

# GRAIN INSPECTION HANDBOOK

## BOOK II, CHAPTER 13

### WHEAT



CHAPTER 13

WHEAT

<b>Section Number</b>	<b>Section</b>	<b>Page Number</b>
13.1	GENERAL INFORMATION	13-1
13.2	GRADES AND GRADE REQUIREMENTS	13-1
13.3	GRADE DESIGNATIONS	13-2
13.4	SPECIAL GRADES	13-3
13.5	OPTIONAL GRADE DESIGNATION	13-4
13.6	BASIS OF DETERMINATION	13-4
13.7	DEFINITION OF WHEAT	13-6
13.8	HEATING	13-6
13.9	ODOR	13-7
13.10	MOISTURE	13-8
13.11	GARLICKY WHEAT	13-8
13.12	INFESTED WHEAT	13-9
13.13	DISTINCTLY LOW QUALITY	13-10
13.14	U.S. SAMPLE GRADE CRITERIA	13-11
13.15	DOCKAGE	13-13
13.16	TEST WEIGHT	13-20
13.17	PROCESSING THE WORK SAMPLE	13-20
13.18	ERGOTY WHEAT	13-22
13.19	LIGHT SMUTTY AND SMUTTY WHEAT	13-22
13.20	TREATED WHEAT	13-23
13.21	SHRUNKEN AND BROKEN KERNELS	13-24
13.22	DAMAGED KERNELS	13-25
13.23	HEAT-DAMAGED KERNELS	13-31
13.24	FOREIGN MATERIAL	13-32
13.25	DEFECTS	13-32
13.26	CONTRASTING CLASSES	13-33
13.27	WHEAT OF OTHER CLASSES	13-33
13.28	CLASS	13-34
13.29	SUBCLASS	13-37
13.30	OFFICIAL CRITERIA	13-38

### **Tables/Charts**

Table No. 1	Grades and Grade Requirements – Wheat	13-2
Table No. 2	Basis of Determination	13-5
Table No. 3	Odor Classification Examples	13-7
Table No. 4	Insect Infestation	13-10
Table No. 5	U.S. Sample Grade Criteria	13-12
Table No. 6	Approximate Analytical Portion Sizes	13-22
Table No. 7	Insect-Damaged Kernel Analysis	13-27
Table No. 8	Contrasting Classes of Wheat	13-33
Chart 1	Procedure for Determining Dockage	13-14
Chart 2	Dividing the Work Sample	13-21

### 13.1 GENERAL INFORMATION

- a. All quantities referenced in this chapter are approximate unless otherwise specified.
- b. Use an approved divider to obtain subportions of a sample for analysis unless otherwise specified.
- c. If an approved mechanical shaker is unavailable, inspectors may handsieve the sample. When handsieving, hold the sieve level in both hands with elbows close to the sides. In a steady motion, move the sieve from left to right approximately 10 inches and then return from right to left. Repeat this motion 30 times.
- d. For specific Visual Reference Images, see W-1.0 – W-9.1.
- e. Official inspection personnel shall document inspection information during sampling and grading. See book IV, chapter 2.

The inspection process provides various factor information used to determine grade and to provide further information on the condition or quality of wheat. Each section of this chapter provides details on recording factor information. If requested by the applicant for inspection, additional information may be provided (e.g., an exact count on stones in addition to the percentage by weight, a percentage for a specific type of damage, etc.).

### 13.2 GRADES AND GRADE REQUIREMENTS

Wheat is divided into eight classes based on color and kernel and varietal characteristics. The eight classes are: Hard Red Spring wheat, Hard Red Winter wheat, Soft Red Winter wheat, Durum wheat, Hard White wheat, Soft White wheat, Unclassed wheat, and Mixed wheat. The classes Hard Red Spring wheat, Durum wheat, and Soft White wheat are further divided into subclasses. Each class and subclass is divided into five U.S. numerical grades and U.S. Sample Grade. Special grades are provided to emphasize special qualities or conditions affecting the value of wheat and are added to and made a part of the grade designation. Special grades do not affect the numerical or sample grade designation.

**TABLE NO. 1 – GRADES AND GRADE REQUIREMENTS – WHEAT**

Grade	Minimum Limits of -		Maximum Limits of -						
	Test Weight per bushel		Damaged Kernels				Wheat of other classes <u>2/</u>		
	Hard Red Spring Wheat or White Club Wheat (pounds)	All other classes and subclasses (pounds)	Heat damage (part of total) (percent)	Total (percent)	Foreign material (percent)	Shrunken and broken kernels (percent)	Defects <u>1/</u> (percent)	Contrasting classes (percent)	Total <u>3/</u> (percent)
U.S. No. 1	58.0	60.0	0.2	2.0	0.4	3.0	3.0	1.0	3.0
U.S. No. 2	57.0	58.0	0.2	4.0	0.7	5.0	5.0	2.0	5.0
U.S. No. 3	55.0	56.0	0.5	7.0	1.3	8.0	8.0	3.0	10.0
U.S. No. 4	53.0	54.0	1.0	10.0	3.0	12.0	12.0	10.0	10.0
U.S. No. 5	50.0	51.0	3.0	15.0	5.0	20.0	20.0	10.0	10.0

U.S. Sample Grade:

U.S. Sample Grade is wheat that:

- Does not meet the requirements for grades U.S. No.1, 2, 3, 4, or 5; or
- Contains 4 or more stones or any number of stones which have an aggregate weight in excess of 0.1 percent of the sample weight, 1 or more pieces of glass, 3 or more crotalaria seeds (*Crotalaria* spp.), 2 or more castor beans (*Ricinus communis* L.), 4 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), 2 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth per 1,000 grams of wheat; or
- Contains 5 or more animal filth, castor beans, crotalaria seeds, glass, stones, or unknown foreign substance(s) in any combination; or
- Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
- Is heating or otherwise of distinctly low quality.
- Contains more than 31 insect-damaged kernels in 100 grams.

1/ Defects include damaged kernels (total), foreign material, and shrunken and broken kernels. The sum of these three factors may not exceed the limit for defects for each numerical grade.

2/ Unclassed wheat of any grade may contain not more than 10.0 percent of wheat of other classes.

3/ Includes contrasting classes.

Grades and Grade Requirements for Mixed Wheat. Grade Mixed wheat according to the U.S. numerical and U.S. Sample Grade requirements of the predominating class in the mixture. Disregard wheat of other classes.

**13.3 GRADE DESIGNATIONS**

After completing the analysis, compare the results with the limits for each grade factor specified in table 1. Use the following guidelines when assigning grades.

- The letters "U.S.";
- The abbreviation "No." and the number of the grade or the words "Sample Grade";

- c. The words "or better" when applicable;
- d. The subclass or, in the case of Hard Red Winter wheat, Hard White wheat, Mixed wheat, Soft Red Winter wheat, and Unclassed wheat, the class;
- e. The applicable special grade in alphabetical order except for treated wheat. The grade designation for treated wheat includes, following the class or subclass and any special grade designations, the word "Treated" followed by a statement indicating the kind of treatment (e.g., scoured, limed, washed, sulfured, etc.); and
- f. The word "Dockage" and the percentage thereof.

In addition, include the following in the "Remarks" section of the certificate:

- a. For Western White wheat, the name and percentage of White Club wheat.
- b. For Unclassed wheat, the color or other characteristics which describe the wheat, together with the percentage thereof.
- c. For Mixed wheat, the name and percentage of the classes that comprise the mixture in the order of predominance.
- d. When applicable, the percentage of protein.

#### 13.4 SPECIAL GRADES

Special grades draw attention to unusual conditions in grain and are made part of the grade designation. Definitions and examples of the designations for special grades in wheat are:

- a. Ergoty Wheat. Wheat that contains more than 0.05 percent of ergot.  
Example: U.S. No. 2 Dark Northern Spring Wheat, Ergoty, Dockage 0.1%
- b. Garlicky Wheat. Wheat that contains in a 1,000-gram portion more than two green garlic bulblets or an equivalent quantity of dry or partly dry bulblets.  
Example: U.S. No. 2 Soft Red Winter Wheat, Garlicky, Dockage 0.9%

- c. Infested Wheat. Wheat that is infested with live weevils or other live insects injurious to stored grain.

Example: U.S. No. 2 Hard Red Winter Wheat, Infested, Dockage 0.0%

- d. Light Smutty Wheat. Wheat that has an unmistakable odor of smut or which contains, in a 250-gram portion, smut balls, portions of smut balls, or spores of smut in excess of a quantity equal to 5 smut balls, but not in excess of a quantity equal to 30 smut balls of average size.

Example: U.S. No. 3 Hard Red Winter Wheat, Light Smutty, Dockage 1.7%

- e. Smutty Wheat. Wheat that contains in a 250-gram portion, smut balls, portions of smut balls, or spores of smut in excess of a quantity equal to 30 smut balls of average size.

