

GRAIN INSPECTION HANDBOOK

BOOK II, CHAPTER 3

CANOLA

CHAPTER 3

CANOLA

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3.1 GENERAL INFORMATION

Rapeseed is a complex crop including not one but three botanical species, Brassica napus L., B. campestris L., and B. juncea L. Moreover, the botanical classification has become even more complicated due to the genetic altering of these species to create new varieties with varying levels of erucic acid and glucosinolates.

Currently, there are rapeseed varieties with levels of high erucic acid and low glucosinolates (HEAR/LG), high erucic acid and high glucosinolates (HEAR/HG), low erucic acid and high glucosinolates (LEAR/HG), and low erucic acid and low glucosinolates (LEAR/LG). Some specific types of LEAR/LG varieties are known as canola.

- a. All quantities referenced in this chapter are approximate unless otherwise specified.
- b. Use an approved divider to obtain subportions of a sample for analysis unless otherwise specified.
- c. If an approved mechanical shaker is unavailable, inspectors may handsieve 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.
- d. For specific Visual Reference Images, see Chapter 1, section 1.2, Visual Grading Aids.
- e. Official inspection personnel shall document inspection information during sampling and grading. See book IV, chapter 2.

The inspection process provides various factor information used to determine grade and to provide further information on the condition or quality of canola. 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 percentage by weight, a percentage for a specific type of damage, etc.). Furthermore, applicants may request the percentage of erucic acid, the amount of glucosinolates, and the percentage of oil.

3.2 GRADES AND GRADE REQUIREMENTS

There are no classes or subclasses in canola. Canola is divided into three numerical grades and U.S. Sample Grade. Special grades emphasize qualities or conditions affecting the value of canola. Special grades do not affect the numerical or sample grade designation.

**TABLE NO. 1 - GRADES AND GRADE REQUIREMENTS -
CANOLA**

Grade	Maximum Limits of -							
	Damaged kernels			Conspicuous Admixture				Inconspicuous Admixture (percent)
	Heat damaged (percent)	Distinctly green (percent)	Total (percent)	Ergot (percent)	Sclerotinia (percent)	Stones (percent)	Total (percent)	
U.S. No. 1	0.1	2.0	3.0	0.05	0.05	0.05	1.0	5.0
U.S. No. 2	0.5	6.0	10.0	0.05	0.10	0.05	1.5	5.0
U.S. No. 3	2.0	20.0	20.0	0.05	0.15	0.05	2.0	5.0

U.S. Sample Grade:
U.S. Sample Grade shall be canola that:

- Does not meet the requirements for grades U.S. No. 1, 2, 3; or
- Contains 1 or more pieces of glass, 2 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), or 4 or more pieces of animal filth; or
- Has a musty, sour, or commercially objectionable foreign odor; or
- Is heating or otherwise of distinctly low quality.

3.3 GRADE DESIGNATIONS

After completing the analysis, compare the results with the limits for each grade factor specified in table 1. Use the following guidelines when assigning grades.

- The letters "U.S.",
- The abbreviation "No." and the number of the grade or the words "Sample Grade",
- The words "or better" when applicable,
- The word "Canola",
- The applicable special grade(s), and
- The word "Dockage" and the percentage thereof.

3.4 SPECIAL GRADES

Special grades identify unusual conditions in grain and are part of the grade designation. The canola standards include two special grades:

- a. Garlicky Canola. Canola that contains more than two green garlic bulblets or an equivalent quantity of dry or partly dry bulblets in a 500-gram portion.

Example: U.S. No. 2 Canola, Garlicky, Dockage 7.5%

- b. Infested Canola. Label canola "Infested" if it is infested with live weevils or other live insects injurious to stored grain.

Example: U.S. No. 2 Canola, Infested

3.5 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, canola may be certified as U.S. No. 2 or better or U.S. No. 3 or better. An "or better" grade designation cannot be applied to a U.S. No. 1 grade designation.

Example: U.S. No. 3 or better Canola

3.6 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, dockage, garlic, live insect infestation, large stones, moisture, temperature, and 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 conspicuous admixture, ergot, sclerotinia, stones, damaged kernels, heat-damaged kernels, distinctly green kernels, and inconspicuous admixture is made on the basis of the sample when free from dockage. Other determinations not specifically provided for under the General Provisions are made on the basis of the sample as a whole, except the determination of odor is made on either the basis of the sample as a whole or the sample when free from dockage. The content of glucosinolates and erucic acid is determined on the basis of the sample according to procedures prescribed in FGIS instructions.

TABLE NO. 2

BASIS OF DETERMINATION			
Lot as a Whole	Factors Determined Before the Removal of Dockage	Factors Determined After the Removal of Machine Separated Dockage	Factors Determined After the Removal of Machine Separated Dockage and Conspicuous Admixture
Distinctly low quality Heating Infested Odor	Distinctly low quality Dockage Garlicky Heating Infested Kind of Grain Moisture Odor U.S. Sample Grade factors	Conspicuous Admixture Ergot Erucic acid content Glucosinolates Odor Oil Sclerotinia Stones	Damaged kernels (total) Distinctly green kernels Heat-damaged kernels Inconspicuous admixture Odor

3.7 DEFINITION OF CANOLA

Canola is defined as:

Seeds of the genus Brassica from which the oil shall contain less than 2 percent erucic acid in its fatty acid profile and the solid component shall contain less than 30.0 micromoles of any one or any mixture of 3-butenyl glucosinolate, 4-pentenyl glucosinolate, 2-hydroxy--3-butenyl, or 2-hydroxy-4-pentenyl glucosinolate, per gram of air-dried, oil free solid. Before the removal of dockage, the seed shall contain not more than 10.0 percent of other grains for which standards have been established under the United States Grain Standards Act.

