44 Beef Grading Standards

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Objectives

- **Present USDA beef carcass and yield grading standards.**
- **Present USDA feeder cattle grading standards.**

USDA Beef Carcass Quality and Yield Grading Standards

Acceptability and value of beef carcasses are determined primarily by two characteristics – eating quality and cutability or yield of sellable beef. USDA grades for beef carcasses identify certain well-defined indicators of quality and cutability and furnish a system for sorting beef into smaller, similar segments (grades). Grades facilitate uniform market reporting, provide a tool for expressing and comparing prices and to enhance marketing and merchandising of beef. Grades also have been promoted as a buying guide for consumers and as a means for reflecting consumer preference back through the marketing system to producers.

Current Grading System

The USDA beef carcass grading system includes two separate grades: quality and yield. Quality grades reflect the expected palatability of cooked beef cuts, for example, tenderness, juiciness and flavor. Yield grades identify carcasses for differences in cutability, such as the percentage yield of boneless, closely trimmed retail cuts from the round, loin, rib and chuck.

Grading is a voluntary service, provided by the Agricultural Marketing Service of USDA and should not be confused with meat inspection, which is conducted by the Food Safety and Inspection Service of USDA, a compulsory service that determines the wholesomeness of meat for human consumption and includes responsibilities for sanitation, product labeling, etc. Packers pay a fee for grading and may designate whether they want a carcass graded or not.

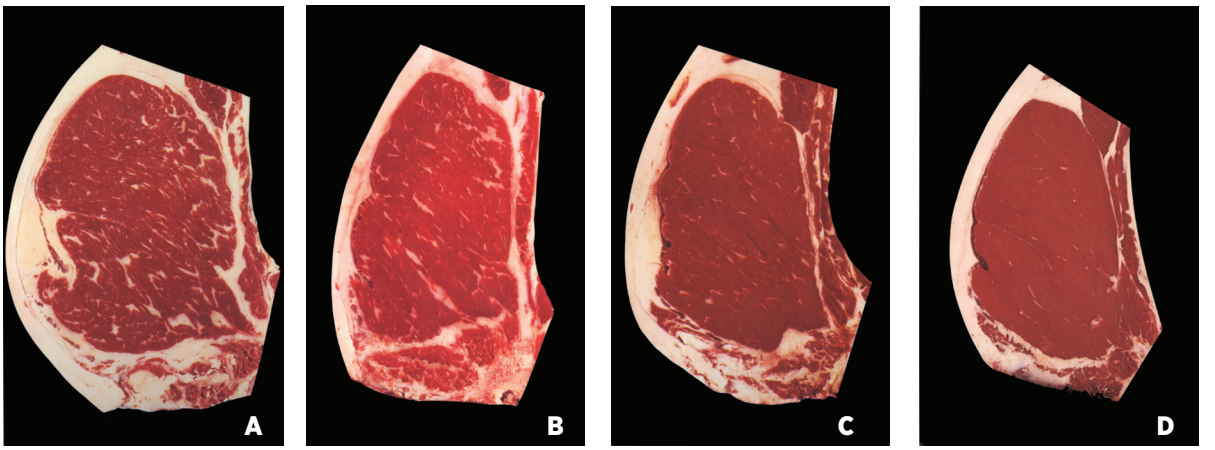
Quality Grading

The eight USDA quality grades are: prime, choice, select, standard, commercial, utility, cutter and canner. Each USDA quality grade relates to a distinct combination of quality indicating characteristics including marbling, firmness and maturity. Essentially all prime, choice and select beef harvested in major packing facilities in the U.S. is officially graded, while very little beef representing the other grades are officially graded. Prime beef is intended primarily for use by high-end restaurants, but is becoming increasingly popular in some retail outlets. Choice and select grade represents the vast majority of beef at retail and food service. Carcasses in the remaining grades are merchandised as processed beef products, blended to trimmings from fed beef to increase lean percentages of ground beef or, if suitable, the middle meats are utilized.

Qualification for a particular quality grade is determined by evaluating the carcass class, maturity, degree of marbling in the ribeye between the 12th and 13th ribs and firmness of the lean, with maturity and marbling being the most important.

