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Grain Grading Primer

Informational Reference

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Grain Grading Primer

Foreword

The effectiveness of the U.S. grain inspection system depends largely on an inspector's ability to sample, inspect, grade, and certify the various grains for which standards have been established under the United States Grain Standards Act, as amended. This publication is designed primarily to provide information and instruction for producers, grain handlers, and students on how grain is graded. It is not designed for Official grain inspectors for they must necessarily use more detailed instruction than that provided herein. In view of this fact, the Federal Grain Inspection Service, published the Grain Inspection Handbook, Book II, Grain Grading Procedures, which documents the step-by-step procedures needed to effectively and efficiently inspect grain in accordance with the Official United States Standards for Grain.

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Grain Grading Primer

Chapter 1

Barley



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Barley Definition

Barley is defined as grain that, before the removal of dockage, consists of 50 percent or more of whole kernels of cultivated barley and not more than 25 percent of other grains for which standards have been established under the United States Grain Standards Act.

The term “barley” as used in these standards shall not include hull-less barley or black barley.



Class

Barley is divided into two classes: Malting barley and Barley.

To meet the requirements for Malting barley, barley may not be infested, blighted, ergoty, garlicky, smutty, or contain any special grades.

Malting Barley

Malting barley is divided into three subclasses: Six-rowed Malting barley, Six-rowed Blue Malting barley, and Two-rowed Malting barley.

The subclass Six-rowed Malting Barley is barley that has a minimum of 95.0 percent of a six-rowed suitable malting type that has 90.0 percent or more of kernels with white aleurone layers that contains not more than 1.9 percent injured-by-frost kernels, 0.4 percent frost-damaged kernels, 0.2 percent injured-by-heat kernels, and 0.1 percent heat-damaged kernels. Six-rowed Malting barley shall not be infested, blighted, ergoty, garlicky, or smutty.

The subclass Six-rowed Blue Malting Barley is barley that has a minimum of 95.0 percent of a six-rowed suitable malting type that has 90.0 percent or more of kernels with blue aleurone layers that contains not more than 1.9 percent injured-by-frost kernels, 0.4 percent frost-damaged kernels, 0.2 percent injured-by-heat kernels, and 0.1 percent heat-damaged kernels. Six-rowed Blue Malting barley shall not be infested, blighted, ergoty, garlicky, or smutty.

The subclass Two-rowed Malting Barley is barley that has a minimum of 95.0 percent of a two-rowed suitable malting type that contains not more than 1.9 percent injured-by-frost kernels, 0.4 percent frost-damaged kernels, 0.2 percent injured-by-heat kernels, 0.1 percent heat-damaged kernels, 1.9 percent injured-by-mold kernels, and 0.4 percent mold-damaged kernels. Two-rowed Malting barley shall not be infested, blighted, ergoty, garlicky, or smutty.

Grade Requirements

Six-rowed Malting and Six-rowed Blue Malting barley are divided into four numerical grades. The factors affecting the numerical grade include: test weight per bushel, suitable malting type, sound barley, damaged kernels total, foreign material, Other grains, skinned and broken kernels, and thin barley.

Six-rowed Malting and Six-rowed Blue Malting barley that does not meet the requirements for U.S. Nos. 1, 2, 3, or 4 Malting are graded under the Barley standards.

Six-rowed Malting Barley Grade Requirements

SIX-ROWED MALTING BARLEY AND SIX-ROWED BLUE MALTING BARLEY								
Grade	Minimum Limits of -			Maximum Limits of -				
	Test weight per bushel (pounds)	Suitable malting type (percent)	Sound barley ¹ (percent)	Damaged kernels ¹ (percent)	Foreign material (percent)	Other grains (percent)	Skinned broken kernels (percent)	Thin barley* (percent)
U.S. No. 1	47.0	95.0	97.0	2.0	0.5	2.0	4.0	7.0
U.S. No. 2	45.0	95.0	94.0	3.0	1.0	3.0	6.0	10.0
U.S. No. 3	43.0	95.0	90.0	4.0	2.0	5.0	8.0	15.0
U.S. No. 4	43.0	95.0	87.0	5.0	3.0	5.0	10.0	15.0

The applicant may request that Malting barley varieties be inspected and graded in accordance with the standards established for the class Barley even though the lot would qualify as Malting Barley.

Two-rowed Malting barley is also divided into four numerical grades.

The factors affecting the numerical grade include: test weight per bushel, suitable malting types, sound barley, wild oats, foreign material, skinned and broken kernels, and thin barley.

Two-rowed Malting Barley Grade Requirements

TWO-ROWED MALTING BARLEY							
Grade	Minimum Limits of -			Maximum Limits of -			
	Test weight per bushel (pounds)	Suitable malting type (percent)	Sound barley ¹ (percent)	Wild Oats (percent)	Foreign material (percent)	Skinned broken kernels (percent)	Thin barley* (percent)
U.S. No. 1	50.0	97.0	98.0	1.0	0.5	5.0	5.0
U.S. No. 2	48.0	97.0	98.0	1.0	1.0	7.0	7.0
U.S. No. 3	48.0	95.0	96.0	2.0	2.0	10.0	10.0
U.S. No. 4	48.0	95.0	93.0	3.0	3.0	10.0	10.0

Two-rowed Malting barley that does not meet the requirements for U.S. Nos. 1, 2, 3, or 4 Malting is graded under the Barley standards.

Barley is divided into three subclasses: Six-rowed barley, Two-rowed barley, and Barley.

Six-rowed Barley is any six-rowed barley that contains not more than 10.0 percent two-rowed varieties.

Two-rowed Barley is any two-rowed barley with white hulls that contains not more than 10.0 percent six-rowed varieties.



Barley is any barley that does not meet the requirements for the subclasses Six-rowed barley or Two-rowed barley.

All subclasses of Barley are divided into five numerical grades and U.S. Sample grade.

The factors affecting the numerical grade include: test weight per bushel, sound barley, damaged kernels total, foreign material, broken kernels, and thin barley.

Barley Grade Requirements

BARLEY							
Grade	Minimum Limits of -		Maximum Limits of -				
	Test weight per bushel (pounds)	Sound barley ¹ (percent)	Damaged kernels ¹ (percent)	Heat Damaged (percent)	Foreign material (percent)	Broken kernels (percent)	Thin barley* (percent)
U.S. No. 1	47.0	97.0	2.0	0.2	1.0	4.0	10.0
U.S. No. 2	45.0	94.0	4.0	0.3	2.0	8.0	15.0
U.S. No. 3	43.0	90.0	6.0	0.5	3.0	12.0	25.0
U.S. No. 4	40.0	85.0	8.0	1.0	4.0	18.0	35.0
U.S. No. 5	36.0	75.0	10.0	3.0	5.0	28.0	75.0

Sample Grade

U.S. Sample grade is barley that does not meet the requirements for the grades U.S. Nos. 1, 2, 3, 4, or 5; or contains stones, glass, crotalaria seeds, castor beans, unknown foreign substances or commonly recognized harmful or toxic substances, cockleburrs or similar seeds, rodent pellets, bird droppings or other animal filth or has a musty, sour, or commercially objectionable foreign odor; or is heating or otherwise of distinctly low quality.

Heating

Barley developing a high temperature from microbial activity is considered heating. Heating barley, in its final stages, will usually have a sour or musty odor.

Care should be taken not to confuse barley that is heating with barley that is warm and moist because of storage in bins, railcars, or other containers during hot weather. Determine heating on evidence obtained at the time of sampling or on the basis of the sample as a whole.

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

Distinctly Low Quality

Consider barley distinctly low quality when it is obviously of inferior quality and the existing grade factors or guidelines do not properly reflect the inferior condition. Use all available information to determine whether the barley is of distinctly low quality. This includes a general examination of the barley during sampling and an analysis of the obtained sample.



Barley containing two or more stones, pieces of glass, pieces of concrete, or other pieces of wreckage or debris which are visible to the sampler and too large to enter the sampling device is considered distinctly low quality.

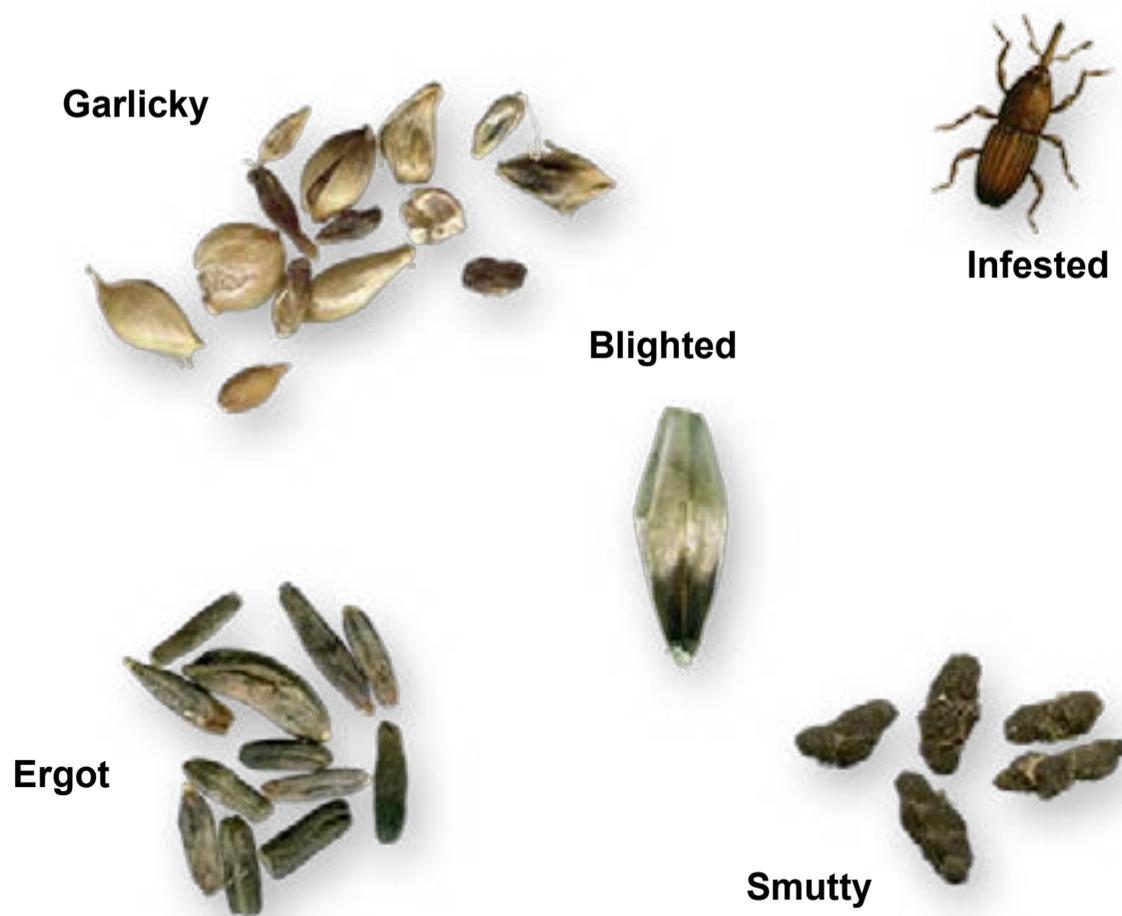
Barley that is obviously affected by other unusual conditions which adversely affect the quality of the barley and cannot be properly graded by use of the grading factors specified or defined in the standards is considered distinctly low quality. Grade distinctly low quality barley as U.S. Sample Grade.

Record the words “Distinctly Low Quality” and the reason why in the “Remarks” section of the certificate.

Special Grades

Special grades draw attention to unusual conditions in the grain and are made part of the grade designation. They do not affect the numerical or sample grade designation.

Special grades in barley are: Blighted Barley, Ergoty Barley, Garlicky Barley, Infested Barley, and Smutty Barley.



Blighted barley is barley that contains more than 4.0 percent of fungus-damaged and/or mold-damaged kernels.

Ergoty barley is barley that contains more than 0.10 percent ergot.

Garlicky barley is barley that contains three or more green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets in 500 grams of barley.

Infested barley is barley that is infested with live weevils or other live insects injurious to stored grain.

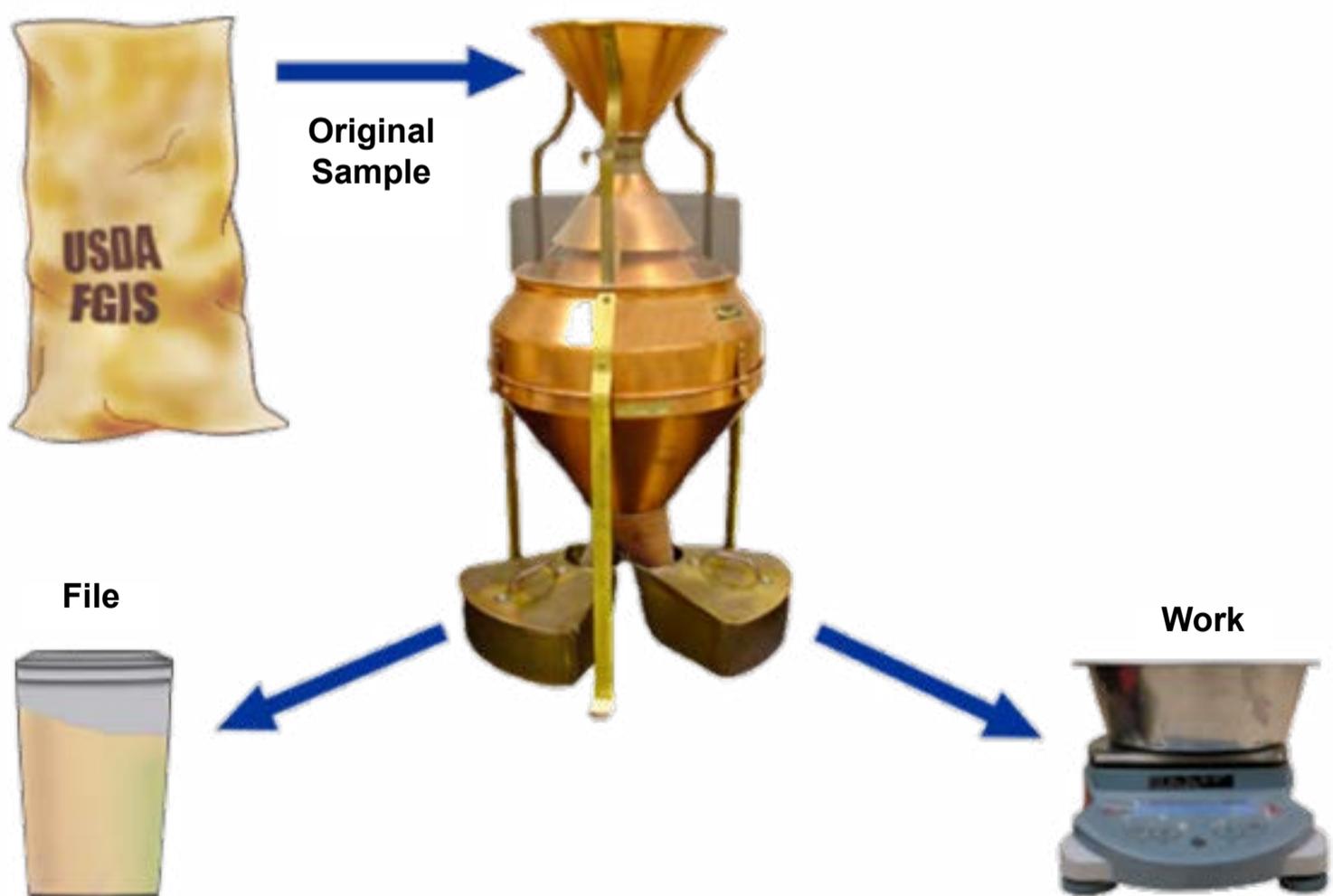
Smut is a plant disease characterized by the appearance of smut balls or smut spores.

Smutty barley is barley that has kernels covered with smut spores to give a smutty appearance in mass, or which contains more than 0.20 percent smut balls.

Processing the Original Sample

The first step in grading a barley sample is to use a Boerner divider to reduce the original sample of approximately 2500 grams into:

- a file sample of approximately 1250 grams; and
- a work sample of 850-950 grams of grain.

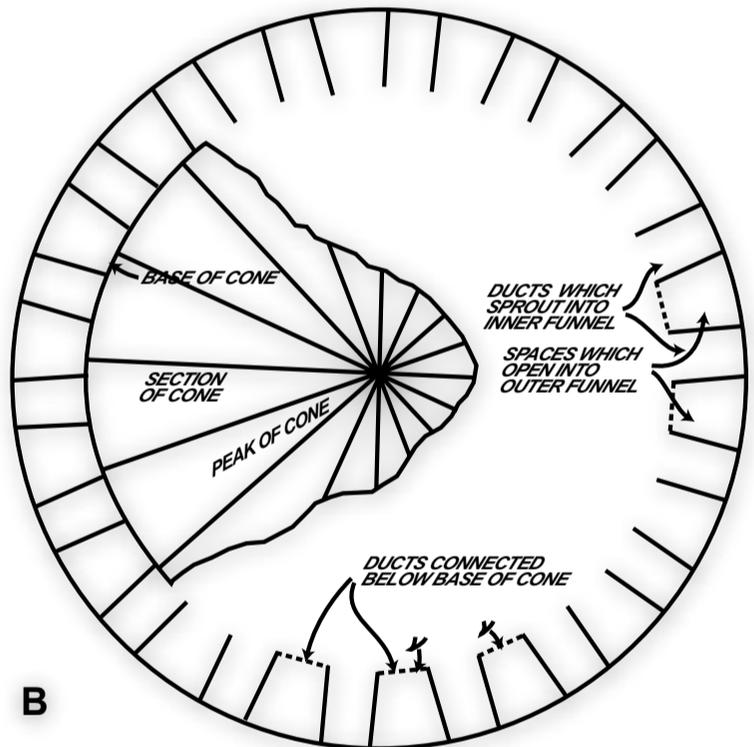
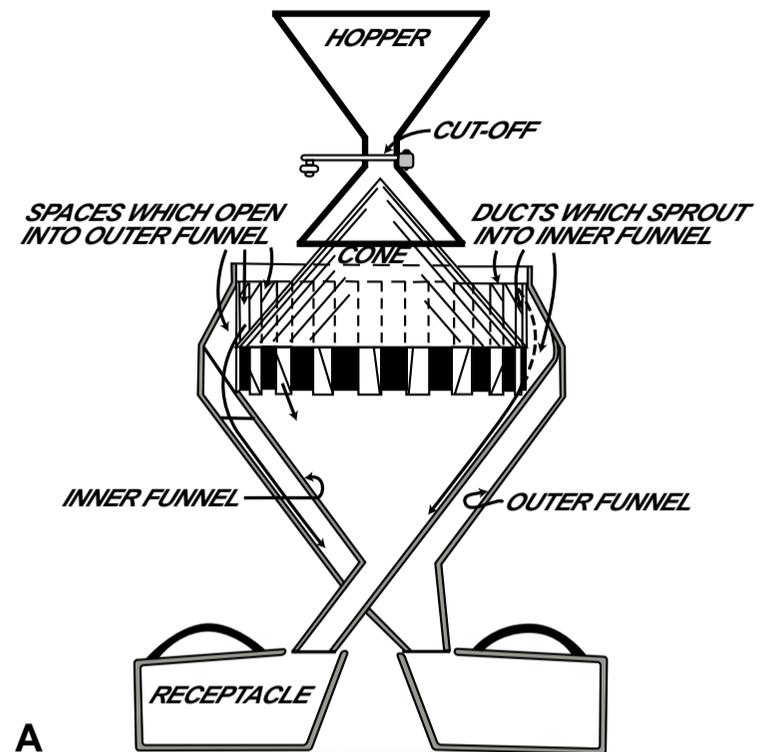


Boerner Divider

The Boerner divider reduces the size of a grain sample while maintaining its representativeness. Each pass of the sample through the divider splits the sample into two equal portions.



Boerner Divider



The Boerner Divider, consists of a hopper, inverted cone, and a series of baffles directing the grain into two collection pans. As the valve or gate at the base of the hopper is opened, gravity carries the grain over the cone, which serves as a surface by which the kernels can separate into a single layer. Arranged in a circle at the base of the cone are a series of baffles forming alternate channels and spaces of equal width. They are arranged in a circle at their summit and are directed inward and downward, the channels leading to one spout and the spaces to an opposite spout. Each kernel has an equal chance of falling into a channel or a space, resulting in two nearly identical portions of the original sample.

When Operating the Boerner Divider:

Check the divider for condition and cleanliness.

Close the hopper valve.

Place empty collection pans under the discharge spout.

Pour the sample into the hopper.

Open the valve quickly.

For larger samples, feed more grain into the hopper during the dividing process.



File Sample

A “file sample,” is a representative sample or representative portion of a sample that is retained for a specified period of time for reference or review purposes.

File samples should be of sufficient size to accommodate subsequent examinations or analysis.

The file sample shall be an unworked portion (if available) of the representative sample used for the inspection.

The worked portion may be retained as the final file only when insufficient sample is available for an unworked file sample.

Use Moisture Proof Containers

Keep all samples in sealed moisture proof containers if they cannot be tested within approximately 15 minutes.

Do not use paper bags, fiber cartons, or similar containers that allow moisture losses. Use metal cans, plastic containers, and plastic bags to preserve the sample integrity.

Do not file samples with paper identification inserted in the grain. Paper absorbs moisture and lowers the moisture of the grain.



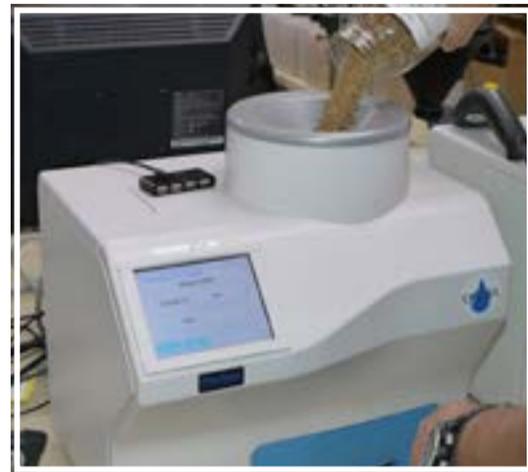
Moisture

Determine moisture before the removal of dockage on a portion of approximately 650-750 grams of grain.

Dickey-john



Perten



The DICKEY-john GAC2500-UGMA and the Perten AM5200-A are the designated official moisture meters for performing moisture analysis in grains. Basically, the instruments measure the change in capacitance of two parallel plates when grain is placed between them. As the moisture content within the grain increases or decreases so does its contribution to capacitance, known as its dielectric constant.

The instruments also measure sample density and temperature and perform automatic corrections for those parameters.

Calibration equations have been developed to convert these properties into precise moisture percentages for each grain measured by the instruments.

The test they perform takes about 30 seconds to complete and is a simple and accurate way to obtain moisture analysis in the field.

Record the percent of moisture on the certificate to the nearest tenth percent.

Check for Sample Grade

Before the removal of dockage check the work portion for sample grade factors. Samples meeting or exceeding any one of these tolerances are Sample Grade:

- 2 or more pieces of glass
- 3 or more crotalaria seeds
- 2 or more castor beans
- 4 or more particles of an unknown foreign substance or a commonly recognized harmful or toxic substance
- 8 or more cocklebur or similar seeds singly or in combination
- 10 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth
- or is heating or otherwise of distinctly low quality.



Check for Garlic

Determine garlicky before the removal of dockage on a work portion of 500 grams.

Garlicky barley is barley that contains three or more green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets in 500 grams of barley.

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

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

Dockage

Determine dockage on a portion of 850-950 grams.



Air



Riddle



Thru #6 Sieve

Dockage is all matter other than barley that can be removed from the original sample using a Carter Dockage tester. Also, underdeveloped, shriveled, and small pieces of barley kernels removed in properly separating the material other than barley and that cannot be recovered by properly re-screening or re-cleaning.

When the sample contains 0.50 percent or more dockage, record the percentage of dockage on the certificate in half and whole percent with a fraction less than one-half percent disregarded.

Mechanical Cleaning

To mechanically clean the sample on the Carter Dockage tester:

- Set the air control on 4 and set the feed control to 6.
- Insert a No. 6 riddle in the riddle carriage, a No. 8 sieve in the top sieve carriage, and a No. 6 sieve in the middle sieve carriage.
- No sieve is required in the bottom sieve carriage.
- Start the Carter Dockage Tester and pour 850-950 grams of barley into the feed hopper.



Carter Dockage Tester

Rescreening

Dockage is the Aspirated material in the air collection pan, the material passing over the No. 6 riddle, excluding barley, and the material that passed through the No. 6 sieve, in the bottom collection pan.

Examine the material that passed over the No. 6 sieve to determine if it contains more than 0.1 percent of wild buckwheat, mustard seed, or similar seed. If so, this material must be rescreened using a 5/64 inch equilateral triangular hole sieve.

To rescreen, place the material on the upper edge of the 5/64 inch sieve, hold the sieve at a 10-20 degree angle and work the material down over the sieve with a gentle side-to-side motion.

Return barley and other material remaining on top of the 5/64 inch sieve to the dockage-free sample. The material passing through the hand sieve is dockage

Check for Insects

Infestation is determined on the lot as a whole or the sample as a whole before the removal of dockage. However, to save time, many inspectors check for insects after dockage is removed. This is permissible as long as both the dockage and cleaned sample are thoroughly examined for insects.

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 barley must be carefully examined to determine if it is infested.

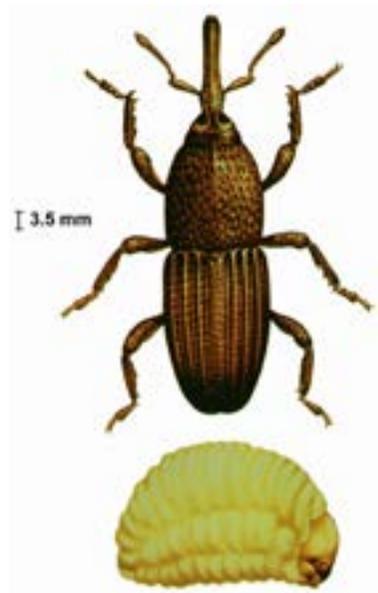
In such cases, examine the work sample and the file sample before reaching a conclusion as to whether or not the barley is infested. Do not examine the file sample if the work portion is insect free. Samples meeting or exceeding any one of these tolerances are infested:

- 2 live weevils
- 1 live weevil + 5 other live insects
- 10 other live insects

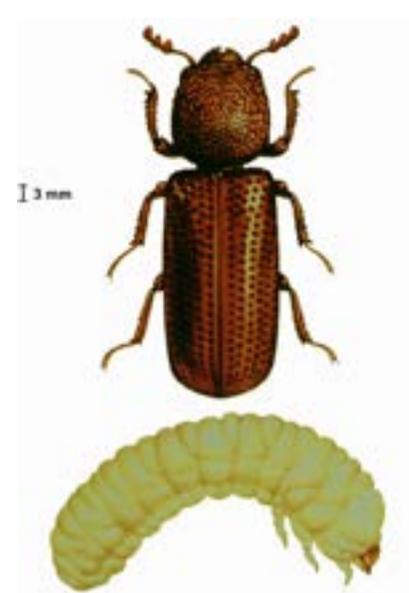


Live Weevils

Live weevils include rice weevils, granary weevils, maize weevils, cowpea weevils, and lesser grain borers.