Other grains for which standards have been established are barley, corn, flaxseed, oats, rye, sorghum, soybeans, sunflower seed, triticale, and wheat.

Basis of Determination. Conduct a visual appraisal and glucosinolate analysis (if necessary) to determine if the sample meets the definition of canola. A glucosinolate analysis is mandatory for all export shipments, regardless of carrier type, and is optional (requested by the applicant for service or deemed necessary by the inspector grading the sample) for domestic lots and submitted samples.

- a. Visual Appraisal. Analyze the sample as a whole. If further visual analysis is needed, use 25 grams before the removal of dockage. To aid in seed identification, use photographs and reference samples provided by the FGIS Board of Appeals and Review.

- b. Glucosinolates. Screen samples to determine whether the seed contains less than 30 micromoles of glucosinolates. Use a 300-gram dockage-free sample for this analysis (refer to Section 3.21, Glucosinolates, for details).

Applicants may request that the glucosinolate content be quantitatively determined using a gas chromatography (GC) method at the FGIS Technical Services Division (TSD), Analytical, Reference, and Testing Services (ARTS). Details are provided in section 3.22. The GC analysis is independent of the grade. Final grading of the sample **should not** be delayed pending the GC result.

- c. Erucic Acid. The definition of canola also includes a maximum limit on erucic acid. A quick, reliable erucic acid test, suitable for grading purposes, is not available. FGIS will randomly select market samples of canola for verification testing.

Applicants may request analysis for erucic acid content at the ARTS' Commodity Testing Laboratory (CTL). Details are provided in section 3.22. This analysis is independent of the grade. Final grading of the sample **should not** be delayed pending the erucic acid result.

Certification. Grade the seed as canola if it meets the canola definition as described above. If the seed does not meet the definition of canola (e.g., high glucosinolate or erucic acid levels or more than 10.0 percent of other grains), examine it further to determine if it is:

- a. Another grain for which standards have been established or
- b. Not standardized grain. No further analysis is necessary on a sample designated as not standardized grain unless a specific factor test is requested.

If the sample is not tested for erucic acid content, use the statement "Erucic acid content not determined." in the "Remarks" section of the official certificate.

Certification details are provided in sections 3.21 and 3.22 for those instances when an applicant requests quantitative analyses for glucosinolates and/or erucic acid.

3.8 INFESTED CANOLA

Infested canola is canola 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 canola 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 canola 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. (See Chapter 1, Section 1.2, Visual Grading Aids.)

Basis of Determination. Determine infestation on the lot as a whole and/or before the removal of dockage on 500 grams. For insect tolerances, see table No. 3.

TABLE NO. 3

INSECT INFESTATION		
<i>Samples meeting or exceeding any one of these tolerances are infested:</i> 2 lw, or 1 lw + 5 oli, or 10 oli		
1,000-gram representative sample <u>1/</u> (+ file sample if needed)	Lot as a Whole (Stationary)	Online Sample (In-Motion) <u>2/</u>
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 <u>3/</u> Components for Shiplots <u>3/</u>
<p><u>1/</u> Examine work portion and file sample if necessary. Do not examine file sample if work portion is insect free.</p> <p><u>2/</u> Minimum sampling rate is 500 grams per 2,000 bushels.</p> <p><u>3/</u> Minimum component size is 10,000 bushels.</p> <p><u>Key:</u> lw = live weevil, oli = other live insects injurious to stored grain</p>		

Certification. When applicable, record the word "Infested" on the certificate in accordance with Section 3.4, Special Grades.

3.9 HEATING

Canola developing a high temperature from excessive respiration is considered heating. Heating canola, in its final stages, will usually have a sour or musty odor. Care should be taken not to confuse canola that is heating with canola that is warm and moist because of storage in bins, railcars, or other containers during hot weather.

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

Certification. Grade heating canola as U.S. Sample Grade and record the word "Heating" in the "Remarks" section of the certificate.

3.10 ODOR

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

TABLE NO. 4

ODOR CLASSIFICATION EXAMPLES		
Sour	Musty	Commercially Objectionable Foreign Odors
Boot Fermenting Insect (acid) Pigpen Smoke <u>1/</u>	Ground Insect Moldy	Animal hides Decaying animal and vegetable matter Fertilizer Fumigant Insecticide Oil products Skunk Smoke Strong weed
<u>1/</u> Smoke odors are considered sour only in canola, flaxseed, soybeans, and sunflower seed.		

Odors from Heat-Damaged Canola. When heat-damaged kernels are present, canola gives off an odor very similar to smoke. Canola containing a “smoke” odor is 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. 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 canola contains a fumigant or insecticide odor that prevents a determination as to 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 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.

Certification. Grade canola 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" in the "Remarks" section of the certificate.

3.11 ANIMAL FILTH, GLASS, AND UNKNOWN FOREIGN SUBSTANCES

Basis of Determination. Determine animal filth, glass, and unknown foreign substances before the removal of dockage on a work portion of 500 grams.

Certification. Grade canola "U.S. Sample Grade" if the level of animal filth, glass, and unknown foreign substances exceeds the limits set forth in table 1 and report the actual count.

3.12 GARLICKY CANOLA

Canola that contains more than two green garlic bulblets or an equivalent quantity of dry or partly dry bulblets in approximately a 500-gram portion.

Basis of Determination. Determine garlicky before the removal of dockage on a work portion of 500 grams. (Reference: Visual Reference Image Nos. [OF-13.0](#) and [OF-13.1](#)).

