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EXTENSION CIRCULAR 551 (REVISED)

COOPERATIVE EXTENSION SERVICE
SOUTH DAKOTA STATE COLLEGE
U. S. DEPARTMENT OF AGRICULTURE

beef performance testing

on farm and ranch

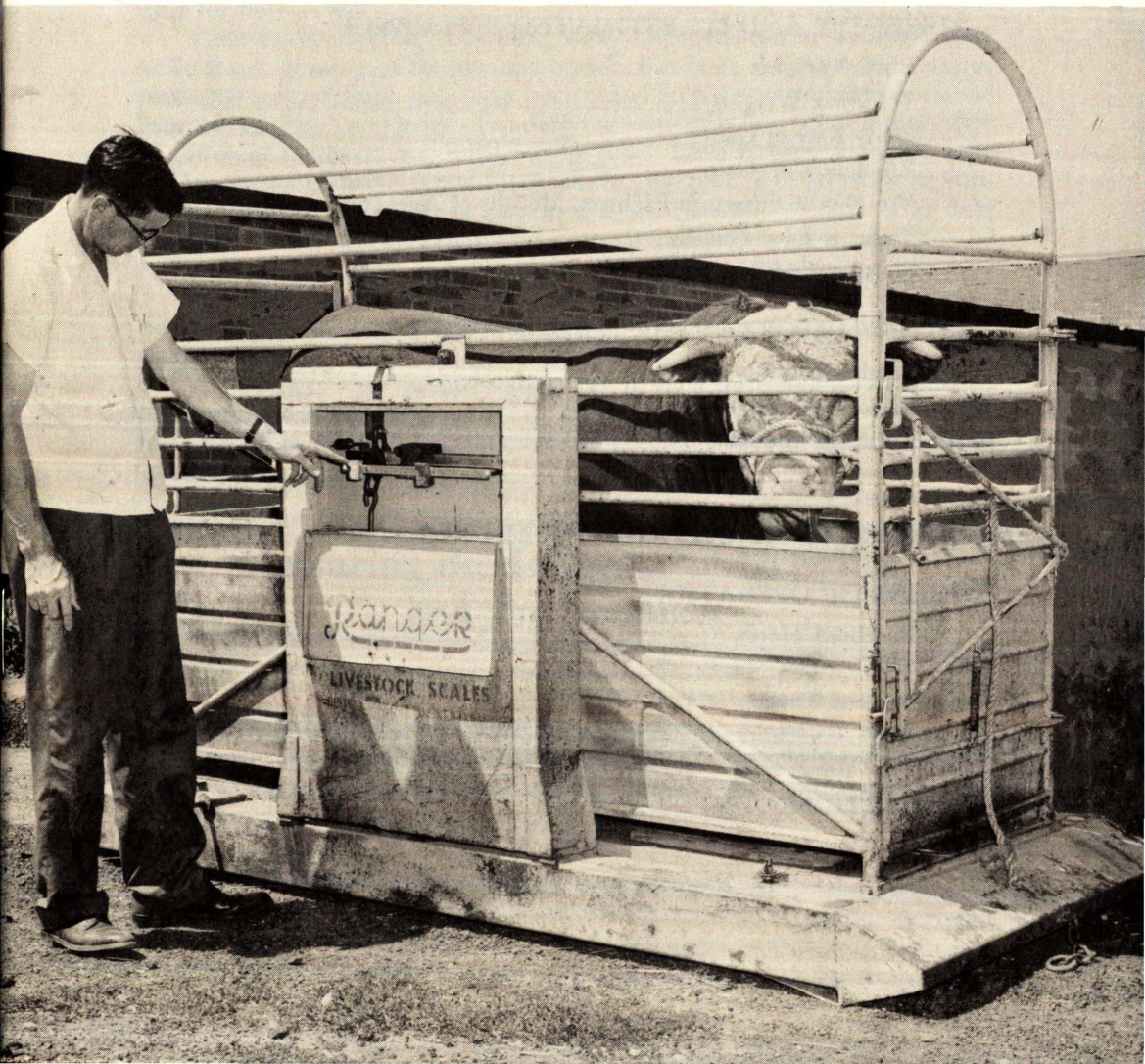


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Beef Performance Testing on Farm and Ranch

By Henry P. Holzman, Associate Animal Husbandman

This circular has been prepared to assist in answering the increasing number of questions being asked by producers of commercial and purebred cattle about the methods, principles and values of the Performance Test for beef cattle.

Performance testing is nothing new. Improvement in livestock ever since the beginning of the various breeds, has been due to some form of performance test. Such tests have been based on either observation or some form of records. Knowledge of underlying principles and the relative value of different methods has, until recent years, been lacking in beef cattle testing. Research projects conducted during the past 25 or 30 years, at various experiment stations have furnished a great amount of data. This data has been used to develop the basic methods and principles which must be followed if a performance test is to adequately serve its purpose.

A performance test for beef cattle may be simple or quite elaborate—depending on the interest of the operator and the objectives of his improvement program.

An operator may be interested only in data on weaning weights; or he may want to combine such data with information on any or all of the following factors: birth weights, rate of gain, efficiency of gain, weight at 12 months, weight at 15 to 18 months and type scores.

Measuring the Influence of Heredity and Environment

Heredity and environment are the two basic things that affect every living thing. To all living things as a whole, they are complimentary. That is, one is as important as the other in the completion of the life cycle.

