilage and bone maturity receive more emphasis because lean color and texture can be affected by other postmortem factors.

Cartilage evaluated in determining beef carcass physiological maturity are those associated with the vertebrae of the backbone, except the cervical (neck). Thus, the cartilage between and on the dorsal edges of the individual sacral and lumbar vertebrae as well as the cartilage located on the dorsal surface of the spinous processes of the thoracic vertebrae (buttons). Cartilage in all these areas are considered in arriving at the maturity group. The buttons are the most prominent, softest, and least ossified in the younger carcasses. As maturity proceeds from A to E, progressively more ossification becomes evident. Ribs are quite round and red in A maturity carcasses, whereas E maturity carcasses have wide and flat ribs. Redness of the ribs gradually decreases with advancing age in C maturity, and in general, become white in color because they no longer manufacture red blood cells and remain white



thereafter. Color and texture of the longissimus muscle are used to determine carcass maturity when these characteristics differ sufficiently from normal.

There is a posterior-anterior progression in maturity. Thus, ossification begins in the sacral region and with advancing age proceeds to the lumbar region; then even later, it begins in the thoracic region (buttons) of the carcass. Because of this posterior-anterior progression of ossification, even young A maturity carcasses will have some ossification in the sacral cartilage.

In terms of chronological age, the buttons begin to ossify at 30 months of age. Determine age using thoracic buttons. When the percentage ossification of the cartilage reaches 10, 35, 70, and 90 percent, the maturity is B, C, D, and E, respectively.

Carcasses are stratified into five maturity groups, based on the estimated age of the live animal:

Carcass maturity	Approximate live age
A	9 - 30 mos.
B	30 - 42 mos.
C	42 - 72 mos.
D	72 - 96 mos.
E	> 96 mos.

Skeletal Ossification

Sacral vertebrae (first to ossify)
Lumbar vertebrae
Thoracic vertebrae (buttons - last to ossify)
Size and shape of the rib bones
Condition of bones

Condition of the bodies of the split chine bones:

A- Red, porous, and soft
B- Slightly red and slightly soft
C- Tinged with red, slightly hard
D- Rather white, moderately hard
E- White, nonporous, extremely hard

Appearance of the ribs:

A- Narrow and oval
B- Slightly wide and slightly flat
C- Slightly wide and moderately flat
D- Moderately wide and flat
E- Wide and flat

Lean Maturity:

Color and Texture - As maturity increases, lean becomes darker in color and coarser in texture.

Balancing lean maturity and bone maturity:

1. Use a simple average when bone and lean maturities are within 40 units of each other.

Ossification of the vertebral column

	MATURITY GROUP				
Vertebrae	A	B	C	D	E
Sacral	Distinct separation	Completely fused	Completely fused	Completely fused	Completely fused
Lumbar	No ossification	Nearly completely ossified	Completely ossified	Completely ossified	Completely ossified
Thoracic	No ossification	Some ossification	Partially ossified	Considerable ossification (outlines of buttons are still visible)	Extensive ossification (outlines of buttons are barely visible)
Thoracic buttons	0-10%	10-35%	35-70%	70-90%	>90%

Lean Maturity Descriptions

Maturity	Lean Color	Lean Texture
A^0	light cherry-red	very fine
B^0	light cherry-red to slightly dark red	fine
C^0	moderately light red to moderately dark red	fine
D^0	moderately dark red to slightly dark red	coarse
E^0	dark red to very dark red	coarse

2. When there is more than 40 units difference in lean and bone maturity, average the two maturities and adjust the average 10% toward the bone except when:

Crossing the B/C line

- If the average of the lean and bone maturities does not move across the B/C line from the bone maturity side (e.g., Bone = B and Lean = C with the average being B or Bone = C and Lean = B with the average being C); average the two maturities and adjust the average to the nearest 10% toward the bone.
- If the bone and lean maturities are not considerably different, but one is in B maturity and the other in C maturity and the average of the two moves across the B/C line from the bone maturity side, the overall maturity will be on the side of bone maturity — it will be either B-100 or C-00.
- In no case may overall maturity be more than one full maturity group different than bone maturity. A80 lean + D20 skeletal = C20 overall.

Determination of Final Quality Grade:

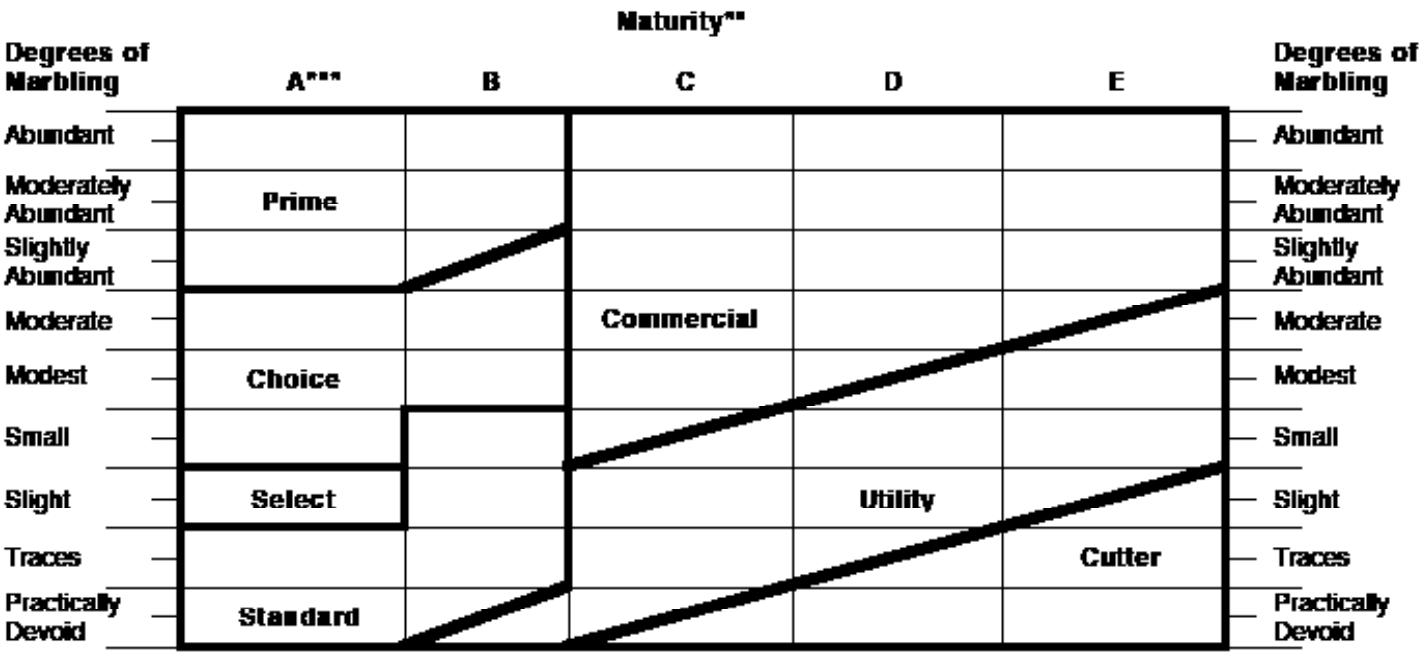
After the degree of maturity and marbling has been determined, these two factors are combined to arrive at the Final Quality Grade. The fundamentals involved in applying quality grades are learning the degrees of marbling in order from lowest to highest and minimum marbling degrees for each maturity group and understanding the relationship between marbling and maturity in each quality grade.

