

INSPECTION OF SPECIALTY TYPE CORN

Contents

1. PURPOSE	2
2. REPLACEMENT HIGHLIGHTS.....	2
3. GENERAL INFORMATION.....	2
4. BACKGROUND.....	2
5. DEFINITION OF SPECIALTY TYPE CORN.....	3
6. BASIS OF DETERMINATION	3
7. ODOR.....	4
8. TEST WEIGHT PER BUSHEL	5
9. MOISTURE.....	5
10. INFESTED SPECIALTY TYPE CORN	5
11. DISTINCTLY LOW QUALITY.....	6
12. ACTIONABLE CRITERIA.....	7
13. BROKEN CORN AND FOREIGN MATERIAL	8
14. DAMAGED AND HEAT-DAMAGED KERNELS	13
15. PURITY	13
16. COLOR.....	13
17. AFLATOXIN TESTING	14
18. CERTIFICATION	14
21. QUESTIONS	14

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1. PURPOSE

This directive establishes uniform procedures for the analysis of Specialty Type Corn (e. g. Blue Corn *Zea mays L. subsp. Amylacea* (Sturtev.) Zhuk.) under the U. S. Grain Standards Act (USGSA).

2. REPLACEMENT HIGHLIGHTS

This directive is revised to specify that any moisture meter listed as approved in the Moisture Handbook can be used to determine moisture content. This directive supersedes FGIS Program Directive 9180.82, dated 5/01/13.

3. GENERAL INFORMATION

- a. Inspection of Specialty Type Corn is upon request and on a factor only basis.
- b. All quantities referenced in this directive are approximate unless otherwise specified.
- c. There are no classes, subclasses, or numerical grades for Specialty Type Corn.
- d. An applicant may request an analysis for quality factors such as moisture, test weight per bushel, damaged kernels, heat-damaged kernels, and aflatoxin.
- e. Use an approved divider to obtain sub portions of a sample for analysis unless otherwise specified.
- f. Official inspection personnel shall document inspection information during sampling and inspection.
- g. Four inspection levels (original, reinspection, appeal, and board appeal) are available under USGSA regulations for single lot and composite lot inspections. For shiplots and unit trains loaded to specific contract requirements, only three levels of inspection (original, review (reinspection or appeal inspection), and board appeal) inspection are available.

4. BACKGROUND

Blue corn (*Zea mays L. subsp. Amylacea* (Sturtev.) Zhuk.) is of the same genus and species as flint (*Zea mays induata*) and dent (*Zea mays indentata*) type of corn, which are presently defined in the U.S. Standards for corn and are classified into two primary classes, Yellow and White corn. However, in contrast, the majority of blue corn is a flour type of corn, which has a soft, floury endosperm covered by a thin, evenly distributed layer of hard, corneous endosperm. The outer endosperm is comprised of a single layer of cells containing blue pigment called the aleurone layer and the pericarp is a thin, transparent layer of crushed cells that cover the entire kernel and serves as the seed coat. The shape of kernels can range from small, flint-type kernels to large hominy types.

5. DEFINITION OF SPECIALTY TYPE CORN

- a. Specialty Type Corn, as described in this directive, is grain that before the removal of broken corn and foreign material consists of 50 percent or more shelled whole kernels of the species *Zea mays L.* subsp. *Amylacea* (Sturtev.) Zhuk. Specialty Type Corn typically has floury endosperm, but may include hard endosperm kernels, and the pericarp color of this subspecies may include blue, red, and purple.
- b. The sample must not meet the definition of white or yellow shelled dent or flint corn (*Zea mays L.*).
- c. Visually examine the sample to determine if it meets the definition of corn or Specialty Type Corn. If an analysis is necessary, make the determination on a 250-gram representative portion on the basis of the sample as a whole. From the 250-gram portion remove all whole kernels (i.e., kernels with less than one fourth broken off) of corn, other standardized grains, and Specialty Type Corn, and calculate the percentage of specialty type corn.

6. BASIS OF DETERMINATION

All determinations, except for kernel color, heat-damaged kernels, and damaged kernels, are based on the sample as a whole. Kernel color, heat-damaged kernels, and damaged kernels analyses are performed on the basis of the corn after the removal of broken corn and foreign material.

