

GRAIN INSPECTION HANDBOOK

BOOK II, CHAPTER 9

SORGHUM

CHAPTER 9

SORGHUM

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9.1 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. For specific Visual Reference Images, see S-1.1 - S-9.0.
- d. 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 sorghum. 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.).

9.2 GRADES AND GRADE REQUIREMENTS

Sorghum is divided into four classes: Sorghum, Tannin sorghum, White sorghum, and Mixed sorghum. There are no subclasses in sorghum. Each class is divided into four numerical grades and U.S. Sample Grade. Special grades are provided to emphasize special qualities or conditions affecting the value of sorghum.

Special grades are added to and made a part of the grade designation. They do not affect the numerical or sample grade designation.

**TABLE NO. 1 - GRADES AND GRADE REQUIREMENTS -
SORGHUM**

| Grade | Minimum Limits of - | Maximum Limits of - | | | |
|----------------------|---------------------------------|---------------------|-----------------|--|-----------------|
| | Test weight per bushel (pounds) | Damaged Kernels | | Broken Kernels and foreign material | |
| | | Heat (percent) | Total (percent) | Foreign material (part of total) (percent) | Total (percent) |
| U.S. No. 1 | 57.0 | 0.2 | 2.0 | 1.0 | 3.0 |
| U.S. No. 2 | 55.0 | 0.5 | 5.0 | 2.0 | 6.0 |
| U.S. No. 3 <u>1/</u> | 53.0 | 1.0 | 10.0 | 3.0 | 8.0 |
| U.S. No. 4 | 51.0 | 3.0 | 15.0 | 4.0 | 10.0 |

U.S. Sample Grade:
 U.S. Sample Grade is sorghum that:

- (a) Does not meet the requirements for grades U.S. No.1, 2, 3, or 4; or
- (b) Contains 8 or more stones which have an aggregate weight in excess of 0.2 percent of the sample weight, 2 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), 8 or more cockleburrs (*Xanthium* spp.) or similar seeds singly or in combination, 10 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth in 1,000 grams of sorghum, 11 or more pieces of other material from any combination of animal filth, castor beans, crotalaria seeds, glass, stones, unknown foreign substances, and cockleburrs, or
- (c) Has a musty, sour, or commercially objectionable foreign odor (except smut odor); or
- (d) Is badly weathered, heating or otherwise of distinctly low quality.

1/ Sorghum which is distinctly discolored shall not grade any higher than U.S. No. 3.

9.3 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.

- a. The letters "U.S.",
- b. The abbreviation "No." and the number of the grade or the words "Sample Grade",
- c. The words "or better" when applicable,
- d. The class,
- e. The applicable special grade in alphabetical order, and
- f. The word "Dockage" and the percentage thereof.

When certificating Mixed sorghum, record in the "Results" section of the certificate, the name and percentage of each class in the mixture.

9.4 SPECIAL GRADES

Special grades identify unusual conditions in grain and are part of the grade designation. The sorghum standards include two special grades:

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

Example: U.S. No. 2 Sorghum, Infested

- b. Smutty Sorghum. Sorghum that has kernels covered with smut spores to give a smutty appearance in mass or contains 20 or more smut balls in 100 grams of sorghum.

Example: U.S. No. 3 Sorghum, Smutty

9.5 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, sorghum 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. 3 or better Sorghum

9.6 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, cockleburs, 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 broken kernels and foreign material is made on the basis of the grain when free from dockage. Each determination of class, damaged kernels, heat-damaged kernels, and stones is made on the basis of the grain when free from dockage and that portion of the broken kernels and foreign material that will pass through a 1.98 mm (5/64 inch) triangular-hole sieve. Other determinations not specifically provided for in the General Provisions are made on the basis of the grain as a whole except the determination of odor is made on either the basis of the grain as a whole or the grain when free from dockage, broken kernels, and foreign material removed by the 1.98 mm (5/64 inch) triangular-hole sieve.

