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Grading of Eggs



**EXTENSION CIRCULAR 1317
SEPTEMBER 1949**

EXTENSION SERVICE
UNIVERSITY OF NEBRASKA COLLEGE OF AGRICULTURE
AND U. S. DEPARTMENT OF AGRICULTURE
COOPERATING

The Grading of Eggs

J. W. GOBLE

THE PURPOSE of grading eggs is to classify them according to their size, interior quality, and shell condition. Sometimes the word "grading" is used to refer only to sorting eggs for size but the term generally implies sorting for all the qualities taken into consideration in packing eggs for market. Grading for size is simple since it is merely the sorting of the eggs according to different size classifications and removal of those with dirty or cracked shells.

The size classes established by the Federal Government for consumer grade eggs are based upon a minimum weight for each group. These groups and the minimum weight per dozen for each are as follows: Jumbo, 30 oz.; Extra Large, 27 oz.; Large, 24 oz.; Medium, 21 oz.; Small, 18 oz.; Pee Wee, 15 oz.

If the grading procedure takes into account the interior quality, then candling of the eggs is necessary. If eggs are graded by candling, the purpose is to separate them into classes which indicate the quality that may be expected when the shell is removed.

CANDLING PROCEDURE

Eggs are candled to determine their interior quality. Candling consists of holding an egg before a ray of artificial light in such a way that the light penetrates the shell, making it possible to observe the condition of the interior contents of the egg. This is the accepted method for determining interior quality without breaking the shell. However, candling does not permit absolute accuracy in evaluating interior quality.

When being candled, the egg is held in a slanting position with the large end against the opening of the candling device through which a beam of light passes. The egg is held by the small end, with the thumb and tips of the first two fingers. It is given one or two quick turns on its long axis, causing the contents of the egg to move and to bring the yolk nearer the shell. This permits the interior condition of the egg to be more easily observed. (See cover picture.)

The candler should stand directly in front of the light located at a convenient height, usually 38 to 44 inches from the floor. The case of eggs to be graded should be placed directly in front or at the side of the candler on a shelf 22 to 26 inches high. The egg case filler may be removed when starting to handle each succeeding layer of eggs, permitting the eggs to lie loose on the flat. In commercial grading, two eggs are held in each hand. After grading one egg, quick manip-

ulation of the thumb and finger reverses the position of the eggs and the remaining egg in each hand is candled. In this way the eggs are alternated before the light until all four have been examined and their quality determined. As the eggs are candled they are graded and each egg is placed in the proper case for its grade. The average candler, working at a steady pace, should candle-grade 18 to 25 cases of eggs in an 8-hour working day.

EQUIPMENT NEEDED

Several types of egg candling lights are manufactured. Most of the devices are simple in construction and relatively low in cost. There are, however, more elaborate machines available in which the light and a weighing device are combined. Such machines are practical only when large volumes of eggs are to be graded.

Homemade egg candling lights may be easily and cheaply constructed. Those using an electric light bulb are most effective and are recommended. A satisfactory candling device can be constructed by using a metal can of sufficient size to hold a light bulb. The lamp cord should be run through a hole in the top of the can. A round hole $1\frac{1}{8}$ inches in diameter should be cut in the side of the can. A 40- or 60-watt bulb is the most satisfactory.

The interior quality specifications for the official U. S. Standards for Quality of Individual Shell Eggs are based on the use of a light delivering 310 to 450 foot-candles of light at the candling opening. The usual box-type candling light, without reflector, using a clean 40-watt frosted bulb about $1\frac{1}{2}$ inches behind an opening of $1\frac{1}{8}$ inches, is adequate for candling. Any type of candler can be used as long as the resulting light is of sufficient intensity.

FACTORS TO CONSIDER IN CANDLING AND GRADING

Egg quality is determined by four primary factors: condition of the shell, size and condition of the air cell, condition of the yolk, and condition of the white (albumen).