Maturity groups A, B, C, D and E, from the youngest to oldest, are determined by evaluating skeletal and lean maturity. The most recent change to beef grading occurred in 2017 when USDA began utilizing dentition (teeth) as the first indicator of maturity. All carcasses deemed under 30 months of age based on dentition and with skeletal maturity less than "D" are graded as "A" maturity. If carcasses have dentition greater than 30 months, maturity is evaluated based on skeletal ossification. Cartilage becomes bone and lean color darkens with increasing age. Skeletal maturity involves evaluating ossification of the cartilage and bone visible in the sacral and lumbar vertebrae as well as the cartilage located on the dorsal surface of the spinous processes of the thoracic vertebrae also known as buttons. Also evaluated are the size, shape and color of the rib bones. Lean color tends to darken from light red to dark red and lean texture tends to become coarser in appearance with advancing maturity. Overall maturity is established by balancing skeletal and lean maturity, with skeletal maturity receiving the most emphasis. Examples of USDA quality grades for A maturity cattle are shown in Figure 44.1.

All Web addresses given in this chapter are subject to change. The links to these websites will be updated regularly at the Master Cattleman website at extension.okstate.edu/programs/master-cattleman.html



A. Low Prime – slightly abundant

B. High Choice – moderate

C. Low Choice – small

D. Select – slight

Figure 44.1. USDA quality grades of beef. Source: National Livestock and Meat Board Official USDA Marbling Photographs.

As a general rule, prime, choice, select and standard grades are restricted to beef from young cattle, dentition less than 30 months or either A or B maturity; however, B maturity cattle are not eligible for the select grade. Likewise, the commercial, utility, cutter and canner grades normally are comprised of carcasses produced by cattle of advanced maturity including C, D and E maturity. Carcasses produced by bullocks, which are A maturity bulls, are not graded.

The second major quality grade determining factor is marbling or intramuscular fat, which is flecks of fat within the muscle. The 10 degrees of marbling are: abundant, moderately abundant, slightly abundant, moderate, modest, small, slight, traces, practically devoid and devoid. Figure 44.2 shows how marbling and maturity are combined to determine the carcass quality grades. To qualify for a particular grade, carcasses also must meet a minimum lean firmness requirement that differs depending upon maturity.

Special consideration is given to dark-cutting beef. Dark cutters sometimes result if cattle are severely stressed 12 hours to 24 hours prior to slaughter. Such stress results in a reduced muscle sugar content prior to slaughter; therefore, muscle pH is not lowered to normal fresh meat pH of 5.6 and remains high. This results in both failure of the muscle color to brighten (bloom) upon exposure to air and a sticky condition of the lean. Varying degrees of dark-cutting beef from slightly shady to black-cutters can be identified. Dependent on the degree to which this characteristic is developed, carcasses can be discounted up to one full quality grade.

Cutability or Yield Grading

USDA yield grades for beef carcasses were officially adopted in June 1965. Yield grades from the highest to the lowest are designated 1, 2, 3, 4 and 5 (Figure 44.3). Expected

Relationship between marbling, maturity and carcass quality grade[1]

Degree of Marbling	Maturity[2] A[3]	B	C	D	E
Slightly Abundant	Prime			Commercial	
Moderate					
Modest	Choice				
Small				Utility	
Slight				Select	
Traces					
Practically Devoid	Standard			Cutter	

1 Assumes that firmness of lean is developed with the degree of marbling and that the carcass is not a "dark cutter."
2 Maturity increases from the left to right (A through E).
3 The A maturity portion of the figure is the only portion applicable to bullock carcasses.

Figure 44.2. Carcass quality grades. Source: American Meat Science Association.

