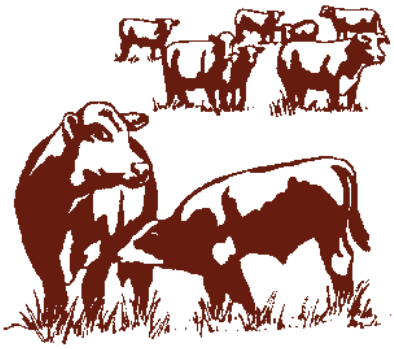
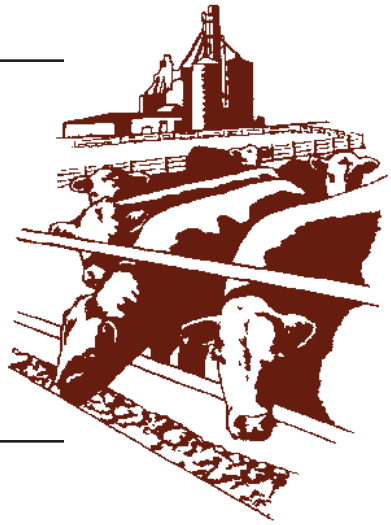


# Beef Cattle Handbook



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## Breeding Soundness Evaluations

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Standardized Performance Analysis (SPA) database information of cow/calf operations running between 200-500 head reveals an investment of over $2000.00 being made for each breeding cow in land, equipment, facilities and animal unit price.[1] When herd bulls are used at 1:25 to 1:40 ratios, this represents an investment of $50,000 to $80,000 which is annually dependent upon the satisfactory reproductive potential of each breeding age bull, regardless of the price paid for the bull.

The use of bulls in natural mating programs accounts for over 95 percent of pregnancies each year in the U.S. beef cattle industry.[2] To impregnate a cow in a natural mating situation, the bull must produce semen of satisfactory quality and be able to successfully mount and deposit the semen in the reproductive system of the cow. Failure to meet either criteria will result in poor reproductive performance. A recent national survey of cow/calf operations found that 47 percent of the producers semen tested newly purchased, borrowed or leased bulls prior to use.[3] Of the bulls held over from the previous breeding season slightly over 18 percent were semen tested. In that same survey, infertility was the most important reason considered when culling a bull. It would appear that many producers are neglecting a valuable management practice only to find at pregnancy examination or during the next year's calving season that a bull's reproductive performance was low.

While semen testing alone will indicate if a bull is producing semen of satisfactory quality at the time of the examination, it will not detect if the bull has the desire or physical ability to successfully breed cows. A breeding soundness evaluation (BSE) of a range bull is a method to standardize the evaluation of the major factors which influence the reproductive potential of the bull. The examination process has several components which include:

1) A detailed medical history about the bull
2) A general physical examination
3) A detailed examination of the reproductive system to include a scrotal measurement
4) An evaluation of the semen
5) Optional tests such as serving capacity evaluation, pelvic measurement, testing for trichomoniasis or evaluating semen for seminal protein levels

### Detailed Medical History

At the outset of a BSE, a detailed medical history of the bull should be completed. Basic collected information should include an identification number, age, breed, weight, specific vaccines and other products use on the bull, injection sites of those products, dates of administration and any previous health information. Of particular importance are health problems occurring within six to ten weeks prior to the semen portion of a BSE because it takes nearly sixty days for a sperm cell to be produced and ready for ejaculation. Thermal and mechanical conditions such as a fever, a retained testicle, hernias, high ambient temperatures (over three weeks), scrotal frost bite, or a chronic debilitating disease, can affect the quality of a semen sample for a prolonged period of time. Additional questions which could be asked of the previous herdsman should focus on the bull's management and how the animal mounts and breeds and can include:

1) How is the bull being fed (type of ration, amount,

mineral)?
2) Has the bull been moved from location to location within the last sixty days?
3) Has the bull been used previously for breeding? If so, how many times, how many cows was he exposed to each breeding period, conception rate(s), calf performance and did the bull produce all normal calves?
4) Has the bull shown evidence of pain during breeding?
5) Can the bull extend his penis and maintain an erection?
6) Can the bull breed a cow?
7) Has the bull ever shown a corkscrew or rainbowing of the penis at the time of breeding?

