

CHAPTER 10: SOYBEANS

CONTENTS

10.1	GENERAL ORDER OF PROCEDURES	10-1
10.2	DEFINITION OF SOYBEANS	10-1
10.3	GRADES AND GRADE REQUIREMENTS	10-2
10.4	GRADE DESIGNATIONS	10-3
10.5	SPECIAL GRADES.....	10-3
10.6	OPTIONAL GRADE DESIGNATION.....	10-4
10.7	BASIS OF DETERMINATION.....	10-4
10.8	HEATING	10-5
10.9	ODOR	10-5
10.10	MOISTURE	10-6
10.11	TEST WEIGHT.....	10-7
10.12	GARLICKY SOYBEANS	10-7
10.13	INFESTED SOYBEANS.....	10-8
10.14	PURPLE MOTTLED OR STAINED	10-9
10.15	DISTINCTLY LOW QUALITY	10-10
10.16	U.S. SAMPLE GRADE CRITERIA	10-11
10.17	FOREIGN MATERIAL.....	10-13
10.18	PROCESSING THE WORK SAMPLE	10-16
10.19	SPLITS.....	10-17
10.20	DAMAGED KERNELS	10-18
10.21	HEAT-DAMAGED KERNELS.....	10-20
10.22	CLASS	10-21
10.23	OFFICIAL CRITERIA	10-22

TABLES

TABLE 10.1 – GRADES AND GRADE REQUIREMENTS FOR SOYBEANS	10-2
TABLE 10.2 – BASIS OF DETERMINATION	10-4
TABLE 10.3 – ODOR CLASSIFICATION EXAMPLES	10-5
TABLE 10.4 – INSECT INFESTATION.....	10-8
TABLE 10.5 – U.S. SAMPLE GRADE CRITERIA.....	10-12
TABLE 10.6 – APPROXIMATE ANALYTICAL PORTION SIZES	10-16

CHARTS

CHART 10.1 – PROCEDURE FOR DETERMINING FOREIGN MATERIAL	10-14
CHART 10.2 – DIVIDING THE WORK SAMPLE	10-16

10.1 GENERAL ORDER OF PROCEDURES

The breakdown and inspection for Soybeans are listed below in the following chapter according to its general order. The order of procedure may slightly vary depending on the quality of the soybeans and the tests requested. More information is available on the [Agricultural Marketing Service Website \(AMS\)](#), in the [U.S. Standards for Soybeans](#), and the [Board of Appeals and Review \(BAR\) Questions and Answers](#).

The inspection process provides various factor information used to determine grade and to provide further information on the condition or quality of the soybeans. 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 percent by weight or a percent for a specific type of damage). Also, upon applicant request any non-grade determining factor may be omitted from the inspections process (e.g. test weight, moisture, protein, or oil).

10.2 DEFINITION OF SOYBEANS

Definition. *Grain that consists of 50 percent or more of whole or broken soybeans (*Glycine max* (L.) merr.) that will not pass through an 8/64 round-hole sieve and not more than 10.0 percent of other grains for which standards have been established under the United States Grain Standards Act.*

Whole soybeans are soybeans with three-fourths or more of the soybean present. Other grains for which standards have been established are barley, canola, corn, flaxseed, oats, rye, sorghum, 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 soybeans. However, if an analysis is necessary, make the determination before the removal of foreign material on a portion of 125 grams.

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

- a. Another grain for which standards have been established; or
- b. Not Standardized Grain (NSG). No further analysis is necessary on a sample designated as NSG unless a specific factor test is requested.

10.3 GRADES AND GRADE REQUIREMENTS

Soybeans are divided into two classes based on color: Yellow soybeans and Mixed soybeans. There are no subclasses. Each class is divided into four numerical grades and U.S. Sample Grade. Special grades emphasize qualities or conditions affecting the value and are added to and made a part of the grade designation. Special grades do not affect the numerical or sample grade designation.

TABLE 10.1 – GRADES AND GRADE REQUIREMENTS FOR SOYBEANS

Grade	Maximum Limits of -				
	Damaged Kernels		Foreign Material (percent)	Splits (percent)	Soybeans of other colors ¹ (percent)
	Heat (part of total) (percent)	Total (percent)			
U.S. No. 1	0.2	2.0	1.0	10.0	1.0
U.S. No. 2	0.5	3.0	2.0	20.0	2.0
U.S. No. 3	1.0	5.0	3.0	30.0	5.0
U.S. No. 4	3.0	8.0	5.0	40.0	10.0
U.S. Sample Grade is soybeans that: a. Do not meet the requirements for grades U.S. No.1, 2, 3, or 4; or b. Contains 4 or more 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 (<i>Crotalaria</i> spp.), 2 or more castor beans (<i>Ricinus communis</i> L.), 4 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), 10 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth in 1,000 grams of soybeans, or c. Contain 11 or more animal filth, castor beans, crotalaria seeds, glass, stones, or unknown foreign substance(s) in any combination, or d. Have a musty, sour, or commercially objectionable foreign odor (except garlic odor); or e. Are heating or otherwise of distinctly low quality. ¹ Disregard for Mixed Soybeans					

10.4 GRADE DESIGNATIONS

After completing the analysis, compare the results with the limits for each grade factor specified in [Table 10.1 – Grades and Grade Requirements for Soybeans](#). 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 name of the class;
- e. The applicable special grades in alphabetical order.

For Mixed soybeans, record the percent of Yellow soybeans and soybeans of other colors to the nearest tenth percent on the work record and "Results" section of the certificate.