BASIS OF DETERMINATION		
Lot as a whole	Factors Determined Before the Removal of Broken Corn and Foreign Material	Factors Determined After the Removal of Broken Corn and Foreign Material
Heating Odor	Heating Moisture Odor Test Weight	Damaged kernels total Heat-damaged kernels Kernel color Odor Purity

7. ODOR

- a. **Basis of Determination.** Determine odor on evidence obtained at the time of sampling or on the sample either before or after the removal of broken corn and foreign material.

Odor Classification Examples

Sour	Musty	Commercially Objectionable Foreign Odors
Boot Fermenting Insect (acrid) Pigpen	Ground Insect Moldy	Animal hides Decaying animal and vegetable matter Fertilizer Fumigant Insecticide Oil products Skunk Smoke Strong weed

- b. **Commercially Objectionable Foreign Odors.** Commercially objectionable foreign odors are 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 corn contains a fumigant or insecticide odor that prevents a determination as to whether any other odor(s) exists, apply the following guidelines:

- (1) Original Inspections. Allow the work portion to aerate in an open container for 4 hours, or less, if the odor dissipates in less time.
- (2) 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.

- c. Record the words "Musty," "Sour", or "Commercially Objectionable Foreign Odor" in the "Results" section of the certificate. If samples have no odor, enter "OK" on the work record.

8. TEST WEIGHT PER BUSHEL

- a. Test weight per Winchester bushel (2,150.42 cubic inches) is determined using an approved device according to procedures prescribed in Federal Grain Inspection Service (FGIS) instructions.
- b. Determine test weight on a representative portion of the original sample with a quantity sufficient to overflow the kettle. 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.
- c. 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.

9. MOISTURE

- a. Moisture is determined by using approved moisture instruments listed in the Moisture Handbook utilizing the approved corn calibration (see FGIS Directive 9180.61).
- b. Determine moisture on a representative portion of approximately 650 grams before the removal of Broken Corn and Foreign Material (BCFM).
- c. Record the percentage of moisture on the work record and certificate to the nearest tenth percent.

10. INFESTED SPECIALTY TYPE CORN

Infested Specialty Type Corn is a specialty type corn 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 corn 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 corn is infested. Do not examine the file sample if the work sample is insect free.

Live weevils 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.

Basis of Determination. Determine infestation on the lot as a whole or the sample as a whole.

INSECT INFESTATION		
Samples meeting or exceeding any one of these tolerances are infested: 2 lw, or 1 lw + 5 oli, or 10 oli		
1,000-gram representative sample ¹ (+ 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. Record the number of insects in the “Results” section of the certificate.

11. DISTINCTLY LOW QUALITY

Consider Specialty Type Corn as 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 corn is of distinctly low quality. This includes a general examination of the corn during sampling and an analysis of the obtained sample(s).

Large Debris. Specialty Type Corn 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. Specialty Type Corn that is obviously affected by other unusual conditions which adversely affect the quality of the corn and cannot be properly graded by use of the grading factors specified or defined in the standards is considered distinctly low quality.

Specialty Type Corn 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 corn contains diatomaceous earth, then the corn is not considered distinctly low quality due to diatomaceous earth. Refer to FGIS Program Directive 9180.49, “Grading and Certification of Grain Containing Diatomaceous Earth and Silica Gel,” for additional information regarding the testing of corn for diatomaceous earth.

Certification. Record the words “Distinctly Low Quality” and the reason(s) why in the “Results” section of the certificate.

12. ACTIONABLE CRITERIA

Lots that exceeds Food and Drug Administration (FDA) limits for certain harmful or toxic substances (e.g., castor beans) must be reported to the local FDA office.

Basis of Determination. Determine Actionable Criteria before the removal of broken corn and foreign material based on a work portion of 1,000 to 1,050 grams. The Actionable Criteria Table provides 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.”

ACTIONABLE CRITERIA			
Criteria	Reference Image	Number/Weight ¹	
		Sample Basis	Lot Basis ²
Animal filth	Animal filth	Excess of 0.20%	N/A
Castor Beans	Castor Beans	2 or more	N/A
Cockleburs	Cockleburs	8 or more	N/A
Crotalaria seeds	Crotalaria	3 or more	N/A
Glass		2 or more	N/A
Commercially Objectionable		Presence	N/A
Foreign Odor			
Stones		Excess of 0.1% by weight	N/A
Unknown foreign substances ³	Fertilizer	4 or more	N/A
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 Consider feed pellets and processed grain products as foreign material, not unknown foreign substance.

* For Distinctly Low Quality, see section 10.

