SECTION 5

Reference Section

Tattooing

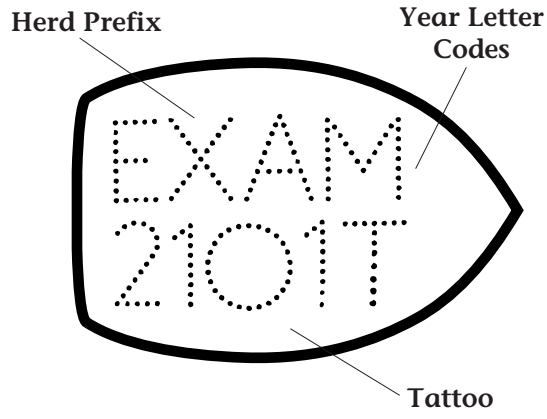
The North American Limousin Foundation requires all cattle submitted to NALF for registration or performance to have an individual tattoo in at least one ear. The tattoo must consist of:

1. The herd prefix assigned by NALF;
2. Individual animal I.D. - up to 4 numbers;
3. Year Letter Code for birth year; **must be the last digit of the tattoo** *(please refer to Registration, page B-8)*

Helpful Management Tips

- Calves should be identified at birth with an ear tag.
- A Limousin tattoo is composed of not more than nine characters applied on two lines, as pictured in Figure E-1.
- For best results, always use fresh tattoo paste that has not been frozen.
- If you want to use a distinct herd identification tattoo other than the registration tattoo, it should not be applied in the ear used for the registration tattoo.
- To guarantee animal identification, tattoos should be checked at weaning and at any other convenient times.
- Use a flashlight when checking hard-to-read tattoos. Press the light to the outside of the ear to illuminate the marks.
- Buyers should check the legibility and verify tattoos with registration certificates before making payment or accepting delivery.
- If any tattoo is unreadable and you are the original owner, re-tattoo the animal in a different ear and notify the NALF office for a certificate correction. Parent verification may be necessary.
- Tattooing equipment may be purchased from livestock supply dealers or directly from the NALF office.
- No two animals of the same sex and herd prefix born in the same year may carry an identical tattoo.
- Animals must be tattooed before applications for registration are submitted.
- Animals must be tattooed with the herd prefix of the original owner.
- Members must report the tattoo exactly as it appears in the animal's ear. For example, the NALF computer differentiates between the following tattoos: EXAM 0003S, EXAM 03S, EXAM3S.

Figure E-1.



How to Tattoo

1. You'll need: a means of restraining the animal's head, tattoo pliers - available from NALF or any livestock supply dealer, necessary tattoo digits and letters for prefix and year, alcohol to clean equipment, green or black tattoo paste (green works best for black cattle) and a rag or sponge to remove ear wax and dirt.
2. Keep it clean. Using alcohol or another disinfectant to clean your equipment will help prevent the spread of warts. Alcohol will also help clean the ear surface.
3. Check and double-check. Check your records to be sure that you're placing the right tattoo in the animal. Use a piece of cardboard to double-check the order of digits in your tattoo pliers.
4. Clean the inside of the ear with a sponge or heavyweight cloth and alcohol.
5. Select a site for the tattoo between the midribs and away from the outer edge of the ear where hair will interfere. The lower section of the right ear should be reserved for Brucellosis vaccination tattoos in heifers (Kansas uses the lower left ear).
6. Position the tattoo pliers parallel with and between the midribs and press hard. Release quickly to avoid tearing.
7. Use plenty of ink and rub it in with your fingers or an old toothbrush. Some people like to pre-ink the tattoo site and then rub it in after applying the tattoo. Be sure all the needle holes have ink.

Cowboy Genetics

Like all other mammals, beef cattle are made up of many different types of cells. To geneticists, the most important part of the cell is the nucleus, which contains chromosomes. These chromosomes contain genes, which determine the heredity of the animal. Chromosomes occur in pairs, and cattle have 30 pairs of chromosomes, therefore, each cell contains 60 chromosomes. Sperm and ovum (eggs) are different, however. These cells contain only one chromosome from each pair, or 30 single chromosomes. When the cow is bred and her egg is fertilized by a bull's sperm, the embryo will contain 30 pairs of chromosomes, one of each pair from the bull, and the other of each pair from the cow.

There are possibly several hundred or several thousand genes on each chromosome. Genes, like chromosomes, occur in pairs. The place where a gene is located on the chromosome is called a "locus". At any locus there are two genes, one on each chromosome. Genes are responsible for controlling, to a greater or lesser degree, growth rate, feed efficiency, coat color, disposition, conformation, and about all other functions of the animal. Traits like birth weight are influenced by a large number of genes. We're going to discuss two traits that are influenced by a single gene pair, horns and color.

Color

Due to upgrading programs within the Limousin breed, both black and red purebred Limousin cattle exist today. This difference in color is influenced by a single gene pair. Let's call the gene responsible for black color **B,** and the gene for red color, or absence of black, **b.** When an animal has both genes for black or both genes for red at the same locus, **BB** or **bb,** we say he is **homozygous.** When an animal has a black gene **B** and a red gene **b** at the same locus, **Bb,** we say he is **heterozygous.** The black gene, **B,** is dominant to the red gene, **b.** When we say 'black is dominant', this means every time the **B** gene appears on an animal's chromosome, the animal will be black in color. For example, both the homozygous black and the heterozygous animal will exhibit the black color. Only the homozygous red animal, **bb,** will exhibit the red color. The animals will pass one of these genes for color onto their offspring. The homozygous black animal, **BB,** will always pass on the black gene. Likewise, the homozygous red animal **bb,** will always pass on the red gene. The heterozygous animal, **Bb,** however, could pass either the black or the red gene on to its offspring. Please refer to Figures E-2 and E-3 on the next page to see how this gene is inherited.

Horned vs. Polled

Like color, polledness is controlled by a single gene pair. The polled condition is dominant to horned. Let's call the polled gene **P,** and the horn gene **p.** The only time an animal will exhibit horns is in the homozygous recessive case, or **pp.** Both the homozygous dominant **PP,** and the heterozygous **Pp,** animals will be polled. Again, please refer to Figures E-4 and E-5 on page E-5.

Scurs

Scurs and smooth polledness (lack of scurs) are separate traits from the horned and polled conditions. Scurs are incompletely developed horns which are generally loose and moveable beneath the skin. In older animals, they may become attached to the skull. Inheritance of scurs is a separate process from inheritance of horns, and involves a different set or sets of genes. Let's call the genes controlling the presence of scurs **Sc,** and the absence of the scur gene **Sn.** The presence or absence of the gene for scurs has no effect on the horned or polled genes. Some horned cattle have the gene for scurs, **Sc,** but its presence is hidden by the horn growth.

The inheritance of the scur gene is more complicated than horns or color. The scurred condition may be affected by more than one pair of genes. In addition, males and females express the gene differently. In males, the scur gene is dominant, or the presence of a single scur gene **Sc** will cause a bull to be scurred. In females, the scur gene is recessive, or the cow must possess two **Sc** genes to be scurred. If the cow is heterozygous, **ScSn,** she will not be scurred but she may pass the scur gene on to some of her calves. A heterozygous cow may be detected if she produces a scurred bull calf from a smooth polled bull. Please refer to the following table which explains the inheritance of scurs:

Inheritance of Scurs

Genetic makeup of animal	Cows	Bulls
Sc Sc	Scurred Polled	Scurred Polled
Sc Sn	Smooth Polled	Scurred Polled
Sn Sn	Smooth Polled	Smooth Polled

GENETICS: Inheritance of Color

Figure E-2.
Offspring of a red sire mated to a red dam and a red sire mated to a heterozygous black dam.

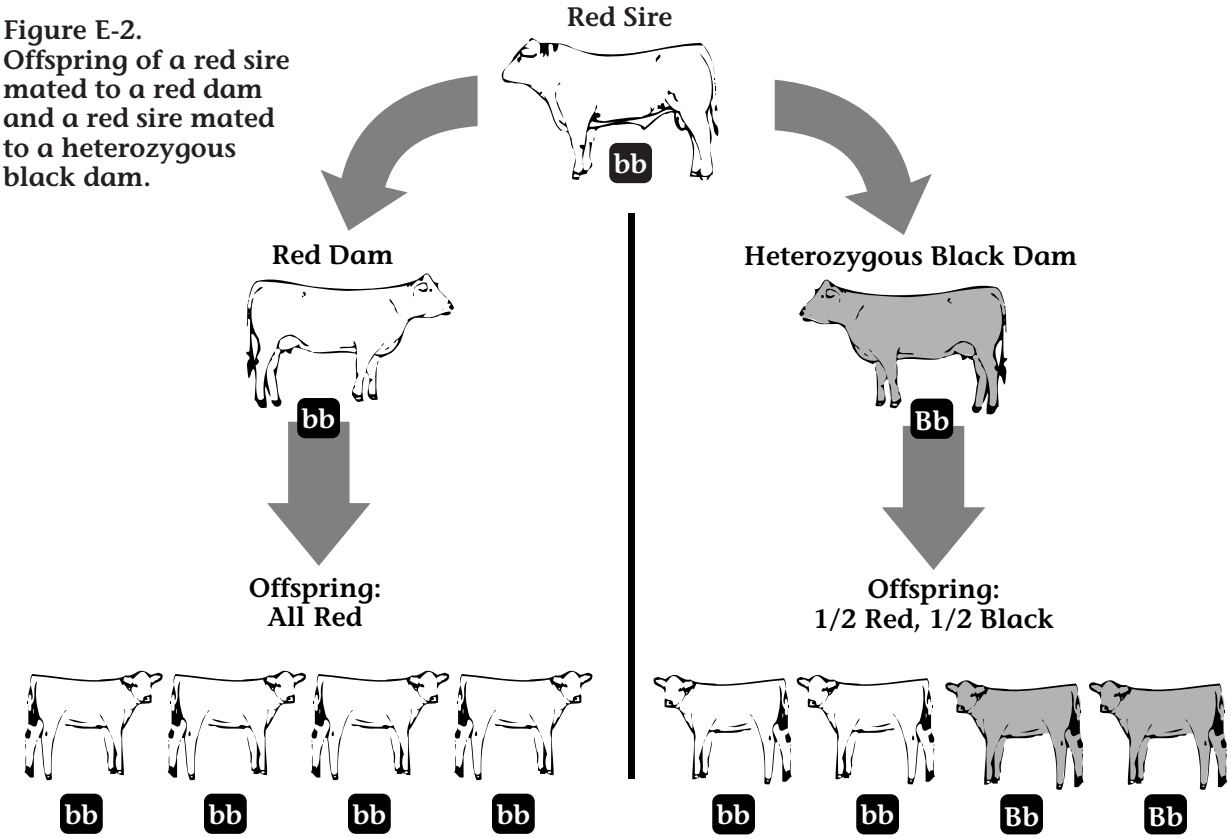
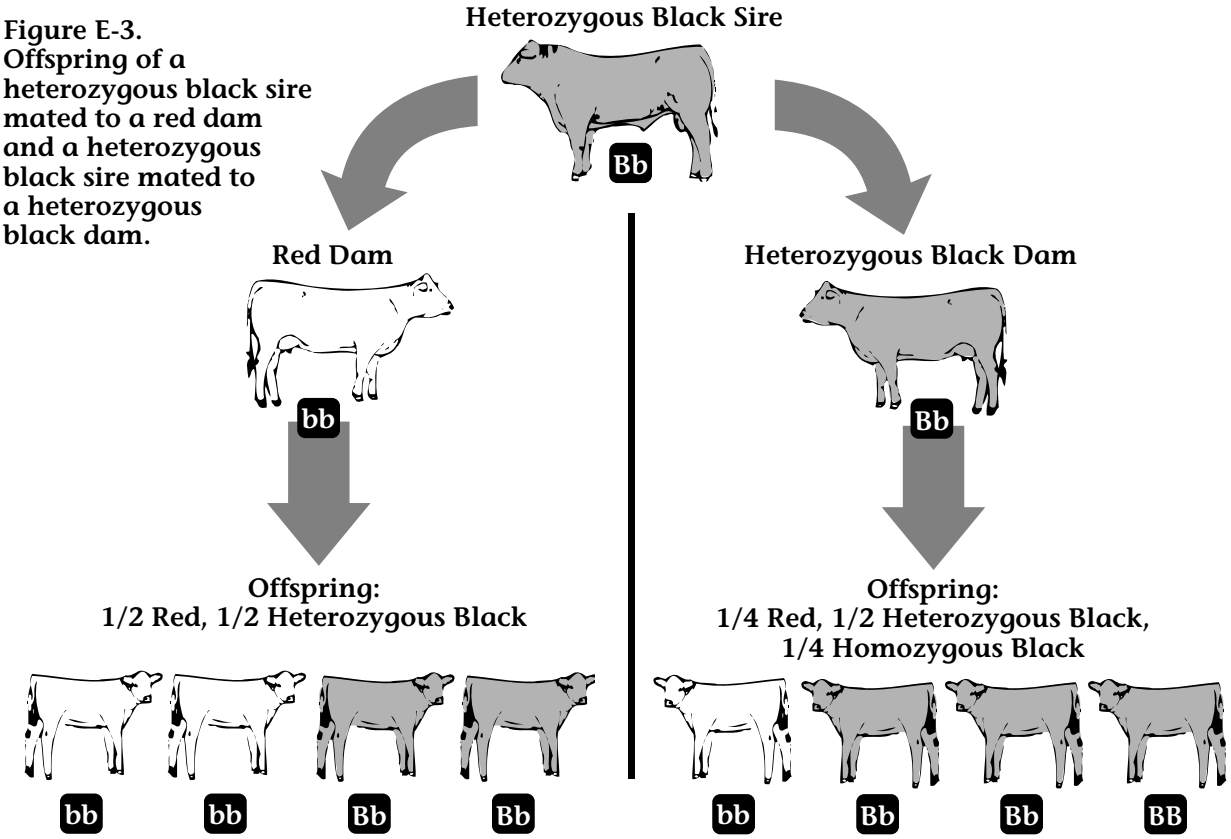


Figure E-3.
Offspring of a heterozygous black sire mated to a red dam and a heterozygous black sire mated to a heterozygous black dam.



GENETICS: Horned vs. Polled

Figure E-4. Offspring of a horned sire mated to a horned dam and a horned sire mated to a heterozygous polled dam.