Example: U.S. No. 2 Yellow Soybeans
U.S. No. 3 Mixed Soybeans

In "Results" section: Yellow Soybeans 75.4%
Soybeans of other colors 24.6%

10.5 SPECIAL GRADES

Special grades draw attention to unusual conditions in the grain and are made part of the grade designation. The special grades and special grade requirements for all classes of soybeans are shown in the [United States Standards for Soybeans](#). Details for determining special grades are included in referenced sections. Definitions and examples of the designations for special grades in soybeans are:

- a. Garlicky Soybeans. Soybeans that contain five or more green garlic bulblets or an equivalent quantity of dry or partly dry bulblets in a 1,000-gram portion. ([Section 10.12](#))

Example: U.S. No. 3 Yellow Soybeans, Garlicky

- b. Infested Soybeans. Soybeans that are infested with live weevils or other insects injurious to stored grain. ([Section 10.13](#))

Example: U.S. No. 2 Yellow Soybeans, Infested

- c. Purple Mottled or Stained Soybeans. Soybeans that are discolored with pink or purple seed coats, dirt or a dirt-like substance, or pokeberry stains, as determined on a portion of 400 grams with the use of an FGIS Interpretive Line Print. ([Section 10.14](#))

Example: U.S. No. 2 Yellow Soybeans, Purple Mottled or Stained.

10.6 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, certify soybeans 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 Yellow Soybeans

10.7 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, an 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 class, heat-damaged kernels, damaged kernels, splits, and soybeans of other colors is made on the basis of the grain when free from foreign material. Other determinations not specifically provided for under the General Provisions are made on the basis of the grain as a whole.

TABLE 10.2 – BASIS OF DETERMINATION

Lot as a Whole	Factors Determined Before the Removal of Foreign Material	Factors Determined After the Removal of Foreign Material
Distinctly Low Quality Heating Infested Odor	Distinctly Low Quality Garlicky Heating Infested Kind of Grain Moisture Odor Purple Mottled or Stained Stones Test Weight Sample Grade Criteria	Heat-Damaged Kernels Damaged Kernels Odor Soybeans of Other Colors Splits

10.8 HEATING

Basis of Determination. Determine heating (HTG) on evidence obtained at the time of sampling or on the basis of the sample as a whole.

Soybeans developing a high temperature from excessive respiration are considered heating. Heating soybeans, in its final stages, will usually have a sour or musty odor. Do not confuse soybeans that are heating with soybeans that are warm and moist because of storage in bins, railcars, or other containers during hot weather.

Certification. When applicable, show the term “Heating” on the work record and “Results” section of the certificate, and grade the soybeans “U.S. Sample Grade.”

10.9 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 foreign material.

TABLE 10.3 – ODOR CLASSIFICATION EXAMPLES

Musty	Sour	Commercially Objectionable Foreign Odors	
Ground Insect Moldy	Boot Fermenting Insect (acid) Pigpen Smoke ¹	Animal Hides Decaying Animal Fertilizer Fumigant Insecticide	Oil Products Skunk Smoke Strong Weed Vegetable Matter
¹ Smoke odors are considered sour only in canola, flaxseed, soybeans, and sunflower seed.			

Odors from Heat-Damaged Soybeans. When heat-damaged kernels are present, soybeans give off an odor very similar to smoke. Soybeans containing a “smoke” odor are considered as having a “sour” odor unless evidence of a fire-burnt material is present in the lot or the original sample. If evidence of a fire-burnt material is present in the lot or the sample, the smoke odor is considered a commercially objectionable foreign odor.

Commercially Objectionable Foreign Odors (COFO) are odors, except garlic odors, foreign to grain that render it unfit for normal commercial usage.

Fumigant, insecticide, or fungicide odors are considered commercially objectionable foreign odors if they linger and do not dissipate. When a sample of soybeans contains a fumigant, insecticide, or fungicide odor that prevents the determination of 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, insecticide, or fungicide odor persists based on the above criteria.

Final Determinations. The inspector is responsible for making the final determination for all odors. Whenever possible, use a consensus of experienced licensed inspectors on samples containing marginal odors. Under the consensus approach, if a clear majority (at least 2/3) of inspectors agree the sample contains a Musty, Sour, or COFO odor, grade the soybeans "U.S. Sample Grade". The consensus approach is not required if the initial inspector does not detect an odor or a distinct odor is detected.

Certification. Grade soybeans 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" on the work record and "Results" section of the certificate.

10.10 MOISTURE

Definition. *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 foreign material on a portion of approximately 650 grams.

The procedures for performing a moisture determination using a FGIS approved moisture instrument utilizing the proper calibrations are described in the [Moisture Handbook](#) and in [Chapter 1](#), General Information.

Certification. Record the percent of moisture on the work record and "Results" section of the certificate to the nearest tenth percent.

10.11 TEST WEIGHT

Definition. *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 (TW) before the removal of foreign material on a portion of sufficient quantity to overflow the kettle.

The procedures for performing the test weight determination are described in [Chapter 1](#), General Information.

Note: Unless an applicant specifically requests that TW determination not be performed, official personnel must perform TW analysis and certify the results as part of official grading services for all types (e.g. submitted samples, shiplots, lash barges, or unit trains) of inspection services.

Certification. Record test weight results on the work record and “Results” section of the certificate to the nearest tenth of a 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 “Remarks” section in whole and tenths.

10.12 GARLICKY SOYBEANS

Definition. *Soybeans that contain five or more green garlic bulblets or an equivalent quantity of dry or partly dry bulblets in a 1,000-gram portion.*

Basis of Determination. Determine garlicky (GAR) before the removal of foreign material on a portion of 1,000 grams. (VRI – [O.F. - 13.0 Green Garlic Bulbs \(Whole\)](#) and [O.F. - 13.1 Dry Garlic Bulbs \(1/3rd\)](#))

Characteristics of Bulblets.

