

INSPECTION OF POPCORN

1. PURPOSE

This directive establishes uniform procedures for the factor analysis of popcorn. This service is provided under the authority of the Agricultural Marketing Act of 1946 (AMA), as amended.

2. REPLACEMENT HIGHLIGHTS

This directive is revised to explain moisture content determination utilizing the Dickey-john GAC 2100, Grain Analysis Computer, and to make minor editorial and format changes. This directive supersedes FGIS Directive 9180.64, dated August 20, 2007.

3. DEFINITION OF POPCORN

- a. Popcorn (*Zea Mays Everta*) as used in this directive is commodity that, before the removal of FM, consists of 80 percent or more of whole or broken popcorn kernels.
- b. Whole kernels are kernels with three-fourths or more of the kernel present.
- c. Normally, a visual appraisal of the sample is sufficient to determine if it meets the definition of popcorn. However, if an analysis is necessary, make the determination on a portion of 125 grams before the removal of FM.

4. GENERAL INFORMATION

There are no classes, subclasses, or grades for popcorn. The inspection of popcorn is on a factor only basis. The factors analyzed are: kind of grain, insects, heating, odor, animal filth, moisture, bird dropping, broken glass, castor beans, cockleburs, color, crotalaria seeds, stones, unknown foreign substances, heat-damaged kernels, damaged kernels, foreign material, aflatoxin, and popping ratio.

5. PERCENTAGES

Except for kind of commodity, state all percentages in whole and tenth percent. State the kind of grain to the nearest whole percent.

6. BASIS OF DETERMINATION

Table 1

Basis of Determination		
Factors Determined on the Basis of Lot as a Whole	Factors Determined Before the Removal of FM	Factors Determined After the Removal of FM
Heating Odor	Heating Insects Kind of grain Moisture Odor Stones Unknown foreign substances Aflatoxin Foreign material	Damaged kernels Heat-damaged kernels Odor Popping ratio Color

7. INSPECTION FACTORS

a. Factors Determined Before the Removal of FM

(1) Insects

Insects refer to popcorn that has live weevils or other live insects injurious to stored grain, according to procedures prescribed in Federal Grain Inspection Service (FGIS) instructions.

- (a) Examination Procedure Order. Examine the work sample and the file for insects. Do not examine the file sample if the work portion is insect free.
- (b) Injurious Insect References. Live weevils will include rice weevils, granary weevils, and lesser grain borers. Other live insects injurious to stored grain will include grain beetles, grain moths, mealworms, vetch bruchids, and larvae.

- (c) Basis of Determination. Determine insects on evidence obtained at the time of sampling on the lot as a whole or the sample before the removal of FM (approximately 1,000 grams).
 - (d) Certification. If the lot is found to contain insects, record the word "Insects" on the certificate and pan ticket showing the number and kind of live weevils and other live insects injurious or damaging to stored grain.
- (2) Heating
- (a) Definition. A high temperature from excessive respiration is considered heating. Heating popcorn in its final stages usually produces a sour or musty odor.

Do not confuse a lot that is heating with a lot that is warm and moist because of storage in bins, railcars, or other containers during hot weather.
 - (b) Basis of Determination. Determine heating on evidence obtained at the time of sampling on the lot as a whole or the sample before the removal of FM.
 - (c) Certification. When heating is detected, show the word "Heating" on the pan ticket and certificate.
- (3) Animal Filth, Glass, and Unknown Foreign Substance
- (a) Basis of Determination. Determine animal filth, glass, and unknown foreign substances on the basis of the sample as a whole before the removal of FM (approximately 1,000 grams).
 - (b) Notification. Immediately report any animal filth found in the sample to the Food and Drug Administration District office nearest to the location of the Popcorn lot.
 - (c) Certification. Record the number of pieces of animal filth, glass, and unknown foreign substances on the pan ticket and the certificate.

(4) Moisture

- (a) Definition. Moisture is the water content in popcorn as determined by the GAC 2100 moisture instrument using the approved calibration (see FGIS Directive 9180.61).
- (b) Basis of Determination. Determine moisture on a portion of approximately 350 grams before the removal of FM.
- (c) Certification. Record the percentage of moisture on the pan ticket and the certificate to the nearest tenth percent.