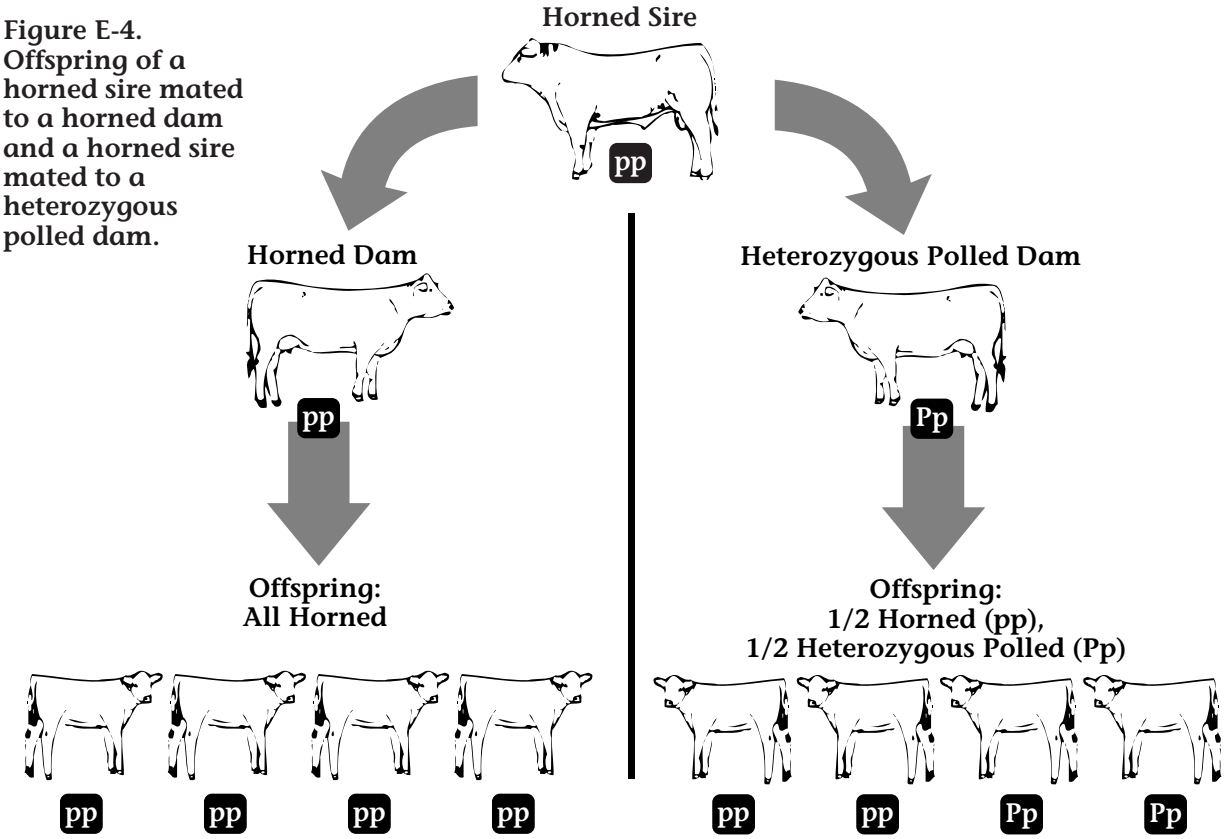
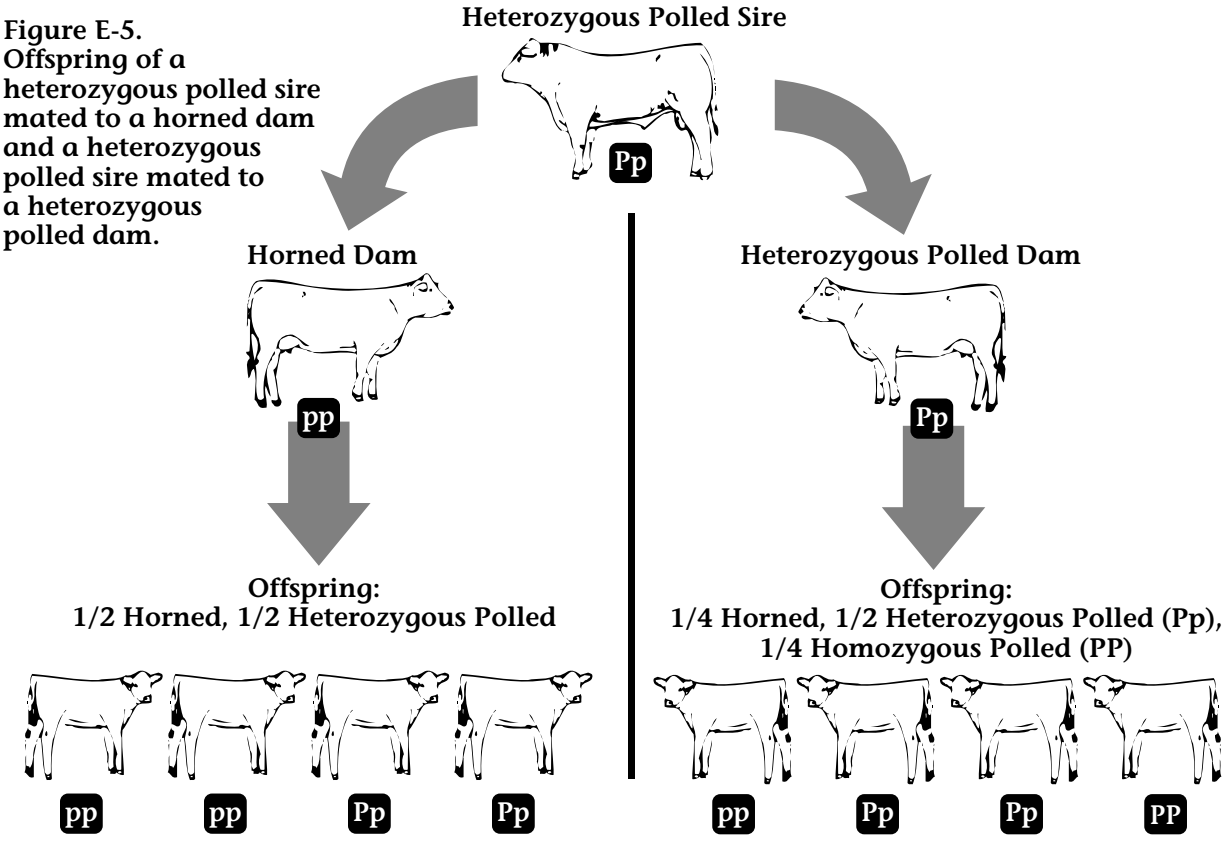


Figure E-5. Offspring of a heterozygous polled sire mated to a horned dam and a heterozygous polled sire mated to a heterozygous polled dam.



Birth Weight

What?

The collection of actual birth weight in pounds.

When?

Actual birth weight should be taken within 48 hours of birth.

Why?

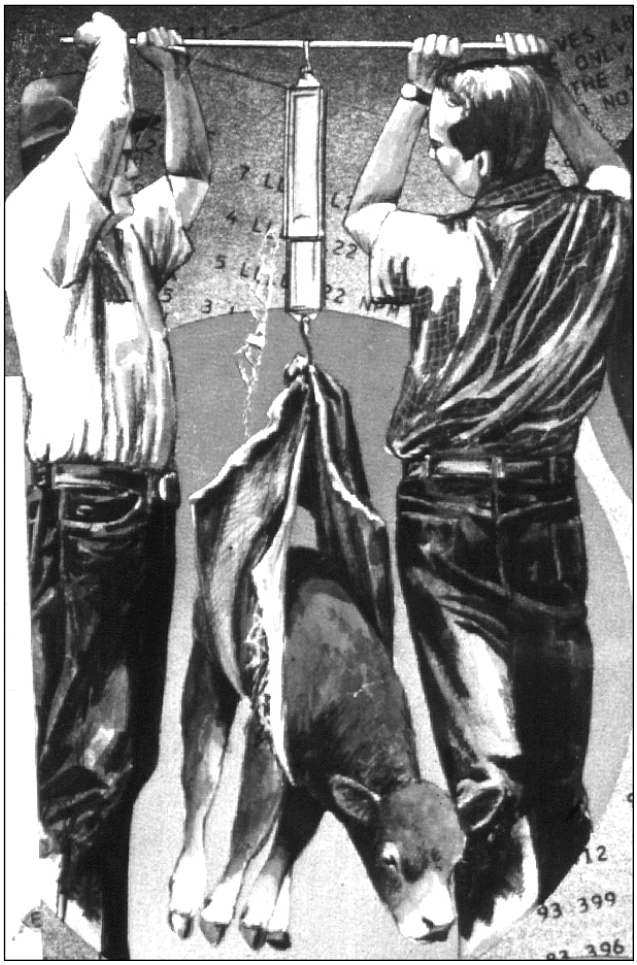
Calving difficulty primarily occurs in first-calf heifers. Research indicates that the birth weight of the calf is the single most influential factor involved in causing calving problems. In turn, calving difficulty is associated with increases in calf death loss, susceptibility to disease in calves, veterinary and labor costs, delayed return to estrus, lower conception rates, and cow mortality. These problems can be minimized by reporting accurate birth weight information and using EPDs for birth weight when making selection decisions. Animals with lower birth weight EPDs are expected to produce calves which weigh less at birth and are born with less calving difficulty. Limousin breeders are encouraged to breed cattle with sensible birth weights through the use of birth weight EPDs, in order to maintain the commercial acceptability of Limousin cattle.

How?

Actual birth weight is taken with a birth weight scale. **Do not estimate birth weight visually or through the use of a hoof measurement tape.** The illustration on this page demonstrates the method for weighing calves.

How the weights are used...

Actual birth weights which you report are adjusted for the age of dam by the NALF computer. It has been documented that cows reach maturity, as measured by the weight of their calves, between approximately 4 to 10 years of age. Prior to reaching this point, dams may allocate more of their nutritional intake towards their own growth, development and maturation. Thus, adjustments are made to more accurately



reflect the genetics a calf possesses for birth weight. Continuous age of dam adjustments are applied according to the formulas described on page E-9 of this manual. These equate closely to the values provided in the table below:

Age of Dam (Years)	Pounds of Adjustment Bulls	Heifers
2	+6	+5
3	+4	+3
4	+2	+2
5	+1	+1
6 to 11	0	0
12 & older	+1	+1

Weaning Weight

What?

The collection of actual weaning weight in pounds.

When?

All calves in a contemporary group should be weighed on the same day, when the youngest calf is at least **160** days old and the oldest calf is not over **250** days of age. Use the date calculation wheel, provided with your original Member's Manual, to determine the possible dates for weighing the calves. If you have more than a 90-day range in birth dates, either weigh the calves as two contemporary groups, or select a date when the largest number of calves or the oldest calves will be within the 90-day group.

Why?

Pre-weaning growth is influenced by genes for growth, passed on by the sire and dam, and the milk provided by the dam. Weaning weights are used to evaluate an animal's ability to transmit genetics for early growth and his daughter's ability to produce milk. Because weaning weight is moderately heritable, placing selection pressure on weaning weight EPDs will produce results. Recommendations made at the Leader's Edge Directions Symposium suggest that Limousin breeders make mating decisions that will produce bulls with a minimum adjusted 205 day weaning weight of 550 lbs. while keeping all progeny within the window of acceptability of birth weight and frame size.

How?

Actual weaning weight is taken with a livestock scale. ***Do not estimate weaning weight.***

How the weights are used...

Actual weaning weights are adjusted to 205 days by the NALF computer using the formula in Figure E-6.

Adjustments are also made for the age of dam, according to the formulas on pages E-10 and E-11 of this manual. The adjustments shown in Figure E-7 correspond closely to those computed by these formulas for the various ages of dams.

Figure E-6.
Weaning Weight Formula

$$\text{Adjusted 205 day Weight} = \left[\left(\frac{\text{Actual Weaning Wt.} - \text{Actual* Birth Wt.}}{\text{Age in Days}}\right) \times 205\right] + \text{Birth Wt.} + \text{Age of Dam Adjustment}$$

**If birth weight is not available, a standard birth weight of 80 lbs. for heifers and 85 lbs. for bulls is used in the adjusted 205 day weaning weight formula.*

Figure E-7.
Weaning Weight Adjustments for Age of Dam

Age of Dam	Bulls Non Creep	Bulls Creep	Heifers Non Creep	Heifers Creep	Steers Non Creep	Steers Creep
2	53.0	50.0	42.0	40.0	53.0	50.0
3	32.0	32.0	26.0	25.0	32.0	32.0
4	16.0	18.0	13.0	14.0	16.0	18.0
5	6.0	8.0	5.0	6.0	6.0	8.0
6	0.7	2.0	0.6	1.6	0.7	2.0
7	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
9	0.2	0.2	0.1	0.1	0.2	0.2
10	3.0	3.0	2.7	2.7	3.0	3.0
11 & up	9.0	9.0	8.4	8.4	9.0	9.0

Yearling Weight

What?

The collection of actual yearling weight in pounds.

When?

All animals in a contemporary group should be weighed on the same day. Yearling weights must be taken at least 140 days after weaning, when the youngest animal is at least 330 days of age and the oldest animal is not over 450 days of age. Use the date calculation wheel provided with your original Member's Manual to find the earliest possible date yearling weight data may be collected.

Why?

Postweaning gain is influenced by genes an animal has inherited for growth. Yearling weight is the trait most closely associated with growth potential through market age and weight. Feeders are very interested in cattle that will not only gain efficiently, as do most Limousin, but also cattle that will gain rapidly. In order to better respond to this industry need, recommendations made at the Limousin Directions Symposium suggest that breeders produce bulls with a minimum 1,000 lbs. adjusted yearling weight. As with selection for higher weaning weight, caution should be taken to keep progeny within an acceptable range for birth weight and frame size.

How?

Actual yearling weight is taken with a livestock scale. ***Do not estimate yearling weight.***

How the weights are used...

Actual yearling weights are adjusted to 365 days by the NALF computer, using the formula in Figure E-8.

Figure E-8.
Yearling Weight Formula*

$$\text{Post-weaning ADG} = \frac{\text{Actual Yearling Wt.} - \text{Actual Weaning Wt.}}{\text{Number of days between weights}}$$

$$\text{Adjusted 365 Day Weight} = (\text{Post-weaning ADG} \times 160) + \text{Adjusted 205 Day Wt.}$$

**Refer to Figure D-13 on page D-17 for the formula used to calculate adjusted 365 day weights for animals which did not have a weaning weight reported.*

University of Georgia
Age of Dam Adjustment Factors
for Birth and Weaning Weight

What?

The continuous age of dam (AOD) adjustment factors used by NALF and the University of Georgia (UG) to calculate adjusted birth and weaning weights.

When?

During routine data processing at NALF and prior to each National Limousin Genetic Evaluation at the University of Georgia, the continuous AOD adjustments are used to correct birth and weaning weights for the age of each animal's dam in days of age.

Why?

Casual observation tells us that, on average, young cows produce calves which weigh less at birth and weaning than middle-aged cows. Young cows are still trying to grow, develop and mature. This affects the birth and weaning weights of their calves and requires that adjustments be made to the weights in order to accurately determine genetic differences.

How?

Figure E-9 graphically illustrates the AOD adjustments applied by NALF and the University of Georgia (UG) to birth weights of bull and heifer calves. The adjustments in figure 1 are a graphic representation of the following formulas used by the UG, considering AOD in days.

Equation for birth weight age of dam (AOD) adjustments – Bulls

*NOTE: In the following equations, * means to multiply; **2 is the same as raise to the second power*

If AOD < 650 days, then AOD = 650 days,

If AOD < 2245 days, then AOD adjustment = (–(.01227263*(AOD–2245)))–((–.00000273)*((AOD**2)–(2245**2))),

If AOD > 5000, then AOD = 5000,

If AOD > 3400, then AOD adjustment = (–(–.00065018*(AOD–3400)))

Equation for birth weight age of dam (AOD) adjustments – Heifers

If AOD < 650 days, then AOD = 650 days,

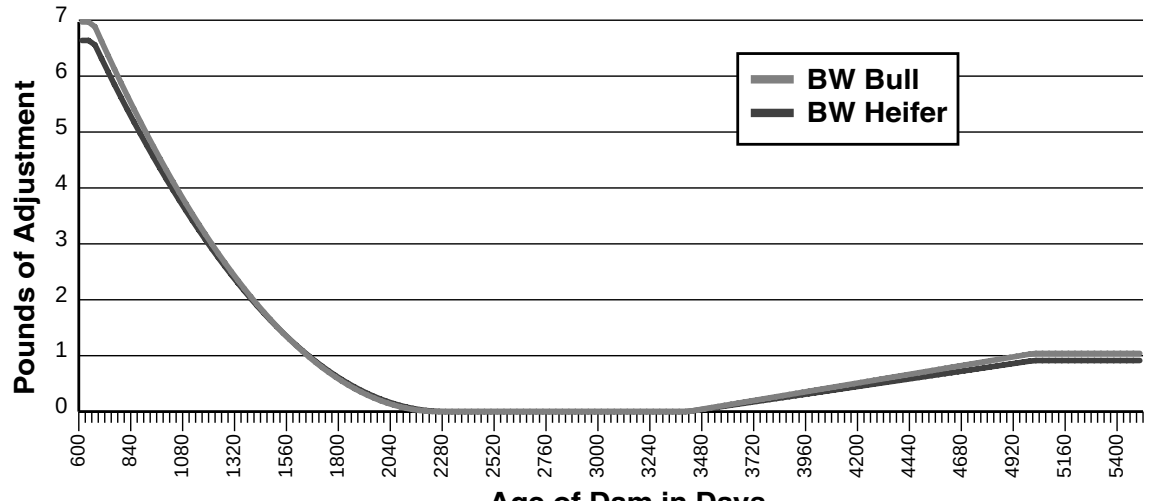
If AOD < 2276 days, then AOD adjustment = (–(.01139747*(AOD–2276)))–((–.00000250)*((AOD**2)–(2276**2))),

If AOD > 5000, then AOD = 5000,

If AOD > 3400, then AOD adjustment = (–(–.00057088*(AOD–3400)))

Birth weight AOD adjustment factors derived according to these equations by NALF and the UG are added to the actual birth weight to obtain the adjusted birth weight.