"A" and "B" Maturity Carcass Thoracic Chine Buttons

"A" Maturity

"B" Maturity

Relationship Between Marbling, Maturity, and Carcass Quality Grade*



* Assumes that firmness of lean is comparably developed with the degree of marbling and that the carcass is not a "dark cutter."
** Maturity increases from left to right (A through E).
*** The A maturity portion of the Figure is the only portion applicable to bullock carcasses.

USDA (1996) Standards for Grades of Slaughter Cattle and Standards for Grades of Carcass Beef.

Step-Wise Procedure for Quality Grading Beef Carcasses

1. Determine carcass skeletal maturity by evaluating the degree of skeletal ossification in the top three thoracic vertebra (buttons), and the sacral and lumbar vertebra. Also evaluate the color and shape of the ribs. Determine lean maturity by evaluating the color and texture of the lean in the ribeye exposed between the 12th and 13th ribs.

   Skeletal Maturity + Lean Maturity = Overall Maturity

   A60 + A40 = A50 (Simple Average)

   B60 + A80 = B30 (>40; 10% to bone)

   C60 + B10 = C00 (B/C line)

   D60 + B20 = C60 (≤ 100% from bone)

2. Evaluate the marbling in the ribeye and determine the marbling score.

   Overall Maturity + Marbling Score = USDA Quality Grade

   A70 + Sm40 = Ch

   B60 + Md40 = Ch°

3. Determine lean firmness to ensure that the minimum degree of firmness specified for each maturity group is met.

Table illustrating the minimum marbling score requirements for USDA quality grades within each final maturity group

USDA QUALITY GRADE	FINAL MATURITY SCORE				
	A^{0}	B^{00}	C^{00}	D^{00}	E^{00}
PRIME+	AB^{00}	AB^{00}	----	----	----
PRIME°	MAB^{00}	MAB^{00}	----	----	----
PRIME-	$SLAB^{00}$	$SLAB^{00}$	----	----	----
CHOICE+	MD^{00}	MD^{00}	----	----	----
CHOICE°	MT^{00}	MT^{00}	----	----	----
CHOICE-	SM^{00}	----	----	----	----
SELECT+	SL^{50}	----	----	----	----
SELECT-	SL^{00}	----	----	----	----
STANDARD+	TR^{00}	TR^{00}	----	----	----
STANDARD-	PD^{00}	PD^{00}	----	----	----
COMMERCIAL+	----	----	MD^{00}	$SLAB^{00}$	AB^{00}
COMMERCIAL°	----	----	MT^{00}	MD^{00}	$SLAB^{00}$
COMMERCIAL -	----	----	SM^{00}	MT^{00}	MD^{00}
UTILITY+	----	----	SL^{00}	SM^{00}	MT^{00}
UTILITY°	----	----	TR^{00}	SL^{00}	SM^{00}
UTILITY -	----	----	PD^{00}	TRv	SL^{00}

* AB = Abundant; MAB = Moderately Abundant; SLAB = Slightly Abundant; MD = Moderate; MT = Modest; SM = Small; SL = Slight; TR = Traces; PD = Practically Devoid.
* Carcasses with B, C, D, or E final maturity scores require an increasing amount of marbling as maturity increases to remain in the same quality grade.
* Carcasses having B final maturity scores with Small and Slight marbling must grade U.S. Standard. There is no U.S. Select grade for B maturity carcasses.

BEEF YIELD GRADES

In beef, yield grades estimate the amount of boneless, closely trimmed retail cuts from the high-value parts of the carcass — the round, loin, rib, and chuck. However, they also show differences in the total yield of retail cuts. We expect a YG 1 carcass to have the highest percentage of boneless, closely trimmed retail cuts, or higher cutability, while a YG 5 carcass would have the lowest percentage of boneless, closely trimmed retail cuts, or the lowest cutability. The USDA Yield Grades are rated numerically and are 1, 2, 3, 4, and 5. Yield Grade 1 denotes the highest yielding carcass and Yield Grade 5, the lowest.

The USDA prediction equation for percent boneless, closely trimmed retail cuts (% BCTRC) of beef carcasses is as follows:

% BCTRC = 51.34
Minus 5.78 (Fat opposite the ribeye, in.)
Minus 0.46 (Percentage KPH fat)
Minus 0.0093 (Carcass weight, pounds)
Plus 0.74 (Ribeye area, in. 2)

YIELD GRADE	% BCTRC
1	> 52.3
2	52.3 - 50.0
3	50.0 - 47.7
4	47.7 - 45.4
5	< 45.5

Meat graders assign a yield grade to a carcass by evaluating:

1. the amount of external fat;
2. the hot carcass weight;
3. the amount of kidney, pelvic, and heart fat; and
4. the area of the ribeye muscle.

