



## WSU CARCASS CALCULATOR APP: A QUICK AND EASY WAY TO CALCULATE CARCASS MERIT

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# WSU Carcass Calculator App: A Quick and Easy Way to Calculate Carcass Merit

## Abstract

Various complex equations are used to determine carcass merit, such as dressing percentage, yield grade, and the cutability of a beef, lamb, or pork carcass. These equations are used by the USDA and throughout the US livestock industry by producers, university faculty, agriculture teachers, carcass graders, buyers, and livestock judges to evaluate carcass merit. Carcass merit and carcass weight are the primary factors used to determine the value of beef cattle, lambs, and pigs when marketed on a carcass basis. The WSU Livestock Carcass Grade & Cutability Calculator app provides users with a quick and easy way to calculate carcass yield grade, dressing percentages, and cutability of beef, lamb, and pork carcasses. Individuals can estimate these carcass merit factors from predicted live animal data of beef cattle, lambs, and pigs, in addition to calculating actual carcass merit from collected carcass data.

## Introduction

Various complex equations are used in both live animal and carcass evaluation to estimate or determine the actual carcass merit of beef cattle, lambs, and pigs. These equations enable one to determine the expected carcass weight and amount of lean or expected retail cuts based on live or carcass merits. These equations are used by the USDA and throughout the US livestock industry by producers, university faculty, agriculture teachers, carcass graders, buyers, judges, and others involved in livestock production.

Potential or actual carcass weight and carcass merit are the primary factors used to determine the value of beef cattle, lambs, and pigs when marketed as finished animals on a live or carcass basis. However, potential carcass merit is also used to sort and value feeder animals at weaning or sales. Carcass traits are moderately to highly heritable (Utrera and Van Vleck 2004; Mortimer et al. 2014; Miar et al. 2014).

Thus, carcass merit of all species can be improved by genetic selection; however, nutrition, management, and timely marketing are also important. Understanding how carcass merit is determined will help producers, managers, and evaluators make management decisions to improve the quality and profitability of their livestock.

The differences between species and the various factors used within the carcass merit equations cause them to be complex and difficult to recall. Use of a basic calculator can be confusing, because algebraic order of operation rules must be followed to ensure accuracy. Most individuals using these equations use a spreadsheet to increase efficiency and accuracy. It is not practical to have a computer available in a barn or carcass cooler to complete calculations. Smartphone and mobile technology allows individuals to have useful decision-making aids at their fingertips.

## WSU Livestock Carcass Grade & Cutability Calculator App

The WSU Livestock Carcass Grade & Cutability Calculator App (Carcass Calculator App; Figure 1) was developed to provide evaluators of livestock and carcasses a quick and easy way to calculate carcass yield grade, dressing percentages, and cutability of beef, lamb, and pork carcasses. Individuals can estimate these carcass merit factors from live animal data of beef cattle, lambs, and pigs, in addition to calculating actual carcass merit from carcass data. The Carcass Calculator App not only allows livestock and carcass evaluators to determine important information about animal and carcass merit, it also allows users to expand their understanding of carcass merit concepts and factors influencing carcass weight and merit.

The Carcass Calculator App allows the user to quickly and easily calculate dressing percentage, estimated yield grade, actual yield grade, and cutability for the three main graded livestock

species: beef cattle, lambs, and pigs, from estimated live values or measured carcass data (Table 1) (Busboom and Lewellyn 2017; Busboom et al. 2004a; Busboom et al. 2004b). The app will report calculated yield grade to the nearest hundredth. It will also report the yield grade per USDA standards, rounding down the calculated yield grade to the

nearest whole number between one and five (Figure 2). Because of differences in packing plant and harvesting procedures, the Carcass Calculator app will allow users to correct chilled carcass weight to a hot carcass basis for all three species and will correct pork carcass merit to a skin-on, head-off basis.



Figure 1. WSU Carcass Calculator App platform advertisement.