### General Physical Examination

A bull must be able to eat, see, smell and move without lameness and successfully breed cows to complete his role in a herd's reproductive performance. The physical examination looks at a bull's general appearance and condition. The bull should be free of warts, ringworm and other skin conditions. Permanent identification of the bull from official ear tags, tattoos, hide brands and/or horn brands can be made at this time.

The eyes must be clear and free of cancer eye lesions or injuries. Bulls with poor vision are prone to injury especially in multiple bull pastures, are dangerous to people and horses, and have lowered reproductive performance.

The teeth should be examined to confirm age and to check for worn or missing teeth. Check the mouth, jaw and neck for abscesses and scar tissue which indicate infection of the bone and soft tissues around the mouth and neck.

How a bull moves is of particular importance. A bull to be used in a natural mating pasture operation must travel and mount cows in heat. Lameness, however slight, particularly on rear legs may be compounded when a bull mounts and travels during the breeding season. A bull should not show evidence of swollen stifle, knee or feet joints, founder, scars around the coronary band, growths between the toes, footrot or hoof cracks prior to turn out. Conformational defects like sickle hock, cow hock, post-leggedness, crooked legs and feet, or splayed toes can lead to stifling or injuries to the feet during the breeding season.

### Reproductive System Examination

The examination of the reproductive system focuses on three areas:
1) the scrotum and its contents
2) the internal reproductive organs
3) the penis and prepuce

The initial examination of the scrotum looks at scrotal conformation, symmetry of testicles, for evidence of previous injury, for evidence of fluid within the scrotum, for skin lesions such as frostbite or parasite irritation, whether the testicles are free and moveable within the scrotum, and if both testicles have descended completely into the scrotum. The testicles are then examined for tone (the testicles should not be soft), resiliency (influenced by scrotal fat and soft testicles) and size (the testicles should not vary in size over 10 percent from each other). Following the testicular examination the epididymis and vas deferens of each testicle should be palpated to check for swelling or if portions may be missing.

One of the most easily obtained and repeatable procedures is a measurement of the scrotal circumference. Scrotal circumference is a moderately to highly heritable parameter. Several researchers have shown a positive relationship between scrotal circumference and male reproductive traits such as the number of normal sperm, sperm concentration, sperm motility, and total daily sperm production.[4] Recent work evaluating over 4,000 bulls has shown a positive relationship between 205-day and 365-day scrotal circumferences. This indicates that if a bull has small testicles at weaning it will also have smaller testicles as a yearling. Scrotal circumference has been favorably correlated with age at puberty, pregnancy rates and growth and performance traits such as birth weight and yearling weights for female offspring. Factors which can influence scrotal circumference are environmental temperature, age, injury, breed to include double muscling and scrotal fat.

It is of particular importance when obtaining a scrotal measurement to have the testicles lying side by side with minimal wrinkling of the scrotum and to measure over the widest portion of the testicles. During periods of cold weather, particularly when temperatures are below freezing, the testicles are drawn near the body which makes accurate measurement more difficult.

The minimum industry requirement established for 12-14 month old bulls across all breeds is 30 cm.[5] Table 1 lists the minimum scrotal circumference guidelines by age established by the Society for Theriogenology. Bulls found below this value may produce semen of satisfactory quality but normal breeding pressures may overcome the limited sperm production capacity of these bulls resulting in poor reproductive performance. Ideally, a producer would want selection criteria set well above these values.