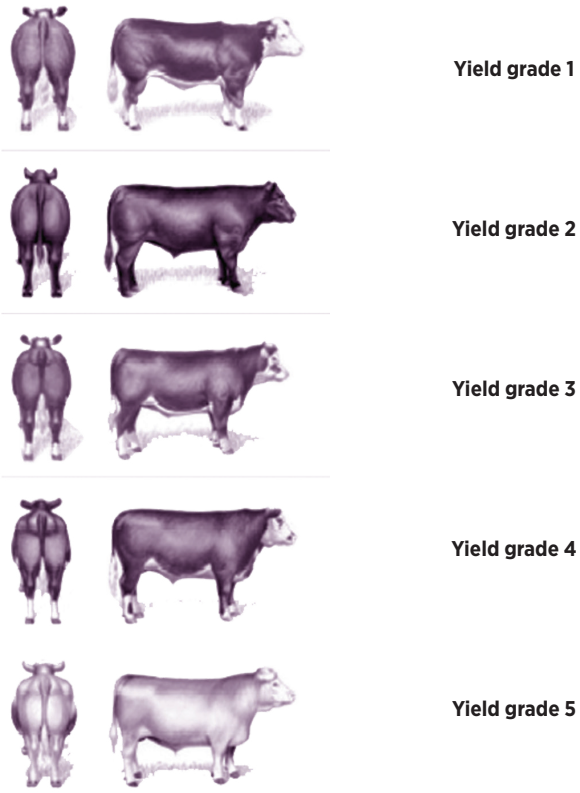


Figure 44.3. USDA yield grades. Source: USDA.

Table 44.1. Relationship between yield grade and average percentage boneless, closely trimmed retail cuts and total yield of semi-boneless, closely trimmed retail cuts.

Yield grade	*Percent BCTRC*[a]	*Percent TRC*[b]
1	53.5	82.0
2	51.2	77.4
3	48.9	72.8
4	46.6	68.2
5	44.3	63.6

a BCTRC = Percentage of carcass weight in boneless, closely trimmed retail cuts from round, loin, rib and chuck.
b TRC = Percentage of carcass weight in semi-boneless, closely trimmed retail cuts from the entire (total) carcass.

average percentage yields by yield grade for both boneless, closely trimmed, retail cuts from the round, loin, rib and chuck (BCTRC) and semi-boneless, closely trimmed retail cuts from the entire carcass (TRC) are presented in Table 44.1. Yield grades are determined by:

1. The thickness of external fat over the ribeye at the 12th rib, adjusted for other than typical distribution of fat elsewhere on the carcass.
2. The percentage (as a percent of hot carcass weight) of kidney, pelvic and heart fat.
3. The surface area in square inches of the ribeye muscle.
4. The hot carcass weight.

These grade-determining factors can be used in the following equation to estimate yield:

2.5
+ 2.5 (adjusted fat thickness, inches)
\+ .20 (kidney, pelvic and heart fat, percent)
\+ .0038 (hot carcass weight, pounds)
– .32 (ribeye area, square inches)
= Yield Grade

USDA Feeder Cattle Grading Standards

Official Feeder Cattle Standards were first issued in 1964. These standards were amended in 1979 and again in 2000. Feeder cattle grading standards were originally used more extensively in the eastern U.S. There, marketing feeder cattle by commingling ownership and packaging by grade and weight is popular due to the small average cow herd size. Nevertheless, the feeder cattle standards have become the descriptive standards used by most of the feeder cattle industry nationwide.

Since 1979, significant changes have occurred in beef cattle genetics and beef production practices. Major changes include nearly 10 times the number of cattle breeds, fewer small-framed cattle, greater genetic potential for growth, a significant increase in carcass size, the use of more aggressive growth promoting implants and various other changes in cattle feeding management. Finishing rations now include greater protein and energy density with less fiber. Technologies, such as ionophore feed additives and growth promoting implants, approved through the Food and Drug Administration, have resulted in heavier carcass weights with a higher percentage of carcass lean red meat yield.

The feeder cattle grades are based on differences in frame size and muscle thickness, two important genetic factors affecting feeder cattle value. Frame size relates to skeletal height and length in relation to an animal's age. Currently, three frame sizes are used in the grading system: large, medium and small (Figure 44.4). By categorizing cattle this way, one can make a rough estimate of the weight at which, under normal feeding conditions, an animal will produce a carcass of a given quality grade. Large-framed cattle must be fed to heavier weights to reach the same quality grade as small-framed cattle.

Frame Size Standards

Large Frame (L) – Feeder cattle that possess typical minimum qualifications for this grade are healthy, have large frames and are tall and long bodied for their age. Steers and heifers are not be expected to produce U.S. Choice carcasses (about 0.50 inch fat at 12th rib) until their live weights exceed 1,250 pounds and 1,150 pounds, respectively.

