

## 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 reduces portion size for damaged kernel determination in popcorn from 250 to 125 grams; provides instruction for reporting animal filth to the Food and Drug Administration (FDA); and incorporates other editorial changes. This directive supersedes FGIS Directive 9180-64, dated May 17, 1999.

### 3. DEFINITION OF POPCORN

- a. Popcorn (*Zea Mays Everta*) as used in this directive is grain that, before the removal of foreign material (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

- a. There are no classes, subclasses, or grades for popcorn.
- b. The inspection of popcorn is on a factor only basis. The factors are: kind of grain, moisture, heating, odor, bird dropping, other animal filth, broken glass, castor beans, cockleburs, *Crotalaria* seeds, stones, temperature, unknown foreign substances, heat-damaged kernels, damaged kernels, foreign material, aflatoxin, and popping ratio.
- c. The AMA regulations provide for three inspection service levels: original inspection, appeal inspection, and Board appeal inspection.

**5. PERCENTAGES**

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

**6. STANDARD ABBREVIATIONS**

Use the following abbreviation table to report the analysis of popcorn:

<b>Factor</b>	<b>Abbr.</b>	<b>Factor</b>	<b>Abbr.</b>	<b>Factor</b>	<b>Abbr.</b>
Popcorn seed	ps	Infested	inf	Damaged Kernels (Total)	dkt
Stones	stn	Moisture	m	Heat Damaged Kernels	ht
Heating	htg	Odor	odor	Commercially Objectionable	
Broken Glass	gls	Musty	must	Odor	cofo
Sour	sour	Aflatoxin	aflx	Unknown foreign substance	fsub
Popping Ratio	pr	Foreign Material	fm		

**7. BASIS OF DETERMINATION**

<b>Basis of Determination</b>		
<b>Factors Determine on the Basis of Lot as a Whole</b>	<b>Factors Determine Before the Removal of FM</b>	<b>Factors Determine After the Removal of FM</b>
Heating Infested Odor	Heating Infested Kind of grain Moisture Odor Stones Unknown foreign substances Aflatoxin Foreign material	Damaged kernels Heat-damaged kernels Odor Popping ratio

**8. INSPECTION FACTORS**

a. Factors Determined before the Removal of Foreign Material

(1) Infestation

(a) Infestation refers to popcorn that is infested with live weevils or other live insects injurious to stored grain, according to procedures prescribed in FGIS instructions.

- (b) The presence of any live weevil or other live insect injurious to stored grain indicates the probability of infestation and warns that the popcorn 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 popcorn is infested. Do not examine the file sample if the work portion is insect free.
  - (c) Live weevils shall include rice weevils, granary weevils, and lesser grain borers. Other live insects injurious to stored grain shall include grain beetles, grain moths, mealworms, vetch bruchids, and larvae. (See Grain Inspection Handbook, Chapter 1, General Information, Section 1.2, Visual Grading Aids.)
  - (d) Basis of Determination. Determine infestation on evidence obtained at the time of sampling on the lot as a whole or the sample before the removal of FM (1-1/8 to 1-1/4 quarts). For specific guidelines, see Grain Inspection Handbook, Book I, Grain Sampling.
  - (e) Certification. If the lot is found to be infested, record the word AInfested≅ 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) A high temperature from excessive respiration is considered heating. Heating popcorn in its final stages usually produces a sour or musty odor.  
  
Care should be taken not to 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 (1-1/8 to 1-1/4 quarts).

- (b) **Immediately report any animal filth** found in the sample to the FDA local field office.
  - (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) Water content in grain as determined by an approved device according to procedures prescribed in FGIS instructions.
  - (b) Basis of Determination. Determine moisture before the removal of FM on exactly 250 grams.
  - (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.

<b>Odor Classification Examples</b>			
<b>Sour</b>	<b>Musty</b>	<b>Commercially Objectionable Foreign Odors</b>	
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 (COFO) are odors foreign to popcorn that render it unfit for normal commercial usage.
- (c) 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 Reinspections, 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) 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 (FM)
  - (a) Foreign material. All matter other than popcorn.
  - (b) Basis of Determination. Determine foreign material on a work portion of 1-1/8 to 1-1/4 quarts.
  - (c) Certification. Record the percentage of FM on the pan ticket and certificate to the nearest tenth percent.

(7) Stones

- (a) 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) 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.
- (b) Basis of Determination. Determine damaged kernels on approximately 125 grams of foreign material-free popcorn.

(2) Types of Damage. 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.

- (a) Blue-eye Mold. A germ infected with blue-eye mold, regardless of 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. (Reference: Interpretive Line Slide No. C-1.0.)