- a. Green garlic bulblets are bulblets which have retained all of their husks intact.
- b. Dry or partially dry garlic bulblets are bulblets which have lost all or part of their husks. Consider bulblets with cracked husks as dry.
- c. Three dry or partly dry garlic bulblets are equal to one green bulblet.

Note: Garlic bulblets apply in the determination of "Garlicky" but also function as foreign material.

Wild onion, sometimes referred to as “crow garlic”, is considered as garlic.

Certification. When applicable, grade the soybeans "Garlicky" on the grade line of the certificate in accordance with [Section 10.5](#), “Special Grades.” Record the number of garlic bulblets in whole numbers or in decimals to the nearest hundredths position (e.g., $1/3 = 0.33$ or $2/3 = 0.67$) on the work record and “Results” section of the certificate.

10.13 INFESTED SOYBEANS

Soybeans that are infested with live weevils (LW) or other live insects injurious to stored grain (OLI).

The presence of any LW or OLI indicates the probability of infestation and warns that the soybeans must be carefully examined to determine if they are infested. In such cases, examine the work sample and the file sample before reaching a conclusion as to whether or not the soybeans are infested. Do not examine the file sample if the work portion is insect free.

LW include rice weevils, granary weevils, maize weevils, cowpea weevils, and lesser grain borers. OLI include grain beetles, grain moths, and larvae. To further define “other insect injurious to stored grain” refer to the [Stored-Grain Insect Reference](#). Images of insects may also be viewed on the [AMS website](#).

Basis of Determination. Determine infestation on the lot as a whole and/or the sample as a whole. For insect tolerances, refer to [Table 10.4 – Insect Infestation](#).

TABLE 10.4 – 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 sample¹ (+ file sample if needed)	Lot as a Whole (Stationary)	Online Sample (In-Motion)²
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 ³ Components for Shiplots ³
¹ Examine work portion and file sample if necessary. Do not examine file sample if work portion is insect free. ² Minimum sampling rate is 500 grams per 2,000 bushels. ³ Minimum component size is 10,000 bushels. Key: LW = Live Weevil, OLI = Other Live Insects injurious to stored grain		

Certification. When applicable, grade the soybeans “Infested” on the grade line of the certificate in accordance with [Section 10.5](#), “Special Grades.” Record the number of live weevils and/or other live insects injurious to stored grain on the work record and “Results” section of the certificate.

10.14 PURPLE MOTTLED OR STAINED

Definition. *Soybeans with pink or purple seed coats as determined on a portion of approximately 400 grams with the use of an FGIS Interpretive Line Print.*

Purple mottled or stained (PMS) is an appearance factor in soybeans and when sufficient amounts of discolored soybeans are found, the soybeans are considered purple mottled or stained.

Soybeans Discolored by the Growth of a Fungus. Soybeans discolored by a fungus have seed coats that are discolored pink or purple. This type of discoloration is caused by the growth of a fungus and may cover all or part of the kernel. Soybeans exhibiting this type of discoloration are considered purple mottled or stained. (ILP – [Soybeans - Purple Mottled or Stained by Growth of a Fungus](#))

Soybeans Discolored by Dirt or a Dirt-Like Substance, Etc. This type of discoloration is caused by dirt or similar matter and includes nontoxic substances. Dirt, dirt-like substances, or other nontoxic substances are substances which can be readily removed by water. Soybeans exhibiting this type of discoloration are considered purple mottled or stained. (ILP – [Soybeans - Purple Mottled or Stained by Dirt or Dirt-like Substances](#))

Soybeans Purple Mottled or Stained by Pokeberry Stain. Soybeans with seed coats discolored by pokeberry stain are considered purple mottled or stained. (ILP – [Soybeans - Purple Mottle or Stained by Pokeberry Stain](#))

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

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

- a. Cut 400 grams of soybeans from the original sample.
- b. Compare the appearance of the sample with the Interpretive Line Print (ILP).
- c. Consider soybeans purple mottled or stained when the sample is equal to or worse in appearance than the soybeans in the ILP.

Certification. When applicable, grade the soybeans "Purple Mottled or Stained" on the grade line of the certificate in accordance with [Section 10.5](#), "Special Grades."

10.15 DISTINCTLY LOW QUALITY

Consider soybeans distinctly low quality when they are obviously of inferior quality and existing grade factors or guidelines do not accurately reflect the inferior condition.

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

- a. Diatomaceous Earth (DIAT). Soybeans suspected of containing DIAT are considered DLQ unless the applicant specifically requests an examination to verify the presence of DIAT. If the laboratory examination verifies that the soybeans contain DIAT, then the soybeans are not considered DLQ due to DIAT. For additional information regarding the testing of soybeans for diatomaceous earth, refer to [Directive 9180.49, "Grading and Certification of Grain Containing Diatomaceous Earth and Silica Gel."](#)
- b. Flood Damaged Grain. Soybeans that are materially affected by flooding are considered DLQ and certified as "U.S. Sample Grade." In addition, official personnel must report identifiable lots that are DLQ to the district Food and Drug Administration (FDA) office as "actionable" in accordance with [FGIS-PN-19-04, "Inspection of Flood Damaged Grain"](#).

The determination of DLQ is based on the appearance and condition of the lot or sample as a whole. Evaluate soybeans affected by flooding on a portion of approximately 400 grams with the use of the ILP – [All Grains/Graded Commodities - Inspection of Flood Damaged Grain](#). If a sample does not meet the requirements for DLQ, but the kernels are materially damaged (stained) by flooding, consider the kernels as damaged and count toward the total percentage of damaged kernels in the sample.