Expected percentage of boneless, closely trimmed retail cuts from beef carcasses within the various yield grades.

Graders evaluate the amount of external fat at the 12th rib by measuring the thickness of fat three-fourths the length of the ribeye from the chine. They adjust this measurement to reflect unusual amounts of fat in other areas of the carcass. Only graders highly skilled in evaluating cutability of beef carcasses make these adjustments according to whether the measured fat thickness is representative of the fat coverage over the rest of the carcass.

Carcass weight is the "hot" or unchilled weight in pounds (taken on the slaughter-dressing floor shortly after slaughter). The grader usually writes this weight on a tag or stamps it on the carcass. The amount of kidney, pelvic, and heart (KPH) fat is evaluated subjectively and is expressed as a percentage of the carcass weight (this usually will be from 2 to 4 percent of carcass weight). The area of the ribeye is determined by measuring the size (in inches, using a dot-grid) of the ribeye muscle at the 12th rib.

The following descriptions will help you understand the differences between carcasses from the five yield grades:

Yield Grade 1 - The carcass is covered with a thin layer of external fat over the loin and rib; there are slight deposits of fat in the flank, cod or udder, kidney, pelvic and heart regions. Usually, there is a very thin layer of fat over the outside of the round and over the chuck.

Yield Grade 2 - The carcass is almost completely covered with external fat, but lean is very visible through the fat over the outside of the round, chuck, and neck. There is usually a slightly thin layer of fat over the inside round, loin, and rib, with a slightly thick layer of fat over the rump and sirloin.

Yield Grade 3 - The carcass is usually completely covered with external fat; lean is plainly visible through the fat only on the lower part of the outside of the round and neck. There is usually a slightly thick layer of fat over the rump and sirloin. Also, there are usually slightly larger deposits of fat in the flank, cod or udder, kidney, pelvic and heart regions.

Yield Grade 4 - The carcass is usually completely covered with external fat, except that muscle is visible in the shank, outside of the flank and plate regions. Usually, there is a moderately thick layer of external fat over the inside of the round, loin, and rib, along with a thick layer of fat over the rump and sirloin. There are usually large deposits of fat in the flank, cod or udder, kidney, pelvic and heart regions.

Yield Grade 5 - Generally, the carcass is covered with a thick layer of fat on all external surfaces. Extensive fat is found in the brisket, cod or udder, kidney, pelvic and heart regions.

Step-Wise Procedure for Yield Grading Beef Carcasses

1. Determine the preliminary yield grade (PYG).

Measure the amount of external fat opposite the ribeye. This measurement should be made at a point three-fourths of the way up the length of the ribeye from the split chine bone. Based on this fat thickness, a preliminary yield grade (PYG) can be established. The base PYG is 2.00. The more fat opposite the ribeye, the higher the numerical value of the PYG.

- A carcass with no fat opposite to ribeye has a PYG of 2.00
- For each 1 inch of fat add 25 to the PYG

Fat opposite ribeye	PYG
0	2.00
.2	2.50
.4	3.00
.6	3.50
.8	4.00
1.0	4.50

2. Adjust for carcass weight deviations from 600 pounds (lbs).

The base weight in the yield grade equation is 600 lbs. If a carcass weighs more than 600 lbs, then we increase the PYG, and if a carcass weighs less than 600 lbs, then we decrease the PYG.

- For each 25 lbs over 600 lbs, add 10 to the PYG
- For each 25 lbs under 600 lbs, subtract 10 from the PYG

Carcass weight (lbs)	Adjustment to the PYG
500	- .40
550	- .20
600	No adjustment
650	+ .20
700	+ .40
750	+ .60

3. Adjust for percentage KPH deviations from 3.5 percent.

It has been determined that the average carcass has 3.5% KPH. If a carcass has more than 3.5% KPH, then the carcass is fatter than the average and the PYG should be adjusted up, raising the numerical yield grade. If a carcass has less than 3.5% KPH, then the carcass is leaner than average, and the PYG should be adjusted down, thus lowering the yield grade.

- For each 1%KPH over 3.5%, add 20 to the PYG
- For each 1%KPH under 3.5%, subtract 20 from the PYG

%KPH	Adjustment to the PYG
1.5	- .40
2.0	- .30
2.5	.20
3.0	- .10
3.5	No adjustment
4.0	+ .10

4. Adjust for ribeye area (REA) deviations from 11.0 sq. in.

The average carcass has a ribeye area of 11 sq. in. If a carcass has a ribeye area greater than 11.0 in., then it is probably more muscular then average, and the PYG should be adjusted down to lower the numerical value of the yield grade. If the ribeye area is less than 11.0 in., then the carcass is probably less muscular than average, and the PYG should be adjusted up.

- For each 1.0 sq. in. over 11.0 sq. in., subtract 33 from the PYG
- For each 1.0 sq. in. under 11.0 sq. in., add 33 to the PYG

Ribeye area (sq. in.)	Adjustment to the PYG
9.5	+ .49
10.0	+ .33
10.5	+ .16
11.0	No adjustment
11.5	- .16
12.0	- .33
12.5	.49
13.0	- .66

Example yield grade problem using the short cut method:

Fat thickness: 0.5 in. Carcass weight: 750 lbs.
%KPH: 2.0 REA: 14.0 sq. in.

a. 0.5 in. = 3.25
b. 750 minus 600 = 150 / 25 = 6 *.1 = .6 (add)
c. 3.5 minus 2.0 = 1.5 * .2 = .30 (subtract)
d. 14.0 minus 11.0 = 3 * .33 = .99 (subtract)

	3.25	PYG
plus	.60	Weight
minus	.30	KPH
minus	.99	REA
	2.56	Final YG

Classification of Drugs

The final products of animal agriculture are meat, milk, and fiber for human consumption. It is extremely important to understand regulations concerning drugs administered to food animals.