Shell Condition

The degree of cleanliness should be observed. Eggs must have clean shells to be classified in the higher grades. According to the U. S. Standards for Quality of Individual Shell Eggs, any eggs that have dirty or stained shells must be placed in a separate classification called U. S. Standards for Quality of Individual Eggs With Dirty Unbroken Shells. Even though the eggs are not graded according to the official U. S. standards, stained or dirty eggs should never be included in the top grades.

Eggs having deformities of the shell or those that are odd shaped should be placed in the lower grades. If the shell is thin or porous the egg should be graded down.

Cracked or checked¹ eggs should be separated from those with sound shells. Often checks may exist but are so fine that it is impossible to detect them without candling.

Eggs with brown shells are more difficult to candle than those with white shells. Brown-shelled eggs have a reddish-brown appearance when held before a candling light. The inexperienced candler may confuse the color with that of a bloody egg.

Size and Position of Air Cell

The size and position of the air cell has an important influence upon the grade. As the egg ages or if it is kept under improper holding conditions, the air cell will increase in size. If the egg is severely jolted or handled too many times, the air cell may become tremulous, that is, the shell membranes become separated over a larger area than is normally occupied by the air cell. (The egg contains two membranes which are fused together except in the large end where the air cell occupies an area between the two, as shown in the cross section on the opposite page.) The air cell may be "free," which permits it to move as the position of the egg is changed. This condition is brought about by the rupture of the inner shell membrane which allows the air to move to a space over the contents of the egg.

Position and Movements of Yolk

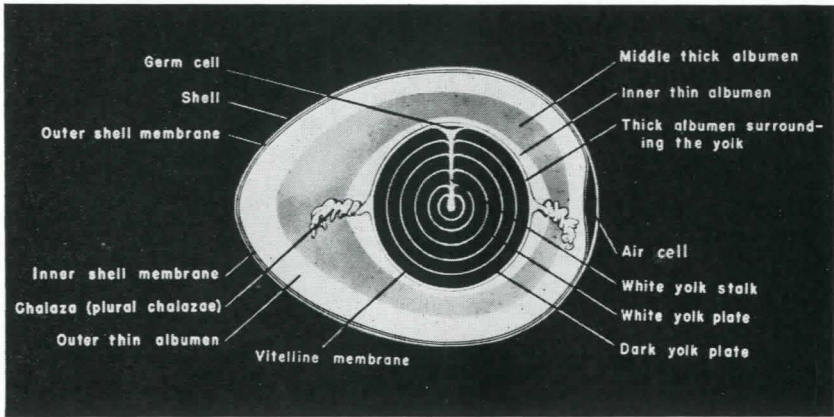
The yolk of a high quality egg will show relatively slight movement from the center position when turned before the candle. As the quality of the egg deteriorates, the albumen becomes thinner and permits the yolk to move more freely and nearer to the shell. The yolk also becomes more clearly outlined, as shown in the colored plate in the center section of this circular.

Condition of Yolk and White

When the egg is held before the candling light, the person doing the candling should observe the yolk for evidence of blemishes or spots. Spots, if present, will appear as dark areas.

Blood spots, a common defect found on the yolk, occur during the formation of the egg. Such spots cause the egg to be placed in either the lowest grade or the inedible class, depending upon the size of the spot.

¹ Definition of cracked and checked eggs on page 9.



Cross section of a shell egg.

Some fertile eggs may be found with a blood ring resulting from the development of the germ to the stage at which blood vessels appear. Upon the death of the developing embryo, the blood tends to gather in a ring about the dead germ. The destruction of the embryo results from cooling or refrigerating the eggs. If the eggs are infertile this condition will be avoided. Slight germ development is not visible by candling, but evidence of growth can be detected as the germ increases in size.