Example: U.S. No. 3 Northern Spring Wheat, Smutty, Dockage 0.5%

- f. Treated Wheat. Wheat that has been scoured, limed, washed, sulfured, or treated in such a manner that the true quality is not reflected by either the numerical grades or the U.S. Sample Grade designation alone.

Example: U.S. No. 1 Amber Durum Wheat, Treated (limed), Dockage 0.2%

### **13.5 OPTIONAL GRADE DESIGNATION**

The Official U.S. Standards for Grain provide for an optional grade designation, commonly referred to as "or better." Upon the request of an applicant, wheat may be certified as U.S. No. 2 or better, U.S. No. 3 or better, etc. An "or better" grade designation cannot be applied to a U.S. No. 1 grade designation.

Example: U.S. No. 2 or better Hard Red Winter Wheat

### **13.6 BASIS OF DETERMINATION**

*Distinctly Low Quality. The determination of distinctly low quality is made on the basis of the lot as a whole at the time of sampling when a condition exists that may or may not appear in the representative sample and/or the sample as a whole.*

*Certain Quality Determinations. Each determination of rodent pellets, bird droppings, other animal filth, broken glass, castor beans, cockleburrs, crotalaria seeds, dockage, garlic, live insect infestation, large stones, moisture, temperature, and unknown foreign substance(s), and a commonly recognized harmful or toxic substance(s) is made on the basis of the sample as a whole. When a condition exists that may not appear in the representative sample, the determination may be made on the basis of the lot as a whole at the time of sampling according to procedures prescribed in FGIS instructions.*

*All Other Determinations. Each determination of heat-damaged kernels, damaged kernels, foreign material, wheat of other classes, contrasting classes, and subclasses is made on the basis of the grain when free from dockage and shrunken and broken kernels. Other determinations not specifically provided for under the General Provisions are made on the basis of the grain when free from dockage, except the determination of odor is made on either the basis of the grain as a whole or the grain when free from dockage.*

**TABLE NO. 2**

<b>BASIS OF DETERMINATION</b>			
Lot as a Whole	Factors Determined Before the Removal of Dockage	Factors Determined After the Removal of Dockage	Factors Determined After the Removal of Dockage and Shrunken and Broken Kernels
Distinctly low quality Heating Infested Odor	Distinctly low quality Garlicky Heating Infested Kind of grain Moisture Odor Odor (smut) Other unusual conditions U.S. Sample Grade factors	Ergot Kind of grain Odor Protein Shrunken and broken kernels Smut Stones Test weight Treated	Class Contrasting classes Damaged kernels (total) Foreign material Heat-damaged kernels Subclass Wheat of other classes

The following sections of this chapter are arranged in a sequence typically followed in the inspection and grading of wheat.

## 13.7 DEFINITION OF WHEAT

Wheat is defined as:

*Grain that, before the removal of dockage, consists of 50 percent or more common wheat (Triticum aestivum L.), Club wheat (T. compactum Host.), and Durum wheat (T. durum Desf.) and not more than 10 percent of other grains for which standards have been established under the United States Grain Standards Act and that, after the removal of dockage, contains 50 percent or more of whole kernels of one or more of these wheats.*

Whole kernels are kernels with three-fourths or more of the kernel present. Other grains for which standards have been established are barley, canola, corn, flaxseed, oats, rye, sorghum, soybeans, sunflower seed, and triticale.

**Basis of Determination.** Normally, a visual appraisal of the sample is sufficient to determine if it meets the definition of wheat. If an analysis is necessary, make the determination on a representative portion of 50 grams. Determine the percentage of wheat and other grains before the removal of dockage. Determine the percentage of whole kernels after the removal of dockage.

If the sample does not meet the definition of wheat, examine it further to determine if it is:

- a. Another grain for which standards have been established or
- b. Not standardized grain. No further analysis is necessary on a sample designated as not standardized grain unless a specific factor test is requested.

## 13.8 HEATING

Wheat developing a high temperature from excessive respiration is considered heating. Heating wheat, in its final stages, will usually have a sour or musty odor. Care should be taken not to confuse wheat that is heating with wheat that is warm and moist because of storage in bins, railcars, or other containers during hot weather.

**Basis of Determination.** Determine heating on evidence obtained at the time of sampling.

**Certification.** Grade heating wheat as U.S. Sample Grade and record the word "Heating" in the "Remarks" section of the certificate.

**13.9 ODOR**

**Basis of Determination.** Determine odor on evidence obtained at the time of sampling or on the sample either before or after the removal of dockage.

**TABLE NO. 3**

<b>ODOR CLASSIFICATION EXAMPLES</b>		
Sour	Musty	Commercially Objectionable Foreign Odors
Boot Fermenting Insect (acid) Pigpen	Ground Insect Moldy	Animal hides Decaying animal and vegetable matter Fertilizer Fumigant Insecticide Oil products Skunk Smoke Strong weed

**Commercially Objectionable Foreign Odors.** Commercially objectionable foreign odors are odors, except smut and garlic odors, foreign to grain that render it unfit for normal commercial usage.

Fumigant or insecticide odors are considered commercially objectionable foreign odors if they linger and do not dissipate. When a sample of wheat contains a fumigant or insecticide odor that prevents a determination as to whether any other odor(s) exists, apply the following guidelines:

- a. Original Inspections. Allow the work portion to aerate in an open container for 4 hours, or less, if the odor dissipates in less time.
- b. Reinspections, Appeal and Board Appeal Inspections. Allow unworked file samples and new samples to aerate in an open container for 4 hours, or less, if the odor dissipates in less time. The 4-hour aeration requirement does not apply when the original work portion was aerated and retained as the final file.

Consider the sample as having a commercially objectionable foreign odor if the fumigant or insecticide odor persists based on the above criteria.

**Final Determination.** The inspector(s) is responsible for making the final determination for all odors. A consensus of experienced inspectors is used, whenever possible, on samples containing marginal odors. The consensus approach is not required if no odor or a distinct odor is detected.

**Certification.** Grade wheat containing a "distinct" musty, sour, or commercially objectionable foreign odor as U.S. Sample Grade. Record the words "Musty," "Sour," or "Commercially Objectionable Foreign Odor" in the "Remarks" section of the certificate.

### 13.10 MOISTURE

*Water content in grain as determined by an approved device according to procedures prescribed in FGIS instructions.*

**Basis of Determination.** Determine moisture before the removal of dockage on a portion of approximately 350 grams.

The procedures for performing a moisture determination using the DICKEY-john Grain Analysis Computer GAC 2100 moisture meter are described in book II, chapter 1, section 1.10.

**Certification.** Record the percent of moisture on the certificate to the nearest tenth percent.

### 13.11 GARLICKY WHEAT

*Wheat that contains in a 1,000-gram portion more than two green garlic bulblets or an equivalent quantity of dry or partly dry bulblets.*

**Basis of Determination.** Determine garlicky before the removal of dockage on a portion of 1,000 grams except in those cases where the garlic bulblet count is in excess of 10 green bulblets. When garlic bulblets are in excess of 10 green bulblets, use a portion of 250 grams. After determining the count of bulblets on the 250-gram portion, multiply the count by 4 to obtain the equivalent number of bulblets in 1,000 grams. (Reference: Visual Reference Image Nos. [OF-13.0](#) and [OF-13.1](#))

Characteristics of Bulblets.

- a. Green garlic bulblets are bulblets which have retained all of their husks intact.
- b. Dry or partly dry garlic bulblets are bulblets which have lost all or part of their husks. Consider bulblets with cracked husks as dry.

**NOTE: Wild onion, sometimes referred to as "crow garlic", is considered as garlic.**

Three dry or partly dry garlic bulblets are equal to one green bulblet.

Garlic bulblets apply in the determination of the special grade "Garlicky" and also function as dockage or foreign material.

**Certification.** When applicable, grade the wheat "Garlicky" in accordance with Section 13.4, Special Grades. Upon request, provide the number of garlic bulblets in whole and/or in decimals to the hundredths position (e.g.,  $1/3 = 0.33$ ,  $2/3 = 0.67$ ).

### 13.12 INFESTED WHEAT

Infested wheat is wheat that is infested with live weevils or other live insects injurious to stored grain.

The presence of any live weevil or other live insect injurious to stored grain indicates the probability of infestation and warns that the wheat must be carefully examined to determine if it is infested. In such cases, examine the work and file sample before reaching a conclusion as to whether or not the wheat is infested. Do not examine the file sample if the work portion is insect free.

Live weevils shall include rice weevils, granary weevils, maize weevils, cowpea weevils, and lesser grain borers. Other live insects injurious to stored grain shall include grain beetles, grain moths, and larvae. (See chapter 1, Section 1.2, Visual Grading Aids.)