On the other hand, in the development of different parts and processes of the living organism, heredity and environment play varying roles. For example: environment plays a very small part in the color of cattle. Deter-

mination of color and markings is due almost entirely to heredity, except in some cases where a fading color is due to sunlight and other weather conditions. On the other hand, milking ability of a cow has been determined to be about 28 per cent due to heredity, with the other 72 per cent due to environment.

1. The fundamental principle underlying all performance test programs is this: if we provide a uniform environment of a quality that will cause the desired development or expression of the characters we are interested in, and if we apply this environment to a group of living things, the differences among the various units in the test or experiment will be almost entirely due to heredity.

2. If the variation between what's desirable and undesirable for any characteristic is great enough, or, in other words, if the influence of heredity is great enough, we can establish a basis for selection and improvement.

3. The variation for any characteristic must be great enough to have significance. This can readily be determined statistically and can be shown by a simple example. A difference in weaning weight of 10 pounds from average would **not** be considered significant when the **greatest** difference was 100 pounds or more. An understanding of this principle is necessary for setting up sound measures for selection.

What Is Performance Testing?

Beef Performance Testing is a method of securing records by which selection standards and practices may be developed and used to improve the quality and producing ability of beef cattle. Similar testing can be done with sheep and hogs.

Why Performance Test?

Testing can improve the average quality and producing ability of livestock which will in turn increase the net return to operators following a planned method of selection.

Much research work in the past 25 years has proven that there are wide variations in birth weights, weaning weights, rate of gain and type in all classes of livestock. These variations continue to exist despite the general level of improvement that has been taking place. This research work indicates that the amount of influence assigned to heredity will vary between factors, but is sufficient in all cases to justify record keeping for selection purposes. Because these variations exist—many being due to heredity—this information furnishes a sound basis for developing a selection program based on the data secured in a Performance Test.

A basic principle of the science of genetics is that nature is constantly exerting a pressure toward the average of the group or population. If we are to successfully resist this pressure toward the average and bring individual herds above the population average or increase the average value

and productivity of the entire population, we must constantly employ all of our knowledge, plus the accurate data and information that we can secure in a performance test program.

Where to Performance Test

The best place to carry on a performance test is a place where all environmental conditions are as nearly equal as possible for all animals on the test. This makes the farm or ranch one of the most suitable places for carrying on such a test.

At the beginning of the Beef Performance Test program in South Dakota, representative sire groups of five or six bull calves from various herds were brought to a central location for a rate of gain test. The idea was that several years of such performance testing would provide performance data on the calves, and also provide a progeny test of the sires represented. This method of carrying on a performance test was abandoned in favor of the method of testing within each herd. Some of the reasons for changing the procedure include:

1. The environment of each of the individual sire groups previous to the test was quite varied. Some groups came from lush mountain range, some from drouthy prairie range and others had been creep fed.

2. There was often considerable difference in age within sire groups and between sire groups.

3. The number of animals that could be tested in any one year was very limited.

4. Available facilities were limited and the cost of feed and labor were such that they acted as a deterrent to active participation.

5. The data secured was limited in application to the individual calves tested and to their sires. The data gave insufficient information on the cow herd and could not be used in culling low producing cows. Nor did it give a complete picture of the sire's producing ability as to type, weaning weights, or rate of gain. Because of the limitations of the cooperative group method outlined above, it was abandoned in favor of a method that could be used on individual farms and ranches.

This method of performance testing for use on individual farms and ranch herds is outlined in the following pages. This method is unlimited in its application because it may be used effectively by any farmer or rancher in improving his herd—regardless of whether the herd is large or small.

This method has a minor disadvantage: because of differences in environment, comparison of the data from different herds would not be valid. This minor disadvantage, however, in no way hinders improvement within the individual herd.

When to Performance Test

The ideal time to start is at calving time. All calves should then be identified with a tag or tattoo, and a record made of birth dates with notations indicating the sex of the calf and the age of the dam. The age of the dam is important for making adjustments for age of dams. With the birth records as a start, an operator can develop a testing program suitable to his individual needs.

Who Should Performance Test?

All ranchers and farmers should carry on a well-planned selection program. There is nothing complicated about the records. Securing accurate data at the proper time is all needed for calculating results. County Extension Agents and Extension Animal Husbandmen will always be glad to assist anyone wishing to carry on a Performance Test program. Only to the extent that farmers and ranchers in general adopt some basic selection program, can the livestock industry make any appreciable progress in the further improvement of livestock. Producers of purebred livestock have for many years carried on improvement programs; but not until producers in general begin to match the efforts of the producers of purebred livestock, can a marked and lasting improvement in the quality and producing ability of our herds be achieved.

Environmental Requirements

Environment includes all things affecting an animal not due strictly to heredity. The environment should be as nearly **uniform** as possible for all animals in any group under test. Animals that nurse foster mothers or that are put on special rations for some particular purpose, should not be compared with animals that are not receiving similar treatment. Records on separate groups on the same farm or ranch can be kept when it is necessary to keep animals under separate environments.

All animals under test should be supplied with a ration that will produce a steady rate of gain. The desirable rate of gain for replacement heifers is about one pound per day from weaning until the range or pasture has sufficient growth to supply the required amount of forage.

Bull calves being fed for a rate of gain test should be furnished a ration that will produce an average rate of gain of approximately two pounds per day per animal for the period of the test. This is important if the bull calves are to show a reasonably-full development of all inherited characteristics by sale time.

It is not necessary to feed animals individually in order to secure records suitable for comparison and selection purposes—except where a test for efficiency of gain is desired. Animals should be fed in groups of 30 head or less when testing for rate of gain. Sufficient bunk space should always be provided.