Characteristics of Bulblets.

- a. Green garlic bulblets are bulblets which have retained all of their husks intact.
- b. Dry or partly dry garlic bulblets are bulblets which have lost all or part of their husks. Consider bulblets with cracked husks as dry.

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

Three dry or partly dry garlic bulblets are equal to one green bulblet.

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

Certification. When applicable, grade the canola "Garlicky" in accordance with Section 3.4, Special Grades. Upon request, provide the number of garlic bulblets in whole and thirds.

3.13 DISTINCTLY LOW QUALITY

Consider canola 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 canola is of distinctly low quality. This includes a general examination of the canola during sampling and an analysis of the obtained sample(s).

- a. Large Debris. Canola 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.
- b. Other Unusual Conditions. Canola that is obviously affected by other unusual conditions which adversely affect the quality of the canola and cannot be properly graded by use of the grading factors specified or defined in the standards is considered distinctly low quality.

Canola 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 canola contains diatomaceous earth, then the canola is not considered distinctly low quality due to diatomaceous earth. Refer to Program Directive 9180.49, Grading and Certification of Grain Containing Diatomaceous Earth and Silica Gel, for additional information regarding the testing of canola for diatomaceous earth.

Certification. Grade distinctly low quality canola as U.S. Sample Grade. Record the words "Distinctly Low Quality" and the reason(s) why in the "Remarks" section of the certificate.

3.14 U.S. SAMPLE GRADE CRITERIA

Basis of Determination. Determine U.S. Sample Grade criteria, except for stones, before the removal of dockage based on a work portion of 500 grams. Table No. 5 shows the criteria and corresponding interpretive live slides, 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."

TABLE NO. 5

U.S. SAMPLE GRADE CRITERIA			
<i>Criteria</i>	<i>Visual Reference Image</i>	Number/Weight <u>1/</u>	
		<i>Sample Basis</i>	Lot Basis <u>2/</u>
Any numerical grading factor		Excess of limit for U.S. No. 3	N/A
Animal filth	OF-1.0	4 or more	N/A
Glass		1 or more	N/A
Odor		Presence	N/A
Unknown foreign substances <u>3/</u>	OF-31.0	2 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/ 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.

* For Distinctly Low Quality, see section 3.13

Certification. Grade canola U.S. Sample Grade when one or more of the limits in table 5 are observed. Record the reason(s) why in the "Remarks" section of the certificate. Record count factors to the nearest whole number.

3.15 MOISTURE

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 dockage on a portion of approximately 350 grams.

The procedures for performing a moisture determination using the DICKEY-john Grain Analysis Computer GAC 2100 moisture meter are described in book II, chapter 1, section 1.10.

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

3.16 DOCKAGE AND CONSPICUOUS ADMIXTURE

a. Dockage. Dockage is:

- (1) All material removed by aspiration;
- (2) Coarse material, except threshed and sprouted kernels of canola, that passed over the riddle; and
- (3) Material that passed through the Number 4 sieve, except for small whole and broken pieces of canola which are reclaimed.

b. Conspicuous Admixture. Conspicuous admixture is all matter other than canola, including but not limited to ergot, sclerotinia, and stones, which is conspicuous and readily distinguishable from canola and which remains in the sample after the removal of machine separated dockage.

The adjusted percentage of conspicuous admixture is added to the percentage of machine separated dockage in the computation of total dockage (refer to example at the end of this section).

Basis of Determination. Determine dockage in canola on 250 grams cut from the original sample.

Procedure. The procedure for determining conspicuous admixture and dockage is performed in two steps: machine cleaning (Carter Dockage Tester and mechanical shaker) and handpicking.

NOTE: Canola contains a high oil content and may gum sieves and other equipment. Care should be taken to clean all equipment. Mild soapy water and/or Alconox lab detergent have been found to be effective for cleaning the equipment.

CHART 1 - PROCEDURE FOR DETERMINING DOCKAGE

STEP 1. Carter Dockage Tester

- a. Set air control on 5 and the feed control on 3.
- b. Insert No. 000 riddle in the riddle carriage and No. 4 sieve in the top sieve carriage.
- c. Start carter Dockage Tester and pour 250 gram sample into feed hopper.
- d. Return any kernels that may be caught in the riddle to the cleaned portion.
- e. Return threshed and separated canola from material over the riddle and add to cleaned canola.

STEP 2. Reclaim Seed

- a. Sieve sizes. Use sieves which achieve maximum cleanout of weed seeds and similar foreign material with a minimum loss of canola.

Material over No. 4 sieve. Visually examine the material that passed over the No. 4 sieve. If the sample contains wheat, buckwheat, weed seeds, or similar foreign material, use a round-hole sieve (5/64, 5.5/64, 6/64, 6.5/64, or 7/64 inch (or larger) as an aid to separate the material from the canola. Return the canola passing through and remaining on top of the round-hole sieve to the clean sample.

