USDA Agricultural Marketing Service

Standards,
Analysis and
Technology Branch

1400 Independence Avenue, SW.
Room 2607-S, STOP 0254
Washington, DC 20250-0254

Method for Grid Assessment of Beef Carcass Ribeye Area
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BACKGROUND

The Department of Agriculture (USDA), Agricultural Marketing Service (AMS), Livestock, and Seed (LS) Program will utilize carcass factors and measurements made by approved measurement tools. The LS Program approves the use of tools that increase the accuracy, precision, and repeatability in the prediction of quality and yield factors and grades. This document describes the methodology to be used for measuring the area of the ribeye muscle when an approved plastic grid is used.

USDA Meat Grading and Certification (MGC) Branch graders evaluate ribeye size visually or through the use of tools such as grids or grading instruments. The following procedures are to be utilized for official determinations of ribeye size at MGC Branch correlations, for use in providing data for research studies or when requested to provide an accurate determination of ribeye size when approved instrument aided measurement are not used.

The guidance for this document was based on a mathematical theorem for determining the area of a polygonal object located on a grid of equally spaced points, Pick's Theorem (Pick, 1899; see also Steinhaus, 1999). As a mathematical theorem, it is a statement or formula that can be demonstrated to be true by accepted mathematical operations and arguments.

PURPOSE AND SCOPE

This document describes the procedures and requirements for the use of LS Program approved grids for use in measuring the area of a ribeye. The scope of this document encompasses the evaluation of yield factors and grades of livestock carcasses and carcass products.

REFERENCE DOCUMENTS

1. Georg Pick, 1899. "Geometrisches zur Zahlenlehre," Sitzungber. Lotos, Naturwissen Zeitschrift, Prague, 19:311-319.

2. Steinhaus, H., 1999. Mathematical Snapshots, Dover Publications, New York, New York.

FORMULA DERIVED THROUGH PICK'S THEOREM

The formula for area given by Pick's Theorem is:

$$Area = interior\ dots + \left(\frac{boundary\ dots}{2}\right) - 1$$

For the case of measuring the area of a beef ribeye, the interior dots are those dots within the perimeter of the ribeye (those completely surrounded by lean) and the boundary dots are those on the perimeter of the ribeye (those touching lean). The scale of the USDA's beef ribeye grid is a grid of equally spaced points representing a scale of 0.1 square inches.

METHADOLOGY FOR GRID PLACEMENT

USDA ribeye grids should be placed randomly on the surface of the ribeye. Aligning a grid to the long axis of the ribeye introduces a sampling bias and thus reduces the precision of measurement since not all dots have an equal probability of being located on an area of the ribeye.

OFFICIAL METHOD FOR MEASURING BEEF CARCASS RIBEYE AREA
The area of the ribeye muscle shall be measured using the following method.
1. Randomly place the ribeye grid on the cut surface of the ribeye so that the grid covers the entire ribeye muscle;
2. Count the interior dots which are completely <u>within</u> the perimeter of the ribeye muscle;
3. Count the boundary dots which are <u>on</u> the perimeter of the ribeye muscle and divide this number by two (2);
4. Calculate the ribeye area by adding the result of steps 2 and 3, then subtract one (1); and,
5. Multiply the result of step 4 by 0.1 square inches to obtain the area.

RAPID METHOD FOR <u>ESTIMATING</u> BEEF CARCASS RIBEYE AREA
An estimate of ribeye area may be made using the following method.
1. Align the grid along the long axis of the ribeye with the edge of the squares aligned along the lean-fat/rib/intercostal boundary so that the grid covers the entire ribeye muscle;
2. Count the interior dots which are completely <u>within</u> the perimeter of the ribeye muscle;
3. Count the boundary dots which are <u>on</u> the perimeter of the ribeye muscle and divide this number by two (2);
4. Calculate the ribeye area by adding the result of steps 2 and 3; and,
5. Multiply the result of step 4 by 0.1 square inches to obtain the area.

The rapid method is only an approximation and on the average, slightly overestimates ribeye area. Because the grid is aligned with the long axis of the ribeye, the rapid method is also subject to a sampling bias. Caution should be considered for any measurement that is within 1.0 square inch (0.32 equivalent yield grade) of critical ribeye area requirement or that results in a change of yield grade.

These processes are to be monitored on a continual basis by LS Program personnel.

Questions or comments shall be submitted to:

Chief, Standards, Analysis, and Technology Branch
USDA, AMS, LS
1400 Independence Avenue, S.W.
Room 2607 South Building
Washington, DC 20250-0254