Identification

Some form of identification is necessary for all the calves under test. It is desirable in all cases, but not absolutely necessary that all cows also be identified in some manner. Producers of purebred livestock have complete identification of all animals in the herd. This is desirable for carrying on a complete test program. Commercial producers, on the other hand, have no means of identifying individual animals unless they use tattoo marks in the ear or brand numbers on each animal. This sort of identification runs into a great deal of work and is not necessary if selection is done only on the **basis of weaning weights**. Selected or culled calves can be used to identify their dams either as individuals or as a group. Cows identified in this manner as low producers, may be temporarily identified by a hair brand or other mark, until it is convenient and practical to dispose of them. Probably the best way to identify calves is with the type of tag used by veterinarians in their various test programs.

Calving Dates and Age of Dams

Calving dates related to identification numbers are absolutely essential for adjusting weaning weight for age. These dates need not be exact, but should be within a week of actual calving, if valid comparisons are to be made at weaning time.

The age of the cow is important. Cows that are two, three or nine or more years of age usually drop calves considerably lighter than the calves dropped at four to nine years of age. An extra adjustment is made for those calves to compensate for the age of the cows. There is not enough average difference in calves dropped by cows that are from four to nine years of age to warrant the work of adjusting weights for the dam's age.

Hereditry and Its Estimated Influence

Birth Weights

The statistical estimate of the heritability of birth weights is 53 per cent. This would indicate that considerable progress could be made by selecting on the basis of birth weights.

Though birth weights have a high heritability, they are not of direct economic importance. Beef calves are seldom sold at birth and the task of securing birth weights at a season of the year when the work load is heavy and weather conditions often unpleasant is difficult.

Birth weights have not been used in the program carried on in Western South Dakota. First, because of the correlation between birth weights and weaning weights and secondly, because of available labor, facilities and weather conditions prevailing at calving time in the area. Records on the birth weights of Hereford calves, indicate a range of from less than 50

pounds to well over 100 pounds with an average of approximately 70 pounds. Similar data would, no doubt, show like variations in all breeds of cattle.

Weaning Weights

The estimated heritability for weaning weights is 28 per cent. This is rather low when compared to similar estimates for other factors. This is due to the large influence of the milking ability of the dam on the weaning weight of the calf. Significant relationships have been found between the weaning weight and the 12-month weight, the 18-month weight and a number of factors contributing to superior carcass grade.

Because of a low heritability and a high environmental factor based on the milking ability of the cow, weaning weight records are very important for use in culling the cow herd for increased production.

Selection on the basis of weaning weights probably offers a greater opportunity for livestock improvement in the way of more efficient production than any other factor upon which selection may be based. This is true because of the positive relationship between weaning weights, rate of gain, carcass grade and area of rib eye muscle. Selection on the basis of weaning weights is also a practice that can be carried on by every livestock producer.

Considerable progress can be made by observation alone at weaning time, if the age of individual calves are known. A scale will, of course, give more accurate data for comparison.

Weaning weights should be taken **before or at weaning time** and as near an average age as possible for which adjustment factors are available. The adjustment factors used in South Dakota were developed by Dr. Leslie E. Johnson and Dr. C. A. Dinkel at the Cottonwood substation of the South Dakota Experiment Station. This table of factors is based on 190 days of age and fits South Dakota conditions very well. Other tables are available for varying ages, most of which are within 20 days of the 190 days age for which this table was developed.*

Weaning weights taken **more than a few days after** actual weaning, cannot be relied upon for selection purposes. This is because each individual calf responds differently to its new environment which may cause wide variations to develop in weights when compared to actual weaning weights.

Weaning weights are taken on a five-pound break. This is accurate enough for comparison and greatly simplifies the job of tabulation and analysis. The weaning weights are then adjusted to 190 days of age and further adjustment is made for the age of the dam.

The adjustments for age of dam are arbitrary in that they were determined after consultation with operators and from the data gathered in the past six years of testing. The idea of the cow-age adjustment is to give

*See Experiment Station Circular 144, "Indexing Beef Cattle."

a "fair break" to the young and old cows when comparing their production with the balance of the herd. Additional records and analysis may make it advisable to reduce or increase the amount of adjustment.

Though beef cows in general have a reputation for being rather poor milkers, it is possible to grade up their milking ability by selecting on the basis of weaning weights of their offspring. Experimental records and records obtained under practical ranch conditions show a variation in weaning weights when adjusted to a common age of 190 days from less than 300 pounds to more than 550 pounds.

Replacement heifers should all be selected on the basis of records made by their dams. The selection of sires should likewise be at least partially based on their individual weaning weights. These same methods are the ones that have made the substantial increase in dairy production per cow, observed in the past 25 years.

Daily Rate of Gain

The estimated heritability for rate of gain is approximately 65 per cent. This indicates a very high influence for heredity on the rate of gain for beef cattle in the feed lot and likewise under ranch or farm conditions. Because of this high heritability, rate of gain is very important in the selection for greater efficiency and volume of production.

Efficiency of gain has been found to be highly correlated to **rate** of gain which makes selection based on the rate of gain factor still more important.