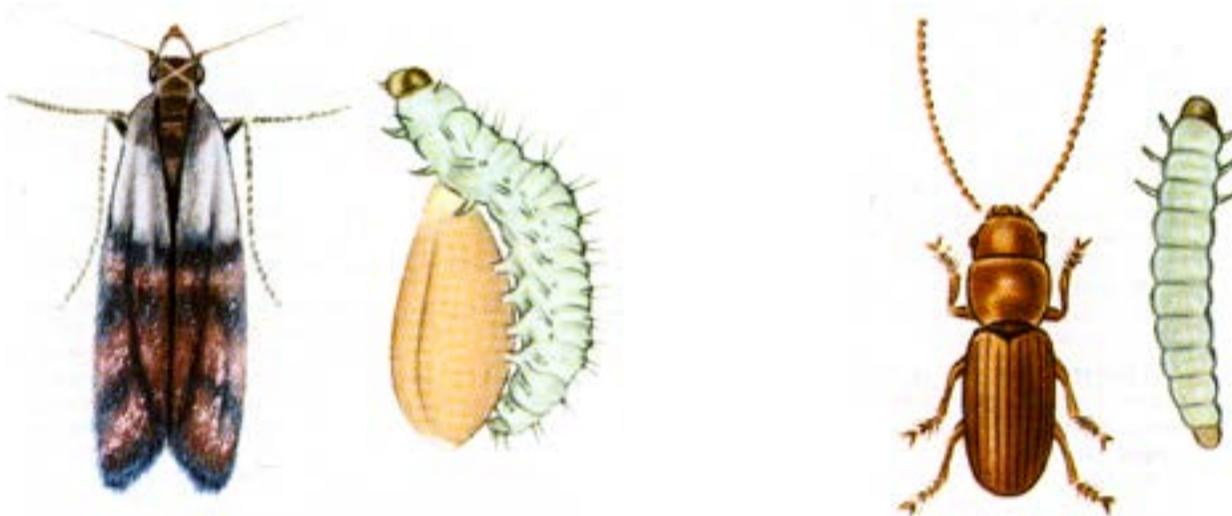
Granary Weevil



Lesser Grain Borer

Other Live Insects

Other live insects injurious to stored grain shall include grain beetles, grain moths, and larvae.



Check Odor

Determine odor on evidence obtained at the time of sampling or on the sample before or after the removal of dockage. Odors are classified as OK, Musty, Sour, or COFO (commercially objectionable foreign odors).

Musty odors indicate the presence of fungal activity in the grain and are generally characterized as an earthy smell.

Sour odors indicate that the grain is fermenting due to microbial activity. Sour odors are often characterized as an acrid, boot pit or pigpen smell.

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.

Check for Stones

After the removal of dockage, check for stones.

Samples containing 8 or more stones or any number of stones which have an aggregate weight in excess of 0.2 percent of the sample weight are Sample Grade.

Test Weight per Bushel

The weight per Winchester bushel for barley is determined on the original sample after the removal of dockage on a portion of sufficient quantity to overflow the kettle.

A Winchester bushel is 2150.42 cubic inches or 35.24 liters.

To determine test weight position the hopper over the center of the kettle, making sure the hopper valve is closed. Pour grain into the hopper.



Filled Hopper



Open the Valve

Open the valve allowing the grain to overflow the kettle. Once the hopper is clear of grain move the hopper to the side.

With a rounded edge striker, place it on the edge of the kettle and move the striker in three zigzag motions across the kettle leveling the grain.



Strike-off Procedure



Weigh the Grain

Move the kettle to a scale and record the test weight measurement.

Record test weight results on the work record as displayed on the electronic scale or in whole and half pounds.

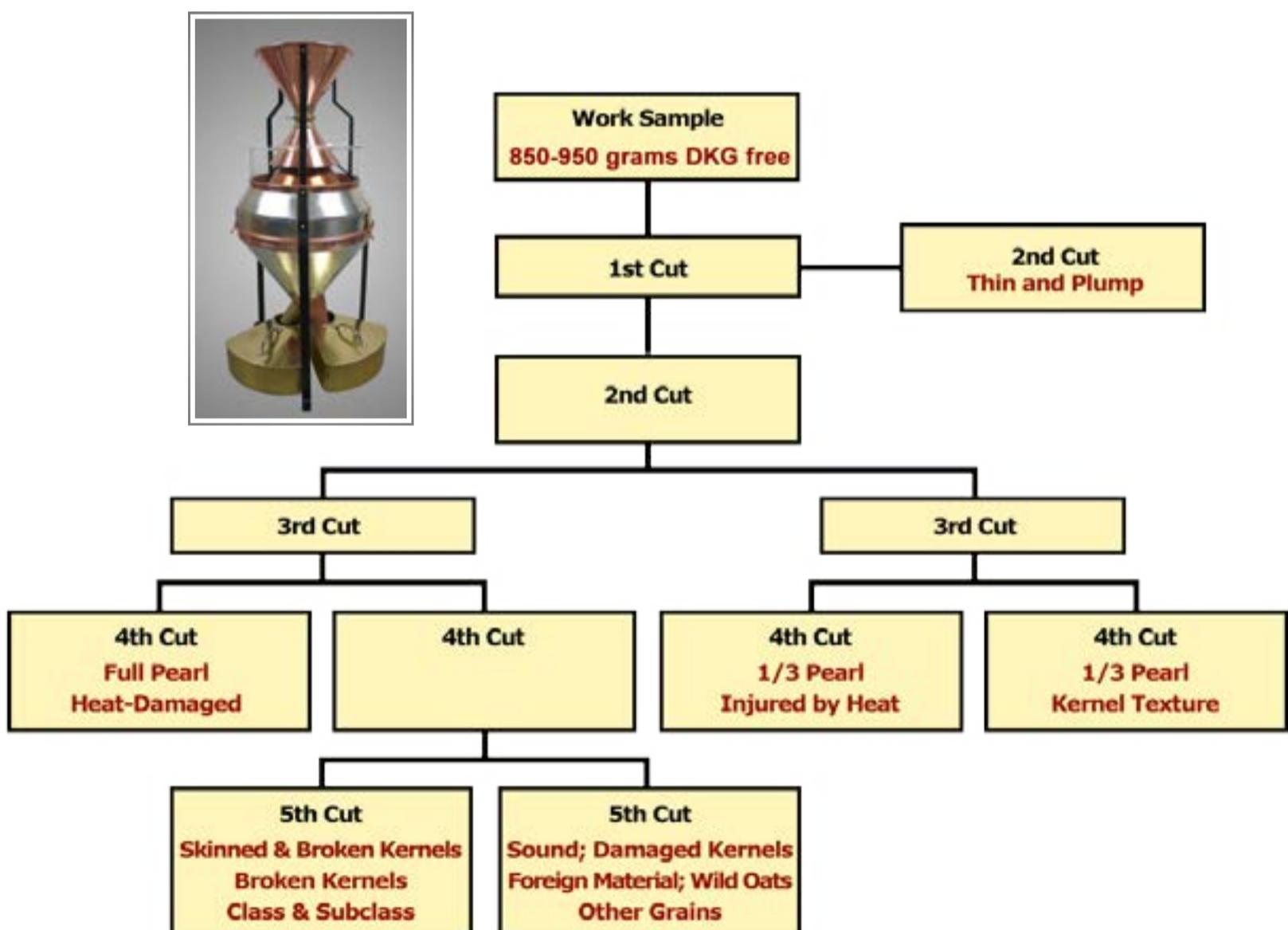
Record the test weight on the certificate in whole and half pounds. Disregard fractions of a half pound.

If requested, convert the pounds per bushel result to kilograms per hectoliter by multiplying the lbs. / bu result by 1.287 and record in the "Remarks" section in whole and tenths

Processing the Work Sample

At this point, all tests required to be performed prior to the removal of dockage have been made and the percentage of dockage has been determined.

Using the Boerner divider divide the work sample, into fractional portions for other determinations required after the removal of dockage.



Check for Smut

Determine the appearance of smutty barley and/or the weight of smut balls on a dockage-free work portion of 500 grams. Smut balls also function as foreign material.

Smut is a plant disease characterized by the appearance of smut balls or smut spores.

Smutty barley is barley that has kernels covered with smut spores to give a smutty appearance in mass, or which contains more than 0.20 percent smut balls.



Check for Ergot

Determine ergoty on a dockage-free portion of 250 grams.

Ergot is a hard, reddish-brown or black grain-like mass of certain parasitic fungi that replaces the kernels of barley. Ergoty barley is barley that contains more than 0.10 percent ergot.



Determine Thin Barley

Thin barley is determined by sieving a dockage-free portion of 250 grams.

In Malting barley thin is defined as: Six-rowed Malting barley that passes through a $\frac{5}{64}$ " x $\frac{3}{4}$ " slotted-hole sieve and Two-rowed Malting barley that passes through a $\frac{5.5}{64}$ " x $\frac{3}{4}$ " slotted-hole sieve.

In barley thin is defined as: Six-rowed barley, Two-rowed barley, or Barley that passes through a $\frac{5}{64}$ " x $\frac{3}{4}$ " slotted-hole sieve.

Mount the applicable sieve and bottom pan on a mechanical sieve shaker set for 30 strokes. Return any material lodged in the perforations to the barley which remained on top of the sieve.

Record the percentage of thin barley on the work record and the certificate to the nearest tenth percent.

Determine Plump Barley

Plump barley is also determined by sieving a dockage-free portion of 250 grams. Plump barley is defined as: Barley that remains on top of a 6/64" x 3/4" inch slotted-hole sieve after sieving.

Mount the applicable sieve and bottom pan on a mechanical sieve shaker set for 30 strokes. Return any material lodged in the perforations to the barley which remained on top of the sieve.

When requested, show the word "Plump" and the applicable percentage range in the "Remarks" section of the certificate. Plump barley is certified in five percent ranges. Percentage ranges are recorded as:

- Below 50 percent
- 50 to 55 percent
- 56 to 60 percent
- 61 to 65 percent, etc.

Sieving Procedure

Mechanical sieving is preferred over hand-sieving because the results are more uniform and accurate in counting the number of strokes. When sieving barley to determine plump or thin:

- Make sure the shaker is level.
- Select the proper sieve and place it over a bottom pan.
- Mount the sieve and bottom pan in the sieve holder making sure that the slotted or oblong perforations are parallel with the sieving action.
- Set the stroke counter for 30 strokes.



Mount Sieve



Set Stroke Count

- Gently pour the dockage-free 250-gram portion in the center of the sieve.
- Turn the machine on.



Pour in Center



Start Shaker

- After the required number of strokes has been completed, the machine will automatically stop.
- Carefully remove the sieve and bottom pan. Jarring the sieve will cause the material remaining on top to pass through the perforations, leading to inaccurate results.
- Combine the material lodged in the perforations with the material that remained on top of the sieve. To remove the lodged material from the perforations, rub the sieve bottom gently.

Tapping will warp the sieve and lead to inaccurate results in future determinations.



Remove lodged Kernels

Determine Class & Subclass

Determine the class and subclass of barley by examining kernel and varietal characteristics on a dockage-free portion of 25 grams.

Two-rowed barley is usually characterized by plump symmetrical kernels with tight creases straight down the center of the kernels. Two-rowed barley often has a slightly wrinkled skin that is generally thinner than the skin of Six-rowed barley.



Two-Row Barley

Six-rowed barley is usually characterized by long, irregularly shaped kernels. The germs and creases in most Six-rowed barley kernels are twisted with the crease flaring open at the end of the kernel. Some kernels, however, have germs and creases which are straight.



Six-Row Barley

Damaged Kernels

Determine damaged kernels on a dockage free portion of 25 grams.

Damaged Kernels are kernels, pieces of barley kernels, other grains, and wild oats that are badly ground-damaged, badly weather-damaged, diseased, frost-damaged, germ-damaged, heat-damaged, injured-by-heat, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged.



Record the percent of damaged kernels on the work record and the certificate to the nearest tenth percent.

Visual Reference Images

Because of the subjectivity involved in determining damage, and other subjective criteria, it is critical that visual references are available to ensure that interpretations are uniformly and consistently applied throughout the national system.

Color images provide a basis for communicating the minimum "line" for various types of damage and other visually determined criteria.

BARLEY GERM DAMAGE



Kernels that have discolored or moldy germs (embryo) are damaged. Scrape the germs carefully to avoid scraping too deeply and destroying the evidence of damage.

Kernel A: Kernels and pieces of barley that have discolored germs as dark or darker than shown shall be damaged. Discolored germs that do not meet the minimum coverage requirement may be considered damage provided the degree of discoloration is greater than shown and the overall "prorated" appearance meets the minimum coverage and intensity level depicted.

Kernel B: Kernels containing any amount of mold shall be damaged. Mold occurs in many colors other than shown.

Blight-Damaged

Blight damage is kernels and pieces of kernels affected with blight to the extent that the discoloration covers at least one-third of the surface area shown (singularly or in combination) with an intensity equal to or greater than shown. Blight is considered damage in all classes of Barley.



Do not confuse blight damage with badly stained, weathered, or water-stained kernels.

Six-rowed Malting Barley may not contain more than 4.0% blight/mold damage. More than 4.0% of blight and/or mold makes the special grade “blighted”.

Mold-Damaged

Mold-damaged is kernels and pieces of kernels in which the discoloration is spotted or blotched. Discoloration may appear on one or both sides but must be equal to or greater than the combined surface area depicted on both kernels.



Mold is considered damage in all classes of Barley.

Two-rowed Malting Barley may not contain more than 0.4% mold damage. More than 4.0% of blight and/or mold damaged kernels makes the special grade “blighted.”

Frost-Damaged Kernels

Frost damage is kernels, pieces of barley kernels, other grains, and wild oats that are badly shrunken and/or distinctly discolored black or brown by frost.



Kernels and pieces of barley (with or without the hull) that are distinctly discolored green, brown, or black to the minimum intensity shown are considered damage. Kernels are usually shrunken or indented.

The illustration shows from left to right:

Kernel 1: The minimum degree of discoloration for green.

Kernel 2: The minimum degree of discoloration for brown or black.

Malting barley may not contain more than 0.4% frost damage. Frost-damaged kernels are scored as damaged kernels and against sound barley limits.



Germ-Damaged (Sick / Mold)

Germ-damaged kernels are kernels that have discolored or moldy germs as a result of microbial activity. Scrape the germs carefully to avoid scraping too deeply and destroying the evidence of damage. The illustration shows from left to right:



Kernel 1: Kernels and pieces of barley that have discolored germs as dark as or darker than shown shall be damaged. Discolored germs that do not meet the minimum coverage requirement may be considered damage provided the degree of discoloration is greater than shown and the overall “prorated” appearance meets the minimum coverage and intensity level depicted.

Kernel 2: Kernels containing any amount of mold shall be damage. Mold occurs in many colors other than shown.

Heat-Damaged

Determine heat-damaged kernels on a 50 gram pearled portion. Heat-damaged kernels are Kernels and pieces of barley which, after the standardized full pearl, are materially discolored (red, black, or brown) to the minimum extent shown when viewed from the top. The illustration shows from left to right:



Kernel 1: Minimum color intensity for Blue barley.

Kernel 2: Minimum color intensity for barley other than Blue barley.

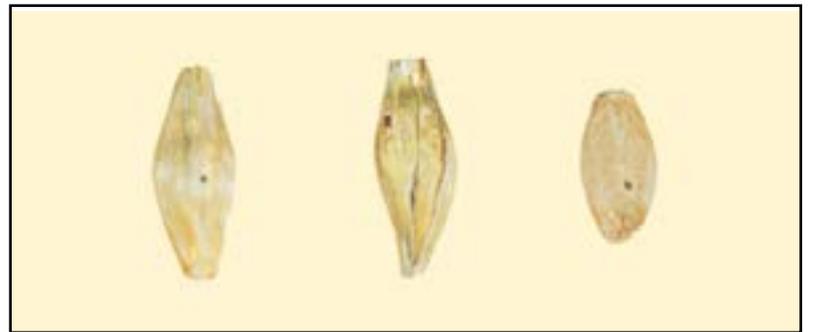
Malting barley may not contain more than 0.1% heat-damaged kernels.

Weevil or Insect-Bored

Weevil or insect-bored barley is kernels and pieces of barley kernels which have been bored or tunneled by insects.

The illustration shows from left to right:

Kernel 1: which has been tunneled.
Kernels 2 & 3: which have been bored.



Sprout-Damaged

Sprout-damaged kernels are kernels and pieces of barley that have sprouted or have swelling over the germ and, after examination, show sprout. The illustration shows from left to right:

Kernel 1: This kernel is showing visible sprout at the bottom of the germ area.

Kernel 2: Kernels which, after careful removal of the seed coat, show any evidence of movement in the germ area. The “sprout” may move towards the top or bottom of the germ or lift upward leaving space between the sprout and germ cavity.

Swelling over the germ area may or may not be an indication of sprout.



Check for Blighted Barley

Determine blighted barley on the dockage-free portion of 25 grams used for damage.

Designate barley containing more than 4.0 percent of fungus-damaged and/or mold-damaged kernels as “Blighted.”

Malting Factors

In addition to the grading factors listed in the grade and grade requirements tables, other limits have been established for malting barley. Malting Factors along with the grade factors, are determined before designating the class or subclass of barley.

MALTING FACTORS							
Subclass	<i>Maximum limits of:</i>						
	Frost Damage	Injured-by-Frost	Heat Damage	Injured-by-Heat	Mold Damage	Injured-by-Mold	Kernel Texture
Six-rowed Malting and Six-rowed Blue Malting	0.4%	1.9%	0.1%	0.2%	---	---	90%
Two-rowed Malting	0.4%	1.9%	0.1%	0.2%	0.4%	1.9%	---
Basis of Determination	25 g	25 g	50 g	50 g	25 g	25 g	50 g

The determinations for Frost Damage, Heat damage, Injured by heat, and Mold damage, can be based on the separation made for damaged kernels.

The determinations for Injured by mold and Injured-by-Frost can also be made on the 25 gram portion used for damaged kernels, although these factors are not included in the damaged kernels determination.

The determination for kernel texture is made on a 50 gram pearled portion. Upon request, malting factors may also be determined on barley that is not considered as a malting type.

Injured-by-Heat

Injured-by-heat kernels are kernels and pieces of barley which, after the standardized one-third pearl, are slightly discolored to the minimum extent shown when viewed from the top. The illustration shows from left to right:

Kernel 1: Minimum color intensity for Blue barley
Kernel 2: Minimum color intensity for barley



Malting barley may not contain more than 0.2% injured-by-heat. Do not confuse with heat-damaged barley.

Injured-by-Frost

Injured-by-frost is kernels and pieces of kernels that are distinctly indented, immature or shrunken, or discolored as a result of frost.

Injured-By-Frost is a malting factor only and does not function as damage or against sound barley. Malting barley may not contain more than 1.9% Injured-By-Frost damage.



Injured-by-Mold

Injured-by-mold kernels are kernels, pieces of barley kernels containing slight evidence of mold.

Injured-by-mold kernels are characterized by mold spores and have a weathered appearance.



Kernel Texture

Kernel texture is the color of the aleurone layer. Determine kernel texture by pearling a 50 gram dockage-free portion.



**90% or more White Aleurone
Six-rowed Malting Barley**



**90% or more Blue Aleurone
Six-rowed Malting Barley**

Six-rowed Malting barley consists of 90.0 percent or more of kernels with white aleurone layers.

Six-rowed Blue Malting barley consists of 90.0 percent or more of kernels with blue aleurone layers.

Barley Pearler Procedure

The barley pearler is used in the determination of heat-damage, injured-by-heat, kernel texture, and sprout.

Before pearling a sample, run the pearler and open the slide to ensure that the pearling chamber is empty.

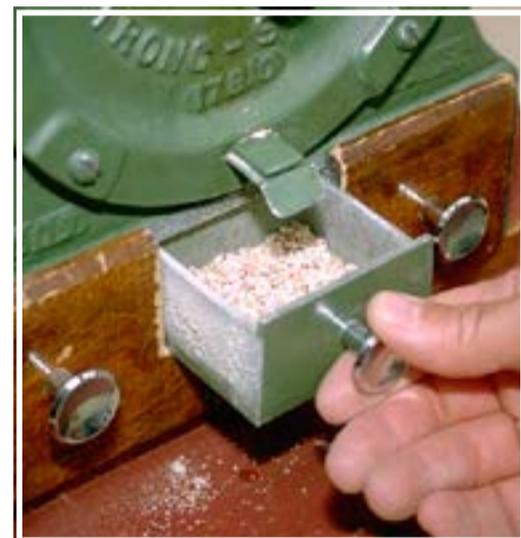
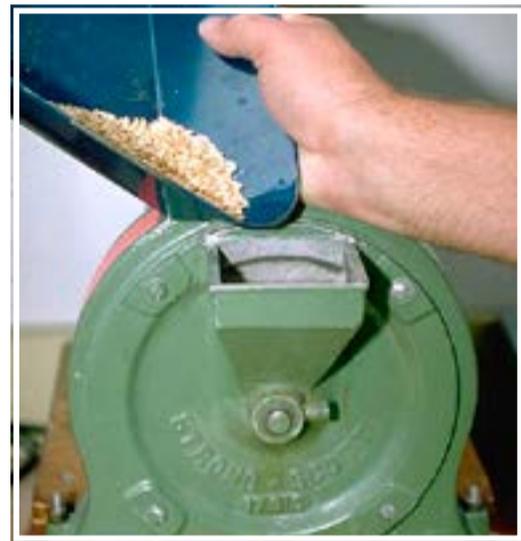
Remove and empty the drawers that catch the barley hulls and pearled portion, replace the drawers and securely close the slide.

Pour 50 grams of dockage-free barley into the pearler and replace the lid.

Set the timer for the factor being determined.

- Use a full standardized Pearl for heat damage
- Use a 1/3 pearl for Injured-by-Heat and Kernel Texture
- Use a 1/5 pearl for injured by sprout

After pearling, pull out the slide and allow the pearled portion to drop into the drawer. With the slide open, briefly restart the machine and clear the pearling chamber. Proceed with the determination as described for the appropriate factor.



Standardizing the Pearler

To standardize a barley pearler it must be referenced to a pearler that has been standardized to the GIPSA Master Pearler using the following procedure:

First, obtain a sample that has been tested on a standardized pearler. Two-rowed barley is preferred for standardization purposes because it is more uniform than six-rowed barley. Use a Boerner divider to cut out four approximately 50 gram portions from the sample. Hand adjust each portion to 50.0 grams.

Pearl the first portion for 60 seconds. Compare the weight of the pearled portion to the weight obtained from the Standard pearler.

The results should be within plus or minus 1.0 gram of the results from the Standard pearler.

If not, adjust the pearling time in 15 second increments and pearl additional portions, until the weight of the pearled portion is within plus or minus 1.0 gram of the Standard pearler. Increase the time if the weight was high and decrease the time, if the weight was low. Some pearlors may require adjustment in increments smaller than 15 seconds.

The pearling time required to obtain results within plus or minus 1.0 gram of the Standard pearler, is established as the "Full Pearl" time for the pearler.

Record the pearling time on a piece of paper and tape it to the pearler in a conspicuous place for easy reference.

The carborundum pearling wheel will wear through use, increasing the time required to pearl a sample. This will require that the pearler be re-standardized periodically. The pearlors used in the official system are checked annually.

Foreign Material

Determine foreign material on a dockage-free portion of 25 grams.

Foreign Material is all matter other than barley, other grains, and wild oats that remains in the sample after the removal of dockage.

Record the percent of foreign material on the work record and the certificate to the nearest tenth percent.



Wild Oats

Determine wild oats on a dockage-free portion of 25 grams.

Wild oats are usually identified by their slender kernels and twisted awns (so called “sucker mouths”) and basal hairs or bristles on the germ end of the kernel.



A grade determining factor only in the subclass Two-rowed Malting barley, wild oats is deducted from the percentage of sound barley in all other classes and subclasses of barley.

Other Grains

Determine other grains on a dockage-free portion of 25 grams.

Other grains are Black barley, corn, cultivated buckwheat, einkorn, emmer, flaxseed, guar, hull-less barley, nongrain sorghum, oats, Polish wheat, popcorn, poulard wheat, rice, rye, safflower, sorghum, soybeans, spelt, sunflower seed, sweet corn, triticale, and wheat. Canola, Oat groats, and hull-less oats are also considered as other grains.



Other grains is a grading factor in the subclasses Six-rowed Malting barley and Six-rowed Blue Malting barley and are not considered as sound in all classes and subclasses of barley.

Sound Barley

Sound barley is kernels and pieces of barley kernels that are not damaged and includes:

- Skinned and broken kernels of barley which are not damaged,
- Broken kernels which are not damaged,
- Green immature kernels of barley not otherwise damaged, and
- Kernels which are considered injured-by-frost and/or injured-by-mold.

Sound barley does not include damaged kernels of barley and material other than barley.

The percentage of sound barley is the sum of the percentages of damaged kernels, foreign material, other grains, and wild oats subtracted from 100 percent. Record the percentage of sound barley on the work record and the certificate to the nearest tenth percent.

Skinned and Broken Kernels

Determine skinned and broken kernels on a dockage-free portion of 25 grams. Skinned and broken kernels are barley kernels that have one-third or more of the hull removed, or that the hull is loose or missing over the germ, or broken kernels, or whole kernels that have a part or all of the germ missing. The illustration shows barley in which part of the germ is missing or the hull is:

Kernel 1: Loose over the germ area on both sides and the front.

Kernel 2: Has one-third or more missing from the kernel.

Kernel 3: Is missing or split over the germ area. The germ area must be visible when viewing from the top only.

Kernel 4: More than one-fourth of the kernel is broken off.

Kernels 5 & 6: Is skinned on both sides of the kernel.



When malting barley does not meet the requirements for malting because it exceeds the limit for skinned and broken kernels, record the percentage of skinned and broken kernels on the work record and in the “Remarks” section of the certificate to the nearest tenth percent.

Broken Kernels

Determine broken kernels on a dockage-free portion of 25 grams.

Broken kernels are barley kernels with more than 1/4 of the kernel removed and are a grade-determining factor in the class barley.