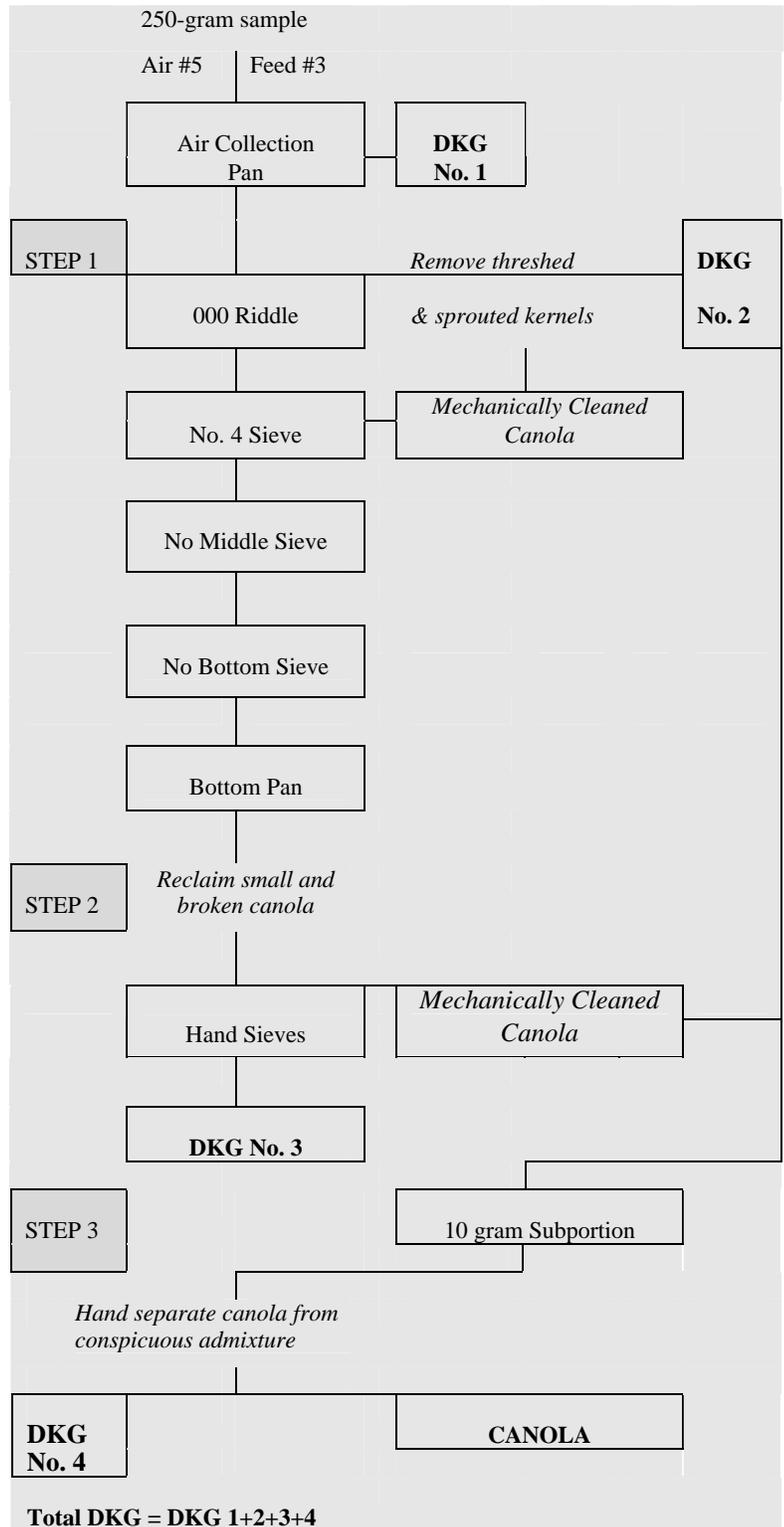
Material through the No. 4 sieve.

Use the .035 x 15/32 inch slotted sieve to reclaim material through the No. 4 sieve. (Upon request, a .028 x 15/32 or .0395 x 15/32 inch slotted hole sieve may be used. When a requested sieve is used, record the sieve size in the remarks section of the certificate). Return the material remaining on the slotted-hole sieve(s) and in the perforations to the clean sample and the material passing through the slotted-hole sieve to the dockage.

- b. Sieve the material (30 strokes) that passed through the No. 4 sieve.
- c. Determine dockage/clean canola.

STEP 3. Handpick (Conspicuous Admixture)

- a. Combine the two mechanically cleaned portions.
- b. Cut down the cleaned sample to a portion of not less than 10 grams.
- c. Handpick the 10-gram portion for conspicuous admixture.
- d. As part of conspicuous admixture, handpick stones, ergot, and sclerotinia (refer to section 3.16 for details).



Final Calculation: Total dockage now consists of all mechanically separated dockage (including any handsieved dockage if applicable) **and** conspicuous admixture (which is equivalent to handpicked dockage).

Computing Total Dockage. In computing the total dockage, all mechanically separated dockage (as removed by the Carter Dockage Tester, mechanical shaker, and hand sieves) is computed on the basis of the sample as a whole. The percentage of conspicuous admixture (handpicked dockage), which is determined on the basis of the weight in grams of the portion used for the hand separation, must be multiplied by the fractional proportion of canola remaining after the removal of the mechanically separated dockage.

Example

Original sample weight	250 grams
Weight of mechanically separated dockage	24.70 grams
Weight of handpicked portion	10.24 grams
Weight of handpicked dockage (conspicuous admixture)	0.20 grams

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

$$(24.70 \text{ g} \div 250 \text{ g}) \times 100 = 9.88\% \text{ mechanically separated dockage.}$$

- b. $(100 \text{ percent} - \text{percent mechanically separated dockage}) \div 100 = \text{change of base factor.}$

$$(100\% - 9.88\%) \div 100 = 0.90 \text{ change of base factor.}$$

- c. $(\text{Weight of handpicked separation, including stones, ergot, sclerotinia, and any other conspicuous admixture} \div \text{weight of handpicked sample}) \times 100 = \text{percent conspicuous admixture.}$

$$(0.20 \text{ g} \div 10.24 \text{ g}) \times 100 = 1.95\% \text{ conspicuous admixture.}$$

- d. $\text{Percent conspicuous admixture} \times \text{change of base factor} = \text{percent conspicuous admixture (adjusted) } \underline{1/}$.

$$1.95 \times 0.90 = 1.75\% \text{ conspicuous admixture (adjusted).}$$

- e. $\text{Percent conspicuous admixture (adjusted)} + \text{percent mechanically separated dockage} = \text{dockage (total).}$

$$1.75\% + 9.88\% = 11.63\% \text{ dockage (total). (add in hundredths) (round to 11.6\%)}$$

1/ Record the adjusted percentage of conspicuous admixture on the certificate.