Figure E-9.
Birth Weight Age of Dam Adjustment



Similar to AOD adjustments for birth weight, NALF and the UG use a more refined procedure for making AOD adjustments to weaning weights. Again, NALF and the UG consider the AOD in units of days, rather than rounding the age of dam to the nearest year of age. Figures E-10 and E-11 graphically illustrate the AOD adjustments used for bull and heifer calves, both creep fed and not creep fed. These figures were derived using the following formulas:

Equation for Adjusted 205 Day Weaning Weight – Bulls, No Creep

If AOD < 650 days, then AOD = 650 days,

If AOD < 2401, then AOD adjustment = (–(.0979713*(AOD–2401)))–((–.0000204)*((AOD**2)–(2401**2))),

If AOD > 5000 days, then AOD = 5000 days,

If AOD > 3400 days, then AOD adjustment = (–(–.0101063*(AOD–3400))),

Equation for Adjusted 205 Day Weaning Weight – Bulls, Creep

If AOD < 650 days, then AOD = 650 days,

If AOD < 2578, then AOD adjustment = (–(.0800666*(AOD–2578)))–((–.0000155)*((AOD**2)–(2578**2))),

If AOD > 5000 days, then AOD = 5000 days,

If AOD > 3400 days, then AOD adjustment = (–(–.0101063*(AOD–3400))),

Equation for Adjusted 205 Day Weaning Weight – Heifers, No Creep

If AOD < 650 days, then AOD = 650 days,

If AOD < 2398, then AOD adjustment = (–(.0778380*(AOD–2398)))–((–.0000162)*((AOD**2)–(2398**2))),

If AOD > 5000 days, then AOD = 5000 days,

If AOD > 3400 days, then AOD adjustment = (–(–.0095215*(AOD–3400))),

Equation for Adjusted 205 Day Weaning Weight – Heifers, Creep

If AOD < 650 days, then AOD = 650 days,

If AOD < 2575, then AOD adjustment = (–(.0640831*(AOD–2575)))–((–.0000124)*((AOD**2)–(2575**2))),

If AOD > 5000 days, then AOD = 5000 days,

If AOD > 3400 days, then AOD adjustment = (–(–.0095215*(AOD–3400))),

The age of dam adjustment factors for weaning weight, as determined by the above formulas are used in the adjusted 205 day weight calculation formula by NALF and the UG. In turn, these 205 day adjusted weights are used in the calculation of adjusted 365 day weights, for purposes of calculating EPDs.

Figure E-10.
Weaning Weight Age of Dam Adjustments for Creep Bulls and Heifers.

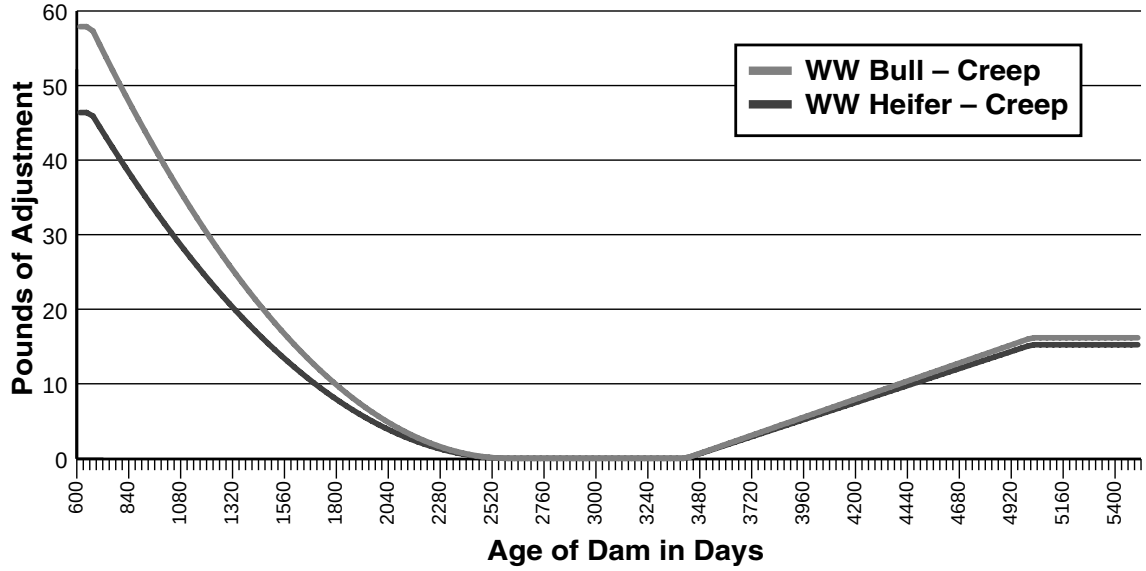
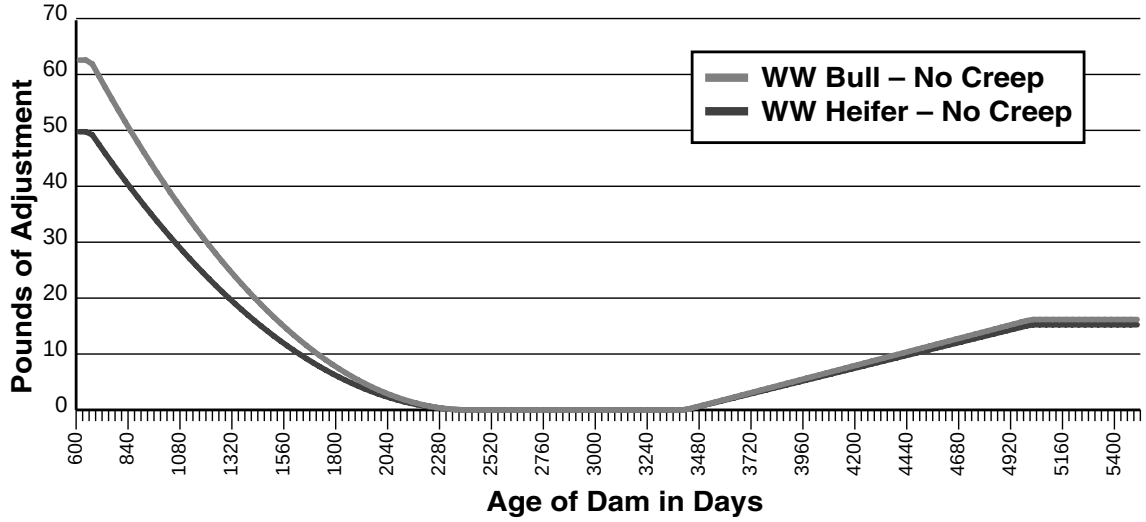


Figure E-11.
Weaning Weight Age of Dam Adjustment for No Creep Bulls and Heifers



Scrotal Circumference

What?

Measuring the scrotal circumference of a bull in centimeters.

When?

Actual scrotal circumference should be measured between 330 and 450 days of age and at least 140 days after weaning weights were calculated.

Why?

Scrotal circumference is a trait that can be utilized to increase fertility in cattle since it is easily measured at young ages, is moderately to highly heritable (approximately 40 percent of observed phenotypic differences are genetic), and is favorably related to growth and reproduction. Research indicates that testicle size is an excellent indicator of age at puberty of a sire's daughters, and is also related to seminal quantity and quality. Moreover, ongoing research has revealed that for every 1 cm increase or decrease in scrotal circumference EPD, a corresponding 30 day (+/- 9 days) change in age of puberty of daughters can be expected. In the Limousin Breed Recommendations manual, breeders are encouraged to market only bulls with a minimum scrotal measurement of 32 centimeters and greater, adjusted to 365 days of age.

How?

Scrotal circumference is measured by using a scrotal tape, available through the NALF office. The correct method for measuring scrotal circumference is illustrated in Figure E-13.

How the measurements are used...

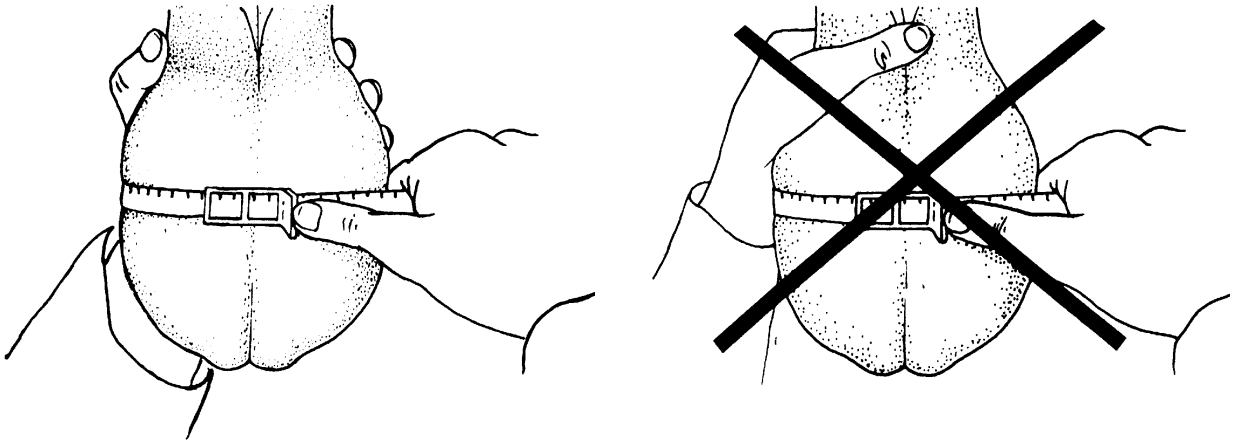
NALF adjusts actual scrotal circumference measurements to a standard 365 day age and mature dam equivalent. Research has shown that the yearling scrotal measurements of bulls from young dams (2 and 3 year olds) and old dams (11 and older) are smaller for environmental reasons and should be adjusted upward. Presumably, this effect is due to lower milk production for cows in these age categories. The formula in Figure E-12 is used to calculate adjusted yearling scrotal circumference.

Age of Dam (AOD) (Years)	Centimeters (cm) of Scrotal Circumference (SC) Adjustment
2	+.52
3	+.42
4 to 10	0
11 & Older	+.35

Figure E-12.
Yearling Adjusted Scrotal Circumference Formula

Yearling Adjusted SC = Actual SC + .0467 cm/day (365 – age) + SC Age of Dam Adjustment

Figure E-13.
Correct Method for Measurement of Scrotal Circumference.



Pelvic Area

What?

Measuring pelvic dimensions, calcuating yearling adjusted pelvic area and using pelvic information.

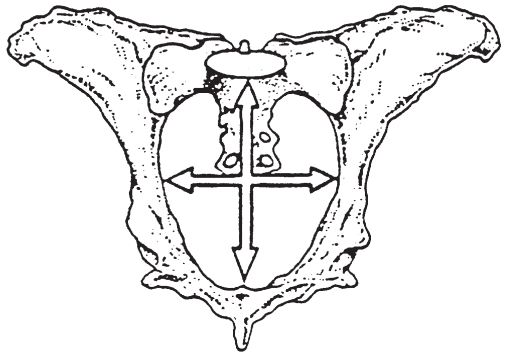
When?

Pelvic measurements should be taken at the same time yearling weights are collected, between 330 and 450 days of age, using the same guidelines for collection of other yearling information.

Why?

A number of theories exist regarding the use of pelvic measurements in addressing problems with calving difficulty. As a starting point, research indicates that the birth weight of the calf is four to five times more important than the pelvic dimensions of the dam in determining calving difficulty. In heifers, research suggests that pelvic information be predominately used as a culling tool to eliminate those females with small birth canals that would run a high risk of dystocia or problems calving. As a general rule, heifers should have a minimum 140 cm measurement adjusted to one year of age. This guideline carries with it numerous points of caution. Foremost, some research indicates that culling based on the width and height of the pelvic girdle, as opposed to its calculated area, may be more effective in avoiding calving problems. Further, it is noteworthy that excessive birth weight is a much greater contributor to dystocia than is pelvic area. When using pelvic area as a selection criteria, it is important to note that it is positively correlated to birth weight, mature body weight and frame size and may result in increasing the mature size of the cow herd. When selecting bulls, it is difficult to know exactly how pelvic information should be used. The idea is to select bulls which sire daughters with the potential to calve easily, due to genetics for low birth weight, combined with genetics for large pelvic size inherited from the sire. Avoid selecting sires with high birth weight EPDs and small pelvic areas if daughters are to be retained as replacements. For more information, contact the NALF office.

Figure E-14.
Pelvic Area Measurement.



How?

Pelvic dimensions are determined by internal measurements which require entering the animal from the rectum with a measuring device called the Rice Pelvimeter (see Figure E-15). Since the measurement requires experience and knowledge of the animal's internal anatomy, a veterinarian's or experienced technician's supervision is recommended. Figure E-14 represents the area being measured:

Both vertical and horizontal measurements are taken, and the two are multiplied together to obtain the pelvic area.

The Rice Pelvimeter (Figure E-15) may be ordered by contacting Lane Manufacturing, Denver, Colorado, 303-745-2603.

Figure E-15.
The Rice Pelvimeter

Art courtesy of:
Lane Manufacturing, Inc.

How Adjusted Pelvic Areas Are Calculated

Research has demonstrated that even though the shape of the pelvis is not square, the product of the height and width measurements adequately describes the pelvic area. Pelvic areas are adjusted by the NALF computer to a constant 365 days of age, using the following adjustment formula:

Adjusted 365 day pelvic area =
actual pelvic area +
growth coefficient* x (365 – actual age)

***The growth coefficient is .27cm2/day for heifers and .25cm2/day for bulls.**

Height & Frame Score

What?

Measuring hip height in inches and calculating frame score.

When?

Animals' heights should be taken when collecting weaning and/or yearling weights.

Why?

Frame size is highly correlated with mature size, age and weight at puberty, and slaughter and carcass weights. Cattle should be selected to perform efficiently in a given environment and to meet specific endpoints. It is generally accepted that with increasing frame score comes increasing mature size of cows and consequently higher nutritional requirements for maintenance. At the same time, under conditions where ample feed is available, larger mature cows are able to produce more pounds of calf at weaning. The key is to choose cattle that are "sized" right for both the producer's environment and that of his/her customers. In the future, given narrowing acceptability in terms of carcass weights, commercial producers will continue to favor moderate frame.

How?

Hip height is taken by measuring the animal between the hooks, using a measuring stick. For an accurate measurement, cattle should stand squarely with even weight distribution. The photo below illustrates this procedure.