TABLE NO. 2

| BASIS OF DETERMINATION | | | |
|---|---|---|---|
| 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, Broken Kernels, and Foreign Material Removed by the 5/64 sieve |
| Distinctly low quality Heating Infested Odor | Distinctly low quality General appearance Infested Kind of grain Moisture Odor Smut Test weight U.S. Sample Grade factors | Broken kernels and foreign material | Class Damaged kernels Heat-damaged kernels Odor Stones |

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

9.7 DEFINITION OF SORGHUM

Sorghum is defined as:

*Grain that, before the removal of dockage, consists of 50 percent or more of whole kernels of sorghum (*Sorghum bicolor* (L.) Moench) excluding nongrain sorghum and not more than 10.0 percent of other grains for which standards have been established under the United States Grain Standards Act.*

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, soybeans, sunflower seed, triticale, and wheat.

Basis of Determination. Normally, a visual appraisal of the sample is sufficient to determine if it meets the definition of sorghum. However, if an analysis is necessary, make the determination before the removal of dockage on a portion of 30 grams.

If the sample does not meet the definition of sorghum, 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.

9.8 HEATING

Sorghum developing a high temperature from excessive respiration is considered heating. Heating sorghum, in its final stages, will usually have a sour or musty odor. Care should be taken not to confuse sorghum that is heating with sorghum 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 or on the basis of the sample as a whole.

Certification. Grade heating sorghum U.S. Sample Grade and record the word "Heating" in the "Results" section of the certificate.

9.9 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, broken kernels, and foreign material.

TABLE NO. 3

| ODOR CLASSIFICATION EXAMPLES | | |
|---|---------------------------|--|
| 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 sorghum 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 Determinations. 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 sorghum 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 "Results" section of the certificate.

9.10 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.

9.11 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 before the removal of dockage on a 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 formula: $\text{lbs./bu} \times 1.287 = \text{kg/hl}$ and record in the "Results" section in whole and tenths.

9.12 INFESTED SORGHUM

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

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

| INSECT INFESTATION | | |
|--|-----------------------------------|--|
| <i>Samples meeting or exceeding any one of these tolerances are infested: 2 lw, or 1 lw + 5 oli, or 10 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 Bargelots <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 sorghum "Infested" in accordance with Section 9.4, Special Grades.

9.13 GENERAL APPEARANCE

Distinctly Discolored. Sorghum which is distinctly discolored shall be graded not higher than U.S. No. 3.

Badly Weathered. Sorghum which is badly weathered shall be graded U.S. Sample Grade.

Basis of Determination. Determine general appearance on the sample as a whole.

Distinctly Discolored (yellow or brown appearance). Distinctly discolored sorghum that has been discolored by adverse weather conditions to a point where a sample has a slightly gray and/or blackened appearance. (Reference: Interpretive Line Print ([sorghum or tannin](#)). Interpretive Line Print ([sorghum/tannin or white](#)); Interpretive Line Print ([white](#)).)

Badly Weathered. Sorghum that has been discolored by adverse weather conditions to a point where many of the kernels are badly discolored. (Reference: Interpretive Line Print ([sorghum or tannin](#)), Interpretive Line Print ([sorghum/tannin or white](#)), Interpretive Line Print ([white](#)).)

In order to ensure a uniform application of the general appearance factors, follow the procedures outlined below:

- a. Cut out 400 grams of sorghum from the original sample.
- b. Pour the sorghum into an empty plastic box until the sorghum is level with the top of the box.
- c. Compare the appearance of the sorghum in the box with the appearance of the sorghum in the Interpretive Line Print.
- d. Sorghum is considered "Distinctly Discolored" or "Badly Weathered" when the representative portion is equal to or worse than the sorghum in the Interpretive Line Print.

Certification. Distinctly discolored sorghum is graded not higher than U.S. No. 3. Record the words "Distinctly Discolored" in the "Results" section of the certificate.

Badly weathered sorghum is graded U.S. Sample Grade. Record the words "Badly Weathered" in the "Results" section of the certificate.

9.14 SMUTTY SORGHUM

Sorghum that has kernels covered with smut spores to give a smutty appearance in mass, or that contains 20 or more smut balls in 100 grams of sorghum.

Smut is a plant disease characterized by the appearance of smut balls or smut spores.