Certification. Record the word "Dockage" and the percentage to the nearest tenth percent in accordance with Section 3.3, Grade Designations. Also record the adjusted percentage of conspicuous admixture to the nearest tenth percent.

3.17 STONES, ERGOT, AND SCLEROTINIA

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

Ergot. Ergot is a hard, reddish-brown or black grain-like mass of certain parasitic fungi that replaces the kernels of certain grains. (Reference: Visual Reference Image No. [OF-12.0](#))

Sclerotinia. Sclerotinia are the dark-colored black resting bodies of the fungi Sclerotinia and Claviceps. (Reference: Visual Reference Image No. [OF-32.0](#))

Basis of Determination. Make the determination for ergot, stones, and sclerotinia on the handpicked portion used in the determination of conspicuous admixture (refer to Section 3.16, Dockage and Conspicuous Admixture, step 3).

Computing Stones, Ergot, and Sclerotinia. To compute the percentages of stones, ergot, and sclerotinia, proceed as follows:

	<u>Example</u>
Weight of handpicked portion	10.24 grams
Weight of stones	0.13 grams
Weight of ergot	0.02 grams
Weight of sclerotinia	0.29 grams
Change of base factor	0.90

a. $(\text{Weight of stones} \div \text{weight of handpicked sample}) \times 100 = \text{percent of stones.}$

Percent of stones x change of base factor = adjusted percent of stones

$(0.13 \text{ g} \div 10.24 \text{ g}) \times 100 = 1.27\% \text{ stones.}$

$1.27 \times 0.90 = 1.14\% \text{ stones (adjusted)}$

b. $(\text{Weight of ergot} \div \text{weight of handpicked sample}) \times 100 = \text{percent of ergot.}$

Percent of ergot x change of base factor = adjusted percent of ergot

$(0.02 \text{ g} \div 10.24 \text{ g}) \times 100 = 0.20\% \text{ ergot.}$

$0.20 \times 0.90 = 0.18\% \text{ ergot (adjusted)}$

c. $(\text{Weight of sclerotinia} \div \text{weight of handpicked sample}) \times 100 = \text{percent of sclerotinia.}$

Percent of sclerotinia x change of base factor = adjusted percent of sclerotinia

$(0.03 \text{ g} \div 10.24 \text{ g}) \times 100 = 0.29\% \text{ sclerotinia.}$

$0.29 \times 0.90 = 0.26\% \text{ sclerotinia (adjusted)}$

Certification. Record the percentage of stones, ergot, and sclerotinia on the certificate to the nearest hundredth percent.

3.18 PROCESSING THE WORK SAMPLE

At this point, determinations have been made for kind of grain, infestation, heating, odor, garlic bulblets, sample grade criteria, moisture, dockage, conspicuous admixture, sclerotinia, stones, and ergot. Now divide the work sample into fractional portions for those determinations required after the removal of machine separated dockage and conspicuous admixture. The following chart and table No. 6 illustrate how the sample is divided into fractional parts using the Boerner divider.

