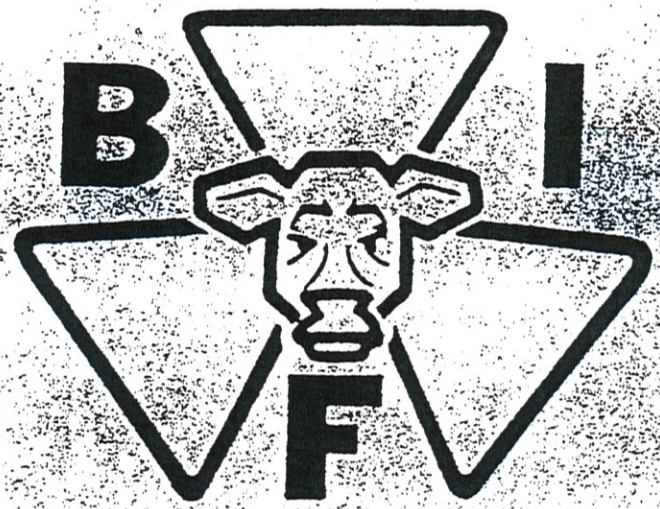
GUIDELINES FOR UNIFORM BEEF IMPROVEMENT PROGRAMS



Beef Improvement Federation

EVALUATION OF BREEDING HERD

Breeders can use specific measures of reproductive performance in the female to monitor overall reproductive performance, identify genetic and environmental areas in which to concentrate improvement efforts, and to make routine selection and culling decisions.

Female Reproduction

Reproduction, or fertility, is the most important economic trait in beef cattle. Breeders should record reproductive performance in both females and males in their herds and build these data into their herd management programs. They are urged to use these data to monitor reproductive performance and to identify areas for improvement.

As breeders are successful in selecting to increase growth rate, the importance of measuring reproduction may increase. Minimum nutritional requirements will be higher to maintain acceptable reproductive performance in faster-growing cattle. Management and environment have significant effects on reproductive performance in faster-growing cattle. Management and environment have significant effects on the reproductive performance of the female as shown by low heritability estimates for general reproductive performance. Thus, the recording and use of reproductive performance data are an important part of the breeder's program.

Additional research is needed on reproductive traits and measures for further refinement and improvement.

Breeding Dates. Record dates of artificial insemination (A.I.) services or of observed natural matings in the conventional manner (month-day-year), but store dates in the data file in Julian form. (In Julian form, the day is recorded sequentially. For example, February 1 would be Julian date 32. This number is followed or preceded by the year.) For pasture matings, record natural service exposure (start and end of breeding season) dates.

Pregnancy Status. Record a score of 0 for open and 1 for pregnant. When females are 50 to 150 days into their pregnancies, rectal palpation for pregnancy should be done by trained personnel. Culling of open females after they are identified is usually the best opportunity to increase reproductive efficiency in the cow herd.

Calving Date. Record in a conventional manner (month-day-year) but store in data files in Julian form.

Calving Difficulty or Ease. Record with the following scores:

Score 1 — No difficulty, no assistance

Score 2 — Minor difficulty, some assistance

Score 3 — Major difficulty, usually mechanical assistance

Score 4 — Caesarean section or other surgery

Score 5 — Abnormal presentation

Scores 1 through 4 may be averaged for data summarization (such as national cattle evaluations), but Score 5 should not be included in averages. Although they contribute to calving difficulty, abnormal presentations do not appear to be related to the genotypes of the calf (sire and dam direct contributions) or the dam. Thus, inclusion of abnormal presentation would bias to some degree any genotypic evaluation.

Dystocia, or calving difficulty, influences the economics of a cow herd in several ways. If calf losses result from delayed or difficult birth, the production from the dam is lost for the year, and the cost of her maintenance must be borne by the cows which actually wean calves. Labor and veterinary costs related to assisting a cow also reduce economic returns. Also, research has shown that cows which require assistance at calving do not rebreed as efficiently as cows which calve unassisted. Thus, producers are encouraged to keep and use calving difficulty records in their management and selection programs. Calving difficulty or ease can be partly attributed to the calves' sires and maternal grandsires. Expected progeny differences for calving ease-direct and calving ease-maternal should be calculated using a threshold model, and then be reported as percentage of unassisted births.

Birth Weight of Calves. Record birth weight on all live and dead calves. Estimates of birth weight are inaccurate and of no value. Birth weight data are very useful in understanding and making selection decisions relating to calving difficulty.