Medium Frame (M) – Feeder cattle that possess typical minimum qualifications for this grade are healthy, have slightly large frames and are slightly tall and slightly long bodied for their age. Steers and heifers are expected to

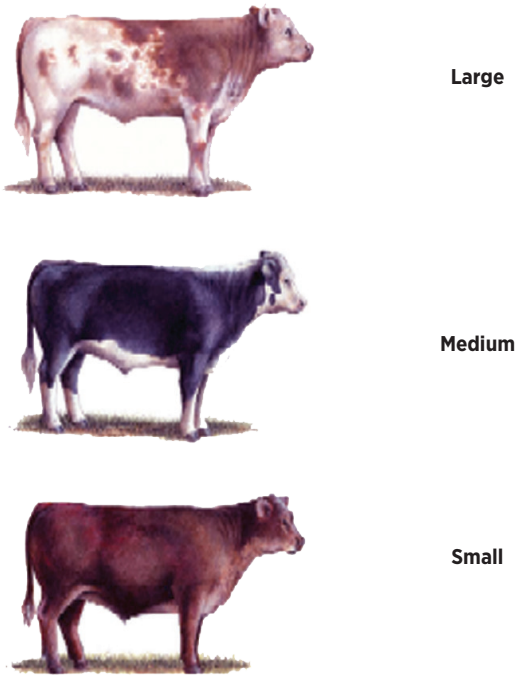


Figure 44.4. USDA frame size. Large- and medium-frame pictures depict minimum grade requirements. Small-frame picture represents an animal typical of the grade. Source: USDA.

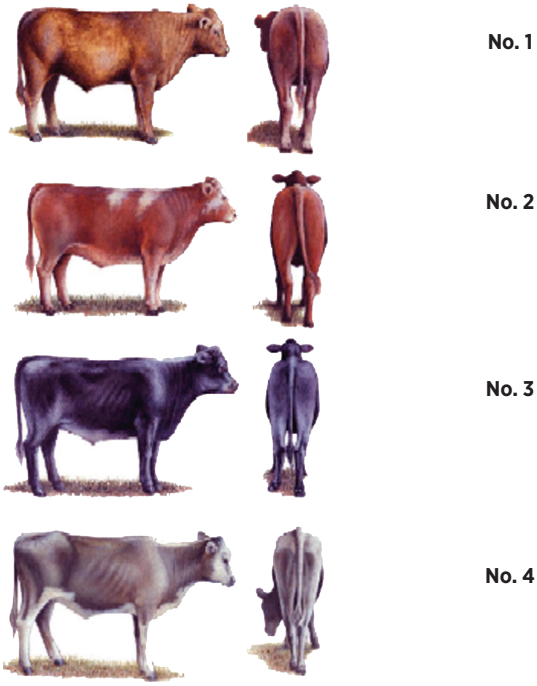


Figure 44.5. USDA muscle thickness standards. No. 1, No. 2 and No. 3 thickness pictures depict minimum grade requirements. No. 4 picture represents an animal typical of the grade. Source: USDA.

produce U.S. Choice carcasses (about 0.50 inch fat at 12th rib) at live weights of 1,100 pounds to 1,250 pounds and 1,000 pounds to 1,150 pounds, respectively.

Small Frame (S) – Feeder cattle included in this grade are healthy, have small frames and are shorter bodied and not as tall as the minimum for the Medium Frame grade. Steers and heifers are expected to produce U.S. Choice carcasses (about 0.50 inch fat at 12th rib) at live weights of less than 1,100 pounds and 1,000 pounds, respectively.

Table 44.2. USDA frame size classifications and expected harvest weight at Low Choice quality grade.

	Small frame	*Medium frame*	*Large frame*
Steers	< 1,100 lbs	1,100 to 1,250 lbs	> 1,250 lbs
Heifers	< 1,000 lbs	1,000 to 1,150 lbs	> 1,150 lbs

Source: USDA Standards for Grades of Feeder Cattle.