Results of research projects and tests carried out under practical ranch conditions show a variation of over one pound per day between the high- and low-gaining calves in the feed lot. The high estimate of heritability for the rate of gain factor in beef cattle is the main reason for much of the publicity given to Beef Performance Testing. This estimate is high and means much to the more economical production of beef, but the importance of weaning weights and type should not be overlooked in an effort to develop a line of high "rate of gain" cattle. In fact, the producer of feeder cattle is more interested in acceptable type and high weaning weights even though the rate of gain factor is important to him directly and indirectly, for sale purposes. He also is interested in selecting replacements that will produce animals with the ability to gain rapidly.

Efficiency of Gain

Comparison of most of the research data indicates a high correlation between rate of gain and efficiency of gain. This does not necessarily mean that every high gaining animal also is highly efficient in the use of feed. It does mean that in comparing a high gaining group of calves with a low gaining group of calves, that the high gaining group will produce 100 pounds of beef with considerably less feed than the low gaining group.

Individuals within each group will vary considerably from the average of their respective groups.

Testing for efficiency of gain is not recommended for use under usual ranch or farm conditions because of the amount of work and facilities involved. Also, since there is a rather high correlation between rate of gain and efficiency of gain, the rate of gain figure is sufficient to indicate the related efficiency of gain.

Weights at 15 to 18 Months of Age

The estimated heritability of the weight of cattle at 15 to 18 months of age, is 86 per cent. This is an extremely high estimate. This estimate has been determined from data secured in rate of gain tests at various experiment stations. It is assumed that this high estimate will apply equally-well to heifers grown out for replacements, as well as young bulls developed for breeding stock.

If this assumption is valid when applied to heifers being grown out at a moderate rate of gain, then selection on this basis should be very valuable in selecting replacement animals. This would then be an added factor to use along with type and weaning weights of replacement heifers in a selection and improvement program.

Type or Live Quality

Type or live quality has been and still is the main factor used in livestock improvement programs. Estimates of heritability for this factor are low. Most research work develops an estimate of about 10 per cent. Its value as an improvement factor has, no doubt, been highly over-rated by some producers, and overly criticized and condemned by others. Regardless of individual opinions, selection based on this type factor has been responsible for most of our livestock improvement in years gone by.

Type, as we know it, has been subject to many minor changes over the years in all classes of livestock. Some of these changes have been valuable in livestock improvement. Others have proved to be a passing fancy that contributed little, if anything, to permanent improvement. Because of the relationship of type to quality of carcass and dressing percentage, it cannot and should not be ignored in any Performance Test program.

Type has another value: it has become a standard within broad limits by which feeder cattle and slaughter cattle are graded and purchased on the hoof. This standard will probably always prevail in livestock marketing, regardless of its relationship to efficiency of production. It is the basis for the saying that "the customer is always right."

All research projects carried on to date, indicate that there is little, if any, relationship between type and the production factors of birth weights, weaning weights, rate of gain and efficiency of gain. This makes the job of performance testing more difficult and means that we must

select both for type and for production factors. Many animals have the combination of a high type score and excellent production records. Other animals will have a low type score with high production records and vice versa. The system of type scoring used in the Beef Performance Test program in South Dakota is based on the observation of three men. This group of three men is usually composed of two ranchers and an Extension worker. Each man works independently after the three have reached a reasonable agreement on two or three animals. Average of the three ratings is used to indicate the type score of each individual animal.

Estimates of Heritability

The heritability of the factors discussed above are based on the averages of a large number of records. Individual animals may vary widely from these estimates in their ability to transmit their hereditary qualities or in their hereditary ability to respond to their particular environment. The fact that these estimates of heredity are high and that a wide variation in all of the above factors is observed in all groups of livestock, makes selection on the basis of records feasible and practical. Selection on such a basis can result in an improvement in the production and the returns from all classes of livestock.

Similar factors that may be used as the basis of a selection program are also found in hogs and sheep.

Other Important Considerations

Equipment Needed

Scales, stationary or portable, ear tags, notebook and pencil are the basic requirements for securing the necessary records.

Forms for records can be secured or made up on a mimeograph by your County Agent.

Methods for adjusting weights to a common age, for age of dam and for sex can also be secured through your County Agent or directly from the Animal Husbandry Department of your State College.

Several devices have been developed for speeding up calculations, such as nomographs and special slide rules. An ordinary slide rule will prove very handy for multiplication or division and an adding machine helps to speed up the job and assists in maintaining accuracy.

Preparing forms in advance of weighing with tag numbers in consecutive order, birth dates in order and divided by sex and sire groups will save a great deal of work after weights have been taken. In large herds, these forms can be tacked to a board or several boards eight inches wide and about three feet long. Such an arrangement will save much time spent in looking for tag numbers on the forms and will keep the forms readily available on a windy day.

Basic Data Required

Facilities for weighing and recording should be such that the job can be done as rapidly and efficiently as possible. Prolonged delay in carrying on the weighing operation can cause a considerable difference between the first and last calves to be weighed. Preliminary investigations have shown that a group of calves can lose as much as one pound per calf every 10 minutes whether walking or standing, while being worked.

In some research projects, the calves are weighed on three successive days and an average of the three weights is used for the record. This sort of weighing usually shows a difference for individual calves, but seldom shows much difference for the group.

In other projects, the calves are given a 12 hour shrink before each weighing. No doubt, either of these methods will give greater accuracy than just weighing at a certain time on each weigh day.

In the South Dakota project, it has been determined that a regular weighing time on each weigh day gave records of sufficient accuracy for selection purposes.

A few years of testing will give an operator sufficient records for him to determine whether or not he wishes to refine the methods and procedures outlined. Taking weights and adjusting them on a five pound break will give sufficient accuracy for practical use.