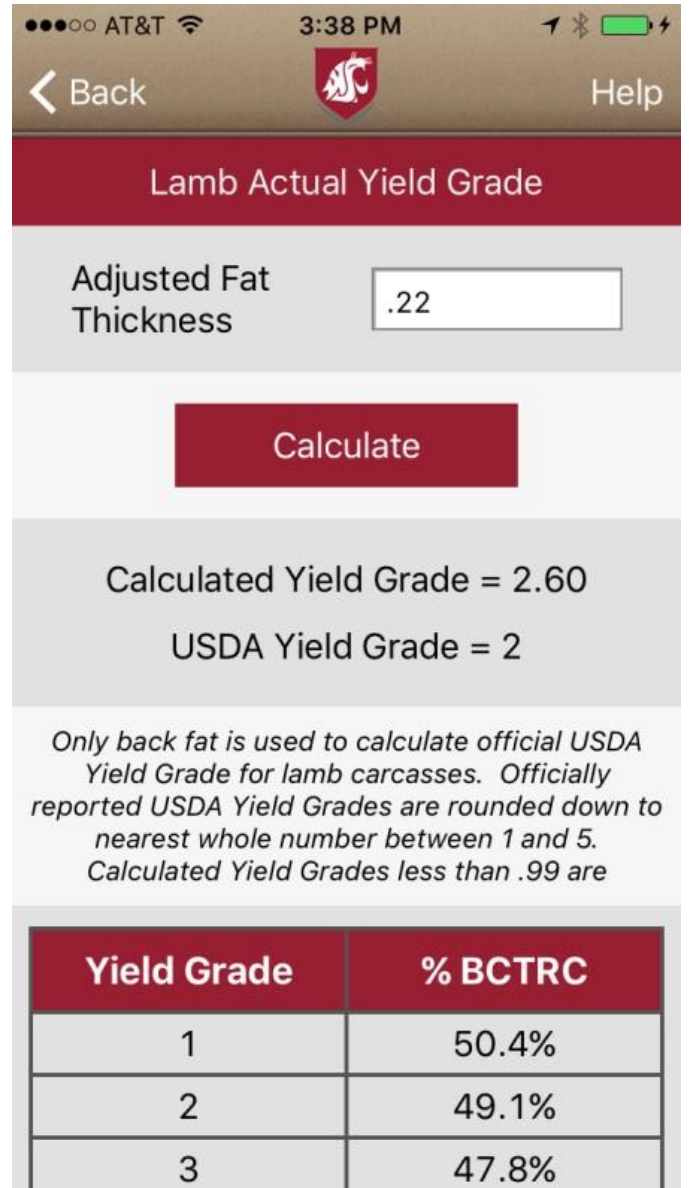


Figure 2. Carcass Calculator App will report calculated yield grade to the hundredth and by USDA standards as a whole number.

Table 1. Carcass Calculator App calculations.

<b>Beef Cattle/Beef Carcasses</b>	
Estimated Yield Grade <sup>1</sup>	$2.50 + (2.5 \times \text{estimated backfat thickness}) + (0.20 \times \text{estimated percent kidney, pelvic, and heart fat}) + [0.0038 \times (\text{live weight} \times \text{estimated dressing percentage})] - (0.32 \times \text{estimated ribeye area})$
Dressing Percentage <sup>2</sup>	$(\text{hot carcass weight} / \text{live weight}) \times 100$
Yield Grade <sup>1</sup>	$2.50 + (2.5 \times \text{adjusted backfat thickness}) + (0.20 \times \text{percent kidney, pelvic, and heart fat}) + (0.0038 \times \text{hot carcass weight}) - (0.32 \times \text{ribeye area})$
Percent Boneless Closely Trimmed Retail Cuts (BCTRC) <sup>2</sup>	$51.34 - (5.78 \times \text{adjusted backfat thickness}) - (5.78 \times \text{hot carcass weight}) - (0.462 \times \text{percentage of kidney pelvic and heart fat}) + (0.740 \times \text{ribeye area})$
<b>Lambs/Lamb Carcasses</b>	
Estimated Yield Grade <sup>1</sup>	$(\text{estimated backfat thickness} \times 10) + 0.4$
Dressing Percentage <sup>2</sup>	$(\text{hot carcass weight} / \text{live weight}) \times 100$
Yield Grade <sup>1</sup>	$(\text{adjusted backfat thickness} \times 10) + 0.4$
Percent Boneless Closely Trimmed Retail Cuts (BCTRC) <sup>2</sup>	$49.936 - (0.0848 \times \text{hot carcass weight}) - (4.376 \times \text{fat thickness}) - (3.530 \times \text{body wall thickness}) + (2.456 \times \text{ribeye area})$
<b>Pigs/Pork Carcasses</b>	
Estimated Percent Muscle	$\{ [8.588 + (0.465 \times \text{live weight} \times \text{dressing percentage}) + (3.005 \times \text{estimated loin eye area}) - (21.896 \times \text{estimated } 10^{\text{th}} \text{ rib fat thickness}) ] / [(\text{live weight} \times \text{dressing percentage})] \times 100 \}$
Dressing Percentage <sup>2</sup>	$(\text{hot carcass weight} / \text{live weight}) \times 100$
Percent Muscle (ribbed carcass) <sup>2,3</sup>	$\{ [8.588 + (0.465 \times \text{hot carcass weight}) + (3.005 \times \text{loin eye area}) - (21.896 \times 10^{\text{th}} \text{ rib fat thickness}) ] / \text{hot carcass weight} \} \times 100$
Percent Muscle (unribbed carcass) <sup>2,3</sup>	$\{ [23.568 + (0.503 \times \text{hot carcass weight}) - (21.348 \times 10^{\text{th}} \text{ rib fat thickness}) ] / \text{hot carcass weight} \} \times 100$