- c. Large Animal Excreta (LGANX). Soybeans containing one or more large animal excreta (e.g., deer or elk pellet) are considered DLQ.
- d. Large Debris. Soybeans containing two or more stones, pieces of glass, pieces of concrete, or other pieces of wreckage or debris which are visible to the sampler and too large to enter the sampling device are considered DLQ.
- e. Other Unusual Conditions. Soybeans that are obviously affected by other unusual conditions which adversely affect the quality of the soybeans and cannot be properly graded by use of the grading factors specified or defined in the standards are considered DLQ.

Certification. When applicable, show the factor DLQ and the reason(s) why on the work record and "Results" section of the certificate, and grade the soybeans "U.S. Sample Grade."

10.16 U.S. SAMPLE GRADE CRITERIA

Basis of Determination. Determine U.S. Sample Grade criteria before the removal of foreign material based on a work portion of 1,000 - 1,050 grams.

[Table 10.5 – U.S. Sample Grade Criteria](#) shows the criteria and corresponding Visual Aids, tolerance limits, and the appropriate basis of determination. Consider identifiable pieces of grain, processed grain products (e.g., soybean meal, sorghum grits, corn meal, or bulgur), or feed pellets in grain as foreign material. Unidentifiable materials or material unrelated to grain must function as “unknown foreign substance (FSUB).”

Soybeans inoculated with a seed treatment which is toxic should not be confused with soybeans stained by pokeberry juice which is not toxic.

If it is difficult to visually determine soybeans stained by pokeberry juice from those stained by a seed treatment, the following procedures may be used:

- a. Place discolored soybean kernels into a 100 x 15 mm petri dish.
- b. Use an eyedropper to add enough hydrochloric acid (HCL) to cover the soybeans. Care should be taken not to get HCL in the eyes or on the skin.
- c. If the soybeans are stained with pokeberry juice, the HCL solution (0.1 N) will remove the stain from the seed coat and the soybeans are not graded “U.S. Sample Grade.” If the soybeans are stained with a toxic seed treatment, the HCL solution will not remove the stain from the seed coat and the soybeans are graded “U.S. Sample Grade.”

TABLE 10.5 – U.S. SAMPLE GRADE CRITERIA

Criteria	Visual Aids	Number/Weight ¹	
		Sample Basis	Lot Basis ²
Any Numerical Grading Factor		Excess of limit for U.S. No. 4	N/A
Animal Filth	Animal Filth	10 or more	N/A
Castor Beans	Castor Bean	2 or more	N/A
Crotalaria Seeds	Crotalaria	3 or more	N/A
Glass		1 or more	N/A
Odor		Presence	N/A
Stones		4 or more and in excess of 0.1% by weight	N/A
Unknown Foreign Substances ³	Fertilizer	4 or more	N/A
Heating		Presence	Presence
Total Other Material ⁴		11 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 Includes any combination of animal filth, castor beans, crotalaria seeds, glass, stones, and unknown foreign substances. The weight of stones is not applicable for total other material. * For Distinctly Low Quality, refer to Section 10.15 .			

Certification. Grade soybeans “U.S. Sample Grade” when one or more of the limits in [Table 10.5 – U.S. Sample Grade Criteria](#) are observed. Record the factors (count factors to the nearest whole number) on the work record and “Results” section of the certificate.

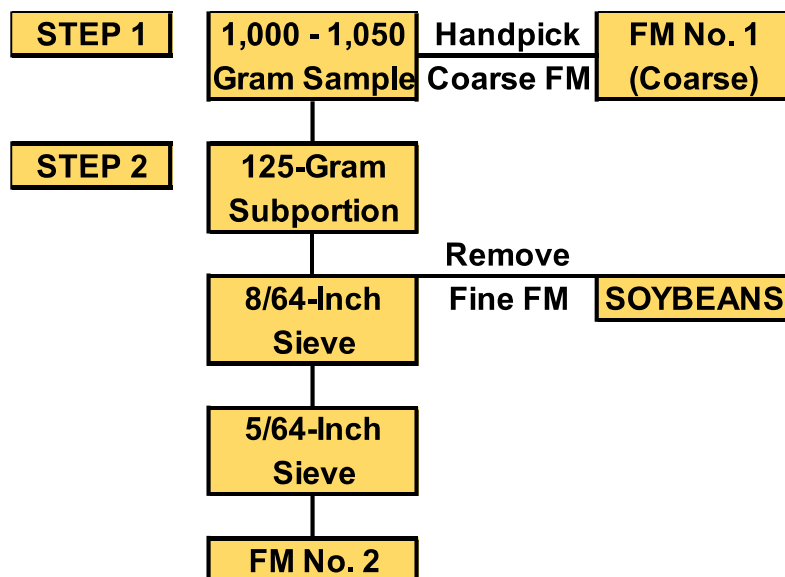
10.17 FOREIGN MATERIAL

Definition. *All matter that passes through an 8/64 round-hole sieve and all matter other than soybeans remaining in the sieved sample after sieving according to procedures prescribed in FGIS instructions.*

- a. Coarse Foreign Material. Coarse foreign material consists of the following:
 - (1) Whole kernels of corn. Whole kernels of corn are kernels with one-fourth or less of the kernel removed.
 - (2) Cocklebur.
 - (3) Sticks if the following criteria are met:
 - (a) Approximately 1 inch or more in length.
 - (b) Approximately 1/2 inch or more with a thickness of 5/32 of an inch (width of the largest soybean slotted sieve).
 - (4) Pods (one-half pod or more). If pods contain soybeans, remove the soybeans and return to sample.
 - (5) Other coarse foreign material may include but is not limited to corn cobs, large feed pellets, pieces of dirt or stones larger than soybeans, sweet corn, large sunflower seeds, and edible beans that are generally larger than soybeans.
- b. Fine Foreign Material. Fine foreign material consists of the following:
 - (1) Broken kernels of corn with more than one-fourth of the kernel removed.
 - (2) Popcorn, sunflower seeds, yellow peas, nightshade berries, and edible beans that are generally equal to or smaller than soybeans.
 - (3) Star thistles, star burs, sandburs, morning glory, and kinghead seeds.
 - (4) Sticks and stones not meeting the criteria for coarse foreign material.
 - (5) Soybean pods less than one-half the total pod.
 - (6) Any other material too small to function as coarse foreign material including broken off soybean sprouts. Soybean hulls which are not removed by the 3.175 mm (8/64) round-hole sieve are not considered foreign material.