Basis of Determination.

- a. Smut spores. Determine smut spores before the removal of dockage on a portion of 1,000 to 1,050 grams. Grade the sorghum smutty when smut spores are present in sufficient quantities to give the sample a smutty appearance.
- b. Smut balls. Determine the number of smut balls before the removal of dockage on approximately 100 grams. Grade the sorghum smutty when 20 or more smut balls are present. Smut balls apply in the determination of smutty but also function as broken kernels, foreign material, and other grains.

Certification. When applicable, grade the sorghum "Smutty" in accordance with Section 9.4, Special Grades. Upon request, show the number of smut balls in the "Results" section of the certificate.

9.15 DISTINCTLY LOW QUALITY

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

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

The following guidelines are provided to assist in determining whether to apply the distinctly low quality designations.

Large Debris. Sorghum 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. Sorghum 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.

Sorghum 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 sorghum contains diatomaceous earth, then the sorghum 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 sorghum for diatomaceous earth.

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

9.16 U.S. SAMPLE GRADE CRITERIA

Basis of Determination. Determine U.S. Sample Grade criteria, except for stones, before the removal of dockage based on a work portion of 1,000 to 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." Determine stones on a dockage and broken kernel and foreign material-free portion.

TABLE NO. 5

| U.S. SAMPLE GRADE CRITERIA | | | |
|--------------------------------------|-----------------------------------|--|---------------------|
| <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 for U.S. No. 4 | N/A |
| Animal filth | OF-1.0 | 10 or more | N/A |
| Castor Beans | OF-3.0 | 2 or more | N/A |
| Cockleburs | OF-6.0 | 8 or more | N/A |
| Crotalaria seeds | OF-8.0 | 3 or more | N/A |
| Glass | | 2 or more | N/A |
| Odor | | Presence | N/A |
| Stones | | 8 or more in excess of 0.2% by weight | N/A |
| Unknown foreign substances <u>3/</u> | OF-31.0 | 4 or more | N/A |
| Total <u>4/</u> | | 11 or more | N/A |
| Badly weathered | | Appearance | Appearance |
| Heating | | Presence | Presence |
| 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/ Include any combination of animal filth, castor beans, crotalaria seeds, glass, stones, unknown foreign substances or cockleburs.

* For Distinctly Low Quality, see section 9.15

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

9.17 DOCKAGE

All matter other than sorghum 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 sorghum kernels removed in properly separating the material other than sorghum.