Value of Indexing

Preparation of an index can be of value as a means of readily determining the relative position of any animal in a test, in comparison with the rest of the herd. Such information may be valuable for sale purposes, and can also be of value in a selection program.

For instance, if we say that a certain animal had a weaning weight of 400 pounds, made a gain of 2.4 pounds per day on test and was rated two minus on the type score, we have said nothing about the relative value of this animal when compared with the rest of the animals that were tested. On the other hand, if we say we have an index based on 75 for average weaning weight, 75 for average rate of gain and 75 for a type score of three minus, and that the above calf has a weaning index of 70, a rate of gain index of 78, a type index of 84, and an average index of 77, we immediately establish the relative value of this animal for three factors, and its average relative value when compared with the balance of the group or herd under test.

The system of developing the index outlined in this circular was prepared to serve as a simple yardstick in measuring relative values of the animals on test. This system is based on simple averages and no effort has been made to adjust or weight the index on the basis of heritability of the factors considered. Future research and analysis will, no doubt, provide a more scientific basis for preparing an index that will serve the purpose

more efficiently. The system outlined has served very well as a yardstick for measuring the performance of individual animals in a test, for establishing selection levels and when more generally understood, can readily be used for advertising and for establishing sale prices.

Indexing has its greatest value in the rating of individual animals and particularly those animals that are to be sold for breeding purposes. It rarely has much value in a commercial herd. The exception would be a commercial herd that had complete identification and records on each animal in the herd. Selection in a commercial herd can readily be carried out by the use of adjusted weights and observation of type.

Time Required

The actual amount of time needed to carry on a Performance Test program during any one year is rather small and will vary somewhat according to the size of the herd. A total of four days of actual time used during any one year in securing and compiling data would be a generous estimate.

The length of time that a rate of gain test is conducted is important. The recommended minimum length of time for rate of gain test is 140 days. Research data indicates that it takes at least 140 days for the valid expression of differences due to heredity and that the longer such a test is carried on, the more definitely can the differences be ascribed to heredity. The tests being carried on in South Dakota are carried on for a period of at least 140 days and usually for 168 days. This amounts to five or six 28-day periods and, when started on time, ends the tests about the time that cattle are turned on summer range.

Little, if any, attention should be paid to rate of gain records over short periods—such as 30 or 60 days. The environmental influence is dominant over such a short period and the hereditary influence has not had sufficient time for definite expression.

Performance Testing cannot be considered from a short time standpoint. If performance testing is to serve as a method of improvement for the livestock producer or the breed as a whole, it must become a permanent part of the farm or ranch operation. The plan of performance testing must also be flexible enough so that it can be adapted to every type of operation.

Immediate benefit can be derived from Performance Testing in that the lowest producing cows can be removed as soon as their records are known. Continuous benefits are derived in the selection of sires and replacement heifers for the herd. A period of at least one cow generation, four to five years, is necessary before benefits can be accurately estimated or observed. Continuous selection on the basis of observed and recorded data is necessary first, to place a herd or group above the average of the breed in appearance and producing ability, and secondly, to maintain the

improved status. The entire benefits derived from a Performance Test program may be lost in one or two cow generations if the program is abandoned and selection is stopped.

A good selection program must come before a good breeding program can be followed. Various plans of breeding can then be used to fix and maintain desired characters within herds or groups.

Suggested Operating Procedures

The procedure used in conducting a Performance Test may vary widely from a very simple set of records on weaning weights that may serve the needs of the commercial operator, to one for the producers of purebreds that takes in all possible factors for which accurate records may be available.

1. Identification: Tag or tattoo for identification and record calving dates within week, and note sex and age of dam.

2. Weaning Weights: Take weaning weights at or near 190 days of age. Record on five pound break.

3. Records:

- a. Make separate records for heifers, bulls, and steers.
- b. Make record by sire groups, if information is available.
- c. Tabulate weaning weights. Considerable time can be saved if the above records on birth dates, sex and sire groups can be entered on proper forms before weaning weights are taken.
- d. Determine age in days.
- e. Adjust all weights to 190 days of age, and record to nearest five pounds. (Adjustments for more than 35 days difference may be somewhat distorted and allowances must be made for animals more than 35 days older or younger than the age for which the adjustment factors have been developed.)
- f. Adjust 190 day weights for age of the dam. There are several ways of adjusting for age of dam. The simplest method and one that is accurate enough for our purpose is as follows:
 Add for two-year-olds; 70 pounds
 three-year-olds; 35 pounds
 four-year olds; 20 pounds
 five-year-olds; 15 pounds
 nine-year-olds; 10 pounds
 ten-year-olds; 20 pounds
 eleven-year-olds; 25 pounds
 twelve-year-olds and older; 40 pounds

9. When all adjustments for age and age of dam have been completed:

- (1) Place a circle around the weight of all calves that have been nursed by cows other than their dams. These calves should be omitted from subsequent calculations. They are usually orphan calves or those receiving special treatment for some other reason.
- (2) Total all weights by sex in commercial herds and by sex and sire groups in purebred herds.
- (3) Determine average weights for each sex and sire group.
- (4) Prepare a summary sheet on herd:
 - (a) In **commercial** herds, there will be only one line unless sire groups can be identified. Enter the number of steers and their average weight, the number of heifers and their average weights. **Determine average weight on steer basis** by adding the total adjusted weight of the steers and the total adjusted weight of the heifers, plus 15 pounds for each heifer and divide by the total number of calves.
 - (b) For **purebred** herds, there will be a line for each sire and a line for the herd. Follow the same process as for commercial calves except that there may be an extra column due to steers and bulls. **Determine average weight on a bull basis** by adding total adjusted weight for bulls, steers and heifers, plus 25 pounds for each steer and 35 pounds for each heifer. Total and divide by the total number of calves. Do this for each sire and for the herd.