<sup>1</sup>Calculated yield grade reported to hundredths. USDA reports official yield grade by rounding down the calculated yield grade to the nearest whole number between one and five. Any calculated yield grades above six are rounded to five and yield grades below one are reported as one.

<sup>2</sup>App will correct chilled weight to a hot carcass weight. App will use a 2% correction for typical loss realized during chilling for beef and lamb carcasses and 1.5% for pork carcasses (Busboom and Llewellyn 2017; Busboom et al. 2004a; Busboom et al. 2004b).

<sup>3</sup>App will correct for both skin-off and head-on for pork carcasses to report pork calculations on a skin-on, head-off basis. App will use 6% correction to carcass weight for skin removal and .1 inch to adjust to a skin-on basis, and will use 6% correction to carcass weight for head remaining on the carcass (Busboom et al. 2004a).

For beef cattle, the app also has an information tab about USDA Quality Grades. The USDA Quality Grade is an estimation of palatability, taste, and tenderness, of a carcass. The USDA Quality Grades for beef carcasses are determined by evaluating the amount of marbling in the ribeye area (longissimus dorsi muscle) and carcass maturity. Users can review pictures of USDA marbling degrees and the USDA Quality Grades coinciding with each marbling degree, based on an “A” maturity beef carcass (Boggs et al. 2006).

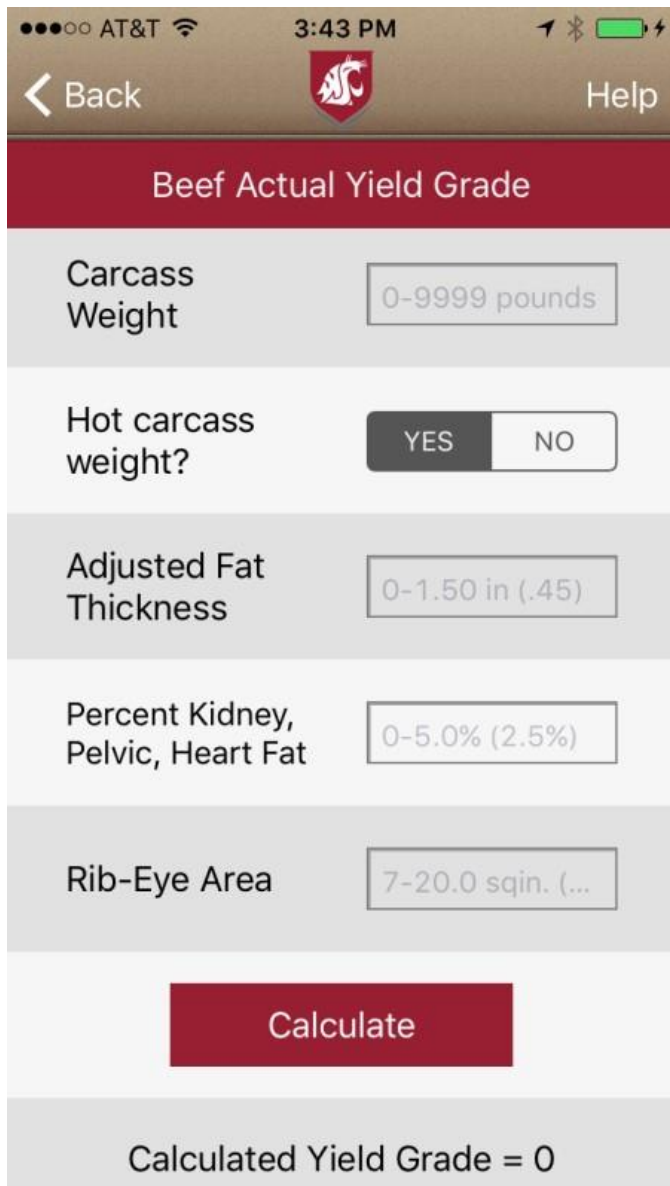


Figure 3. Expected range and industry average for measurement is identified in input cell.