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

CHART 1 - PROCEDURE FOR DETERMINING DOCKAGE

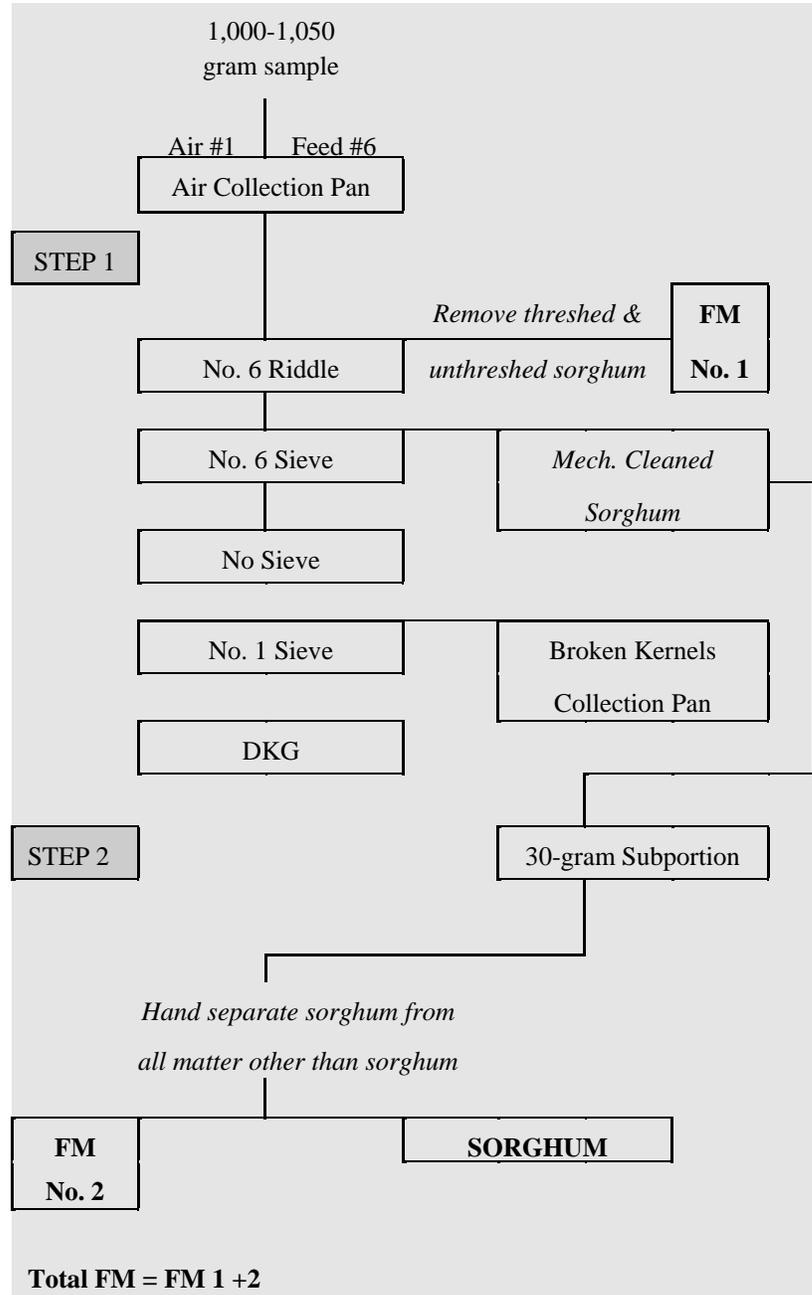
STEP 1. Carter Dockage Tester

- a. Set the air control to 1, and the feed control to 6.
- b. Insert the No. 6 riddle in the riddle carriage, a No. 6 sieve in the top sieve carriage, and a No. 1 sieve in the bottom sieve carriage. No sieve required in the middle sieve carriage.
- c. Run 1,000 – 1,050 grams through the dockage tester.
- d. Return sorghum kernels that may be caught in the riddle to the cleaned portion.
- e. Remove threshed, unthreshed and clumps of sorghum from material that passed over the riddle and add it to the cleaned sorghum

STEP 2. Handpick Foreign Material

- a. From the mechanically cleaned sample, obtain approximately a 30-gram representative portion.
- b. Handpick the 30-gram portion for matter other than sorghum.

NOTE: If a number 6 riddle is not available, the coarse material is handpicked. A 12/64 (4.76 mm) round-hole hand sieve may be used as an aid when removing the coarse material.



Certification. Record the word "Dockage" and the percentage on the work record in hundredths. When the sample contains 1 percent or more dockage, record the percentage of dockage on the certificate in whole percent with a fraction of a percent disregarded.

1.00 to 1.99 percent is recorded as 1.0 percent

2.00 to 2.99 percent is recorded as 2.0 percent, etc.

9.18 BROKEN KERNELS AND FOREIGN MATERIAL

Broken Kernels and Foreign Material. *The combination of broken kernels and foreign material as defined.*

Broken Kernels. *All matter which passes through a 5/64 triangular-hole sieve and over a 2.5/64 round-hole sieve according to procedures prescribed in FGIS instructions.*

Foreign Material. *All matter, except sorghum, which passes over the number 6 riddle and all matter other than sorghum that remains on top of the 5/64 triangular-hole sieve according to procedures prescribed in FGIS instructions.*

Nongrain Sorghum. *Seeds of broomcorn, Johnson-grass, Sorghum alnum Parodi, and-sudangrass; and seeds of Sorghum bicolor (L.) Moench that appear atypical of grain sorghum*

Characteristics of Nongrain Sorghum. Kernels of nongrain sorghum are small and have tightly clasped hulls that are shiny red, black, lemon yellow, or buff in color. Kernels of nongrain sorghum are very rarely white in color. Kernels of nongrain sorghum are usually more elongated than kernels of sorghum and range in size from a large mustard seed to a large cockle seed. (Reference: Visual Reference Image No. [\(S\) OF-16.0](#))

Unthreshed Kernels. Unthreshed kernels of sorghum are not considered as broken kernels and foreign material.