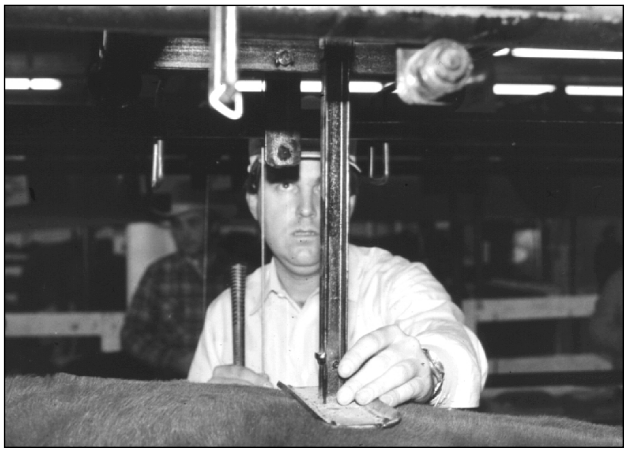


Figure E-15.
Frame scores can be useful in projecting mature weights of cattle. Use the following table to calculate frame scores.

Bulls

Age in Months		Frame Score 5	6	7	8	9
	5	41.9	44.4	46.9	49.5	52.0
	6	42.9	45.4	47.8	50.3	52.8
	7	43.8	46.2	48.7	51.1	53.6
Weaning	8	44.6	47.1	49.5	51.9	54.3
	9	45.5	47.9	50.2	52.6	55.0
	10	46.2	48.6	51.0	53.3	55.7
	11	47.0	49.3	51.7	54.0	56.3
	12	47.6	50.0	52.3	54.6	56.9
Yearling	13	48.3	50.6	52.9	55.2	57.5
	14	49.0	51.2	53.5	55.8	58.0
	15	49.6	51.8	54.0	56.3	58.5
	16	50.1	52.3	54.6	56.8	59.0
	17	50.6	52.8	55.0	57.2	59.5
	18	51.1	53.3	55.5	57.7	59.9
	19	51.6	53.8	55.9	58.1	60.2
	20	52.0	54.2	56.3	58.5	60.6
	21	52.5	54.6	56.7	58.8	60.9
	22	52.8	54.9	57.0	59.1	61.2
	23	53.2	55.3	57.3	59.4	61.5
	24	53.5	55.6	57.6	59.7	61.7
	36	55.7	57.5	59.3	61.2	63.0

Hip Height in inches

Females

Age in Months		Frame Score 5	6	7	8	9
	5	41.7	44.0	46.3	48.5	50.8
	6	42.5	44.7	47.0	49.3	51.5
	7	43.2	45.4	47.7	49.9	52.5
Weaning	8	43.9	46.1	48.4	50.6	52.8
	9	44.6	46.8	59.0	51.2	53.4
	10	45.2	47.4	49.6	51.8	54.0
	11	45.8	48.0	50.2	52.4	54.6
	12	46.4	48.6	50.8	52.9	55.1
Yearling	13	47.0	49.1	51.3	53.5	55.6
	14	47.5	49.6	51.8	54.0	56.1
	15	48.0	50.1	52.3	54.4	56.6
	16	48.5	50.6	52.7	54.9	57.0
	17	48.9	51.1	53.2	55.3	57.4
	18	49.4	51.5	53.6	55.7	57.8
	19	49.8	51.9	54.0	56.1	58.1
	20	50.2	52.3	54.3	56.4	58.5
	21	50.5	52.6	54.7	56.7	58.8
	22	50.9	52.9	55.0	57.0	59.1
	23	51.2	53.2	55.3	57.3	59.4
	24	51.5	53.5	55.6	57.6	59.6
	36	53.5	55.4	57.3	59.2	61.1

Hip Height in inches

Protoporphyria in Limousin Cattle

Users of Limousin genetics are fortunate for more than the genetic merits of the breed which continue to draw increased interest. Users are fortunate because the breed is relatively free of genetic defects.

While all animal populations will spawn isolated examples of genetic abnormality from time to time, so far only one genetic abnormality of any magnitude has been documented in the Limousin breed. What's more, since protoporphyria was discovered in 1978, rather than sweeping it under the rug, the North American Limousin Foundation (NALF) and its membership have researched and openly discussed the problem. In 1994, that research resulted in the development of a DNA test at the University of Missouri which identifies carrier animals and makes it possible to identify carriers of the defective gene and thus manage protoporphyria.

What It Is

Protoporphyria is the only genetic abnormality of any magnitude documented in the Limousin breed. It is a genetic disease, heritable in both the bovine and human species. Protoporphyria is not a communicable disease. While the disease has been documented in other breeds of cattle, it seems to be most prevalent in the Limousin breed.

In a nutshell, protoporphyria is caused by a deficiency in the activity of the enzyme ferrochelatase which in turn leads to high levels of free-porphyrin in the blood.

The bottom line is that protoporphyria is not a physical defect; it is an inherited metabolic disease of the blood.

Diseased animals can express a number of physical symptoms, most notably, extreme sensitivity to sunlight. The skin on the ears and nose of diseased calves may exhibit lesions or weeping sores, then scabs. The hair is usually missing from the tips of the ears, and sores may also develop above the eyes and on spots on the back where the hair is thin or parted. Calves with protoporphyria will actively avoid the sunlight and seek shade if possible. If shade is not available, calves may stop eating. In extreme cases, calves will starve themselves to death. Exposed to sunlight, diseased calves can start exhibiting the above symptoms within days of being born.

Its Incidence

Estimates put the incidence of protoporphyria carriers in the Limousin breed at somewhere around 2 percent.

While the incidence is low, keep in mind this is a best guess based off of the number of known diseased calves reported to NALF. What's more, the mode of inheritance means as many as 20 percent of some herds may be carriers of the disease.

How It's Inherited

All research since 1978 paints the inheritance of protoporphyria as a simple recessive that involves only a single pair of genes.

If you already understand how polledness and color are inherited, you're three steps ahead because protoporphyria is inherited the same way, with the normal gene (N) being dominant to the defective (d) gene.

For those of you who would like a more detailed description of basic genetics, here goes:

Strictly by the book, a simple recessive mode of inheritance involves only a single pair of genes, one that is passed on by the sire and one that is passed on by the dam. Let's use the polled/horned trait as an example. A calf will inherit one gene, either horned (p) or Polled (P) from each of its parents. The polled gene is dominant to the horned, so both homozygous polled (PP) and heterozygous (Pp) animals will be polled. Only homozygous recessive (pp) animals will be horned.

All indications are that inheritance of the gene for protoporphyria works essentially the same way. Both parents pass along one gene, either proto-normal (N) or proto-defective (d) to their offspring. The proto-normal gene is dominant to the proto-defective gene. Consequently, heterozygous (Nd) offspring will appear normal, yet are carriers of protoporphyria, and homozygous defective (dd) offspring will be diseased. Only homozygous (NN) proto-free calves will carry no defective genes.

Confusion sometimes creeps into this scenario because carrier (Nd) animals do not exhibit the physical symptoms of the disease. To the naked eye, carrier (Nd) animals appear the same as proto-normal (NN) animals because the proto-normal (N) gene is dominant to the proto-defective (d) gene.

Figures E-16 and E-17 show the results of possible matings.

GENETICS: Inheritance of Protoporphyria

Figure E-16. Offspring of a normal sire mated to a normal dam and a normal sire mated to a carrier dam

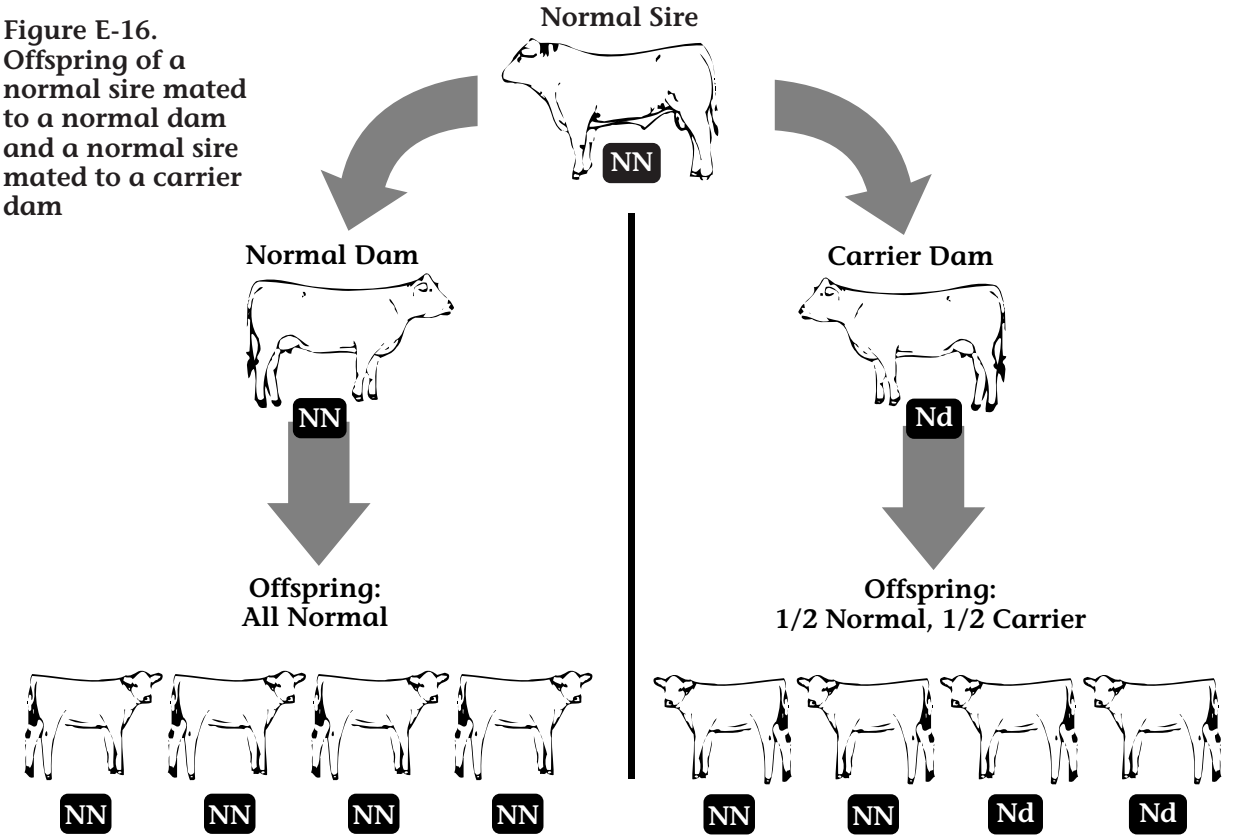
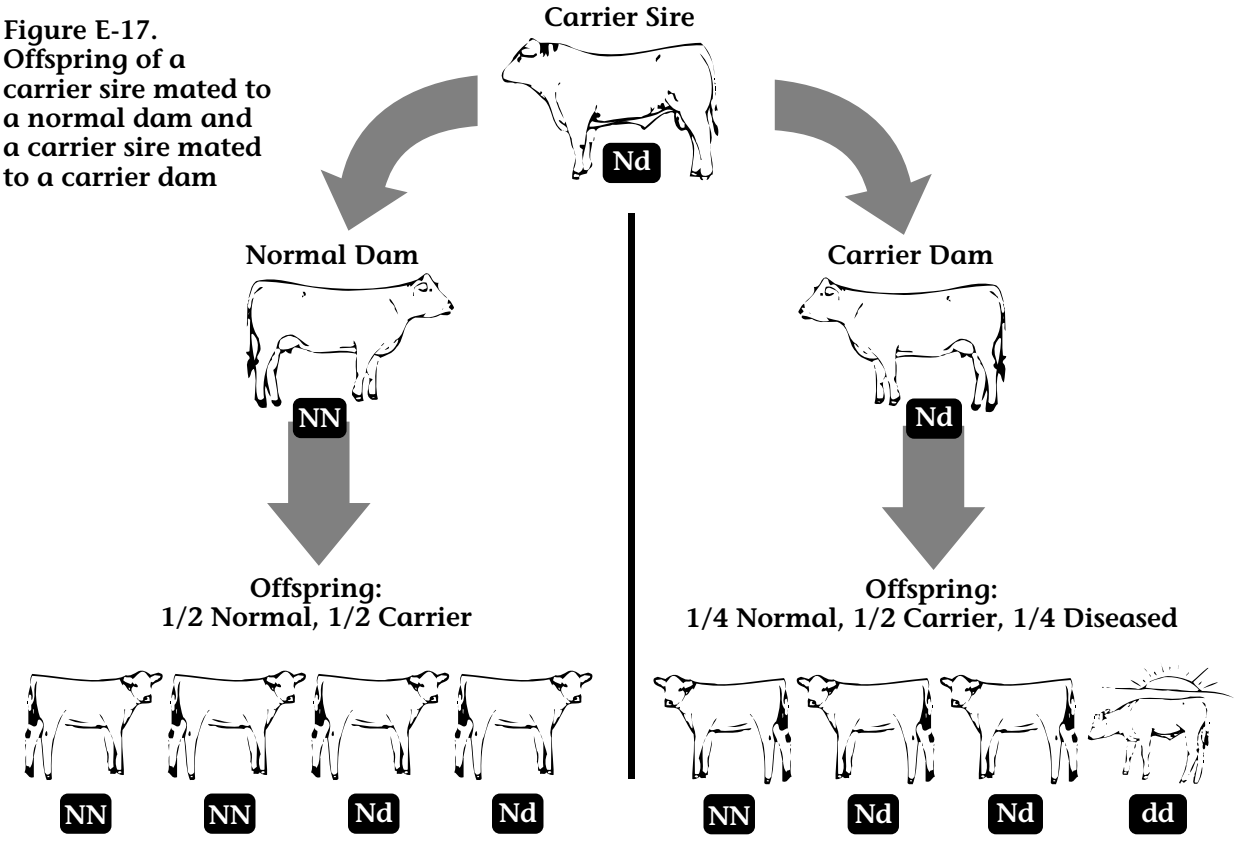


Figure E-17. Offspring of a carrier sire mated to a normal dam and a carrier sire mated to a carrier dam



Should You Be Concerned?

As long as breeders monitor the disease, identify carriers and mate them appropriately, it doesn't appear that protoporphyria presents any major obstacle for the breed.

At the same time, paying no attention to the disease could lead to a decrease in acceptance by the commercial industry.

In all likelihood, due to the accuracy of the DNA test for protoporphyria, more and more breeders will routinely expect to know the proto status of potential seedstock just as they expect to see all performance data on animals before making their purchase decisions.

How to get the DNA proto test

The new protoporphyria test at the University of Missouri identifies the specific genotype of animals as normal, carrier or diseased. If you have animals that you would like to have tested, the following is a step by step description of the testing, reporting and follow-up process, along with additional NALF policies.

Step 1. Contact the NALF office to obtain the necessary protoporphyria testing form, blood tubes and instructions for collecting and shipping samples.

Step 2. An animal's genotype can be determined from either semen or blood samples.

For **semen**, it is not necessary to ship samples in liquid nitrogen. Simply send two straws or ampules of semen in a padded envelope, along with a cold pack and the completed protoporphyria testing form, to the address listed on the form. All samples should be sent on Monday, Tuesday or Wednesday in order to prevent them from arriving during the weekend (send next-day via UPS or Federal Express). Please make sure all samples are clearly identified.

Blood samples must be collected in the purple top (EDTA) tubes which are also used for blood typing. Ideally, samples should be collected from the jugular rather than from the tail in order to minimize contamination. After collection, refrigerate the samples for two to four hours, pack in a padded envelope along with a cold pack and the completed testing form and mail to the address provided on the form. Again, send samples on Monday, Tuesday or Wednesday (next-day via UPS or Federal Express) and make sure they are clearly identified. An example form is included on page E-20.