Within the data entry section for each species and each equation, an expected range is highlighted in gray with the average for that specific carcass measurement identified in parentheses (Figure 3) (Boggs et al. 2006). Each species section of the app has a “Help” section with equations and glossary definitions (Figure 4). All measures in the app are reported in U.S. weights and measurements. By using the app, users can expand their understanding of factors affecting carcass merit, how they are calculated, and expected averages and ranges for the industry.



**Live weight** - Weight prior to slaughter.

**Dressing Percentage** - This is the proportion of live weight that is contained in the carcass. (Equation used in app - ((Hot carcass weight / final live weight) x 100). If carcass is not a hot carcass, divide hot carcass weight by 0.985. Most carcasses shrink about 1.5% during the chilling process. Adjust skinned, head-off carcasses to a skin-on basis by dividing warm weight by 0.94 (skin is about 6% of the carcass). Adjust head-on skin-on carcasses to a head-off basis by multiplying warm weight by 0.94 (the head is about 6% of the carcass). Head-on/skin-off and head-off/skin-on carcasses require no weight adjustment.)

Figure 4. Carcass Calculator App has a glossary for each species under the “Help” tab.

## Use and Limitations

Download of the app is available, free for both Android and iOS platforms at:

- [Android link](#)
- [iTunes Store](#)

The accuracy of calculated carcass merit using this app or any computer/calculator is based on the accuracy of measurements entered. To increase accuracy in determining the dressing percentage, yield grade, and cutability, the user needs to have accurate measurements. A basic understanding of carcass evaluation will enhance the user's ability to use the app. This tool is not meant to replace or verify USDA grades determined by USDA graders or grid pricing used to determine value of specific livestock or carcasses.

## Measuring Carcass Data

Carcass data measurements of adjusted fat thickness and ribeye (loineye) area is performed the same way for beef, lamb, and pork carcasses. The following paragraphs describe how to accurately measure fat thickness and ribeye (loineye) area to enter into Carcass Calculator App to calculate carcass merit:

**Adjusted Fat Thickness:** To accurately measure adjusted backfat data, one needs a backfat probe or ruler measuring in tenths or hundredths of an inch. Beef carcasses are ribbed or divided into front and hind quarters between the 12th and 13th ribs. Fat thickness is measured at the 12th rib at three-fourths of the lateral length of the longissimus (ribeye) muscle, measured from the backbone end of the muscle and perpendicular to the outside surface of the fat (Figure 5).

Lamb carcasses are often not ribbed. However to obtain accurate backfat and ribeye measurements, lamb carcasses should be ribbed between the 12th and 13th rib. Lamb carcasses are left whole and not split down the center (backbone) like beef or pork carcasses. Backfat on a lamb carcass is measured on the 12th rib one half of the lateral length of the longissimus muscle from the backbone (Figure 6).

Pork carcasses should be ribbed between the 10th and 11th rib so backfat can be measured at the 10th rib at three-fourths of the lateral length of the longissimus muscle, measured from the backbone, as described for the beef carcass (Figure 7).

Usually only one side of a carcass is evaluated to determine backfat, but in the case of uneven fat cover (from hide pulling, skinning, etc.), both sides can be evaluated, and an average can be used for backfat measurement. Backfat measurement may be adjusted as necessary to reflect any unusual distribution of fat on other parts of the carcass and therefore is referred to as adjusted fat thickness. Adjustments to backfat measurements are made by evaluating the fat distribution over the entire carcass. (Busboom and Llewellyn 2017; Busboom et al. 2004a; Busboom et al. 2004b).



Figure 5. Location to measure backfat of a beef carcass. This carcass measures .7 in.



Figure 6. Location to measure backfat of a lamb carcass. This carcass measures .1 in.