Other Official Criteria

Other tests that can be performed on barley include testing for the mycotoxin Deoxynivalenol, pesticide residue, and injured-by-sprout.

Injured-by-Sprout

Kernels and broken kernels of barley which, after pearling, contain a visible germ area showing evidence of sprout, sprout socket, or 2/3 or more of the germ missing are considered “Injured by Sprout”. Also consider kernels as “Injured by Sprout” if the germ area has been broken off and the remaining kernel is at least 2/3 of a whole kernel. Injured by Sprout does not function as damage.



Upon request determine injured-by-sprout on 55 grams plus or minus one gram divided from the dockage free work portion. By using a portion pearled by a standardized Barley pearler injured by sprout kernels of barley can be determined more effectively.

- Using a stopwatch, pearl the portion for 1/5 of the standardized full pearl time, plus or minus one second.
- Using an aspirator or comparable device, remove the excess hulls remaining in the pearled portion.
- Remove all the injured-by-sprout kernels from the portion.

Determine Grade Designation

After completing the analysis, compare the results with the limits for each grade factor.

The factor with the lowest grade designation determines the grade assigned to the sample.

The Official U.S. Standards for Grain provide an optional grade designation, commonly referred to as “or better.”

Upon request of the applicant, barley may be certified as U.S. No. 2 or better, U.S. No. 3 or better, etc.

An “or better” grade designation cannot be applied to U.S. No. 1 grade designation.

Documenting the Grade

Use the following guidelines when documenting the grade.

First write the letters "U.S." followed by the abbreviation "No." and the number of the grade or the words "Sample grade";

Then the words "or better" when applicable followed by the name of the subclass;

Next is the applicable special grades in alphabetical order followed by the word "dockage" and the percentage thereof.

Location Northree		Field Office Grand Forks		Identification #1111	
1 Supervision	Inspection Point Code	Grain Code 03	01 Wheat 02 Corn 03 Barley 04 Oats	05 Rye 06 Sorg. 07 Flax 08 Soyb.	09 Mixed 10 Triticale 12 Sunflower 13 Canola
2 Sustained Appeal					99 Not Stdr.
3 Not Sustained Appeal					1 IN 3 LOC 5 EXP 2 OUT 4 SUB
06 HOPPER	08 BOXCAR	10 BARGE	12 OTHER	1 MECH	3 CUP
07 TRUCK	09 SHIP	11 SEA VAN		2 PELICAN	4 PROBE
				1 FILE	2 ORIGINAL
				3 F&I	
4428	OTS <input checked="" type="checkbox"/>	Date Supv./Appeal - . -	ORIGINAL INSP.	SUPV./APPEAL INSP.	BAR INSP. B-
Sampled By	Date Sampled	BNS	Name John Doe		
Appeal No.	To BAR (Date)	Quantity	Date 05/18/03		
Remarks					

Code	Factor	Original	Supv/Appeal	Initials	BAR	Code	Factor	Original	Supv/Appeal	Initials	BAR
	CL	Blu				24	HFFM				
02	DKG	1.32				25	MSFM				
03	TW	44.5				26	BNFM				
04	M	12.1				33	SKBN				
05	ODOR	OK				36	OCOL SBOC				
06	HT	0.1				60	LW				
07	ODK					62	STON				
08	SKD					29	SND	94.5			
09	DKT	3.5	<input type="checkbox"/>			31	DL	5.1			
10	CHSE					32	THD	5.6			
11	FINE										
12	FM	0.9									
13	SHBN										
14	DEF										
15	CCL										
16	WOCL										
17	DHV		<input type="checkbox"/>								
18	HVAC										
19	WHCB										
20	EMOD FMOR										
21	SPL										
23	BCFM										
WORK SAMPLE SIZE		GRADE U.S. NO.		CLASS AND SPECIAL GRADE							
SUPV./APPEAL	BAR	Org	2	SRB DKG 1.0							
SEAL(S) BROKEN		Bar									
SEAL(S) APPLIED											

FORM FGIS-920 (5-93) Previous edition obsolete. GRAIN SAMPLE TICKET USDA-FGIS

Grain Grading Primer

Chapter 2

Canola



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Canola Definition

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 glucosinolate per gram of air-dried, oil free solid.

Before the removal of dockage, the seed shall contain no more than 10.0 percent of other grains for which standards have been established under the United States Grain Standards Act.

Canola Grades and Grade Requirements

CANOLA								
	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)	
Grade								
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: <ol style="list-style-type: none"> (a) Does not meet the requirements for grades U.S. No. 1, 2, 3; or (b) 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 (c) Has a musty, sour, or commercially objectionable foreign odor; or (d) Is heating or otherwise of distinctly low quality. 								

Grade Requirements

There are no classes or subclasses in canola. Canola is divided into three numerical grades and U.S. Sample grade. The factors affecting the numerical grade include: Heat Damage, Distinctly Green, Total Damage, Ergot, Sclerotinia, Stones, Conspicuous Admixture, and Inconspicuous Admixture.

Sample Grade

U.S. Sample grade is canola that does not meet the requirements for the grades U.S. Nos. 1, 2, or 3; or

- contains glass,
- unknown foreign substances or
- a commonly recognized harmful or toxic substance,
- animal filth;
- has a musty, sour, or commercially objectionable foreign odor;
- is heating or
- otherwise of distinctly low quality.

Heating

Canola developing a high temperature from microbial activity (fermenting), insect infestation, or sprouting is considered heating. As heating progresses canola will develop a sour or musty odor. Care should be taken not to confuse canola that is heating with canola that is warm because of storage in bins, railcars, or other containers during hot weather.

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

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

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. 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).

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.

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.

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.

Special Grades

Special grades identify unusual conditions in grain and are part of the grade designation. They do not affect the numerical or sample grade designation. The canola standards include two special grades.



The special grade garlicky is applied to canola that contains more than two green garlic bulbets or an equivalent quantity of dry or partly dry bulbets.



The special grade infested is applied to canola that is infested with live weevils or other live insects injurious to stored grain.

Processing the Original Sample

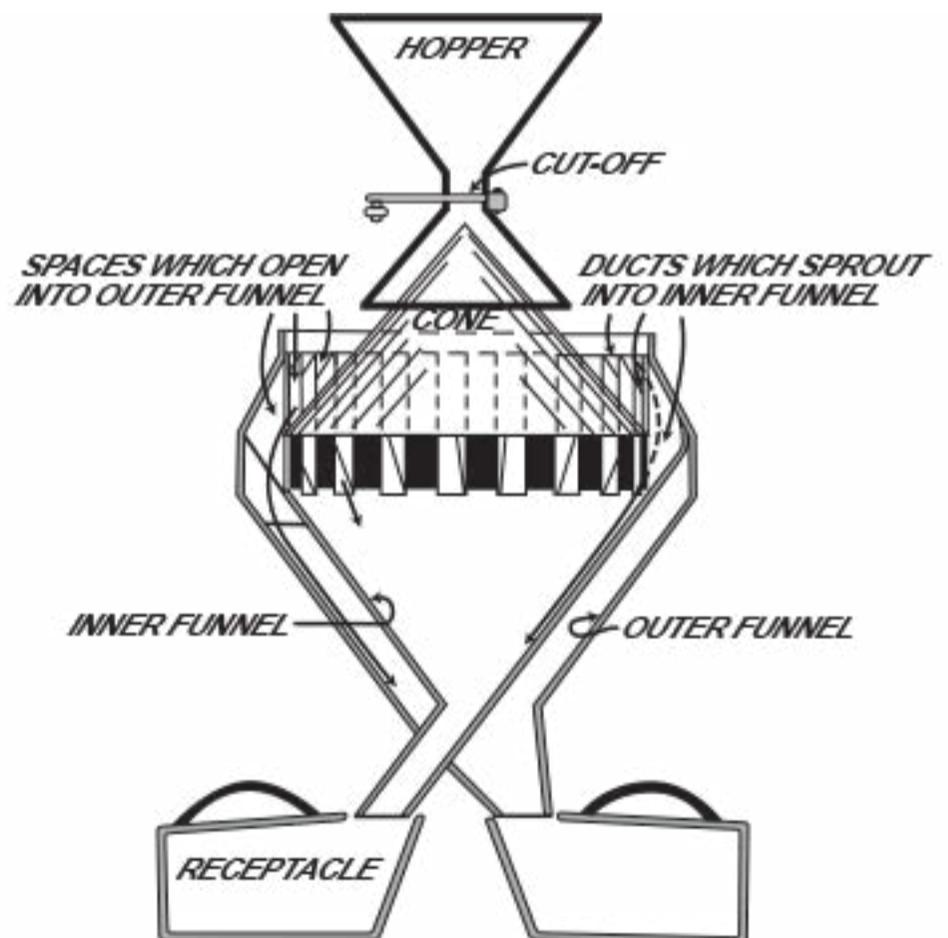
The first step in grading a canola sample is to use a Boerner divider to reduce the original sample into an:

- 850 gram file sample, and a
- 500 gram work portion.



Boerner Divider

The Boerner divider reduces the size of a grain sample while maintaining its representativeness. Each pass of the sample through the divider splits the sample into two equal portions. The Boerner Divider, consists of a hopper, inverted cone, and a series of baffles directing the grain into two collection pans. As the valve or gate at the base of the hopper is opened, gravity carries the grain over the cone, which serves as a surface by which the kernels can separate into a single layer. Arranged in a circle at the base of the cone are a series of baffles forming alternate channels and spaces of equal width. They are arranged in a circle at their summit and are directed inward and downward, the channels leading to one spout and the spaces to an opposite spout. Each kernel has an equal chance of falling into a channel or a space, resulting in two nearly identical portions of the original sample.



When Operating the Boerner Divider:

- Check the divider for condition and cleanliness.
- Close the hopper valve.
- Place empty collection pans under the discharge spout.
- Pour the sample into the hopper.
- Open the valve quickly.

For larger samples, feed more grain into the hopper during the dividing process.

File Sample

A “file sample,” is a representative sample or representative portion of a sample that is retained for a specified period of time for reference or review purposes. File samples should be of sufficient size to accommodate subsequent examinations or analysis.

The file sample shall be an unworked portion (if available) of the representative sample used for the inspection. The worked portion may be retained as the final file only when insufficient sample is available for an unworked file sample.



Use Moisture Proof Containers

Keep all samples in sealed moisture proof containers if they cannot be tested within approximately 15 minutes.

Do not use paper bags, fiber cartons, or similar containers that allow moisture losses. Use metal cans, plastic containers, and plastic bags to preserve the sample integrity.

Do not file samples with paper identification inserted in the grain. Paper absorbs moisture and lowers the moisture of the grain.



Moisture

Moisture is the water content of sorghum as determined by an approved device before the removal of dockage. Record the percent of moisture on the certificate to the nearest tenth percent.

Determine moisture before the removal of dockage on a portion of approximately 650 – 750 grams of grain.



DICKEY-john GAC2500



Perten AM5200-A

The DICKEY-john GAC2500-UGMA and the Perten AM5200-A are the designated official moisture meters for performing moisture analysis in grains.

Basically, the instruments measure the change in capacitance of two parallel plates when grain is placed between them. As the moisture content within the grain increases or decreases so does its contribution to capacitance, known as its dielectric constant.

The instruments also measure sample density and temperature and perform automatic corrections for those parameters.

Calibration equations have been developed to convert these properties into precise moisture percentages for each grain measured by the instruments.

The test they perform takes about 30 seconds to complete and is a simple and accurate way to obtain moisture analysis in the field.

Record the percent of moisture to the nearest tenth percent.

Check for Sample Grade Factors

Check the 500 gram work portion for U.S. Sample grade criteria, before the removal of dockage.

Canola is Sample Grade if the work portion contains:

- 2 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s),
- 1 or more pieces of glass,
- or 4 or more pieces of animal filth.



Check Odor

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.

Odors are classified as OK, Musty, Sour, or COFO (commercially objectionable foreign odors).

Musty odors indicate the presence of fungal activity in the grain and are generally characterized as an earthy smell.

Sour odors indicate that the grain is fermenting due to microbial activity. Sour odors are often characterized as an acrid, boot pit or pigpen smell.

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 are odors foreign to grain that render it unfit for normal commercial usage.

Fumigant or Insecticide Odor

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 odors exist, allow the work portion to aerate in an open container for 4 hours, or less, if the odor dissipates in less time. Consider the sample as having a commercially objectionable foreign odor if the fumigant or insecticide odor persists after 4 hours.

Grade canola containing a “distinct” musty, sour, or commercially objectionable foreign odor as U.S. Sample grade.



Check for Garlic

Check for the special grade garlicky, before the removal of dockage on a work portion of 500 grams.

If the 500 gram portion contains more than two green garlic bulblets or an equivalent quantity of dry or partly dry bulblets the special grade garlicky applies.

Green garlic bulblets are bulblets which have retained all of their husks intact.

Dry or partly dry garlic bulblets are bulblets which have lost all or part of their husks. Consider bulblets with cracked husks as dry.

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



Green Garlic Bulblets



Dry Garlic Bulblets

Check For Insects

Check for the special grade Infested on the lot as a whole or before the removal of dockage on a work portion of 500 grams. 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.

Samples meeting or exceeding one of these tolerances are infested:

Live Weevils

Live weevils include rice weevils, granary weevils, maize weevils, cowpea weevils, and lesser grain borers.



Rice Weevil



Granary Weevil



Maize Weevil



Cowpea Weevil



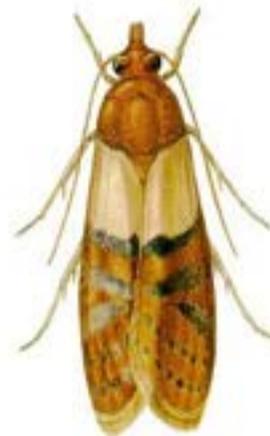
Lesser Grain Borer

Other Live Insects

Other live insects injurious to stored grain shall include grain beetles, grain moths, and larvae.



Angoumois Grain Moth



Indian Meal Moth



Red Flour Beetle



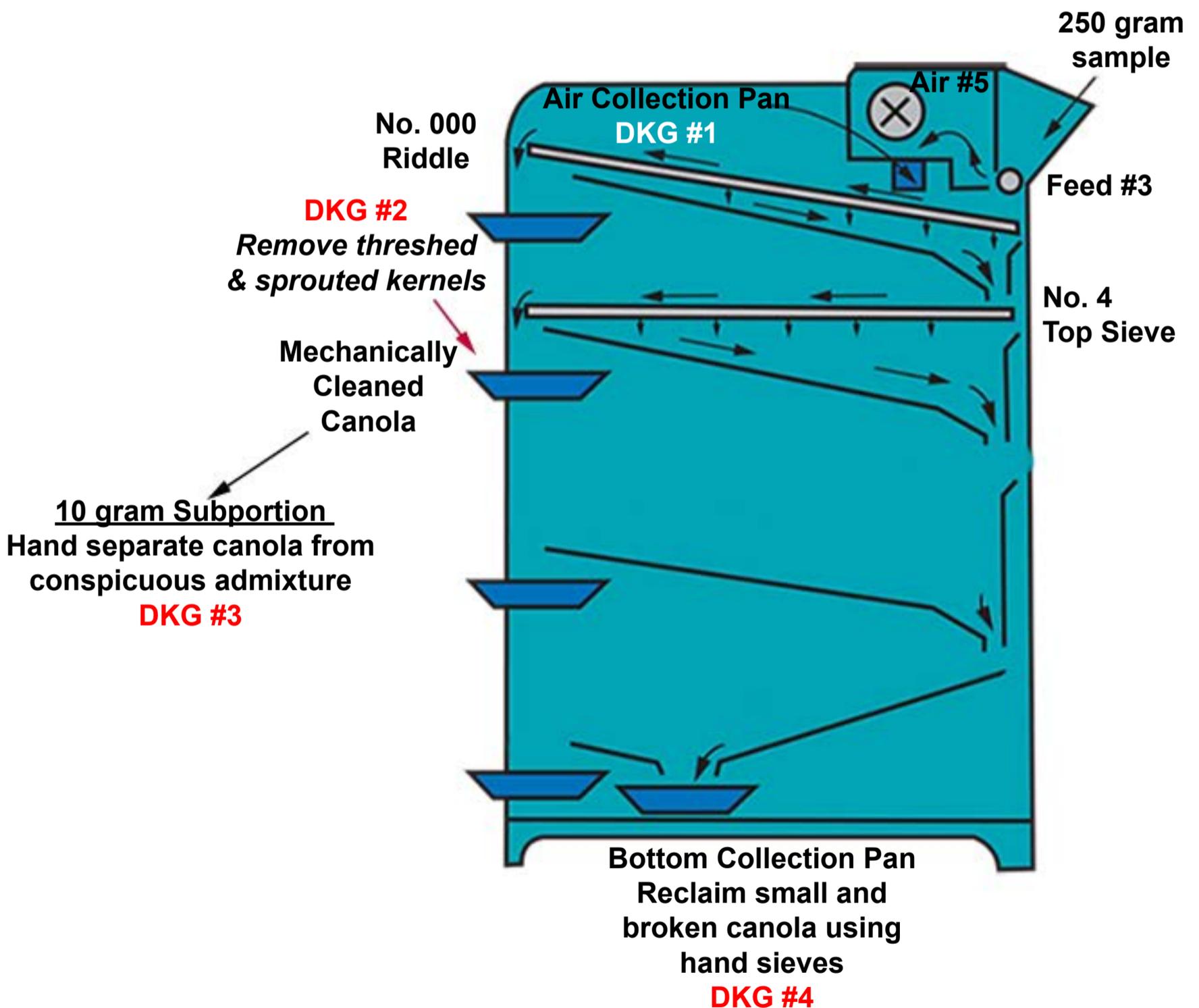
Flat Grain Beetle

Reduce Work Portion to 250g.

At this point, determinations have been made for kind of grain, infestation, heating, odor, garlic bulblets, sample grade criteria, and moisture. Now use a Boerner divider to reduce the work portion to a 250 gram subsample for machine cleaning.

Machine Separated Dockage

Machine separated dockage is all material removed by aspiration, coarse material, except threshed and sprouted kernels of canola, that passed over the riddle, and material that passed through the Number 4 sieve, except for small whole and broken pieces of canola which are reclaimed.



$$\text{Total DKG} = \text{DKG } 1+2+3+4$$

Mechanical Cleaning

First the sample is machine cleaned using the Carter Dockage Tester. To operate the Carter Dockage Tester, insert the 000 riddle in the riddle carriage, the number 4 sieve in the top sieve carriage, set the air to 5, and set the feed control to 3.

Then, run the 250 gram portion through the dockage tester. Return kernels of canola caught in the riddle to the cleaned portion. Finally, Remove threshed and separated canola from material over the riddle and add to cleaned canola.

Reclaim

Next sieves are used to maximize the clean-out of weed seeds and similar foreign material with a minimum loss of canola. 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 to separate the material from the canola.

- Sieve the material for 30 strokes.
- Return the material passing through the sieve to the clean sample.
- Use a .035 x 15/32 inch slotted sieve to reclaim small whole and broken pieces of canola that passed through the No. 4 sieve.
- Sieve the material for 30 strokes.
- Return the material remaining on the slotted-hole sieve and in the perforations to the clean sample and the material passing through the slotted-hole sieve to the dockage.
- Combine the two mechanically cleaned portions.

Upon request, a .028 x 15/32 inch 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.

Conspicuous Admixture

After the canola has been machine cleaned, cut down the cleaned sample to a portion of not less than 10 grams. Handpick the 10-gram portion for conspicuous admixture.

Conspicuous Admixture is all matter other than canola, which is conspicuous and readily distinguishable from canola and which remains in the sample after the removal of machine separated dockage. Conspicuous admixture includes but is not limited to ergot, sclerotinia, and stones. Stones are concreted earthy or mineral matter and other substances of similar hardness that do not disintegrate in water.



Ergot is a hard, reddish brown or black sclerotia of the *Claviceps purpurea* fungi that replaces the kernels of rye (its most common host), as well as triticale, wheat and barley.

Sclerotinia are the dark colored sclerotia of the *Sclerotinia* fungi.



Stones



Ergot



Sclerotinia

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

Computing Total Dockage

In computing the total dockage, all mechanically separated dockage is computed on the basis of the sample as a whole.

The percentage of conspicuous admixture or 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.

For Example:

- if the original sample weight is 250 g,
- the weight of mechanically separated dockage is 24.70 g,
- the weight of the handpicked portion is 10.24 g, and
- the weight of handpicked dockage or conspicuous admixture is 0.20 g.

Then the weight of the Dockage divided by the original sample weight multiplied by one hundred equals the percent of mechanically separated dockage or 9.88%.

One hundred percent minus the 9.88% mechanically separated dockage then divided by one hundred equals the change of base factor or 0.90.

The weight of handpicked separation divided by the weight of the handpicked portion times one hundred equals the percent of conspicuous admixture or 1.95%.

The percent of conspicuous admixture times the change of base factor equals the adjusted conspicuous admixture or 1.75%.

The adjusted conspicuous admixture plus the percent of mechanically separated dockage equals the total dockage or 11.63 percent which rounded to the nearest tenth is 11.6

Damaged Kernels

At this point, determinations have been made for dockage, conspicuous admixture, sclerotinia, stones, and ergot. Now reweigh the portion which was used for picking conspicuous admixture and use it to determine damage and inconspicuous admixture.

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

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.

Visual Reference Images

Because of the subjectivity involved in determining damage, and other subjective criteria, it is critical that visual references are available to ensure that interpretations are uniformly and consistently applied throughout the national system. Color images provide a basis for communicating the minimum “line” for various types of damage and other visually determined criteria.

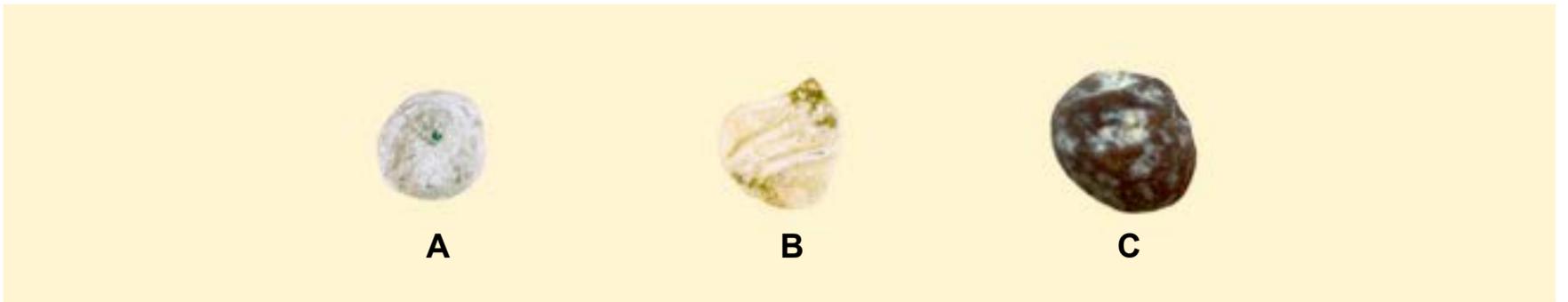
Sprout Damage



Sprout damaged kernels are canola and pieces of canola that are sprouted. The sprout must be distinct and equal to or greater than shown to be considered damage. Do not confuse sprout damage with swollen Endosperm.

Canola and pieces of canola with swollen endosperm shall not be considered damage.

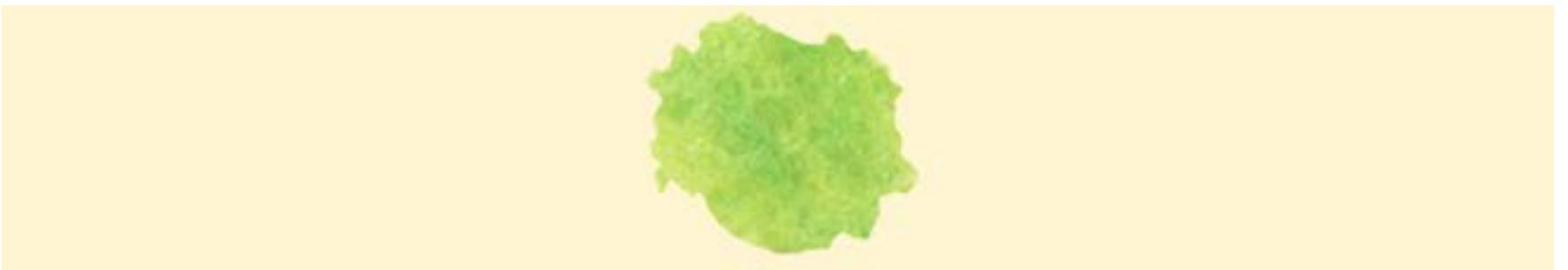
Other Damage (Rimed & Frost)



Other damage includes canola and pieces of canola which are completely covered with a whitish, frosted coloration or “rime” and canola and pieces of canola which are distinctly shriveled or shrunken by frost to the degree illustrated.

- A. Canola and pieces of canola which are completely covered with a whitish, frosted coloration (rime) shall be considered damage.
- B. Canola and pieces of canola which are distinctly shriveled or shrunken (frost damaged) to the degree illustrated shall be considered damage.
- C. Canola and pieces of canola containing the amount of surface mold depicted shall be considered damage.

Distinctly Green Kernels



Distinctly green kernels are canola and pieces of canola which, after being crushed, are a distinct green.

Any amount of coverage equal to or greater than the intensity shown is considered damage.

Disregard the crushed seed coat in making this determination.

Heat Damaged Kernels



Heat damaged kernels are canola and pieces of canola which, after being crushed, are materially discolored and damaged by heat. Any amount of coverage equal to or greater than the intensity shown is considered damage.

Disregard the crushed seed coat in making this determination.

Determine Damage

To determine damage, first, handpick the 10 gram portion for distinctly shrunken or shriveled kernels as in frost- damaged kernels, kernels discolored by mold, rimed kernels, sprouted kernels, excessively weathered kernels, and any other kernels of canola that are distinctly damaged. These kernels are “other damaged” kernels.

Then cut down the balance of the 10 gram portion to 5 grams and sprinkle the 5 gram portion across the damage seed counter to fill a 500 hole board. After filling the board and applying tape but before crushing, observe the strip for inconspicuous admixture. If a 100-hole board is used repeat the process five times.



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.

Finally, after the strip, or 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.

Add the percentage of distinctly green, heat damaged, and other damaged kernels of canola to compute damaged kernels total.

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

Inconspicuous Admixture

Inconspicuous Admixture includes any seed which is difficult to distinguish from canola. This includes, but is not limited to, common wild mustard, domestic brown mustard, yellow mustard, and seed other than the mustard group.