Certification. Report Actionable Criteria on the work record and in the “Results” section of the certificate. Record count factors to the nearest whole number.

13. BROKEN CORN AND FOREIGN MATERIAL

Broken Corn. All matter that passes readily through a 12/64 round-hole sieve and over a 6/64 round-hole sieve according to procedures prescribed in FGIS instructions.

Foreign Material. All matter that passes readily through a 6/64 round-hole sieve and all matter other than Specialty Type Corn that remains on top of the 12/64 round-hole sieve after sieving according to procedures prescribed in FGIS instructions. Shelled flint and/or dent corn (*Zea mays*, L.) as defined in the U.S. Standards for Corn, is considered as foreign material.

Broken Corn and Foreign Material. All matter that passes readily through a 12/64 round-hole sieve and all matter other than corn that remains in the sieved sample after sieving according to procedures prescribed in FGIS instructions.

Basis of Determination. Determine the factor broken corn and foreign material (BCFM) on a portion of 1,000 to 1,050 grams.

Procedure. The approved methods for determining the factor BCFM are the methods described in this section.

The procedure is performed in two steps: A mechanical separation of BCFM is made using a Carter Dockage Tester to remove the larger and finer particulate matter from the sample. The mechanically cleaned sample is then handpicked to remove any remaining similarly sized foreign material from the sample. To avoid repeating operations, check the material found in the BCFM sieve catch pans for live weevils and other live insects injurious to stored grain, stones, distinctly low quality, and other actionable criteria factors.