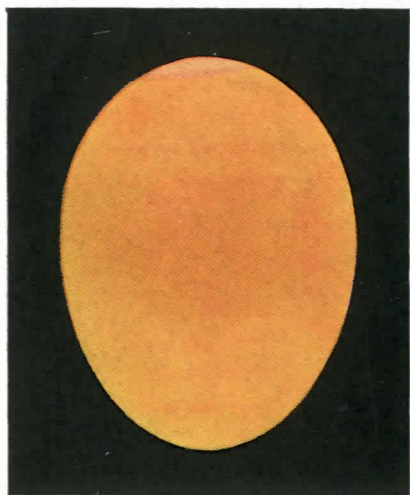
The viscosity and condition of the white is determined by the behavior of the yolk when viewed before the candling light. If the yolk remains centered when the egg is twirled, the white usually contains a high proportion of firm (viscous) albumen. If the white is thin and watery the yolk will move rapidly away from the normal centered position.

Foreign materials in the white appear as dark spots before the candle and cause the egg to be graded down. Such particles are usually meat spots or blood spots. If blood is diffused throughout the white, the contents of the egg will have a pink or red appearance when held before the light. Where this condition exists, the egg must be graded as inedible.

Certain feed stuffs such as green feed may cause the yolks to appear dark. The whites may also be affected by the ration. Eggs with yolks and whites of abnormal color are placed in the lowest grade of edible eggs.

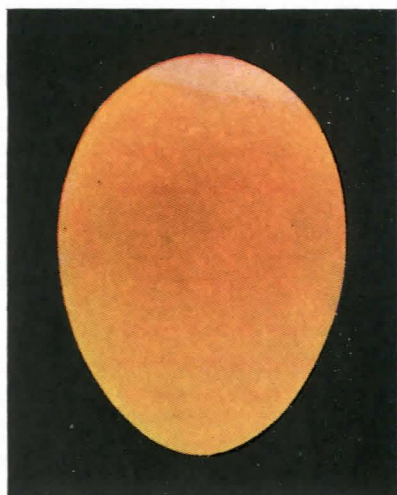
UNITED STATES STANDARDS FOR QUALITY

Illustrations of candled appearance of white-shelled eggs showing major defects



AA Quality

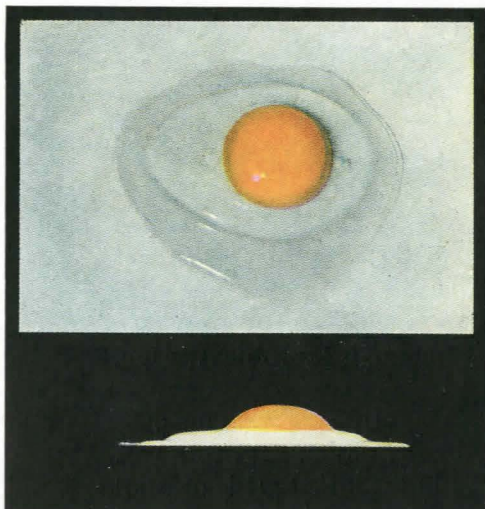
1. Shell—clean; unbroken; practically normal.
2. Air cell— $\frac{1}{8}$ inch or less in depth; practically regular.
3. White—clear; firm.
4. Yolk—well centered; outline slightly defined; free from defects.



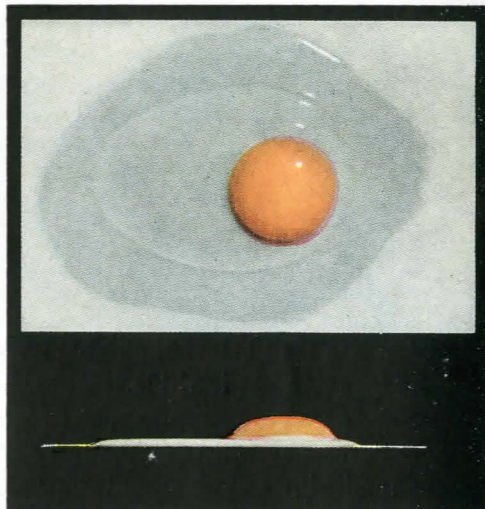
A Quality

1. Shell—clean; unbroken; practically normal.
2. Air cell— $\frac{2}{8}$ inch or less in depth; practically regular.
3. White—clear; may be reasonably firm.
4. Yolk—may be fairly well centered; outline fairly well defined; practically free from defects.