The Food and Drug Administration (FDA) broadly categorizes veterinary drugs as Over the Counter (OTC) or Prescription Drugs. Purchase of OTC drugs does not require the involvement of a licensed veterinarian. Use of OTC drugs in any manner that deviates from the label is illegal, unless a veterinarian prescribes the deviation. For example, the OTC label for penicillin G procaine in cattle specifies 1 mL/cwt given IM (in the muscle) and treatment should not exceed four consecutive days. Producers should not administer 2 mL/ cwt, continue for five consecutive days, or administer the product SQ (under the skin), because any of these practices constitutes extra-label drug use. If you deviate from label instructions then the treatment effectively becomes extra-label drug use, reclassifying the drug as a prescription product. Prescription products require involvement of a licensed veterinarian and the establishment of a veterinarian-client-patient relationship.

A Veterinarian-Client-Patient Relationship requires the establishment of the following three criteria:

a) A veterinarian has assumed the responsibility for making clinical judgments regarding the health of the animal(s) and the need for medical treatment, and the client has agreed to follow the veterinarian's instructions.

b) The veterinarian has sufficient knowledge of the animal(s) to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s). This means that the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of an examination of the animal(s) or by medically appropriate and timely visits to the premises where the animal(s) are kept.

c) The veterinarian is readily available for follow-up evaluation, or has arranged for emergency coverage, in the event of adverse reactions, or failure of the treatment regimen.

Prescription drugs bear the statement "Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian" on their label. A veterinarian cannot, under the law, dispense or prescribe prescription drugs in the absence of a valid veterinarian-client-patient relationship.

Compounding

Compounding from FDA-approved drugs is considered extra-label drug use under FDA rules. According to the American Veterinary Medical Association, "compounding is the customized manipulation of an approved drug(s) by either a veterinarian, or by a pharmacist upon the prescription of a veterinarian, to meet the needs of a particular patient." Mixing two injectable products would be an example of compounding.

Compounding of bulk drugs for food animals is prohibited, except under special circumstances, such as antidotes or large-volume electrolytes, and the FDA states that investigations into violations will be given high regulatory priority.

Extra-label drug use includes any deviation from label instructions in OTC drugs, the use of any prescription drug in a manner not on the label, and the use of compounded drugs that are FDA approved. Extra-label drug use is only allowed if the animal(s) is suffering or death would result from failure to treat the affected animal(s). Otherwise, extra-label use of drugs is not condoned by FDA under any other circumstances, such as compounding hormones or using FDA approved drugs for estrus synchronization when they are not labeled for such use.

All veterinary prescription drugs, OTC drugs used extra label, and FDA approved compounded drugs require veterinary involvement and the establishment of a veterinarian-client-patient relationship.

The list of prohibited drugs may be amended by the FDA; therefore, the list is accurate as of publication of this document.

Prohibited in Food Producing Animals:

- Chloramphenicol
- Clenbuterol
- Diethylstilbestrol
- Dimetridazole, Ipronidazole, or other
- Nitroimidazoles
- Nitrofurazone, Furazolidone in any manner to include topical treatments
- Glycopeptides (Vancomycin)
- Fluoroquinolones in any extra-label manner. (Example Baytril 100 is indicated for the treatment of bovine respiratory disease associated with Mannheimia haemolytica, Pasteurella multocida and Histophilus somni. It is illegal to use Baytril 100 to treat any other condition in cattle such as foot rot or diarrhea.)
- Dipyrone

Prohibited therapy in lactating dairy cows:

- Any sulfonamide except for approved uses of sulfadimethoxine, sulfamethazine, and sulfaethoxypyridazine.

Prohibited therapy in female dairy cattle 20 months of age or older:

- Phenylbutazone

Ruminant Ban Fact Sheet

Purpose and Scope of Regulation: The Food and Drug Administration (FDA) adopted the "Animal Proteins Prohibited from Ruminant Feed" regulation to prevent the establishment of bovine spongiform encephalopathy (BSE) in the United States through feed and, thereby, minimize any risk to animals and humans.

The regulation prohibits the use of protein derived from mammals in ruminant animal feed. However, there are certain exceptions to the rule. For current information on BSE and regulations on the use of mammalian-derived proteins in ruminant feed, please visit the FDA website at www.fda.gov.

Glossary of Terms

Abscess: A swollen, inflamed area in body tissue in which pus gathers.

Accuracy: A measure of reliability associated with an Expected Progeny Difference (EPD). The measure ranges from 0 to 1, with values closer to 1 indicating greater reliability because of the inclusion of more information.

Active ingredient: The specific drug component part of a chemical compound.

Additive: An ingredient or substance added to a basic feed mix, usually in small quantities for the purpose of fortifying it with certain nutrients, stimulants and/or medications.

Animal unit: Common animal denominator based on feed/forage consumption.

Anthelmintic: A drug or chemical that kills or expels worms.

Antibiotic: A class of drugs, such as penicillin, used to control or cure disease. Antibiotics are used to treat both human and animal diseases caused by bacteria.

Antiseptic: A substance that reduces or stops growth of organisms in or on living tissue.

Artificial insemination (AI): The technique of placing semen from the male into the reproductive tract of the female by means other than natural service.

Average daily gain: Measurement of an animal's daily body weight change.

Backcross: The mating of a crossbred (F1) animal back to one of its parental breeds (for example, a Hereford-Angus crossbred mated to an Angus bull).

Beef Quality Assurance (BQA): Begun in 1987, the beef industry's BQA program includes training for cattle producers aimed at ensuring beef safety from conception to the consumer's dinner plate. It includes instruction on everything from proper vaccination procedures and withdrawal times to monitoring feed ingredients for potential chemical contaminants.

Bloat: A digestive disorder of ruminants usually characterized by an abnormal accumulation of gas in the rumen. Usually seen on the animal's upper left side.

Body Condition Score: A score on a scale of 1 to 9, reflecting the amount of fat reserves in a cow's body, where 1 = very thin and 9 = extremely fat.

Bos indicus: These are Zebu (humped) cattle that originated in India. Includes breeds like the Brahman breed in the United States.

Bos taurus: British and European/Continental breeds are derived from this species.