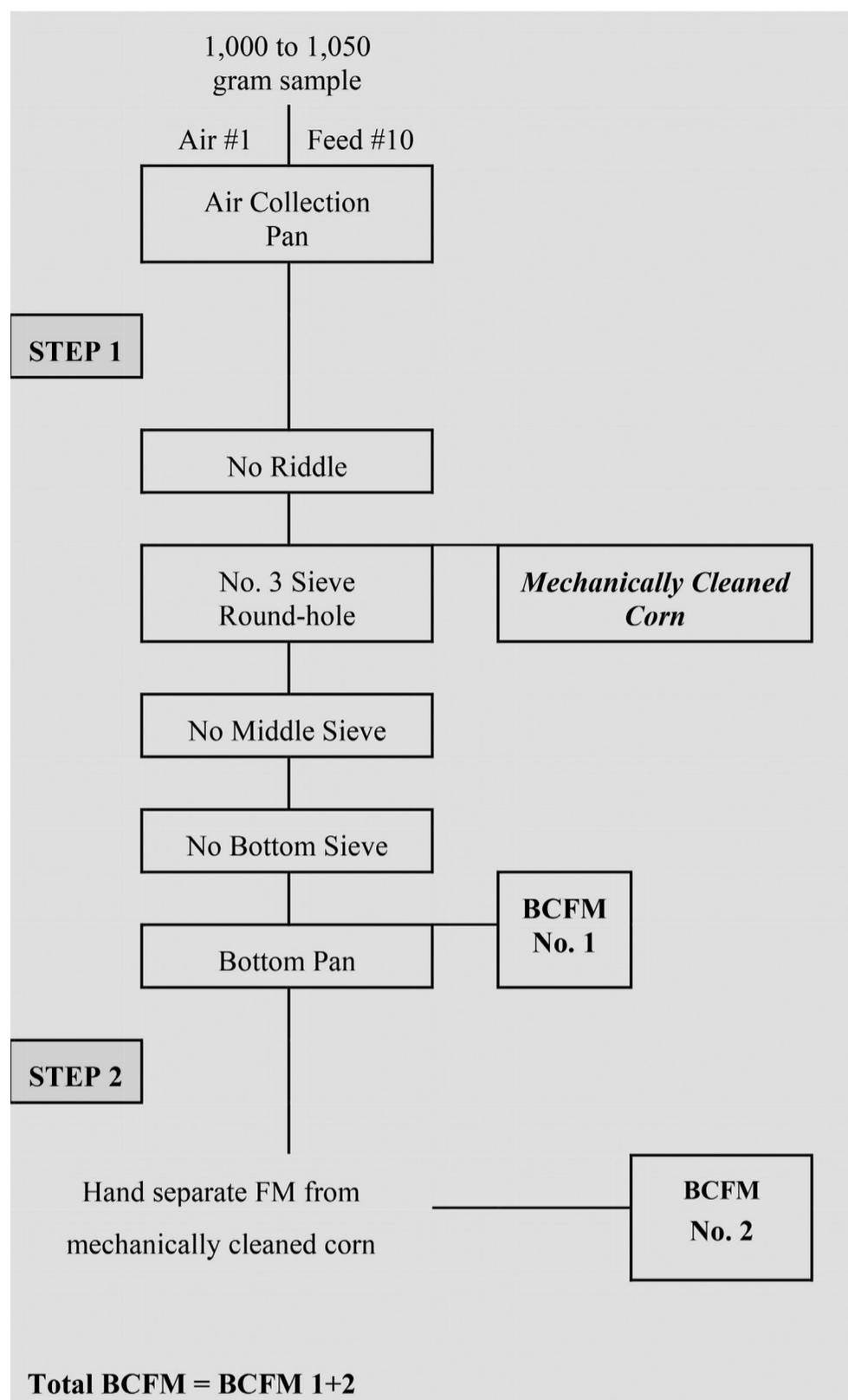
PROCEDURE FOR DETERMINING BCFM

STEP 1. Carter Dockage Tester.

- a. Set the air control to 1 and the feed control to 10.
- b. Insert the No. 3 sieve in the top sieve carriage.
- c. Run 1,000 – 1,050 grams through the dockage tester.

STEP 2. Handpick (foreign material)

- a. Remove all matter other than corn, including sweet corn, standardized shelled flint and/or dent corn (*Zea mays*, L.), and popcorn. (Reference: Visual Reference Image No. OF-Sweet Corn & Popcorn), from the mechanically cleaned portion.
- b. Combine the mechanically separated and handpicked BCFM.



Certification. Record the percentage of BCFM on the work record and certificate to the nearest tenth percent. Upon request, use the following alternate procedure which allows for the separation of BC and FM.