Calf History. Record as follows:

Score 1 — Calf alive at weaning

Score 2 — Calf sold before weaning

Score 3 — Calf alive at 72 hours, but dead before weaning

Score 4 — Calf alive at birth, but dead within 72 hours

Score 5 — Calf dead at birth

Calf history scores identify the source of losses, if every cow does not wean a calf.

Cow Reproduction or Disposal History. This record is made each year for all cows, starting with the previous year's breeding season. The records are summarized after weaning of calves for the past year's breeding and calving history. Record as follows:

Score 1 — Cow open, sold

Score 2 — Cow open, kept alive

Score 3 — Cow open, died

Score 4 — Pregnancy unknown, sold

Score 5 — Pregnancy unknown, died

Score 6 — Pregnant, sold before calving

Score 7 — Pregnant, died before calving

Score 8 — Pregnant, aborted

Score 9 — Cow calved

This history of each cow for the calf crop just weaned identifies when success or failure occurred in weaning a live calf, as well as disposal of cows from the herd.

Gestation Length. Calculate the number of days between known breeding date (conception) and subsequent calving date. Cows with longer gestation periods have a shorter period of time after calving to get ready for rebreeding, if they are to stay on a yearly calving schedule.

Age at First Calving. Calculate the age of heifers in months at first calving. Heifers calving at a young age will be represented by a lower replacement female cost in the cow herd operation. Care must be taken in evaluating age at first calving in a group of females if the females vary in age when they are first exposed for breeding. Older females will have their age at first calving biased upward compared with younger females in a group that was exposed to first breeding at the same time. This bias occurs because older females at first breeding will be older at first calving.

Calving Interval. For yearly calving intervals, calculate as the number of days between the last and second-to-last calving. This measure is one indicator of a cow's reproductive performance for the past year. Cows with consistently long yearly calving intervals may eventually fail to rebreed under fixed breeding season management. Evaluating the latest average yearly calving interval for all cows in the herd will help the breeder identify areas for management improvement.

Lifetime average calving interval is calculated as the number of days between first and last calving, plus 365, divided by the number of calvings. The equation is:

$$\text{Lifetime Calving Interval} = \frac{\text{Age at Last Calving} - \text{Age at First Calving} + 365}{\text{No. of Calvings}}$$

Measurement of calving interval is more important as a tool to monitor herd performance than as a tool for culling cows. Culling open cows after the breeding season will keep variation in calving interval small.

Yearly Prolificacy. Record as follows:

Score 1 — Cow had one calf

Score 2 — Cow had twins

Score 3 — Cow had triplets, quadruplets, etc.

Prolificacy scores will be helpful in determining which cows have had multiple births and which sires have female relatives with multiple births, thus providing data for selection of twinning. These data provide a base for research in twinning as a method for increasing reproductive rate in cattle.

Male Reproduction

An examination of bulls for breeding soundness before the breeding season can detect the majority of bulls which have obvious potential fertility problems. This examination should be performed by a veterinarian or other experienced, competent personnel. Techniques presently available do not allow accurate predictions for degrees of fertility. Results from an actual breeding season are the best test of a bull's breeding ability.

Breeding Soundness Exam. The Society of Theriogenology has developed procedures for the evaluation of breeding soundness. They incorporate a physical examination, minimum recommended scrotal circumference by age, a minimum recommendation for percent normal

sperm, and a minimum recommendation for gross and (or) individual motility, as described below.

Physical Examination.

- Palpate scrotum and testes
- Rectally palpate internal glands
- Examine extended penis and prepuce

Scrotal Circumference. Scrotal circumference gives an indication of a bull's ability to produce sperm and is related to younger age at puberty. Record actual measurement (in centimeters) of the circumference of the scrotum. Also, record age of the bull at time of measurement.

Minimum Recommended Scrotal Circumference

Age of Bull	Minimum SC (cm.)
15 months or younger	30
15 to 18 months	31
18 to 21 months	32
21 to 24 months	33
Older than 24 months	34

Semen Evaluation. Record percent motility and morphology description. Procedures for scoring motility and morphology have been developed by the Society of Theriogenology. The minimum recommended motility is 30% individual and(or) fair (F) gross motility. For sperm morphology, the minimum threshold is 70% normal cells.