Step 3. The lab will fax the test results to the NALF office as soon as they are available. Animals will be designated as one of the following:

*PN - Proto Normal (genotype - NN)

*PC - Proto Carrier (genotype - Nd)

*PD - Proto Diseased (genotype - dd)

In turn, NALF will process the information and send test results to you and all current and past owners of the animal (if applicable). At present, the cost of the test is $35.00 per animal for the initial evaluation, which NALF will bill to your account. Animals may be retested at a cost of $100.00 per animal. Retests will be conducted individually, rather than on a batch basis, thus adding to the costs. The above prices for testing and retesting are subject to increase in the future.

Step 4. The protoporphyria genotype becomes part of an animal's record in the NALF herd book and is printed on NALF's qualitative trait report, which is available upon request. Again, animals tested as proto normal are designated as ***PN**, while proto carriers are coded as ***PC** and proto diseased identified by ***PD.** For animals which have not been tested, no code will appear. The following example pedigree of a diseased animal (*PD), its carrier parents (*PC) and its normal (*PN) and carrier (*PC) grandparents illustrates how to read a proto pedigree.

MR PROTO NORMAL PGS	0000	*PN
MR PROTO CARRIER SIRE	0000	*PC
MRS PROTO CARRIER PGD	0000	*PC
MR PROTO DISEASED CALF	0000	*PD
MR PROTO NORMAL MGS	0000	*PN
MISS PROTO CARRIER DAM	0000	*PC
MRS PROTO CARRIER MGD	0000	*PC

Sires and dams of documented diseased calves (verified through DNA testing or free-porphyrin blood testing and parent verification) which do not have a protoporphyria genotype on file are designated by a *PC, also identifying these animals as carriers. These documented diseased calves are designated by a *PD.

In cases where an animal is determined to be a carrier on the basis of the DNA test and either the sire or dam have been identified with the DNA test as normal, if the opposite parent has not been tested, it will be identified as *PS (Proto Suspect), indicating that the parent has produced a carrier

offspring but has not been tested. As well, the sire and dam of animals tested as *PD will be coded as *PS if a DNA test has not been conducted. As well, cattle will be designated as *PP and be identified to be free of the defective gene based on pedigree as long as they are the result of parents that have both been DNA tested and found to be proto free. NOTE: Bulls from which semen is collected and to be used in more than one herd artificially must have a proto genotype on file at the NALF office, regardless of the genotype of the bull's parents. Also, since the reliability of the *PP designation is highly dependent on the accuracy of pedigree information, breeders are advised to inquire about the parent verification and blood typing of parents to *PP designated animals.

Consistent with NALF policy regarding an open herd book for disclosure of pedigree and performance information, available protoporphyria genotype information may be obtained on any animal by writing, faxing or calling the NALF office.

Step 5. In order to help all users of Limousin genetics and for purposes of follow-up, NALF recommends full disclosure of all test results to prospective buyers and breeders and recommends testing relatives of carrier animals (offspring, parents, grandparents, etc.).

Important Notes:

Genotype tests will not be performed for animals which are not on file at the NALF office or for animals which do not have the sire and dam designated on the accompanying form.

NALF and the designated testing laboratory reserve the right to use any samples maintained at the laboratory for parent verification.

NALF recommends that parent verification blood typing be conducted on all animals identified as carriers or diseased.

In the case of testing conducted by non-owners or a member of a partnership, all owners and partners will be informed of the test results. NALF will disclose the name of the party which submitted the initial sample for testing.

NALF and the official laboratory expect to have test results available within two weeks from the time samples are received at the lab.

NALF's policy:

1. NALF will make available, upon request, proto test results on any tested animal and will provide on a request basis a "protoporphyria pedigree" report.
2. NALF will periodically publish the names and registration numbers of bulls for whom DNA protoporphyria testing has been completed that also have calves by them recorded, together with the test results.
3. **Effective July 1, 1995,** all sires used through artificial insemination in more than one member herd must have a protoporphyria genotype on file at the NALF office. Offspring of untested AI sires are ineligible for registration until such time as the sire's genotype is determined.
4. **Effective January 1, 1995,** all animals to be sold in NALF sponsored sales are required to have a protoporphyria genotype on file at least 30 days prior to the sale.
5. **Effective June 1, 1994,** NALF discontinued subsidizing the free-porphyrin blood test conducted by Ellefson Analytical in Minnesota. As well, the DNA test is not subsidized by NALF.

NALF's intention is to handle disclosure of test results in an accurate, timely and professional manner.

NALF reserves the right to require retests at its discretion. Any such retests are at NALF's expense.

In the absence of handling and labeling errors, NALF believes the test to be 100 percent accurate. NALF may revise these policies and procedures.

Managing Protoporphyria

Managing protoporphyria is easy if its mode of inheritance is clearly understood. As explained previously, all research indicates that proto is controlled by a single pair of genes, where the proto-normal (N) gene is dominant to the recessive proto-defective (d) gene. The following combinations are possible:

Genotype		Type of Animal
NN	=	Normal
Nd	=	Carrier
dd	=	Diseased

In the case of normal animals, all sperm and egg cells produced by these animals possess a normal copy of the gene. By contrast, one-half of the sperm and egg cells produced by carrier animals contain a defective copy of the gene. Since the normal gene is dominant to the defective gene, the carrier animals do not show symptoms of the disease. Diseased animals produce sperm and eggs which all carry the defective gene. Experimental matings of diseased animals mated to other diseased animals have resulted in all diseased calves. An animal must possess two defective copies of the gene in order to display symptoms.

Protoporphyria can be managed effectively if the genotypes of the parents are known and the likelihood of getting carrier and diseased calves from different matings are understood. Figures E-16 and E-17 on page E-16 graphically illustrate the combinations of mating normal and carrier sires to normal and carrier dams.

Fortunately, most matings involve normal sires mated to normal dams, which result in all normal offspring. Less frequently, one of the two parents (either sire or dam) is a carrier. Calves from one carrier parent bred to a normal parent have a 50/50 chance of being carriers. Said another way, half of the calves from this mating are expected to be carriers and half are expected to be normal. Occasionally, carrier sires are mated to carrier dams. In this scenario, one out of four calves will be normal, one-half of the calves will be carriers and one-fourth will be diseased. The new DNA test makes it easy to determine the normal and carrier animals.

Mating and Testing Strategies

There are a number of different strategies which breeders can use to immediately eliminate the chances of producing any diseased calves and ultimately cleanse their herds of the defective gene. Strategies range from adopting the simple practice of only using sires tested as normal, to testing all cows in the herd, culling carrier cows and only breeding to tested normal bulls. This latter approach greatly reduces the need to do any further testing. However, the strategy which is right for you depends upon the economics of the situation and the extent to which your cow herd may carry the defect.

Unfortunately, testing the entire cow herd all at once may be cost prohibitive. A logical compromise might be to test cows which may be carriers based on their pedigree or free-porphyrin blood test scores. For example, testing all cows which have sires, grandsires or great grandsires that are known carriers and/or which have free-porphyrin proto scores in the gray (70 to 100) and/or suspect carrier range (>100) might identify nearly all the carriers in your herd. Conversely, cows which do not have any carriers or under investigation sires in their pedigrees, or which have low free-porphyrin scores (<70) are likely of lower priority for testing.

Should I use any carrier sires?

Using carrier sires can be risky and potentially expensive. Unless you are sure that carrier sires are bred to all normal cows, there is a chance of producing diseased calves. Even if the carrier is mated only to normal dams, by definition each calf produced has a 50/50 chance of being a carrier. As such, all offspring of carrier sires should be tested to limit spread of the defect. Depending upon the number of calves produced, testing all offspring of a carrier sire could also get quite expensive. Without question, it is smart to test all sires used in your breeding program.

If a breeder is inclined to use a carrier sire because it possesses a unique pedigree and/or superior genetic proof in a combination of traits, the sire should be mated only to cows tested as normal. All offspring should be screened since, on average, half of them will be carriers. In order to justify not castrating any resulting carrier bull calves from the sire, the bull offspring should also have a unique combination of pedigree and performance and should be used carefully. It is not advisable to sell carrier bulls to the commercial industry. Carrier daughters of the bull may be retained and bred to only tested normal sires, with all of their resulting calves tested.

What should I do with carrier dams?

Carrier cows have a 50/50 chance of producing carrier offspring when bred to bulls tested as normal. To that extent, their value is potentially diminished. However, it is likely not cost effective in most situations to automatically cull all carrier cows. Aggressive testing of offspring is a less costly alternative that will identify carrier progeny and allow them to be handled properly. In the case of carrier cows being used in embryo transplant, on average, half of their calves will be carriers and may be discounted. A smart strategy might be to compromise and cull carrier cows and offspring if there are other reasons why they should be culled anyway (i.e. age, pregnancy status, low production, undesirable EPDs, etc.). High producing carrier cows may be retained, bred to tested normal sires, and the resulting progeny screened.

Protoporphyria Genotype Identification Test Research

Please include this form with all blood and semen samples. Use a new needle and syringe for collecting each sample to prevent contamination. Mark each tube or straw with prefix-tattoo and owner's name. Refrigerate samples until shipped. Send about 2 ml of blood using EDTA tubes (purple top) or two straws of semen in a padded envelope. It is not necessary to ship semen in liquid nitrogen. Provide proper semen identification if not printed on the straw. Fill blood tubes no more than 1/3 full. Sex is noted as follows: B=bull; S=steer; F=female. Membership number is required for samples to be processed.

SEND SAMPLES TO:
Protoporphyria Research
c/o Dr. Gary Johnson
University of Missouri—Vet Pathology
1600 E. Rollins, Room W213, VetMed
Columbia, Missouri 65211

NORTH AMERICAN LIMOUSIN FOUNDATION

Results of the test will be withheld if parental information is not provided. Both the sire and dam identification of animals tested must be included on this form. NALF will bill you $35 per animal tested.

Owner Information

Membership Name (1) **Limousin Farms**
Address (3) **0000 Lean Lane**
Anywhere, CO 80000
Phone (5) **000-000-0000**

Member # (2) **N1000**
(4) **LIMO**

FOR LAB USE ONLY

Date sample received_____ Date results mailed_____

Comments_____

Date sample drawn_____ Date sample sent_____

Genotype is: N=normal C=carrier D=diseased

Sample	Herd Prefix	Tattoo ID	Yr Code	Sex	Date of Birth	NALF Reg. Number (if available)	Sire Reg. Number	Dam Reg. Number	Exhibits symptoms of photosensitivity? (Y or N)	Retest (Y or N)	Case # (lab use only)	Genotype (lab use only)
1	LIMO	.01	C	B	01/01/93	NPM 000000	NPM 100000	NPF 100000	Y	N		
2	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
3												
4												
5												
6												
7												
8												
9												
10												

These test results are being used to learn more about Protoporphria and help breeders control the disease. Please identify all samples by tattoo and make sure the animal is on file by submitting an "application for entry" form on every animal tested, if not already registered. The animals do not have to be registered, and can be placed on file for "performance only," then later changed to "registered" if you desire. Results of these tests may be inconclusive, and retesting may be required.

I certify that the blood tubes and/or straws of semen are labeled correctly with the tattoo of the animal whose sample is submitted, and that the membership listed above is submitting the sample(s) for testing and accepts responsibility for testing charges.

Signature (18)_____ Date_____

Print Complete Name_____

Instructions

1. Membership name as printed on your NALF membership card
2. NALF member number – this is required for samples to be processed
3. Complete address
4. NALF assigned herd prefix
5. Daytime phone number
6. Herd prefix
7. Tattoo number
8. The year code for the birth year of the calf
9. B=bull, H=heifer, S=steer
10. Calf's birthdate (month, day, year)
11. Enter complete registration number including three letter prefix (i.e. NPM, NFF, etc.)
12. See 11
13. See 11
14. Does your animal exhibit lesions or weeping sores on the skin of the ears and nose? Does this animal have sores above the eyes or open sores on its back? Answer yes or no.
15. Is this sample for an animal being retested?
16. Case # for lab use only
17. Genotype test results:
    N=Normal
    C=Carrier
    D=Diseased
18. Signature of applicant

Forms are available by contacting the NALF office.

IMPORTANT:

Instructions for sending blood or semen samples to the official proto testing laboratory:

Sending Samples to the Lab:

1. Time your mailing so that samples arrive at the lab no later than Thursday of the week. Please remember that weekends and holidays will delay movement of mail.
2. Your samples must be mailed one-day by either UPS or Federal Express. This is to assure that samples arrive in good condition.

Collection of Blood Samples:

1. Protoporphyria genotype testing forms and purple-topped Vacutainer tubes, which draw approximately 10 ml of blood and contain an anti-coagulant, can be obtained through the NALF office.
2. Before collecting the blood sample, identify the animal and label the tube with the animal's herd prefix and tattoo number. The number on the tube must correspond with information on the identification form, or the lab will use the number that is on the tube.
3. Blood samples may be taken by a veterinarian or any individual who will:
   a. Draw the blood through a clean, dry, sterile needle, preferably from the jugular vein, into the blood tube. Blood tubes are vacuum type. Use a hypodermic syringe to collect the sample, then inject the blood into the tube. Avoid removing the tube stopper. **Use a new, clean, dry, sterile needle and syringe for collection of each sample.**
   b. Fill the tube about 2/3 full, replace the stopper if it has been removed, and invert several times to thoroughly mix the blood with the anti-coagulant.
   c. Be extremely careful to prevent contamination of the blood sample.

Refrigerate Blood Samples:

1. Place blood samples in refrigerator immediately and cool them to a temperature of between 35 and 40 degrees. Do not subject to freezing temperatures. Two hours of refrigeration is suggested as a minimum, but keep your samples in the refrigerator until mailed.

Mailing Blood Samples:

1. Mail blood samples as soon as possible after being cooled. Samples must not be held for more than 2 or 3 days in the refrigerator before mailing.
2. The samples should be wrapped in a paper towel and enclosed in a box, making certain that the sample is cushioned with stuffing in order to prevent breakage. Please include refrigerant that has been included in your DNA kit with your sample. Under no circumstance should the blood sample be frozen. Wrap packages in boxes or place in cardboard container for mailing. Mark the package Fragile, Rush, Perishable and send to the laboratory.

When Sending Semen: Be sure to wrap the semen very carefully to prevent the straw from breaking during shipping. You do not need to keep the semen frozen during shipping, but you should take the straw directly from the tank and send it to the lab. Ship with refrigerant ice pack.