**Ribeye (Loineye) Area:** The ribeye (loineye) area measurement is taken on the longissimus dorsi muscle in the same rib location as described to measure backfat (see above), between the 12th and 13th rib for beef and lamb, and between the 10th and 11th rib for pork. To accurately measure beef ribeye area, one needs a clear plastic beef grid. To measure the ribeye area, place the grid on the cut surface of the ribeye and count all the squares/dots in which the longissimus dorsi muscle surrounds the dot (Figure 8 and Figure 9). If dots lie directly on the perimeter of the muscle, count only every other dot so that ribeye area will not be overestimated. Divide the number of squares/dots counted by ten. The resulting number is the area of the ribeye in square inches. For example, if one counts 142 dots in the longissimus dorsi area of the grid, the ribeye (loineye) area would be reported as 14.2 in<sup>2</sup>. Many of the plastic grids used to measure beef ribeye area will have outlined areas identified by an eight, nine, or ten for beef grids. These outlined areas designated by the number contain 80, 90, or 100 dots, respectively, to help speed up the process of counting dots for determining ribeye area size.

Use the same procedure to measure lamb ribeye area, except use a lamb and pork grid, which has 20 dots per inch and has outlined areas identified by two, three, or four containing 40, 60, or 80 dots, respectively. Pork loineye area is measured between the 10th and 11th rib. A beef grid can be used on the much larger pork loineye areas common today.



Figure 7. Location to measure backfat of a pork carcass. This carcass measures .9 in. with the skin on.

**Kidney, Pelvic, and Heart Fat:** The amount of kidney, pelvic, and heart fat is only used in beef carcasses to calculate yield grade and cutability. Kidney, pelvic, and heart fat (KPH) is the amount of fat accumulated in the body cavity of a carcass (Figure 10). Its weight is estimated and reported as a percentage of the hot carcass weight, usually to the nearest 0.5%. For example, if the hot carcass weight of a beef carcass weighs 850 pounds, and one visual appraisal estimate of 15–18 pounds of kidney, pelvic, and heart fat, then the reported KPH would be 2%.

**Body Wall Thickness:** The body wall thickness measurement is used to calculate the percentage of boneless closely trimmed retail cuts (BCTRC) of a lamb carcass. To accurately measure body wall thickness, one needs a backfat probe or ruler measuring in tenths or hundredths of an inch. Body wall thickness is measured at the ribs beyond the ribeye, approximately five inches from the midline (spinal cord) of a ribbed carcass (Figure 11).

Differences in body wall thickness between carcasses are primarily due to fat (Boggs et al. 2006).

## Conclusion

Complex algebraic equations are used to determine carcass merit. The merit of a carcass is not only used to make management decisions concerning genetic selection and nutrition, but also helps individuals make marketing decisions for the value of beef cattle, lambs, and pigs from farm through harvest. The WSU Livestock Carcass Grade & Cutability

Calculator App is an easy and portable way for producers, niche marketers, butchers, livestock judges, meat evaluators, and youth to accurately and quickly determine the dressing percentage, yield grade, and cutability of beef, lamb, or pork carcasses. As individuals use the app to determine carcass merit, they will learn how specific carcass factors positively or negatively influence the carcass merit, which in turn can be used to impact future decisions about animal selection, production, evaluation, sorting, and marketing.

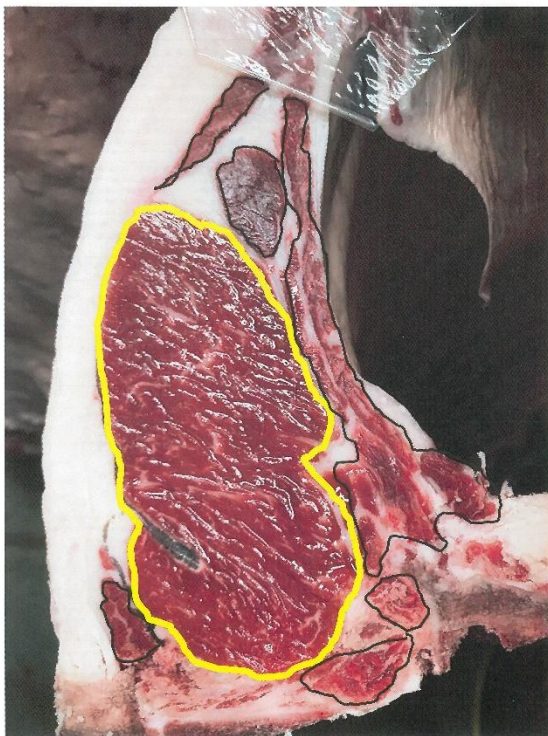


Figure 8. To accurately measure the ribeye (loineye) area, measure only the longissimus dorsi muscle (outlined in yellow). Do not include the other muscles (outlined in black).