Bovine Spongiform Encephalopathy (BSE): It is an extremely rare, chronic degenerative disease affecting the central nervous system of cattle. It was first identified in Great Britain in 1986. Based upon USDA surveillance efforts, there are no documented cases of BSE in the United States.

Breed: Animals with a common origin and common characteristics that distinguish them from other groups of animals within that same species.

Breeding program goals: The objective or "direction" of breeders' selection programs. Goals are basic decisions breeders must make to give "direction" to their breeding programs. Goals should vary among breeders due to relative genetic merit of their cattle, their resources, and their markets.

Breeding soundness examination: Inspection of a bull involving evaluation of physical conformation and soundness through genital palpation, scrotal circumference and testing semen for mobility and morphology.

Breed type: The combination of characteristics that makes an animal better suited for a specific purpose.

British breeds: Breeds of cattle originating in Great Britain, such as Angus, Hereford and Shorthorn.

Calving difficulty (Dystocia): Abnormal or difficult labor, causing difficulty in delivering a fetus and/or placenta.

Carcass evaluation: Techniques of measuring components of quality and quantity in carcasses.

Carcass merit: Desirability of a carcass relative to quantity of components (muscle, fat, and bone), USDA Quality Grade and potential eating qualities.

Carcass yield: The carcass weight as a percentage of the live weight.

Carrier: A heterozygous individual having one recessive gene and one dominant gene for a given pair of genes (alleles). For example, an animal with a dominant gene for polledness and a recessive gene for horns will be polled but can produce horned offspring when mated to another animal carrying the gene for horns.

Clinical disease: Visible signs of poor health due to the presence of invading organisms.

Colostrum: The milk secreted by mammalian females for the first few days before and following parturition, which is high in antibodies and laxative.

Compensatory gain: Gain from cattle that have been nutritionally deprived for part or all of their lives. When fed feedlot rations, they compensate for the earlier restriction of feed by gaining very rapidly and efficiently.

Composite or Combination breed: A breed formed from a combination of two or more breeds.

Concentrate: A broad classification of feedstuffs that are high in energy and low in crude fiber (less than 18%).

Conformation: The shape and arrangement of the different body parts of an animal.

Congenital: Acquired during prenatal life. Condition exists at or dates from birth. Often used in the context of congenital (birth) defects.

Contemporary group: A group of cattle that are of the same breed and sex and have been raised in the same management group (same location on the same feed and pasture). Contemporary groups should include as many cattle as can be accurately compared.

Continental breeds: Breeds that originate from Europe (other than British Isles).

Correlation: A measure of how two traits vary together. A correlation of +1.00 means that as one trait increases, the other also increases — a perfect positive relationship. A correlation of -1.00 means that as one trait increases, the other decreases — a perfect negative, or inverse, relationship. A correlation of 0.00 means that as one trait increases, the other may increase or decrease — no consistent relationship. Correlation coefficients may vary between +1.00 to -1.00.

Creutzfeldt-Jakob Disease (CJD): It is a human disease of a class of rare degenerative brain diseases called Transmissible Spongiform Encephalopathies (TSE), some of which affect humans and some of which affect animals. While the agents which cause CJD are poorly understood, CJD occurs spontaneously at a consistent rate worldwide of one case per million persons per year. (Also see new variant CJD.)

Crossbreeding: The mating of animals of one breed or breed combination to dams of another breed or breed combination. Crossbreeding usually results in positive heterosis (hybrid vigor).

Culling: The process of eliminating cattle from a herd, especially because of low productivity or less desirability.

Cutability: An estimate of the percentage of salable meat (muscle closely trimmed of external fat) from the high-valued cuts (round, loin, rib, and chuck) vs. percentage of waste fat. Percentage of retail yield of carcass weight can be estimated by a USDA prediction equation that includes hot carcass weight, ribeye area, fat thickness and estimated percent of kidney, pelvic and heart fat. Also estimated by USDA Yield Grade.

Dark cutter: Refers to the dark appearance of the lean muscle tissue in a carcass and is usually caused by stress (excitement) of the animal prior to harvest.

Dioxin: An organic compound found throughout the world in air, soil, water, and food. It is the by-product of natural events like forest fires and man-made processes, such as manufacturing and vehicle exhaust. Humans are exposed to dioxins through the air they breathe and the water they drink. Humans can also be exposed to dioxins in the food they eat. Due to the efforts of many industries, including beef, human dioxin levels have declined more than 72% during the past 20 years.

Disinfectant: A chemical capable of destroying disease-causing microorganisms or which inactivates viruses.

Dressing percent: (Hot carcass weight divided by live weight) x 100.

Dry matter basis: A method of expressing the level of a nutrient contained in a feed on the basis that the material contains no moisture.

Dystocia (calving difficulty): Abnormal or difficult labor causing difficulty in delivering the fetus and/or placenta.

Ear notching: Makings slits or perforations in an animal's ears for identification purposes.

E. coli 0157:H7: A class of bacteria commonly found in the environment. E. coli 0157:H7 is a virulent strain

of this bacteria found in the intestinal tract and feces in animals and humans. While E. coli 0157:H7 can cause food poisoning, thorough cooking destroys the bacteria. The beef industry continues to develop new technologies and procedures aimed at reducing the risk of E. coli 0157:H7.

Energy feeds: Feeds that are high in energy and low in fiber (less than 18%), and usually contain less than 20% protein.

Environment: All external (non-genetic) conditions, not just climate, that influence the reproduction, production, and carcass merit of cattle.

Established safe level: Concentration of drug metabolite in tissue considered to be without hazard to consumers and below which the FDA normally will not take regulatory action.

Estrous: The female reproductive cycle, averaging 21 days in cattle.

Estrus: Regularly recurrent state of sexual excitability during which the female (cow or heifer) will accept the male (bull). Also called heat.

Estrus synchronization: Causing a group of cows or heifers to exhibit estrus together at one time by artificial manipulation of the estrous cycle.