Muscle Thickness Standards

Muscle thickness is related to the ratio of muscle to bone at a given degree of fatness. Four muscle thickness grades are currently used, No. 1, No. 2, No. 3 and No. 4, from thickest to thinnest, respectively (Figure 44.5). The result is a relatively strong relationship with the USDA carcass yield grading system with thicker muscled feeder cattle producing carcasses with a higher percentage of lean red meat.

Based on extensive research and requests from the feeder cattle industry, this updated feeder cattle grading system was implemented Oct. 1, 2000. Table 44.2 summarizes the estimated harvest weight at low choice quality grade for steers and heifers in the three frame size categories.

Changes also have been implemented for the muscle thickness grading standards to incorporate four, rather than three grades. Obviously, this change allows for more specific description of cattle with heavy and moderate muscling.

No. 1 – Feeder cattle that possess minimum qualifications for this grade usually display predominant beef breeding. They must be healthy and moderately thick throughout. They are moderately thick and full in the forearm and gaskin, showing a rounded appearance through the back and loin, with moderate width between the legs, both front and rear. Cattle show this thickness with a slightly thin covering of fat; however, cattle eligible for this grade may carry varying degrees of fat.

No. 2 – Feeder cattle that possess minimum qualifications for this grade usually show a high proportion of beef breeding and slight dairy breeding may be detected. They must be healthy and tend to be slightly thick throughout. They tend to be slightly thick and full in the forearm and gaskin, showing a rounded appearance through the back and loin with slight width between the legs, both front and rear. Cattle show this thickness with a slightly thin covering of fat; however, cattle eligible for this grade may carry varying degrees of fat.

No. 3 – Feeder cattle that possess minimum qualifications for this grade are healthy and thin through the forequarter and the middle part of the rounds. The forearm and gaskin are thin and the back and loin have a sunken appearance. The legs are set close together, both front and rear. Cattle show this narrowness with a slightly thin covering of fat; however, cattle eligible for this grade may carry varying degrees of fat.

No. 4 – Feeder cattle included in this grade are healthy animals, which have less thickness than the minimum requirements specified for the No. 3 grade.

Instrument Grading

Technology to improve the accuracy and uniformity of U.S. beef grading has been evident to producers, packers and retailers for some time, and even to U.S. Congress for more than 30 years, since the U.S. General Accounting Office reported the need for improvement. An outstanding historical review of instrument assessment of beef carcass yield and quality was presented by Woerner and Belk (2008). The beef industry has long sought objective methods to measure yield and quality factors of beef carcasses and cuts, as a prediction of cutability (red meat yield) and/or palatability (specifically tenderness). Table 44.3 presents a chronological summary of instrument grading approval dates by the USDA, including ribeye area, yield grade and marbling assessment. Instrument grading initiatives are based on the premise that grading accuracy, precision and consistency benefits all segments of the beef industry – production to consumption. Thus, by increasing accuracy, precision and consistency, carcasses would more likely be classified correctly into their respective USDA Quality Grades (QG). An instrument to assess marbling score (MS) of beef carcasses would reduce the variation that has long existed between graders, shifts and plants.

Video image analysis (VIA) has proven to be a viable objective measure of carcass cutability traits and was approved by the USDA for assessment of the LM area and officially assigning USDA Yield Grades. Performance requirements for instrument marbling evaluation (PRIME I; USDA, 2006a) were developed utilizing information from Moore et al. 2006. The instrument approval process described in PRIME I is a two-phase approach:

Phase I: Demonstration of the repeatability of marbling score prediction on stationary beef carcasses.

Phase II: Demonstration of the accuracy and precision of marbling score prediction at line speeds. Supervisors of USDA served as the "gold standard" for evaluation of MS during the approval process.

Table 44.3. USDA MRP AMS Livestock, Poultry and Seed Program instrument grading chronological summary.