Illustrations of broken-out appearance (top)



AA Egg covers small area; much thick white surrounds yolk; has small amount of thin white; yolk round and upstanding.

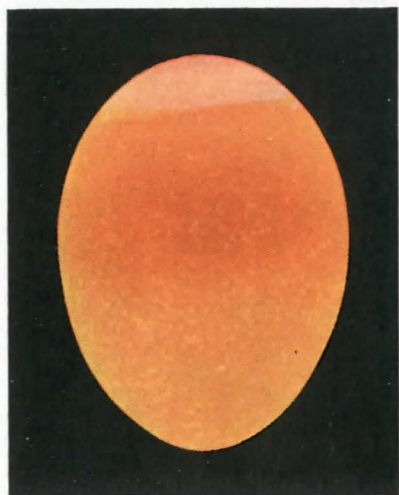


A Egg covers moderate area; has considerable thick white; medium amount of thin white; yolk round and upstanding.

Graders should check their work by breaking out an egg occasionally and comparing it

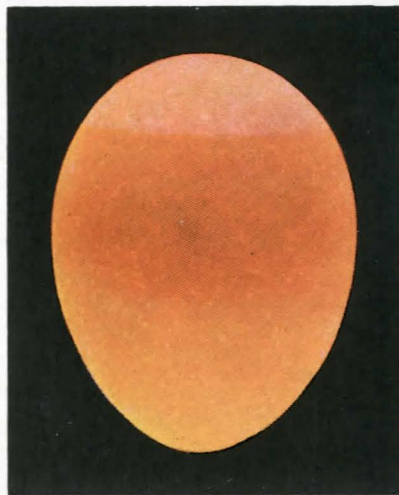
QUALITY OF INDIVIDUAL SHELL EGGS

Maximum depth of air cell and outline and position of yolk in each quality



B Quality

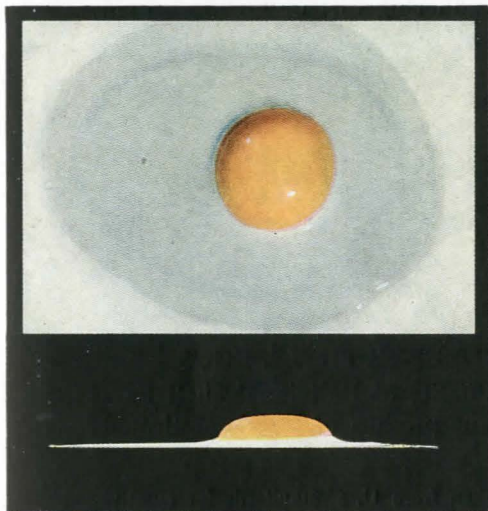
1. Shell—clean; unbroken; may be slightly abnormal.
2. Air cell— $\frac{3}{8}$ inch or less in depth; may show movement not over $\frac{3}{8}$ inch; if not over $\frac{2}{8}$ inch, may be free.
3. White—clear; may be slightly weak.
4. Yolk—may be off center; outline well defined; may be slightly enlarged and flattened; may show definite but not serious defects.