CHART 2 - DIVIDING THE WORK SAMPLE

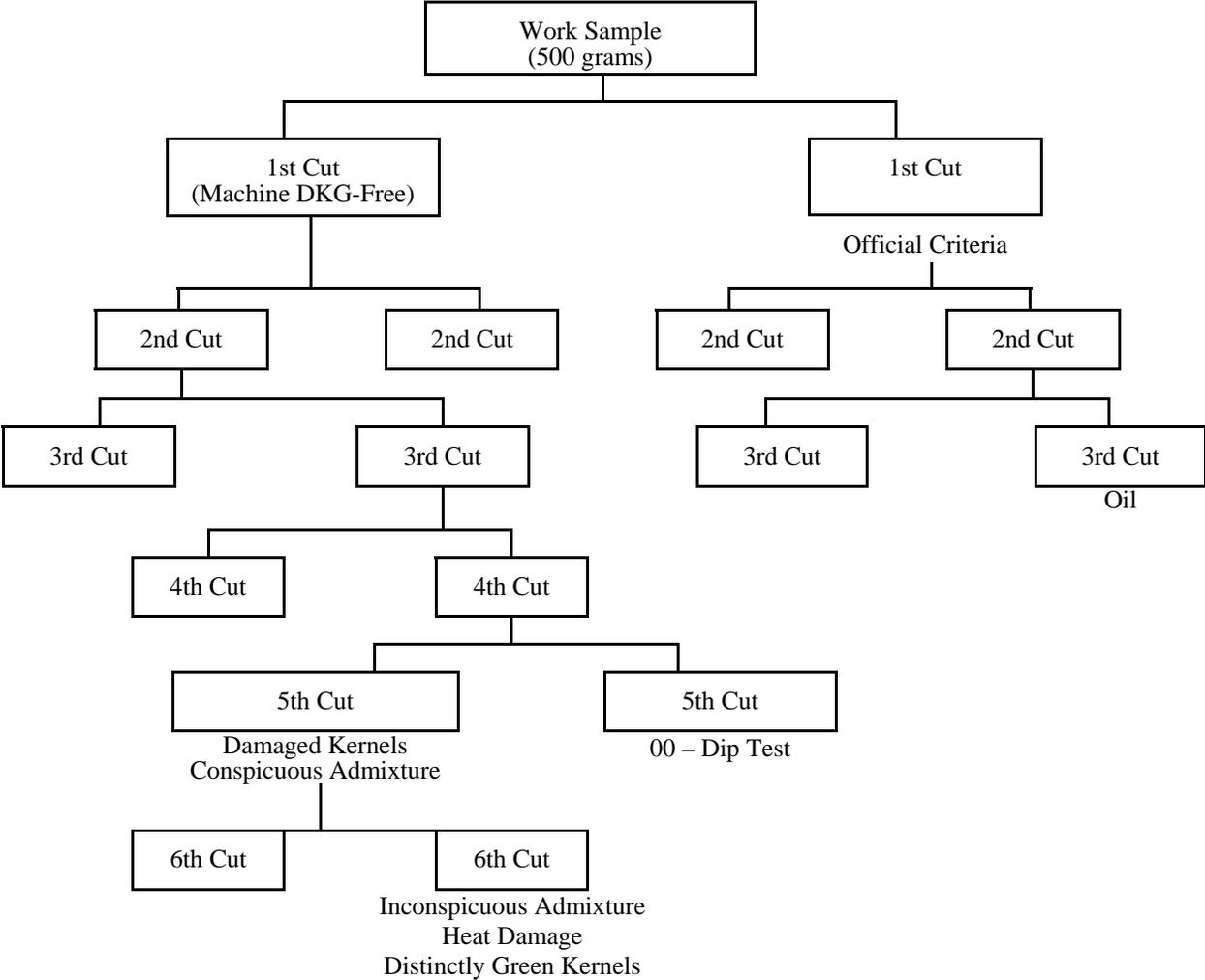


TABLE NO. 6

APPROXIMATE ANALYTICAL PORTION SIZES	
<i>Factors</i>	<i>Grams</i>
Damaged kernels	10
Heat-damaged kernels	5
Distinctly green kernels	5
Inconspicuous admixture	5

3.19 DAMAGED KERNELS

Canola and pieces of canola that are heat-damaged, sprout-damaged, mold-damaged, distinctly green-damaged, frost-damaged, rimed-damaged, or otherwise materially damaged.

Basis of Determination. Determine the amount of damaged kernels on a representative portion cut from the work sample after the removal of dockage and conspicuous admixture. Use the portion which was used for picking dockage and conspicuous admixture. Note that this portion must be reweighed.

Damage must be distinct. In general, a kernel of canola is considered damaged when the damage is distinctly apparent and of such character as to be recognized as damaged for commercial purposes. Insect-bored kernels are not considered damaged.

Distinctly Green Kernels. Canola and pieces of canola which, after being crushed, exhibit a distinctly green color. (Reference: Visual Reference Image No. [Canola 1.0](#)).

Heat-Damaged Kernels. Canola and pieces of canola which, after being crushed, exhibit that they are discolored and damaged by heat. (Reference: Visual Reference Image No. [Canola 2.0](#)).

Procedure. The steps for determining the 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-damaged), 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 canola that are distinctly damaged. These kernels are other-damaged kernels. (Reference: Visual Reference Images Nos. [Canola 3.0](#) and [Canola 4.0](#)).

- STEP 2** Cut down the balance of the 10-gram portion to 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 once for 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 1/.
- STEP 5** With a roller, crush the canola, examine the rows, and count the number of heat-damaged kernels, distinctly green kernels, and seeds that are obviously not canola, (inconspicuous admixture 1/).
- 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.

Determine all percentages of damage, except for distinctly green and heat-damaged kernels, upon the basis of weight. Determine the percentage of distinctly green and heat-damaged kernels on the basis of count.

Calculation. To compute damaged kernels (total), add the percentage of distinctly green, heat-damaged, and other-damaged kernels of canola.

Example

Weight of representative portion	10.04 grams
Weight of other-damaged kernels	0.10 grams
Number of non-canola kernels	10
Number of heat-damaged kernels	25
Number of distinctly green kernels	12

- a. (Weight of other-damaged kernels ÷ weight of representative portion) x 100 = percent other-damaged kernels.

$$0.10 \text{ g} \div 10.04 \text{ g} = 0.0099 \times 100 = 0.99\% \text{ other-damaged kernels.}$$

- b. 500 - number of noncanola kernels = number of canola kernels.

$$500 - 10 = 490 \text{ canola kernels.}$$

1/ Refer to Section 3.20, Inconspicuous Admixture, for details.

- c. (Number of heat-damaged kernels ÷ number of canola kernels) x 100 = percent heat-damaged kernels.

$$25 \text{ kernels} \div 490 \text{ kernels} = 0.0510 \times 100 = 5.10\% \text{ heat-damaged kernels.}$$

- d. (Number of distinctly green kernels ÷ number of canola kernels) x 100 = percent distinctly green kernels.

$$12 \text{ kernels} \div 490 \text{ kernels} = 0.0244 \times 100 = 2.44\% \text{ distinctly green.}$$

- e. Percent other-damaged kernels + percent heat-damaged kernels + percent distinctly green kernels = percent damaged kernels (total).

$$0.99\% + 5.10\% + 2.44\% = 8.53 \text{ percent damaged kernels (add in hundredths)} \\ \text{(round to 8.5\%)}$$

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

3.20 INCONSPICUOUS ADMIXTURE

Any seed which is difficult to distinguish from canola. This includes, but is not limited to, common wild mustard (Brassica kaber and B. juncea), domestic brown mustard (Brassica juncea), yellow mustard (B. hirta), and seed other than the mustard group.

