

## INSPECTION OF MUSTARD SEED

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## **1. PURPOSE**

This directive establishes procedures for the factor analysis of mustard seed under the Agricultural Marketing Act of 1946 (AMA), as amended.

## **2. REPLACEMENT HIGHLIGHTS**

This directive is revised to establish the approximate sample size for the GAC2500-UGMA and Perten AM 5200-A, and to make other minor editorial changes. This directive supersedes FGIS Program Directive 9180.52, dated 6/22/09.

## **3. GENERAL INFORMATION**

There are no classes, subclasses, or grades in mustard seed.

Inspection of mustard seed is on a factor only basis. Factors analyzed are: kind of grain, infestation, heating, odor, animal filth, glass, unknown foreign substances, garlic bulblets, moisture, dockage, stones, ergot, *Sclerotinia sclerotiorum* (sclerotinia), conspicuous admixture, buckwheat, other weed seed, other material, yellow mustard seed, brown mustard seed, oriental mustard seed, wild mustard seed, cow cockle, damaged kernels (total), heat-damaged kernels, distinctly green kernels, and inconspicuous admixture.

## **4. PERCENTAGES**

Except for stones and ergot, show percentages in whole and tenth percent to the nearest tenth percent. Show percentages of stones and ergot to the nearest hundredth percent.

Calculate percentages based on count by dividing the number of unsound kernels by total number of seeds in the portion and multiplying by 100.

Round percentages according to Federal Grain Inspection Service (FGIS) procedures.

## 5. STANDARD ABBREVIATIONS

Use the following abbreviations in the analysis of mustard seed:

Mustard seed	MS	Heating	HTG
Conspicuous admixture	CADM	Sclerotinia	SCT
Damaged kernels (total)	DKT	Ergot	ERG
Distinctly green kernels	DGK	Other material	OM
Dockage	DKG	Animal filth	ANFL
Heat-damaged kernels	HT	Broken glass	GLAS
Inconspicuous admixture	IADM	Unknown foreign substance	FSUB
Infested	INF	Other weed seed	OWS
Moisture	M	Garlic bulblets	GARB
Odor	ODOR	Buckwheat	BW
Musty	MUST	Yellow mustard seed	YMS
Sour	SOUR	Brown mustard seed	BMS
Commercially objectionable		Oriental mustard seed	OMS
foreign odor	COFO	Wild mustard seed	WMS
Stones	STON	Cow cockle	CCKL

## 6. BASIS OF DETERMINATION

How factors are determined:

**Table No. 1 - Basis of Determination**

Before Removing Dockage	After Removing Dockage	After Removing Dockage and Conspicuous Admixture
Animal filth	Brown mustard seed	Damaged kernels (total)
Dockage	Buckwheat	Heat-damaged kernels
Garlic bulblets	Conspicuous admixture	Distinctly green kernels
Glass	Ergot	Inconspicuous admixture
Infestation	Odor	Odor
Kind of grain	Other material	Wild mustard seed
Moisture	Other weed seed	Cow cockle
Odor	Oriental mustard seed	
Unknown foreign Substances	Sclerotinia	
	Stones	
	Yellow mustard seed	

## 7. DEFINITION OF MUSTARD SEED

**Mustard seed** (*Brassica hirta* and *B. juncea*) consists of 50.0 percent or more of whole mustard seed kernels before the removal of dockage. The term mustard seed does not include wild mustard seed.

Whole kernels are kernels with more than three-fourths of the kernel present.

**Basis of Determination.** A visual appraisal of the sample is sufficient to determine if it meets the definition of mustard seed. However, if analysis is necessary, make it before removing dockage on a portion of approximately 25 grams.

## 8.1 INFESTATION

Infestation refers to mustard seed infested with live weevils or other live insects injurious to stored grain according to procedures in FGIS instructions.

The presence of a live weevil or other live insect injurious to stored grain indicates the probability of infestation and warns you to examine the mustard seed to determine if it is infested. In such cases, examine the work sample and file sample before concluding the mustard seed is infested. Do not examine file sample if work portion is insect free.

Live weevils include rice weevils, granary weevils, cowpea weevils, maize weevils, and lesser grain borers. Other live insects injurious to stored grain include grain beetles, grain moths, vetch bruchids, and larvae. (See Grain Inspection Handbook, Book II, Chapter 1, General Information, Section 1.2, Visual Grading Aids).

**Basis of Determination.** Determine infestation on the lot as a whole and/or sample as a whole (approximately 500 grams). For specific guidelines, see Table No. 2 and Grain Inspection Handbook, Book I, Grain Sampling.