(5) Odor

- (a) Basis of Determination. Determine odor on evidence obtained at the time of sampling, either before or after the removal of FM. Odor detected at the time of sampling must be recorded on the pan ticket. However, the final determination for odor must be performed in the laboratory.

Table No. 2 - 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

- (b) Commercially Objectionable Foreign Odors. Commercially Objectionable Foreign Odors (COFO) are odors foreign to popcorn that render it unfit for normal commercial usage.

- (c) Odor Dissipation. Fumigant or insecticide odors are considered COFO if they linger and do not dissipate. When a sample of popcorn contains a fumigant or insecticide odor that prevents a determination as to whether any other odor(s) exists, apply the following guidelines:
- 1 Original Inspection. Allow the work portion to aerate in an open container for 4 hours, or less, if the odor dissipates in less time.
 - 2 Appeal Inspections, and Board Appeal Inspections. Allow unworked file samples and new samples to aerate in an open container for a period not to exceed 4 hours. Do not aerate file samples (unworked files) which were previously aerated and retained as the final file.
- (d) Odor Does Not Dissipate. Consider the sample as having a COFO if the fumigant or insecticide odor persists based on the above criteria.
- (e) Certification. If present, record the words "Musty," "Sour," or "Commercially Objectionable Foreign Odor" on the pan ticket and the certificate.

(6) Foreign Material

All matter other than popcorn.

- (a) Basis of Determination. Determine the factor Foreign Material (FM) on a portion of approximately 1,000 grams.

The approved methods for determining the factor FM are the methods described in this section. The procedure is performed in two steps: The sieve sizes are used as an aid in the determination of FM.

- 1 A mechanical separation of FM is made using a Carter Dockage Tester to remove the larger and finer particulate matter from the sample.
- 2 The mechanically cleaned sample is then handpicked to remove any remaining similarly sized FM from the sample.

To avoid repeating operations, check the material found in the FM sieve catch pans for live weevils and other live insects injurious to stored grain, stones, distinctly low quality, and other sample grade factors. Live weevils, other live insects injurious to stored grain, and sample grade factors are considered FM.