Basis of Determination. Make the determination for inconspicuous admixture on the 5-gram portion used in the determination for heat-damaged and distinctly green kernels (refer to Section 3.19, Damaged Kernels, steps 2-4).

Prior to crushing, mark any seeds suspected of not being canola and observe with a dissecting scope or magnifying glass. Use the reference samples and photographs as an aid in identification.

NOTE: 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.

Any seeds suspected of not being canola should be marked to be confirmed after crushing. After crushing, canola tends to be a golden yellow while crushed wild mustard is pale yellow to white and cow cockle is white.

Calculate the percentage of inconspicuous admixture on the basis of count.

Example: $10 \text{ kernels} \div 500 \text{ kernels} = 0.02 \times 100 = 2.0\%$ inconspicuous admixture.

Certification. Record the percentage of inconspicuous admixture on the certificate to the nearest tenth percent.

3.21 GLUCOSINOLATES

Testing for glucosinolates is accomplished through a screening process using a 00-Dip-Test developed at the Institute for Plant Breeding, University of Gottingen, Germany. This is a relatively quick process that can be conducted at the time of grading.

Basis of Determination. A glucosinolate analysis using the 00-Dip-Test is performed after the removal of machine-separated dockage on a portion of 15 grams.

NOTE: The following information on reagents, equipment, and procedure refer to only the 00-Dip-Test.

Reagents.

- a. Distilled water.
- b. Glucose.
- c. Cellulose powder.
- d. Clinistix reagent strips (Miles Inc.; 2844P).

Equipment.

- a. Coffee mill or equivalent (e.g., Moulinex electric coffee, spice, and nut grinder).
- b. Five-ounce paper cups.
- c. Whatman No. 2 fluted filter paper (12.5 cm) or coffee filters (specific type of paper is not critical).
- d. Stop watch or equivalent.

- e. Graduated cylinder (100 ml; plastic).
- f. Small paint brush (1 inch or 2.54 cm bristles).
- g. One powder funnel (stainless steel or plastic; 3 inch or 7.62 cm).
- h. Teflon stirring rod (3/16 x 6 inch or 0.48 x 15.24 cm).
- i. Scoopula.
- j. Balance capable of weighing to the nearest 0.01g.

Precautions.

- a. Store the Clinistix reagent strips in a closed container, out of direct sun, and at room temperature (60 to 85° F).
- b. Do not remove the test strip from its container until a sample is ready for testing.
- c. Record on each new bottle the date that the bottle is first opened. Do not use the strips in a bottle beyond 6 months after the date the bottle was first opened or beyond the expiration date.
- d. Before using any test strip from a freshly opened bottle, check the activity of one strip from that bottle with a 2 percent glucose solution. Thereafter, check the activity of the test strips in that bottle weekly (see procedure, step b, in this section).
- e. After a sample has been tested for glucosinolates with a Clinistix strip, flush the sample down the drain and dispose the strip and paper cup in the trash.

Procedure. The procedures for screening canola samples for glucosinolate levels and for testing Clinistix strips for enzymatic activity are as follows:

- a. Procedure for Screening Canola Samples for Glucosinolate Levels.
 - (1) Remove any stones, straws, and other grain remaining in the 15-gram subsample.
 - (2) Weigh 7.0 grams of the subsample into a labeled, tared paper cup. Transfer the sample from the cup to the grinding chamber of the coffee grinder.

NOTE: If the moisture content of the sample is 12 percent or more, add 0.7 grams of cellulose powder to the sample.

- (3) Grind the sample in two 15-second bursts. Invert and shake the grinder gently between grinding bursts.
- (4) Use a powder funnel to transfer the ground sample from the grinder to the paper cup. Use a brush to aid in transferring the sample and for cleaning out the grinder.
- (5) Add 70 ml of distilled water (68 to 82 ° F) to the sample in the cup. Stir the mixture vigorously for 30 seconds. Wait 4 minutes and then stir the mixture for 10 seconds.
- (6) Place a fluted filter into the cup. Wait a few seconds, and then dip a Clinistix reagent strip into the solution inside the filter paper for 2 seconds. Remove the test strip. Wait 20 seconds for the color to develop. Match the color of the test strip to the appropriate portion of the color chart on the test strip bottle.

NOTE: The color comparison must be made within 1 minute after the test strip is removed from the test mixture because the color fades rapidly with time.

- (7) A Clinistix strip color which is lighter than the medium color on the color chart indicates that the glucosinolate content of that sample is less than 30 micromoles per gram of defatted sample. Such samples are certified as canola (see Certification in this section).

A Clinistix strip color which is equal to or darker than the medium color on the color chart indicates that the glucosinolate content of that sample is approximately equal to or greater than 30 micromoles per gram of defatted sample. Such samples are certified as not standardized grain (see Certification in this section).

b. Procedure for Testing Clinistix Strips for Enzymatic Activity.

- (1) The activity of the Clinistix strips are estimated using a 2 percent glucose solution. Prepare the solution by placing 2.0 grams of glucose in a 100 ml volumetric flask. Fill the flask with distilled water to the 100 ml mark. Mix the solution by inverting the flask several times.

NOTE: The 2 percent glucose solution can be kept for 6 months when stored in a stoppered flask at 40 ° F.

- (2) To test the activity of a test strip, place 2 mL of the glucose solution (68 to 82° F) in a dish. Dip a test strip into the solution and hold for 2 seconds.
- (3) Remove the test strip, and check the color after 20 seconds. A 2 percent glucose solution should turn the test strip a dark blue. If this is not the case, then the entire bottle of test strips should be discarded. A new bottle should be opened and tested for enzymatic activity.