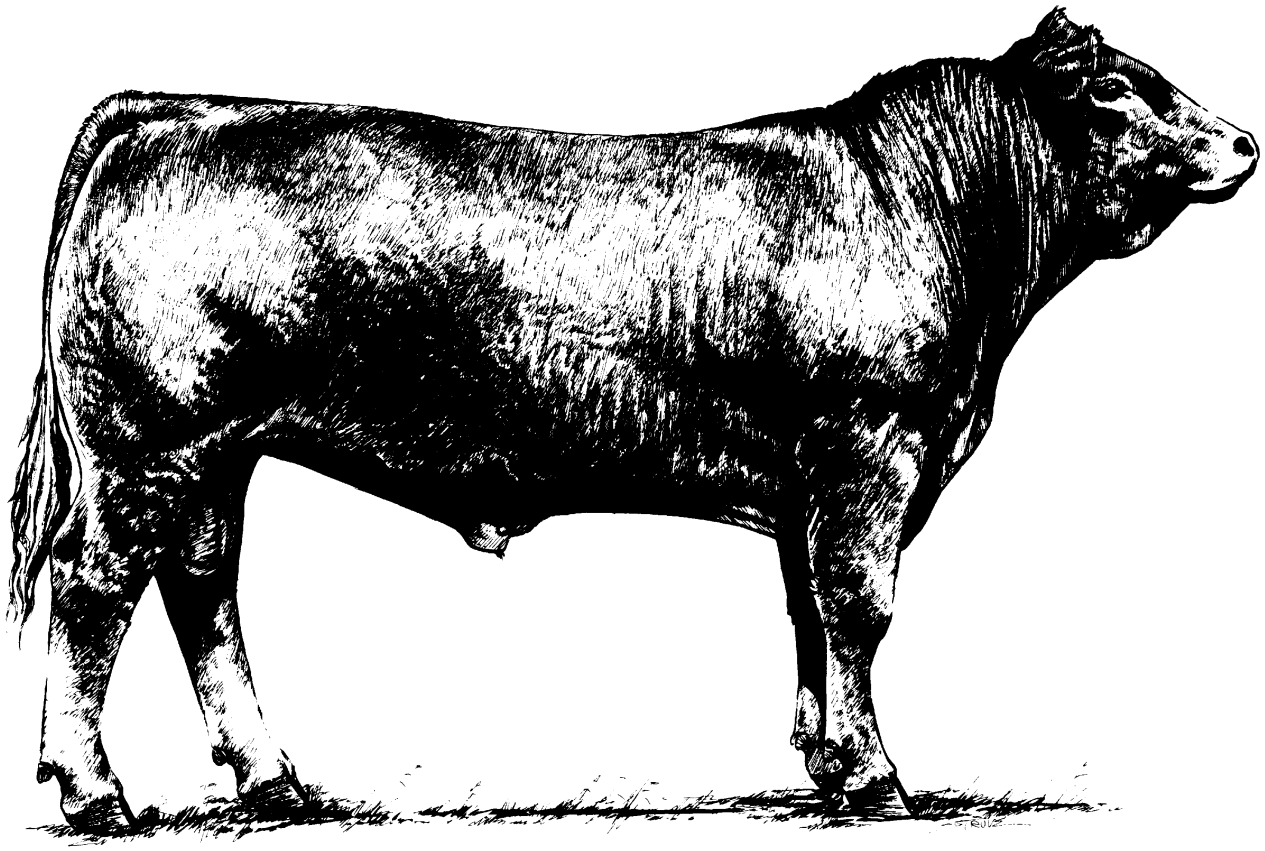
Reporting Abnormalities in Limousin Cattle

The North American Limousin Foundation's bylaws state that it is every member's duty to promptly report any abnormal condition or genetic defect found in Limousin cattle to the Foundation. With the aid of qualified geneticists, every effort will be made to determine the cause and document parentage for every reported defect. Any effort to conceal such information is considered an unethical practice by the Foundation and may result in suspension or expulsion from the membership.

Please use the form (see page E-23 for example) to report an animal with any abnormality as soon as it is discovered. Full and complete reporting is necessary to provide the documentation necessary to diagnose and evaluate possible corrective actions.

1. Enclose pictures of the affected animal, if possible.
2. Include a report from a veterinarian or diagnostic laboratory if available.
3. Keep the animal alive, if possible, or freeze the affected body parts, such as head, legs, etc... Members may also be asked to send abnormal calves, dead or alive, to a dignostic lab by NALF direction.
4. Unless a blood type is already on file, a blood sample should be drawn from the calf, as well as its sire and dam, and submitted to the approved NALF serology lab to verify parentage. NALF will provide blood tubes and the necessary forms and pay blood typing fees for all abnormal animals.
5. Please contact NALF with further instruction regarding what to do with the form and the samples:

NORTH AMERICAN LIMOUSIN FOUNDATION
P. O. Box 4467
Englewood, Colorado 80155
303•220•1693



OWNER INFORMATION

Name of Owner: _____

Address: _____

NALF Member Number: _____Telephone : _____

I Certify that the information is true and correct to the best of my knowledge and belief. The North American Limousin Foundation has my permission to use this information without restriction.

_____ _____
Signature of owner making report Date

_____ _____
Signature of attending veterinarian (if applicable) Date

ABNORMAL ANIMAL REPORT

Abnormal Animal:

☐ Male ☐ Female

Date of Birth: _____ Identification (tag, tattoo, etc...) _____

☐ Single Birth ☐ Twin

☐ E.T. Calf A.I. Sired Service Date: _____

Sire (NALF Registration #): _____

Dam (NALF Registration #): _____

If dead, Date of Death: _____

ANALYSIS

Physical Description of the Abnormality: _____

_____

Name of Veterinarian: _____

Address: _____

Phone: _____

Has the abnormal animal been blood typed? ☐ Sire? ☐ Dam? ☐

Check Below any of the areas relating to abnormality. Explain.

- ☐ Size _____
- ☐ Conformation _____
- ☐ Bone _____
- ☐ Muscle _____
- ☐ Nervous System _____
- ☐ Joints _____
- ☐ Hair, Hide _____
- ☐ Teeth, Jaws, Lips _____
- ☐ Limbs _____
- ☐ Feet _____
- ☐ Tail _____
- ☐ Sex Organs _____
- ☐ Internal Organs _____
- ☐ Other _____

Becoming a Least-Cost Producer

Profit = Returns – Costs

As beef producers, we are very well versed in the returns from our operation. For commercial cow-calf producers, it may be weight and price of feeder calves sold. For a feedlot manager, it may be the close-out on a pen of cattle - total dollars brought in versus cost of gain and initial purchase price. For a purebred producer, it may be average price from last spring's bull sale or the value of replacement females sold. Too often, though, we tend to forget about the costs associated with producing and marketing our product. And costs are fully one-half of the equation for profitability. No matter what aspect of beef production we talk about, profitability is the bottom line.

Many scientists are critical of the beef industry for not adapting to new technology as rapidly as our competitors, pork and poultry. However, many information people, such as extension specialists, argue that adaptation of certain technologies is not necessarily cost effective. One thing is certain, astute producers who know their costs and returns are generally on the cutting edge and embrace new technologies to take their operation to new heights in profitability. Low cost, efficient producers will be the ones who survive.

It is imperative that beef producers have an intimate understanding of costs associated with their operation and that they try to be low-cost producers. The simple fact is that operation costs must be identified before costs can be reduced.

You may want to ask the following questions of your operation:

- What is the production efficiency of my cow herd?
- What is the reproductive efficiency of my cow herd?
- What are the major expenses of my enterprise?
- What is my unit cost of production per pound of calf weaned?
- Is my financial position in balance with the cash flow of my enterprise?
- Is my enterprise meeting my goals and objectives for profit?
- How can I better manage or control costs?

If these questions are hard to answer or have never been addressed in your operation, you may want to examine more critically the cost side of production.

Integrated Resource Management, or IRM, has been around for a number of years and has gained popularity recently as a low-cost approach for beef operations. Part of IRM that has helped address the issue of costs has been Standardized Performance Analysis or SPA. SPA is a standardized cow-calf enterprise production and financial performance analysis process. It was developed to provide cow-calf producers a standardized means of measuring production and financial performance of the enterprise.

SPA can be best described as an information summary tool that helps the beef cattle business transform production and financial data collected throughout the year into performance measures. These performance measures are calculated according to a standardized format that helps in identifying opportunities for profitable change.

Decisions on which changes are appropriate and how they should be implemented must be based on accurate information and meaningful analysis to positively affect profits. Increased profitability usually results from informed decisions.

Some specific ways to control costs are:

- Know your costs of production and update cost calculations in a timely manner.
- Express costs on a per breeding cow and per pound of calf weaned basis so the values serve as reference points - i.e. turn financial cost data into meaningful management decision information.
- Anticipate in advance what costs should be – plan for cost control.
- Manage cost by exception - identify extraordinarily large cost items for cost control or small cost items for expenditure opportunities.
- Clearly identify which costs can be managed.
- Insure that meaningful decision and performance evaluation information gets back to those who generate data.
- Budget for a profit on the basis of complete cost of production, including indirect costs and opportunity costs.
- Market for a profit, not just for break-even.
- Invest in profitable assets and technologies and eliminate assets that do not provide for profitable returns.

Data collection through analysis and implementation is an ongoing business process. Monitoring and feedback are essential for implementation and control. Measuring performance will lead to managing for performance. Effective managers using the SPA analysis process to make informed decisions will find ways to

increase their profits. Many of the specific ways to control costs are common sense recommendations that may need only to be revisited rather than totally revamped.

Profitability is the key, and based on the level of profitability, production characteristics of cow-calf operations vary greatly. Numerous studies have been conducted that evaluate the characteristic of low, average and high profit cow-calf operations. One study of North Dakota, Iowa and Kansas cow-calf producers produced the following results:

ITEM	PROFIT CATEGORY LOW	AVERAGE	HIGH
Average number of cows	88	103	89
Feed cost per cow, $/year	208	187	142
Reproductive rate, %	88	91	95
Weaning weight, pounds	488	518	553

The major yearly cost in most cow-calf operations is feed cost. Having moderate sized, low maintenance cows that fit your environment, coupled with utilizing low cost and by-product feeds, is a prudent approach to minimizing costs. There are several general approaches to minimizing feed costs:

- Let the cows do the harvesting (dry grass, stover, etc.)
- Lower stored feed supplies.
- Ration formulation for winter diets.
- Maximize use of by-product and low quality (and generally low cost) feeds.

The following table puts the cost/return/profit scenario into clear perspective. Based on all types and sizes of cow-calf producers, the following apply:

CHANCE OF NET LOSS ACCORDING TO COST

ITEM	ABOVE OR BELOW AVERAGE	CHANCE OF NET LOSS
Total cost per cow	above	33%
	below	4%
Feed cost per cow	above	30%
	below	5%
Capital cost per cow	above	20%
	below	13%
Production per cow	above	17%
	below	33%

This table makes a dramatic statement about controlling costs in the cow-calf operation.

When profitability in the cow-calf operation is positive, it may be easier to overlook costs, such as cost of replacement females. As everyone knows, replacement females are a major investment, but just how much is appropriate to pay or invest? The following table puts those costs into perspective:

Breakeven ownership period of a cow (years).[a]

Replacement Heifer Value	Salvage Value	Net Return/Cow[b] $50	$100	$150
$500	$400	4	2	1
	450	2	1	1
	500	1	1	1
$600	$400	8	3	2
	450	6	2	2
	500	5	2	1
$700	$400	14	5	3
	450	12	4	3
	500	10	3	2

[a] Dalsted and Gutierrez, 1989.

[b] 90% weaning rate and 5% discount rate.

Being a least-cost producer should be a prioritized, attainable goal within your operation. The ways by which this can be accomplished are as numerous as there are producers. One thing is almost certain – least-cost beef producers will be the survivors in the future.

Reproduction in Beef Cattle

Reproduction in beef cow herds has been shown to be more important to overall profitability than production traits such as average daily gain or feed efficiency, or product traits such as yield grade and quality grade. From a simplistic stand point, it makes sense. No matter how fast they grow, how efficient they are, or how good the carcass is, if you can't get cows pregnant, you can't have a live calf on the ground. Reproductive traits are lowly heritable when compared to growth and other traits, thus genetic improvement is slower and more difficult to make. Environmental influences greatly influence reproduction and as a result fertility can vary drastically from year to year. The level of nutrition coupled with the weather are the most important of these environmental influences. Since reproduction and nutrition are intimately linked, improvement in herd fertility results from an understanding of the interaction of the two.

Genetic Progress

Genetic progress in fertility is possible. The most practical means we have available now is through selection of bulls with large testicular development. Research has shown that bulls with greater yearling adjusted scrotal circumference will produce daughters that reach puberty at an earlier age, with more fertility in general. In fact, Limousin research shows for each additional centimeter of scrotal EPD, daughters reach puberty 30 days earlier (±9 days). It is important to select and propagate bulls with a scrotal circumference of at least 32 cm, adjusted to a year of age in order to build inherent fertility into Limousin cattle. Any bull with less than 32 cm at one year of age is a prime candidate for culling.

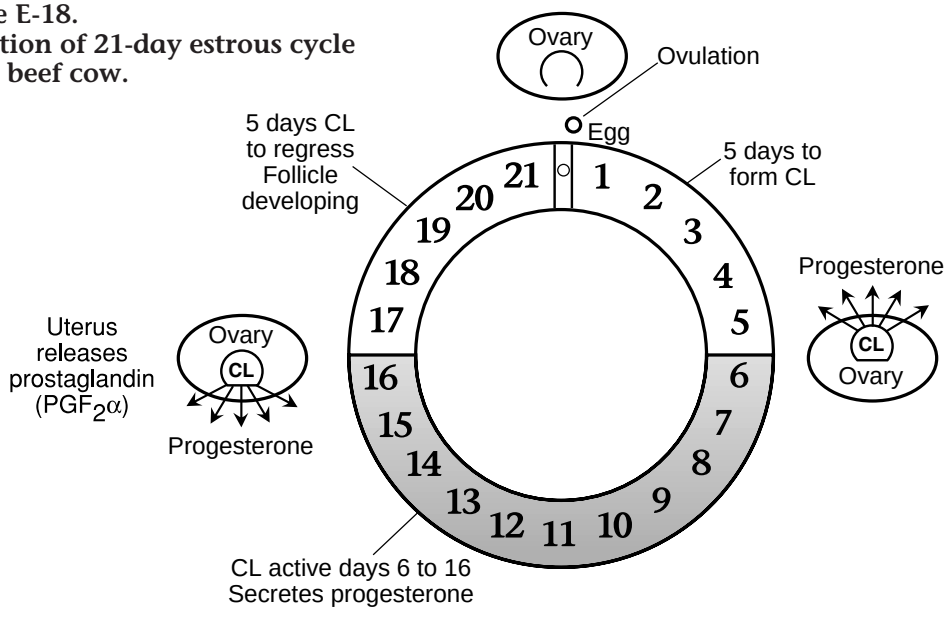
Reproductive Management

For cattlemen, a basic understanding of reproduction can lead to more fertility in the cow herd and hopefully more live calves per cow exposed. It's like trying to get more miles per gallon out of your pickup. To do that you have to understand how the engine works.

Approximately every 21 days the beef female releases an egg from the ovary and prepares the uterus for a possible pregnancy. If fertilization occurs and the prepared uterus accepts the embryo, pregnancy will ensue. If fertilization does not occur, the uterus cleans itself out and prepares for the next ovulation and possible pregnancy. These events happen about every 21 days – hence, the 21-day estrous cycle of the beef cow. Some cows will cycle as many as three days shorter, some three days longer, so a range of 18 to 24 days is considered normal. Beyond that you may start to question whether something is affecting or altering cycle length. Figure E-18 depicts the 21-day estrous cycle.

Ovulation or release of the egg from the ovary is most always accompanied by estrus or heat activity. Cows typically ovulate about 30 hours after the onset of estrus. Thus, when artificially

Figure E-18.
Depiction of 21-day estrous cycle of the beef cow.



inseminating cows (AI), we use the AM/PM rule to breed, or about 12 hours after we detect estrus. If the cow is in heat in the morning, breed her that evening; if she is in heat in the evening, breed the next morning. Once the cow has ovulated, a corpus luteum (CL) is formed at the site of ovulation on the ovary. The function of the CL is to produce the hormone progesterone. The main function of progesterone is to maintain the pregnancy. If the egg is fertilized, the embryo "tells" the CL to keep producing progesterone. This keeps the uterus quiet so pregnancy can be maintained. If fertilization does not occur, the hormone prostaglandin is released by the uterine lining causing a regression of the corpus luteum, thus sharply reducing progesterone levels in the blood. Once the CL ceases to function, the whole cycle starts over again. Control of the estrous cycle actually centers around control of the CL, which is the principle upon which estrus synchronization is founded.

Estrus Synchronization

Synchronization, or grouping of estrus periods (heat) in beef cows and heifers, is a viable management tool for many cattlemen. By tightening the breeding and calving periods, heat synchronization may also make AI practical where it may not be otherwise. There are numerous advantages to using estrus synchronization, coupled with AI in replacement heifers:

1. Selection of the appropriate calving ease sire. This entails the correct breed, type, and performance in terms of genetic information and reliability (EPD plus accuracy) for birth weight.
2. Grouping of labor requirements at breeding and calving.
3. Enhanced fertility.
4. Opportunity to save replacements from these matings (heifers out of heifers) and build calving ease into the herd.