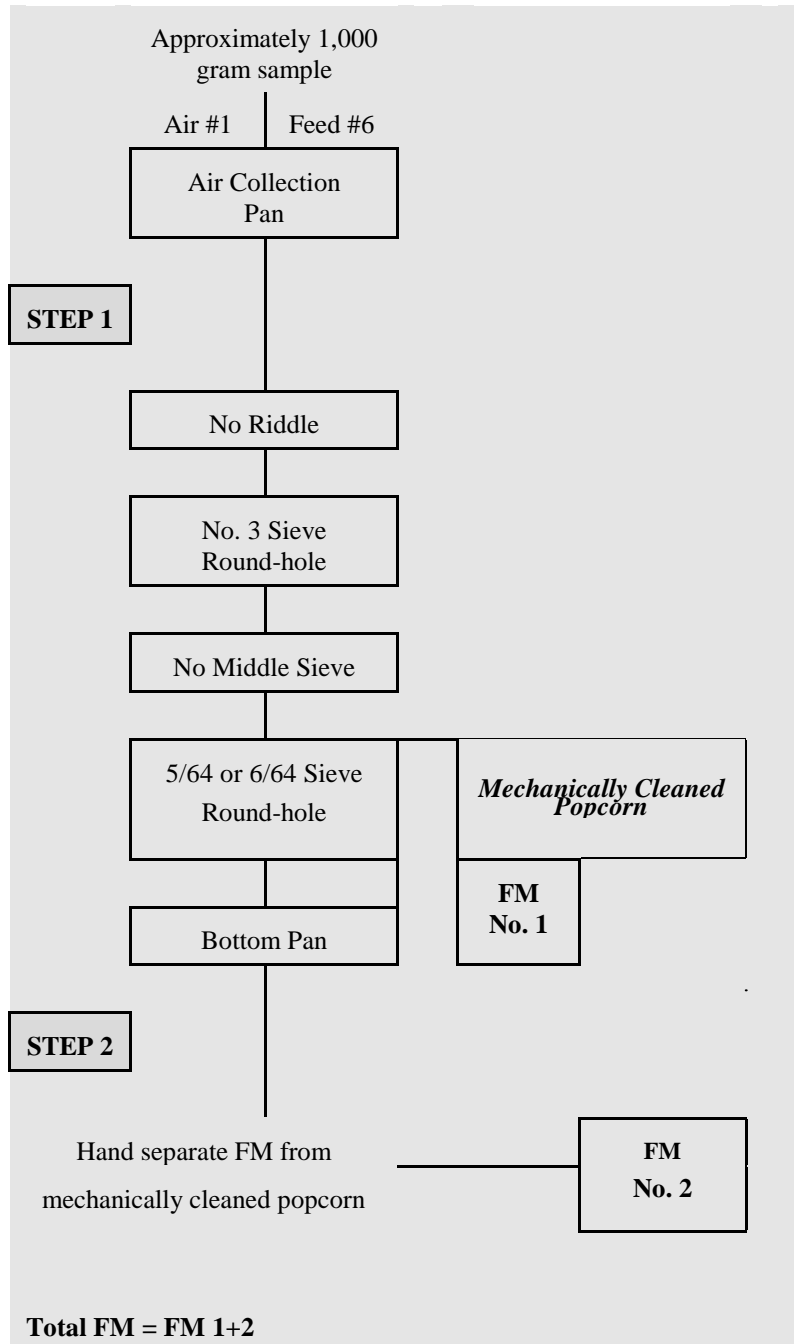
PROCEDURE FOR DETERMINING FM

STEP 1. Carter Dockage Tester.

- a. Set the air control to 1 and the feed control to 6.
- b. Insert the No. 3 (12/64) sieve in the top sieve carriage
- c. Insert a 5/64 or 6/64 round-hole sieve in the bottom sieve carriage.
- d. Run 1,000 – 1,050 grams through the dockage tester.

STEP 2. Handpick (foreign material)

- a. Remove all matter other than popcorn from the mechanically cleaned portion.
- b. Combine the mechanically separated and handpicked FM.



(b) Alternate Procedure for Determining FM (Hand Sieve Method).

Official personnel have the option of manually hand-sieving or mechanically sieving (using a sizer shaker) the FM portion.

Follow the procedures listed below to separate the component FM.

1 Mechanically Sieving Method

- a Mount a 5/64 or 6/64 round-hole hand sieve and a bottom collection pan on a mechanical sieve shaker.
- b Set the stroke counter to 5.
- c Add approximately 250 grams of the work portion to the sieve shaker.
- d Turn the sieve shaker on.
- e After the sieve shaker has stopped carefully remove the sieve and bottom collection pan.
- f Combine the material that lodged in the perforations with the material that remained on top of the sieve. Consider this material as popcorn.
- g Consider the material in the bottom collection pan as foreign material.
- h Remove all matter other than popcorn from the mechanically cleaned portion and combine with the foreign material in step g above. This combination of mechanically separated FM and hand-picked FM functions as foreign material.
- i Repeat the above steps until all of the sample has been sieved.
- j Calculate the percentage FM.

2 Hand Sieving Method

- a Mount a 5/64 or 6/64 round-hole hand sieve to a bottom collection pan.

- b Add approximately 250 grams of the work portion to the sieve.
 - c Hold the sieve level in both hands with elbows close to the body.
 - d In a steady motion, move the sieve from left to right approximately 10 inches and then return from right to left.
 - e Repeat this operation 5 times.
 - f Combine the material that lodged in the perforations with the material that remained on top of the sieve. Consider this material as popcorn.
 - g Consider the material in the bottom collection pan as foreign material.
 - h Remove all matter other than popcorn from the mechanically cleaned portion and combine with the foreign material in step g above. This combination of mechanically separated FM and hand-picked FM functions as foreign material.
 - i Repeat the above steps until all of the sample has been sieved.
 - j Calculate the percentage FM.
- (c) Certification. Record the percentage of FM on the certificate to the nearest tenth percent.