If the glucose solution turns the test strip a dark blue, then the test strips in that bottle can be used for estimating glucosinolate content.

Certification. If the 00-Dip-Test indicates that the sample has a low level of glucosinolates, certify the sample as canola. If the 00-Dip-Test indicates that the sample has a high level of glucosinolates, certify the sample as not standardized grain.

3.22 OFFICIAL CRITERIA

- a. Glucosinolate Analysis - Gas Chromatography (GC) Method. Glucosinolate analysis using the GC method is available at the FGIS Technical Center as a separate test, independent of grade. The Technical Center will notify the local field office of the GC results which, in turn, will notify the official agency involved **or** issue a certificate depending on the level of service. The GC result is certificated independent of the grade certificate.

If the GC results are equal to or greater than 30.0 micromoles, the applicant has the option of surrendering the outstanding grade certificate for corrections. Official personnel shall issue a "corrected certificate" labeling the seed as "not standardized grain" rather than canola. Likewise, if the GC results are less than 30.0 micromoles and the previous result(s) (screening or GC) was equal to or greater than 30.0 micromoles, the applicant has the option of surrendering the outstanding grade certificate for corrections.

For review inspections (reinspection, appeal inspection, or Board appeal inspection), GC results supersede any previous results. The screening method does not supersede GC results. Review inspections involving factors/reasons other than the glucosinolate content do not require a re-analysis for glucosinolates. The previous results may be used for definition purposes.

If a review inspection is performed for grade and official personnel know, based on previous testing, that the glucosinolate content is equal to or greater than 30 micromoles, grade the review inspection "not standardized grain" and cross reference the certificate that reported the high glucosinolate content.

Basis of Determination. A glucosinolate analysis using the GC method is performed after the removal of machine separated dockage on a portion of 300 grams. Only ARTS at the FGIS Technical Center can perform GC analysis. If GC analysis is requested, submit the portion to ARTS at the FGIS Technical Center in Kansas City, Missouri:

TSD, ARTS
USDA, GIPSA, FGIS Technical Center
10383 N. Ambassador Drive
Kansas City, Missouri 64153-1394
Fax: (816) 891-7314
Tel: (816) 891-0437

Include the following information with the sample: analysis required, sample ID, field office and/or official agency, and date mailed.

Place the sample portion in a moisture-proof plastic bag (6-mil) and securely close or seal the bag. Place the sample and sample ticket inside a canvas mailing bag. Do not place the sample ticket inside the plastic bag in direct contact with the sample.

Use a buff colored mailing tag to send samples. Indicate on the reverse of the mailing tag the analysis to be performed by the laboratory.

Samples should be mailed at the expense of the field office or agency sending the sample. FGIS Business Reply Mail is not appropriate for this purpose.

Certification. Record the glucosinolate content on the work record and in the "Remarks" section of the certificate to the nearest tenth of a micromole/gram.

Example: Gas chromatography glucosinolates 20.0 micromoles.

- b. Erucic Acid. The long-chain fatty acid, erucic acid ($C_{22}H_{43}O_2$), is a component of canola/rapeseed and its oil. A high level of erucic acid is desired for the production of certain chemicals, industrial lubricants, fully hydrogenated rapeseed oil, and superglycerinated fully hydrogenated rapeseed oil. A low level is desired for the production of salad and vegetable oils, margarine, and shortening.

As stated in Section 3.7, Definition of Canola, an erucic acid test suitable for grading purposes does not exist. However, an analysis for erucic acid content is available at ARTS as a separate test, independent of grade. ARTS will notify the local field office of the test results which, in turn, will notify the official agency involved **or** will issue a certificate depending on the level of service. The erucic acid results are certificated independent of the grade certificate.

If the erucic acid result is equal to or greater than 2.0 percent, the applicant has the option of surrendering the outstanding grade certificate for corrections. Official personnel shall issue a "corrected certificate" labeling the seed as "not standardized grain" rather than canola.

If a review inspection is performed for grade and official personnel know, based on previous testing, that the erucic acid content is equal to or greater than 2.0 percent, grade the review inspection "not standardized grain" and cross reference the certificate that reported the high erucic acid level.

Basis of Determination. If an analysis for erucic acid content is requested, submit a portion of 300 grams free of machine separated dockage to CTL in Kansas City, Missouri:

USDA, GIPSA, FGIS
Technical Services Division, ARTS
Commodity Testing Laboratory
10383 North Ambassador Drive
Kansas City, Missouri 64153-1394
Fax: (816) 891-7314
Tel: (816) 891-0437

If an applicant requests both erucic acid and GC analysis for glucosinolates, submit a portion of 300 grams free of machine separated dockage to ARTS (refer to the sample preparation and mailing instructions given for glucosinolate analysis using the GC method).

Certification. Certify the erucic acid content to the nearest tenth percent. See general information above for further certification requirements.

Example: Erucic acid 1.2%.

c. Oil. Lipids are oils and fats that are liquid at room temperature.

Basis of Determination. If an analysis for oil content is requested, submit a portion of 100 grams free of machine separated dockage to ARTS.

If an applicant requests an oil analysis and GC analysis for glucosinolates, submit a portion of 300 grams free of machine separated dockage to ARTS (refer to the sample preparation and mailing instructions given in Section 3.21, Glucosinolates).

Certification. Certify the percentage of oil to the nearest tenth percent.

Example: Oil content 38.9%.

- d. Test Weight. 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 on a dockage-free portion of sufficient quantity to overflow the kettle.

Certification. Record test weight results in the “Remarks” section to the nearest tenth 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.