European Hormone Ban: A ban instituted in 1989 by the European Community (now called the EU) on imported meat and meat products treated with hormones. While the EU continues to argue that the ban is based on health risk, there is no scientific evidence to support their claims. The United States views the ban as an artificial trade barrier erected by the EU to keep imported meat from competing with EU member countries who had created huge surpluses of domestic meat when the ban was initiated.

Expected Progeny Difference (EPD): The difference in performance to be expected from future progeny of an individual, compared with that expected from future progeny of another individual. EPD is an estimate of one-half of the transmittable breeding value of an animal.

Extra-label usage: Administering a drug or other substance in a manner not specified on the label. Can be performed or authorized only by a licensed veterinarian.

F1: Offspring resulting from the mating of a purebred (straightbred) bull to purebred (straightbred) females of another breed.

Fat thickness: Depth of fat in tenths of inches over the ribeye muscle between the 12th and 13th rib interface. It consists of a single measurement at a point 3/4 of the lateral length of the ribeye muscle from the split chine bone.

FDA: The Food and Drug Administration is part of the U.S. Department of Health, Education and Human Services. It is charged with the responsibility of safeguarding American consumers against injury, unsanitary food, and fraud.

Feed conversion (feed efficiency): Units of feed consumed per unit of weight gained; also, the production (meat, milk) per unit of feed consumed.

Fed cattle: Steers and heifers that have been fed concentrates prior to harvest.

Feeder cattle: Young, underfinished animals that will be placed on feed for slaughter.

Frame Score: An estimate of relative skeletal size based on height measured over the hips.

Frame Size: A subjective evaluation of differences in skeletal size, related to estimated slaughter weight at 0.5 inches external fat over the ribeye (predicted to result in low-Choice quality grade).

Freemartin: Female twin born with a male twin calf. Approximately 9.8 out of 10 of these female twins will not be fertile.

Genes: The basic units of heredity that occur in pairs and have their effect in pairs in the individual, but which are transmitted singly (one or the other gene at random of each pair) from each parent to offspring.

Genetic correlations: Correlations between two traits that arise because some of the same genes affect both traits. When two traits (i.e., weaning and yearling weight) are positively and highly correlated to one another, successful selection for one trait will result in an increase in the other trait. When two traits are negatively and highly correlated (i.e., birth weight and calving ease) to one another, successful selection for one trait will result in a decrease in the other trait.

Genotype: Actual genetic makeup (constitution) of an individual determined by its genes or germ plasm. For example, there are two genotypes for the polled phenotype PP (homozygous dominant) and Pp (heterozygote).

Genotype x environment interaction: Variation in the relative performance of different genotypes from one environment to another. For example, the "best" cattle (genotypes) for one environment may not be the "best" for another environment.

Gestation: The period of pregnancy or the period of time from conception until birth.

Hazard Analysis and Critical Control Points (HACCP): A systematic, science-based approach to assuring the production of safe food. The USDA Food Safety and Inspection Service requires all U.S. meat and poultry processing facilities to implement the system.

Heredity: The transmission of genetic factors from parent to offspring.

Heritability: The proportion of the difference among cattle, measured or observed, that is transmitted to the offspring. Heritability varies from 0 to 1. The higher the heritability of a trait, the more accurately does the individual performance predict breeding value and the more rapid should be the response due to selection for that trait.

Heritability estimate: An estimate of the proportion of the total phenotypic variation between individuals for a certain trait that is due to heredity. More specifically, hereditary variation due to additive gene action.

Heterosis (hybrid vigor): Amount by which measured traits of the crossbreds exceed the average of the purebreds mated to produce the crossbreds.

Heterozygous: Genes of a specific pair (alleles) are different in an individual.

Homozygous: Genes of a specific pair (alleles) are alike in an individual.

Hormones: Naturally occurring chemical substances in all animals that affect such things as growth and development. Hormones are present naturally in virtually all foods of plant or animal origin. Growth-promoting hormones utilized by the U.S. beef industry to produce leaner beef more efficiently have the same effect as naturally occurring hormones. Neither naturally occurring hormones nor growth-promoting hormones used in beef production pose any sort of health risk to consumers.

Hot carcass weight: Weight of a carcass before chilling.

Immunity: The ability of an animal to resist or overcome an infection to which most members of its species are susceptible.

Immunization: The process and procedures involved in creating immunity (resistance to disease) in an animal. Vaccination is a form of immunization.

Implants: All growth-promoting hormone products used in the U.S. beef industry are manufactured as implants, which are placed beneath the skin on the back side of an animal's ear.

Intramuscular fat: Fat within the muscle, or marbling.

Intramammary: Placement of drugs and other substances directly into the udder, usually through the teat opening.

Intramuscular injection (IM): An injection into the muscle.

Intrauterine: Placement of drugs and other substances directly into the uterus.

Intravenous injection (IV): Injection of a drug or other substance directly into a vein.

Irradiation: The non-injurious exposure of food to low levels of radiation to eliminate harmful microbes. It destroys fungi, parasites, and insects in and on food.

Kidney, pelvic and heart fat (KPH): Internal carcass fat associated with the kidney, pelvic cavity and heart expressed as percentage of chilled carcass weight. The kidney is included in the estimate of kidney fat.

Labeling: Written information detailing the content, intended use, instructions for use, withholding times and other specifics attached to the drug container and/or on a separate sheet accompanying the container.

Lactation: The period following calving during which milk is formed in the udder.

Lesion: The change in the structure or form of an animal's body caused by disease or an injury.

Marbling: The specks of fat (intramuscular fat) distributed in muscular tissue. Marbling is usually evaluated in the ribeye between the 12th and 13th rib.

Maturity: An estimation of the chronological age of an animal or carcass by assessing the physiological stages of maturity of bone and muscle characteristics.

Medicated feed: Any feed which contains drug ingredients intended or represented for the cure, mitigation, treatment, or prevention of diseases of animals.

Metritis: Inflammation of the uterus.

Microorganism: A living creature, such as a virus or bacterium, capable of being seen only under a microscope.

Microflora: Microbial life characteristic of a region, such as the bacteria and protozoa populating the rumen.

Morbidity: A state of sickness or the rate of sickness.

Mortality: Death or death rate.