**Table No. 2 - Insect Infestation**

<b>Samples meeting or exceeding any one of these tolerances are infested: 2 lw, or 1 lw+5 oli, or 10 oli</b>
I. 1,000-Gram Representative Sample <sup>1</sup> (+ file sample if needed) <ul style="list-style-type: none"> <li>• Submitted Samples</li> <li>• Probed Lots</li> <li>• D/T Sampled Landcarriers</li> </ul>
II. Lot as a whole (Stationary) <ul style="list-style-type: none"> <li>• Probed Lots (at the time of sampling)</li> </ul>
III. Online Sample (In-Motion) <sup>2</sup> <ul style="list-style-type: none"> <li>• Railcars Under Cu-Sum</li> <li>• Subsamples for Sacked Grain Lots</li> <li>• Components for Bargelots <sup>3</sup></li> <li>• Components for Shiplots <sup>3</sup></li> </ul>
<sup>1</sup> Examine work portion and file sample if necessary. Do not examine file sample if work portion is insect free.
<sup>2</sup> Minimum sampling rate is 500 grams per 2,000 bushels
<sup>3</sup> Minimum component size is 10,000 bushels.
Key:            lw = live weevil            oli = other live insects injurious to stored grain

**Certification.** Record the word “infested” on the work record and certificate.

## 9. HEATING

Seed developing a high temperature from excessive respiration is heating. Heating seed in its final stages produces a sour or musty odor. Do not confuse heating seed with seed warm and moist because of storage in bins, railcars, or other containers during hot weather.

**Basis of Determination.** Determine heating on evidence obtained at time of sampling.

**Certification.** Record the word "Heating" on the work record and certificate.

## 10. ODOR

**Basis of Determination.** Determine odor on evidence obtained at the time of sampling, on the sample either before or after removing dockage, or on the crushed strips (used to determine heat damage and distinctly green damage). When crushed strips are used, determine odor immediately after crushing. Record on the work record odors detected at time of sampling.

**Table No. 3 - Odor Classification Examples**

<b>Sour</b>	<b>Musty</b>	<b>Commercially Objectionable Foreign Odors</b>
Boot Fermenting Insect (acrid) Pigpen Smoke *	Ground Insect Moldy	Animal hides Decaying animal and vegetable matter Fertilizer Fumigant Insecticide Oil products Skunk Smoke (evidence of fire- burnt material) Strong weed
* Consider smoke odors as sour unless there is evidence of fire-burnt material.		

Odors from Heat-Damaged Mustard Seed. When heat-damaged kernels are present, mustard seed will give off an odor similar to smoke. Consider mustard seed containing a "smoke" odor 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 sample, consider the smoke odor as a commercially objectionable foreign odor.

Commercially Objectionable Foreign Odors. Commercially objectionable foreign odors are odors foreign to mustard seed that render it unfit for normal commercial use.

Fumigant or insecticide odors are commercially objectionable foreign odors if they linger and do not dissipate. If a sample of mustard seed contains a fumigant or insecticide odor that prevents you from determining if other odor(s) exists, apply the following guidelines:

- a. Original Inspections. Allow work portion to aerate in an open container for a period not to exceed 4 hours.
- b. Appeal, and Board Appeal Inspections. Allow unworked file samples and new samples to aerate in an open container not to exceed 4 hours. Do not aerate file samples (worked files) which were previously aerated and retained as the final file.

A sample has a commercially objectionable foreign odor if fumigant or insecticide odor persists based on above criteria.

**Certification.** Record the words “Musty,” “Sour,” or “Commercially Objectionable Foreign Odor” on work record and certificate.

## 11. ANIMAL FILTH, GLASS, AND UNKNOWN FOREIGN SUBSTANCES

**Basis of Determination.** Determine animal filth, glass, and unknown foreign substances based on the sample as a whole (approximately 500 grams).

**Certification.** Record the number of pieces of animal filth, glass, and unknown foreign substances on the work record and certificate.

## 12. GARLIC BULBLETS

**Basis of Determination.** Determine number of garlic bulblets on sample as a whole (approximately 500 grams).

Three dry or partly dry garlic bulblets are equal to one green bulblet. Reference Image: [Garlic Bulbs](#).

**Certification.** Record the number of garlic bulblets on the work record and certificate in whole and decimals to the nearest hundredth percent. (i.e.  $1/3=0.33$ ,  $2/3= 0.67$ )

## 13. MOISTURE

Moisture is the water content of mustard seed as determined by the GAC2500-UGMA and Perten AM 5200-A instruments using the approved calibration (See FGIS Directive 9180.61).