Unattached Hulls. Unattached hulls are considered as broken kernels and foreign material.

Unattached hulls with a sliver or more of a kernel inside are not considered as broken kernels and foreign material.

Basis of Determination. Broken kernels and foreign material are determined by:

- a. Sieving 1,000 to 1,050 grams of dockage-free sorghum with a 1.98 mm (5/64) triangular-hole sieve (Number 6 sieve used in the Carter dockage tester); and
- b. Handpicking a portion of 30 grams after removal of dockage and the mechanically separated broken kernels and foreign material.

Computing Broken Kernels and Foreign Material. The mechanically separated broken kernels and foreign material used to make this calculation are in the bottom collection pan and the riddle collection pan. (See section 9.17.) Obtain the total percentage of broken kernels and foreign material by adding the percentage of broken kernels, mechanically cleaned foreign material, and handpicked foreign material. When adding these portions, as shown in the following example, add the results in hundredths (disregard thousandths) and round the sum to the nearest tenth percent.

- STEP 1.** Percent of dockage = (Weight of dockage ÷ weight of original sample) x 100
- STEP 2.** Weight of dockage-free sample = Weight of original sample - weight of dockage
- STEP 3.** Percent of broken kernels (BN) = (Weight of BN ÷ weight of dockage-free sample) x 100
- STEP 4.** Percent of mechanically separated foreign material (FM) = (Weight of FM removed by No. 6 riddle ÷ weight of dockage-free sample) x 100
- STEP 5.** Percent of handpicked FM = (Weight of handpicked FM (including other grains) ÷ weight of handpicked portion) x 100
- STEP 6.** Total percent of FM = Percent of handpicked FM + percent of mechanically separated FM
- STEP 7.** Total percent of broken kernels and foreign material (BNFM) = Percent BN + total percent FM

Example

| | |
|---|-------------|
| Original sample weight | 1,007 grams |
| Dockage weight | 3.81 grams |
| Mechanically separated broken kernels weight | 54.11 grams |
| Foreign material removed by No. 6 riddle weight | 4.33 grams |
| Handpicked portion weight | 29.70 grams |
| Handpicked separation weight | 0.37 grams |

- STEP 1.** Percent dockage = $3.81 \div 1,007 \times 100 = 0.37$
- STEP 2.** Dockage-free sample weight = $1,007 - 4 (3.8 \text{ rounded}) = 1,003$
- STEP 3.** Percent broken kernels = $54.11 \div 1,003 \times 100 = 5.39$
- STEP 4.** Percent mechanically separated FM = $4.33 \div 1,003 \times 100 = 0.43$
- STEP 5.** Percent handpicked FM = $0.37 \div 29.7 \times 100 = 1.24$
- STEP 6.** Percent total FM = $1.24 + .43 = 1.67$ (round to 1.7)
- STEP 7.** Percent total broken kernels and foreign material (BNFM) =
 $5.39 + 1.67 = 7.06$ (rounded to 7.1)

Certification. Record the total percent of broken kernels and foreign material (step 7) and the percent of foreign material (step 6) on the certificate to the nearest tenth percent. Upon request, report the percent of broken kernels (step 3) on the certificate to the nearest tenth.

Adjustment of Factors. In certain instances, when reporting broken kernels and foreign material separately, the sum of BN and FM in sorghum, due to rounding, will not equal the percentage of BNFM recorded on the certificate. When this occurs, it is necessary to adjust the component (BN or FM) nearest a midpoint (e.g.: .05, .15, .25, .35, etc.) by adding or subtracting 0.1.

9.19 PROCESSING THE WORK SAMPLE

At this point, all other tests required to be performed prior to the removal of dockage have been made and the percentage of dockage has been determined. Now the work sample is ready to be divided into fractional portions for those determinations required after the removal of dockage, broken kernels, and foreign material. The following chart and table No. 6 illustrate how the sample is divided into fractional parts using the Boerner divider.