Gross and Individual Sperm Motility

Rating	Gross Motility	Individual Motility
Very Good, VG	Rapid Swirling	>70%
Good, G	Slower Swirling	50-69%
Fair, F	General Oscillation	30-49%
Poor, P	Sporadic Oscillation	<30%

Body Condition Score

Body condition is related to maintenance, growth, reproduction, milking ability, and productive life. The influence of body condition on these economically important traits brought about interest in a tool for measuring cow condition. A popular method used across the United States to assess condition in beef cows utilizes a subjective scoring system.

Body condition scoring has been used as an indicator of nutritional status of the beef cow. Adequate body energy reserves are necessary for optimal reproductive ability. A scoring system allows cow-calf operators to evaluate the effectiveness of various feeding programs in the cow herd. Many beef producers are adapting this management tool to their programs.

Body condition scoring allows for more clear and concise communication of the cow's actual condition or fat level. Terms such as thin, moderate flesh, etc. are often visualized differently by different people. The numerical scoring system, even though it is subjective, attempts to quantify actual levels of fat and provides an opportunity for standardization.

Another advantage of the scoring system is that a feeding program can be fine-tuned for a beef cow herd. It is generally accepted that one body condition change on a 1050 to 1100 lb. cow equates to 75 to 80 lb. of tissue weight change. With the use of the net energy system, the feeding program can be designed with a relatively high degree of precision. This is especially true where intake of feeds is known. If it is determined that one body condition score needs to be gained, a feeding program can be formulated to allow the cow to gain 75 to 80 lb. of body tissue weight in a given time period.

Body Condition Scoring System. Body condition scores are numerical values to estimate the relative fatness or condition of the beef cow. A popularly used description for beef cattle is the 9-point system. Scores are assessed subjectively, ranging from 1 = Severely Emaciated to 9 = Very Obese.

Visual body condition scoring is generally practiced. Palpation or feeling of the cow's condition may be beneficial in situations where cows are carrying thick hair coats. Preferences for areas to evaluate on the cow may differ slightly among evaluators. However, the general areas of consideration include the last half of the ribs, edge of the loin, and the spinous processes, hooks and pins, as well as tail-head, brisket and shoulder area. Consistency in scoring is the key in utilizing this system as a management tool. Also, the producer must know how to adjust feed resources, depending on body condition and the stage of the production year. Use of condition scores as a tool for assessing the nutritional needs of the beef cow requires the consideration of her production environment. For example, a body condition Score 5 cow in Nebraska would still be a body condition Score 5 cow in Florida. However, the recommendations for meeting her nutritional needs for efficient reproduction will differ for the two environments. Standardization of the condition scoring system does not imply standardization of the recommendations for management of cows fitting various scores.

Body condition scoring should be constantly monitored on a herd basis. Even though body condition at calving is very predictive of rebreeding performance, it is then too late to make corrective feeding changes. Evaluating body condition prior to, or at, weaning allows adequate time to alter the feeding program to provide proper body condition at calving. Body condition scores are as follows:

Score 1 — Severely Emaciated. All ribs and bone structure easily visible and physically weak. Animal has difficulty standing or walking. No external fat present by sight or touch.

Score 2 — Emaciated. Similar to 1, but not as weakened.

Score 3 — Very Thin. No palpable or visible fat on ribs, brisket or shoulder blades. Individual muscles in the hind quarter are easily visible and spinous processes are very apparent.

Score 4 — Thin. Ribs and pin bones are easily visible and fat is not apparent by palpation on ribs or pin bones. Individual muscles in the hind quarter are apparent.

Score 5 — Moderate. Ribs are less apparent than in 4, and have less than 0.2 in. of fat on them. Last two or three ribs can be felt easily. No fat in the brisket. At least 0.4 in. of fat can be palpated on pin bones. Individual muscles in hind quarter are not apparent.

Score 6 — Good. Smooth appearance throughout. Some fat deposition in brisket. Individual ribs are not visible. About 0.4 in. of fat on the pin bones and on the last two or three ribs.

Score 7 — Very Good. Brisket is full, tail-head and pin bones have protruding deposits of fat on them. Back appears square because of fat. Indentation over spinal cord due to fat on each side. Between 0.4 and 0.8 in. of fat on last two to three ribs.

Score 8 — Obese. Back is very square. Brisket is distended with fat. Large protruding deposits of fat on tail-head and pin bones. Neck is thick. Between 1.2 and 1.6 in. of fat on last two to three ribs. Large indentation over spinal cord.

Score 9 — Very Obese. Description of Score 8 taken to greater extremes.