**Basis of Determination.** Determine moisture on a portion of approximately 650 grams before the removal of dockage.

**Certification.** Record the percentage of moisture on the work record and certificate to the nearest tenth percent.

## 14. DOCKAGE

Dockage is material, other than mustard seed, that you can remove easily with sieves and/or a cleaning device. Dockage includes underdeveloped, shriveled, and small pieces of mustard seed that you cannot recover by rescreening or recleaning.

**Basis of Determination.** Determine dockage on a representative portion of approximately 250 grams cut from original sample.

Procedure. Determine dockage using the following 2 steps:

**NOTE: Mustard seed has a high oil content and may gum equipment. Ensure that all equipment is first cleaned with mild soapy water and/or Alconox lab detergent before testing.**

### **STEP 1.** Procedure for Determining Dockage with the Carter Dockage Tester.

- a. Insert appropriate sieves and riddles, and set air and feed controls to proper position. Turn off the Carter Dockage Tester when inserting or removing sieves.

	<u>Air</u>	<u>Feed</u>	<u>Riddle</u>	<u>Top</u>	<u>Middle</u>	<u>Bottom</u>
Mustard Seed	5	3	000	4	-----	-----

- b. Run sample portion through the Carter Dockage Tester.
- c. Machine separated dockage is all material removed by aspiration; coarse material, except threshed and sprouted kernels of mustard seed, that passed over the riddle; and material that passed through the No. 4 sieve, except for small whole and broken pieces of mustard seed which are reclaimed.

**NOTE: Return kernels of mustard seed caught in riddle to cleaned portion.**

### **STEP 2.** Procedure for Determining Dockage with Slotted Sieves (Reclaiming).

- a. Examine material that passes over the No. 4 sieve for wheat, buckwheat, weed seeds, or similar foreign material. If present, use one or more of the following sieves to separate material from the mustard seed: 5\64, 5.5\64, 6\64, 6.5\64, 7\64-inch, or larger.
- b. Place the mustard seed on the upper edge of the hand sieve. Hold the sieve at a 10-to 20-degree angle and work the material down over the sieve with a gentle side-to-side motion.
- c. Manually remove all mustard seed remaining on top of the round hole sieve and return to the mechanically cleaned sample.

- d. Reclaim material passing through the No. 4 sieve by sieving the material over the .035 x 15\32-inch sieve using an approved mechanical shaker.

Upon request, you may use the .028 x 15\32 or .0395 x 15\32 sieve, provided you record the sieve size in the remark section of the certificate.

- e. Mount the appropriate sieve and a bottom pan on an approved mechanical shaker.

If an approved mechanical shaker is unavailable, inspectors may hand sieve the sample. When handsieving, hold the sieve level in both hands with elbows close to the sides. In a steady motion, move the sieve from left to right approximately 10 inches and then return from right to left. Repeat this motion 30 times.

- f. Set the count stroker at 30. Pour onto the appropriate sieve the material that passes through the No. 4 sieve. Turn on the shaker.
- g. Return material to the appropriate portion. Material passing through the sieve is dockage.

Computing Dockage. All dockage is computed on the basis of the sample as a whole. When computing dockage, proceed as follows:

$$(\text{Weight of all Dockage} \div \text{original sample weight}) \times 100 = \text{percent dockage.}$$

Example:

Original sample weight	250	grams
Weight of all dockage	24.70	grams

$$24.70 \text{ grams} \div 250 \text{ grams} = 0.0988 \times 100 = 9.88\% \text{ Certify as } 9.9\% \text{ dockage}$$

**Certification.** Record the percentage of dockage on the work record and certificate to the nearest tenth percent.



## 15. STONES, ERGOT, AND SCLEROTINIA

Stones are concreted earthy or mineral matter and other substances of similar hardness that do not disintegrate readily in water.

Ergot is a hard, reddish-brown or black grain-like mass of certain parasitic fungi that replaces the kernels of certain grains. When determining the presence of ergot, refer to Reference Image: [Ergot](#).

Sclerotinia are the dark-colored black resting bodies of the fungi [Sclerotinia](#) and [Claviceps](#). When determining the presence of sclerotinia, refer to Reference Image: [Sclerotinia](#).

**Basis of Determination/Procedure.** Determine stones, ergot, and sclerotinia by handpicking a representative portion of approximately 10 grams cut from the dockage free portion.

**Certification.** Record the percentage of stones and ergot on the work record and certificate to the nearest hundredth percent. Record the percentage of sclerotinia on the work record and certificate to the nearest tenth percent.

## 16. CONSPICUOUS ADMIXTURE

Conspicuous admixture is all matter other than mustard seed which is conspicuous and readily distinguishable from mustard seed and which remains in the sample after removing dockage.