**Basis of Determination.** Determine infestation on the lot as a whole and/or the sample as a whole. For insect tolerances, see table No. 4.

**TABLE NO. 4**

<b>INSECT INFESTATION</b>		
<i>Samples meeting or exceeding any one of these tolerances are infested: 2 lw, or 1 lw + 1 oli, or 2 oli</i>		
1,000-gram representative sample <u>1/</u> (+ file sample if needed)	Lot as a Whole (Stationary)	Online Sample (In-Motion) <u>2/</u>
Submitted samples Probed lots D/T sampled land carriers	Probed lots (at time of sampling)	Railcars under the Cu-sum Subsamples for Sacked Grain lots Components for Bargetlots <u>3/</u> Components for Shiplots <u>3/</u>
<p><u>1/</u> Examine work portion and file sample if necessary. Do not examine file sample if work portion is insect free.</p> <p><u>2/</u> Minimum sampling rate is 500 grams per 2,000 bushels.</p> <p><u>3/</u> Minimum component size is 10,000 bushels.</p> <p><u>Key:</u> lw = live weevil, oli = other live insects injurious to stored grain</p>		

**Certification.** When applicable, grade the wheat "Infested" in accordance with Section 13.4, Special Grades.

### 13.13 DISTINCTLY LOW QUALITY

Consider wheat distinctly low quality when it is obviously of inferior quality and the existing grade factors or guidelines do not accurately reflect the inferior condition.

**Basis of Determination.** Use all available information to determine whether the wheat is of distinctly low quality. This includes a general examination of the wheat during sampling and an analysis of the obtained sample(s).

Large Debris. Wheat containing two or more stones, pieces of glass, pieces of concrete, or other pieces of wreckage or debris which are visible to the sampler but are too large to enter the sampling device is considered distinctly low quality.

Other Unusual Conditions. Wheat that is obviously affected by other unusual conditions which adversely affect its quality but which cannot be properly graded by use of the grading factors specified or defined in the standards is considered distinctly low quality.

Wheat suspected of containing diatomaceous earth is considered distinctly low quality unless the applicant specifically requests an examination to verify the presence of diatomaceous earth. If the laboratory examination verifies that the wheat contains diatomaceous earth, then the wheat is not considered distinctly low quality due to diatomaceous earth. Refer to Program Directive 9180.49, Grading and Certification of Grain Containing Diatomaceous Earth and Silica Gel, for additional information regarding the testing of wheat for diatomaceous earth.

**Certification.** Grade distinctly low quality wheat as U.S. Sample Grade. Record the reason(s) why on the certificate.

### **13.14 U.S. SAMPLE GRADE CRITERIA**

**Basis of Determination.** Determine U.S. Sample Grade criteria, except stones, before the removal of dockage based on a work portion of 1,000 - 1,050 grams. Table No. 5 shows the criteria and corresponding Visual Reference Images, tolerance limits, and the appropriate basis of determination. Consider identifiable pieces of grain, processed grain products (e.g., soybean meal, sorghum grits, corn meal, bulgur, etc.), or feed pellets in grain as foreign material. Unidentifiable materials or material unrelated to grain shall function as "unknown foreign substance." Kernels of wheat discolored by treatment with a fungicide or similar substance (pink wheat) are considered as being discolored by an unknown foreign substance.

**TABLE NO. 5**

<b>U.S. SAMPLE GRADE CRITERIA</b>			
<i>Criteria</i>	<i>Visual Reference Image</i>	Number/Weight <u>1/</u>	
		<i>Sample Basis</i>	Lot Basis <u>2/</u>
Any numerical grading factor		Excess of limit except wocl for U.S. No. 5	N/A
Animal filth	<a href="#">OF-1.0</a>	2 or more	N/A
Castor beans	<a href="#">OF-3.0</a>	2 or more	N/A
Crotalaria seeds	<a href="#">OF-8.0</a>	3 or more	N/A
Glass		1 or more	N/A
Insect-damaged kernels		32 or more	
Odor		Presence	N/A
Stones		4 or more or any number in excess of 0.1% by weight	N/A
Unknown foreign substances <u>3/</u> <u>4/</u>	<a href="#">OF-31.0</a>	4 or more	N/A
Heating		Presence	Presence
Total other material <u>5/</u>		5 or more	N/A
Large debris *		N/A	2 or more
Other unusual conditions *		Presence	Presence

1/ Record count factors to the nearest whole number.

2/ The entire sample of a submitted sample is considered as the lot.

3/ Consider feed pellets and processed grain products as foreign material, not unknown foreign substance.

4/ Kernels of wheat discolored by treatment with a fungicide or similar substance (pink wheat) are considered as being discolored by an unknown foreign substance (Visual reference Image No. [\(W\) OF-17.0](#))

5/ Includes any combination of animal filth, castor beans, crotalaria seeds, glass, stones, and unknown foreign substances.

\* For Distinctly Low Quality, see section 13.13

**Certification.** Grade wheat U.S. Sample Grade when one or more of the limits in table 5 are observed. Record the reason(s) why in the "Remarks" section of the certificate. Record count factors to the nearest whole number.

### 13.15 DOCKAGE

*All matter other than wheat that can be removed from the original sample by use of an approved device according to procedures prescribed in FGIS instructions. Also, underdeveloped, shriveled, and small pieces of wheat kernels removed in properly separating the material other than wheat and that cannot be recovered by properly rescreening or recleaning.*

**Basis of Determination.** Determine dockage on a portion of 1,000 to 1,050 grams of the original sample.

When performing the dockage determination, check the material that passes over the riddle for threshed or unthreshed kernels and sprouted kernels of wheat.

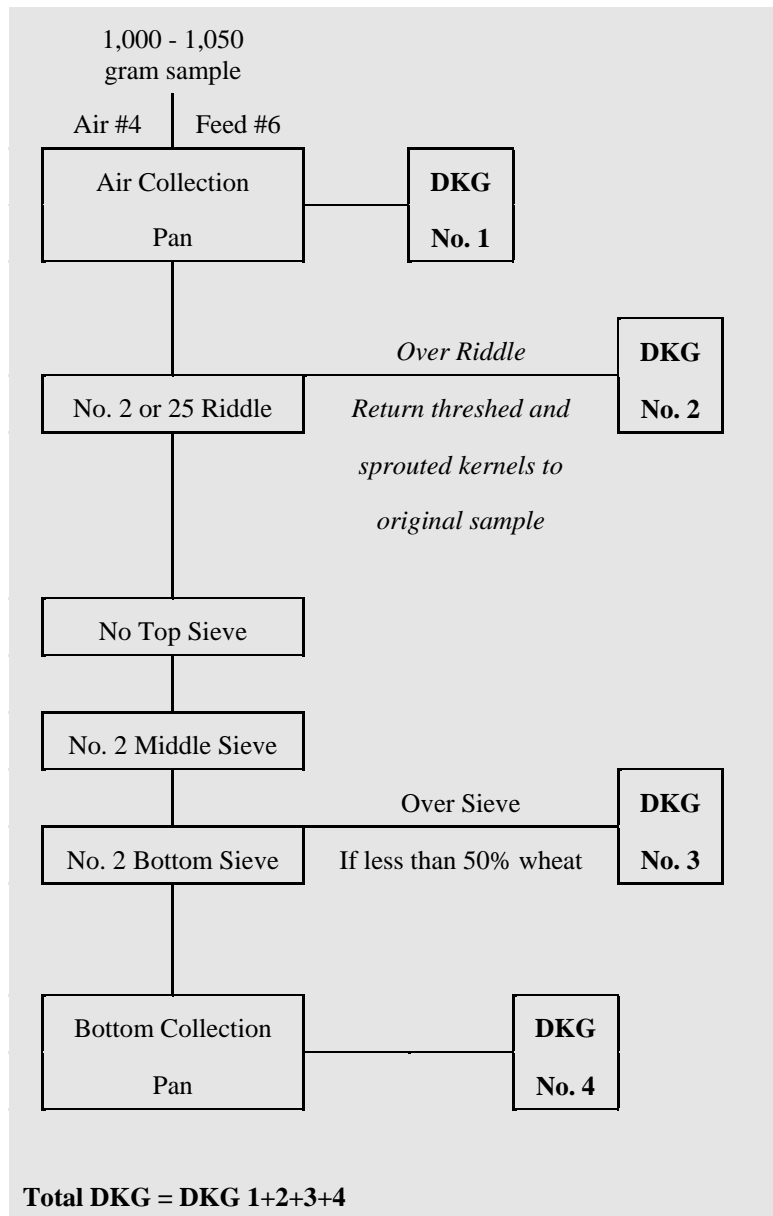
Threshed and sprouted kernels that pass over the riddle are not considered dockage. Return all such kernels to the dockage-free sample. Threshed kernels of wheat are kernels with either no glumes attached or not more than one glume attached.