(7) Stones

- (a) Definition. Stones are concreted earthy or mineral matter and other substances of similar hardness that do not readily disintegrate in water.
- (b) Basis of Determination. Determine stones on a representative portion of approximately 1-1/8 to 1-1/4 quarts.
- (c) Certification. Show stones on the work record and certificate to the nearest tenth percent.

b. Factors Determined After the Removal of FM

(1) Damaged Kernels

- (a) Definition. Kernels and pieces of popcorn 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. A kernel is considered damaged for inspection and grading purposes when the damage is distinctly apparent and of such character as to be recognized as damaged for commercial purposes.
- (b) Basis of Determination. Determine damaged kernels on approximately 125 grams of foreign material-free popcorn.

(2) Types of Damage See Visual Reference Images ([Visual Reference Library](#) for Corn).

- (a) Blue-eye Mold. A germ infected with blue-eye mold, regardless of the amount. If the mold is distinct, it is not necessary to open or scrape the kernel. Otherwise, lift the germ cover carefully to avoid destroying the evidence of mold.

Do not confuse purple plumule with blue-eye mold. Purple plumule is not damage but is a genetic or varietal characteristic.

- (b) Cob Rot. Cob rot is caused by a fungus that attacks weakened plants. It is detected by the presence of a distinct discoloration or rotting. Opening the kernel is not required to detect cob rot but may be necessary to determine the extent of other types of damage.
- (c) Drier-Damaged Kernels. Kernels and pieces of kernels which have a discolored, wrinkled, and blistered appearance; or which are puffed or swollen and slightly discolored and which often have damaged germs; or whose seedcoats are peeling off or have already peeled off; or which have a fractured or checked appearance resulting from external heat caused by artificial drying methods. Do not confuse drier damage with heat damage (drier).
- (d) Germ-damaged Kernels (Slight Discoloration By Respiration). Kernels and pieces of kernels damaged by respiration or heat but not materially discolored.

In most cases, the germ covering will have to be removed, exposing the area around the plumule. The discoloration must extend into the meat of the germ to be considered damaged.

- (e) Heat-Damaged Kernels. Kernels and pieces of kernels which are materially discolored by excessive respiration, with the dark discoloration extending out of the germ through the sides and into the back of the kernel.
- (f) Heat-Damaged Kernels (Drier). Kernels and pieces of kernels, which are puffed or swollen and materially discolored and damaged by external heat caused by artificial drying methods. Determine heat-damaged kernels on a portion of 125 grams of FM-free popcorn.

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

- (g) Insect-Bored Kernels. Kernels and pieces of kernels with obvious insect-bored holes or which have tunneling, insect webbing, or insect refuse. Do not consider kernels partially eaten but entirely free from refuse, webbing, insects, or other forms of damage as damaged. Do not cut open the kernel when making this determination. If the determination cannot be made without cutting the kernel, the kernel is considered damaged.
- (h) Mold-Damaged Kernels. Kernels and pieces of kernels infected with mold on exposed endosperm. When a kernel of popcorn has been broken exposing the starch, it becomes susceptible to mold. Check broken pieces carefully for mold.
- (i) Mold-like Substance. Whole kernels of popcorn that are 50 percent or more covered and pieces of kernels which are discolored and covered with a mold-like substance. Do not confuse kernels that have dirt on them with kernels containing mold. Mold is usually blue or green in color.
- (j) Silk-Cut Kernels. Kernels and pieces of kernels with mold in silk-cuts. Kernels with clean silk cuts and are otherwise sound are not considered as being damaged.
- (k) Surface Mold (Blight). Kernels and pieces of kernels which have mold caused by popcorn leaf blight on them which appears to be only on the surface but actually penetrates the seed coats.

- (l) Surface Mold. Kernels and pieces of kernels, which contain surface, mold in any area or combination of areas equal to or greater than shown on the visual reference image.
- (m) Mold (pink Epicoccum). Kernels and pieces of kernels with germs infected with mold.
- (n) Sprout-Damaged Kernels. Sprouted kernels or those showing evidence of a sprout.
- (o) Certification. Record the percent of damaged kernels on the pan ticket and certificate to the nearest tenth percent.

(3) Color

There are no subclasses in Popcorn. Popcorn is either white or yellow in color.