Mycotoxins: Toxic metabolites produced by molds during growth, sometimes present in feed materials.

National Cattle Evaluation: Program of cattle evaluation conducted by breed associations to genetically compare animals. Carefully conducted national cattle evaluation programs give unbiased estimates of expected progeny differences (EPDs). Cattle evaluations are based on field data and rely on information from the individual animal, relatives, and progeny to calculate EPDs.

Natural beef: A USDA label used by some beef purveyors. By definition (minimally processed and without food additives), all beef produced in the United States qualifies for the natural label.

New variant CJD (nvCJD): A new form of Creutzfeldt-Jakob Disease (CJD) identified in Great Britain. Some scientists believe it is related to Bovine Spongiform Encephalopathies (BSE), but it is clearly different from normal CJD. There are no documented cases of nvCJD in the United States.

Non-fed cattle: Animals slaughtered without a finishing period, usually cull cows and bulls sold for slaughter.

Number of contemporaries: The number of animals of similar breed, sex, and age against which an animal is compared in performance tests. The greater the number of contemporaries, the greater the accuracy of comparisons.

Offal: All organs or tissues removed from the carcass.

Optimum level of performance: The most profitable or favorable ranges in levels of performance for the economically important traits in a given environment and management system. For example, although some cows may produce too little milk, in every management system there is a point beyond which higher levels of milk production may reduce fertility and decrease profit.

Oral: Placement of a drug or other substance into an animal through its mouth.

OTC: Drugs and other substances that can be bought by anyone over the counter because adequate instructions for safe and effective use by laymen can be printed on the label.

Outcrossing: Mating of individuals that are less closely related than the average of the breed. Commercial breeders and most purebred breeders should be outcrossing by periodically adding new sires that are unrelated to their cow herd. This outcrossing should reduce the possibility of loss of vigor due to inbreeding.

Pathogen: A type of bacteria, such as Salmonella or E. coli 0157:H7, that causes foodborne illnesses.

Palatability: Overall eating satisfaction to be sufficiently agreeable in tenderness, texture, and taste.

Parturition: The act of giving birth or calving.

Pedigree: A tabulation of names of ancestors, usually only those of the three to five closest generations.

Percent calf crop: The percentage of calves weaned within a herd in a given year relative to the number of cows and heifers exposed to breeding.

Performance data: Records of individual animals for reproduction, production, and carcass merit. Traits include things like birth, weaning and yearling weights, calving ease, milk production, marbling, etc.

Pesticide: A broad class of crop protection compounds used to combat insects, fungus, and rodents.

Phenotype: The visible or measurable expression of a character; for example, weaning weight, postweaning gain, reproduction, etc. Genotype and environment influence phenotype.

Phenotypic correlations: Correlations between two traits caused by both genetic and environmental factors influencing both traits.

Polled: Naturally hornless cattle.

ppb: Parts per billion.

ppm: Parts per million.

Postpartum: After the birth of an individual.

Preconditioning: A way of preparing the calf to withstand the stress and rigors of leaving its mother, learning to eat new feeds, and being shipped to a stocker or feedyard operation.

Preweaning gain: Weight gained between birth and weaning.

Prion: A protein molecule found in the membrane of brain cells. Prions are hypothesized by some researchers as the responsible agents for rare degenerative neurological diseases called Transmissible Spongiform Encephalopathies.

Progeny: The offspring of the parents.

Progeny records: Lifetime performance records of progeny of sires and dams.

Progeny testing: Comparison, under the same conditions, of the progeny of more than one parent for purposes of estimating relative breeding value.

Protein supplements: Products that contain more than 20% protein or protein equivalent.

Puberty: The age at which reproductive organs become functionally operating and secondary sex characteristics begin to develop.

Purebred: An animal of known ancestry within a recognized breed that is eligible for registry in the official herd book of that breed.

Qualitative traits: Traits in which there is a sharp distinction between phenotypes, such as black and white or polled and horned. Usually, only one or a few pairs of genes are involved in the expression of qualitative traits.

Quality Grade: An estimate of palatability based primarily on marbling and maturity, and to a lesser extent on color, texture, and firmness of lean.

Quantitative traits: Traits in which there is no sharp distinction between phenotypes, with a gradual variation from one phenotype to another, such as weaning weight. Usually, many gene pairs are involved, as well as environmental influences.

Rate of genetic improvement: Rate of improvement per unit of time (year). The rate of improvement is dependent on: (1) heritability of traits considered, (2) selection differentials, (3) genetic correlations among traits considered, (4) generation interval in the herd and (5) the number of traits for which selections are made.

Recessive gene: Recessive genes affect the phenotype only when present in a homozygous condition. Recessive genes must be received from both parents before the phenotype caused by the recessive genes occurs.

Replacement females: Females entered into a herd to replace loss of numbers from culling or death. May be heifers produced in the herd or animals brought in from outside.

Residues: Remnants of the compounds in drugs and other substances found in fluid, tissues, and feeds.

Retained ownership: Refers to cow-calf producers maintaining ownership of their cattle beyond weaning for growing and/or finishing.

Ribeye area (REA): Area of the longissimus muscle measured in square inches at the 12th rib interface on the beef forequarter.

Rotational crossbreeding: A system of crossing two or more breeds where the crossbred females are bred to bulls of the breed contributing the least genes to that female's genotype. Rotation systems maintain relatively high levels of heterosis and produce replacement heifers from within the system. Opportunity to select replacement heifers is greater for rotation systems than for other crossbreeding systems.

Route of administration (ROA): The method by which a drug or other substance is given to an animal (oral, subcutaneous, intramuscular, topical, etc.).

Rx (prescription drugs): Drugs that must be prescribed by a licensed veterinarian.

Salmonella: A family of bacteria that includes more than 2,000 strains, 10 of which are responsible for most cases of reported illness associated with the bacteria. Salmonella can be found on any raw food of animal origin. Thorough cooking destroys the bacteria.

Sanitary: Clean. Absence of organisms that can cause disease or ill health.

Scurs: Horny tissue or rudimentary horns attached to the skin rather than the bony parts of the head.