Figure 9. Correct placement of grid to measure ribeye (loineye) area. Count the dots in the highlighted yellow area representing the longissimus dorsi muscle. This example ribeye measures 13.5 in<sup>2</sup> (134–136 dots counted divided by 10). This is the same procedure for beef, lamb, and pork carcasses.

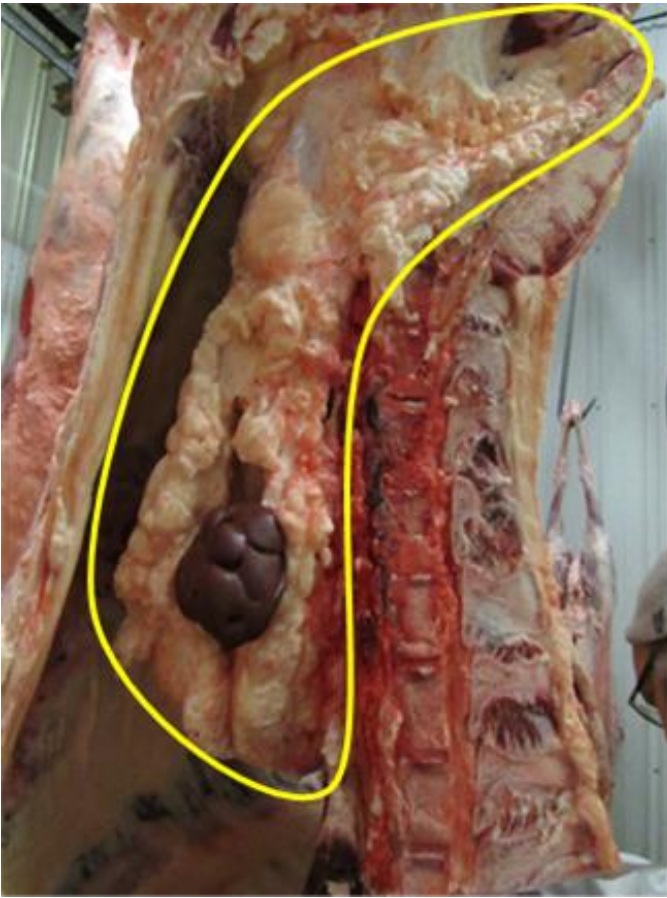


Figure 10. Kidney, pelvic, and heart (KPH) fat is determined by estimating the amount of fat in the body cavity as a percentage of the hot carcass weight. One pound of fat is approximately the size of a softball. For example, this 850-pound beef carcass has an estimated KPH of 2.5%.

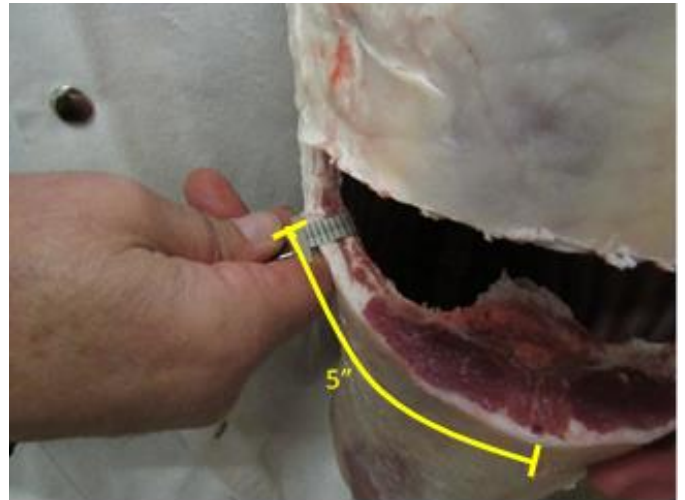


Figure 11. The body wall thickness of a lamb carcass is measured approximately five inches from the midline of a lamb carcass ribbed between the 12th and 13th rib. The body wall of this lamb carcass is .65 in.

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