- (a) Certify the lot as popcorn without any description of color (e.g., yellow, white, mixed).
- (b) Upon request, the percentage of yellow and/or white kernels can be determined.
- (c) When the percentage of color is requested, make this determination on a representative portion of approximately 125 grams.
- (d) Record the percentage of white and/or yellow kernels in the sample portion on the work record and the certificate in whole percentages.

8. TYPE OF SERVICES

- a. Lot Inspection Service requires FGIS or an authorized cooperator to obtain a representative sample from an identified lot using the following procedures and forwarding the sample to the Technical Services Division, Quality Systems and Services Unit (QSS) for popping ratio testing.

1. Maximum Lot Size.

- (a) The maximum lot size is 500,000 lbs. (225,000 kg.).

- (b) If the lot exceeds the maximum lot size, inform the applicant that the lot will have to be divided into smaller lots that do not exceed the maximum lot size.

2. Sample Rates

The following table shows the number of individual containers or the time intervals to use for obtaining sample portions.

Lot Size In Pounds	Lot Size In Kilograms	Number of Containers or Time Intervals Per Lot
45,000 or less	20,250 or less	12
45,001 - 180,000	20,251 - 81,000	20
180,001 - 500,000	81,001 - 225,000	35

- b. Submitted Sample Inspection Service consists of an applicant obtaining and forwarding a sample to QSS through a field office for testing. The applicant must identify the sample and send it to the local FGIS field office or QSS for popping ratio testing.

9. LEVEL OF SERVICE

- a. Original service is the initial inspection of a lot or a submitted sample.
- b. Field Office or TSD personnel will perform only one appeal inspection on any original inspection service. An applicant may request an appeal inspection on any of the kinds of inspection services performed for an original inspection. For appeal inspections, the field office and/or TSD can analyze the specified quality factor(s) that would be predetermined during an appeal or a Board appeal. For appeal inspections of analytical factors, however, the QSS must perform the analysis.
- c. An applicant who is dissatisfied with the original or appeal inspection results may appeal to the FGIS Board of Appeals and Review (BAR). The Board appeal is limited to an analysis of the file sample. When a request for a Board appeal inspection is filed, the file sample(s) and all other pertinent information will be immediately submitted to the BAR. The field office will act as a liaison between the BAR and the applicant.

10. TESTING SERVICE

- a. Testing will be performed at the Technical Services Division, QSS. Interested persons wishing to receive these testing services may contact QSS directly or request service through their local field office or an authorized cooperator to arrange for service. Application forms may be obtained from FGIS field offices.
- b. QSS will, upon request, provide popping ratio on all submitted and official file samples.
- c. Field personnel will maintain representative file samples when official sampling services are provided. FGIS personnel and cooperators will forward samples for testing to QSS. QSS will maintain a file sample (balance of the representative portion after testing) on each original, retest, and appeal inspection service.
- d. QSS uses a Metric Weight Volume Tester (MWVT) approved by the Popcorn Institute in the determination of popping ratio. Samples are analyzed 1 or 2 business days after QSS receives the sample. Results are immediately reported to the appropriate FGIS field office or cooperator after analyses are recorded by QSS. (see section 11 b., Certification and Billing).
- e. For MWVT information, cooperators and interested parties in the popcorn industry may obtain a copy of the basis guideline for the MWVT at the following address:

Popcorn Board
401 N. Michigan Ave.
Chicago, IL 60611-4267
Phone: (312) 644-6610
Fax: (312) 321-6869

11. CERTIFICATION

- a. Type of Certificate. Certify the analysis of popcorn on officially sampled lots on a commodity inspection certificate (FGIS-993). Issue a submitted sample certificate (FGIS-994) for samples submitted by an applicant or their agent.
- b. Certification and Billing. For all popping ratio service performed by QSS, the field office or cooperator nearest the location where the request originated will issue the applicable certificate(s) based on the results from QSS and complete the billing. Testing fees will be assessed in accordance with section 868.90 of the AMA regulations.

- c. Popping Ratio Unit of Measure. The appropriate field office/cooperator will show the popping value on the work record and certificate in cubic centimeters of popped corn per gram of raw corn.

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