Basis of Determination. Determine foreign material by handpicking and sieving as follows:

CHART 10.1 – PROCEDURE FOR DETERMINING FOREIGN MATERIAL



Coarse Foreign Material.

Handpick the 1,000 – 1.050 gram portion for coarse foreign material. Refer to [Section 10.17](#) for the definition of coarse foreign material.

Fine Foreign Material.

- Cut down the cleaned sample (free of coarse foreign material) to a portion of 125 grams.
- Using an approved shaker or hand sieve, sieve (5 strokes) the 125-gram portion with and 8/64" (3.175 mm) round-hole sieve.
- Handpick the material other than soybeans from the material remaining on the 8/64" sieve and add it to the fine foreign material. Soybean hulls which remain on the 8/64" sieve are not considered foreign material.

Note: An 8/64 x 3/4 (3.175 x 19.050 mm) or 9/64 x 3/4 (3.572 x 19.050 mm) oblong-hole sieve, or 10/64 x 3/4 (3.969 x 19.050 mm) oblong-hole sieve may be mounted on top of the 8/64" round-hole sieve and used as an aid in separating splits. Refer to [Section 10.19](#), "Splits," for the determination of splits. When a sieve is used as an aid, the material remaining on top of the 8/64" round-hole sieve and the material remaining on top of the sieve used as an aid is analyzed for additional fine foreign material.

Calculating Foreign Material. Calculate foreign material in soybeans by adding the percent of coarse foreign material to the percent of fine foreign material in hundredths (disregard thousandths) and round the sum to the nearest tenth percent.

Example: Foreign Material Calculation

Weight of representative sample	1,025 grams
Weight of coarse foreign material	5.00 grams
Weight of portion to be sieved	125 grams
Weight of fine foreign material	1.60 grams

- a. **Percent of coarse foreign material.**
 $(5.00\text{g} \div 1,025\text{g}) \times 100 = 0.48\%$.
- b. **Percent of fine foreign material.**
 $(1.60\text{g} \div 125\text{g}) \times 100 = 1.28\%$.
- c. **Percent of foreign material.**
 $(0.48\% + 1.28\%) = 1.76\%$ (rounded to 1.8%)

Certification. Record the percent of foreign material on the work record and “Results” section of the certificate to the nearest tenth percent.

10.18 PROCESSING THE WORK SAMPLE

At this point, all tests required to be performed prior to the removal of foreign material have been completed and the percent of foreign material has been determined. Also, the sample has been 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 the foreign material.

[Chart 10.2 – Dividing the Work Sample](#) and [Table 10.6 – Approximate Analytical Portion Sizes](#) illustrate how the sample is divided into fractional parts using an approved divider.

CHART 10.2 – DIVIDING THE WORK SAMPLE

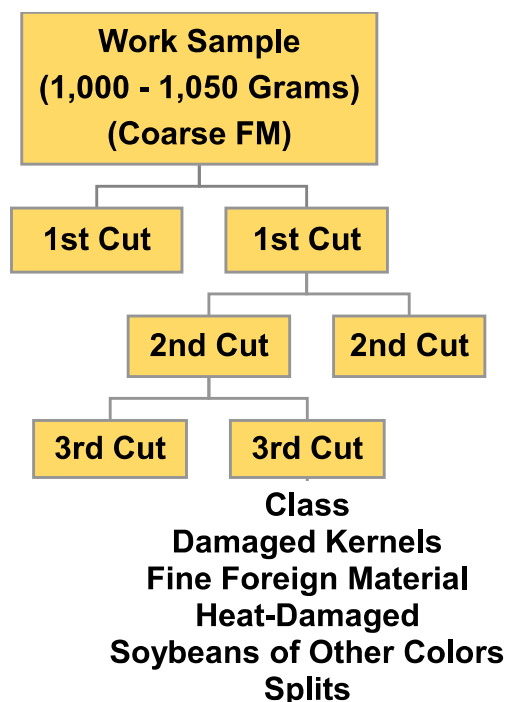


TABLE 10.6 – APPROXIMATE ANALYTICAL PORTION SIZES

Factors	Grams
Damaged Kernels	125
Foreign Material	125
Heat-Damaged Kernels	125
Kind of Grain ¹	125
Soybean of Other Colors	125
Splits	125

¹ Factor determined before the removal of foreign material.

10.19 SPLITS

Definition. Soybeans with more than one-fourth of the bean removed and that are not damaged.

Basis of Determination. Determine splits (SPL) on a portion of 125 grams after the removal of foreign material.

Note: A smaller portion size (approximately 60 grams) may be used for the analysis of splits when a sample contains approximately 50 percent or more of whole soybeans that pass through a 10/64 oblong-hole sieve.

Sieves Used to Facilitate the Splits Determination. An 8/64 x $\frac{3}{4}$ (3.175 x 19.050 mm) or 9/64 x $\frac{3}{4}$ (3.572 x 19.50 mm) oblong-hole or 10/64 x $\frac{3}{4}$ (3.969 x 19.50 mm) oblong-hole hand sieve may be used to separate splits. Use these sieves in conjunction with the 8/64-inch round-hole sieve used to determine foreign material.