Herd Measures of Reproductive and Cow Efficiency

Several measures can be summarized to evaluate reproductive efficiency, or inefficiency, of overall herd or bull mating groups. Identification of bull or overall herd problems will allow breeders to determine where action should be taken to improve reproduction in their herds. Measures to calculate are as follows:

Number of Cows Exposed. This is the number of cows exposed for either A.I. or natural service breeding, either in the present year's breeding season or in the past year's breeding season. This figure should be calculated on a bull-mating-group basis.

Percent Palpated Pregnant. This is a measure of the success of the breeding season. It is calculated as follows:

$$\text{Percent Palpated Pregnant} = \frac{\text{No. of cows palpated pregnant}}{\text{No. of cows exposed}} \times 100$$

Live Calving Percent. This is a measure of the success of the cumulative results of the breeding and calving seasons. It is calculated as follows:

$$\text{Live Calving Percent} = \frac{\text{No. of live calves}}{\text{(No. of cows exposed} - \text{No. of cows sold or died} + \text{No. of pregnant cows purchased)}} \times 100$$

Weaning Percent. This measure, also called "percent calf crop weaned", relates the cumulative results of breeding, calving, and preweaning to reproductive efficiency in the cow herd. Percent calf crop weaned has been

recognized as the most descriptive single measure of reproductive efficiency, or inefficiency. It is calculated as follows:

$$\text{Weaning Percent} = \frac{\text{No. of calves weaned + No. calves sold preweaning}}{\text{(No. cows exposed − No. cows sold or died + No. of pregnant cows purchased)}} \times 100$$

A summarization of breeding and calving dates is helpful in evaluating reproduction in the cow herd or in sire breeding groups. A review of breeding date records will help to identify such early breeding problems as a bull's failure to get cows pregnant, or the cow herd's not cycling well. Review of calving-date records is an "after-the-fact" reflection of the previous year's conception dates and may also be used to plan methods to shorten the breeding and calving seasons in future years.

Cow Efficiency Measures the Ratio of Beef Output Per Unit of Nutrient Input. The beef output includes the beef from cull cows as well as progeny slaughtered. Beef output is relatively easy to access. However, it has not been possible to measure nutrient intake of reproducing animals under practical management systems.

One measurement of efficiency that has been considered is the ratio of calf weight to cow weight. In this ratio, the numerator represents output, and the denominator, cow weight or cow weight$^{0.75}$, represents input or feed required for maintenance of the breeding herd.

Unfortunately, research involving individually fed calves and individually fed cows has shown that this ratio is not a good predictor of the ratio of weight of progeny to feed consumed by the cow and calf to weaning. One study showed that weaning weight of progeny alone is slightly more accurate than the ratio of calf weight to cow weight as an indicator of cow efficiency. Several other studies have shown that the ratio of calf weight to cow weight, or cow weight$^{0.75}$, is too biased (penalizing large cows and favoring small cows) to be of practical use as an indicator of cow efficiency.

Adjustment Factors for 365-day Scrotal Circumference

Breed	Adj.
Angus	0.0374
Red Angus	0.0324
Brangus	0.0708
Charolais	0.0505
Gelbvieh	0.0505
Hereford	0.0425
Polled Hereford	0.0305
Limousin	0.0590
Salers	0.0574
Simmental	0.0543

Central Test Stations

Central test stations are locations where animals from several herds are assembled to evaluate differences in certain performance traits under uniform conditions. Uses of central test stations include: (1) comparing individual performance of seedstock herd-sire prospects and commercial bulls; (2) finishing steers and (or) heifers in progeny-testing programs; and (3) educating purebred breeders and commercial producers on the value and utilization of performance records.

The objectives of each central test station should be clearly defined, with testing procedures designed to accomplish these objectives. Only general principles will be discussed because specific objectives and procedures vary from station to station.

Central bull test stations are used in many parts of the country to evaluate postweaning performance of bulls under uniform conditions. The first test stations were used to demonstrate performance concepts and improve growth rate in breeds of beef cattle. With the development of national cattle evaluations conducted by many breeds today, central test stations are now used by seedstock breeders as an additional source of performance records on their bulls. Also, central test stations may serve as a demonstration of how to conduct an on-farm performance test.

Central test stations demonstrate postweaning gain performance and provide educational opportunities for prospective bull buyers. Also, the stations serve as a good source of bulls for commercial and seedstock herds. The test station not only provides a seed stock producer with a place to market individual bulls, but it also gives producers an opportunity to advertise the breeding program by placing their bulls side-by-side with bulls from other breeders. Bulls consigned to central tests should meet rigid qualifications for age, preweaning performance and soundness.