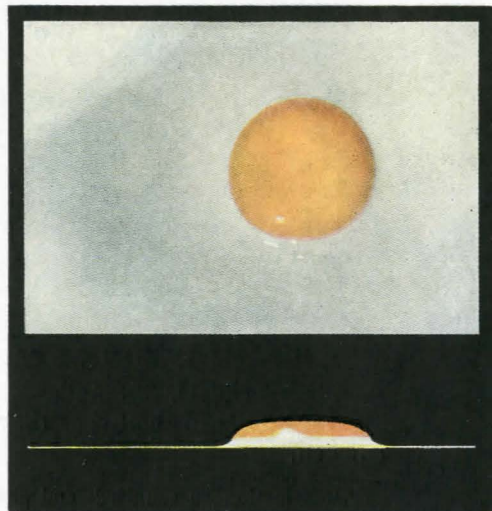
C Quality

1. Shell—clean; unbroken; may be abnormal.
2. Air cell—may be over $\frac{3}{8}$ inch in depth; may be free or bubbly.
3. White—clear; may be weak and watery; small blood clots or spots may be present.
4. Yolk—may be off center, enlarged, and flattened; may show clearly visible germ development but no blood; may show other serious defects; outline plainly visible.

and side views) of each quality— $\frac{1}{3}$ actual size



B Egg covers wide area; has small amount of thick white; much thin white; yolk somewhat flattened and enlarged.



C Egg covers very wide area; has no thick white; large amount of thin white thinly spread; yolk very flat and enlarged.

U. S. STANDARDS AND GRADES ²

Official standards for quality of individual eggs have been established by the Federal Government. These standards provide a means of standardizing the various grades used on the egg market. If the official grades are used by an individual, certain requirements must be met. For example, if eggs are to be labeled U. S. Grade A, certain requirements and obligations must be met before the Government will permit the use of the letters U. S. as a prefix to the grade. This does not prevent the use of the grades as a guide and the use of the term Grade A or other grade under which the eggs might be classified.

The Nebraska Egg Law (effective August 27, 1949) stipulates certain requirements for merchandising eggs. A producer retailing eggs or a buyer or seller of eggs should become thoroughly familiar with the requirements of the law and the officially recognized State grades. The State grades are patterned after those established under the Federal standards. Additional information about the State law and the egg grades being used can be secured from the Nebraska Agricultural Extension Service, College of Agriculture, or from the State Director of Agriculture.

U. S. Standards for Eggs with Clean Shells

The specifications required for eggs with clean shells to be classified as AA, A, B, and C are shown in the colored plate in the center section of this publication. Standards are also provided for eggs with dirty unbroken shells and for eggs with checked or cracked shells.

U. S. Standards for Eggs with Dirty Unbroken Shells

Stained—Individual egg that has no adhering dirt or no more than a combined total of one-eighth of the shell surface stained or soiled.

Dirty—Individual egg that has adhering dirt or more than a combined total of one-eighth of the shell surface stained or soiled.

U. S. Standards for Eggs with Checked or Cracked Shells

Check—Individual egg that has a broken shell or crack in the shell but with no leakage of the contents.

Leaker—Individual egg that has a broken shell or crack in the shell membranes with the contents exuding or free to exude through the shell.

TERMS USED IN STANDARDS FOR SHELL EGGS

The official U. S. Standards for Quality of Individual Shell Eggs are applicable to shell eggs that are the product of the domesticated chicken.

² Information on standards and grades taken from U. S. Standards for Quality of Individual Shell Eggs, U. S. Department of Agriculture.

Terms Descriptive of Shell

1. **Clean**—A shell that is free from foreign matter and from stains or discolorations that are readily visible. Eggs with only very small specks or stains may be considered clean, if such eggs are not of sufficient number in a package to detract appreciably from its appearance. Eggs that show traces of processing oil on the shell are considered clean unless the shell is otherwise soiled.

2. **Stained**—A shell with stained or soiled spots that together cover not more than one-eighth of the shell surface but without adhering dirt.

3. **Dirty**—A shell with adhering dirt or with stained or soiled spots that together cover more than one-eighth of the shell surface.

4. **Unbroken**—A shell that is free from checks or breaks.

5. **Checked or Cracked**—A shell that has an actual break but its membranes are unbroken and its contents do not leak.

6. **Leaker**—A leaker is an egg in which the shell and the shell membranes are broken to the extent that the egg contents are exuding or are free to exude through the shell.