Yellow & Wild Mustard Mix



Brown Mustard



Oriental Mustard

Make the determination for inconspicuous admixture on the 5-gram portion used in the determination for heat-damaged and distinctly green kernels.

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.

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.

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.



Canola



Yellow Mustard



Cow Cockle



Brown Mustard



Wild Mustard

Calculate the percentage of inconspicuous admixture on the basis of count. Record the percentage of inconspicuous admixture to the nearest tenth percent.

Erucic Acid

The long-chain fatty acid, erucic acid, is a component of canola 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.

An erucic acid test suitable for use in the field does not exist. However, an analysis for erucic acid content is available at the National Grain Center as a separate test. The erucic acid results are certificated to the nearest tenth percent independent of the grade certificate.

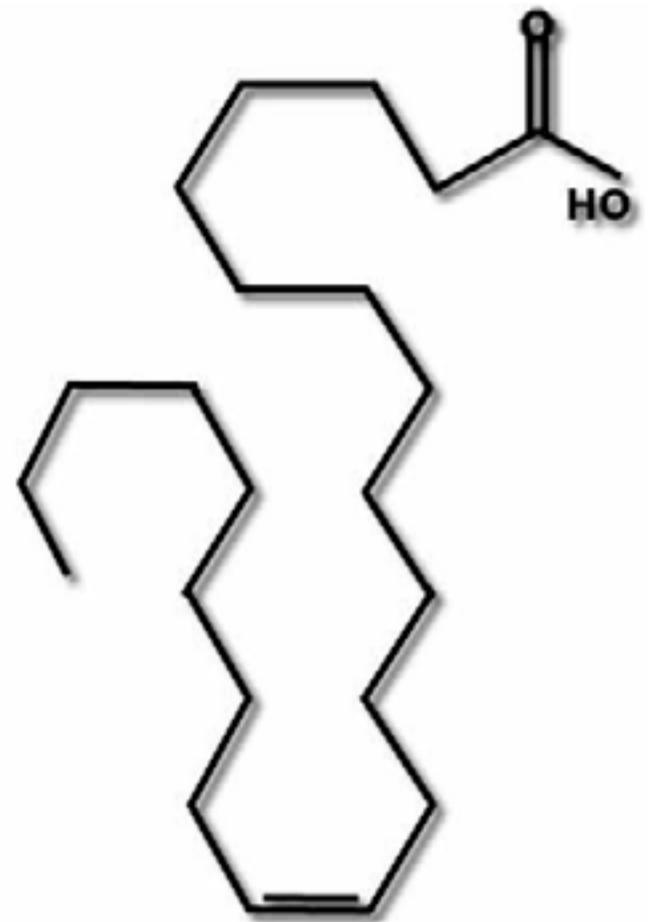
If the erucic acid result is equal to or greater than 2.0 percent, the applicant has the option of surrendering the outstanding grade certificate for corrections. Official personnel shall issue a “corrected certificate” labeling the seed as “not standardized grain” rather than canola.

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.

Oil

Lipids are oils and fats that are liquid at room temperature. If an analysis for oil content is requested, submit a portion of 100 grams free of machine separated dockage to the National Grain Center.

Certify the percentage of oil to the nearest tenth percent.



Test Weight

The weight per Winchester bushel is determined using an approved device according to procedures prescribed in FGIS instructions. A Winchester bushel is 2150.42 cubic inches or 35.24 liters. Determine test weight on a dockage-free portion of sufficient quantity to overflow the kettle.

Position the hopper over the center of the kettle, making sure the hopper valve is closed. Pour grain into the hopper.

Open the valve allowing the grain to overflow the kettle. Once the hopper is clear of grain move the hopper to the side.

With a rounded edge striker, place it on the edge of the kettle and move the striker in three zigzag motions across the kettle leveling the grain.

Move the kettle to a scale and record the test weight measurement.

Record test weight results in the “Remarks” section to the nearest tenth pound. If requested, convert the pounds per bushel result to kilograms per hectoliter using the following formula:

$$\text{lbs. / bu.} \times 1.287 = \text{kilograms per hectoliter}$$



Determine Grade Designation

After completing the analysis, compare the results with the limits for each grade factor. The factor with the lowest grade designation determines the grade assigned to the sample.

Or Better

The Official U.S. Standards for Grain provide an optional grade designation, commonly referred to as “or better.” Upon request of the applicant, barley may be certified as U.S. No. 2 or better, U.S. No. 3 or better, etc. An “or better” grade designation cannot be applied to U.S. No. 1 grade designation.

Code	Factor	Original	Suprv/Appeal	Initials	BAR	Code	Factor	Original	Suprv/Appeal	Initials	BAR
	CL					24	HPFM				
02	DKG	8.93				25	MSFM				
03	TW					26	BNFM				
04	M	9.8				33	SKBN				
05	ODOR	ok				36	CCOL EBOC				
06	HT	0.1				60	LW				
07	ODK					62	STON	0.03			
08	SKD										
09	DKT					66	GARB	4			
10	CRSE	2.5				43	ERG	0.01			
11	FINE					73	CADM	1.55			
12	FM					74	IADM	1.3			
13	SHBN					75	SCT	0.02			
14	DEF					76	DGK	2.1			
15	CCL										
16	WOCL										
17	DHV										
18	HVAC										
19	WHCB										
20	EMOY FMOR										
21	SPL										
23	BCFM										
WORK SAMPLE SIZE					GRADE U.S. NO.		CLASS AND SPECIAL GRADE				
SUPV/APPEAL		BAR									
				ok	3	Canola, Garlicky, Dockage 8.9%					

Documenting the Grade

Use the following guide for documenting the assigned grade.

- First write the letters “U.S.”,
- Then the abbreviation “No.” and the number of the grade or the words “Sample grade”,
- Followed by the words “or better” when applicable,
- The word “Canola” shall be shown next, followed by the applicable special grade(s),
- and last show the word “dockage” and the percentage thereof to the nearest tenth percent.

When applicable record the words “Musty,” “Sour,” or “Commercially Objectionable Foreign Odor” in the “Remarks” section of the certificate.

Grain Grading Primer

Chapter 3

Corn



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Definition of Corn

Corn is defined as:

*Grain that consists of 50 percent or more of whole kernels of shelled dent corn and/or shelled flint corn (*Zea mays L.*) and may contain not more than 10.0 percent of other grains for which standards have been established under the United States Grain Standards Act.*

Corn Classes

Corn is divided into three classes based on color: **Yellow corn, White corn, and Mixed corn.**



Grade Requirements

Each class is divided into five U.S. numerical grades and U.S. Sample Grade.

Special grades are provided to emphasize special qualities or conditions affecting the value and are added to and made a part of the grade designation. They do not affect the numerical or sample grade designations.

Grades and Grade Requirement Chart

CORN				
Grade	Minimum Limits of -	Maximum Limits of -		
	Test weight per bushel (pounds)	Heat-Damaged kernels (percent)	Damaged kernels total (percent)	Broken Corn and Foreign material (percent)
U.S. No. 1	56.0	0.1	3.0	2.0
U.S. No. 2	54.0	0.2	5.0	3.0
U.S. No. 3	52.0	0.5	7.0	4.0
U.S. No. 4	49.0	1.0	10.0	5.0
U.S. No. 5	46.0	3.0	15.0	7.0

U.S. Sample Grade:

U.S. Sample Grade is corn that:

- (a) Does not meet the requirements for grades U.S. No.1, 2, 3, 4, or 5; or
- (b) Contains stones which have an aggregate weight in excess of 0.1 percent of the sample weight, 2 or more pieces of glass, 3 or more crotalaria seeds (*Crotalaria* spp.), 2 or more castor beans (*Ricinus communis* L.), 4 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), 8 or more cockleburs (*Xanthium* spp.) or similar seeds singly or in combination, or animal filth in excess of 0.20 percent in 1,000 grams; or
- (c) Has a musty, sour, or commercially objectionable foreign odor; or
- (d) Is heating or otherwise of distinctly low quality.

Basis of Determination

The “Basis of Determination” establishes the rules for testing/analyzing all factors. ***Do not analyze any factor until the basis for making the determination is known.***

BASIS OF DETERMINATION		
Lot as a Whole	Factors Determined Before the Removal of Broken Corn and Foreign Material	Factors Determined After the Removal of Broken Corn and Foreign Material
Distinctly low quality Heating Infested Odor	Distinctly low quality Heating Infested Kind of Grain Moisture Odor Stones Test Weight U.S. Sample Grade factors	Class Damaged kernels Flint corn Flint and dent corn Heat-damaged kernels Odor Waxy

The determination of Distinctly Low Quality (DLQ) 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.

Each determination of rodent pellets, bird droppings, other animal filth, broken glass, castor beans, cockleburs, crotalaria seeds, 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.

Each determination of class, damaged kernels, heat-damaged kernels, waxy corn, flint corn, and flint and dent corn is made on the basis of the grain after the removal of the broken corn and foreign material. Other determinations not specifically provided for under the General Provisions are made on the basis of the grain as a whole, except the determination of odor is made on either the basis of the grain as a whole or the grain when free from broken corn and foreign material.

Distinctly Low Quality

Consider corn DLQ when it is obviously of inferior quality and the existing grade factors or guidelines do not accurately reflect the inferior condition.

Use all available information to determine whether the corn is DLQ. This includes a general examination of the corn during sampling and an analysis of the obtained sample.

Corn containing two or more stones, pieces of glass, pieces of concrete, or other pieces of wreckage or debris which are visible to the sampler but are too large to enter the sampling device is considered DLQ.

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

Heating

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



Infested

Infested corn is corn that is infested with live weevils or other live insects injurious to stored grain.

The presence of any live weevil or other live insects injurious to stored grain found in the work sample indicates the probability of infestation and warns that the corn must be carefully examined to determine if it is infested. In such cases, examine the work sample and the file sample before reaching a conclusion as to whether or not the corn is infested. Do not examine the file sample if the work sample is insect free.

INSECT INFESTATION		
<i>Samples meeting or exceeding any one of these tolerances are infested: 2 lw, or 1 lw + 5 oli, or 10 oli</i>		
1,000-gram representative sample ¹ (+ file sample if needed)	Lot as a Whole (Stationary)	Online Sample (In-Motion) ²
Submitted samples Probed lots D/T sampled land carriers	Probed lots (at time of sampling)	Railcars under the Cu-sum Subsamples for Sacked Grain lots Components for Bargelots ³ Components for Shiplots ³
¹ Examine work portion and file sample if necessary. Do not examine file sample if work portion is insect free. ² Minimum sampling rate is 500 grams per 2,000 bushels. ³ Minimum component size is 10,000 bushels. Key: lw = live weevil, oli = other live insects injurious to stored grain		

Odor Determination

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

When grain has a “distinct” odor, it should be graded *musty, sour, or commercially objectionable foreign odor.*

The definition of “distinct”, when it pertains to odor, is not the intensity of the off-odor, but the presence of the off-odor. The consensus approach is not required if no odor, or a distinct odor, is present.



Musty odors indicate the presence of fungal activity in the grain and are generally characterized as an earthy smell.

Sour odors indicate that the grain is fermenting due to microbial activity. Sour odors are often characterized as an acrid, boot pit or pigpen smell.

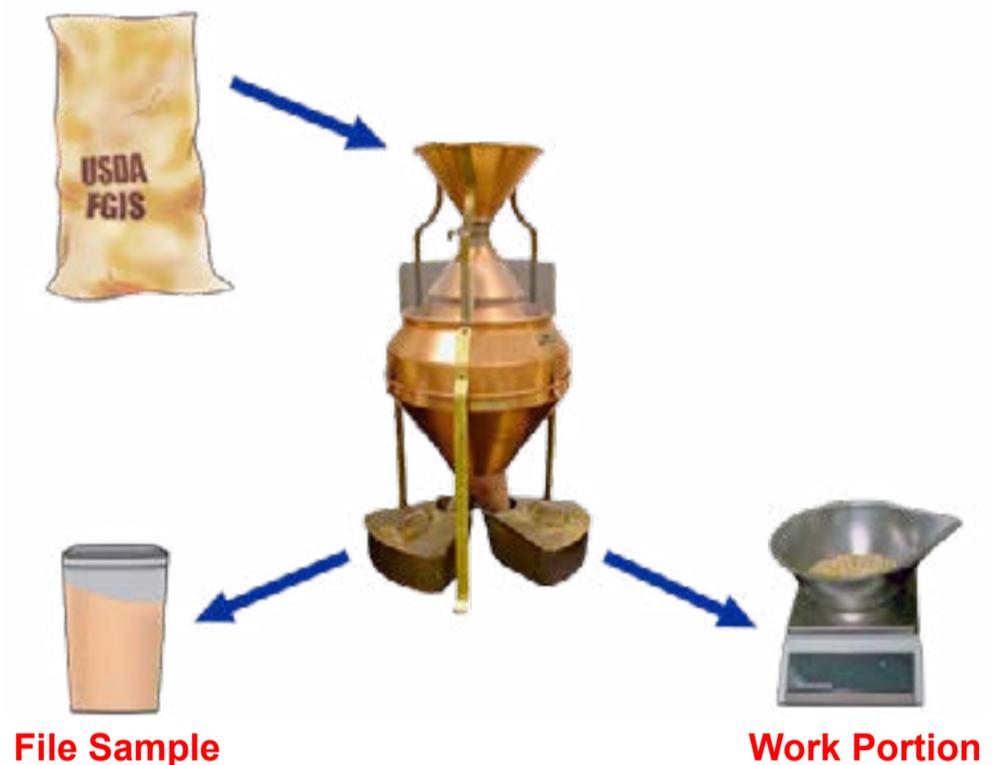
Commercially Objectionable Foreign Odor (COFO) are odors, except smut and garlic odors, foreign to grain that render it unfit for normal commercial usage. Sources of COFO include fumigants, oil products, smoke, fertilizer, weeds, decaying animal or plant matter, etc.

Processing the Original Sample

The Boerner Divider reduces the size of a grain sample while maintaining the representativeness of the original sample. Use the Boerner divider, or a divider that gives equivalent results, when reducing a sample to the portion size required for a specific test/analysis.

When dividing the original sample the first pass through the divider will result in two equal portions.

- One portion is set aside as a **“file sample”**.
- One portion is the **“work portion”** which is reduced down to smaller work portions for use in determining required tests and analysis specific to the type of grain being graded.



Operating Procedures

- Check the divider for condition and cleanliness
- Close the hopper valve
- Place empty collection pans under the discharge spouts
- Pour the sample into the hopper
- Open the valve quickly. For large samples, feed more grain into the hopper during the dividing process

File Sample

A “file sample” is a representative sample or representative portion of a sample that is retained for a specified period of time for reference or review purposes. File samples should be of sufficient size to accommodate subsequent examinations or analysis. The file sample shall be an unworked portion (if available) of the representative sample used for the inspection. The worked portion may be retained as the final file only when insufficient sample is available for an unworked file sample.

Keep all samples in sealed moisture proof containers if they cannot be tested within approximately 15 minutes. Do not use paper bags, fiber cartons, or similar containers that allow moisture losses. Use metal cans, plastic containers, and plastic bags to preserve the sample integrity. Do not file samples with paper identification inserted in the grain. Paper absorbs moisture and lowers the moisture of the grain.



Moisture Determination

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 650 grams.*

The user interfaces are slightly different for the two UGMA compatible moisture meters. Use the keypad to choose the type of grain to analyze.

Fill the hopper and press the load key to start the test cycle. After the moisture analysis is complete observe the result on the display, record it and reclaim the sample from the discharge tray.

For additional information, refer to the GIPSA Moisture Handbook.

GAC2500-UGMA



Perten AM 5200-A



Test Weight

Test weight per bushel is the weight per Winchester bushel (2,150.42 cubic inches) as determined using an approved device. The determination for test weight is made on a portion of sufficient quantity to overflow the kettle.

General Operating Procedures

1. Level and balance the test weight per bushel apparatus.
2. Close the hopper valve.
3. Pour the work sample into the hopper.
4. Center the hopper over the kettle.
5. Fill the kettle by opening the hopper valve quickly.
6. Move the hopper all the way to the left before proceeding. Do not jar the apparatus. Jarring could cause inaccurate results.
7. Using a standard stoker, stroke the kettle by holding the stoker in both hands with the flat sides in a vertical position. Level the grain in the kettle by making three full length, zigzag motions with the stoker.
8. Place an empty sample pan or the test weight kettle on the scale and zero the scale. Pour the sample from the kettle into the sample pan or place the filled kettle onto the scale as appropriate. Read the result from the test weight mode selected.
9. Record the test weight per bushel on the work record.



U.S. Sample Grade Factors

Basis of Determination. *Determine U.S. Sample Grade criteria before the removal of broken corn and foreign material based on a work portion of 1,000 to 1,050 grams.*

Consider identifiable pieces of grain, processed grain products such as 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”.

**Toxic Seeds
(Crotalaria)**



Animal Filth



Broken Corn and Foreign Material (BCFM)

BCFM is all matter that passes readily through a 12/64 round-hole sieve and all matter other than corn that remains in the sieved sample after sieving.

The determination of BCFM is performed in two steps .

A **mechanical separation** of BCFM is made using a Carter Dockage Tester to remove the larger and finer particulate matter from the sample.

The mechanically cleaned sample is then **handpicked** to remove any remaining similarly sized foreign material from the sample.

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

Live weevils, other live insects injurious to stored grain, and sample grade factors are considered FM but, when present in sufficient quantities, are considered in the determination of U.S. Sample Grade and/or the special grade “Infested.”



Procedure for Determining BCFM

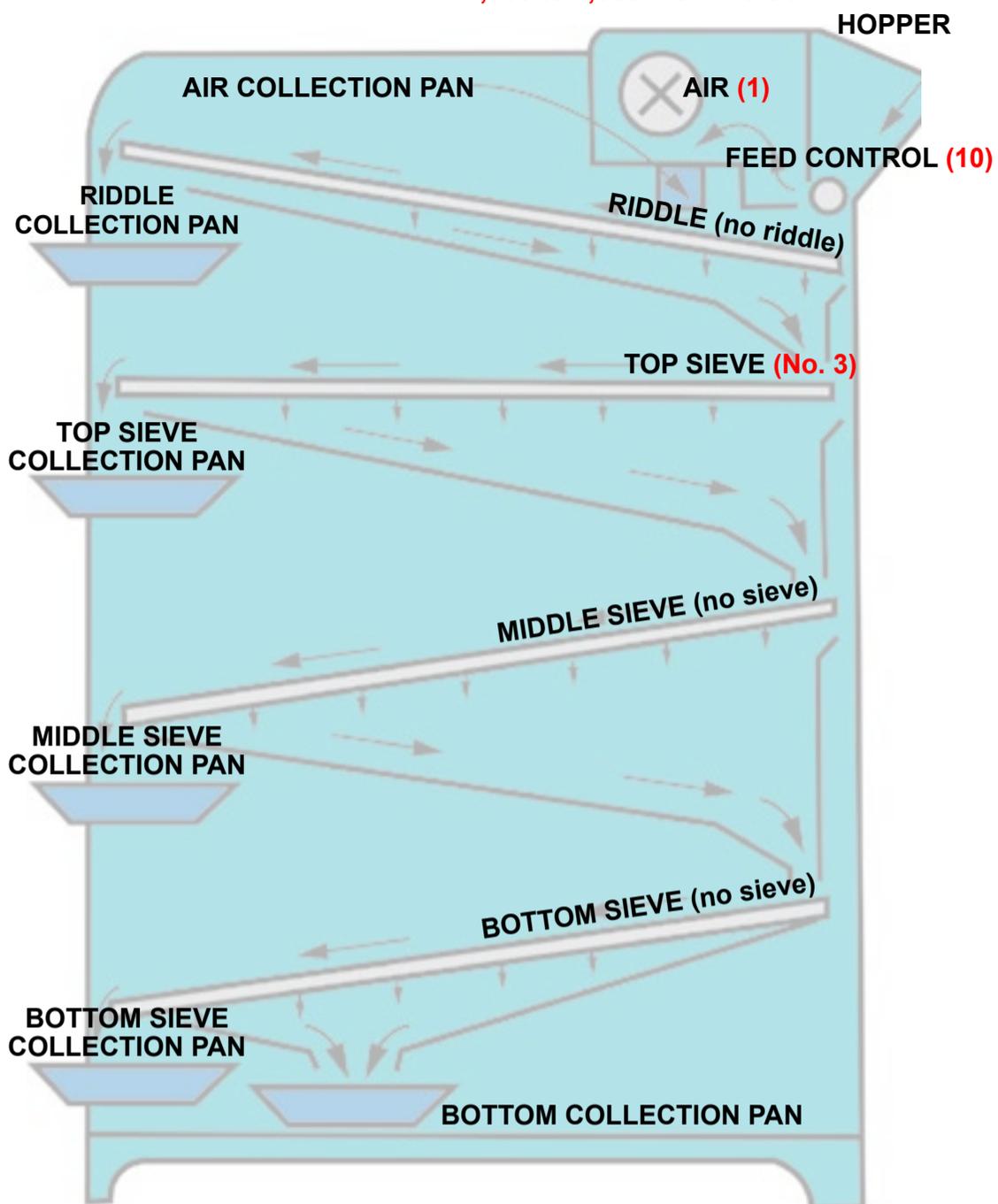
1,000 to 1,050 Work Portion

Step 1: Carter Dockage Tester

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

Step 2: Handpick

- a. Remove all matter other than corn, including sweet corn, blue corn, and popcorn from the mechanically cleaned portion.
- b. Combine the mechanically separated and handpicked BCFM.



Processing the BCFM-Free Work Sample

After determinations have been made on the work portion prior to the removal of BCFM and then processed to remove BCFM, divide the BCFM-free work portion into the following approximate analytical portion sizes for the factors listed.

APPROXIMATE ANALYTICAL PORTION SIZES	
Factors	Grams
Class	250
Damaged kernels	250
Flint corn	250
Flint and dent corn	250
Heat-damaged kernels	250

Class

Determine the class of corn by the color characteristics of the kernels.

Yellow Corn is corn that is yellow-kerneled and contains not more than 5.0 percent of corn of other colors. Yellow kernels of corn with a slight tinge of red are considered Yellow corn.

White Corn is corn that is white-kerneled and contains not more than 2.0 percent of corn of other colors. White kernels of corn with a slight tinge of light straw or pink color are considered White corn.

Mixed Corn is corn that does not meet the color requirements for either of the classes Yellow corn or White corn and includes white-capped Yellow corn.

When determining the class of corn, consider “Indian Corn” as “Corn of other Colors.”

Record the percentage of corn of other colors on the certificate to the nearest tenth percent. When certifying Mixed corn, record the percentage of the mixture, in the order of predominance, in the “Remarks” section to the nearest tenth percent.



Visual Reference Images (VRI)

Because of the subjectivity involved in determining damage and other criteria, it is critical that visual references are available to ensure that interpretations are uniformly and consistently applied throughout the national system.

Visual Reference Images provide a basis for communicating the minimum “line” for various types of damage and other visually determined criteria.

For complete inventory and description of the VRI visit our website.

CORN GERM DAMAGE



A. DAMAGE



B. NOT DAMAGE

A. Kernels with germ areas (cotyledon) discolored to the degree shown or worse are considered damage.

If necessary, carefully remove the germ covering from the kernel. Disregard the plumule (embryo) when determining germ damage.

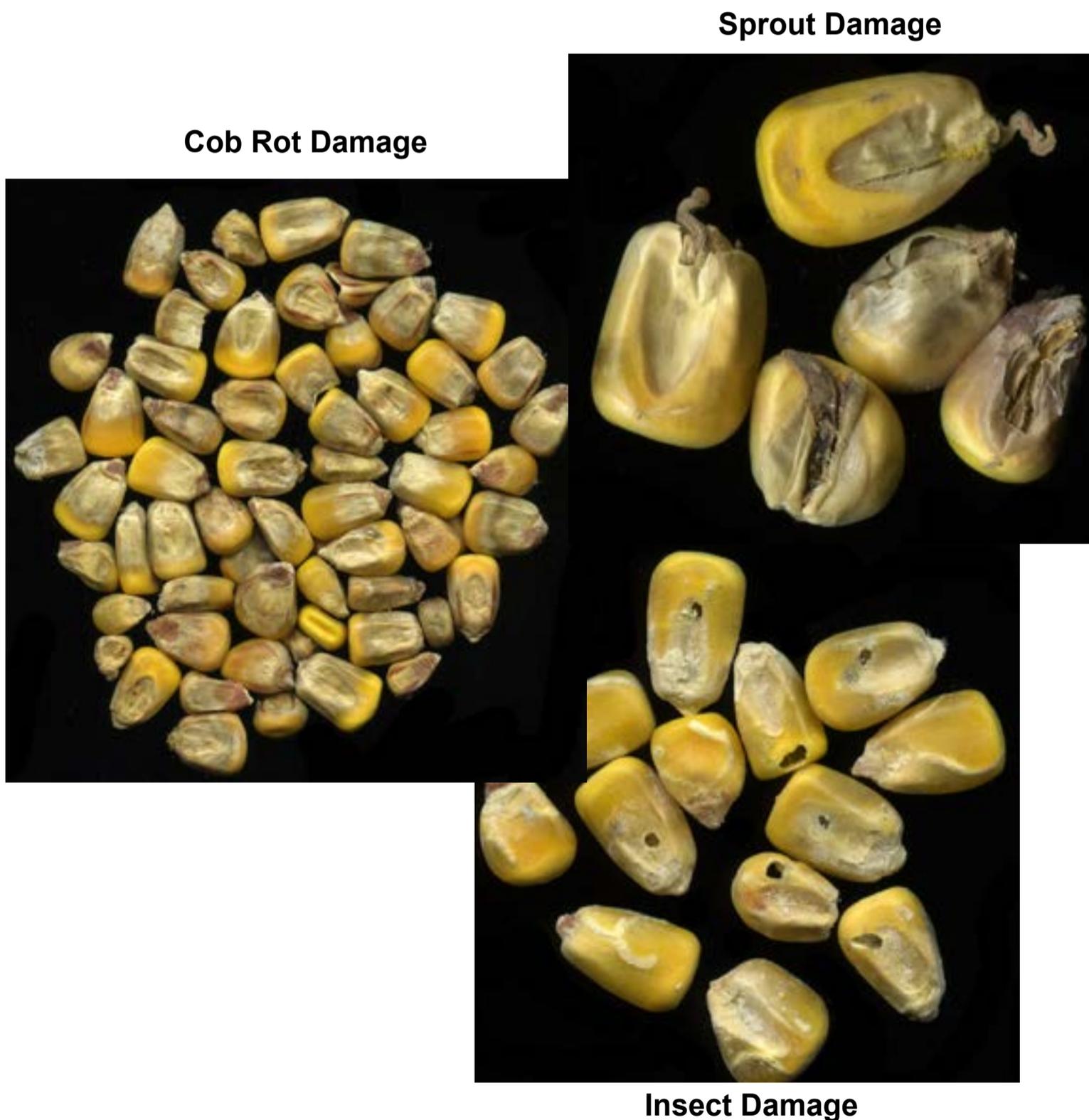
B. Kernels of corn with only the plumule (embryo) discolored **ARE NOT** considered damage. The outward appearance is similar to blue-eye mold. Consequently, it may be necessary to gently lift/remove the germ cover to make an accurate determination.