Seedstock: Breeding animals.

Seedstock breeders: Producers whose primary role is to produce breeding animals for other producers.

Selection: Causing or allowing certain individuals in a population to produce offspring in the next generation.

Sibs: Brothers and sisters of an individual.

Sire summary: Published comparative results of sires from a breed's national cattle evaluation programs.

Stockers: Calves and yearlings, both steers and heifers, intended for eventual finishing and harvesting, which are being fed and cared for in such a manner to produce growth, rather than finishing. Stockers are usually younger than feeder cattle.

Stress: Any physical or emotional factor to which an animal fails to make a satisfactory adaptation. May be caused by excitement, temperament, fatigue, shipping, disease, hot or cold weather, nervous strain, number of animals together, previous nutrition, breed, age or management. The greater the stress, the more exacting the nutritional requirements.

Subcutaneous (SQ): An injection under the skin.

Systems approach: An approach to evaluating alternative individuals, breeding programs and selection schemes that involves assessment of these alternatives in terms of their net impact on all inputs and output in the production system. This approach specifically recognizes that intermediate optimum levels of performance in several traits may be more economically advantageous than maximum performance for any single trait.

Terminal sires: Sires used in a breeding system where all their progeny, both male and female, are marketed. For example, F1 crossbred dams could be bred to sires of a third breed and all calves marketed. This system allows maximum heterosis and breed complementary, but replacement females must come from outside the herd.

Therapy: Treatment of disease or health disorders.

Tolerance: Maximum legally allowable level or concentration of a drug or chemical in a food product at the time the milk is marketed, or the animal is slaughtered.

Topical: Application of a drug or other substance to the skin surface or an external membrane, usually concentrated in a small area.

Transmissible Spongiform Encephalopathies (TSE): A class of rare, degenerative brain diseases that affect both animals and humans. Human TSEs include Creutzfeldt-Jakob Disease and Fatal Familial Insomnia. Animal TSEs include Bovine Spongiform Encephalopathy in cattle and scrapie in sheep.

Ultrasonic measurements: Used to estimate carcass and reproductive characteristics. Operates off the principle that sound waves echo differently with different densities of tissue.

Yield Grade: Estimate of carcass cutability categorized into numerical categories with 1 being the highest in lean-to-fat ratio and 5 being the lowest.

Vaccination: An injection of vaccine, bacterin, antiserum or antitoxin to produce immunity or tolerance to disease.

Vaccine: A preparation containing microorganisms controlled in such a way as to create a response by the recipient animal's body that results in increased protective immunity.

VCPR: Valid veterinarian-client-patient relationship, in general, meaning that the veterinarian knows and regularly sees the animals and the individual responsible for authorizing medical treatment for those animals agrees to follow the veterinarian's instructions.

Variance: Variance is a statistic that describes the variation we see in a trait. Without variation, no genetic change is possible.

Weaning rate: Number of calves weaned divided by number of cows exposed to a bull.

Weight per day of age (WDA): Weight of an individual divided by days of age.

Withdrawal time: The time required between the application or feeding of a drug or additive and the harvest of the animal to prevent any residue of the drug from remaining in the carcass. Withdrawal times are legally specified by the FDA.

Zero-Tolerance: The standard to which U.S. beef processors must adhere when it comes to fecal and ingesta carcass contamination. In layman's terms, no visible contamination is allowed on beef carcasses. (Executive Summary of the National Non-Fed Beef Quality Audit, 1994. National Cattlemen's Beef Association. Englewood, CO.)

Animal Health Products Inventory (Example)

Date Received	Supplier/Distributor	Product Name	Quantity	Cost	Serial #	Expiration Date

Individual Animal Health Record (Example)

I.D.	Date	Weight	Temp.	Diagnosis	Home Pen	Treatment	ROA*	Dose	Treatment Location	Date of Withdrawal	Initials of Processor

GROUP PROCESSING / TREATMENT MAP

Select SQ products when possible.
Never give an injection in the rear leg or top butt.

Group:_____ **Date:**_____ **ID: Rt. Ear/ Lft Ear:** _____

Booster/Reprocess Date:_____ **Pen/Pasture #:** _____

Class: S / H / Bulls / Cows **Age:**_____ **Weight:**_____ **Hd. Processed** _____

Other Management (√): Castrate___ **Dehorn** ___ **Other** _____ **Crew** _____

Right Left

Product and Company	Lot or Serial #	Exp. Date	ROA*	Dose	Booster Date	Withdrawal Date
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

*ROA – Route of Administration

Comments:

Mass Medication Pen Record (Example)

Group / Pen:_____

Diagnosis	Date(s)	Severity	Product #1	Product #2	Comment	WD	
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

WD = Withdrawal time

Signatures:
1._____ Date _____
2. _____ Date _____
3. _____ Date _____
4. _____ Date _____
5. _____ Date _____
6. _____ Date _____
7. _____ Date _____
8. _____ Date _____

Feed Ingredient Record

Name of Ingredient_____

Date Received	Rec by	Source	Quantity Received	Special ID	Comments
Total (yearly)					

Mass Medication In Feed, Group/Pen Record

Number Cattle _____ Approximate Wt/hd _____ Pen # _____

Approved by: _____ Date: _____

Date	Reason for Medication	Amount Medication	Amount per ton	per head	Total Used	Withdrawal
Total						

Pesticide Inventory Record

Name of Product	Date Received	Rec by	Source	Quantity Received	Special ID	Comments
Total						

Pesticide Use Record

Date	Product	Location	Withdrawal Time	Comments
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Signatures:

1._____ Date _____

2. _____ Date _____

3. _____ Date _____

4. _____ Date _____

5. _____ Date _____

6. _____ Date _____

7. _____ Date _____

8. _____ Date _____

9. _____ Date _____

10._____Date _____

Cattle Movement Record

Date	Number Head Moved	Moved From Where	Moved To Where	Reason for Move	Moved by

Cattle Transfer Record

WD = withdrawal time

Date Received	Rec by	Source	Number of Cattle	Special ID	Shipped to	Date Shipped	WD Checked by