TABLE NO. 6

| APPROXIMATE ANALYTICAL PORTION SIZES | |
|--------------------------------------|--------------|
| <i>Factors</i> | <i>Grams</i> |
| Damaged kernels | 15 |
| Heat-damaged kernels | 30 |
| Kind of grain | 30* |

* Factor determined before the removal of dockage.

9.20 CLASS

- a. Sorghum. *Sorghum which lacks a pigmented testa (subcoat) and contains less than 98.0 percent White sorghum and not more than 3.0 percent Tannin sorghum. The pericarp color of this class may appear white, yellow, red, pink, orange, or bronze.*
- b. Tannin Sorghum. *Sorghum which has a pigmented testa (subcoat) and contains not more than 10.0 percent of kernels without a pigmented testa.*
- c. White Sorghum. *Sorghum which lacks a pigmented testa (subcoat) and contains less than 98.0 percent of kernels with a white pericarp, and contains not more than 2.0 percent of sorghum of other classes. This class includes sorghum containing spots that, singly or in combination, cover 25.0 percent or less of the kernel.*
- d. Mixed Sorghum. *Sorghum which does not meet the requirements for any of the classes Sorghum, Tannin sorghum, or White sorghum.*

Pericarp. The pericarp is the outer layers of the sorghum grain and is fused to the seedcoat.

Basis of Determination. Determine the class of sorghum by the color characteristics of the pericarps and/or subcoats (testa) of the kernels. When an analysis for class is necessary, use the S/J mixer method 1/ to bleach a portion of 15 (15 ± 1.5) grams after the removal of dockage and machine-separated broken kernels and foreign material. (Reference: Visual Reference Images Nos. [\(S\) OF-33.0](#), "White sorghum," and [S-9.0](#), "Tannin sorghum (Bleached)."

Bleach Procedure. Similarities in the bleaching methods used in the determination for sorghum germ damage and class determination allow inspectors to effectively use the germ damage portion to screen samples for class. If the bleached damage portion contains darkened kernels similar to those depicted in Visual Reference Image No. [S-9.0](#), bleach a separate portion for classing purposes. The bleach method for class determination is identical to that listed in section 9.21, Damaged Kernels, Germ Damage Determination, with the following exceptions:

- a. Determine the percentage of White sorghum present in a mixture before bleaching due to the difficulty of distinguishing between White sorghum and Sorghum after bleaching. Recombine the sample before proceeding.
- b. Use 5 grams of potassium hydroxide (KOH) pellets.
- c. After bleaching, Sorghum and White sorghum kernels remain light in color; sorghum kernels with brown subcoat (testa) turn black (Reference: Visual Reference Image No. [S-9.0](#))

Do not confuse field damaged Sorghum/White sorghum kernels with Tannin sorghum. Field damage may discolor/stain the kernel making it difficult to distinguish the bleached Tannin sorghum from the damaged Sorghum/White sorghum.

Do not confuse Tannin sorghum having a bluish-white pericarp with damaged Sorghum/White kernels. When bleached, this type of Tannin sorghum is partially discolored similar to damaged Sorghum/White kernels. If necessary, quickly review an unbleached portion for the presence of kernels having pericarps with a bluish-white cast. If this type of sorghum is not present, consider the sorghum in question as Sorghum.

Sorghum with White Pericarps and Brown Subcoats. Sorghum of this type has a somewhat bluish-white appearance. To determine the presence or absence of brown subcoats with white pericarps, it may be necessary to scrape small areas of the pericarp.

Certification. For Mixed sorghum, record the name and percentage of each class to the nearest tenth percent as individual factors in the "Results" section of the certificate.

1/ For equipment and materials, see section 1.17.

9.21 DAMAGED KERNELS

Kernels, pieces of sorghum 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.

Basis of Determination. The determination of damaged kernels is a two-step process.