Unthreshed kernels that pass over the riddle are considered dockage. Unthreshed kernels are kernels with more than one glume attached. (Reference: Visual Reference Image No. [\(W\) OF-30.0](#))

**CHART 1 - PROCEDURE FOR DETERMINING DOCKAGE**

**Carter Dockage Tester Setup**

- a. Set air control on 4 and the feed control on 6.
- b. In the riddle carriage, use the No. 2 plastic riddle for HRW, HRS, SRW, HDWH, and SWH. Use the No. 25 plastic riddle for DU. For Mixed wheat, use the No. 2 riddle unless DU is the predominant class. If Durum wheat is predominant, use the No. 25 riddle. For Unclassed wheat, use the riddle size applicable for the kernel size. If kernels are approximately the size of Durum wheat kernels, use the No. 25 riddle; otherwise use the No. 2 riddle.
- c. Use no sieve in the top sieve carriage.
- d. Insert a No. 2 sieve in the middle and bottom sieve carriages.
- e. Start Carter Dockage Tester and pour sample into feed hopper.
- f. Aspirated material in the air collection pan is dockage.
- g. Material over the riddle, except for threshed and sprouted kernels, is dockage. Threshed kernels do not have more than one glume attached (Visual Reference Image No. [\(W\) OF-30.0](#)). Place threshed and sprouted kernels in the cleaned wheat (over middle sieve).
- h. Material passing over the bottom sieve is dockage if it contains less than 50 percent (by weight) of wheat kernels. If 50 percent or more of wheat kernels pass over the bottom sieve, return the material to the cleaned wheat.
- i. Material in the bottom collection pan is dockage.



To avoid repeating operations, check the dockage for garlic bulblets, infestation, and U.S. Sample Grade factors (except stones). (See sections 13.11, 13.12, and 13.14.)

**Certification.** Record the word "Dockage" and the percentage to the nearest tenth percent on the work record and the certificate. If the dockage is less than one-tenth percent, report as "Dockage 0.0%."

Additional Dockage Procedures. When wheat contains wild buckwheat and similar seeds, cob joints and chaff, chess or similar seeds, canola or flaxseed, determine dockage as follows:

- a. Wheat Containing Wild Buckwheat or Similar Seeds. If it appears that the sample contains more than 0.5 percent of wild buckwheat, yellow or green foxtail, millet, wild mustard, or similar seeds, analyze a 50-gram portion cut from the original sample before the removal of dockage. If the representative portion contains more than 0.5 percent of wild buckwheat, yellow or green foxtail, millet, wild mustard, or other similar sized seeds, proceed as follows: (Reference: Visual Reference Image No. [OF-27.0](#))
  - (1) Set up the Carter Dockage Tester as follows:
    - (a) Use the appropriate riddle (see page 13-15);
    - (b) Use no sieve in the top sieve carriage;
    - (c) Insert a No. 8 sieve in the middle sieve carriage; and
    - (d) Insert a No. 2 sieve in the bottom sieve carriage.
  - (2) After removing the dockage, sieve 50 grams of the material that passed over the No. 2 sieve (bottom sieve collection pan) by placing it on the upper edge of a 5/64 equilateral triangular hand sieve. Hold the sieve at a 10 to 20-degree angle and work the material down over the sieve with a gentle side-to-side motion.
  - (3) Repeat "Step 2" on additional 50-gram portions until all the material in the bottom collection pan has been sieved.
  - (4) If the material remaining on top of the hand sieve consists of 50 percent or more, by weight, of wheat kernels, return it to the cleaned wheat. Otherwise, add it to the dockage.
  - (5) Examine the material that passed through the hand sieve. If the material consists of 50 percent or more, by weight, of wheat kernels, repeat the hand sieving process on 50-gram portions of all the material that passed through the hand sieve. Do not perform this hand sieving process more than twice.

- (6) All material that passed through the hand sieve is dockage.
- (7) Dockage will then consist of:
  - (a) The material removed by the aspirator (air collection pan).
  - (b) The coarse material, except for threshed and sprouted kernels of wheat, that passed over the riddle (riddle collection pan).
  - (c) The material that passed through the No. 2 sieve (bottom collection pan).
  - (d) The material that passed through the hand sieve.
  - (e) The material that remained on the hand sieve when the material consists of less than 50 percent, by weight, of wheat.
- b. Wheat Containing Chess or Similar Seeds. If it appears that the sample contains more than 0.5 percent of chess or similar seeds, analyze a 50-gram portion cut from the original sample before the removal of dockage. If the representative portion contains more than 0.5 percent of chess and similar seeds, proceed as follows: (Reference Visual Reference Image No. [OF-4.0](#))
  - (1) Set up the Carter Dockage Tester as follows:
    - (a) Use the appropriate riddle (see page 13-15);
    - (b) Insert a No. 9 combination large chess swaged-hole sieve in the top sieve carriage;
    - (c) Use no sieve in the middle sieve carriage; and
    - (d) Insert a No. 2 sieve in the bottom sieve carriage.
  - (2) When the wheat has cleared the No. 9 sieve, clean the sieve by sliding it in and out of the carriage several times while the machine is operating. DO NOT collect material until the sieve has been cleaned.
  - (3) Examine the wheat that passed over the No. 9 sieve (top collection pan). If it contains more than 0.5 percent of chess and similar seeds, repeat the operation one more time.

- (4) Examine the material that passed over the No. 2 sieve (bottom sieve collection pan). This material may be reduced in size to a representative portion of **not less** than 8 grams for analysis. If it consists of 50 percent or more, by weight, of whole or broken kernels of wheat, recombine the entire sample and determine dockage using the normal dockage procedures.
  - (5) When the material that passed over the No. 2 sieve consists of less than 50 percent of whole or broken kernels of wheat, the dockage will consist of:
    - (a) The material removed by the aspirator (air collection pan);
    - (b) The coarse material, except threshed and sprouted kernels of wheat, that passed over the riddle (riddle collection pan);
    - (c) The material that passed through the No. 2 sieve (bottom collection pan); and
    - (d) The material that passed over the No. 2 sieve (bottom sieve collection pan).
- c. Wheat Containing Cob Joints and Chaff. If it appears that the sample contains more than 0.5 percent of cob joints and chaff, analyze a 50-gram portion cut from the original sample after the removal of dockage. If the dockage-free representative portion contains more than 0.5 percent of cob joints and chaff, proceed as follows: (Reference: Visual Reference Image No. [OF-5.0](#))
- (1) Set up the Carter Dockage Tester as follows:
    - (a) Use the appropriate riddle (see page 13-15);
    - (b) Insert a No. 8 sieve in the top sieve carriage;
    - (c) Use no sieve in the middle sieve carriage; and
    - (d) Insert a No. 2 sieve in the bottom sieve carriage.
  - (2) Run the dockage-free representative portion through the Carter dockage tester.

- (3) Place 50 grams of the material that passed over the No. 2 sieve (bottom sieve collection pan) on the upper edge of a 5/64 equilateral triangular hand sieve. Hold the sieve at a 10 to 20-degree angle and work the material down over the sieve with a gentle side-to-side motion.
  - (4) Repeat "Step 3" on additional 50-gram portions until all the material has been sieved.
  - (5) If the material remaining on top of the hand sieve consists of 50 percent or more, by weight, of whole or broken kernels, return it to the cleaned wheat. Otherwise, add it to the dockage.
  - (6) Examine the material that passed through the hand sieve. If the material consists of 50 percent or more, by weight, of whole or broken kernels of wheat, return it to the cleaned wheat. Otherwise, add it to the dockage.
  - (7) Dockage will then consist of:
    - (a) The material removed by the aspirator (air collection pan);
    - (b) The coarse material, except threshed and sprouted kernels of wheat, that passed over the riddle (riddle collection pan);
    - (c) The material that passed through the No. 2 sieve (bottom collection pan);
    - (d) The material that passed through the hand sieve (see "Step 6" above); and
    - (e) Material that remained on the hand sieve when the material consists of less than 50 percent, by weight, of whole or broken kernels of wheat.
- d. Wheat Containing Canola, Flaxseed, or Rapeseed: If it appears that the sample contains 0.3 percent or more of canola, flaxseed, or rapeseed, analyze a dockage-free portion of 50 grams. If the representative portion contains 0.3 percent or more of canola, flaxseed, or rapeseed, sieve the entire dockage-free sample. Use the appropriate sieve, a 5/64 triangular-hole sieve for removing canola/rapeseed, a 3/64-inch wide by 3/8-inch long or 3/64-inch wide by 1 1/32-inch long sieve for removing flaxseed as follows:
- (1) Mechanical Sieving Method.