Examination of the internal reproductive organs

Table 1: Minimum Recommended Scrotal Circumference in Centimeters by Age for Bulls[a]

| Age (months) | Scrotal Circumference (cm) |
|---|---|
| 15 | 30 |
| >15 18 | 31 |
| >18 21 | 32 |
| >21 24 | 33 |
| >24 | 34 |

[a] *Adapted from the Breeding Soundness Evaluation Form, Society for Theriogenology, Hastings, NE.*

involves a rectal palpation of the seminal vesicular glands, internal portions of the vas deferens, prostate gland and the internal portion of the penis. Of particular importance are the paired seminal vesicles. These sac-like glands can become inflamed which may cause infertility because of the discharge of pus into the semen. While a high percentage of a group of young bulls can develop seminal vesiculitis, the industry average appears to range from 0.85-9 percent for bulls less than two-years of age.[6]

The penis and prepuce can be examined following the internal examination generally by hand massaging the internal reproductive organs or by using an electro-ejaculator. If an electro-ejaculator is used, the internal examination helps remove feces from the rectum allowing the electro-ejaculator probe to fully contact the surface of the rectum and aids in sexually stimulating the bull prior to the procedure.

The penis should be fully extended and examined thoroughly. In older bulls frequently observed conditions are prepucial prolapses, lacerations of the penis and prepuce, adhesions of the prepuce, and abscesses and hematomas along the shaft of the penis. In a study of 1,111 ten to fifteen month-old bulls, over 30 percent were found to have abnormalities of the penis and prepuce.[7] The most commonly occurring conditions were an incomplete separation of the penis and prepuce, persistent penile frenulum, hair rings and fibropapillomas (warts). These conditions can impair a bull's ability to successfully breed cows because of poor extension, pain or physical blockage of the entry of the penis into the cow at breeding.

## Semen Evaluation

While many methods are available to obtain semen samples. The most frequently used is with an electro-ejaculator. Electro-ejaculators utilize a probe placed into the rectum of the bull. Mild rhythmic electrical stimuli are applied to the internal reproductive organs and surrounding pelvic structures. The electrical pulsations will initially cause pre-ejaculatory secretions to occur, then extension of the penis. As the rate and frequency of pulsations are increased, ejaculation will occur.

To evaluate semen quality, the collected sample is examined with a microscope to determine overall and individual sperm motility and the percent of normal sperm. Both motility and morphology have been shown to be positively correlated to pregnancy rates. The minimum industry standards are to have over 70 percent normal sperm in a sample with 30 percent of the sperm being progressively motile. Care must be taken when handling semen samples to protect them from the environment, as cold shock, wind and dust can affect the outcome of the evaluation.

Because it takes about sixty days for a mature sperm cell to be produced, the evaluation of a yearling bull will actually be looking at semen produced when the bull was ten-months old. If a bull had reached puberty at that time, the semen quality is generally acceptable. If the semen evaluation produces negative results, it should not be considered conclusive because semen quality has been shown to improve for up to four months following puberty. Subsequent evaluations at monthly intervals can monitor quality grade improvements.

## Optional tests

Serving Capacity Evaluation - To achieve a high number of pregnancies during a short breeding season, a bull needs to have acceptable semen and exhibit acceptable mating behavior in seeking out and successfully mating with the females in his breeding group. However, semen quality, hormone levels, or scrotal circumference are not correlated well to a bull's sex drive or mating ability. In recent years, tests have been developed which attempt to evaluate a bull's serving capacity or mating ability. These tested are designed to evaluate the amount of interest and number of mating a bull demonstrates in a limited amount of time. The majority of work has been done in Australia and New Zealand. Many of those tests evaluated older bulls and have shown a positive relationship between mating ability and pregnancy rates. In the U.S., the majority of bulls are sold as yearlings. Mating evaluations in yearlings and correlations with subsequent pregnancy rates has been inconclusive. In recent work, inexperienced bulls categorized as low mating capacity at the start of the breeding season were found to have improved mating ability as the breeding season progressed.[2]

At present, serving capacity testing of inexperienced bulls may not adequately evaluate a bull's inherent ability to successfully breed large numbers of females. Routine observation of all bulls during the early part of the breeding season to see if they have the desire and ability to breed coupled with periodic observations during the breeding season and critical evaluation of pregnancy rates appears to be the most workable alternative until better evaluators become available.