NOTE: The above adjustments for age of dam and sex are arbitrarily determined and are subject to change. Considerable work is in progress for the purpose of determining more accurate adjustments for age of dam and for sex.

4. **Initial Type Score (optional)**. The initial type score is not used for official records or index. It has some value in assisting an operator in culling off calves with poor conformation before placing them on feed.

5. **Rate of Gain Test**. The rate of gain test applies primarily to bull calves retained for sale as breeding animals. It can also provide valuable information for use in selecting breeding stock when applied to females at 12 months or 18 months of age.

Bull calves should be fed in a manner that will provide a reasonably full expression of their inherited characteristics. The average daily gain for the group should be approximately two pounds per day.

An average daily gain of one and one half pounds per day or less will probably give just about as good information for selection purposes as the two pound-per-day gain, but it will produce an animal that lacks size and development at sale time. Such under-sized animals are usually subject to a heavy discount at sale time.

Initial Weight. The initial weights for a rate of gain test may be the actual weaning weights, or they may be weights taken at a later date when the calves have become used to feed. Using the actual weaning weights for initial weights will give data that is accurate enough for indexing and comparison.

Using initial weights taken sometime after weaning may result in higher average and individual rates of gain. When higher rates of gain have value for registry, advertising or sale purposes, then it is advisable to take initial weights three or four weeks after weaning when the calves have become accustomed to feed.

Intermediate Weights. Intermediate weights are only necessary for the information of the feeder. They give information on the rate of gain and may indicate when some adjustment of the ration may be necessary to provide the average rate of gain desired for the feeding period. When scales are handy, intermediate weights are highly recommended. If scales and the necessary time in transporting them are not readily available, intermediate weights may be omitted.

The length of time calves have been on feed and the amount of feed being consumed can be used in arriving at a fair estimate of the amount of weight gained and of the amount of adjustment needed in the ration to maintain the desired rate of gain.

Final Weights. Final weights may be taken at any time after 140 days of the testing period.

The conditions under which the final weights are taken should be as nearly similar as possible to conditions at the time initial weights were taken. If the initial weights were taken immediately after a morning feed, or after an over-night shrink, then the final weights should be taken under the same conditions. Large differences in weighing conditions between initial and final weighing periods can cause considerable differences in the individual and herd average rates of gain. These differences may be important under some circumstances.

Differences between conditions at initial and final weights, even though large, if they are uniform for the group, will have little, if any, effect in determining the comparative values for each animal.

Tabulation. Determine the total amount of gain for each calf and the averages for each sex and sire group. Calculate and assign an index for rate of gain to each calf.

6. Final Type Score. The final type score is usually applied only to bull calves completing a rate of gain test. It may be used on heifers that are retained for replacements if the operator so desires.

Procedure. Select three men to do the scoring—preferably two live-stock producers and one Animal Husbandman from the Extension Service or the College staff. The animals are turned out of a yard or chute in view of the three selected scorers, at a distance of at least 25 feet.

Three calves are scored and then the scorers pause for a few moments to compare notes. If the scores on each of the three calves are within one full grade, they are satisfactory and the scorers proceed with the rest of the animals. If the differences between the three scores exceeds one grade, some consultation is necessary. Occasionally, one of the scorers puts too much emphasis on some minor character.

Score as follows:

- 1—Choice: show quality
- 2—Excellent
- 3—Good: a good range bull
- 4—Fair
- 5—Poor

Add plus or minus to each of the above numbers, if necessary. This system provides 15 individual scores. Under practical operating conditions, the calves scoring four and five are culled before the calves are placed on feed. Because of this, there are few, if any, four and five calves at the time final type scores are assigned.

When the three scores are averaged, they break down into three fractions of each or any one of the 15 possible scores.

Under the South Dakota system, an index number has been assigned to each one of these fractions, beginning with a 54 index for a five minus and ending with a 99 index for a one plus score. Either extreme is rare.

In actual practice (since poor and fair calves were culled previous to the rate of gain test) about two-thirds of the calves in any sizeable group will score from three minus to two.

After scoring, the proper number is assigned to each score—beginning with one for one plus and ending with 15 for five. Numbers of the three scores are totaled and divided by three. The result is then assigned the index indicated above.

7. Fifteen to 18 Month Weights. This record applies primarily to replacement heifers. Weights on bulls may also be taken at this time, if desired. Usually, the herd of bull calves has been broken up by this time, through the sale of some and a change in treatment on others.

Considerable data gathered during the past few years indicates that this information, acquired by taking weights at 18 months of age and

observing conformation at that time, is very valuable in the selection of replacement animals. This applies to male as well as female animals.

- a. Weigh all animals on which records are desired.
- b. Adjust weights for age and compare gains from actual weaning weights to 18 months weights.
- c. Type score again, if desired.
- d. Mark animals for replacements or disposal.

8. Summary. At what ever point a Performance Test is completed, there should be a summary made of the information collected. This summary should show the averages for each sire group, the averages for each sex group, the herd averages for each sex group and the averages on a common basis such as steer basis or bull basis.

These summaries are valuable in giving information on the progress made in herd improvement, the performance of the various sires being used and the influence of major environmental conditions.