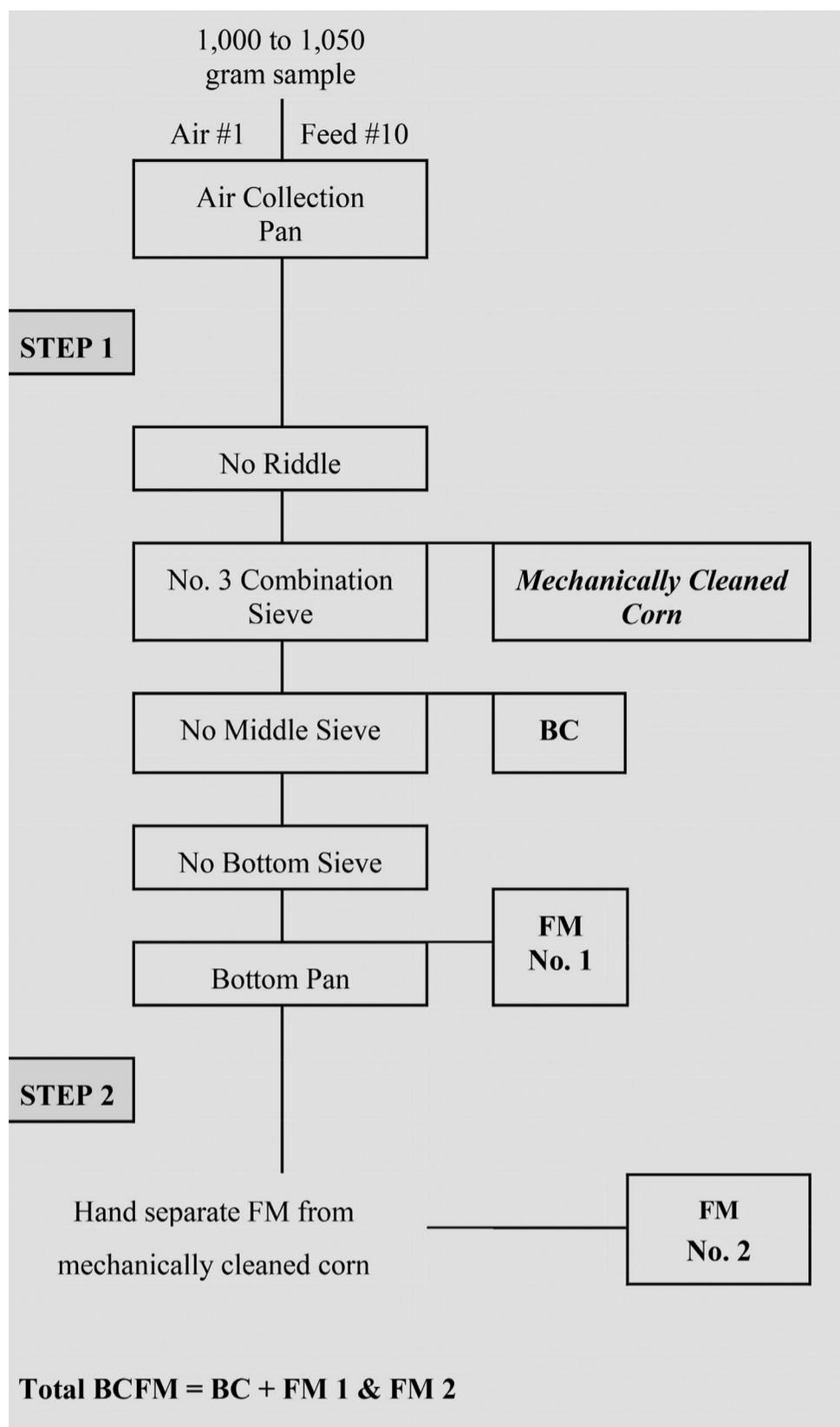
ALTERNATE PROCEDURE FOR DETERMINING BC AND FM

STEP 1. Carter Dockage Tester.

- a. Set the air control to 1 and the feed control to 10.
- b. Insert the combination 12/64 inch and 6/64 inch No. 3 sieve in the top sieve carriage.
- c. Run 1,000 – 1,050 grams through the dockage tester.
- d. BC consists of all material passing through the 12/64 inch sieve and over the 6/64 inch sieve (collected in the middle sieve collection pan).
- e. FM consists of all material passing through the 6/64 inch sieve (collected in the bottom collection pan).

STEP 2. Handpick (foreign material)

- a. Remove all matter other than corn, including sweet corn, standardized shelled flint and/or dent corn (*Zea mays, L.*), and popcorn from the mechanically cleaned portion.
- b. Combine the mechanically separated and handpicked FM.



Alternate Procedure for Determining BCFM (Hand Sieve Method). Official personnel have the option of manually hand-sieving or mechanically sieving (using a sizer shaker) the BCFM portion.

Follow the procedures listed below to separate the components BC and FM from machine (Carter Dockage Tester) separated BCFM.

a. Mechanically Sieving Method.

1. Mount a 6/64 round-hole hand sieve and a bottom collection pan on a mechanical sieve shaker.
2. Set the stroke counter to 5.
3. Remove the BCFM collection pan from the Carter Dockage Tester and pour the contents into the center of the 6/64 round-hole sieve.
4. Turn the sieve shaker on.
5. After the sieve shaker has stopped carefully remove the sieve and bottom collection pan.
6. Combine the material that lodged in the perforations with the material that remained on top of the sieve. Consider this material as broken corn.
7. Consider the material in the bottom collection pan as foreign material.
8. Remove all matter other than corn, including sweet corn, standardized shelled flint and/or dent corn (*Zea mays*, L.), and popcorn from the mechanically (Carter Dockage Tester) cleaned portion and combine with the foreign material in step 7 above. This combination of mechanically separated FM and hand-picked FM functions as foreign material.
9. Calculate the percentages of BC and FM separately.

b. Hand Sieving Method.

1. Mount a 6/64 round-hole hand sieve to a bottom collection pan.
2. Remove the BCFM collection pan from the Carter Dockage Tester and pour the contents into the center of the 6/64 round-hole sieve.
3. Hold the sieve level in both hands with elbows close to the body.
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 5 times.

6. Combine the material that lodged in the perforations with the material that remained on top of the sieve. Consider this material as broken corn.
7. Consider the material in the bottom collection pan as foreign material.
8. Remove all matter other than corn, including sweet corn, standardized shelled flint and/or dent corn (*Zea mays*, L.), and popcorn from the mechanically (Carter Dockage Tester) cleaned portion and combine with the foreign material in step 7 above. This combination of mechanically separated fm and hand-picked FM functions as foreign material.
9. Calculate the percentages of BC and FM separately.

Adjustment of Factors. In certain instances, when using the alternate procedure, the sum of BC and FM in corn, due to rounding, will not equal the percentage of BCFM recorded on the certificate. When this occurs, it is necessary to adjust the component nearest a midpoint (e.g.; .05, .15, .25, .35, etc.) by adding or subtracting 0.1.