Phone: (202) 720-4486
FAX: (202) 720-1112
Email: Martin.OConnor@ams.usda.gov

Approved: /S/ Martin E. O'Connor May 4, 2011   .
               Martin E. O'Connor, Chief
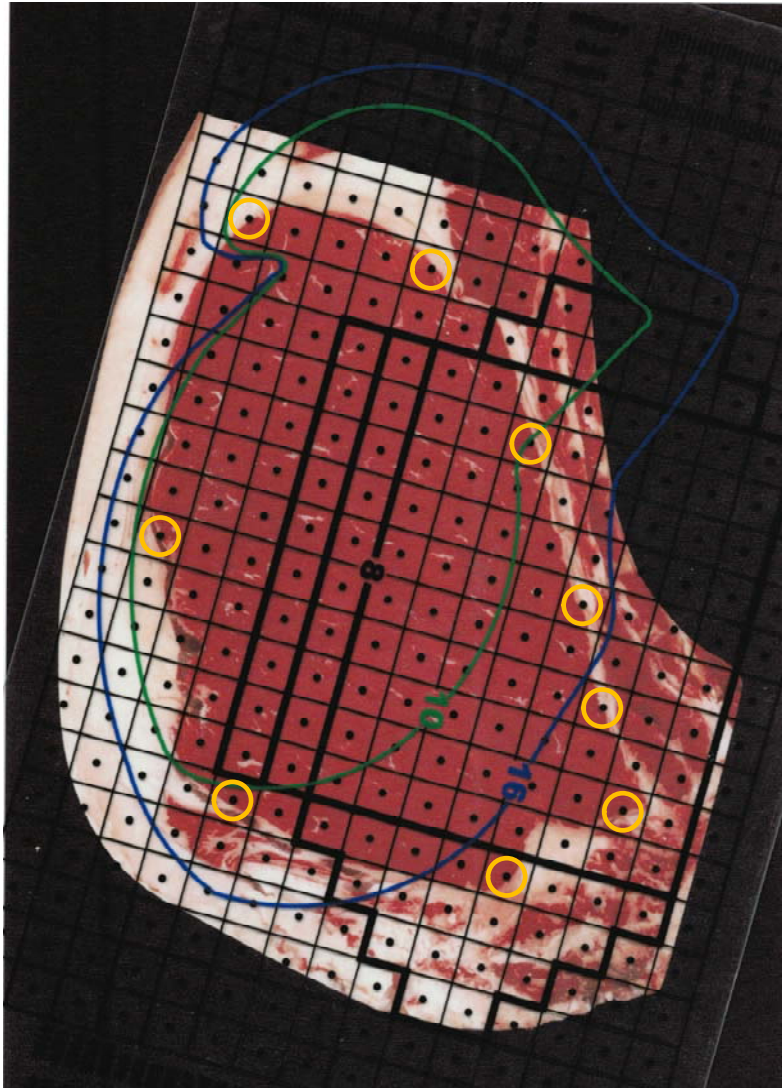   Standards, Analysis, and Technology Branch

Figure 1. Example of using the "OFFICIAL METHOD FOR MEASURING BEEF CARCASS RIBEYE AREA." The grid is randomly placed on the surface of the ribeye. There are 98 "interior" dots (dots completely surrounded by lean). There are 9 "boundary" dots (the perimeter dots surrounded by the gold circle) and 9 divided by 2 is 4.5. The area is thus 0.1 x (98 + 4.5 – 1) or 0.1 x (101.5) or 10.15 square inches.
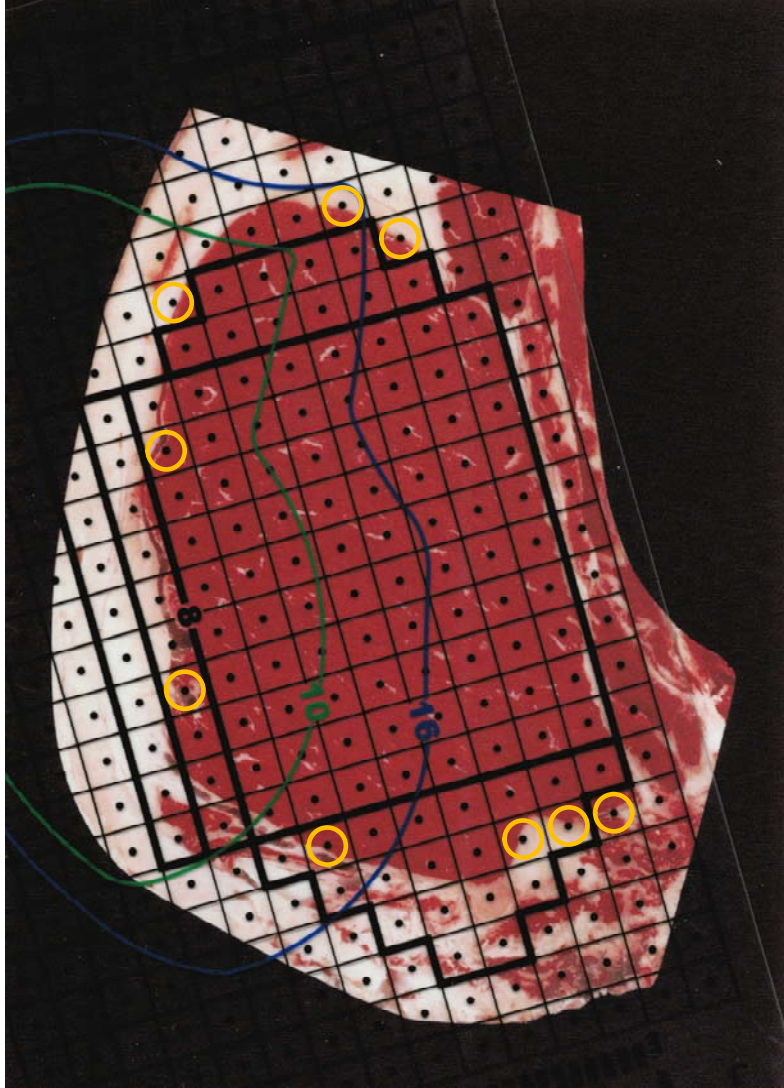
Figure 2. Example of using the "RAPID METHOD FOR <u>ESTIMATING</u> BEEF CARCASS RIBEYE AREA." The grid is aligned along the long axis of the ribeye with the edge of the squares aligned along the lean-fat/rib/intercostal boundary. There are 100 "interior" dots (dots completely surrounded by lean). There are 9 "boundary" dots (the perimeter dots surrounded by the gold circle) and 9 divided by 2 is 4.5. The area is thus 0.1 x (100 + 4.5) or 0.1 x (104.5) or 10.45 square inches.