They are also valuable data for use in research since they will furnish information on large numbers of livestock under practical operating conditions.

They will also provide information that may result in a modification or refinement in the methods and procedures we are now using in our Performance Test program.

9. Progeny Test. The above records, if properly tabulated and retained, will serve as a progeny test record on the herd sires in those cases where all animals are identified and the sire of each calf is known and recorded. One year's record will give a fair indication of a sire's hereditary value in comparison with other sires in the herd, but two or more years of record on a sire will give a much clearer and more definite indication of his hereditary value.

10. Indexing. A performance index is a number assigned to an animal in a herd in regard to weaning weight, rate of gain, conformation or any other factor for which comparative records are available. An index will indicate this relative position in the herd without reference to herd averages and individual weights or scores.

Indexing has its greatest value when used with bull calves being developed for sale as herd sires.

- a. It immediately indicates the animal's position in relation to the herd averages in regard to weaning weights and rate of gain and gives an indication of the conformation value at the time an animal came off the rate of gain test.

- b. It offers an easy and effective way for establishing minimum requirements for bulls to be entered in a Performance Test consignment sale.

c. It offers the buyers the opportunity of establishing a minimum standard based on performance for the bulls that he intends to purchase.

Indexing of females in a purebred herd can be valuable if complete performance records are maintained on the cow herd. Such records could aid considerably in developing a high producing and high quality herd. It would tend to point out some cow families that were low in the production and quality of their offspring.

Indexing of animals in a commercial herd is seldom of value due to a lack of identification of individual cows. The exceptions to this statement would be in the very few commercial herds where individual cows and sire groups could be identified.

The following system of indexing is being used in South Dakota. Further experience or the development of new information may make it necessary to modify or refine our methods. It will still basically remain a measuring stick for rapidly evaluating the worth of an animal on the basis of performance in comparison with the other animals in a herd.

(1) Weaning Weights

- (a) Add adjusted weaning weights, omitting those that have been circled.
- (b) Divide total by number of calves, omitting those whose numbers have been circled, to determine average adjusted weaning weight.
- (c) Assign an index of 75 to the average adjusted weaning weight and an index of 100 to the highest adjusted weaning weight.
- (d) Subtract the average adjusted weaning weight from the highest adjusted weaning weight.
- (e) Divide the result by 25 to establish a point value.
- (f) Subtract the average adjusted weaning weight from the adjusted weaning weight of each calf, or vice versa for those below average.
- (g) Divide the difference by the point value and add or subtract the result to or from 75 to establish the index for each calf.

Example:

Highest adjusted weaning weight.....	500
Average adjusted weaning weight.....	400
	Difference 100

Difference, 100 divided by 25 = 4.

Applied:

Adjusted Weaning Weight.....	440
Average Weaning Weight.....	400
	Difference 40

40 divided by 4 = 10, 75 + 10 = 85 Index

(2) Rate of Gain

- (a) Follow same procedure as for weaning weight.
- (b) Use actual pounds of gain rather than rate per day. This is advisable because the rate per day is adjusted somewhat because of adding or dropping hundredths of a pound.

(3) Final Type Index

- (a) Use final type ratings, if available.
- (b) Assign numerical value to each rating.
- (c) Add the three numerical values and divide by three to determine average score value.
- (d) Enter the index for each calf.
- (e) Total type indexes for all calves in each sire group and determine type average for comparison with other sire groups.
- (f) Total the type indexes for all calves in the test and determine the average type index for the group or herd.

- (4) Average Index.** The average index is the total of the weaning index, the rate of gain index and the type index, divided by three. In effect, this index rates an animal in comparison with the rest of the group or herd on the basis of three factors rather than just one factor.

A complete summary sheet containing all pertinent information such as adjusted weaning weight, rate of gain and type scores with indexes for each and an overall average index is valuable for quick reference.

Such a summary can also give information on sires that can be used in establishing a progeny record for each sire.

Plans of Operation

Purebred Herds

Producers of purebred cattle usually have quite complete records. These records make the task of gathering performance test records rather easy. A few suggestions may help in getting the job done.

1. Though purebred calves are usually tattooed at birth, an ear tag will make identification much easier at weighing time. A tattoo is sometimes hard to read, particularly so on a cold windy day.

2. Performance records should contain the following information for a complete production record on purebred herds:

Weaning information:

a. Ear tag number	Tattoo Number
Sex	Date calved
Sire name	No. of dam—(tattoo, not registration number)
Age of dam	Actual weaning weight and weigh date

b. *Rate of Gain*

Initial weight and date (May be actual weaning weight)

Final weight and date

c. *Eighteen Month Weights*

Actual weaning weight and date

Eighteen month weight and date

d. *Conformation data*

Individual scores by three persons taken at end of rate of gain test.

The above information will supply all the data necessary for determining the relative producing ability of every animal in the herd. After completing all adjustments and calculations, the records should be analyzed and plans made for improvement.

1. Plan to replace sires whose offspring have low production and conformation records.

2. Sort off the top one-half of the heifers on the basis of production records. Sort again for acceptable conformation and breed characteristics. These heifers should never be sold at any price until future testing proves some of them to be inferior and not suitable for replacements.

3. Select bull calves for rate of gain test. Set a minimum standard of performance for calves that are to be sold as breeding stock. If calves with weaning weights below a certain minimum are removed before the rate of gain test along with calves having poor conformation, there will only be a few that will not meet the minimum standards of the rate of gain test.