**Basis of Determination.** Determine conspicuous admixture (buckwheat, other weed seed, and other material) on a representative portion of not less than 10 grams cut from the work sample after removing dockage.

Procedure for Determining Conspicuous Admixture by Handpicking.

**STEP 1.** Cut the mechanically cleaned sample down to approximately 10 grams, but not less than 10 grams.

**STEP 2.** Handpick the 10-gram portion for conspicuous admixture (buckwheat, other weed seed, and other material) which is readily distinguishable by visual inspection.

**NOTE: Buckwheat (Fagopyrum esculentum) includes both buckwheat and wild buckwheat.**

**STEP 3.** Calculate percentage of each factor.

To compute conspicuous admixture, add the weight of buckwheat, other weed seed, and other material.

$0.10 \text{ grams} \div 10.24 \text{ grams} = 0.0097 \times 100 = 0.97\%$  buckwheat

$0.02 \text{ grams} \div 10.24 \text{ grams} = 0.0019 \times 100 = 0.19\%$  other weed seed

$0.01 \text{ grams} \div 10.24 \text{ grams} = 0.0009 \times 100 = 0.09\%$  other material

$(0.10 + 0.02 + 0.01) \div 10.24 \text{ grams} = 0.0126 \times 100 = 1.26\%$  conspicuous admixture (add in hundredths and certify in tenths)

**Certification.** Record the percentages of conspicuous admixture, buckwheat (including wild buckwheat) and other weed seed on the work record and certificate to nearest tenth percent.

## 17. PURITY

### Yellow mustard seed (Brassica hirta).

Color: light, creamy yellow to yellow; occasionally, a seedcoat is light or yellowish-brown.

Size: large, 2 to 3 mm in diameter.

Shape: spherical but occasionally oval (rounder than brown or Oriental mustard seed).

Surface: texture is similar to an orange peel or a grapefruit; white hilum.

### Brown mustard seed (Brassica juncea).

Color: reddish to dark-brown.

Size: small, less than 2 mm in diameter.

Shape: oval.

Surface: predominate netting; texture is similar to a golf ball; black hilum.

### Oriental mustard seed (Brassica juncea).

Color: predominantly yellow to dark-yellow, with from 3 percent to 10 percent ranging from light-brown to brown.

Size: small, less than 2 mm in diameter.

Shape: oval.

Surface: fine netting which is not nearly as predominant as for brown mustard seed; light-brown to dark-brown hilum.

**Basis of Determination/Procedure.** Determine percentages of yellow, brown, and Oriental mustard seed by color of seedcoat on a portion of approximately 10 grams after removing dockage.

**Certification.** Record the percentage of yellow, brown, and Oriental mustard seed to the nearest tenth percent on the work record and certificate.

## 18. DAMAGED KERNELS

Damage must be distinct. In general, a kernel of mustard seed is damaged when the damage is apparent and of such character as to be recognized as damaged for commercial purposes.

- a. Damaged Mustard Seed. Kernels and pieces of kernels of mustard seed which are heat-damaged, sprout-damaged, mold-damaged, distinctly green, frost-damage, rime-damaged, or otherwise materially damaged.
- b. Heat-Damaged Kernels. Kernels and pieces of kernels of the mustard seed which, after being crushed, are materially discolored and damaged by heat.
- c. Distinctly Green Kernels. Kernels and pieces of kernels of the mustard seed which, after being crushed, are a distinct green throughout the kernel.

**Basis of Determination.** Determine damaged kernels on a representative portion cut from the work sample after removing dockage and conspicuous admixture. Use the portion that you used for picking conspicuous admixture. Note that you must reweigh this portion.

Procedure. The steps for determining various damages are as follows:

**STEP 1.** Handpick the 10-gram portion (clean of dockage and conspicuous admixture) for distinctly shrunken or shriveled kernels (frost damage), kernels discolored by mold, rimed kernels (kernels that are completely covered with a whitish coloration), sprouted kernels, excessively weathered kernels, and any other kernels of mustard seed that are distinctly damaged.

These kernels are other-damaged kernels. Reference Image: [Canola Other Damage](#) (ILP: CANOLA 3.0).

**STEP 2.** Cut down balance of the 10-gram portion to approximately 5 grams.

**STEP 3.** Sprinkle the 5-gram portion across the damage seed counter to fill the 100-hole board (must be repeated five times) or the 500-hole board.

**STEP 4.** After each filling (total of 5 fillings when using the 100-hole board) and before crushing, tape and observe for inconspicuous admixture. Refer to section 19 for details.

**STEP 5.** With a roller, crush the mustard seed, examine the rows, and count the number of heat-damaged kernels, distinctly green kernels, and seeds that are obviously not mustard seed (inconspicuous admixture).