- (a) Mount the sieve and a bottom pan on an approved mechanical sieve shaker.
  - (b) Place one-fourth of the dockage-free portion in the center of the sieve.
  - (c) Set the stroke counter at 30 strokes.
  - (d) Follow the procedures described in Book II, Chapter 1, Section 1.13, Mechanical Sieve Shaker.
  - (e) When the shaker has stopped, return the material lodged in the perforations to the wheat remaining on top of the sieve.
  - (f) Clean the sieve and repeat this procedure with the remaining similar-sized portions.
- (2) Hand-Sieving Method.
- (a) Mount the sieve on a bottom pan.
  - (b) Place one-fourth of the dockage-free sample in the center of the sieve.
  - (c) Hold the sieve level in both hands with elbows close to the sides and the sieve perforations parallel to the direction of movement.
  - (d) In a steady motion, move the sieve from left to right approximately 10 inches and then return from right to left.
  - (e) Repeat this operation 30 times.
  - (f) Return the material lodged in the perforations to the wheat remaining on top of the sieve.
  - (g) Clean the sieve and repeat this procedure with the remaining similar-sized portions.
- (3) If the material which passed through the sieve consists of less than 50 percent, by weight, of whole or broken kernels of wheat, add it to the dockage. If it consists of 50 percent or more, by weight, of whole or broken kernels, recomposite it with the material remaining on top of the sieve.

- 4) Dockage will consist of:
- (a) The material removed by the aspirator (air collection pan);
  - (b) The coarse material, except threshed and sprouted kernels, that passed over the riddle (riddle collection pan);
  - (c) The material that passed through the Number 2 sieve (bottom collection pan); and
  - (d) The material which passed through the hand sieve if it consists of less than 50 percent, by weight, of whole and broken kernels of wheat.

### 13.16 TEST WEIGHT

*The weight per Winchester bushel (2,150.42 cubic inches) as determined using an approved device according to procedures prescribed in FGIS instructions.*

**Basis of Determination.** Determine test weight on a dockage-free portion of sufficient quantity to overflow the kettle.

The procedures for performing the test weight determination and available services are described in book II, chapter 1, section 1.11.

**Certification.** Record test weight results on the work record as displayed on the electronic scale or in whole and tenth pounds to the nearest tenth pound. Record the test weight on the certificate in whole and tenth pounds to the nearest tenth pound. If requested, convert the pounds per bushel (lbs./bu) result to kilograms per hectoliter (kg/hl) using the following formulas: for Durum wheat,  $[1.292 \times \text{lbs./bu}] + 0.630 = \text{kg/hl}$ ; for all other types of wheat,  $[1.292 \times \text{lbs./bu}] + 1.419 = \text{kg/hl}$ . Grade Mixed wheat or Western White wheat based on the predominating class or predominating Soft White wheat subclass in the mixture.

### 13.17 PROCESSING THE WORK SAMPLE

At this point, all tests required to be performed prior to the removal of dockage have been made and the percentage of dockage has been determined. Also, the sample has been test weighed and examined for certain sample grade and special grade factors. Now the work sample is ready to be divided into fractional portions for other determinations required after the removal of dockage. The following chart and table No.6 illustrate how the sample is divided into fractional parts using the Boerner divider.

**CHART 2 - DIVIDING THE WORK SAMPLE**

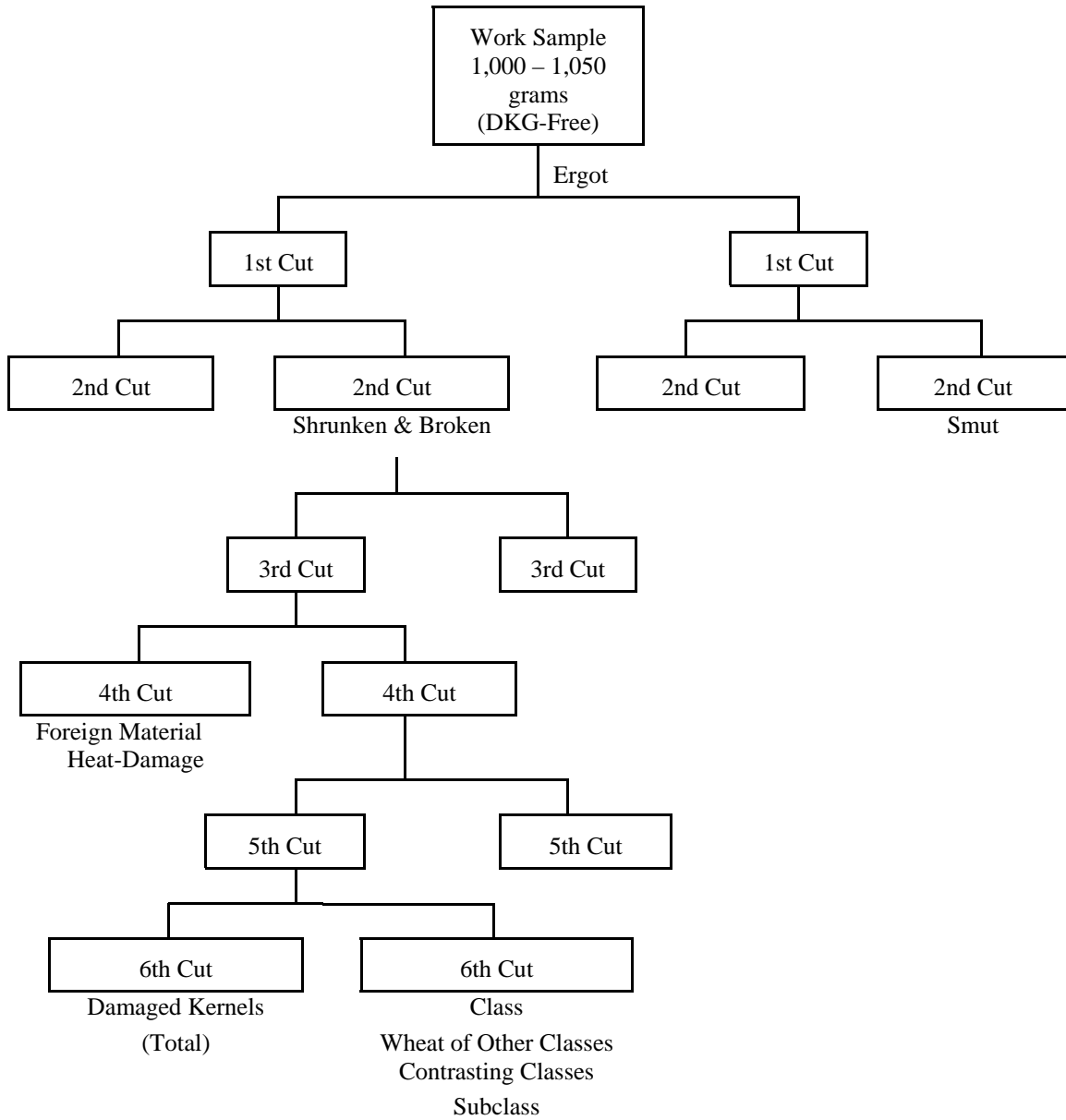


TABLE NO. 6

APPROXIMATE ANALYTICAL PORTION SIZES	
<i>Factors</i>	<i>Grams</i>
Ergot	1,000
Shrunken and broken kernels	250
Smut	250
Class	15
Contrasting classes	15
Damaged kernels (total)	15
Foreign material	50
Heat-damaged kernels	50
Insect-damaged kernels	100
Insect-damaged kernels Stage 1	15
Insect-damaged kernels Stage 2	15
Insect-damaged kernels Stage 3	100 – (Stage 1 + Stage 2)
Subclass	15
Wheat of other classes	15

### 13.18 ERGOTY WHEAT

*Wheat that contains more than 0.05 percent of ergot*

Ergot is a hard, reddish-brown or black grain-like mass of certain parasitic fungi that replaces the kernels of wheat. (Reference: Visual Reference Image No. [OF-12.0](#))

**Basis of Determination.** Determine ergoty on a dockage-free portion of 1,000 grams. Ergot applies in the determination of ergoty and also functions as foreign material.

**Certification.** When applicable, grade the wheat "Ergoty" in accordance with Section 13.4, Special Grades. Upon request, show the percentage of ergot to the nearest hundredth percent on the work record and the certificate.

### 13.19 LIGHT SMUTTY AND SMUTTY WHEAT

Light Smutty. *Wheat that has an unmistakable odor of smut, or which contains, in a 250-gram portion, smut balls, portions of smut balls, or spores of smut in excess of a quantity equal to 5 smut balls, but not in excess of a quantity equal to 30 smut balls of average size.*

Smutty. *Wheat that contains, in a 250-gram portion, smut balls, portions of smut balls, or spores of smut in excess of a quantity equal to 30 smut balls of average size.*

**Basis of Determination.** Determine "Light smutty" on the sample as a whole (odor only) or on a dockage-free portion of 250 grams. Determine "Smutty" on a dockage-free portion of 250 grams. Smut balls apply in the determination of the special grades "Light smutty" or "Smutty" but also function as foreign material.