On the other hand, one needs to realize what synchronization will not do. Generally, synchronization does not increase conception rate compared with normally cycling cows in good condition. Synchronization products are ineffective in non-cycling females. Without a doubt, synchronization does not substitute for a lack of nutrition, herd health or proper management.

Methods of Synchronization

Three general approaches to heat synchronization have been developed in recent years using the following products:

1. **Prostaglandins (Lutalyse®, Estrumate®, Boviline®)**
2. **Syncro-Mate B®**
3. **Progesterone (MGA®) plus prostaglandin**

Prostaglandins

Prostaglandin ($PGF_2\alpha$) is a naturally occurring hormone in beef females produced by the uterus. $PGF_2\alpha$ works by regressing the CL. Prostaglandins will synchronize heat only if cows are cycling and are effective only on certain days of the cycle.

Day of the cycle Day 0 = heat	Effectiveness of regressing the CL
0-4	Minimal
5-10	Moderate
10-17	Very High

Prostaglandins have been about 90 percent effective in regressing the CL between days 5 and 17 of the cycle. Estimates of successful heat synchronization after prostaglandin administration in cycling females has been about 70-90 percent. Conception rate of synchronized cows compared to unsynchronized cows or heifers is equal.

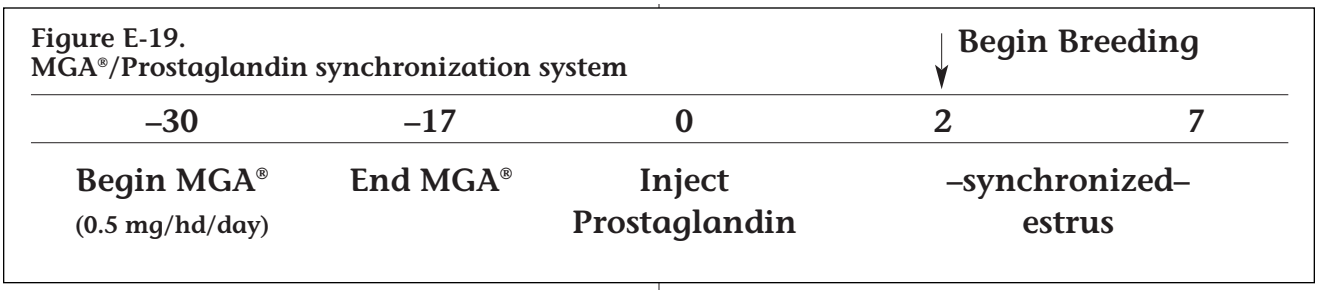
Four basic prostaglandin programs have been used to synchronize heat:

1. Conventional AI for five to six days and on the last day inject all cows that have not been inseminated with prostaglandin.
2. A single injection at the start of the breeding period.
3. Two injections 10 to 12 days apart and AI only after the second injection.
4. One injection and AI all cows in heat during the next 6 to 12 days. A second injection can be given to cows that have not been inseminated at any time from 6 to 12 days after the first injection. Do not inject any cows that have been bred as prostaglandin will cause abortion.

Syncro-Mate B®

Synchronization with Syncro-Mate B® involves using a norgestomet ear implant and injecting norgestomet and estradiol valerate intramuscularly at the time the implant is inserted. The implant is removed after nine days. Females are then bred upon estrus detection or can be time-inseminated 48 to 54 hours after implant removal. Calf removal can also be used with Syncro-Mate B®.

Figure E-19.
MGA®/Prostaglandin synchronization system



One advantage of Syncro-Mate B® is that it will bring some non-cycling cows into heat but only those close to estrus initially. Conception rates have been variable with Syncro-Mate B®, sometimes the highest and sometimes the lowest; conception generally runs from 30-60 percent on first service. Synchronization of estrus with Syncro-Mate B® should be closer together than with prostaglandins.

Progesterone-prostaglandin combination

A relatively new synchronization concept is the combined use of a progesterone-like compound such as melengestrol acetate (MGA®) in combination with a prostaglandin. MGA® is most widely used in feedlot heifers to suppress estrus, but more recently received attention as an effective part of a synchronization program.

Colorado researchers have developed a system combining MGA® feeding and prostaglandin injection (Figure E-19). With day 0 as the anticipated start of the breeding period, MGA® feeding needs to begin 30 days prior. MGA® is incorporated into a grain mix at the level of 0.5 mg/hd/day for 14 days. Estrus will be evident a few days after MGA® feeding is stopped, however, first service conception rates are generally low with this heat thus the cattle are not bred. Seventeen days after MGA® feeding, a prostaglandin injection is given and females should exhibit estrus approximately 48 hours later.

The most extensive use of this system in the cattle industry has been with heifers, but considerable research is ongoing to develop an effective progesterone-prostaglandin synchronization system for cows.

Helpful Synchronization Tips

Most failures connected with a synchronization program have resulted from heifers or cows not cycling before treatment. Before using synchronization, it should be determined if the heifers or cows are good candidates for synchronization (good body condition, adequate postpartum period, adequate development). The success rate of synchronization on cows (percent conceiving during the synchronized period) which one could expect is about the same percentage that calved in the first 21 days of the calving season. Optimal development of replacement heifers is critical to ensure success in first service conception. Generally, replacement heifers should weigh at least 65 percent of their potential mature weight at first breeding. With well developed heifers and a successful synchronization program, an AI program for heifers will allow more flexibility in terms of bull selection for calving ease.

Replacement Heifer Selection

For the cow-calf producer, potential for future improvement and profitability lies in the replacement heifers selected. Building improvement into a cow herd through replacements is a long term process, but one that will pay off. The most important trait good cattlemen look for in a replacement heifer is **fertility.**

All the factors relating to heifer selection and development will ultimately be reflected in fertility – her fertility as a first calf heifer and subsequent lifetime fertility as a mature cow.

Selection can be accomplished by using available performance records, visual appraisal, or even better, a combination of both. If possible, it is suggested to select 25 to 50 percent more heifers than you plan to breed next spring or summer. This will allow additional evaluation and culling after yearling weights are taken. Performance of each individual heifer will play a big role in selection. Simple records such as birth date and weaning weight can be used effectively. Since a common goal is to have the heifers calve at 24 months of age, they must be bred by 14 to 15 months of age. Puberty in heifers is a function of weight, age and breed. Therefore, knowing which are the older, heavier heifers at weaning time will be useful upon making your initial selection. It is useful to take the sire's EPDs for scrotal circumference and maternal traits into consideration upon selection, if these values are known and available. Bulls with superior scrotal and maternal traits will produce superior females in terms of puberty, milking ability and pounds of calf weaned (see page E-12).

A topic that has gained attention and importance in recent years is evaluation of pelvic area. Many people agree on the use of pelvic area measurements (measured around one year of age) to assist in identifying potential calving problems. Research has shown calving difficulty results in a longer interval from parturition to first estrus and subsequent rebreeding the following year. Heifers with an extremely small pelvic area should be eliminated. More and more, pelvic area is becoming a key management practice in selecting replacements. Please refer to page E-13 for more information.

Along with use of these performance records, meaningful visual appraisal will ensure a set of functional replacement heifers. Many producers give special consideration to body capacity and fleshing ability and select according to their personal preference. Also, cattlemen should pay particular attention to structural soundness. Skeletal soundness throughout the female's lifetime will allow greater productivity and longevity.

Replacement Heifer Management

Once the group of replacement heifers has been selected, it is critical they are managed correctly, especially in terms of nutrition, to allow expression of their brood cow potential. The first step to correct management is to separate the replacement heifers from the rest of the herd. Their size, age and higher nutritional demand make it difficult for them to compete with mature cows or to utilize poor quality forages. As noted earlier, replacements should reach 65 to 70 percent of their mature weight by breeding time. If your cows weigh 1,100 lbs. on the average, your heifers should weigh at least 700 to 750 lbs. by breeding time.

Generally weight gain should be 1.0 to 1.5 lbs. per day from weaning to breeding, dependent on weaning weight and the length of the feeding period. Research has shown that heifers that gained 1.0 lbs./day compared to 0.5 lbs./day over the winter reached puberty 1.4 to 2.8 months sooner and were 44 to 78 lbs. heavier. Weight and age at puberty, as mentioned previously, are linked to future productivity.

Feeding adequate levels of concentrate when developing heifers through the winter results in enhanced conception, rebreeding and heavier weaning weights of their first calf. It is important to meet the minimum daily requirements to guarantee optimal productivity. Also, a sound health and vaccination program is basic to development of quality replacements. Your local veterinarian is a good source of advice and information regarding herd health. Finally, when breeding season arrives, heifers should be bred three to four weeks earlier than the cows. This allows the heifers extra time after their first calving to recycle and breed back to fit in with the cow herd.

In summary, key points to remember are:

- Implement a rigorous selection program.
- Heifers should reach 65 to 70 % of their mature weight by breeding time.
- Manage heifers separately from mature cows.
- Follow a sound vaccination and health program.

Improving Fertility

Other management tools such as bull exposure, temporary calf removal, early weaning, high lipid or protein supplements, anthelmintics (dewormers) and ionophores can help improve fertility; especially when nutrition is lacking, as reflected by thin cows, or with late calvers or poorly developed heifers.

In purebred herds, good reproductive management is vitally important. Intense reproductive management is important with tools like AI and embryo transfer. Good inherent fertility can ensure that your cattle are right for the commercial industry.

Nutrition

As a member of NALF, there may be times when you get caught up in all of the responsibilities of a purebred breeder and forget the most important thing that is working for you - your cows! With performance data to be collected and submitted, cattle to be registered, mating decisions to be made, and the next copy of the Members Memo waiting to be read, sometimes the day-to-day workings of the cow herd are overlooked.

The success of a cow herd, purebred or commercial, big or small, any breed, is dictated by the quality of the nutrition program in place. The producing ability of the herd in terms of number and pounds of calf produced hinges on a successful nutrition program. A good nutrition program entails knowledge about two areas:

1) the nutrient requirements of your cow herd
2) the amount and quality of feedstuffs you have available

Success lies in being able to accurately inventory the two and then match them up at the lowest cost possible. It's safe to say low-cost producers have greater potential for profit and will be the competitive beef cattle producers in future years. See page E-25.

The Beef Cow's Diet

We all need energy and protein to live, and cows are no exception. Energy and protein are the two most important nutrients in the diet of beef cattle.

Energy

Diets for cows, ruminants, are generally quite different from non-ruminants. Ruminants have the unique ability to digest and obtain energy from cellulose, the predominant carbohydrate in forages. The common vegetable celery is packed with cellulose but none of us can imagine growing and living on only celery! Ruminants are host to bacteria, protozoa, and fungi (collectively called microbes) that live in the rumen, one of the four compartments of the ruminant stomach. The rumen is essentially a big fermentation vat where these microorganisms thrive and reproduce. The warm temperature, constant humidity, neutral pH and supply of food (cellulose) keeps them alive and growing. The microbes are responsible for digesting the cellulose in the forage; without them, the cow would not be any more able to use grass than humans. Once the microbes have reproduced, grown, and died (about 48 hours), they pass out of the rumen to the omasum and finally to the abomasum where they are digested and provide nutrients for the cow. So, the cow gets energy from fiber, but that energy has to go through the microbes first. In feeds such as hay, silage, or pasture, we can estimate the amount of energy potentially available to the cow. Most often used is TDN, or total digestible nutrients. Given as a percentage, TDN estimates what percent of the feedstuff is digestible and available as energy.

A more accurate assessment that is ideal to have in a feed analysis is acid detergent fiber, or ADF. This simply measures the amount of fiber (cellulose) that is extracted from a feed sample after being washed with an acidic detergent. It is more valuable as it depicts the amount of cellulose available for digestion by rumen microbes to be used as an energy source and as a potential energy source for the cow.

Energy is the nutrient needed in greatest quantity by the cow, no matter what the stage of production or season. Energy is comparable to fuel for your pickup – once it's on 'E', you can't drive much further.

Protein

Protein is needed in the next greatest quantity by the cow and is a valuable estimate to have in a feed analysis. Analysis for protein is actually determined by the amount of nitrogen (N) in a feed sample. Since all protein is about 16% N, a figure of 6.25 (100 divided by 16) is used to estimate the amount of crude protein (N x 6.25 = % crude protein). Ruminant requirements for protein are again different than those of non-ruminants. The microbes digested by the cow for energy are also packed with protein. As they reproduce and grow, their bodies are partly made of protein. The microbes effectively "create" protein from energy and nitrogen to form microbial protein which the cow digests in the abomasum and small intestine. That is why cattle can use urea as a protein source when urea itself contains no protein, just N. Natural protein sources such as soybean meal can also be used by ruminants, but the microbes break down most of the perfectly good protein to get at the nitrogen and reform it into microbial protein. Not very efficient, to say the least, so at times we "bypass" the microbes and feed rumen-bypass or more appropriately, rumen escape protein. These protein sources, such as blood meal, are largely unavailable to the microbes, but in the acidic

environment of the abomasum, can be broken down and utilized by the cow. Rumen-escape protein may be especially important in high producing animals such as lean, fast growing calves or cows during lactation, especially dairy cows. Completely using rumen-escape protein is not a good idea because the microbes still need some N to live on. Judicious use of rumen-escape protein seems best.

Protein is to the cow like oil to your pickup. Keep it checked and changed and your truck will last. We all know it doesn't take long for the engine to lock up and be ruined if oil is lacking - same with the cow and protein. Think of the cow as running on the fuel of energy and keeping the body parts working smoothly with the oil of protein.

Vitamins and Minerals

Much information about vitamin and mineral nutrition has been published lately from researchers and the popular press. Vitamin and mineral nutrition are gaining more attention as the realization of their importance in a sound, balanced nutrition program grows. Care should be taken in a proper nutrition program to ensure vitamins and minerals are at adequate levels. Vitamins and minerals are needed in very small amounts by the body when compared to energy and protein. However, vitamins and minerals generally perform very specific and highly important functions in the body; take them away and the body cannot operate. In the pickup example, vitamins and minerals may be like the key to the ignition or the battery or the spark plugs. They perform very specific but quite critical jobs and the whole system can't get along without them.

Vitamin A is especially important and is present in fresh forages or green, high quality hays. Cattle can store a couple months supply in the liver, so day to day shortages are not a problem. Since Vitamin A is so inexpensive, it's good to supplement Vitamin A on a regular basis, especially with harvested forages. The minerals calcium and phosphorus are also quite important and should be priority in balancing a mineral supplement. Many producers like to elevate phosphorus during the breeding period. Adequate phosphorus and reproductive success go hand-in-hand. Special attention should be given to Vitamin E and the trace mineral selenium, as they act in partnership in the body. Selenium levels should be monitored, especially in areas that are historically deficient in selenium in the soil. Finally, low copper and/or high molybdenum may be problematic in some areas, depending on your soil and forage types. Copper deficiency can be manifested in off-color hair coats, poor reproductive performance, and compromised immune systems, especially in young calves.

Please take caution! Do not count on one vitamin or mineral or product to be the magic potion or silver bullet for your herd. A good understanding of beef nutrition coupled, with thorough feed analysis, can go a long way in complete herd management and low cost production.

Simple Steps for a Successful Nutrition Program

A sound beef cow nutrition program consists of three basic steps:

1. Inventory the feedstuffs available

Many producers typically think of this as 'how many bales of hay' or 'how many acres or sections of grass' or 'how many tons of corn silage.' But take that a few steps further. Combine the amount of feed with the nutrient analysis (dry matter, energy, protein) and figure the feed inventory as 'how many tons of energy' or 'how many pounds of protein', on a dry matter basis, are available to feed this year.