All splits are not separated by sieving. Therefore, the material remaining on top of the sieve and the material that passed through the sieve have to be examined for splits.

Since splits are normally separated during the determination of foreign material, the weight of the foreign material must be subtracted from the weight of the representative portion before calculating the percent of splits.

Example: Splits Calculation

Weight of representative portion	125 grams
Weight of fine foreign material (material passing through the 8/64 round-hole sieve and all matter other than soybeans on top of the sieve)	2.40 grams
Weight of splits	10.60 grams

a. **Portion size used to calculate splits (adjusted).**

125g – 2.40g (rounded to 2) = 123 grams.

b. **Percent of splits.**

(10.60g ÷ 123g) x 100 = 8.61% (rounded to 8.6%).

Certification. Record the percent of splits on the work record and “Results” section of the certificate to the nearest tenth percent.

10.20 DAMAGED KERNELS

Definition. Soybeans and pieces of soybeans that are badly ground-damaged, badly weathered-damaged, diseased, frost-damaged, germ-damaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, stinkbug-stung, or otherwise materially damaged. Stinkbug-stung kernels are considered damaged kernels at the rate of one-fourth of the actual percentage of the stung kernels.

Basis of Determination. Determine damaged kernels (DKT) on a portion of 125 grams after the removal of foreign material.

Note: A smaller portion size (approximately 60 grams) may be used for the analysis of damaged kernels when a sample contains approximately 50 percent or more of whole soybeans that pass through a 10/64 oblong-hole sieve.

In general, consider soybeans to be 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.

Cross section soybeans through the middle of the hilum. Cross section stinkbug soybeans through the suspected sting. Do not cross section lengthwise.

TYPES OF SOYBEAN DAMAGE.

Badly Ground and/or Weather-Damaged Kernels. Soybeans and pieces of soybeans in which the seed coats are discolored by ground or weather damage. The discoloration may be on one side or both sides. (VRI – [SB - 1.0 Badly Ground and/or Weather Damage](#) and [SB - 1.1 Weather Damage \(Gray/Black\)](#))

Damaged-By-Heat Kernels. Soybeans and pieces of soybeans which have been discolored and damaged-by-heat but not to the extent they are considered heat damaged. Cross section the whole soybean to determine the extent of the damage. Do not cross-section splits and pieces of soybeans. (VRI – [SB - 2.0 Damaged-By-Heat](#))

Frost-Damaged Kernels (Waxy). Soybeans and pieces of soybeans which have a glassy, wax-like appearance. The color of affected soybeans may vary. Do not cross-section splits and pieces of soybeans. (VRI – [SB - 3.2 Frost Damage \(Waxy\)](#))

Green-Damaged. Soybeans and pieces of soybeans which are discolored green in the cross section. This is applicable to any variety of soybeans. Do not cross section splits and pieces of soybeans. (VRI – [SB - 3.0 Green Damage](#))

Heat-Damaged Kernels. Soybeans and pieces of soybeans which are materially discolored and damaged-by-heat. Cross section the whole soybean to determine the extent of damage. Do not cross section splits and pieces of soybeans. (VRI – [SB - 5.0 Heat Damage \(Materially Damaged/Heating\)](#))

Note: Heat-damaged kernels are included in the total percent of other damaged kernels.

Immature Kernels (Wafers). Soybeans and pieces of soybeans which are immature and have a thin, flat, wrinkled, or wafer like appearance. Cross section soybeans and pieces of soybeans that are immature and have a thin, flat, wrinkled, or wafer-like appearance to determine if there is "meat" in the kernel. If there is "meat" in the kernel and the "meat" is not otherwise damaged, the wafers are sound. Wafered kernels without "meat" are considered damaged. (VRI – [SB - 6.0 Immature \(Wafer\)](#))

Insect-Bored Kernels. Soybeans and pieces of soybeans which bear evidence of boring or tunneling, indicating the possible inner presence of insects, insect webbing, or insect refuse. Kernels which have been partially eaten by insects or rodents but which are entirely free from refuse, webbing, insects, or other forms of damage are considered as sound kernels. Do not cut open the kernel when making this determination. (VRI – [SB - 7.0 Insect-Bored Kernels](#))

Mold-Damaged Kernels.

- a. Invaded-By-Mold. Soybeans that are discolored; elongated; misshapen; may have splits, cracks, or fissures in the seed coat and which contain a white to gray moldy growth. Soybeans and pieces of soybeans with mold on exposed areas (meat), regardless of amount, are considered damaged. (VRI – [SB - 8.0 Mold Damage](#))
- b. Surface Mold Growth. Soybeans with little or no apparent deterioration having a milky white or grayish crusty growth caused by downy mildew. Seedcoat is not discolored and contains no splits, cracks, or fissures. Soybeans that contain mildew on 50 percent or more of the seedcoat in sufficient concentration are considered damage. (VRI – [SB - 8.0 Mold Damage](#))
- c. Mold Damage (Pink). Soybeans and pieces of soybeans with a pink discoloration caused by fungal activity. The discoloration may appear on one or both sides. (VRI – [SB - 8.1 Mold Damage \(Pink\)](#))

Cross sectioned soybeans that have a pinkish discoloration on the cotyledon extending around the entire perimeter with color intensity meeting VRI – [SB - 8.1 Mold Damage \(Pink\)](#) are considered damaged. If the color intensity is greater than shown, the extent of the discoloration around the perimeter may be prorated.