**Certification.** When applicable, grade the wheat "Light smutty," or "Smutty" in accordance with Section 13.4, Special Grades. Upon request, show the odor (in the case of light smutty) or the number of smut balls.

### 13.20 TREATED WHEAT

*Wheat that has been scoured, limed, washed, sulfured, or treated in such a manner that the true quality is not reflected by either the numerical grades or the U.S. Sample Grade designation alone.*

**Basis of Determination.** Determine treated on the basis of the dockage-free work sample. If at the time of sampling, odor or other conditions indicate that the wheat has been treated, place a portion of the sample in an airtight container for examination in the laboratory.

Three qualities are associated with natural, untreated wheat:

- a. A natural, live, healthy feeling;
- b. A bright, attractive appearance; and
- c. A natural wheat odor.

Any artificial or mechanical process which tends to impair or conceal the true quality of wheat causes wheat to grade treated. Such processes include:

Scoured or Washed. Wheat which has been scoured or washed, in whole or in part, so that the true quality of the wheat is not reflected by either the U.S. numerical or U.S. Sample Grade designation alone, and which meets one or more of the following conditions is considered treated and graded as scoured or washed.

- a. Presents a blistered and/or abraded bran coat appearance as a result of treatment; or
- b. Has a so-called laundry odor or wet smut odor; or
- c. A dull, lifeless appearance or feeling; or
- d. Has the appearance of having been scoured for the purpose of increasing the test weight per bushel.

Sulfured Wheat. Wheat which, in whole or in part, has been bleached with any bleaching agent is considered treated and graded as sulfured.

Limed Wheat. The presence of lime in a sample of wheat (which has not been scoured) is considered as evidence that the lime was added for the purpose of covering up some defect in the wheat. Such wheat is considered treated and graded as limed.

Treatment for Infestation. Wheat which has been treated to exterminate live weevils or other live insects is not considered treated unless the wheat has the characteristics of treated wheat as described above.

**Certification.** When applicable, grade the wheat "Treated," along with the type of treatment, in accordance with Section 13.3, Grade Designations.

### 13.21 SHRUNKEN AND BROKEN KERNELS

*All matter that passes through a 0.064 x 3/8 oblong-hole sieve after sieving according to procedures prescribed in FGIS instructions.*

**Basis of Determination.** Determine shrunken and broken kernels on a dockage-free portion of 250 grams using one of the following methods:

- a. Mechanical Sieving Method.
  - (1) Mount the sieve and the bottom pan on the mechanical sieve shaker.
  - (2) Set the stroke counter for 30 strokes.

- (3) Follow the procedure described in Book II, Chapter 1, Section 1.13, Mechanical Sieve Shaker.
- (4) All material passing through the sieve is considered shrunken and broken kernels. Return the material lodged in the perforations to the wheat which remained on top of the sieve.

b. Hand Sieving Method.

- (1) Mount the sieve on a bottom pan.
- (2) Place the 250-gram portion in the center of the sieve.
- (3) Hold the sieve level in both hands with elbows close to the body and the sieve perforations parallel to the direction of movement.
- (4) In a steady motion, move the sieve from left to right approximately 10 inches and then return from right to left.
- (5) Repeat this operation 30 times.
- (6) All material passing through the sieve is considered shrunken and broken kernels. Return the material lodged in the perforations to the wheat which remained on top of the sieve.

Determine shrunken and broken kernels prior to analyzing the sample for heat-damaged kernels, damaged kernels, foreign material, subclass, wheat of other classes, and contrasting classes.

**Certification.** Record the percentage of shrunken and broken kernels on the certificate to the nearest tenth percent.

### 13.22 DAMAGED KERNELS

*Kernels, pieces of wheat kernels, and other grains that are badly ground-damaged, badly weather-damaged, diseased, frost-damaged, germ-damaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged.*

Special Insect Damage Analysis. To coincide with the Food and Drug Administration's defect action levels, the U.S. Standards for Wheat consider wheat containing 32 or more insect-damaged kernels per 100 grams as U.S. Sample Grade.

**Basis of Determination.**

- a. Damaged Kernels. Determine damaged kernels on a dockage-free and shrunken and broken-free portion of 15 grams.
- b. Insect-Damaged Kernels. Determine insect-damaged kernels on a representative portion of dockage-free and shrunken and broken-free wheat. Insect-damaged kernels are kernels bored or tunneled by insects. (Reference: Visual Reference Image No. [W-9.0](#)) A three-stage inspection process has been developed to eliminate the need to always examine 100 grams. This process involves examining up to a total of 100 grams and applying tolerances calculated to duplicate, as near as possible, the 32 insect-damaged kernels per 100 grams limit. Use the following guidelines and table No. 7 for determining whether wheat contains 32 or more insect-damaged kernels per 100 grams.

**STAGE 1** Examine 15 grams (i.e., damaged kernel portion) for insect-damaged kernels and apply the result to the following guidelines:

<u>Insect-Damaged Kernels</u>	<u>Decision</u>
0 – 1	not sample grade
2 – 8	go to stage 2
9 or more	sample grade

**STAGE 2** Examine a second portion of approximately 15 grams (e.g., classing portion) for insect-damaged kernels and apply the result to the following guidelines:

<u>Insect-Damaged Kernels</u>	<u>Decision</u>
0 – 1	not sample grade
2 – 8	go to stage 3
9 or more	sample grade

**STAGE 3** Examine a third portion for insect-damaged kernels. Determine this portion size by subtracting from 100 grams the combined weight of the work portions used in Stage 1 and Stage 2. Add together the total number of insect-damaged kernels found in all three stages and apply the total to the following guidelines:

<u>Total Insect-Damaged Kernels</u>	<u>Decision</u>
31 or less	not sample grade
32 or more	sample grade

The following table summarizes the three-stage process for easy reference.

**TABLE NO. 7**

<b>INSECT-DAMAGED KERNEL ANALYSIS</b>				
Stage	Sample Size	Damaged Kernel Count		Sample Grade
		Not Sample Grade	Advance to Next Stage	
1	15 g	1	2 – 8	9 or more
2	15 g	1	2 – 8	9 or more
3	100 g – Stages (1 +2)	31 or less *	N/A	32 or more

\* The decision rule in the third stage is based on the total insect-damaged kernels from all three stages.

If an applicant requests that an entire 100 grams be examined and the actual number of insect-damaged kernels reported, inspectors may provide such service.

In general, a kernel of wheat and/or kernels of other grains are considered damaged for inspection and grading purposes only when the damage is distinctly apparent and of such character as to be recognized as damaged for commercial purposes. The general types of damage found in wheat are listed below.

TYPES OF WHEAT DAMAGE.

Black Tip Fungus. Kernels affected by black tip fungus to the extent that the fungus growth is on the germ and extends into the crease of the kernel. (Reference: Visual Reference Image No. [W-1.0](#))

Heat-Damaged Kernels. Kernels materially discolored and damaged by heat. It is necessary, in most cases, to cut the kernels and make a cross-section analysis to determine if the color is reddish-brown, mahogany, or creamy. (Reference: Visual Reference Image Nos. [W-6.0](#) for heat-damaged (Durum) and [W-6.1](#) for heat-damaged (other than Durum))

Blight or Scab. Kernels with a dull, lifeless, and chalky appearance resulting from disease. The germ and crease may also have a moldy appearance. Kernels which are not damaged enough to function as scab damage should be examined further for moldy germs and creases. (Reference: Visual Reference Image No. [W-2.0](#))

Frost-Damaged Kernels (Blistered). Kernels with distinct frost blisters extending around the back of the kernel and into the crease. (Reference: Visual Reference Image No. [W-3.0](#))

Frost-Damaged Kernels (Candied). Kernels that have a distinctly wax-like or candied appearance. Frost-damaged (candied) kernels can be greenish, greenish yellow, brownish, or blackish in color. They frequently have dark stripes showing through the sides of the kernels. (Reference: Visual Reference Image No. [W-3.1](#))

Frost-Damaged Kernels (Flaked). Kernels that have a slightly flaked-off bran coat due to frost. Evidence of frost must be present. Do not confuse flaked-by-frost with kernels which have had the bran coat rubbed off because of handling. (Reference: Visual Reference Image No. [W-3.3](#))

Frost-Damaged Kernels (Discolored Black or Brown). Kernels which are discolored black or brown and/or have a bleached or blistered appearance with dark lines showing through both sides. (Reference: Visual Reference Image No. [W-3.2](#))

Germ-Damaged Kernels (Mold). Kernels which have mold in the germ. The bran coat covering the germ should be removed carefully as scraping the bran coat too deep could remove the mold. (Reference: Visual Reference Image No. [W-4.1](#))

Green Damage (Immature). Kernels which are intense green (immature) and without any yellow appearance. (Reference: Visual Reference Image No. [W-5.0](#))

Mold-like Substance. Whole kernels of wheat which are 50 percent or more covered and pieces of kernels which are discolored and covered with a mold-like substance.