Damaged Kernels

Kernels and pieces of corn kernels that are badly ground-damaged, badly weather-damaged, diseased, frost-damaged, germ-damaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged.

Types of Corn Damage

A kernel of corn 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.



Blue-Eye Mold Damage



A germ affected with blue-eye mold, regardless of the size of the mold is a damaged kernel. If mold is distinct, it is not necessary to open or scrape kernel. When necessary, carefully lift the germ cover to avoid destroying evidence of mold. NOTE: Do not confuse blue-eye mold with purple plumules. Any amount of mold that penetrates the seed coat of the kernel is considered damage (e.g., crown, tip, sides, or back).

Purple Plumule (Not Damage)



Purple plumule IS NOT damage. The condition (light to dark purple discoloration) is due to a genetic or varietal characteristic and is restricted to the plumule area (center of germ). NOTE: The outward appearance is similar to blue-eye mold. Consequently, it may be necessary to gently lift/remove the germ cover to make an accurate determination.

Cob Rot Damage



A distinct discoloration or rotting caused by a fungus that attacks ears of weakened plants. Since the damage is distinct, it is unnecessary to open the kernel for examination. NOTE: If kernels do not meet the interpretation, it may be necessary to open the kernels to determine if the kernels are otherwise damaged.

Drier Damage



Kernels which have a discolored, wrinkled, and blistered appearance; or which are puffed and/or swollen and slightly discolored and often have damaged germs; or whose seed coats are peeling off and are slightly discolored; or whose seed coat is peeling off (or has already peeled off), having a crazed or checked appearance.

Heat Damage (Yellow)



Kernels which are materially discolored from spoilage. The discoloration originates from the germ area and continues through the sides and back of the kernel (continuous band). Provided the band is continuous, there is no minimum width requirement.

]

Heat Damage (Drier)



Kernels of corn which are often puffed or swollen and materially discolored by external heat from artificial drying methods. NOTE: The entire kernel must be discolored to this intensity to be heat damage. This applies to all classes of corn.

Germ Damage



Kernels of corn which are damaged by respiration or heat, but which are not materially discolored, shall be considered damaged. Kernels with germ areas discolored to the degree shown or worse are considered damage.

Heat Damage (White)



Kernels which are materially discolored from spoilage. The discoloration originates from the germ area and continues through the sides and back of the kernel (continuous band). Provided the band is continuous, there is no minimum band width requirement.

Insect Damage



Whole or broken kernels with obvious weevil-bored holes or which have evidence of boring or tunneling (tracings) indicating the possible inner presence of insects, insect webbing, or insect refuse. NOTE: Do not probe into or further expose weevil-bored holes or tunneling. Weevil bored holes that are completely visible and are free of insect webbing and/or refuse are sound.

Mold Damage



Whole or broken kernels which contain any amount of mold on the exposed part of the kernel are considered damage. NOTE: Do not confuse mold with dirt. Mold occurs in many colors.

Not Damage (Dirt)



Whole or broken kernels which have dirt on the exposed part of the kernel. NOTE: Do not confuse dirt with mold.

Silk Cut



Kernels which contain any amount of mold in the silk cut are damaged. Kernels which contain clean silk cuts and are otherwise undamaged are sound kernels.

Surface Mold (Blight)



Kernels which have a mold, caused by corn leaf blight, that appears to be only on the surface but actually penetrates the seed coat. Kernels which contain surface mold (blight) on one or both sides equal to or greater than that shown on both kernels are considered as surface mold (blight) damage.

Surface Mold (More than Slight)



Kernels of corn which contain surface mold in any area or combination of areas equal to or greater than shown on the VRI.

Mold Damage (Pink Epicoccum)



A germ affected with mold, regardless of the size of the mold, is a damaged kernel. If the mold is distinct, it is not necessary to open or scrape kernel. If opening kernel is necessary, lift germ cover carefully to avoid destroying evidence of mold. NOTE: Do not confuse pink epicoccum with the reddish genetic characteristics found in some corn hybrids.

Sprout Damage



Kernels which are sprouted or show evidence of sprouting are considered damage. NOTE: Anytime the sprout extends beyond the germ area, regardless of whether it actually breaks through the seed coat or not, the affected kernel is considered damaged.

Flint Corn and Flint and Dent Corn

Flint Corn is corn that consists of 95 percent or more of Flint corn.

A kernel of Flint corn normally has a rounded crown and is usually smaller than a dent kernel.

Flint and Dent Corn is corn that consists of a mixture of Flint and Dent corn containing more than 5.0 percent but less than 95 percent of Flint corn.

A kernel of Dent corn is normally characterized by a distinct depression or dent in the crown of the kernel.

In mixtures of Flint and Dent corn, there is frequently a difference in the color of the two types. The shape of the kernel, the size, the texture, and the color characteristics are used in making a determination in mixtures of Flint and Dent corn.



Waxy Corn

Waxy Corn is corn that consists of 95 percent or more waxy corn according to procedures prescribed in FGIS instructions.

Basis of Determination. When corn appears to contain 95 percent or more waxy kernels, test the sample to determine whether the special grade Waxy applies. Use exactly 100 kernels cut out of a 35-gram portion of BCFM-free corn.

When determining class for a sample of corn designated Waxy, apply the following guidelines: For the special grade Waxy, the requirement of white kernels of corn with a slight tinge of light straw is not applicable; however, kernels which are “slightly yellow” are considered as corn of other colors.

All other color requirements remain in effect for all classes of Waxy corn.

Slightly Yellow in (White Waxy) Corn



Procedure for Testing Waxy Kernels of Corn

NOTE: For required materials and equipment, refer to *Grain Inspection Handbook Book II - Chapter 1 General Information - Section 1.18*

CAUTION - Wear safety equipment. spray iodine solution only in a well ventilated area or within the working area of a laboratory hood. To prevent staining tables and surrounding areas, place the petri dish on a covered surface before spraying.

1. Pour 30 ml of the iodine stock solution into a spray bottle and dilute it with 30 ml of distilled water.
2. Cut each of the whole kernels lengthwise (tip to crown) or across the top exposing the starch in the endosperm. Place one-half of each kernel into a petri dish and discard the other half.
3. Carefully spray (do not soak) all the cut kernels with the iodine solution.

4. Approximately 1 to 3 minutes after spraying, the starch of the Waxy corn kernels will turn a red or reddish-brown color. The starch of nonwaxy kernels will turn a blue or violet color. Consider samples with 95 kernels (95 percent) turning red or reddish-brown color as Waxy corn.

Waxy & Non-Waxy



Official Criteria

Stress Crack Analysis is determined only upon request. It does not affect the grade designation.

Stress crack analysis is determined on the basis of a predetermined number of whole kernels. Do not include kernels that are broken, chipped, or cracked (i.e., a ruptured seed coat), or which otherwise limit the ability to identify stress cracks, e.g., waxy or discolored kernels. Use a divider to obtain the appropriate analytical portion size based on the requested service. Removal of broken corn and foreign material prior to obtaining the analytical portion may facilitate whole kernel selection.

1. For percent total stress crack analysis, obtain approximately 25 grams to select 50 whole kernels. Multiply the number of stressed kernels by 2 before reporting.
2. For percent single, double, and multiple stress crack analysis, obtain approximately 50 grams to select 100 whole kernels. Report number of stressed kernels as obtained.

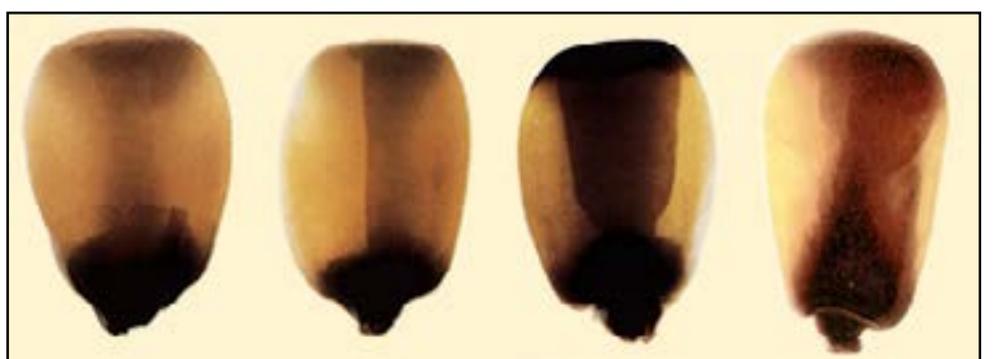
NOTE: *The above portion sizes are the minimum required. Upon request, larger portion sizes are permitted. If a larger portion size is used, adjust test results as appropriate before reporting.*

3. Upon request, separate and count the number of kernels in the three stress crack categories: single, double, and multiple stress cracks. Visually inspect whole kernels on a light board for internal narrow cracks in the endosperm as follows:

- a. Place kernels on the light board with germ side down. Visually inspect each kernel for stress cracks and separate stressed kernels.

- b. Turn remaining kernels germ side up. Visually inspect each kernel for stress cracks and separate stressed kernels.

- c. Count the total number of stressed kernels.



Presence of Waxy Kernels procedure is applicable only for determining the presence of waxy corn and does not replace the procedure for determining the special grade “Waxy.”

A representative portion of at least 35 grams of corn on the basis of the sample as a whole.

1. Pour 30 ml of the iodine stock solution into a spray bottle and dilute it with 30 ml of distilled water.
2. Coarse grind the 35 gram sample.

NOTE: A Romer Mill – Model 2A, Bunn Grinder, or equivalent, must be used to coarsely grind samples. The grinder must be adjusted so that 80 percent or more of the sample remains on top of an 8/64 round-hole sieve and that all kernels are broken open to expose the endosperm.

3. Carefully spray (do not soak) the entire sample with the iodine solution. If an 8/64 sieve was used to separate the broken kernels from the fine material, then spray only the material that remains on top of the sieve.
4. Shortly after spraying the kernels (approximately 1 to 3 minutes), the starch of waxy corn kernels will turn a red or reddish-brown color. The starch of nonwaxy kernels will turn a blue or violet color.
5. Analyze the sprayed kernels to determine if any waxy kernels are present. If a single kernel is determined to be “waxy”, consider the sample as positive for the presence of waxy corn, otherwise, the sample is negative for waxy kernels.

Grade Designation

After completing the analysis, compare the results with the limits for each grade factor. The factor with the lowest grade designation determines the grade assigned to the sample.

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, corn may be certified as U.S. No. 2 or better, U.S. No. 3 or better, etc. An “or better” grade designation cannot be applied to a U.S. No. 1 grade designation.

Example: U.S. No. 3 or better Yellow Corn

Documenting the Grade

Use the following guidelines when documenting the grade.

- 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 name of the class and kind of grain
- The special grade “Flint” when applicable
(**Example:** U.S. No. 3 Yellow Corn, Flint)
- The special grade “Flint and Dent”, (when applicable) along with the approximate percentage of flint corn
(**Example:** U.S. No. 2 Yellow Corn, Flint and Dent, Flint Corn 35 percent)
- The special grade “Infested” when applicable
(**Example:** U.S. No. 2 Yellow Corn, Infested)
- The special grade “Waxy” (when applicable) shall be shown last in the grade designation.
(**Example:** U.S. No. 1 White Corn, Waxy)

When more than one special grade applies, list them in alphabetical order.

When certificating Mixed corn, record the percent of each corn in order of predominance in the “Remarks” section to the nearest tenth percent.

Grain Grading Primer

Chapter 4

Flaxseed



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Flaxseed Definition

Flaxseed is defined as grain that before the removal of dockage, consists of 50 percent or more of common flaxseed and not more than 20 percent of other grains for which standards have been established under the United States Grain Standards Act and which, after the removal of dockage, contains 50 percent or more of whole flaxseed.

Normally, a visual appraisal of the sample is sufficient to determine if the sample meets the definition for flaxseed. However, if an analysis is necessary, make the determination before the removal of dockage on a representative portion of 25 grams. There are no classes, subclasses, or special grades in flaxseed.

Grade Requirements

Flaxseed is divided into two numerical grades and U.S. Sample grade.

The factors affecting flaxseed grades include: test weight, heat damaged kernels, and total damage.

U.S. Sample grade is flaxseed that does not meet the requirements for the grades U.S. Numbers. 1 or 2 or contains stones, glass, crotalaria seeds, castor beans, an unknown foreign substance or a commonly recognized harmful or toxic substance, rodent pellets, bird droppings, or other animal filth; or has a musty, sour, or commercially objectionable foreign odor; or is heating or otherwise of distinctly low quality.

FLAXSEED			
Grade	Minimum Limits of -	Maximum Limits of -	
	Test weight per bushel (pounds)	Heat-Damaged kernels (percent)	Damaged kernels total (percent)
U.S. No. 1	49.0	0.2	10.0
U.S. No. 2	47.0	0.5	15.0

U.S. Sample Grade is flaxseed that:

- (a) Does not meet the requirements for grades U.S. No. 1, or 2; or
- (b) Contains 8 or more stones which have an aggregate weight in excess of 0.2 percent of the sample weight, 2 or more pieces of glass, 3 or more crotalaria seeds (*Crotalaria* spp.), 2 or more castor beans (*Ricinus communis* L.), 4 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), 10 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 1 1/8 to 1 . quarts of flaxseed, or
- (c) Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic); or
- (d) Is heating or otherwise of distinctly low quality.

Heating

Flaxseed developing high temperature from excessive respiration due to microbial activity (fermenting), insect infestation, or sprouting is considered heating. Heating flaxseed, in its final stages, will usually have a sour or musty odor. Care should be taken not to confuse flaxseed that is heating with flaxseed that is warm because of storage in bins, railcars, or other containers during hot weather.

Determine heating on evidence obtained at the time of sampling or on the basis of the sample as a whole. Grade heating flaxseed U.S. Sample Grade and record the word "Heating" in the "Remarks" section of the certificate.

Distinctly Low Quality

Consider flaxseed distinctly low quality when it is obviously of inferior quality and the existing grading factors or guidelines do not properly reflect the inferior condition. Use all available information to determine whether the flaxseed is of distinctly low quality. This includes a general examination of the flaxseed during sampling and an analysis of the obtained sample(s).

Flaxseed containing two or more stones, pieces of glass, pieces of concrete, and/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.

Flaxseed that is obviously affected by other unusual conditions which adversely affect the quality of the flaxseed and cannot be properly graded by use of the grading factors specified or defined in the standards is considered distinctly low quality.

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

Processing the Original Sample

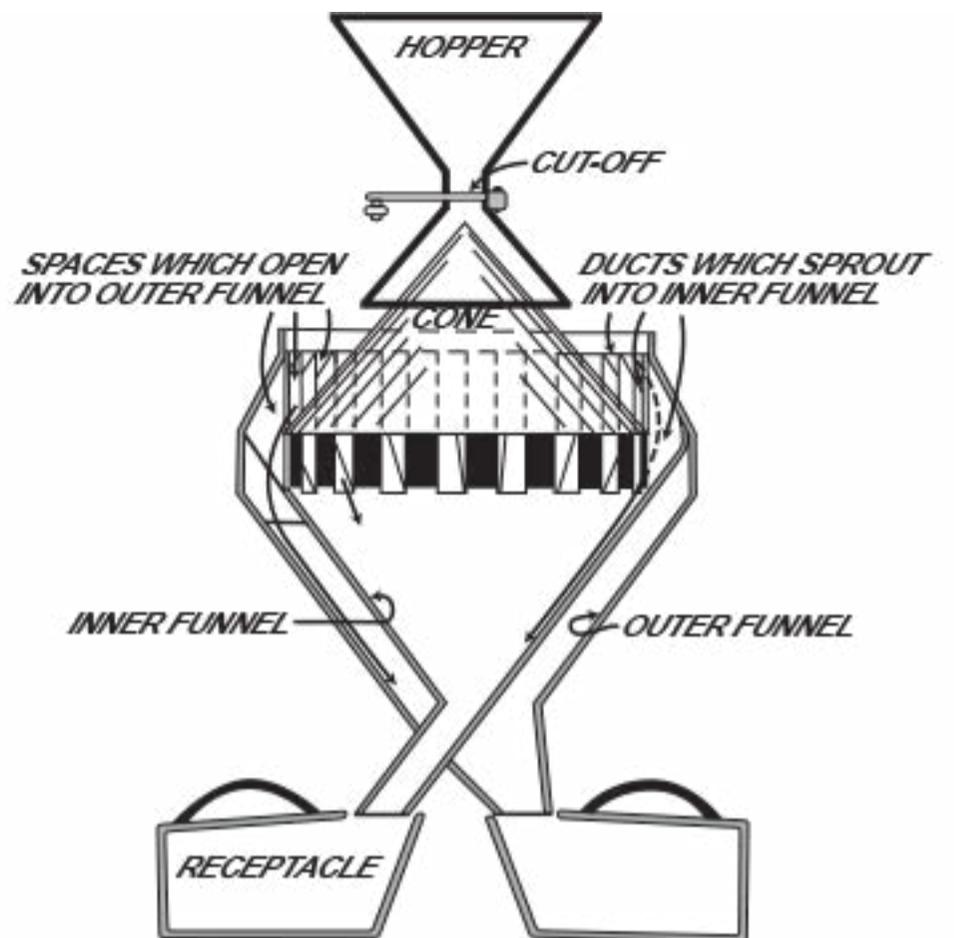
The first step in grading a flaxseed sample is to use a Boerner divider to reduce the original sample into a file sample and a work portion.

The Boerner divider reduces the size of a grain sample while maintaining its representativeness.



Boerner Divider

The Boerner divider reduces the size of a grain sample while maintaining its representativeness. Each pass of the sample through the divider splits the sample into two equal portions. The Boerner Divider, consists of a hopper, inverted cone, and a series of baffles directing the grain into two collection pans. As the valve or gate at the base of the hopper is opened, gravity carries the grain over the cone, which serves as a surface by which the kernels can separate into a single layer. Arranged in a circle at the base of the cone are a series of baffles forming alternate channels and spaces of equal width. They are arranged in a circle at their summit and are directed inward and downward, the channels leading to one spout and the spaces to an opposite spout. Each kernel has an equal chance of falling into a channel or a space, resulting in two nearly identical portions of the original sample.



- When Operating the Boerner Divider:
- Check the divider for condition and cleanliness.
- Close the hopper valve.
- Place empty collection pans under the discharge spout.
- Pour the sample into the hopper.
- Open the valve quickly.

For larger samples, feed more grain into the hopper during the dividing process.

File Sample

A “file sample,” is a representative sample or representative portion of a sample that is retained for a specified period of time for reference or review purposes.

File samples shall be of sufficient size to accommodate subsequent examinations or analysis.

The file sample shall be an unworked portion (if available) of the representative sample used for the inspection.

The worked portion may be retained as the final file only when insufficient sample is available for an unworked file sample.



Use Moisture Proof Containers

Keep all samples in sealed moisture proof containers if they cannot be tested within approximately 15 minutes.

Do not use paper bags, fiber cartons, or similar containers that allow moisture losses. Use metal cans, plastic containers, and plastic bags to preserve the sample integrity.

Do not file samples with paper identification inserted in the grain. Paper absorbs moisture and lowers the moisture of the grain.



Check for Odor



Determine odor on evidence obtained at the time of sampling or on the sample either before or after the removal of Dockage. Odors are classified as OK, Musty, Sour, or COFO (commercially objectionable foreign odors).

Musty odors indicate the presence of fungal activity in the grain and are generally characterized as an earthy smell.

Sour odors indicate that the grain is fermenting due to microbial activity. Sour odors are often characterized as an acrid, boot pit or pigpen smell.

Commercially objectionable foreign odors are odors foreign to grain that render it unfit for normal commercial usage.

When heat-damaged kernels are present, flaxseed gives off an odor very similar to smoke. Flaxseed 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.

The inspector is responsible for making the final determination for all odors. However, a consensus of experienced inspectors should be used, whenever possible, on samples containing marginal odors.

Grade flaxseed 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.

Fumigant or Insecticide Odors

Fumigant or insecticide odors are considered commercially objectionable foreign odors if they linger and do not dissipate. When a sample of flaxseed contains a fumigant or insecticide odor that prevents a determination as to whether any other odor(s) exists, allow the work portion to aerate in an open container for 4 hours, or less, if the odor dissipates in less time.

Consider the sample as having a commercially objectionable foreign odor if the fumigant or insecticide odor persists after 4 hours.



Sample Grade Criteria

Determine U.S. Sample grade criteria, except for stones, before the removal of dockage based on the work portion of approximately 1000 grams. U.S. Sample grade is flaxseed that contains:

- 2 or more pieces of glass,
- 3 or more crotalaria seeds,
- 2 or more castor beans,
- 4 or more particles of an unknown foreign substance(s), or a commonly recognized harmful or toxic substance(s),
- 10 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 1000 grams of flaxseed; or
- is heating or otherwise of distinctly low quality.

When flaxseed is graded “U.S. Sample grade” record the reason why in the “Remarks” section of the certificate. Record count factors to the nearest whole number.

Dockage

Determine dockage on a portion of 1,000 - 1,050 grams.

Dockage is all matter other than flaxseed that can be removed from the original sample by use of the Carter Dockage Tester. Also, underdeveloped, shriveled, and small pieces of flaxseed kernels removed in properly separating the material other than flaxseed and that cannot be recovered by properly re-screening or re-cleaning.

Record the word “Dockage” and the percentage on the work record in hundredths. When the sample contains 1 percent or more dockage, record the percentage of dockage on the certificate in whole percent with a fraction of a percent disregarded.

For example:

1.00 to 1.99 percent is recorded as 1.0 percent

2.00 to 2.99 percent is recorded as 2.0 percent, etc.

Determine Dockage

To determine dockage using the Carter Dockage Tester, first insert the Number 4 sieve in the top sieve carriage, the number 2 sieve in the middle carriage, the number 7 sieves in the bottom sieve carriage and the 000 riddle in the riddle carriage. Set the air to 3.5 and the feed control to 4.

Next, run 1,000 - 1,050 grams through the dockage tester.

Then, if matted lumps of flaxseed clog or kick over the riddle, remove the riddle and the No. 4 sieve and proceed with the dockage determination.

Finally, if the material that passes over the No. 4 sieve contains lumps of flaxseed that cannot be reclaimed, add this portion to the mechanically cleaned flaxseed.

Reclaim

Using an approved hand sieve, reclaim the flaxseed passing over the No. 4 sieve.

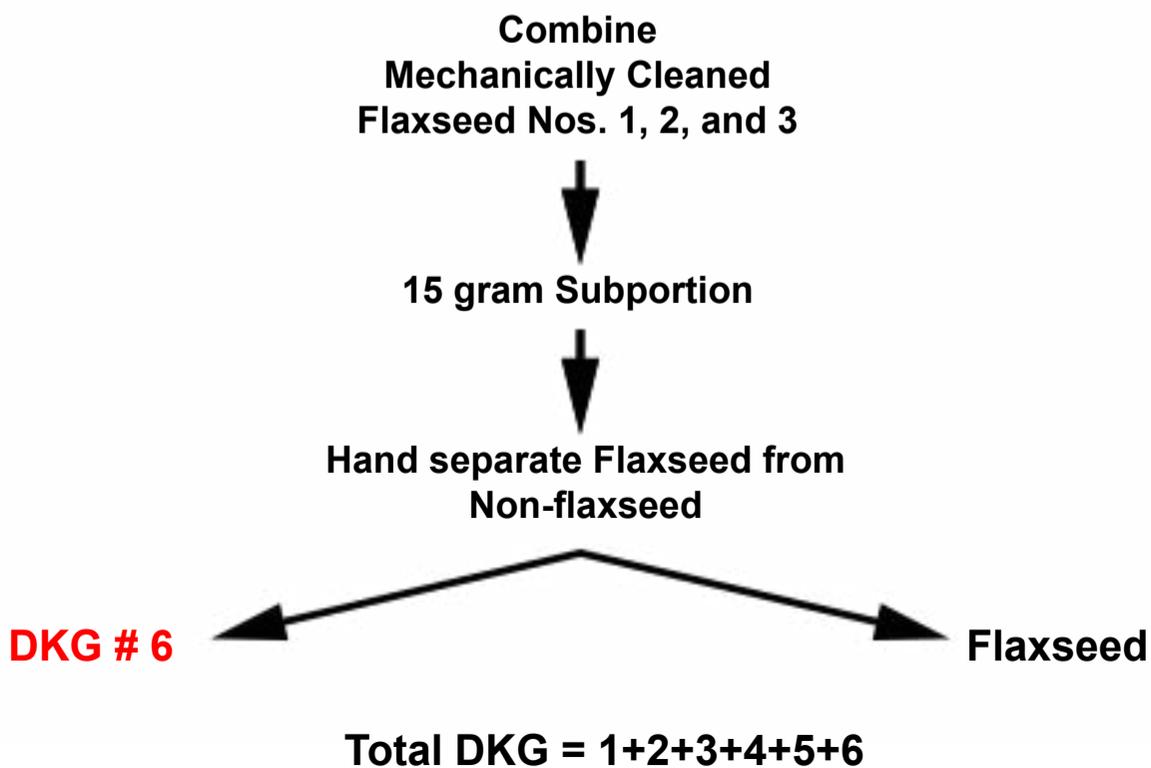
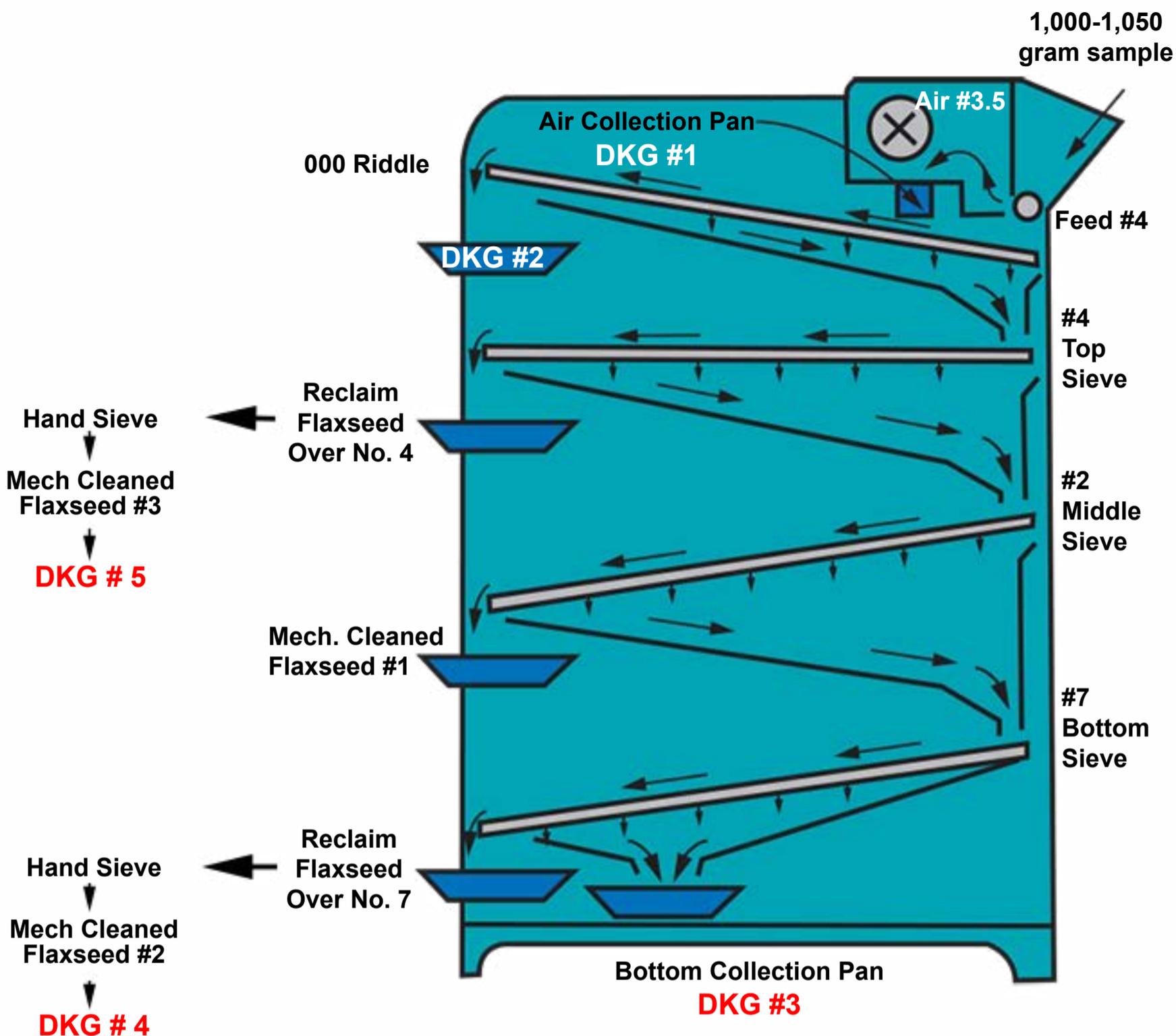
When the material contains large-sized flaxseed, sieve with a 0.064 by 3/8 inch sieve using 30 strokes.