Example

Original sample weight	1,012 grams
Weight of BC	38.34 grams
Weight of FM	2.64 grams
Weight of BCFM	40.98 grams

STEP 1 $(38.34 \div 1,012) \times 100 = 3.78\%$ BC (rounded 3.8%).

STEP 2 $(2.64 \div 1,012) \times 100 = 0.26\%$ FM (rounded 0.3%).

STEP 3 $(40.98 \div 1,012) = 4.04\%$ BCFM (rounded 4.0%).

Since the sum of the rounded BC and FM results (3.8% BC + 0.3% FM = 4.1%) does not equal the rounded BCFM results (4.0% BCFM), an adjustment of -0.1 is needed. In this instance, the rounded result for FM (0.3%) is adjusted downward to 0.2% because the unrounded result (0.26%) is nearer to a midpoint (0.25) than the unrounded result for BC.

Certification. Record the percentage of BC and the percentage of FM separately to the nearest tenth in the “Results” section of the certificate. Record the total percentage of BCFM to the nearest tenth percent.

14. DAMAGED AND HEAT-DAMAGED KERNELS

- a. Damaged kernels are whole kernels or pieces of corn kernels 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.
- b. Heat-damaged kernels are whole kernels or pieces of corn kernels that are materially discolored and damaged by heat.
- c. Determine total damaged kernels and heat-damaged kernels on the basis of a 250-gram portion that is free from broken corn and foreign material (BCFM).
- d. Report the percentage of total damaged kernels and heat-damaged kernels to the nearest tenth percent on the work record and certificate.

15. PURITY

Purity refers to the total percentage of specialty corn minus the percentage of BCFM (standardized corn, popcorn, and sweet corn function as BCFM).

Basis of Determination. Determine Purity on a portion of 1,000 to 1,050 grams.

Procedure: Calculate the percentage of BCFM in the sample. Subtract the percentage of BCFM from 100 percent. The resulting difference is the actual percent of Specialty Type Corn in the sample.

For example a sample contains 3.2 percent of BCFM, the purity is equal to 96.8 percent (100.0 – 3.2).

Certification. Certify purity on the work record and certificate to the nearest tenth percent.

16. COLOR

Determine kernel color on the pericarp color of the kernels. Pericarp colors may include blue, red, and purple kernels.

Basis of Determination. Determine the color of Specialty Type Corn by the color characteristics of the kernels. Use a 250-gram portion of BCFM-free corn and consider all kernels and pieces of corn kernels for the determination.

Certification. Record the percentage of the color(s) of Specialty Type Corn in the sample to the nearest tenth percent on the work record and in the “Results” section of the certificate. For example: Blue Kernels 98.2 percent, Red Kernels 1.8 percent.

17. AFLATOXIN TESTING

- a. Samples may be tested for aflatoxin using only FGIS-approved quantitative or qualitative test kits.
- b. The minimum sample size is based on the type of lot. Applicants may request a sample size larger than the minimum sample size.

Lot Type	Minimum Sample Size (lbs.)/ grams
Trucks	2 pounds / approximately 908 grams
Railcars	3 pounds / approximately 1,362 grams
Barges/Sublots	10 pounds / approximately 4,540 grams
Submitted Samples	10 pounds / approximately 4,540 grams (recommended)

Note: A minimum sample size of 10 pounds is required for composite type samples (e.g., a single sample representing multiple carriers). A 10-pound sample size is also recommended, but not required, for submitted samples.

Testing locations that receive submitted samples that contain less than the recommended 10-pound sample size must grind the entire sample as submitted. For submitted samples that are 10-pounds or more, a minimum of 10-pounds must be ground for testing purposes.

- c. Perform aflatoxin testing and certification in accordance with the applicable instructions in the Aflatoxin Handbook.

18. CERTIFICATION

- a. Certify lots/samples of Specialty Type Corn as “Not Standardized Grain” on the gradeline of the certificate. Delete the word “Grade” on the grade line of the certificate and enter the words “Not Standardized Grain.”
- b. In the “Remarks” section of the certificate enter “Specialty Type Corn.”
- c. Enter the test results of all factors determined in the “Results” section of the certificate.

21. QUESTIONS

Direct any questions concerning this directive to the Policies, Procedures, and Market Analysis Branch at (202) 720-0228.