- a. Determine damaged kernels of other grains (e.g., corn, soybeans) removed by the No. 6 riddle on the basis of the mechanically cleaned sample portion (approximately 1,000 grams).
- b. Determine damaged kernels on a portion of 15 grams after the removal of dockage and broken kernels, foreign material, and other grains removed by the 1.98 mm (5/64) triangular-hole sieve.

TYPES OF SORGHUM DAMAGE.

In general, a kernel of sorghum is 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.

Germ-Damaged Kernels. Kernels and pieces of kernels of sorghum which, after bleaching, contain dark colored germs. Sorghum containing a germ damage or suspected of containing germ damage must be bleached. (Reference: Visual Reference Image No. [S-1.1](#))

Ground and/or Weather-Damaged Kernels. Kernels and pieces of kernels of sorghum which contain dark stains or discolorations and have a rough cake-like appearance caused by ground and/or weather conditions. (Reference: Visual Reference Image No. [S-2.0](#))

Heat-Damaged Kernels. Kernels and pieces of kernels of sorghum which are materially discolored and damaged by heat. (Reference: Visual Reference Image No. [S-3.0](#)) It is necessary in most cases to cross section the kernels and make an analysis to determine if the color is creamy.

Insect-Bored Kernels. Kernels and pieces of kernels of sorghum which have been bored or tunneled by insects. (Reference: Visual Reference Image No. [S-4.0](#))

Mold-Damaged Kernels. Kernels and pieces of kernels of sorghum containing surface mold. (Reference: Visual Reference Image No. [S-5.0](#)) Do not confuse mold with dark stains or discolorations caused by ground and/or weather conditions.

Mold-Damaged Kernels (Internal Mold). Kernels and pieces of kernels of sorghum that contain mold which penetrates the seed coat. Internal molds vary in color and are usually confined to the germ area. (Reference: [Visual Reference Image No. S-5.1](#))

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

Purple Pigment Damaged Kernels. Kernels and pieces of kernels which are materially discolored by purple pigment. (Reference: Visual Reference Image No. [S-8.0](#))

Sprout-Damaged Kernels. Kernels and pieces of kernels of sorghum in which the sprout definitely protrudes from the germ. In the application of this definition, one of the following three conditions must be met:

- a. The sprout has split the germ covering and is sticking straight up, or
- b. The sprout has split the germ covering and extends out of the upper portion of the germ area, or
- c. The sprout has split the germ covering and extends down over the tip of the kernel. (Reference: Visual Reference Image No. [S-6.0](#))

Kernels and pieces of kernels of sorghum which have a split over the germ area, but which have no sprout protruding, are considered sound unless otherwise damaged. (Reference: Visual Reference Image No. [S-7.0](#))

Germ and Internal Mold Damage Determination. Use the S/J mixer method to determine germ-damage and when inspecting weathered sorghum (optional for non-weathered), internal mold damage. (For equipment and materials, see section 1.17)

New crop sorghum, in most cases, will not contain germ damage and will not have to be bleached, as it typically contains no germ damage and very little mold damage. However, improperly stored or sorghum which has been subjected to poor harvesting conditions is susceptible to these types of damage. In both instances, bleaching improves the efficiency and accuracy of the damage assessment by removing the protective bran and exposing distinctively discolored germs. After bleaching, sorghum germs containing internal mold will appear black; traditional “germ” damaged sorghum will appear dark brown in color.

Prior to bleaching, remove all types of damaged kernels, except germ and internal mold-damaged kernels, from the representative portion and calculate the percentage. The representative portion, less the other types of damaged kernels, can now be bleached. After bleaching, reweigh the bleached portion, remove the germ and internal-damaged kernels, and calculate the percentage.

Bleach Procedure.

- a. Place 15 grams (± 1.5 grams) of sorghum 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 damage kernels from the second portion before bleaching.
- b. Add 15 grams of KOH pellets.
- c. Add 40 ml of bleach. 1/
- d. Set stirring head on jar, place jar on mixer, and mix for 3 minutes.
- e. Pour the sorghum from the mixing jar into the tea strainer and rinse with warm tap water to remove the KOH-bleach solution.
- f. 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.
- g. Place the sorghum 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 sorghum from the drying sieve and weigh. The kernels with germ or internal-damage should now be readily apparent. Germ area which appear dark brown in color function as "germ" damage; blackened germs will function as internal mold. Carefully lift any bran remaining over the germ area to examine for damage.