When the material contains small-sized flaxseed, sieve with a 3/64 by 3/8 inch or a 3/64 by 11/32 inch sieve using 30 strokes.

Using an approved hand sieve, reclaim the flaxseed passing over the No. 7 sieve. Sieve with a 3/64 by 11/32 inch sieve or a 3/64 by 3/8 inch sieve using 30 strokes.

Combine the three mechanically cleaned portions.

Dockage Procedure



Stones

Determine stones on the dockage-free portion.

Consider identifiable pieces of grain, processed grain products such as soybean meal, sorghum grits, corn meal, bulgur, etc., or feed pellets in grain as dockage. Unidentifiable materials or material unrelated to grain shall function as “unknown foreign substance.”

Flaxseed that contains 8 or more stones which have an aggregate weight in excess of 0.2 percent of the sample weight, is U.S. Sample grade.

Test Weight

Test weight is the weight per Winchester bushel or 2,150.42 cubic inches. Determine test weight on a portion of sufficient quantity to overflow the kettle.

Record test weight results on the work record as displayed on the electronic scale or in whole and half pounds. Disregard fractions of a half-pound. Record the test weight on the certificate in whole and half pounds.

If requested, convert the pounds per bushel result to kilograms per hectoliter using the formula pounds per bushels times 1.287 equals kilograms per hectoliter and record in the “Remarks” section in whole and tenths.

$$\text{lbs./bu.} \times 1.287 = \text{kg/hl}$$

Position the hopper over the center of the kettle, making sure the hopper valve is closed. Pour grain into the hopper.

Open the valve allowing the grain to overflow the kettle. Once the hopper is clear of grain move the hopper to the side.

With a rounded edge striker, place it on the edge of the kettle and move the striker in three zigzag motions across the kettle leveling the grain.

Move the kettle to a scale and record the test weight measurement.



Moisture Determination

Moisture is the water content in grain.

Determine moisture on approximately 650 - 750 grams of the original sample.

The DICKEY-john GAC2500-UGMA and the Perten AM5200-A are the designated official moisture meters for performing moisture analysis in grains.



DICKEY-john GAC2500



Perten AM5200-A

Basically, the instruments measure the change in capacitance of two parallel plates when grain is placed between them. As the moisture content within the grain increases or decreases so does its contribution to capacitance, known as its dielectric constant.

The instruments also measure sample density and temperature and perform automatic corrections for those parameters.

Calibration equations have been developed to convert these properties into precise moisture percentages for each grain measured by the instruments.

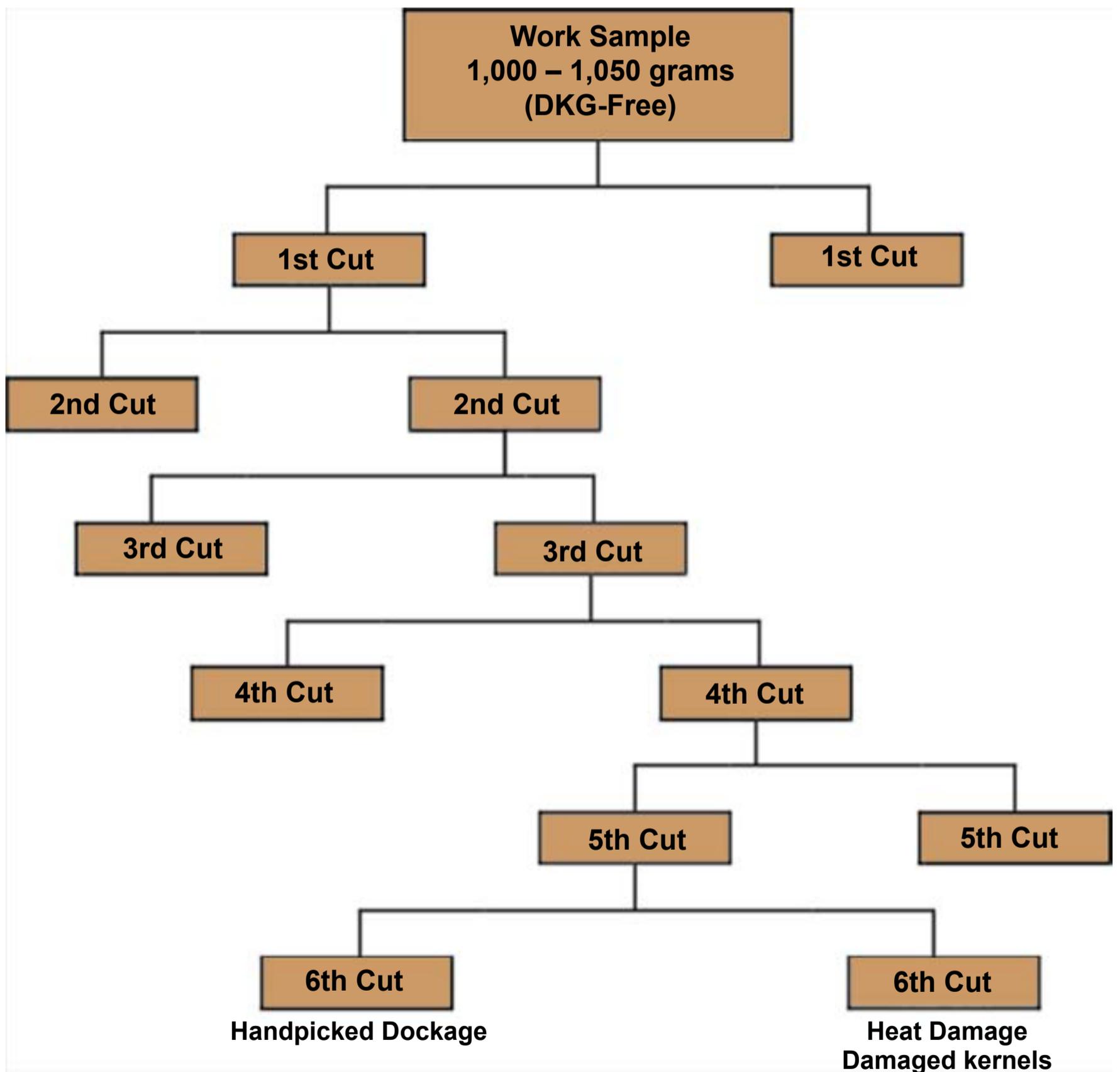
The test they perform takes about 30 seconds to complete and is a simple and accurate way to obtain moisture analysis in the field.

Record the percent of moisture to the nearest tenth percent.

Dividing the Work Sample

At this point, all tests required to be performed prior to the removal of dockage have been made and the percentage of dockage has been determined. Also, determinations for moisture and test weight have been performed.

Now the work sample is ready to be cut into fractional parts for those determinations required to be performed after the removal of dockage. Use the Boerner divider to cut out portions for handpicked dockage, damage, and heat damage.



Handpicked Dockage

Handpick a 15-gram portion for material other than flaxseed.

Matted kernels of flaxseed are considered flaxseed even though portions of flax bolls adhere to the matted kernels.

Computing Dockage

Compute the percentage of dockage by adding the percentage of mechanically separated dockage to the percentage of handpicked dockage in hundredth. Disregard thousandths.



First divide the weight of mechanically separated dockage by the original sample weight and multiply by 100. This gives you the percent of mechanically separated dockage.

Subtracting the percent of mechanically separated dockage from 100 and dividing the result by 100 yields the change of base factor.

Then divide the weight of handpicked dockage by the weight of the handpicked portion and multiply the result by 100. The result is the percent of handpicked dockage.

Then multiply the percent of handpicked dockage by the change of base factor. The result is the adjusted percentage of handpicked dockage.

Finally add the percent of mechanically separated dockage to the adjusted percentage of handpicked dockage to obtain the percent of dockage.

Dockage Example

Original sample weight	= 1,000 grams
Weight of mechanically separated dockage	= 68.00 grams
Weight of handpicked portion	= 15.30 grams
Weight of handpicked dockage	= 0.55 grams

STEP 1. $(68.00 \div 1,000) \times 100 = 6.80\%$ mechanical dockage

STEP 2. $(100\% - 6.80\%) \div 100 = 0.93$ change of base factor

STEP 3. $(0.55 \div 15.30) \times 100 = 3.59\%$ handpicked dockage

STEP 4. $3.59 \times .93 = 3.33\%$ adjusted percentage of handpicked dockage

STEP 5. $6.80\% + 3.33\% = 10.13\% = 10.0\%$ dockage

Damaged Kernels

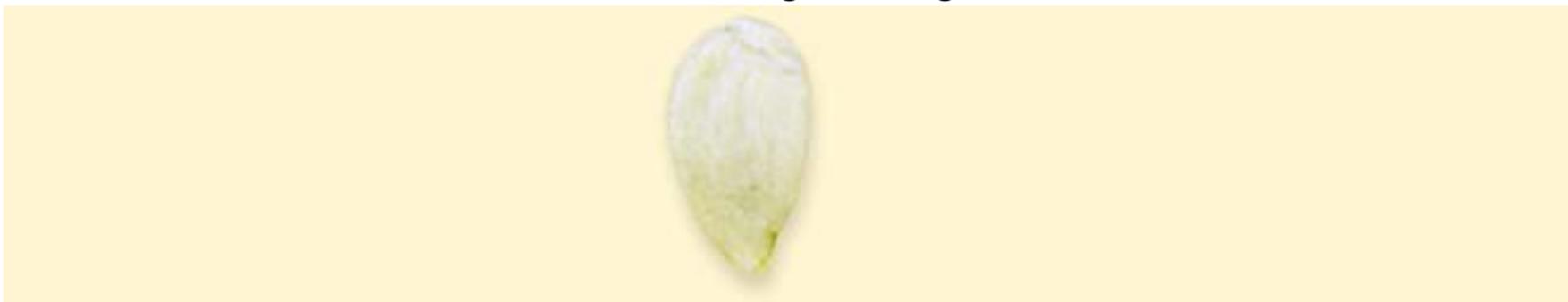
Determine damaged kernels on a mechanically cleaned portion of 15 grams. Damaged kernels are kernels and pieces of flaxseed kernels that are badly ground-damaged, badly weather-damaged, diseased, frost-damaged, germ-damaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged.

In general, consider flaxseed to be damaged for inspection and grading purposes only when the damage is distinctly apparent and of such character as to be recognized as damaged for commercial purposes. Green kernels of flaxseed which are otherwise sound are not damaged.



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

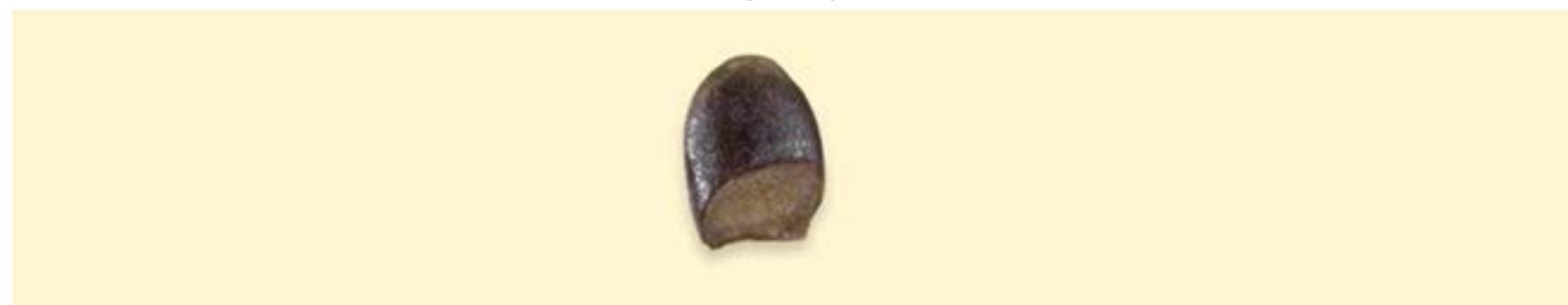
“Bees Wings” Damage



Damaged flaxseed is usually characterized by a distinct discoloration, such as white, dark brown, or black discolorations caused by disease or by a moldy, scabby, or a dead appearance.

Very thin whitish, paper like seeds of flaxseed, commonly known as “fly’s wings” or “bee’s wings” are also considered damaged.

Damaged by Heat



Flaxseed and pieces of flaxseed which are damaged as a result of heat but which are not materially discolored.

Heat-Damaged



Determine heat-damaged kernels on mechanically cleaned portion of 15 grams

Heat-damaged kernels are kernels and pieces of flaxseed kernels that are materially discolored and damaged. It is necessary, in most cases, to cross-section the kernels to determine if the color is a chocolate color.

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

Grade Designations

After completing the analysis, assign a grade by comparing the results with the limits for each grade factor specified in the grade chart.

The factor with the lowest grade designation determines the grade assigned to the sample.

Code	Factor	Original	Supv/Appeal	Initials	BAR
	CL				
02	DKG	3.43			
03	TW	52.0			
04	M	6.4			
05	ODOR	OK			
06	HT	0.0			
07	ODK				
08	SKD				
09	DKT	0.2			
GRADE U.S. NO.		CLASS AND SPECIAL GRADE			
Orig.	1	Flax DKG 3.0%			
Appeal					
Bar					

GRAIN SAMPLE TICKET USDA-FGIS

Or Better

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, flaxseed may be certificated as U.S. No. 2 or better, U.S. No. 3 or better, etc.

For Example:

U.S. No. 2 or better Flaxseed, Dockage 1.0%

An “or better” grade designation cannot be applied to a U.S. No. 1 grade designation.

Documenting the Grade

Use the following guide for documenting the assigned grade:

- First write the letters “U.S.”,
- Then the abbreviation “No.” and the number of the grade or the words “Sample grade”, followed by the words “or better” when applicable.
- The word “flaxseed” shall be shown next, and last the word “dockage” (when applicable) and the percentage thereof.

U.S. No. 1 Flaxseed, Dockage 1.0%

U.S. No. 2 or better Flaxseed, Dockage 1.0%

Grain Grading Primer

Chapter 5

Oats



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Definition of Oats

Oats are defined as grain that consists of 50 percent or more of oats and may contain slightly or in combination not more than 25 percent of wild oats and other grains for which standards have been established under the United States Grain Standards Act.

Normally, a visual appraisal of the sample is sufficient to determine if the sample meets the definition of oats. However, if an analysis is necessary, make the determination on a portion of 30 grams.

If the sample does not meet the definition of oats, examine it further to determine if it is either another grain for which standards have been established or grain that is not standardized. No further analysis is necessary on a sample designated as not standardized grain unless a specific factor test is requested.

Grade Requirements

There are no classes or subclasses in oats. Oats are divided into four numerical grades and U.S. Sample grade.

OATS					
Grade	Minimum Limits of -		Maximum Limits of -		
	Test weight per bushel (pounds)	Sound Oats (percent)	Heat-Damaged kernels (percent)	Foreign material (percent)	Wild oats (percent)
U.S. No. 1	36.0	97.0	0.1	2.0	2.0
U.S. No. 2	33.0	94.0	0.3	3.0	3.0
U.S. No. 3 ¹	30.0	90.0	1.0	4.0	5.0
U.S. No. 4 ²	27.0	80.0	3.0	5.0	10.0

U.S. Sample Grade

U.S. Sample Grade are oats that:

- (a) Does not meet the requirements for grades U.S. No.1, 2, 3, or 4; or
- (b) Contains 8 or more stones which have an aggregate weight in excess of 0.2 percent of the sample weight, 2 or more pieces of glass, 3 or more crotalaria seeds (*Crotalaria* spp.), 2 or more castor beans (*Ricinus communis* L.), 4 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), 8 or more cockleburs (*Xanthium* spp.) or similar seeds singly or in combination, 10 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth per 1 1/8 to 1 . quarts of oats; or
- (c) Have a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor) ; or
- (d) Are heating or otherwise of distinctly low quality.

¹ Oats that are slightly weathered shall be graded not higher than U.S. No. 3.

² Oats that are badly stained or materially weathered shall be graded not higher than U.S. No. 4.

Special Grades

Special grades are provided to emphasize special qualities or conditions affecting the value of the oats and are added to and made a part of the grade designation. Special grades do not affect the numerical or sample grade designation. The oats standards include nine special grades: bleached oats, bright oats, ergoty oats, extra-heavy oats, garlicky oats, heavy oats, infested oats, smutty oats, and thin oats.

Bleached oats are oats that in whole or in part, have been treated with sulfurous acid or any other bleaching agent.

Bright oats are oats, except bleached oats, that are of good natural color.

Ergoty oats are oats that contain more than 0.10 percent ergot. Ergot is a hard, reddish-brown or black grain like mass of certain parasitic fungi that replaces oat kernels.

Heavy oats are oats that have a test weight per bushel of 38 pounds or more but less than 40 pounds.

Extra-heavy oats are oats that have a test weight per bushel of 40 pounds or more.

Garlicky oats are oats that contain 4 or more green garlic bulblets or an equivalent quantity of dry or partly dry bulblets in 500 grams of oats.

Infested oats are oats that are infested with live weevils or other insects injurious to stored grain.

Smutty oats are oats that have kernels covered with smut spores to give a smutty appearance in mass or that contain more than 0.2 percent of smut balls.

Thin oats are oats that contain more than 20.0 percent of oats and other matter, except fine seeds, that pass through a 0.064 x 3/8 oblong-hole sieve but remain on top of a 5/64 triangular-hole sieve after sieving.

Heating

Oats developing high temperature from excessive respiration due to microbial activity (fermenting), insect infestation, or sprouting is considered heating. As heating progresses oats will develop a sour or musty odor.

Care should be taken not to confuse oats that are heating with oats that are warm because of storage in bins, railcars, or other containers during hot weather.

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

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

Distinctly Low Quality

Consider oats distinctly low quality when they are obviously of inferior quality and the existing grade factors or guidelines do not accurately reflect the inferior condition.

Use all available information to determine whether the oats are of distinctly low quality. This includes a general examination of the oats during sampling and an analysis of the obtained sample.

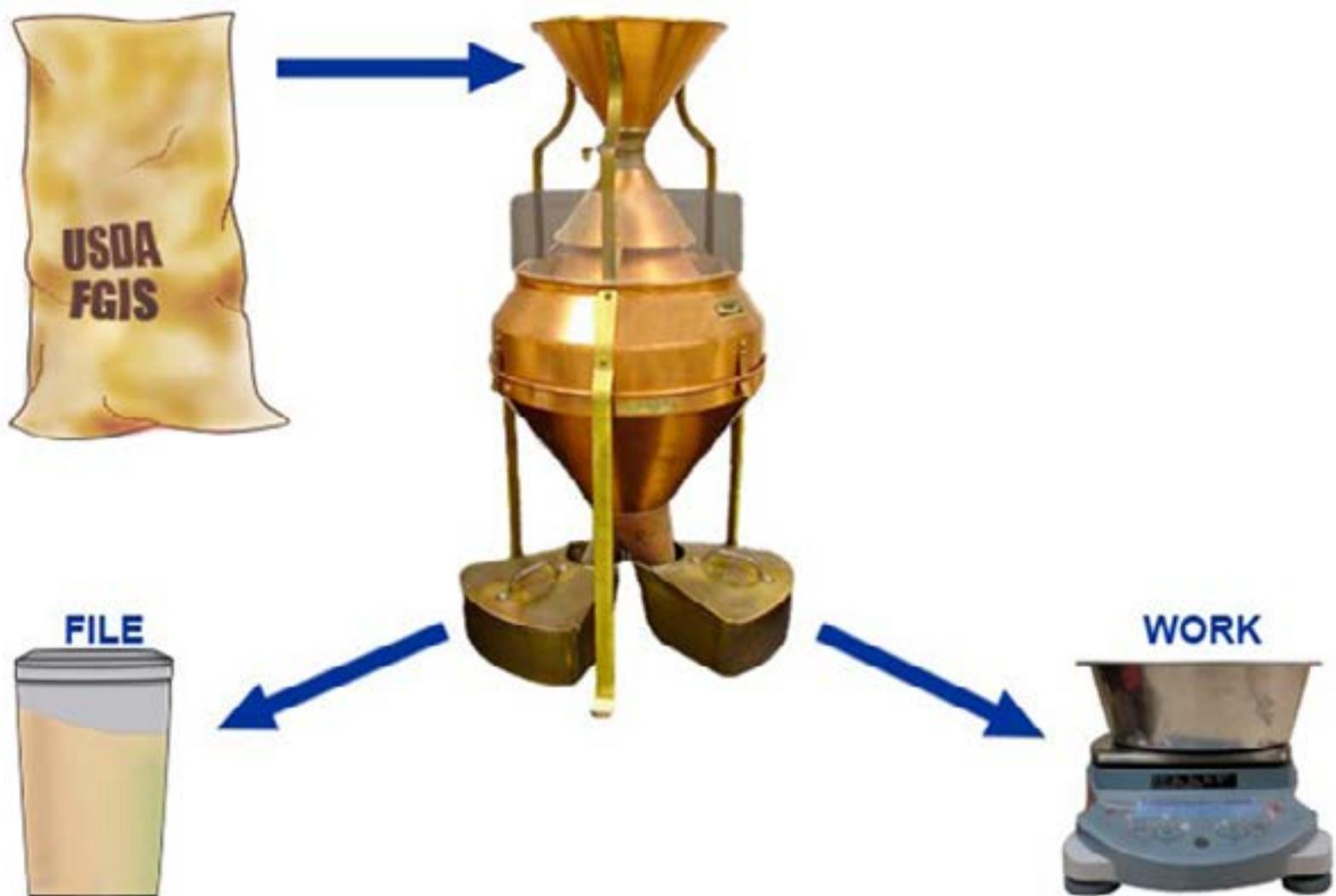
Oats containing two or more stones, pieces of glass, pieces of concrete, or other pieces of wreckage or debris which are visible to the sampler but too large to enter the sampling device are considered distinctly low quality.

Oats that are obviously affected by other unusual conditions which adversely affect the quality of the oats and cannot be properly graded by use of the grading factors specified or defined in the standards are considered distinctly low quality.

Grade distinctly low quality oats U.S. Sample Grade. Record the reason(s) why the oats were distinctly low quality on the certificate.

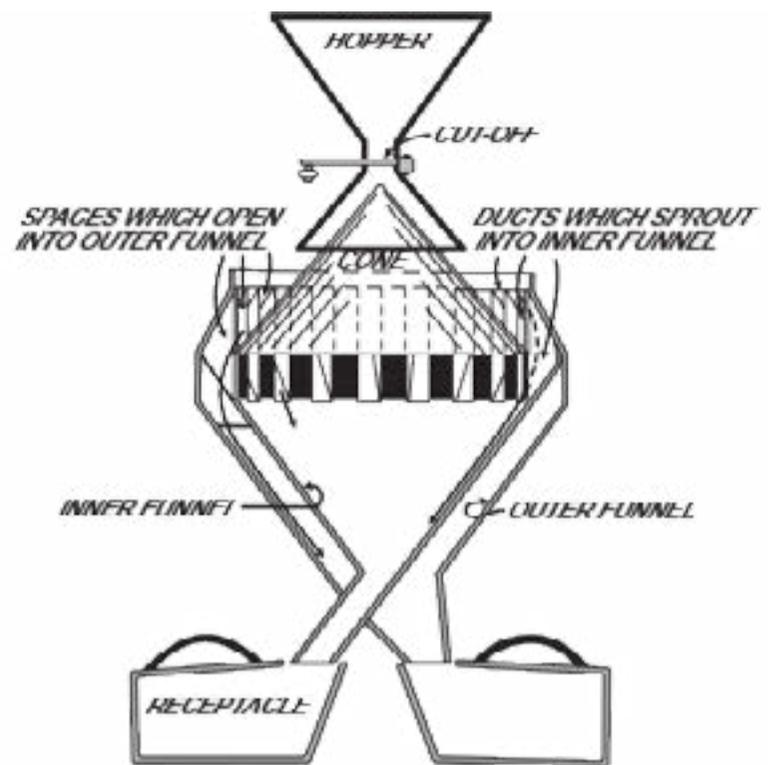
Processing the Original Sample

The first step in grading an oats sample is to use a Boerner divider to reduce the original sample into a file sample and a work portion.