4. Cull low producing cows as rapidly as superior replacements become available.

5. Retain old cows with good production records as long as they continue to produce and remain in good condition.

Commercial Herds

A few large commercial herds and some small herds can follow a program similar to the one outlined for purebred herds.

Most **commercial herds** in the **range area** will have to follow a modified program. The following program is being used and is giving excellent results:

1. Ear tag all calves at birth, or within a day or two.

2. Record calving date, sex, age of dam, i.e., two or three years old or nine or more years old.

3. Previous to taking weaning weights:

a. List tag number of calves on a form in consecutive order, but divided for sex.

b. Enter calving dates.

c. Enter age of dam if it can be determined.

d. Determine age of each calf in days and enter in proper column.

e. Establish a culling level on the basis of the estimated average

weaning weight at 190 days of age. If the calves are about average in weight, then 360 to 370 pounds for steers and 10 pounds less for heifers will be about right.

- f. Calculate a minimum culling weight for all calves according to age in days and age of dams, and enter in a column for each calf ahead of the weaning weight column.
- g. Provide yourself with a pair of roaching shears and whenever a calf does not meet the minimum weight requirements, mark it with a hair brand.
- h. Turn out the hair-branded calves so they may identify their dams. Sort off the low-producing cows and mark in a suitable manner so that they may be disposed of when suitable replacements become available.
- i. Complete the adjustments and calculations on the entire herd and make a list of the tag numbers of all heifers that are average or above in weaning weight.
- j. Sort off the heifers with average or above average weaning weight. Select replacement heifers from this group on the basis of acceptable conformation and breed characteristics.
- k. Sire replacements should always be animals with acceptable conformation having records average or above for weaning weights and rate of gain in the herd where they originate.

Progress will be slow for the first three years and will depend upon the number of suitable replacements and herd management. On the average, it will take one-third of the heifers each year to replace cows for age and disease. If good management makes it possible to select replacements from the top one-third of the heifers, improvement can be quite rapid, once it is under way. On the other hand, if the need for replacements requires that selection must come from the top **two-thirds** of the heifers, improvement will be a much slower process.

Rule of Thumb Method—Commercial Herds Only

No scales and no records.

It takes a keen eye and a good memory, but it will work, though it is not as accurate and progress will not be as rapid.

1. Before weaning, sort off all cows with smaller than average calves. Make allowances for calf age and cow age and sort off the cows that are definitely low in production. Mark them in some manner so that they may be culled when replacements are available.

2. Sort off all large sized heifer calves with good conformation for replacements. Make some allowance for age of calf and age of dam. There is good reason for some calves to be somewhat light because of age or age of dam.

3. Always buy top quality sires with weaning weights and rate of gain well above the average of the herd in which they are produced.

Cooperation and Organization

Any producer of livestock can carry on a Performance Testing program with or without equipment. The value of such an effort by the individual producer will depend on his available equipment and facilities, the methods that he uses in securing records and the analysis and use that he makes of the records after they have been completed.

Records gathered by the individual operator will be just as valuable for selection purposes as similar records would be if gathered under some other system. The value of an individual's records for sale purposes will depend on the integrity of the operator, the volume of the product that he has for sale and how well he advertises his product.

In order to assist livestock producers in carrying on a Performance Testing program, associations have been organized in a number of states, including South Dakota. The most immediate objectives of such an association are providing portable scales, setting up uniform methods and procedures, providing the necessary forms and setting up a schedule of fees for the assistance provided.

A general outline of the objectives of such associations follows:

1. To officially record the production and performance records of animals tested under the rules of procedure adopted by the association and to certify the production and management practices of herds and flocks meeting the standards specified in the rules of procedure.

2. To issue individual Performance Registry certificates for all animals which have been tested under approved standards and have met the minimum qualifications for registry.

3. To certify both purebred and commercial herds that have adopted specified standards of selection and maintain certain standards of production as outlined in the rules of procedure.

4. To issue Production Registry certificates on proven sires when the records of their progeny indicate that they are of superior quality.

5. To encourage and assist with the development of more accurate and simplified methods of measurement for hereditary traits or factors in all classes of livestock.

6. To cooperate with all other livestock groups or associations, in the improvement of quality and the more economical production of all classes of livestock.

7. To encourage the use of breeding stock with certified records for high production and rapid and efficient gaining ability in both registered and commercial herds and to assist in establishing markets for the produce from certified herds.

8. To publish such literature and reports as may be necessary to keep the membership informed and such other material of interest to persons wishing to purchase high quality Performance Tested livestock, or their offspring.

9. To acquire and hold such real and personal property as may be required to carry out the association's corporate undertakings.

For further information, contact your County Extension Agent.

"Selection"

"Selection is the basis of all livestock improvement"

"Records form the basis for good selection"

You, as a livestock producer, have the undisputed privilege of determining which animals in your herd shall be retained for reproduction. Your judgment and the information that you use in exercising this privilege determines the quality and producing ability of your herd. You exercise this privilege every time you select a herd sire and every time that you select replacement females.

Observation of livestock on the pastures and ranges of South Dakota does not indicate that the best information and judgment have always been used in selecting the animals that make up our herds.

Performance testing can assist you in doing a better job of improving the quality and producing ability of your herd.

This publication is a revision of a previous publication entitled "Beef Performance Testing on Farm and Ranch."

Revisions made are mainly in methods and procedure. Experience has indicated some modifications that could be made in the previous outline of methods and procedure. These revisions will not affect the basic principles of selection or the value of the information for selection purposes, under practical operating conditions.

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