**STEP 6.** After the strip (all 5 strips when using the 100-hole board) has been crushed and kernels counted, calculate the percentage of each type of damage.

All percentages of damage, except for distinctly green and heat-damaged kernels, are determined based on weight. Percentage of distinctly green and heat-damaged kernels is determined based on count.

To compute damaged kernels (total), add the percentage of distinctly green, heat-damaged, and other-damaged kernels of mustard seed. Proceed as follows:

- a.  $(\text{Weight of other-damaged kernels} \div \text{weight of representative portion}) \times 100 =$  percent other-damaged kernels.
- b.  $500 - \text{number of non-mustard seed kernels} =$  number of mustard seed kernels.
- c.  $(\text{Number of heat-damaged kernels} \div \text{number of mustard seed kernels}) \times 100 =$  percent heat-damaged kernels.
- d.  $(\text{Number of distinctly green kernels} \div \text{number of mustard seed kernels}) \times 100 =$  percent distinctly green kernels.
- e. Percent other-damaged kernels + percent heat-damaged kernels + percent distinctly green kernels = percent damaged kernels (total).

Example:

Weight of representative portion	10.11 grams
Weight of other-damaged kernels	0.10 grams
Number of non-mustard seed kernels	10
Number of heat-damaged kernels	25
Number of distinctly green kernels	12

- (1)  $0.10 \text{ grams} \div 10.11 \text{ grams} = 0.0099 \times 100 = 0.99\%$  other-damaged kernels.
- (2)  $500 - 10 = 490$  mustard seed kernels.
- (3)  $25 \text{ kernels} \div 490 \text{ kernels} = 0.0510 \times 100 = 5.10\%$  heat-damaged kernels.
- (4)  $12 \text{ kernels} \div 490 \text{ kernels} = 0.0244 \times 100 = 2.44\%$  distinctly green kernels.
- (5)  $0.98\% + 5.10\% + 2.44\% = 8.52\%$  damaged kernels (add in hundredths and round to 8.5%).

**Certification.** Record the percentages of heat-damaged, distinctly green, and damaged kernels (total) on the work record and certificate to the nearest tenth percent.

## 19. INCONSPICUOUS ADMIXTURE

**Inconspicuous admixture** is any seed, which is difficult to distinguish from mustard seed. Examples of inconspicuous admixture include but are not limited to rapeseed, canola, wild mustard seed, and cow cockle.

### Wild mustard seed.

Color: varying shades of black to light reddish-brown.

Size: small.

Shape: uniformly round or spherical compared to the irregular shape of rapeseed.

Surface: at a magnification of 40/80 power, the reticulations appear thick and float with very small interspaces and stipples.

**NOTE: Wild mustard seed does not have a longitudinal crease with a ridge on the center of the kernel.**

### Cow Cockle.

Color: black.

Size: about the same size as wild mustard seed.

Shape: not as round as wild mustard seed.

Surface: very bumpy.

**NOTE: After crushing, cow cockle tends to be white.**

**Basis of Determination.** Determine inconspicuous admixture using the same 5-gram portion used to determine heat-damaged and distinctly green kernels (refer to section 18, Steps 3 - 5).

Before crushing, mark any seeds suspected of not being mustard seed and observe with a dissecting scope or magnifying glass. Use reference samples as an aid in identification.

**It is extremely important for inspectors to rely on a dissecting scope or a magnifying glass and the crushed strips for identification of inconspicuous admixture.**

**All electrical units must have a seal of approval from Underwriters Laboratory (U/L) or a similar testing laboratory.**

Mark seeds you suspect are not mustard seeds so that you can confirm after crushing.

Calculate the percentage of inconspicuous admixture based on count.

Example:

10 kernels ÷ 500 kernels = 0.02 x 100 = 2.0% inconspicuous admixture.

**Certification.** Record the percentage of inconspicuous admixture on the work record and certificate to the nearest tenth percent.

Applicants may request certification of the percentage of wild mustard seed and cow cockle. If requested, show percentages of these factors on work record and certificate to nearest tenth percent.

## **20. CERTIFICATION**

Certify the analysis of mustard seed on a commodity inspection certificate. Issue a commodity inspection certificate (FGIS- 993) for lots officially sampled. Issue a commodity submitted sample inspection certificate (FGIS-994) for a sample submitted by an applicant or an agent.

When an applicant requests analysis for only specific factors record the following sentence on the certificate:

“Specific factor analysis only.”

## **21. QUESTIONS**

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

*/s/Robert Lijewski*

Robert Lijewski, Director  
Field Management Division