Other Damage. Kernels with cracks, breaks, or chews and which contain mold or fungus. (Reference: Visual Reference Image No. [W-7.0](#))

Sprout-Damaged Kernels. Kernels with the germ end broken open from germination exhibiting sprout or from which the sprouts have been broken off. (Reference: Visual Reference Image Nos. [W-8.0](#) and [W-8.1](#))

Insect-Bored Kernels. Kernels that have been bored or tunneled by insects. (Reference: Visual Reference Image No. [W-9.0](#))

Germ-Damaged Kernels (Sick). Kernels damaged as a result of heat but are not materially discolored. Sick kernels should be scraped very carefully to avoid the loss of discoloration and/or "popping" or removal of the germ. (Reference: Visual Reference Image Nos. [W-4.0](#) and [W-4.2](#))

Bleach Method. The bleaching procedure that uses the S/J mixer may be used as an alternate method for determining germ-damaged wheat. <sup>1/</sup> Prior to bleaching, remove all types of damaged kernels, except germ-damaged, from the representative portion and calculate the percentage. The portion, minus the other types of damaged kernels, can now be bleached. After bleaching, reweigh the bleached portion, remove the germ-damaged kernels, and calculate the percentage.

Bleach Procedure.

- a. Place 15 grams (13.5 to 16.5) of wheat in the mixing jar. If the amount of "other damage" present in the original 15-gram portion reduces the weight of the sample to be bleached below 13.5 grams, an additional 15-gram portion must be analyzed for germ damage. It is not necessary to remove the other damaged kernels from the second portion before bleaching.
- b. Add 15 grams of potassium hydroxide (KOH) pellets.
- c. Add 20 ml of bleach.
- d. Set stirring head on jar, place jar on mixer, and mix for 3 minutes.
- e. Pour the wheat from the mixing jar into the tea strainer and rinse with warm tap water to remove the KOH-bleach solution.
- f. After rising, lightly tap the tea strainer against the edge of the sink to remove the excess water. Gently press the bottom of the tea strainer on a dry paper towel to remove any additional water.
- g. Place the wheat on the dryer sieve and dry for 1 – 1 1/2 minutes or until the kernels are not tacky when picked up with a pair of tweezers.
- h. Remove the wheat from the drying sieve and weigh. The kernels with germ damage should now be readily apparent. If not, it is permissible to carefully lift the bran coat from over the germ area to examine for damage.

---

<sup>1/</sup> For equipment and materials, see section 1.17.

Any deviation from the previously described procedures may result in improperly bleached wheat and could produce a hazardous condition. Further,

- Safety equipment should be worn while the bleach operation is in progress and the lab area thoroughly cleaned once bleaching is complete.
- Accidental spills should first be neutralized with vinegar before the liquid is wiped up.
- Avoid mixing the KOH-bleach solution used in this test with chemical reagents or waste solutions associated with other tests.
- When disposing of the KOH-bleach solution, wash the solution down the sink drain with large quantities of water.

Computing Damaged Kernels. Obtain the percentage of total damaged kernels by adding the percentage of germ-damaged kernels and other damaged kernels. Add the results, as shown in the following example, in hundredths (disregard thousandths) and round the sum to the nearest tenth percent.

- STEP 1.**       $\text{Weight of other type damaged kernels} \div \text{weight of sample before bleaching} \times 100 = \text{percent of other type damaged kernels.}$
- STEP 2.**       $100 \text{ percent} - \text{percentage of other type damaged kernels} \div 100 = \text{change of base factor.}$
- STEP 3.**       $\text{Weight of germ-damaged portion} \div \text{weight of damaged portion after bleaching} \times 100 = \text{percent of germ-damaged kernels.}$
- STEP 4.**       $\text{Percentage of germ-damaged kernels} \times \text{change of base factor} = \text{adjusted percent of germ-damaged kernels.}$
- STEP 5.**       $\text{Percent of other damaged kernels} + \text{adjusted percent of germ-damaged kernels} = \text{percent of damaged kernels.}$

Example

Original weight of damage portion	16.10 grams
Weight of other type damaged kernels	2.40 grams
Sample weight before bleaching	13.70 grams
Sample weight after bleaching	11.95 grams
Weight of germ-damaged kernels	4.33 grams

- STEP 1.**       $(2.40 \div 16.10) \times 100 = 14.90$  percent of other type damaged kernels.
- STEP 2.**       $(100 \text{ percent} - 14.90 \text{ percent}) \div 100 \text{ percent} = 0.85$  change of base factor.
- STEP 3.**       $(4.33 \div 11.95) \times 100 = 36.23$  percent of germ-damaged kernels.
- STEP 4.**       $0.85 \times 36.23 = 30.79$  adjusted percent of germ-damaged kernels.
- STEP 5.**       $14.90 + 30.79 = 45.69$  (rounded to 45.7) percent damaged kernels.

**Certification.**

- a.      Damaged Kernels. Record the percent of damaged kernels on the certificate to the nearest tenth percent.
  
- b.      Insect-Damaged Kernels. When the wheat contains 32 or more insect-damaged kernels per 100 gram tolerance (basis three-stage decision table), grade the wheat as U.S. Sample Grade and record the portion size and the number of insect-damaged kernels found in each stage, as applicable, on the work records. Include in the "Remarks" section of the certificate the statement "Sample Grade due to insect-damaged kernels." If an applicant requests that the number of insect-damaged kernels be reported on the certificate, use the approved statements in book IV, chapter 3, section 3.5.

**13.23 HEAT-DAMAGED KERNELS**

*Kernels, pieces of wheat kernels, and other grains that are materially discolored and damaged by heat that remain in the sample after the removal of dockage and shrunken and broken kernels.*

**Basis of Determination.** Determine heat-damaged kernels on a dockage-free and shrunken and broken-free portion of 50 grams. (Reference: Visual Reference Image Nos. [W-6.0](#) and [W-6.1](#))

**Certification.** Record the percent of heat-damaged kernels on the certificate to the nearest tenth percent.

### 13.24 FOREIGN MATERIAL

*All matter other than wheat that remains in the sample after the removal of dockage and shrunken and broken kernels.*

**Basis of Determination.** Determine foreign material on a dockage-free and shrunken and broken-free portion of 50 grams.

Other grains including oat groats, hullless oats, glumes on threshed or unthreshed kernels, and all matter other than wheat are considered foreign material and removed from the portion. Remove the glumes from the kernels of wheat and add to the foreign material.

**Certification.** Record the percent of foreign material on the certificate to the nearest tenth percent.

### 13.25 DEFECTS

*Damaged kernels, foreign material, and shrunken and broken kernels. The sum of these three factors may not exceed the limit for the factor defects for each numerical grade.*

**Basis of Determination.** Determine defects on the sum of damaged kernels, foreign material, and shrunken and broken kernels.

A percentage for defects cannot be shown when only one or two of the factors defined as defects have been determined. However, when one or two factors are determined and their sum would change the numerical grade, or come close to changing the grade, determine the other factor and record the percentage of defects.

**Certification.** Record the percent of defects on the certificate to the nearest tenth percent.

When the percentages for damaged kernels, shrunken and broken kernels, and foreign material are added together and the total exceeds 100 percent, adjust the percentage of defects by adjusting damaged kernels (total).

### 13.26 CONTRASTING CLASSES

Contrasting classes are defined as:

*(1) Durum wheat, Soft White wheat, and Unclassed wheat in the classes Hard Red Spring wheat and Hard Red Winter wheat; (2) Hard Red Spring wheat, Hard Red Winter wheat, Hard White wheat, Soft Red Winter wheat, Soft White wheat, and Unclassed wheat in the class Durum wheat; (3) Durum wheat and unclassified wheat in the class Soft Red Winter wheat; and (4) Durum wheat, Hard Red Spring wheat, Hard Red Winter wheat, Soft Red Winter wheat, and Unclassed wheat in the classes Hard White wheat and Soft White wheat.*

**Basis of Determination.** Determine contrasting classes on a dockage-free and shrunken and broken-free portion of 15 grams. Use kernel and varietal characteristics when making this determination. (Refer to wheat variety library, section 13.28, and table 8.)