If the purpose of a central test station is to progeny test herd sires to evaluate differences, the sample of each sire's offspring must be representative, or at least all selected in the same manner. A minimum of 6 to 8 progeny from each sire should be evaluated. These may be bull, steer or heifer calves fed to evaluate postweaning growth, feed conversion and carcass traits.

The recommendations for central test stations are based on many years of research and experience and are designed to maximize reliability and clarity of results. Even if all test stations followed the recommendations, comparisons of performance of animals at different locations would be invalid due to differences in climate, rations, etc. Central test data are valid for comparison of animals

only within a particular test and not between years and test stations.

The following general procedures and policies are recommended for all types of central bull tests:

1. Calves should be 180 to 270 days old at time of delivery to the test.

2. Test groups should have a maximum age spread of 90 days.

3. Ratios should be calculated only within breed contemporary groups.

4. Consignors' herds should be enrolled in their respective breed association performance program. State BCIA programs are acceptable for herds whose breed associations do not have performance records programs.

5. Calves should complete the weaning phase of the performance record program with their contemporary group.

6. Initial and final test weights may be either full or shrunk weights. If full weights are taken, initial and final weights should be an average of two weights taken on consecutive days to minimize fill effects. If shrunk weights are taken, a single weight after a shrink of 12 hours is adequate.

7. All bulls sold in a central test station sale should be evaluated for structural soundness by competent personnel.

8. All bulls sold in a central test station sale should be required to pass a complete Breeding Soundness Examination conducted by a qualified veterinarian or reproductive physiologist.

9. Nutritional programs should provide adequate levels of protein and energy for the expression of genetic differences in growth between bulls. Test ration composition and analysis should be stated in all test station sale catalogs.

10. Sire-group testing of bulls is more desirable than individual testing because it provides more information to both breeders and prospective buyers.

11. Expected Progeny Differences (EPDs) for birth weight, weaning weight, yearling weight, maternal milk and direct and maternal calving ease (if available) with their corresponding accuracies should be provided in all test station sale catalogs.

12. EPD distributions (percentile rankings) and breed average EPDs by trait within breed for bulls of a given birth year should be presented in all test station sale catalogs to allow entire breed population comparisons.

Full-Feed Central Bull Tests. The following procedures and policies are recommended for all full-feed central bull tests:

1. There should be a minimum pre-test adjustment period of 21 days.

2. The minimum length of the test should be 112 days.

3. Test rations with 60% to 70% TDN (total digestible nutrients) on an as-fed basis should be fed free-choice.

4. BIF recommends that central test stations use the following formula for calculating 365-day weight:

$$\text{Full-Feed Central Test 365-Day Wt.} = \frac{\text{Final Wt.} - \text{Birth Wt.}}{\text{Age in Days}} \times 365 + \text{Birth Wt.} + \text{Weaning Wt. Age-of-dam Adj.}$$

An alternative equation that has the favorable effect of standardizing length of pre-test and on-test periods may be used:

$$\text{Full-Feed Central Test 365-Day Wt.} = \frac{\text{Initial Wt.} - \text{Birth Wt.}}{\text{Initial Age}} \times 205 + \frac{\text{Final Wt.} - \text{Initial Wt.}}{\text{Days on Test}} \times 160 + \text{Birth Wt.} + \text{Weaning Wt. Age-of-dam Adj.}$$

5. Efficiency of feed conversion should be expressed as pounds of feed (as-fed) per pound of gain adjusted to a common body weight, because weight differences affect feed requirements for maintenance.

6. Full-feed, centrally tested bulls can benefit from a post-test period (4 to 6 weeks) of reduced grain intake and exercise prior to cow herd exposure to facilitate optimal reproductive and performance efficiency.

Forage Bull Tests in the Southeast. These tests evaluate the performance of bulls on forage programs similar to those of commercial cow-calf producers rather than in full-feed, gain-feedlot environments. Also, bulls are tested for longer periods of time because they are on moderate levels of nutrition, rather than on high levels of nutrition which are characteristic of traditional gain tests.

The following procedures and policies are specifically recommended for forage central bull tests:

1. Feasibility depends on whether a year-round forage program of high quality, lush forages can be put together in consultation with Cooperative Extension forage agronomists.

2. Backup forage supply of silage is necessary because environmental factors such as rain and temperature guarantee that there will be periods when adequate grazing will not be available.