Boerner Divider

The Boerner divider reduces the size of a grain sample while maintaining its representativeness. Each pass of the sample through the divider splits the sample into two equal portions. The Boerner Divider, consists of a hopper, inverted cone, and a series of baffles directing the grain into two collection pans. As the valve or gate at the base of the hopper is opened, gravity carries the grain over the cone, which serves as a surface by which the kernels can separate into a single layer.



Arranged in a circle at the base of the cone are a series of baffles forming alternate channels and spaces of equal width. They are arranged in a circle at their summit and are directed inward and downward, the channels leading to one spout and the spaces to an opposite spout. Each kernel has an equal chance of falling into a channel or a space, resulting in two nearly identical portions of the original sample.

- When Operating the Boerner Divider:
- Check the divider for condition and cleanliness.
- Close the hopper valve.
- Place empty collection pans under the discharge spout.
- Pour the sample into the hopper.
- Open the valve quickly.

For larger samples, feed more grain into the hopper during the dividing process.

File Sample

A “file sample,” is a representative sample or representative portion of a sample that is retained for a specified period of time for reference or review purposes.

File samples should be of sufficient size to accommodate subsequent examinations or analysis.

The file sample shall be an unworked portion (if available) of the representative sample used for the inspection.

The worked portion may be retained as the final file only when insufficient sample is available for an unworked file sample.



Use Moisture Proof Containers

Keep all samples in sealed moisture proof containers if they cannot be tested within approximately 15 minutes.

Do not use paper bags, fiber cartons, or similar containers that allow moisture losses. Use metal cans, plastic containers, and plastic bags to preserve the sample integrity.

Do not file samples with paper identification inserted in the grain. Paper absorbs moisture and lowers the moisture of the grain.



Odor Determination

Determine odor on evidence obtained at the time of sampling or on the ample either before or after the removal of foreign material. The inspector is responsible for making the final determination for all odors but a consensus of experienced inspectors should be used, whenever possible, on samples containing marginal odors. The consensus approach is not required if no odor or a distinct odor is detected.

Odors are classified as OK, Musty, Sour, or COFO (commercially objectionable foreign odors).

Grade oats 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.



Odors

Musty odors indicate the presence of fungal activity in the grain and are generally characterized as an earthy smell.

Sour odors indicate that the grain is fermenting due to microbial activity. Sour odors are often characterized as an acrid, boot pit or pigpen smell.

Commercially objectionable foreign odors are odors, except smut and garlic 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 oats contains a fumigant or insecticide odor that prevents the determination as to whether any other odors exist allow the work portion to aerate in an open container for 4 hours, or less, if the odor dissipates in less time. Consider the sample as having a commercially objectionable foreign odor if the fumigant or insecticide odor persists.

Moisture Determination

Moisture is the water content in grain.

Determine moisture on approximately 400 grams of the original sample.

The DICKEY-john GAC2500-UGMA and the Perten AM5200-A are the designated official moisture meters for performing moisture analysis in grains.



DICKEY-john GAC2500



Perten AM5200-A

Basically, the instruments measure the change in capacitance of two parallel plates when grain is placed between them. As the moisture content within the grain increases or decreases so does its contribution to capacitance, known as its dielectric constant.

The instruments also measure sample density and temperature and perform automatic corrections for those parameters.

Calibration equations have been developed to convert these properties into precise moisture percentages for each grain measured by the instruments.

The test they perform takes about 30 seconds to complete and is a simple and accurate way to obtain moisture analysis in the field.

Record the percent of moisture to the nearest tenth percent.

General Appearance

Oats has three general appearance factors. They are “bright” oats, “slightly weathered” oats, and “badly stained or materially weathered” oats. The factors “Slightly Weathered,” and “Badly Stained or Materially Weathered” denote a discolored condition caused by adverse weather conditions.

Determine general appearance on the sample as a whole. Consider oats “slightly weathered,” or “badly stained or materially weathered” when the sample is equal to or worse than the oats in the visual reference image. No visual reference image exists for the special grade “Bright Oats”.

Record the words “Bright,” “Slightly Weathered,” or “Badly Stained or Materially Weathered” in the “Remarks” section of the certificate.

Bright Oats

Bright oats are oats which have been ripened and harvested under favorable weather conditions and have a good natural color.

Oats which do not have a good natural color usually appear dull and lifeless, or are stained, or green from immaturity. Do not consider a mixture of bright oats with any appreciable quantity of poorly colored oats as bright, but bright oats which contain smut masses or a light trace of smut spores on the kernels are considered bright.

Oats which did not have a good natural color but were treated with a bleaching agent to improve their color and appearance are considered “Bleached”.

Determine bleached on the general appearance and odor of the sample as a whole.

The odor of sulfur or any other bleaching agent is associated with bleached oats. When the odor or general appearance indicate that oats have been artificially bleached, either in whole or in part, the oats are “bleached.”

When applicable grade bleached oats in accordance with the Special Grades section.

Slightly Weathered Oats

In order for a sample of oats to be designated slightly weathered, each individual kernel must have a slightly dusty, gray appearance on the brush end in sufficient amounts to give the entire sample a slightly weathered appearance or the sample may contain severely weathered kernels in a sufficient number to give it a slightly weathered appearance. In either case, the oats are slightly weathered.



Oats that are slightly weathered shall be graded not higher than U.S. No. 3.

Materially Weathered Oats

When kernel discoloration due to weather has progressed to a point where many of the kernels are badly discolored and weathered, the oats are considered “badly stained or materially weathered”.



Oats that are badly stained or materially weathered shall be graded not higher than U.S. No. 4.

Test Weight

Test weight is the weight per Winchester bushel or 2,150.42 cubic inches. Determine test weight on a portion of sufficient quantity to overflow the kettle.

Record test weight results on the work record as displayed on the electronic scale or in whole and half pounds. Disregard fractions of a half-pound. Record the test weight on the certificate in whole and half pounds.

If requested, convert the pounds per bushel result to kilograms per hectoliter using the formula pounds per bushels times 1.287 equals kilograms per hectoliter and record in the “Remarks” section in whole and tenths.

$$\text{lbs./bu.} \times 1.287 = \text{kg/hl.}$$

TW Procedure

Position the hopper over the center of the kettle, making sure the hopper valve is closed. Pour grain into the hopper.

Open the valve allowing the grain to overflow the kettle. Once the hopper is clear of grain move the hopper to the side.

With a rounded edge striker, place it on the edge of the kettle and move the striker in three zigzag motions across the kettle leveling the grain.

Move the kettle to a scale and record the test weight measurement.



Heavy/Extra-Heavy Oats

There are two special grades in oats that are based on test weight. First, extra-heavy oats are oats that have a test weight per bushel of 40 pounds or more. And secondly heavy oats which are oats that have a test weight per bushel of 38 pounds or more but less than 40 pounds.

When applicable, make the special grades “Extra Heavy” or “Heavy” a part of the grade designation and record on the certificate.

Check for Insects

Check the lot as a whole and/or the sample as a whole for insects.

The presence of any live weevil or other live insects injurious to stored grain indicates the probability of infestation and warns that the oats must be carefully examined to determine if they are infested. In such cases, examine the work sample and the file sample before reaching a final conclusion. Do not examine the file sample if the work portion is insect-free.

Samples meeting or exceeding any one of these tolerances are infested:

2 live weevils

10 other live insects

1 live weevil + 5 other live insects

Live Weevils

Live weevils include rice weevils, granary weevils, maize weevils, cowpea weevils, and lesser grain borers.



Rice Weevil



Granary Weevil



Maize Weevil



Cowpea Weevil



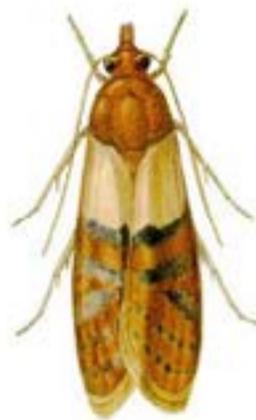
Lesser Grain Borer

Other Live Insects

Other live insects injurious to stored grain shall include grain beetles, grain moths, and larvae.



Angoumois Grain Moth



Indian Meal Moth



Red Flour Beetle



Flat Grain Beetle

Sample Grade Factors

Determine U.S. Sample grade criteria before the removal of coarse foreign material and other grains based on a work portion of 700 - 800 grams. U.S. Sample grade are oats which contain:

- 8 or more stones which have an aggregate weight in excess of 0.2 percent of the sample weight,
- 2 or more pieces of glass,
- 3 or more crotalaria seeds,
- 2 or more castor beans,
- 8 or more cocklebur or similar seeds singly or in combination,
- 0 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth per 1 to 1¼ quarts of oats,
- 4 or more particles of an unknown foreign substance or a commonly recognized harmful or toxic foreign substance.

Consider identifiable pieces of grain, processed grain products, like soybean meal, sorghum grits, corn meal, bulgur, or feed pellets in grain as foreign material. Unidentifiable materials or material unrelated to grain shall function as “unknown foreign substance.”

Determine Thin Oats

Determine “thin oats” on a portion of 250 grams of the original sample.

Thin oats are oats that contain more than 20.0 percent of oats and other matter, except fine seeds, that pass through a 0.064 by 3/8-inch oblong hole sieve but remain on top of a 5/64 inch triangular –hole sieve.

Fine seeds are all matter that passes through a 5/64 inch triangular-hole sieve. When applicable, grade the oats “thin”.

Thin Oats Procedure

To separate the thin oats from the sample, mount a 0.064 x 3/8 inch oblong hold sieve and a bottom pan on the mechanical sieve shaker.

- Next, set the stroke counter for 30 strokes.
- Then, place one-third of the sample in the center of the sieve and start the machine.
- After the sieve shaker has stopped, remove and clean the sieve and empty the bottom pan. Return the material lodged in the perforations to the oats on top of the sieve.
- Repeat this operation on the remaining portions until the entire sample has been sieved.
-
- Take the material which passed through the 0.064 x 3/8 inch oblong hole sieve and sieve it over a 5/64 inch triangular-hole sieve, often called the small buckwheat sieve, to remove the fine seeds which may be present.
- Place the material that passed through the 0.064 x 3/8 inch oblong hole sieve on the upper edge of the small buckwheat sieve.



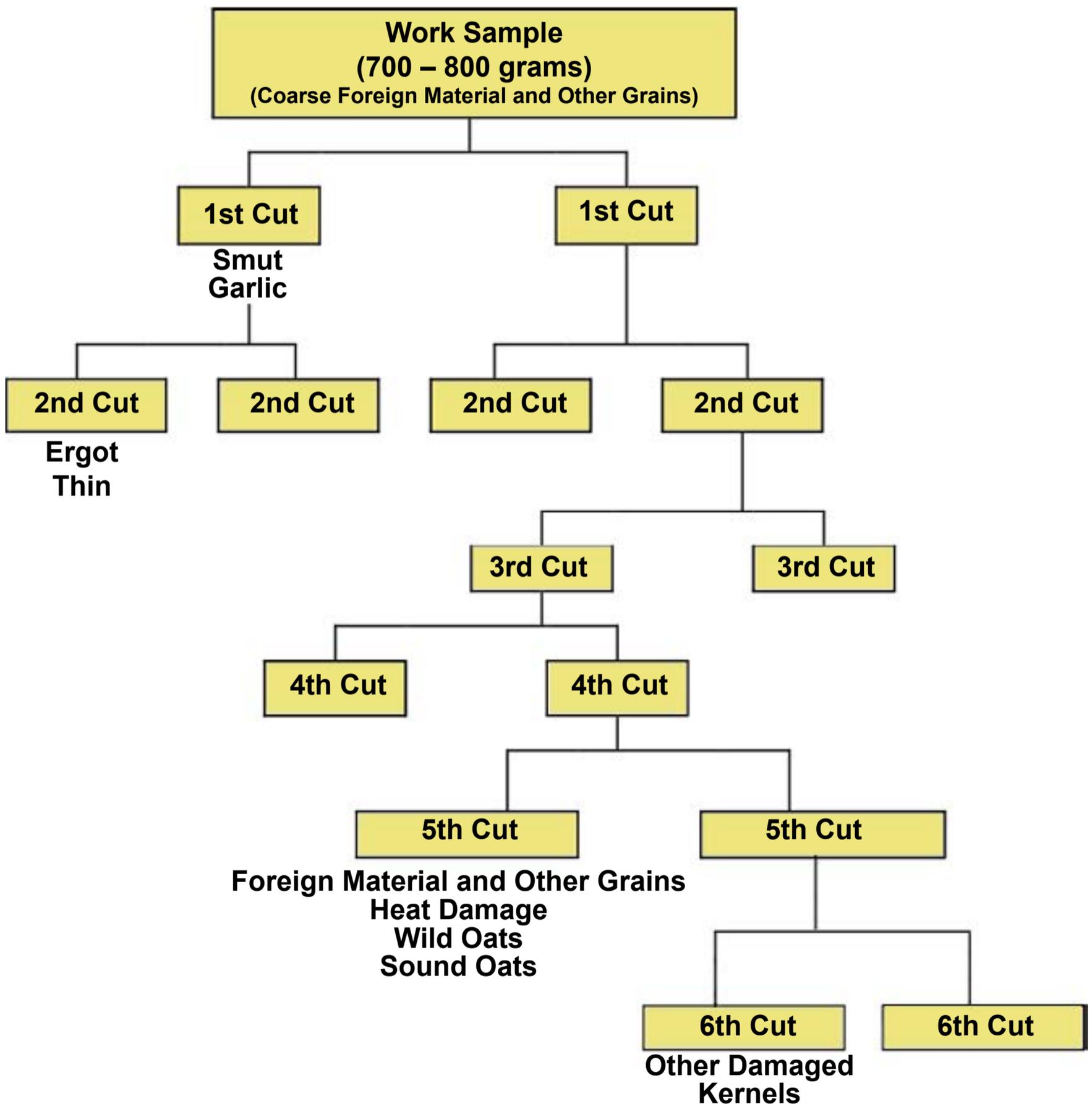
- Hold the sieve at a 10-to-20-degree angle and work the material down over the sieve with a gentle side-to-side motion.

The fine seeds, and other material passing through the small buckwheat sieve, are considered fine seeds. The oats and other material that passes through the 0.064 x 3/8 inch oblong hole sieve, but remain on top of the 5/64 inch triangular hole sieve or small buckwheat sieve are thin oats.

Dividing the Work Sample

At this point, determinations have been made for heating, odor, moisture, general appearance, bleached, test weight, infestation, distinctly low quality, sample grade factors, and thin.

Now divide the work sample into fractional portions for determining smut, garlic, ergot, foreign material and other grains, heat damaged kernels, wild oats, other damaged kernels, and sound oats.



Determine Smutty Oats

Determine smutty oats on a portion of 500 grams of the original sample. Oats that have kernels covered with smut spores to give a smutty appearance in mass or that contain more than 0.2 percent of smut balls are graded smutty.

When smut spores are in a sufficient quantity to give the entire sample a smutty appearance, grade the oats smutty. In such cases, there is often a sufficient quantity of smut balls, in excess 0.2 percent, which would cause the sample to grade smutty.

Smut balls apply in the determination of the special grade “Smutty” but also function as foreign material. When applicable, grade the oats “Smutty”.



Determine Garlicky Oats

Determine garlicky oats on a portion of 500 grams of the original sample. Oats that contain four or more green garlic bulblets or an equivalent quantity of dry or partly dry bulblets in 500 grams of oats are garlicky.

Green garlic bulblets are bulblets which have retained all of their husks intact. Also dry or partly dry bulblets are bulblets which have lost all or part of their husks. Consider bulblets with cracked husks as dry. Note that three dry or partly dry bulblets are equal to one green garlic bulblet. When appropriate, record the word “Garlicky” on the certificate.



Ergoty Oats

Determine ergoty oats on a portion of 250 grams of the original sample. Ergoty oats are oats that contain more than 0.10 percent ergot.

Ergot is a hard, reddish-brown or black grain like mass of certain parasitic fungi that replaces oat kernels.

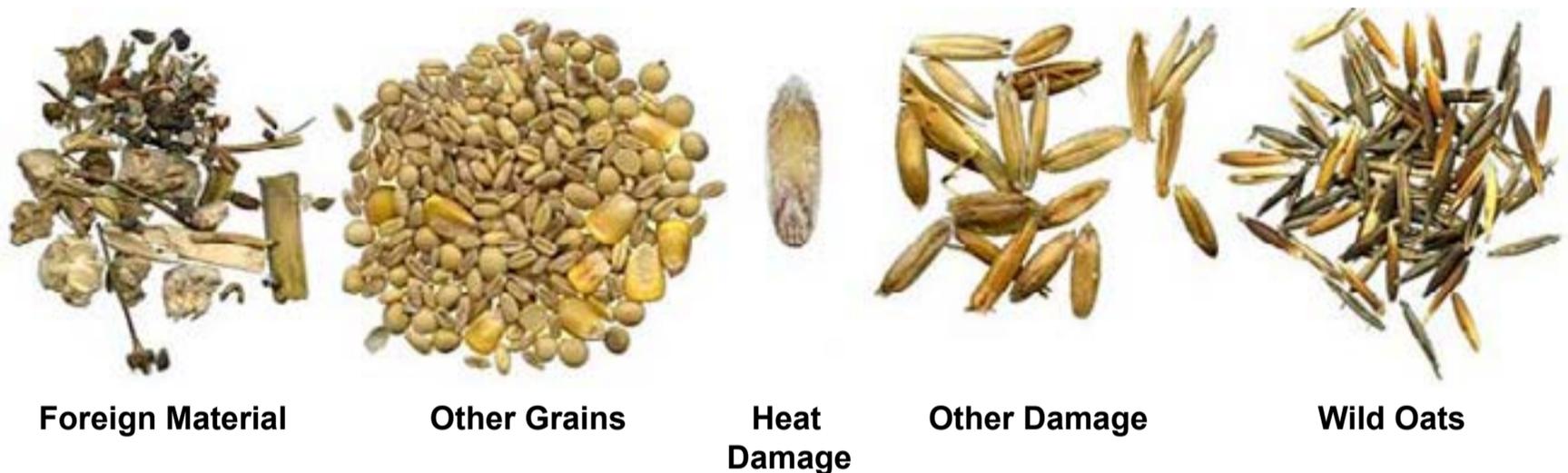
When appropriate, record the word “Ergoty” on the certificate.



Sound Oats

Sound oats are kernels and pieces of oat kernels (except wild oats) that are not badly ground- damaged, badly weather-damaged, diseased, frost-damaged, germ-damaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged. To determine the percentage of sound oats, separate all damaged oats and all matter other than cultivated oats from the work portion.

This involves, first separating the coarse foreign material and whole kernels of corn and soybeans from the work sample, then separating the foreign material, other grains, heat-damaged kernels, and wild oats from a work portion of 30 grams, and finally separating the other damaged kernels from a work portion of 15 grams.



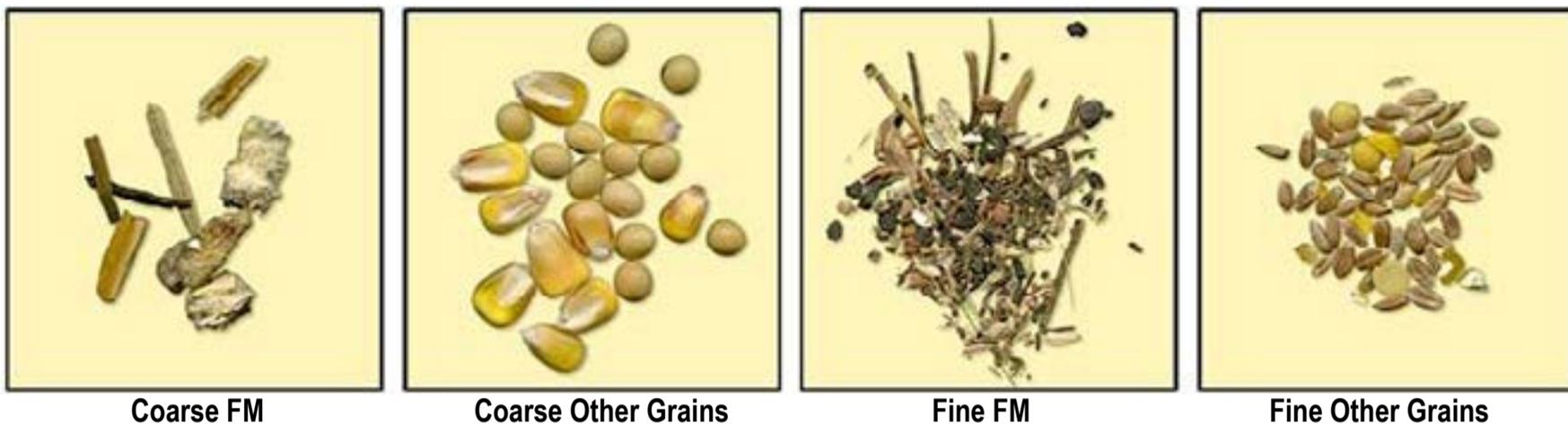
Calculating Sound Oats

The sum of the percentages of foreign material, other grains, heat-damaged kernels, other damaged kernels, and wild oats subtracted from 100 percent, equals the percentage of sound oats.

Record the percentage of sound oats on the certificate to the nearest tenth percent.

Foreign Material & Other Grains

Foreign Material is all matter other than oats, wild oats, and other grains. Consider oat clippings and detached oat hulls and pieces of detached hulls as foreign material. Other Grains are Barley, corn, cultivated buckwheat, einkorn, emmer, flaxseed, guar, hull-less barley, non-grain sorghum, Polish wheat, popcorn, Poulard wheat, rice, rye, safflower, sorghum, soybeans, spelt, sunflower seed, sweet corn, triticale, and wheat.



Foreign material and other grains consist of coarse foreign material, coarse other grains, fine foreign material, and fine other grains. Record the percent of foreign material (includes coarse and fine) on the certificate to the nearest tenth percent. Record the percent of other grains (includes coarse and fine) on the work record to the nearest tenth percent.

Coarse FM & Other Grains

For coarse foreign material and coarse other grains, handpick the 700 – 800 gram work portion for coarse foreign material and coarse other grains.

Coarse Foreign Material includes cockleburs, sticks if they are approximately 2.5 cm or more in length and 1.3 cm or more in thickness, soybean pods (one-half pod or more), or other coarse foreign material which may include large feed pellets, pieces of dirt, sweet corn, and edible beans.

Coarse Other Grains, includes whole kernels of corn which are kernels with one-fourth or less of the kernel removed and also, whole soybeans which are soybeans with one-fourth or less of the soybean removed. Maintain individual separations for coarse foreign material and for coarse other grains.

Fine FM & Fine Other Grains

Determine fine foreign material and fine other grains after the removal of coarse foreign material and coarse other grains on a work portion of 30 grams. Either handpick the 30-gram portion for fine foreign material and fine other grains; or use, as an aid, a 5/64-inch triangular-hole sieve to remove the fine foreign material and fine other grains.

When using the sieve, gently slide the sample across the sieve then separate the oats, wild oats, and fine other grains from the material that passed through the sieve. Remove all fine foreign material from the material remaining on top of the sieve.

Fine Foreign Material includes star thistles, star burs, sandburs, morning glory, kinghead seeds, sticks not meeting the criteria for coarse foreign material, soybean pods that are less than one-half the total pod, and any other material too small to function as coarse foreign material and other grains.

Fine Other Grains includes Broken kernels of corn and sweet corn with more than one-fourth of the kernel removed, broken soybeans with more than one-fourth of the soybean removed, Dehulled sunflower seeds, and other grains.

Fine Other Grains include broken kernels of corn with more than one-fourth of the kernel removed, broken soybeans with more than one-fourth of the soybean removed, and other grains as defined earlier.

Heat-Damaged Kernels

Heat-damaged kernels are Kernels and pieces of oat kernels, other grains, and wild oats that are materially discolored and damaged by heat. Determine heat-damaged whole corn and soybeans on a work portion of 700 - 800 grams. Whole corn and soybeans that show evidence of distinct discoloration and damage by heat are examined to determine if they are heat damaged.



Determine heat-damaged Oats, Wild Oats, and Other Grains after the removal of coarse foreign material and coarse other grains on a work portion of 30 grams. Kernels of oats and wild oats that show evidence of distinct discoloration and damage by heat are hulled to determine if they are heat damaged. When the hulled kernels show a reddish discoloration extending out of the germ, the kernels are heat damaged.

Groats showing moldy, mold-like substance, sprouted, or dead germs but no reddish cast or discoloration function against sound cultivated oats but not as heat-damaged kernels. Other grains that show evidence of distinct discoloration and damage by heat are examined to determine if they are heat-damaged.

Compute Heat-Damaged Kernels

Compute the percentage of heat-damaged kernels by adding the percentage of heat-damaged whole corn and soybeans to the percentage of heat-damaged oats, wild oats, and other grains in hundredths (disregard thousandths).

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

Heat-Damage Computation Example

Weight of representative sample	= 700 grams
Weight of heat-damaged whole corn & soybeans	= 3.00 grams
Percent of heat-damaged whole corn & soybeans	= $(3.00 \div 700) \times 100 = 0.42 \%$
Weight of representative portion	= 30.00 grams
Weight of heat-damaged oats, wild oats, & other grains	= 0.30 gram
Percent of heat-damaged oats, wild oats, & other grains	= $(0.30 \div 30.00) \times 100 = 1.00 \%$
Percent of heat-damaged kernels	= $(0.42 + 1.00) = 1.42 \%$ = 1.4 %

Other Damaged Kernels

Determine other damaged kernels after the removal of coarse foreign material and coarse other grains on a work portion of 30 grams. In general, oat kernels are considered damaged for inspection and grading purposes only when the damage is distinctly apparent and of such character as to be recognized as damaged for commercial purposes.

Other damaged kernels include kernels and pieces of oat kernels, except heat-damaged kernels, that are badly ground-damaged, badly weather-damaged, diseased, frost-damaged, germ-damaged, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged.

Heat-damaged kernels are not considered as part of other damaged kernels. Oat groats; hull-less oats; and green, immature kernels of oats that are not otherwise damaged are considered sound.

Record the percent of other damaged kernels to the nearest tenth percent.

Badly Ground / Weather Damage



Kernels which are badly discolored by ground and/or weather condition.

The discoloration must appear on both sides of the kernel equal to or greater than shown to be considered damage.

Such damaged kernels do not count as “sound cultivated oats”.