Factor/grade	*Date*
Ribeye area	**February 2001**
Instrument first approved	February 2001
Official Use	August 2001
USDA yield grade	**March 2005**
Instrument first approved	June 2005
Official Use	March 2007
ADDENDUM A - fat thickness	**March 2007**
Instrument first approved	March 2007
Marbling score	**June 2007**
Instrument first approved	November 2006
Grade Line Divergence Investigation	
Study 1: Instrument Data Review	September 2007
Study 2: Image Review	November 2007
Grade Line Review with Industry	November 2007
Grade line Alignment with Grader Input	
Instrument Data Review	September 2008
Image Review	November 2008
Grade Line Review with Industry	February 2009
Official Use of Instrument Grading	September 2009

In June 2006, CVS (Computer Vision System; RMS Research Management Systems, USA, Inc., Fort Collins, CO) and VBG2000 (E+V Technology, Oranienburg, Germany) met the rigorous performance requirements of PRIME I to assess MS. The instruments incorporate several variables including the amount, size and distribution of fat (marbling) present within the exposed ribeye, as well as variables of lean and fat color. Once approved through PRIME I by the USDA Agriculture Marketing Service Livestock, Poultry and Seed Program (USDA-AMS LPS), companies and technology providers must obtain approval through PRIME II (USDA, 2006b). Individual establishments utilizing instruments to assess MS for beef carcasses must conform to the operational procedures outlined in PRIME II. Specifically, PRIME II states: demonstration of a documented-program, in-plant procedures and verifications that ensure accurate and precise determinations are made by properly calibrated and verified instruments (USDA, 2006b). The approval process utilizes thousands of carcasses at multiple locations in assessing the predictive accuracy of an instrument and ensuring the functionality of the technology relative to the U.S. beef carcass population.

Gray et al. (2012) and Moore et al. (2012) surveyed commercial beef processing facilities across the nation to evaluate quality and yield grade characteristics assessed by instruments and by USDA personnel, respectively, of carcasses for the 2011 National Beef Quality Audit (NBQA). This is the first NBQA where instrument grading was being utilized for assessment of MS. The instrument assessment data (Gray et al., 2012) showed similar frequencies to in-plant chilled carcass assessments (Moore et al. 2012): USDA prime – 2.7% and 2.1%; USDA choice – 61.5% and 58.9%; USDA select – 31.5% and 32.6%; other – 4.3% and 6.3%, respectively. In addition, these studies found very similar mean MS for in-plant assessments of Small40 (Moore et al., 2012) and instrument assessments of Small50 (Gray et al., 2012). These results are extremely positive for the credibility of instrument grading and its relationship to field grading assessments. The use of instruments to grade beef carcasses definitely adds more consistency and uniformity to the system; ultimately ensuring beef producers are being fairly compensated for the cattle they produce and that consumers are receiving the quality of beef they expect.

Certified Beef Programs

The first USDA certified beef program was initiated in 1978, Certified Angus Beef. This program focused on branding Angus beef and marketing to consumers as higher

quality than typical commodity beef. Specifications were outlined for the program, such as more than 50% black hide, no *Bos indicus* influence, adequate marbling, A-maturity and at least a modest degree of marbling to qualify. The USDA grading service would "certify" carcasses and identify them with G-1 stamp (government schedule 1), as well as the USDA accepted stamp. The number of certified programs increased slowly, but the early 2000s saw rapid growth, leading to more than 100 current USDA Certified Beef Programs. These programs have many different requirements and can include both live animal and carcass specifications. The purpose of certified programs is to distinguish products from commodity beef to offer some attribute, for which consumers would be willing to pay a premium. Some certified programs utilize lean carcasses with lower quality grades for marketing to consumers looking for cuts with lower percentage fat.

In addition to certified beef programs, many other beef products are "branded." All certified programs are branded beef programs because they have a specific brand name associated with them. However, not all branded beef is certified. Both programs can be confusing and misleading to consumers, but importantly, if consumers have a positive eating experience from beef labeled with a certain brand, they are likely to be a repeat buyer and vice versa.

Conclusion

Federal grading standards are presented to familiarize producers with USDA's standards for beef carcass quality and yield grading as well as feeder cattle grading. These grading standards provide benchmarks that can be used to improve carcass quality and uniformity. Grading standards also facilitate uniform market reporting, provide a tool for expressing and comparing prices and enhance merchandising of beef. Many attempts have been made to improve USDA grading standards by using other tools or instrumentation. These instruments can be used in combination with USDA grades, but cannot fully take their place. The USDA grades are a worldwide market tool for fresh beef.

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