Sprout-Damaged Kernels. Soybeans and pieces of soybeans which are sprouted with the sprout protruding. Soybeans with broken off sprouts are considered sound unless otherwise damaged. (VRI – [SB - 9.0 Sprout Damage](#))

Stinkbug Stung Kernels. Soybeans and pieces of soybeans which show an indentation or discoloration on the seed coat. Cross section kernels through the suspected sting to determine the extent of damage. Stinkbug stung kernels should not be confused with kernels that are damaged by weevils. (VRI – [SB - 10.0 Stinkbug or Insect Stung Kernels](#))

Stinkbug stung kernels are considered damaged at the rate of one-fourth of the actual percent.

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

Example: Damaged Kernels Calculation

Weight of representative portion (after removal of FM)	123 grams
Weight of other damaged kernels	1.60 grams
Weight of stinkbug damage	15.00 grams

- a. **Percent of other damaged kernels.**
 $(1.60\text{g} \div 123\text{g}) \times 100 = 1.30\%$.
- b. **Percent of stinkbug damage.**
 $(15.00\text{g} \div 123\text{g}) \times 100 \div 4 = 3.04\%$.
- c. **Damaged kernels (total).**
 $(1.30\% + 3.04\%) = 4.34\%$ (rounded to 4.3%).

Certification. Record the percent of damaged kernels on the work record and “Results” section of the certificate to the nearest tenth percent.

10.21 HEAT-DAMAGED KERNELS

Definition. *Soybeans and pieces of soybeans that are materially discolored and damaged-by-heat.*

Basis of Determination. Determine heat-damaged kernels on a portion of 125 grams after the removal of foreign material. (VRI – [SB - 5.0 Heat Damage \(Materially Damaged/Heating\)](#))

Note: Heat-damaged kernels are included in the total percent of other damaged kernels.

Certification. Record the percent of heat-damaged kernels on the work record and “Results” section of the certificate to the nearest tenth percent.

10.22 CLASS

Soybeans are divided into the following classes:

- a. Yellow Soybeans. *Soybeans that have yellow or green seed coats and which in cross section, are yellow or have a yellow tinge, and may include not more than 10.0 percent of soybeans of other colors.*
- b. Mixed Soybeans. *Soybeans that do not meet the requirements of the class Yellow soybeans.*

Basis of Determination. Determine class by the color characteristics of the kernels on a portion of 125 grams after the removal of foreign material.

Soybeans of Other Colors. *Soybeans that have green, black, brown, or bicolored seed coats. Soybeans that have green seed coats will also be green in cross section. Bicolored soybeans will have seed coats of two colors, one of which is brown or black, and the brown or black color covers 50 percent of the seed coats. The hilum of a soybean is not considered a part of the seed coat for this determination.* (VRI – [SB - 12.0 Soybeans of Other Colors](#))

Soybeans of other colors (SBOC) is not a class of soybeans.

Soybeans with green seed coats that are yellow when cross sectioned are considered Yellow soybeans.

Yellow or Green soybeans with distinct black or brown pigmented streaks or splotches covering 50 percent or more of the seed coat are considered bicolored soybeans.

The pioneer variety that has a smoky green color function as soybeans of other colors when found in yellow soybeans.

Black or Brown soybeans with distinct yellow or green pigmented streaks or splotches covering 50 percent or more of the seed coat are considered bicolored soybeans.

Certification. For Mixed soybeans, record the percent of Yellow soybeans and soybeans of other colors on the work record and “Results” section of the certificate to the nearest tenth percent.

When not a mixture, record the percent of "soybeans of other colors," on the work record and “Results” section of the certificate to the nearest tenth percent.

10.23 OFFICIAL CRITERIA

Official criteria factors are determined only on request and do not affect the grade designation.

- a. Oil and/or Protein. An applicant may request analysis for oil, protein, or oil and protein content.

Basis of Determination. All oil and protein analyses must be performed in accordance with official procedures established by FGIS.

Certification. Record the percent of Oil and/or Protein on the work record and “Results” section of the certificate to the nearest tenth percent on a 13.0% moisture basis. For more information, refer to the [NIRT Handbook](#) and the [Grain Inspection Handbook III, Inspection Procedures](#).

- b. Sclerotinia Sclerotiorum. The fungus *S. sclerotiorum* causes a stem disease (stem rot) in soybeans which results in large black growths (sclerotinia) on the stem and pods. Seeds may occasionally become infected within diseased pods. If infected early, the seeds are flattened and badly shriveled and are sometimes replaced by sclerotinia. (VRI – [O.F. - 32.0 Sclerotia](#))

Basis of Determination. Examine the work portion, 1,000 – 1,050 grams, for the presence of sclerotinia.

Certification. Record the percent of sclerotinia on the work record and “Results” section of the certificate to the nearest tenth percent.

- c. Black Soybeans. Soybeans that have black seed coats.

Basis of Determination. Determine the percent of black soybeans on the color characteristics of the kernels on a 125-gram portion after the removal of FM.

Certification. Record the percent of black soybeans on the work record and “Results” section of the certificate to the nearest tenth percent.

- d. Seed Sizing. Consists of a measurement of soybeans passing through or remaining on top of a sieve(s) size specified by the applicant for service.

Basis of Determination. Determine seed sizing on a portion of 125 grams, after the removal of foreign material, using the following method:

Mechanical Sieving Method.

- a. Mount the sieve and the bottom pan on the mechanical sieve shaker.
- b. Set the stroke counter to 20 strokes.
- c. Put the representative portion in the center of the sieve and actuate the shaker.

- d. All soybeans passing through or remaining on top of the sieve(s) will determine the percent of size fractions.