7. **Practically Normal (AA) (A)**—A shell that approximates the usual shape and that is of good even texture and strength and free from rough areas or thin spots. Slight ridges and rough areas that do not materially affect the shape, texture and strength of the shell are permitted.

8. **Slightly Abnormal (B)**—A shell that may be somewhat unusual in shape or that may be slightly faulty in texture or strength. It may show definite ridges but no pronounced thin spots or rough areas.

9. **Abnormal (C)**—A shell that may be decidedly misshapen or faulty in texture or strength or that may show pronounced ridges, thin spots or rough areas.

Terms Descriptive of the Air Cell

10. **Depth of Air Cell** (air space between shell membranes, normally in the large end of the egg)—The depth of the air cell is the distance from its top to its bottom when the egg is held with the air cell upward.

11. **Practically Regular (AA) (A)**—An air cell that maintains a practically fixed position in the egg and shows a fairly even outline, with no more than $\frac{1}{8}$ -inch movement in any direction as the egg is rotated.

12. **Movement Not in Excess of $\frac{3}{8}$ Inch (B)**—An air cell that shows a total movement not in excess of $\frac{3}{8}$ inch in any direction as the egg is rotated.

13. **Free Air Cell (B) (C)**—An air cell that moves freely toward the uppermost point in the egg as the egg is rotated slowly.

14. **Bubbly Air Cell (C)**—A ruptured air cell resulting in one or more small separate air bubbles usually floating beneath the main air cell.

Terms Descriptive of the White

15. **Clear (AA) (A) (B)**—A white that is free from discoloration or from any foreign bodies floating in it. (Prominent chalazae should not be confused with foreign bodies such as spots or blood clots.)

16. **Firm (AA)**—A white that is sufficiently thick or viscous to permit but limited movement of the yolk from the center of the egg, thus preventing the yolk outline from being more than slightly defined or indistinctly indicated when the egg is twirled.

17. **Reasonably Firm (A)**—A white that is somewhat less thick or viscous than a firm white. A reasonably firm white permits the yolk to move somewhat more freely from its normal position in the center of the egg and approach the shell more closely. This would result in a fairly well defined yolk outline when the egg is twirled.

18. **Slightly Weak (B)**—A white that is lacking in thickness or viscosity to an extent that permits the yolk to move quite freely from its normal position in the center of the egg. A slightly weak white will cause the yolk outline to appear well defined when the egg is twirled.

19. **Weak and Watery (C)**—A white that is thin and generally lacking in viscosity. A weak and watery white permits the yolk to move freely from the center of the egg and to approach the shell closely, thus causing the yolk outline to appear plainly visible and dark when the egg is twirled.

20. **Blood Clots and Spots** (Not due to germ development)—Blood clots or spots on the surface of the yolk or floating in the white. These blood clots may have lost their characteristic red color and appear as small spots or foreign material commonly referred to as meat spots. Such blood clots or spots are incorporated in the egg during its formation or after the yolk leaves the ovary. If they are small (not over $\frac{1}{8}$ inch in diameter) the egg may be classed as C quality. If larger and/or showing diffusion of blood in the white surrounding them, the egg shall be classified as loss.

21. **Bloody White (Loss)**—An egg, the white of which has blood diffused through it. Such a condition may be present in new-laid eggs. Eggs with bloody whites are classed as loss.

Terms Descriptive of Yolk

22. **Well Centered (AA)**—A yolk that occupies the center of the egg and moves only slightly from that position as the egg is twirled.

23. **Fairly Well Centered (A)**—A yolk that is not more than one-fourth of the distance from its normal central position toward the

ends of the egg and swings not more than one-half of the distance from its normal position toward the sides of the egg as it is twirled.

24. **Off Center (B) (C)**—A yolk which is distinctly above or below center and swings close to the sides of the egg as it is twirled.

25. **Outline Slightly Defined (AA)**—A yolk outline that is indistinctly indicated and appears to blend into the surrounding white as the egg is twirled.