2. Inventory the cow herd.

This inventory is more extensive and dynamic, and dependent not only on the number of cows, but on their weight, age, stage and level of production and environment. Once these factors are considered, the bottom line is describing the herd in terms of how many tons of energy and pounds of protein it will require.

3. Match the feed inventory and the cow inventory.

If you have done a good job in steps 1 and 2, you can fairly estimate whether your feed resources can carry the herd. Once that is established, then the exciting part of fine-tuning the ration is made easy.

The year in the life of a cow can be broken down into four general periods:

Period	Days	Description	Nutrient Requirements
1	80	post-calving to pre-breeding	highest
2	125	pregnant and lactating	intermediate
3	110	mid-gestation and non-lactating	lowest
4	50	pre-calving (late gestation)	intermediate

Nutritional needs of the cow vary greatly among these periods, so fine-tuning becomes important. The time of highest nutritional need is

post-calving and pre-breeding. The cow has priority for lactation, the uterus has to return to normal to accept a pregnancy, and first-calf heifers are still growing. Too often, reproduction becomes a luxury during this time! The inventory of the cow herd should be done to describe their nutritional needs during each of these periods, then matched up with the feed resources available.

Nutrient analysis information can be completed on your feeds with help from your local extension service, feed nutritionist, or possibly your veterinarian. They are good resource persons for information on the proper procedure for sampling, how to handle samples, and what to test for in nutrient analysis. Almost without exception, feeds should be analyzed for:

- **Dry Matter (or Moisture)**
- **Energy Content (TDN or ADF)**
- **Crude Protein**

Other possible analyses, depending on the forages, soil type, and environment would include:

- **Calcium**
- **Phosphorus**
- **Selenium**
- **Copper**
- **Nitrates**

Consult your local resource person (extension agent, veterinarian, feed dealer, etc.); they are generally your best source of information on what analysis is appropriate in your area.

Information on the nutrient requirements of the cow is available in the National Research Council (NRC) *Nutrient Requirements of Beef Cattle.* This book is a guide to the nutrient requirements of cattle and accounts for differences in age of cattle and stages and levels of production. This text is available from your local extension service, feed dealer or veterinarian.

For a typical 1,100 lb. cow during period 3 (mid-gestation) her nutrient requirements are as follows:

TDN (lbs./day)	**9.5**
Protein (lbs./day)	**1.4**
Calcium (grams/day)	**17**
Phosphorus (grams/day)	**17**
Vitamin A (IU/day)	**25,000**

Assume the cow is fed grass hay with the following analysis:

Dry Matter, %	**90**
TDN, %	**55**
Crude Protein, %	**8**

The following steps will match the feedstuffs available to the nutrient requirements of the cow, and decide if energy and protein are deficient or adequate in this case:

1. Determine how much the cow eats per day on a dry matter basis (dry matter intake). A general guideline is that a cow will eat 1.5% to 3.0% of her body weight on a dry matter basis, depending on forage quality (low quality about 1.5%; high quality about 3.0%). A good starting figure for dry matter intake is 2.0% of body weight. For an 1,100 lb. cow, an estimate of dry matter intake would be: 1100 X 2.0% = 22.0 lbs. of dry matter intake.
2. Multiply dry matter intake by the concentration of the particular nutrient present in the feed (% TDN, % Crude Protein, etc...).
3. Determine the nutrient requirements for the cow, considering age and stage and level of production, weight, weather, etc. (Be sure to accurately assess average weight of the cow herd.)
4. Do the two match? Assess nutrients vs. requirements.
5. Determine appropriate supplementation if deficiencies are apparent.

Also, good trace mineralized salt and dicalcium phosphate are essential to meet mineral requirements. Again, your local information source, such as your extension agent or feed dealer, can be a good source of information on supplementing vitamins and minerals. It is important to consult someone locally who is versed in mineral nutrition since deficiencies and toxicities vary greatly across the country. A good, solid, basic mineral mix is imperative; it doesn't have to be anything fancy or expensive, just functional.

Determining Cow Herd Condition

Did you know that all cattle producers use body condition scores? Their eye influences the size of the feed bucket. "Boy, my cows are a little thin, I'd better feed them more or start into the better hay," or, "They sure are really fleshy and the weather's good, I think I can rough them along on this poor hay that was rained on." These observations are typical, but more and more producers are using body condition scores to better tailor nutrition, saving on feed costs and fine-tuning their feeding program. Body condi-

tion scores can help track nutrition in your herd and are good information to collect from year to year. Body condition scores give a general reflection of nutritional status, and not surprisingly, have been linked positively to reproductive performance. This summary of 18 research trials from recent years describes fertility as it relates to body condition:

Body Condition Score	% Pregnant	Range
<4	12 to 70	58
5	50 to 90	40
>6	87 to 98	11

(For more information on how to condition score cattle, see pages D-8 and D-19.)

Some thin cows can be fertile and be comparable to fleshy cows. However, the fertility in thin cows is quite variable. These cows don't have the nutritional flexibility built in like fleshy cows do, making it harder for thin cows to deal with changes in environment and the demands of production.

The nutritional status of a cow is probably best reflected through the condition of her body (fat and muscle) in relation to her stage of production. Producers can tell when their cows look "thin" or "fleshy", but how body condition affects reproduction may be more difficult to assess. Body condition scores (BCS) have been used extensively in research and by some producers to subjectively evaluate the body condition of their cows. This allows producers to form a "ballpark estimate" of how thin or fleshy their cows are in relation to the optimum, and more importantly, to have some idea how condition will impact reproduction.

The 1-9 scoring system is utilized by the North American Limousin Foundation. A score of 1 represents very thin body condition, while a score of 9 represents extreme fatness. A cow with BCS 5 should appear in average flesh and probably represent the target many cattlemen strive for. Please refer to pages D-8 and D-19 for the scoring system.

The amount of body fat in beef cows at different stages of production greatly influences reproductive performance and overall productivity. Utilizing the BCS system, cattlemen can plan winter feeding programs to achieve the level of reproduction desired. Changes in BCS can be used as a guideline by cattlemen to accurately reflect the level of nutrition being received by cows without having to weigh the cows. Research has clearly indicated a positive link between body condition and weight changes.

While a BCS of 5 fits a mature cow well, the first calf heifer may need to be a BCS 5.5 or 6. Remember, heifers are still growing and normally take longer to cycle after calving than mature cows. Finally, it's important to keep in mind that the early calving cow can be a bit thinner, but for the late calving cow, it's absolutely imperative that she carry some additional condition if she's going to rebreed.

It's clear that thin or marginal body condition leads to headaches in terms of getting cows rebred. It is important to have cows in the proper body condition at calving to ensure they rebreed. The proper body condition must be reproductively and economically efficient. As you can imagine, there's no sense in getting cows too fleshy and spending that extra money on feed cost. But, given a choice, a little extra feed will cost much less than the extra open cows next fall.

One BCS equates to about 60 to 80 lbs. of weight. With that in mind a BCS 4 cow needs to gain about 60 to 80 lbs. by the time she calves. Adding 100 to 150 lbs. to that for calf and placental weight, that cow needs to gain 160 to 230 pounds by calving. That figures to 2.0 to 2.5 lbs./day weight gain from December 1 to March 1. Imagine what a BCS 2 or 3 cow would need in terms of weight gain! These values are typical of average daily gains in feedlot cattle. The bottom line is that it is important to allow plenty of time to change condition on cows.

The practical use of this system is that BCS allows you to sort cows according to their nutritional needs. It's not feasible to sort cows by individual scores or to sort into numerous small groups. The practical solution is to winter cows in at least two groups if possible. One group should be moderate to fleshy condition cows that maintain their body condition up to calving. The second group could consist of thin body condition cows and first calf heifers. The second group will require more nutritional input if you want reproductive return from them next spring. This will allow you to feed a higher energy diet formulated for the desired weight gain these cows and heifers need, while not putting extra feed into the fleshy cows. The whole concept of evaluating body condition isn't new: the eye of the producer always influences the size of the feed bucket. With a structured system of evaluating body condition, cattlemen can more closely assess the influence of nutrition on reproduction in their cow herds.

Serving Your Customers

The beef cattle industry has long been a tradition-based industry. While tradition can be one of our greatest strengths, it can also be a major barrier or obstacle impeding the industry from taking seriously the challenges of the future.

Fortunately, one of the strengths of the Limousin breed has always been the quality of people associated with it. Limousin breeders are friendly, conscientious, hard-workers who strive to be helpful to breeders new to Limousin. Most individuals are part of the cattle business because they love to work and manage cows. However, as change is most certainly upon us, to be successful in the seedstock business it is imperative that cattlemen also learn to manage people – namely their customers.

The cattle industry continues to become increasingly competitive. There are more breeds and crosses of breeds than ever before. Hybrids, composites and purebreds are all competing for market share of the commercial cattleman's bull purchasing power. With the increased competition, seedstock producers must become more aggressive in the services they provide their customers. The old days of raising breeding bulls and then simply waiting for buyers to come knocking at your door are gone!

Customer Service Facts

In order to properly service your customers, it is essential that you understand a few basic principles about customer behavior. As you read through and study these facts (compiled by customer service expert Michael Aun), keep in mind that they have been researched and are proven to be accurate:

Fact #1 Dissatisfied customers tell an average of 10 other people about their bad experience.

Fact #2 Satisfied customers tell only five people about their positive experience.

Fact #3 It costs 5 to 10 times more money to attract a new customer than to keep an existing one.

Fact #4 If 20 customers are dissatisfied with your service or product, 10 won't tell you.

Fact #5 Customers are willing to pay for better service through loyalty.

Fact #6 95 percent of dissatisfied customers will become loyal customers again if their complaints are handled quickly and efficiently.

Hence, it becomes apparent that keeping customers from becoming disgruntled is really the challenge. Not only does a dissatisfied customer cost you money through lost sales, they also damage your reputation. Keep in mind, it takes, on average, 12 positive statements to overcome a single negative statement.

What Do Your Customers Expect

In order to keep your customers satisfied, you need to fulfill or exceed their expectations. Therefore, it becomes absolutely necessary that you know what they expect.

Too many times, seedstock producers set their commercial customers up for a less-than-satisfying experience. Rather than "road test" their cattle in adverse environments, they pamper them with tender loving care. Think for a minute of how other industries test their products. For instance, car battery companies force their products to work under extreme conditions...such as starting 200 cars in Alaska in sub-zero weather. Often times, the best a purchased seedstock animal looks is the day it leaves the seedstock producer's place.

Seedstock producers must produce animals that are capable of performing under their customers' most extreme conditions. For example, if your customer calves at 2 years of age, you should make sure the animals you produce are capable of calving at 2 years of age.

Contact Your Customer

It makes good business sense to contact your customers at least once, if not more often, to see if the cattle purchased are working as expected. Remember, dissatisfied customers won't let you know if they are unhappy. Equally as important, 95 percent of dissatisfied customers will once again become loyal customers if their problem is handled quickly and efficiently.

Therefore, visits to your commercial clients should be scheduled following calving season and again at pregnancy checking time — two crucial times when satisfaction is important.

Quality Is The Bottom Line

You can be the world's best at providing service to customers, but if you have an undesirable product, you will still be unsuccessful.

To a large extent, you can avoid many of the potential reasons for dissatisfied customers by simply having a strict culling/selling program. It becomes a matter of *short-term gain* vs. *long-term profit*. While it may be tempting to sell those questionable bulls/females, remember, they will catch up with you sooner or later.

Edson P. Williams, Vice President of the Ford Motor Company said it best when he stated, "Serve the customer. You have to have your costs right, quality right, all those other things that have to be done. But we must always think the customer is the middle of the thrust of what we're trying to do. I think that's what we've learned. I don't think it's much more complicated than that, and I would suggest it for your consideration."

Marketing Your Cattle

Today's progressive cow/calf producer must do more than sell calves - he must also market them. Just what does marketing cattle achieve that selling doesn't? Marketing allows the potential for greater profit by giving the producer full value for the genetics he produced.

Effective marketing involves having a game plan. The first step is to decide who your customers are, and finding out what their needs are. For most, this simply involves talking to commercial cattlemen in your area and hearing what they need. Remember, generally speaking 90 percent of purebred cattle are sold within 100 miles of the ranch or farm.

Producing Cattle That Are In Demand

Essentially, seedstock producers should be developing the following types of bulls: 1) calving ease specialists; 2) all-use specialists, or 3) growth and feedlot specialists. Depending on your particular situation, you should strive to produce the appropriate number of each for your specific customer's needs.

Growth and Carcass Sire

The growth and feedlot specialists are often referred to as 'terminal types.' These cattle excel in rapid growth and muscle, are moderate in size to avoid heavy carcasses, and may or may not offer milk and maternal traits. Typically, growth and carcass specialists are used on mature cows and no replacement females are kept. Criteria for this type of specialist might be:

BW ≤ 3.5 WW ≥ 20.0 YW ≥ 35.0 MA – N/A
ADJ. YEARLING SCROTAL ≥ 32.0 cm

Calving Ease Sire (Heifer Bull)

These types of bulls are designed to be used on heifers or in herds that have a high birth weight problem. As the name implies, these cattle feature below average birth weights and birth weight EPDs, combined with adequate growth and milk, and large testicles. Keep in mind, that to be successful, all Limousin cattle should have superior muscle, adequate volume, and acceptable phenotype of sensible size. Sample criteria for calving ease specifics might be:

BW ≤ –1.0 WW ≥ +4.0 YW ≥ +8.0 MA ≥ +1.0
ADJ. YEARLING SCROTAL ≥ 34.0 cm

Maternal "All-Purpose" Sire

The most difficult to produce and the most sought after type of bull. These bulls do well in many areas. They are most likely going to be used on mature cows with replacement females being kept. These bulls should have acceptable birth weight, moderate-to-high growth, moderate milk, large testicles, and excel in phenotype. Sample criteria for this type of animal might include:

BW ≤ 3.0 WW ≥ +15.0 YW ≥ +25.0 MA ≥ +5.0
ADJ. YEARLING SCROTAL ≥ 34.0 cm

Since marketing is, to a large extent, having what your customer wants, you probably need to be producing one or more of these types of animals. Typically, there is no market (and rightfully so) for cattle that are high in birth weight, low in growth, those that have small testicles, and are light muscled. There is no substitute for Quality!

Produce The Product at a Reasonable Cost

Commercial and seedstock producers are no different as customers than you. They want a superior product that has value.

Also, like you they want to buy that product for as little as possible. Therefore, to be competitive, you need to produce a high quality product for the greatest value possible. Remember, for you to make money long-term, your customers must be able to make money on their purchase.

Let Them Know You Exist

Now that you are producing a high quality product that is in demand and at the appropriate cost, the next step is developing a plan to market your calves. Remember, you can produce a high quality product, but if no one knows about it, it doesn't do you a whole lot of good.

Keep in mind what was mentioned earlier: typically, 90 percent of purebred cattle are sold within 100 miles of the farm and ranch. That says that local advertising is essential. A neat, presentable farm sign may be your most economical investment. You might also look into doing a direct mailing to cattlemen in your area. Mailing labels are available from NALF at 10 cents per name for anyone who purchased a Limousin bull in your area. While expensive relative to print advertising, often a direct mailing may prove to be more effective. Also, you want to make sure that your farm or ranch is where interested individuals can find it...list your farm/ranch in your state directory and/or the Limousin World Blue Book, etc.

In summary, a good marketing program is all-encompassing. It involves: 1) producing cattle that are in demand; 2) producing cattle at a reasonable cost; 3) letting the customer know you exist; and 4) servicing your customer. ALL are essential ingredients for successful marketing. One without the other may not prove successful.