3. The pre-test adjustment period of 21 days is optional. Differences in shrink at delivery will be negated, depending on the length of the test.
4. The minimum length of the test should be 168 days.

5. If a test ration with 60 to 70% TDN (total digestible nutrients) on an as-fed basis is fed, it should be limit-fed.

6. BIF recommends that forage central bull tests use the following formula for calculating 452-day weight:

$$\text{Forage Central Test 452-Day Wt.} = \frac{\text{Final Wt.} - \text{Birth Wt.}}{\text{Age in Days}} \times 452 + \text{Birth Wt.} + \text{Weaning Wt. Age-of-dam Adj.}$$

Social problems of fighting and riding are a natural part of the conditioning process that

bulls on forage tests go through because of their age. It is prudent to anticipate some injuries and to inform consignors of the risks involved. These problems become very pronounced when grazing runs short and the bulls are constantly hungry. Keeping bulls full by daily limit-feeding a test ration formulated to maximize forage utilization, and by providing silage to back up the forage program, minimizes these social problems.

General Considerations. Test average daily gain (ADG) and ratio are the most important data in test station results because they measure growth only during the period when all bulls are under the same test conditions. Selection for test gain should also improve preweaning growth and thus weaning weights, because some genes affect both traits. An individual's ADG ratio is calculated by dividing his ADG by his breed contemporary group average ADG and multiplying by 100. A ratio of 100 means the bull's ADG is average. A 115 ratio means he gained 15% faster than the average bull. A 90 ratio means he gained 10% slower than the average bull. This ratio makes comparisons easier and is more informative than actual ADG.

Adjusted 205-day weaning weights and within-contemporary-group ratios provide good comparisons of bulls from the same herd, but have little value for comparing bulls from different herds. Weaning weight is the best available estimate of a dam's milking ability. Therefore, an adjusted 205-day weaning weight ratio of 100+ is desirable.

Adjusted yearling weight and ratio combine adjusted weaning weight and postweaning gain into a single composite measurement which is highly heritable. The ratio is the best measure for comparing growth of calves from the same herd. However, use care when comparing adjusted yearling weights and ratios of bulls from different herds, because the weaning weight portions of their growth were not made under comparable conditions.

Weight per-day-of-age and ratio are alternative measurements of growth during the same period, but do not include adjustment for age of dam, which can be large. Therefore, these measurements are biased by differences in age-of-dam, weaning age, preweaning nutritional levels and length of the period from weaning until the start of the test.

Even under the best possible conditions at a central test station, not all pre-test environmental effects can be eliminated. However, all bulls do have an equal opportunity to express their genetic potential while at the station.

Breeders must decide which traits will receive the most emphasis in their selection programs. Only a few traits and limited numbers of bulls can be evaluated at central test stations. Complete performance programs in seedstock herds are essential to maximize genetic progress in the beef cattle industry.

Test Station Reports. Following is the recommended information to include in test reports:

1. Test ear tag number
2. Sire's name
3. Bull's permanent identification
4. Horned, polled, scurred status
5. Birth month, day and year

6. Actual birth weight
7. Adjusted 205-day weaning weight
8. Adjusted 205-day weaning weight ratio
9. Adjusted 205-day weaning weight number of contemporaries (number of bull calves in the same weaning-management group). Put "ET" in column for embryo transplant calves
10. Age of dam at calving (years)
11. Birth weight EPD
12. Weaning weight EPD
13. Yearling weight EPD
14. Maternal pure milk EPD
15. Direct calving ease EPD
16. Maternal calving ease EPD
17. Initial (on-test) weight
18. Final (off-test) age (days)
19. Final (off-test) weight
20. Test ADG = (Initial weight — Final weight) / Days of test
21. Test ADG Ratio = (Test ADG / Breed test group average ADG) × 100
22. WDA = (Final weight / Final age)
23. WDA Ratio = (WDA / Breed test group average WDA) × 100
24. Scrotal circumference (cm.) at the end of the test or on first weigh day after 365 days of age
25. Adjusted 365- or 452-day weight (YW)
26. Adjusted 365- or 452-day weight ratio = (YW / Breed test group average YW) × 100

Optional:

27. Frame score — function of hip height (in.) measured directly over the hip bones (hooks) and age
28. Feed conversion adjusted to a common body weight
29. Actual 12th-rib fat thickness (in.) measured by ultrasound
30. Station index varies with individual test objectives; usually includes gain ratio, adj. yearling weight ratio and (or) weight per day of age ratio or some combination thereof