## Pelvic Measurement

Measurement of the internal height and width of the pelvis has been used to determine pelvic area in young bulls. This is a skeletal measurement which has a moderate correlation to frame size. Thus as pelvic area increases, the potential exists for frame size to increase proportionally. A recent study in Colorado reported a .6 genetic correlation between male and female pelvic areas indicating that selection for larger pelvic size in bulls could result in increased pelvic size of female offspring.[8] Pelvic areas of young bulls tend to be smaller than those of heifers at the same age. For example, yearling bulls weighing between 900-1100 pounds average about 150-170 $cm^2$ in pelvic area which is similar to yearling heifers weighing only 650-700 pounds. It is estimated that pelvic area in a bull will grow at approximately .31 $cm^2$ per day of age.[9] To compare bulls it is important that pelvic area be adjusted to a comparable age and possibly weight.

Testing for Trichomoniasis - *Tritrichomonas fetus* is a one-cell protozoa which causes a venereal disease in cattle. The disease is associated with poor reproductive performance, characterized primarily by abortions during the first five months of pregnancy. Bulls are inapparent carriers of the organism showing no signs of disease after becoming infected. Young bulls generally less than two-years of age, when infected, do not carry the organism for long periods of time. Older bulls once infected can carry the organism indefinitely. Bulls can be tested by culturing mucous from the prepuce and penis at the time of a breeding soundness evaluation. It is recommended that all bulls be tested annually, particularly in open range herds. Because the culture test is only 85-90 percent successful in finding the organism on a single test, if one bull from a group is found positive, the remaining bulls should be cultured a minimum of two additional times to increase the likelihood of finding the organism in any given bull.

### Heparin Binding Proteins

Attempts to use sperm membrane and seminal plasma proteins to evaluate bull fertility show promise. Recent identification of seminal plasma proteins has revealed their role in sperm capacitation and acrosomal exocytosis. A class of complex carbohydrates known as glycosaminoglycans (GAGs), which include heparin and chondroitin sulfate, are found in the reproductive tract of both males and females. They are thought to have a significant influence on sperm-ovum interaction by contributing to cellular adhesion, proliferation, migration and differentiation among other roles.[10] Bovine seminal proteins bind and interact with GAGs thus influencing both capacitation and the acrosomal reaction. In particular, the bovine accessory sex glands are thought to be the major source of heparin binding proteins (HBPs) in seminal plasma.[11]

A recent study by Bellin, *et.al.* (1994), identified HBPs on sperm membranes and in seminal fluid.[12] The protein with the highest affinity for heparin binding was designated HBP-B5. Bulls used in the study had successfully passed a breeding soundness evaluation and were allotted to treatment groups by the amount of HBP-B5 on sperm membranes and in the seminal plasma. Cows exposed to bulls with HBP-B5 on sperm membranes, but undetectable in seminal plasma, had a 17 percent improvement in fertility compared to cows in breeding groups exposed to bulls with HBP-B5 on sperm membranes and in seminal fluid, in seminal fluid only or with no detectable HBP-B5.

Commercial testing of semen for seminal plasma protein is available. Following collection, the semen sample needs to be immediately placed on dry ice and shipped to the laboratory for analysis. The selection of bulls with high HBP-B5 levels bound to sperm membranes coupled with the successful passing of breeding sounding evaluation may be a method to enhance overall herd fertility.

### Classification of Bulls

Using guidelines established by the Society for Theriogenology, bulls are classified as satisfactory potential breeders, unsatisfactory potential breeders or classification deferred following a breeding soundness examination.[5] Those in the satisfactory category have met the minimum criteria for semen motility, semen morphology, scrotal circumference and no evidence of physical abnormalities have been found. Bulls with serious semen or physical defects or which fail to met minimum criteria for scrotal circumference are placed into the unsatisfactory potential breeder classification. Bulls placed into the deferred classification do not have severe problems but have conditions which through age or medical treatment may improve over time. A general recommendation is to retest classification deferred bulls at thirty day intervals until a decision can be made to place a bull in either the satisfactory or unsatisfactory potential breeder classification.

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