Any deviation from the previously described procedures may result in improperly bleached sorghum 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.

1/ Store bleach in cool, dry place and replace any unused bleach at least every 3 months following the date of purchase.

- Avoid mixing the potassium hydroxide (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 damaged kernels by adding the percentage of germ-damaged kernels, other damaged kernels, and damaged kernels of grain removed by the No. 6 riddle. Add the results, as shown in the following example, in hundredths (disregard thousandths) and round the sum to the nearest tenth percent.

- STEP 1.** Weight of other type damaged kernels ÷ weight of sample before bleaching x 100 = percent of other type damaged kernels.
- STEP 2.** 100 percent - percent of other type damaged kernels ÷ 100 = change of base factor.
- STEP 3.** Weight of germ damaged portion ÷ weight of damaged portion after bleaching x 100 = percent of germ damaged kernels.
- STEP 4.** Percent of germ damaged kernels x change of base factor = adjusted percent of germ damaged kernels.
- STEP 5.** Weight of damaged kernels of corn/soybeans removed by No. 6 riddle ÷ weight of mechanically cleaned sample = percent of damaged corn/soybeans.
- STEP 6.** Percent of other damaged kernels + adjusted percent of germ damaged kernels + percent of damaged corn/soybeans = percent of damaged kernels.

Example

| | |
|--|-------------|
| Weight of mechanically cleaned sample | 949 grams |
| Original weight of damaged 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 |
| Weight of damaged kernels of corn/soybeans removed by No. 6 riddle | 2.50 grams |

- STEP 1.** $(2.40\text{g} \div 16.10\text{g}) \times 100 = 14.90$ percent of other type damaged kernels.
- STEP 2.** $(100\% - 14.90\%) \div 100 = 0.85$ change of base factor.
- STEP 3.** $(4.33\text{g} \div 11.95\text{g}) \times 100 = 36.23$ percent germ damaged kernels.
- STEP 4.** $0.85 \times 36.23 = 30.79$ adjusted percent of germ damaged kernels.
- STEP 5.** $(2.50\text{g} \div 949) \times 100 = 0.26$ percent damaged kernels of corn/soybeans
- STEP 6.** $14.90\% + 30.79\% + 0.26\% = 45.95$ (rounded to 46.0) percent damaged kernels.

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

9.22 HEAT-DAMAGED KERNELS

Kernels, pieces of sorghum kernels, and other grains that are materially discolored and damaged by heat.

Basis of Determination. Determine heat-damaged kernels after the removal of dockage and machine-separated broken kernels and foreign material on a portion of 30 grams. It is necessary, in most cases, to cross-section the kernels to determine if the color is creamy. (Reference: Visual Reference Image No. [S-3-.0](#))

Procedure for Determining Heat-Damaged Kernels of Grain Removed by Riddle. (See section 9.17.) The percent of heat-damaged kernels of corn and/or soybeans removed by the Number 6 riddle during the determination of dockage, broken kernels, and foreign material is added to the percent of heat-damaged kernels removed from the 30-gram portion. Compute the percent of heat-damaged kernels of corn and/or soybeans on the basis of the weight of the sample after the removal of dockage and mechanically cleaned broken kernels and foreign material. See page 9-24, step 5, for calculations.

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

9.23 OFFICIAL CRITERIA

The analysis for the percentage of ergot is considered as an “official criteria” factor in sorghum. Ergot analysis is performed only upon request of the applicant for service and does not affect the grade designation.

Basis of Determination. Determine ergot before the removal of dockage on a work portion of approximately 1,000 to 1,050 grams.

Certification: Record the percentage of ergot on the work record to the nearest hundredth percent. Use one of the following statements (as requested by the applicant) to record the percentage of ergot in the “Results” section of the certificate.

“Ergot (*Claviceps* spp.): _____%.”

“Does not exceed _____ percent of sclerotia of the following species of sorghum ergot: *Claviceps Africana*, *C. sorghi*, and *C. sorghicola*.”