26. **Outline Fairly Well Defined (A)**—A yolk outline that is discernible but not clearly outlined as the egg is twirled.

27. **Outline Well Defined (B)**—A yolk outline that is quite definite and distinct as the egg is twirled.

28. **Outline Plainly Visible (C)**—A yolk outline that is clearly visible as a dark shadow when the egg is twirled.

29. **Slightly Enlarged and Slightly Flattened (B)**—A yolk in which the yolk membranes and tissues have weakened somewhat causing it to appear slightly enlarged and flattened.

30. **Enlarged and Flattened (C)**—A yolk in which the yolk membranes and tissues have weakened and moisture has been absorbed from the white to such an extent that it appears definitely enlarged and flat.

31. **Free from Defects (AA)**—A yolk that shows no spots or areas on its surface indicating the presence of germ development or other defects.

32. **Practically Free from Defects (A)**—A yolk that shows no germ development but may show other very slight defects on its surface.

33. **Definite but Not Serious Defects (B)**—A yolk that may show definite spots or areas on its surface but with only slight indication of germ development or other pronounced or serious defects.

34. **Other Serious Defects (C)**—A yolk that shows well developed spots or areas and other serious defects, such as olive yolks, which do not render the egg inedible.

35. **Clearly Visible Germ Development (C)**—A development of the germ spot on the yolk of a fertile egg that has progressed to a point where it is plainly visible as a definite circular area or spot with no blood in evidence.

36. **Blood Due to Germ Development (Inedible)**—Blood caused by development of the germ in a fertile egg to the point where it is visible as definite lines or blood ring. Such eggs are classified as inedible.

General Terms

37. **Loss**—Eggs that are inedible, smashed, broken so that contents are leaking, contaminated, or containing bloody whites, large blood spots, large unsightly meat spots, or other foreign material are classed as loss.

38. Inedible Eggs—Under the Food, Drug, and Cosmetic Act, eggs that are filthy, putrid, or decomposed, or otherwise unfit for food in whole or in part, are adulterated. Eggs of the following descriptions are classed as inedible: black rots, white rots, mixed rots (addled eggs), sour eggs, eggs with green whites, eggs with stuck yolks, moldy eggs, musty eggs, eggs showing blood rings, eggs containing embryo chicks (at or beyond the blood ring stage), and any other eggs that are filthy, decomposed, or putrid.

SUMMARY OF U. S. STANDARDS FOR SHELL EGGS

(Figure after each descriptive term refers to the definition of the term on pages 9 to 12.)

SPECIFICATIONS FOR EACH QUALITY FACTOR				
Quality Factor	AA Quality	A Quality	B Quality	C Quality
Shell	Clean (1) Unbroken (4) Practically normal (7)	Clean (1) Unbroken (4) Practically normal (7)	Clean (1) Unbroken (4) May be slightly abnormal (8)	Clean (1) Unbroken (4) May be abnormal (9)
Air Cell	$\frac{1}{8}$ inch or less in depth (10) Practically regular (11)	$\frac{1}{4}$ inch or less in depth (10) Practically regular (11)	$\frac{3}{8}$ inch or less in depth (10) May show movement not over $\frac{3}{8}$ inch (12) If not over $\frac{1}{4}$ inch, may be free (13)	May be over $\frac{3}{8}$ inch in depth (10) May be free or bubbly (13) (14)
White	Clear (15) Firm (16)	Clear (15) May be reasonably firm (17)	Clear (15) May be slightly weak (18)	Clear (15) May be weak and watery (19) Small blood clots or spots may be present (20)
Yolk	Well centered (22) Outline slightly defined (25) Free from defects (31)	May be fairly well centered (23) Outline may be fairly well defined (26) Practically free from defects (32)	May be off center (24) Outline may be well defined (27) May be slightly enlarged and flattened (29) Definite but not serious defects (33)	May be off center (24) Outline may be plainly visible (28) May be enlarged and flattened (30) May show clearly visible germ development but no blood (35) May show other serious defects (34)

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