Do not confuse purple plumule with blue-eye mold. Purple plumule is not damage but is a genetic or varietal characteristic. (Reference: interpretive Line Slide No. C-1.1)

- (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. (Reference: Interpretive Line Slide No. C-2.0.)
- (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). (Reference: Interpretive Line Slide No. C-3.0.)
- (d) Germ Damaged Kernels (slight discoloration by respiration). Kernels and pieces of kernels damaged by respiration or heat but not materially discolored. (Reference: Interpretive Line Slide No. C-4.0.) 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. (Reference: Interpretive Line Slide No. C-5.1 for Heat-damaged White popcorn, and No. 5.2 for Heat-damaged Yellow popcorn.)
- (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. (Reference: Interpretive Line Slide Nos. C-5.0, 5.1, and 5.2.)

(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. (Reference: Interpretive Line Slide No. C-6.0.)

(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. (Reference: Interpretive Line Slide No. C-7.0.)

Do not confuse kernels that have dirt on them with kernels containing mold. Mold is usually blue or green in color. (Reference: Interpretive Line Slide No. C-7.1.)

(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.

(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. (Reference: Interpretive Line Slide No. C-8.0.)

(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. (Reference: Interpretive Line Slide No. C-10.0.)

(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 interpretive line slide. (Reference: Interpretive Line Slide No. C-11.0.)

(m) **Mold (pink Epicoccum).** Kernels and pieces of kernels with germs infected with mold. (Reference: Interpretive Line Slide No. C-7.2.)

(n) **Sprout-Damaged Kernels.** Sprouted kernels or those showing evidence of a sprout (Reference: Interpretive Line Slide No. C-9.0.)



- (o) Certification. Record the percent of damaged kernels on the pan ticket and certificate to the nearest tenth percent.

## 9. POPPING RATIO

- a. General. Upon request FGIS will test popcorn for popping ratio. Testing will be done at the Analytical, Reference, and Testing Services Branch (ARTS). Interested persons wishing to receive these testing services may contact ARTS 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. When requesting official sampling services, the applicant must ensure that the lot is accessible and indicate the location of the product.
- b. Kind of Services. ARTS will, upon request, provide popping ratio on all submitted and official file samples. A retest analysis is based on the official file sample. Only one retest inspection service may be performed on any original inspection service.
  - (1) Appeal Inspection Service. This analysis is based on the official file sample or a new sample. An appeal inspection shall be based on a new sample only if the lot can be positively identified by official personnel as the one that was previously inspected and the entire lot is available and accessible for sampling and inspection.
  - (2) Lot Inspection Service. This service requires FGIS or an authorized cooperator to obtain a representative sample from an identified lot using approved procedures for **processed commodities** and forwarding the sample to ARTS for testing.
  - (3) Submitted Sample Inspection Service. This service consists of an applicant obtaining and forwarding a sample to ARTS through a field office for testing. The applicant must identify the sample and send it to the local FGIS field office or cooperator.
- c. Sample Size. For a quality inspection service, official personnel shall sample according to the guidelines in Book I of the Grain Inspection Handbook. A minimum of 250 grams of popcorn is needed to complete an analysis for popping ratio.

Field personnel will maintain representative file samples when official sampling services are provided. FGIS personnel and cooperators will forward samples for testing to ARTS. ARTS shall maintain a file sample (balance of the representative portion after testing) on each original, retest, and appeal inspection service.

- d. Test Procedure. ARTS 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 ARTS receives the sample. Results are immediately reported to the appropriate FGIS field office or cooperator after analyses are recorded by ARTS (see Certification and Billing).
- e. Address. Cooperators and interested parties in the popcorn industry may obtain a copy of the basis guideline for the MWVT at the following address:
 

Popcorn Institute  
401 N. Michigan Ave.  
Chicago, IL 60611-4267  
Phone: (312) 644-6610  
Fax: (312) 321-6869
- f. Certification and Billing. For all popping ratio service performed by ARTS, the field office or cooperator nearest the location where the request originated shall issue the applicable certificate(s) based on the results from ARTS and complete the billing. Testing fees will be assessed in accordance with Section 868.90 of the AMA regulations.
- g. 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.

**10. CERTIFICATION**

- a. Types of Certification. The analysis of popcorn shall be certified on a commodity certificate (FGIS-993). A lot inspection certificate must be issued for those lots that are officially sampled. A submitted sample certificate (FGIS-994) must be issued for a sample submitted by an applicant or an agent. Show the results of the analysis on a commodity inspection certificate in the following order:

Infestation	Moisture
Heating	Foreign material
Odor	Damaged kernels (total)
Animal filth	Heat-damaged kernels
Glass	Stones
Unknown foreign substance	Popping ratio

- b. Factor Only. When an applicant requests analysis for only a specific factor(s), record in the remarks section of the certificate "**Specific Factor Analysis Only**".

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