Example: Seed Sizing Calculation

Weight of representative portion	125 grams
Weight of foreign material	2.87 grams
Weight of material remaining on top sieve	50.0 grams
Weight of material passing through sieve	72.0 grams

- a. **Portion size used to calculate size (adjusted).**
 $125\text{g} - 3\text{g} (2.9 \text{ rounded}) = 122 \text{ grams.}$
- b. **Percent remaining on top of sieve.**
 $(50\text{g} \div 122\text{g}) \times 100 = 40.98\% \text{ (rounded to } 41.0\%).$
- c. **Percent passing through sieve.**
 $(72\text{g} \div 122\text{g}) \times 100 = 59.02\% \text{ (rounded to } 59.0\%).$

Certification. Record the percent of the size fractions, as requested by the applicant, on the work record and “Results” section of the certificate to the nearest tenth percent.

- e. Seed Count. A measurement of the number of soybeans contained in a specified weight (i.e., number of soybeans per 1,000 grams or one pound).

Basis of Determination. Determine the count on a representative portion of 25 grams as illustrated below, after the removal of foreign material and non-whole soybeans (soybeans with more than one-fourth of the bean removed).

Example: Seed Count Calculation

Weight of representative portion	25.00 grams
Weight of foreign material	0.87 grams
Weight of non-whole soybeans	2.93 grams

- a. **Weight of whole soybeans.**
 $25\text{g} - (0.87\text{g} + 2.93\text{g}) = 25 - 4 \text{ (rounded)} = 21.00 \text{ grams.}$
- b. **Average count per gram (Truncated – disregard thousands).**
 $(172 \div 21\text{g}) = 8.19 \text{ whole soybeans.}$
- c. **Seed count per 1,000 grams.**
 $8.19 \times 1,000 = 8,190 \text{ whole soybeans.}$

Certification. Record seed count on the work record and “Results” section of the certificate.

- f. White Hilum. A test to determine the percent of whole soybeans with clear white hilum. Upon request, tests for other hilum colors (e.g., buff or brown) can be provided. (VRI – [\(SB\)-O.F. - 36.0 White Hilum](#))

The percent of whole soybeans is also obtained using this criteria.

Basis of Determination. Determine the percent of clear white hilum on a portion of 125 grams after the removal of foreign material and non-whole soybeans (soybeans with more than one-fourth of the bean removed).

When performing a white hilum test, consider damaged whole soybeans but do not consider soybeans of other colors in the percent of whole soybeans with clean white hilum.

Example: White Hilum Calculation

Weight of representative portion	125 grams
Weight of foreign material	2.36 grams
Weight of non-whole soybeans	4.69 grams
Weight of non-clear white hilum	1.55 grams

- a. **Weight of whole soybeans.**
 $125\text{g} - (2.36\text{g} + 4.69\text{g rounded}) = 125 - 7 = 118.0\text{ grams.}$
- b. **Weight of clear white hilum soybeans.**
 $118\text{g} - 2\text{g (1.55g rounded)} = 116.0\text{ grams.}$
- c. **Percent of whole soybeans.**
 $(118\text{g} \div 125\text{g}) \times 100 = 94.40\% \text{ (rounded to 94.4\%).}$
- d. **Percent of clear white hilum soybeans.**
 $(116\text{g} \div 118\text{g}) \times 100 = 98.30\% \text{ (rounded to 98.3\%).}$

Certification. Record the percent of whole soybeans and the percent of clear white hilum soybeans on the work record and “Results” section of the certificate to the nearest tenth percent.

- g. Cracked Seedcoats. Soybeans with cracked seedcoats must be whole (three-fourths or more of a whole soybean) sound soybeans which have readily discernable cracked seedcoats, have all or part of the seedcoat removed, or have growth stress cracks tight and next to the hilum.

Basis of Determination. Determine the percent of cracked seedcoats on a portion of 125 grams after the removal of foreign material and damaged kernels.

Example: Cracked Seedcoats Calculation

Weight of representative portion	125 grams
Weight of foreign material	3.85 grams
Weight of damaged soybeans	1.98 grams
Weight of split soybeans	17.90 grams
Weight of whole soybeans with cracked seedcoats	17.50 grams

- a. **Weight of whole soybeans.**
 $125\text{g} - (3.85\text{g} + 1.98\text{g} + 17.90\text{g}) = 125 - 24$ (rounded)
 $= 101.1$ grams.
- b. **Percent of whole soybeans with cracked seedcoats.**
 $(17.50\text{g} \div 101\text{g}) \times 100 = 17.32\%$ (rounded to 17.3%).

Certification. Record the percent of cracked seedcoats on the work record and “Results” section of the certificate to the nearest tenth percent.

- h. Shriveled and Wrinkled Soybeans. Whole non-damaged soybeans with an atypical size and appearance that pass through a 10/64" x 3/4" oblong-hole sieve and remain on top of the 8/64" round-hole sieve.
(VRI – [SB - 13.0 Shriveled and Wrinkled](#))

Basis of Determination. Determine shriveled and wrinkled soybeans after the removal of foreign material on a representative portion of 125 grams.

Example: Shriveled and Wrinkled Soybeans Calculation

Weight of representative portion	125 grams
Weight of foreign material	2.57 grams
Weight of damaged soybeans	1.46 grams
Weight of split soybeans	15.00 grams
Weight of whole shriveled and wrinkled soybeans	24.88 grams

- a. **Weight of whole soybeans that passed through a 10/64" x 3/4" oblong-hole sieve and remain on top of the 8/64" round-hole sieve.**
 $125\text{g} - (2.57\text{g} + 1.46\text{g} + 12.90\text{g}) = 125 - 17$ (rounded)
 $= 108.0$ grams.
- b. **Percent of whole shriveled and wrinkled soybeans.**
 $(24.88\text{g} \div 108\text{g}) \times 100 = 23.03\%$ (rounded to 23.0%).

Certification. Record the percent of shriveled and wrinkled of the work record and “Results” section of the certificate to the nearest tenth percent.