

## **Beef Improvement Federation Guidelines for Feed Efficiency Testing as of March 26<sup>th</sup>, 2019**

The economic importance of intake as the largest non-fixed cost of beef production is well known. Since the mid 1990's there has been a dramatic increase in the capacity for collection of individual feed intake data on group fed beef cattle, due largely to technological advances in equipment used for collecting intake records. Concurrently, research on the genetic, nutritional, physiological, and economic aspects of feed intake and efficiency has increased. Genetic evaluation programs for feed intake and efficiency are developing, recognizing the economic relevance of cost-stream input traits to genetic improvement in profitability. Thus, the objective of this section is firstly to recommend procedures for collection of individual feed intake records on young, growing cattle, and secondly to discuss alternative methods for the expression and reporting phenotypes and EPD related to feed utilization.

**Equipment and Facilities for Intake Measurement:** Several types of equipment are currently available to measure individual feed intake. Reliable data can be obtained with the use of Calan gate systems (<http://americancalan.com>) as well as with newer technologies that use electronic scales within feed bunks along with radio frequency animal identification (e.g., GrowSafe Systems, Ltd.; <http://www.growsafe.com>). An important distinction is that research has shown the inadequacy of feed intake data for the purposes of genetic evaluation which is derived from animals fed alone in individual confinement pens. Thus it is assumed here that individual feed intake data are indeed measured on individual animals housed in groups.

The increase in capacity for collection of feed intake data has come in two forms. With the advent of electronic hardware and software systems, research facilities have been established across North America to increase their ability to conduct experiments where feed intake is of interest. At the same time, existing performance testing centers have retro-fit their facilities with feed intake measurement capabilities. Because most of the equipment mentioned above is scalable, the recommendations in this chapter have been written to accommodate both types of facilities.

**Pre-Test Information:** For feed intake records to be suitable for inclusion in genetic evaluation programs, pre-test information on individual animals should be recorded. Individual animal identification (e.g., registration number) should be easily compatible with other databases and unique. Depending on the traits included in genetic evaluation(s), birth and weaning dates and weights, age of dam and information to define contemporary groups will also be required. It has been shown that feed intake is related to the age of animals when feeding tests are conducted. Animals entering a feed intake test should have actual birth date recorded so that age at the beginning of the test can be calculated. Weaning data are generally required to be collected before animals reach 260 d of age. The age at which an animal begins a feed intake test should be after weaning but not be younger than 240 d. Within a feeding contemporary group, animals should have start of test ages within a 60-d range. Feed intake measurement on test should be completed before an animal reaches 390 d of age.

**Adaptation Period:** In order to acclimate to the testing facility and test diet, an adaptation or warm-up period of at least 21 d should be incorporated into the test calendar. During this period, animals should adapt to the test facility and the final test diet. Daily individual feed intake records collected during the pre-conditioning period or when animals are consuming transitional diets should not be used in the

computation of daily feed intake. Transitional diets are those that differ from the test diet (bulls) or are different from the finishing diet (steers and cull heifers).

**Test Diets:** Diets used in feeding tests will vary according to animal type, animal gender, environmental constraints, feed ingredient availability, cost, and management. Therefore, data collection should be implemented such that diets can be adjusted insofar as possible to a common nutritional base. All animals within one test should be fed the same test diet, and the diet should be formulated to provide essential nutrients and sufficient energy to ensure expression of animal differences for both growth and intake. The ingredient composition of the diet should be recorded, and the ingredient composition of the diet maintained throughout the test period. It is desirable for samples of diet ingredients or of the complete diet to be sent to a commercial laboratory for complete chemical analysis. Diets used in tests with growing bulls should contain at least 2.4 Mcal ME/(kg DM). Diets used in tests with finishing steers should contain at least 2.9 Mcal ME/(kg DM). There is a growing number of reports in the scientific literature in which data from intake tests are adjusted to a common energy content, mainly to increase across-test comparability. That is, statistical adjustment to a constant energy density requires recording of enough chemical composition data on the diet(s) to derive metabolizable energy (ME) in megacalories (Mcal) on a dry matter basis. Average daily intake and functions of intake data should be reported on a dry matter basis. Expression of daily feed intake values on a dry matter basis removes variability in the moisture content across a diversity of diets, and increases the comparability across multiple tests and studies. As-fed measurement of daily feed intake can be recorded as well, but for further data analyses, sufficient information must be supplied to convert feed intake to a dry matter (DM) basis.

**Test Period:** The length of the test period should be at least sufficient to accurately determine both rate of gain and intake in order to make inference to efficiency of gain. Research has demonstrated that a minimum of a 70-d test period is required to accurately compute average daily gain for individual animals. Most studies agree that adequate estimates of daily feed intake can be obtained when individual feed intake is recorded for a minimum of 45 d. Thus, a test period at least 70 d following and adaptation period of no less than 21 d is recommended. At a minimum animals should be weighed twice (on separate days) at the beginning and at the end of the test period. Recording live weights at periodic intervals during the test period and calculating rate of gain by regression may enhance the accuracy of measured rate of gain somewhat and thus allow for a slightly shorter test period. It is recommended that the test period should be defined as the final 70 d of a 91-d or longer test. In order to compute start and end of test ages (and days on test), and related metrics, dates of the beginning and end of tests as well as when the adaptation period ended should be recorded. During the test period, animals must be provided ad libitum access to feed and water to avoid data bias. Wherever possible, daily intake records should be deleted when animals do not have ad libitum access to either feed or water. Examples where feeding may be restricted include days when animals are removed from the pen due to maintenance, equipment failure, and sickness, or for collection of related data (e.g., live weights, ultrasound, etc.). Feed intake data recorded on days when animals do not have ad libitum access to feed due to feed delivery failures or being absent from the pen should not be used to compute average daily feed intake. Intake data from days where animals were absent from the pen, or intake data judged to be unusable should be set to missing, or at least corresponding dates indicated so the data can be removed prior to further analyses. Missing feed intake data may be estimated using a regression approach as suggested by

Hebart et al. (2004), however, large (> 5 d) blocks of data cannot be missing at the beginning or end of the test for any animal. If there are some missing data, and usable data includes at least 45 d of intake recording, the missing data need not be replaced or estimated.

**Pen Stocking Rates:** In tests that use electronic feed intake recording equipment, managers should not exceed the manufacturer recommendations on animal density (number of animals per feed bunk) to obtain accurate measurements of feed intake. Optimal animal density may need to be adjusted for the age of cattle, energy density of the test diet, and minimum bunk and pen space required per animal. Researchers are encouraged to consult with their local animal care and use committee for these specifications, whereas commercial testing centers should consult with animal scientists or other knowledgeable professionals to ensure that animal numbers per pen is not excessive. It is important to maintain appropriate pen density to facilitate normal feeding behavior, and accurate measurement of ad libitum intake.

**Data Auditing:** For electronic intake data recording systems, data auditing functions monitor the quality of intake records, and are used to judge the suitability of intake data prior to further analyses. Feed delivered to animals and that recorded by the system as consumed should not differ by more than 5%. Data integrity features available on individual feed intake recording systems should be used. Once daily dry matter intake is computed for individual animals, simple correlations among intake (DMI), growth rate (ADG), and live weight (LWT) should be computed. Correlations that are not at least moderate and positive indicate suspect data. Researchers and test managers are encouraged to consult with experts to conduct further data auditing to ensure the highest possible integrity of test data before proceeding with further analyses.