**TABLE NO. 8**

<b>CONTRASTING CLASSES OF WHEAT</b>	
<i>Class</i>	<i>Contrasting Class</i>
Hard Red Winter and Hard Red Spring wheat	Durum, Soft White, and Unclassed wheat
Durum wheat	Hard Red Spring, Hard Red Winter, Soft Red Winter, Hard White, Soft White, and Unclassed wheat
Soft Red Winter wheat	Durum and Unclassed wheat
Hard White and Soft White wheat	Durum, Hard Red Winter, Hard Red Spring, Soft Red Winter, and Unclassed wheat

**Certification.** Record the percent of contrasting classes on the certificate to the nearest tenth percent.

### 13.27 WHEAT OF OTHER CLASSES

Wheat of other classes is the total of all classes of wheat other than the predominating class and which, combined with the predominating class, meets the requirements for any one of the classes except Mixed wheat. Wheat of other classes includes contrasting classes. Wheat of other classes is not applicable to Durum wheat.

**Basis of Determination.** Determine wheat of other classes on a dockage-free and shrunken and broken-free portion of 15 grams. Use kernel and varietal characteristics when making this determination. (Refer to wheat variety library and section 13.28.)

**Certification.** Record the percent of wheat of other classes on the certificate to the nearest tenth percent unless that percentage falls within 10.1 to 10.4 percent. When this occurs, to be consistent with the reporting requirements for Mixed wheat, certify wheat of other classes as 10.0 percent.

### 13.28 CLASS

There are eight classes for wheat: Durum wheat, Hard Red Spring wheat, Hard Red Winter wheat, Soft Red Winter wheat, Hard White wheat, Soft White wheat, Unclassed wheat, and Mixed wheat.

- a. *Durum Wheat. All varieties of white (amber) Durum Wheat. This class is divided into the following three subclasses:*
  - (1) *Hard Amber Durum Wheat. Durum wheat with 75 percent or more of hard and vitreous kernels of amber color.*
  - (2) *Amber Durum Wheat. Durum wheat with 60 percent or more but less than 75 percent of hard and vitreous kernels of amber color.*
  - (3) *Durum Wheat. Durum wheat with less than 60 percent of hard and vitreous kernels of amber color.*
  
- b. *Hard Red Spring Wheat. All varieties of Hard Red Spring wheat. This class is divided into the following three subclasses:*
  - (1) *Dark Northern Spring Wheat. Hard Red Spring wheat with 75 percent or more of dark, hard, and vitreous kernels.*
  - (2) *Northern Spring Wheat. Hard Red Spring wheat with 25 percent or more but less than 75 percent of dark, hard, and vitreous kernels.*
  - (3) *Red Spring Wheat. Hard Red Spring wheat with less than 25 percent of dark, hard, and vitreous kernels.*
  
- c. *Hard Red Winter Wheat. All varieties of Hard Red Winter wheat. There are no subclasses in this class.*
  
- d. *Soft Red Winter Wheat. All varieties of Soft Red Winter wheat. There are no subclasses in this class.*

- e. Hard White Wheat. All hard endosperm white wheat varieties. There are no subclasses in this class.
- f. Soft White Wheat. All soft endosperm white wheat varieties. This class is divided into the following three subclasses:
  - (1) Soft White Wheat. Soft endosperm white wheat varieties which contain not more than 10 percent of White Club wheat.
  - (2) White Club Wheat. Soft endosperm White Club wheat containing not more than 10 percent of other soft white wheats.
  - (3) Western White Wheat. Soft White wheat containing more than 10 percent of White Club wheat and more than 10 percent of other Soft White wheats.
- g. Unclassed Wheat. Any variety of wheat which is not classifiable under other criteria provided in the wheat standards. There are no subclasses in this class. This class includes any wheat which is other than red or white in color.
- h. Mixed Wheat. Any mixture of wheat which consists of less than 90 percent of one class and more than 10 percent of one other class, or a combination of classes which meet the definition of wheat.

**Basis of Determination.** Determine class on a dockage-free and shrunken and broken-free portion of 15 grams. Use kernel and varietal characteristics when making this determination.

Kernel Characteristics. Kernel characteristics include the color, shape, and length of the kernel and the shape of the germ, crease, and brush. Inspection personnel should be familiar with kernel characteristics of all classes of wheat handled in their market.

Varietal Characteristics. Some varieties possess characteristics of two or more classes. Knowledge of distinct varietal characteristics is necessary in making class determinations. Inspection personnel should be familiar with the characteristics of all varieties of wheat handled in their market.

Classification of Recognized Varieties. Hard red varieties of wheat grown during the winter season in Arizona, California, Nevada, New Mexico, and Texas and marketed in these States are classed as Hard Red Winter Wheat.

**Certification.** For Mixed wheat, record the percentages of each class to the nearest whole percent on the certificate in accordance with section 13.3, Grade Designations.

Distinguishing Between White and Red Kernels in Hard or Soft Wheat. To assist in the detection of white and red wheat kernels in samples of Hard or Soft wheat, official personnel may use the commercially available sodium-hydroxide test kit, or the potassium-hydroxide test method developed by FGIS. The tests can serve as a useful tool when samples challenge the normal visual inspection method. Due to the resulting similarity in kernel color after the process is completed and the affect these chemical processes may have on kernel morphology, it is necessary to determine whether a sample contains different classes of white or red wheat prior to performing the test.

- a. Sodium-Hydroxide Test. The sodium-hydroxide turns red wheat a dark red in color, and turns white wheat a straw yellow in color. When using the commercially available test kit, follow the procedures as provided by the test kit manufacturer.
  
- b. Potassium-Hydroxide Test. Follow the procedures outlined below. <sup>1/</sup>
  - (1) Place approximately 15 grams of wheat in a mixing jar.
  - (2) Add 10 grams of potassium-hydroxide (KOH) pellets.
  - (3) Add 40 ml of bleach.
  - (4) Set stirring head on jar, place jar on mixer, and mix for 1 to 1½ minutes.
  - (5) Pour the wheat from the mixing jar into a tea strainer and rinse with warm tap water to remove the sodium-hydroxide/bleach solution.
  - (6) After rinsing, lightly tap the tea strainer against the edge of the sink to remove the excess water. Gently press the bottom of the tea strainer on a dry paper towel to remove any additional water.
  - (7) Place the wheat on a dryer sieve and dry until the kernels are not tacky when picked up with a pair of tweezers.
  - (8) Remove the wheat from the drying sieve and observe the color. White wheat turns a light straw or amber color. Red wheat turns a dark brownish /red color.

**Caution: Too much potassium-hydroxide (step 2) or over mixing (step 4) may remove the bran in red wheat.**

---

<sup>1/</sup> For equipment and materials, see section 1.17.

### 13.29 SUBCLASS

Subclass is determined on Hard Red Spring wheat, Durum wheat, and Soft White wheat.

**Basis of Determination.** When an analysis is necessary, determine subclass on a dockage-free and shrunken and broken-free portion of 15 grams.

Observe the following guidelines when determining dark, hard, and vitreous kernels (DHV); hard and vitreous kernels of amber color (HVAC); and White Club Wheat.

a. Hard Red Spring Wheat.

- (1) Consider hard red spring kernels which are bleached but are hard, or hard and vitreous as DHV.
- (2) Consider hard red spring kernels which have cracks or checks that cause a cloudy or shadowy spot on the kernel but are otherwise dark, hard, and vitreous as DHV.
- (3) Consider kernels of Soft Red Winter wheat and Hard Red Winter wheat as DHV when they are dark, hard, and vitreous in texture.
- (4) Kernels which are yellow or contain a mottled spot (regardless of size), distinctly green immature kernels, severely affected by scab, sprouted, foreign material, and kernels of Hard White wheat, Unclassed wheat, Soft White wheat, and Durum wheat are not considered DHV.

b. Durum Wheat.

- (1) Consider Durum kernels which are bleached but which are hard and vitreous as HVAC.
- (2) Consider Durum kernels which have cracks or checks that cause a cloudy or shadowy spot on the kernel but which are otherwise hard and vitreous as HVAC.
- (3) Kernels with mottled or chalky spots, regardless of size, are **not** considered HVAC.
- (4) Distinctly green immature kernels, kernels affected by scab, sprouted kernels, foreign material, and all other classes of wheat are not considered HVAC.

- c. Soft White Wheat. The percentage of White Club wheat is applicable to all subclasses of Soft White wheat.

**Certification.** Record the subclass and percentage of DHV; HVAC; and White Club wheat kernels on the work record to the nearest tenth percent and on the certificate to nearest whole percent in accordance with Section 13.3, Grade Designations.

### 13.30 OFFICIAL CRITERIA

Factors, such as protein, and single kernel hardness, are considered as "official criteria factors" that are determined upon request and do not affect the grade.

**Basis of Determination.** All such analyses shall be determined in accordance with official procedures established by the Grain Inspection, Packers and Stockyards Administration.

**Certification.** Refer to the appropriate instructions.