Weather Damaged (Stained)



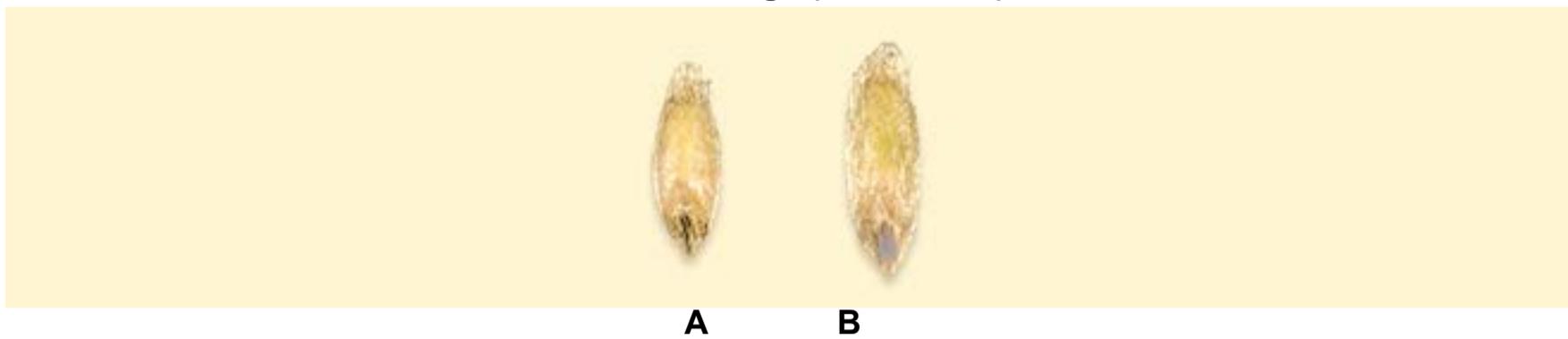
Processing discolored (stained) oats reduce rolled oat yields and may result in a less than desirable flake color, depending on its severity.

Oat groats having a dark brown/black discoloration on the surface meeting the minimum coverage and intensity as shown are considered damaged.

Kernel A is a Suspect Oat. Its lightly discolored hull indicates possible damage. The hull must be removed to confirm the presence and extent of discoloration.

The hull has been removed from Kernel B and the damage is confirmed. This kernel illustrates the minimum coverage and intensity required.

Germ Damage (Sick / mold)



Kernels in which the germ is discolored or moldy as a result of microbial activity are damaged.

Kernels and pieces of oats that have discolored germs as dark or darker than Kernel A shall be damaged. Discolored germs that do not meet the minimum coverage requirement may be considered damage provided the degree of discoloration is greater than shown and the overall “prorated” appearance meets the minimum coverage and intensity level depicted.

Kernels containing any amount of mold such as Kernel B shall be damage. The hull must be removed to determine extent of damage to germ.

Such damaged kernels do not count as “sound cultivated oats”.

Mold Damage



Kernels in which mold has penetrated the hull leaving a grayish discoloration on the groat to the minimum coverage and intensity as shown are considered damaged.

The hull must be removed to determine extent of damage.

Such damaged kernels do not count as “sound cultivated oats”.

Insect Damage



Kernels which have been bored or tunneled by insects are considered damaged.

Such damaged kernels do not count as “sound cultivated oats”.

Sprout Damage



Kernels which have sprouted or generally have a crack in the seed coat over the germ area.

The hull must be removed to determine if cracked seed coat indicates sprouting.

Such damaged kernels do not count as “sound cultivated oats”.

Wild Oats



Determine wild oats after the removal of coarse foreign material and coarse other grains on a work portion of 30 grams.

Wild oats are usually identified by their characteristic slender kernels with twisted awns and basal hairs or bristles on the germ end of the kernels.

Wild oats function against sound oats.

Seed Sizing (Official Criteria)

Seed Sizing is considered an “official criteria” and is determined only upon request. It does not affect the grade designation. Determine seed size on a portion of 250 grams of the original sample.

Use a 5/64 x 3/4 inch slotted hole sieve to determine the percentage of oats and other materials, except for fine seeds, that pass through the sieve.



Take the material which passed through the 5/64x 3/4 inch slotted hole sieve and sieve it over a 5/64 triangular-hole or small buckwheat sieve. The fine seeds and other material passing through the 5/64 triangular-hole sieve or small buckwheat sieve are considered “fine seeds.”

Record the results of the sizing test to the nearest tenth percent in the “Remarks” section of the certificate.

Grade Designations

After completing the analysis, assign a grade by comparing the results with the limits for each grade factor specified in the grade chart. The factor with the lowest grade designation determines the grade assigned to the sample.

Code	Factor	Original	Supv/Appeal	Initials	BAR	Code	Factor	Original	Supv/Appeal	Initials	BAR
	CL					24	HPTM				
02	DKG					25	MS/M				
03	TW	37.5				26	BN/M				
04	M	11.9				33	SKBN				
05	ODOR	OK				36	DCOL SLOC				
06	HI	0.1				60	LW				
07	ODK					62	STON				
08	SKD					28	WO	0.2			
09	DKT					29	SND	96.2			
10	ORSE										
11	FINE	0.2									
12	FM										
13	SHBN										
14	DEF										
15	CC										
16	WOCL										
17	DNV										
18	HVAC										
19	WHCR										
20	ZAGOD TIMOR										
21	SP										
23	BC/M										

Grade	Minimum Limits		Maximum Limits		
	Test Weight per bushel (pounds)	Sound oats (percent)	Heat-damaged kernels (percent)	Foreign material (percent)	Wild Oats (percent)
U.S. No. 1	36.0	97.0	0.1	2.0	2.0
U.S. No. 2	33.0	94.0	0.3	3.0	3.0
U.S. No. 3 1/	30.0	90.0	1.0	4.0	5.0
U.S. No. 4 2/	27.0	80.0	3.0	5.0	10.0

1/ Oats that are slightly weathered shall be graded not higher than U.S. No. 3.
2/ Oats that are badly stained or materially weathered shall be graded not higher than U.S. No. 4.

WORK SAMPLE SIZE		GRADE U.S. NO.		CLASS AND SPECIAL GRADE	
SUPV/APPEAL	BAR	2	Oats		
SEAL(S) BROKEN					
SEAL(S) APPLIED					

FORM FGIS-929 (3-93) PREVIOUS EDITION OBSOLETE. GRAIN SAMPLE TICKET USDA-FGIS

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, oats may be certificated as U.S. No. 2 or better, U.S. No. 3 or better, etc. An “or better” grade designation cannot be applied to a U.S. No. 1 grade designation.

For example, U.S. No. 2 or better oats.

Documenting the Grade

Use the following guidelines when documenting grades on work records and certificates.

- First write the letters “U.S.”, then the abbreviation “No.” and the number of the grade or the words “Sample Grade”,
- Next the words “or better” when applicable, and the special grade, (For Example “Heavy”) when applicable,
- Followed by the word “oats”, and the applicable special grade (For Example “Ergoty) in alphabetical order.

Example: U.S. No. 1 Heavy Oats, Ergoty

Grain Grading Primer

Chapter 6

Rye



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Rye Definition

Rye is defined as grain that, before the removal of dockage, consists of 50 percent or more of common rye and not more than 10 percent of other grains for which standards have been established under the United States Grain Standards Act and that, after the removal of dockage, contains 50 percent or more of whole kernels of rye.

Grade Requirements

There are no classes or subclasses in rye. Rye is divided into four numerical grades and U.S. Sample grade. The factors affecting rye grades include: test weight, foreign material, heat damaged kernels, total damage, and thin.

RYE						
Grade	Minimum Limits of -	Maximum Limits of -				
	Test weight per bushel (pounds)	Foreign Material		Damaged Kernels		Thin Rye (percent)
		Foreign matter other than wheat (percent)	Total (percent)	Heat Damaged (percent)	Total (percent)	
U.S. No. 1	56.0	1.0	3.0	0.2	2.0	10.0
U.S. No. 2	54.0	2.0	6.0	0.2	4.0	15.0
U.S. No. 3	52.0	4.0	10.0	0.5	7.0	25.0
U.S. No. 4	49.0	6.0	10.0	3.0	15.0	---

U.S. Sample grade is rye that:

- Does not meet the requirements for the grades U.S. Nos. 1, 2, 3, or 4; or
- Contains stones, glass, crotalaria seeds, castor beans, particles of an unknown foreign substance or a commonly recognized harmful or toxic foreign substance, rodent pellets, bird droppings, or an equivalent quantity of other animal filth; or
- Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
- Is heating or otherwise of distinctly low quality.

Special Grades

Special Grades draw attention to unusual conditions in grain, and are made part of the grade designation. The special grades in Rye are: Ergoty, Garlicky, Infested, Light Garlicky, Light Smutty, Plump, and Smutty.

Heating

Rye developing high temperature from excessive respiration due to microbial activity (fermenting), insect infestation, or sprouting is considered heating. Heating rye, in its final stages, will usually have a sour or musty odor.

Care should be taken not to confuse rye that is heating with rye that is warm because of storage in bins, railcars, or other containers during hot weather.

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

Grade heating rye as U.S. Sample Grade and record the word “Heating” in the “Remarks” section of the certificate.

Distinctly Low Quality

Consider rye distinctly low quality when it is obviously of inferior quality and the existing grade factors or guidelines do not properly reflect the inferior condition.

Use all available information to determine distinctly low quality. This includes a general examination of the rye during sampling and an analysis of the obtained sample.

Rye containing two or more stones, pieces of glass, pieces of concrete, or other pieces of wreckage or debris which are visible to the sampler and too large to enter the sampling device is considered distinctly low quality.

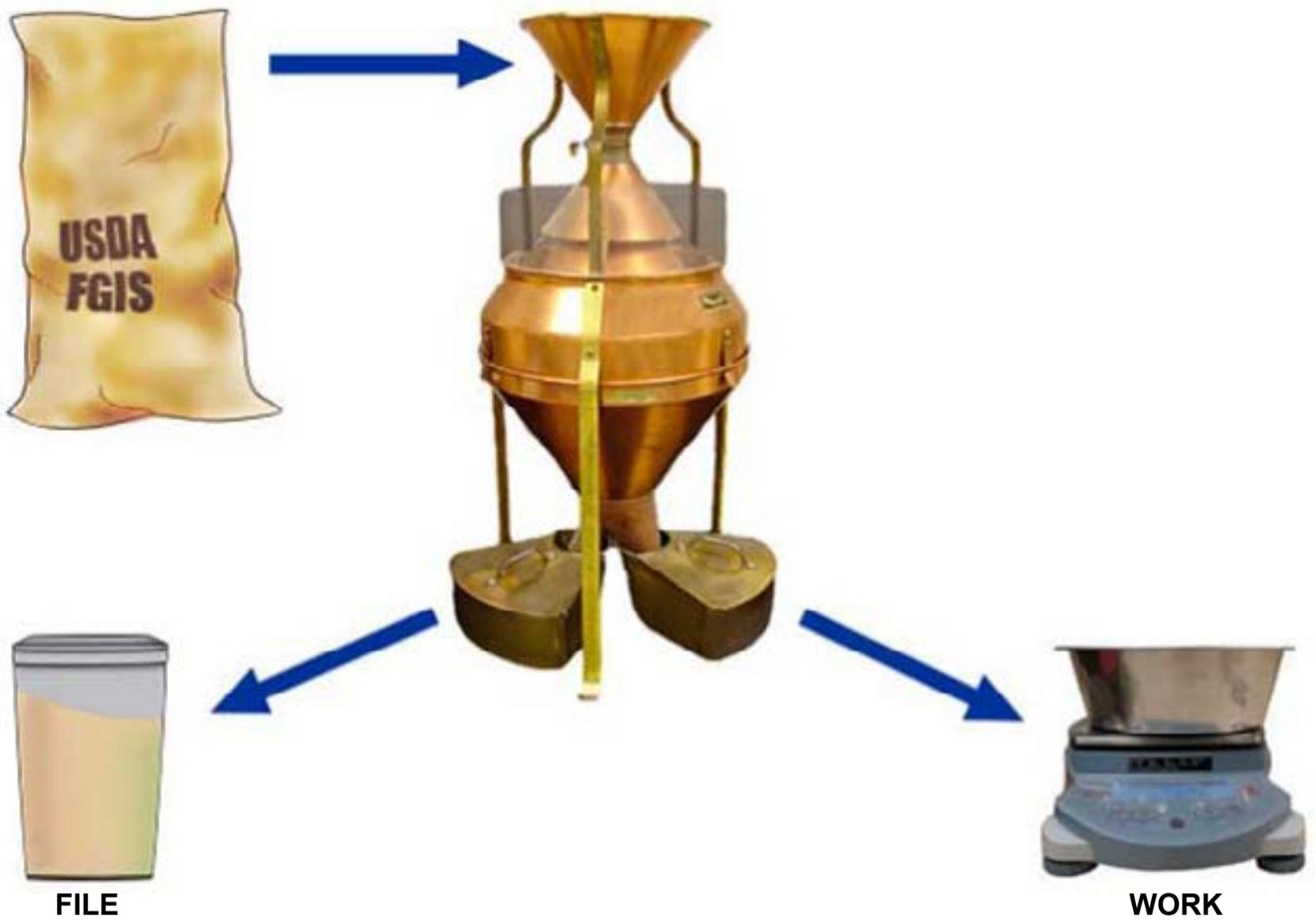
Rye that is obviously affected by other unusual conditions which adversely affect the quality of the rye and cannot be properly graded by use of the grading factors specified or defined in the standards is considered distinctly low quality.

Grade distinctly low quality rye as U.S. Sample Grade. Record the words “Distinctly Low Quality” and the reason why in the “Remarks” section of the certificate.

Processing the Original Sample

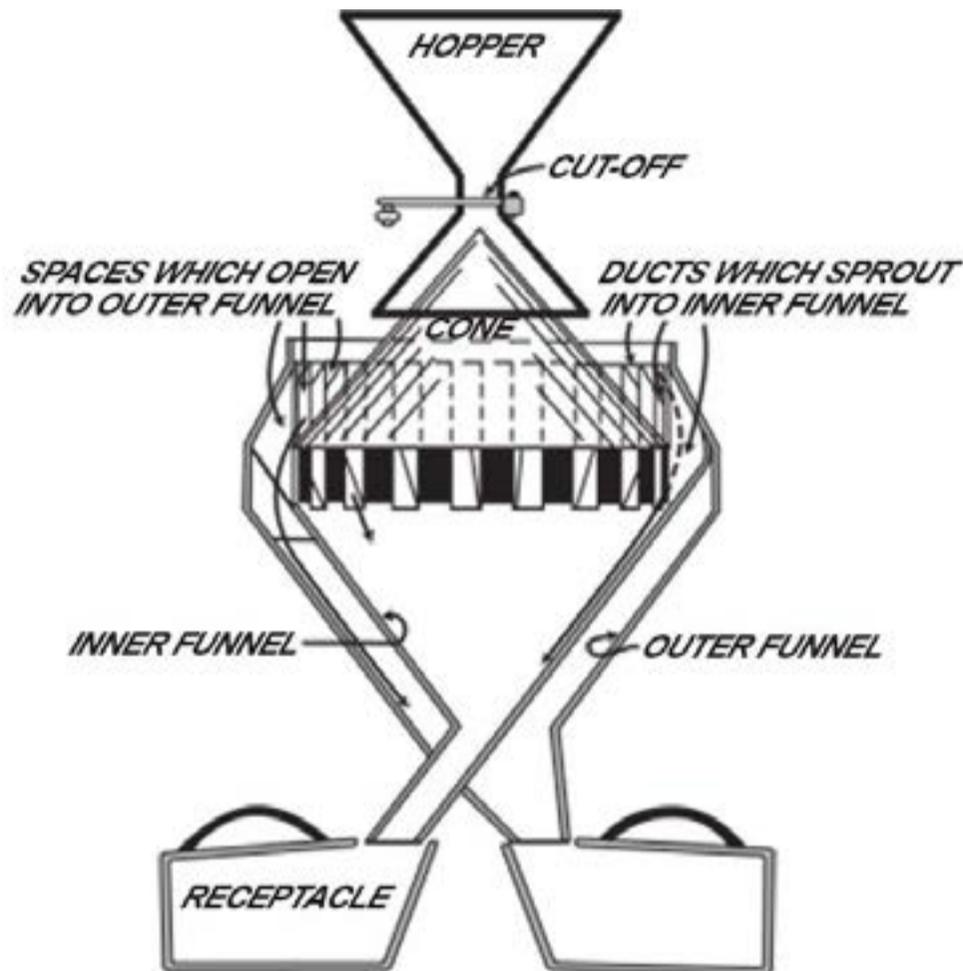
The first step in grading a rye seed sample is to use a Boerner divider to reduce the original sample into:

- A file sample of approximately 1350 grams.
- A work portion of approximately 1000 grams.



Boerner Divider

The Boerner divider reduces the size of a grain sample while maintaining its representativeness. Each pass of the sample through the divider splits the sample into two equal portions. The Boerner Divider, consists of a hopper, inverted cone, and a series of baffles directing the grain into two collection pans. As the valve or gate at the base of the hopper is opened, gravity carries the grain over the cone, which serves as a surface by which the kernels can separate into a single layer.



Arranged in a circle at the base of the cone are a series of baffles forming alternate channels and spaces of equal width. They are arranged in a circle at their summit and are directed inward and downward, the channels leading to one spout and the spaces to an opposite spout. Each kernel has an equal chance of falling into a channel or a space, resulting in two nearly identical portions of the original sample.

When Operating the Boerner Divider:

Check the divider for condition and cleanliness.

Close the hopper valve.

Place empty collection pans under the discharge spout.

Pour the sample into the hopper.

Open the valve quickly.

For larger samples, feed more grain into the hopper during the dividing process.

File Sample

A “file sample,” is a representative sample or representative portion of a sample that is retained for a specified period of time for reference or review purposes.

File samples should be of sufficient size to accommodate subsequent examinations or analysis.

The file sample shall be an unworked portion (if available) of the representative sample used for the inspection.

The worked portion may be retained as the final file only when insufficient sample is available for an unworked file sample.



Use Moisture Proof Containers

Keep all samples in sealed moisture proof containers if they cannot be tested within approximately 15 minutes.

Do not use paper bags, fiber cartons, or similar containers that allow moisture losses.

Use metal cans, plastic containers, and plastic bags to preserve the sample integrity.

Do not file samples with paper identification inserted in the grain.



Check Odor

Determine odor on evidence obtained at the time of sampling or on the sample either before or after the removal of dockage. Odors are classified as OK, Musty, Sour, or COFO (commercially objectionable foreign odors).

The inspector 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.

Grade rye 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.



Musty odors indicate the presence of fungal activity in the grain and are generally characterized as an earthy smell.

Sour odors indicate that the grain is fermenting due to microbial activity. Sour odors are often characterized as an acrid, boot pit or pigpen smell.

Commercially Objectionable Foreign Odors. Commercially objectionable foreign odors are odors, except smut and garlic 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.

Check for Insects

Determine infestation on the lot as a whole and/or the sample as a whole. Infested rye is rye 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 indicates the probability of infestation and warns that the rye must be carefully examined to determine if it is infested. In such cases, examine the work sample and file sample before reaching a conclusion as to whether or not the rye is infested. Do not examine the file sample if the work portion is insect free.

Samples meeting or exceeding any one of these tolerances are infested:

2 live weevils

2 other live insects

1 live weevil + 1 other live insect

When applicable, include the word “Infested” in the grade designation.

Live Weevils

Live weevils include rice weevils, granary weevils, maize weevils, cowpea weevils, and lesser grain borers.



Rice Weevil



Granary Weevil



Maize Weevil



Cowpea Weevil



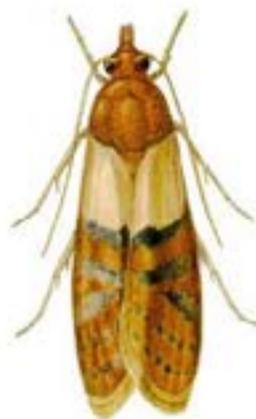
Lesser Grain Borer

Other Live Insects

Other live insects injurious to stored grain shall include grain beetles, grain moths, and larvae.



Angoumois Grain Moth



Indian Meal Moth



Red Flour Beetle



Flat Grain Beetle

Garlicky and Light Garlicky

Determine garlicky and light garlicky before the removal of dockage on a portion of 1,000 grams. Rye is Garlicky if it contains in a 1,000 gram portion more than six green garlic bulblets or an equivalent quantity of dry or partly dry bulblets.

Rye is Light Garlicky if it contains in a 1,000 gram portion, two or more, but not more than six, green garlic bulblets or an equivalent quantity of dry or partly dry bulblets.

Green garlic bulblets are bulblets which have retained all of their husks intact. Dry or partly dry garlic bulblets are bulblets which have lost all or part of their husks. Consider bulblets with cracked husks as dry. Three dry or partly dry garlic bulblets are equal to one green bulblet.

When applicable, include the words “Garlicky” or “Light Garlicky” in the grade designation. Upon request, record the number of garlic bulblets in whole and thirds.



Check for Sample Grade Factors

Determine U.S. Sample grade criteria, except for stones, before the removal of dockage based on a work portion of 1,000 - 1,050 grams. Rye is Sample Grade if it contains:

Consider identifiable pieces of grain, processed grain products such as soybean meal, sorghum grits, corn meal, or bulgur, or feed pellets in grain as foreign material. Unidentifiable materials or material unrelated to grain shall function as “unknown foreign substance.”



Grade rye U.S. Sample grade when one or more of the limits above are exceeded. Record the reasons why in the “Remarks” section of the certificate. Record count factors to the nearest whole number.

Determine Moisture

Moisture is the water content determined before the removal of dockage on approximately 650 grams.

The DICKEY-john GAC2500-UGMA and the Perten AM5200-A are the designated official moisture meters for performing moisture analysis in grains.



DICKEY-john GAC2500



Perten AM5200-A

Basically, the instruments measure the change in capacitance of two parallel plates when grain is placed between them. As the moisture content within the grain increases or decreases so does its contribution to capacitance, known as its dielectric constant.

The instruments also measure sample density and temperature and perform automatic corrections for those parameters.

Calibration equations have been developed to convert these properties into precise moisture percentages for each grain measured by the instruments.

The test they perform takes about 30 seconds to complete and is a simple and accurate way to obtain moisture analysis in the field.

Certify moisture to the nearest tenth percent.

Dockage

Determine dockage on a portion of 1,000 - 1,050 grams of the original sample.

Dockage is all matter other than rye that can be removed from the original sample by use of an approved device in accordance with procedures prescribed in FGIS instructions.

Also, underdeveloped, shriveled, and small pieces of rye kernels removed in properly separating the material other than rye and that cannot be recovered by properly rescreening and re-cleaning.

Dockage Procedure

When determining dockage on rye, the first step is to set air control on 4 and the feed control to 6.

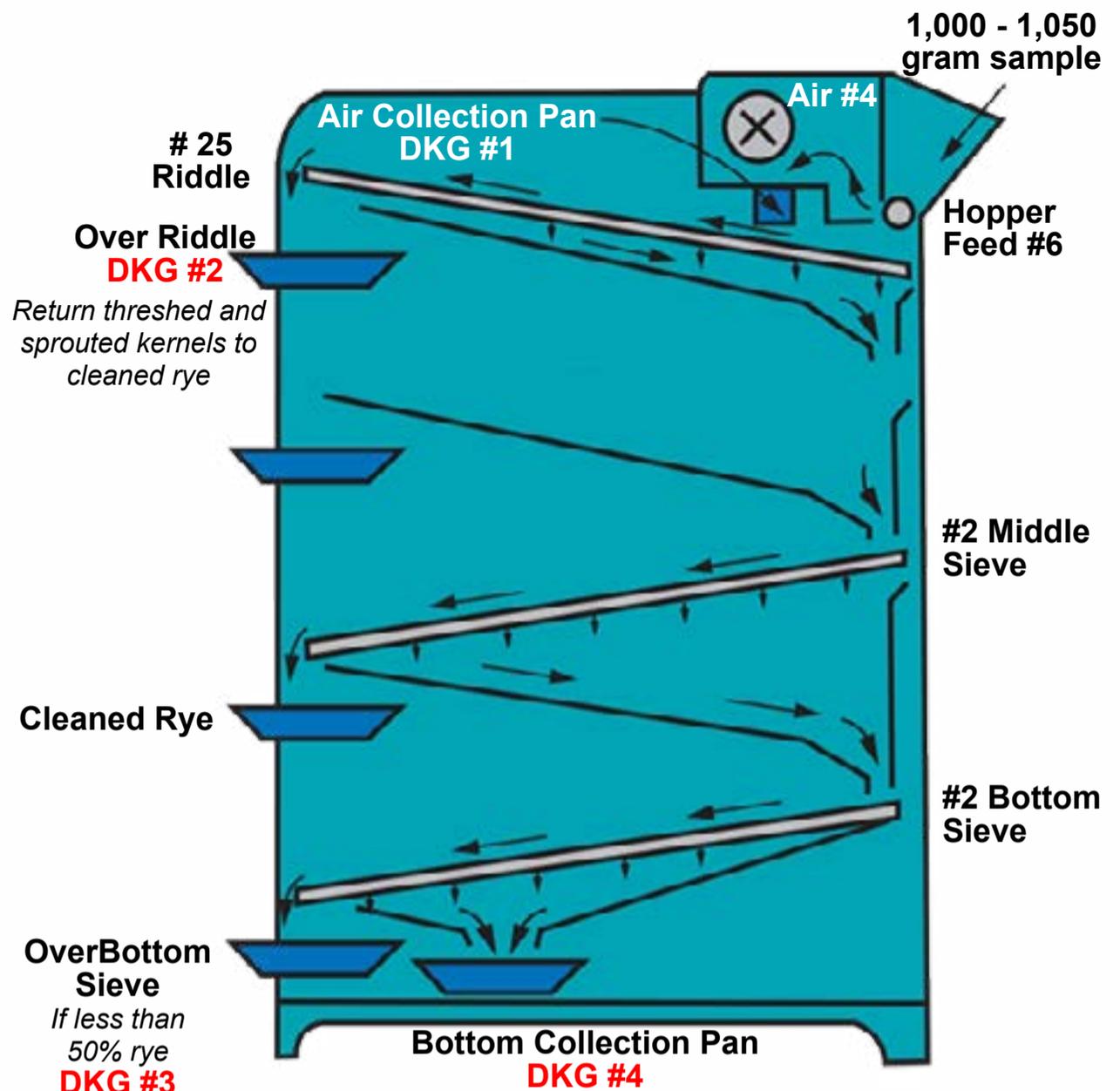
Second, insert the No. 25 plastic riddle in the riddle carriage.

Use no sieve in the top sieve carriage.

Next insert the No. 2 sieve in the middle and bottom sieve carriages.

Then start the Carter Dockage Tester and pour sample into feed hopper.

- The aspirated material in the air collection pan is dockage.
- Material over the riddle, except for threshed and sprouted kernels, is dockage.
- Threshed and sprouted kernels of rye that pass over the riddle are not considered dockage. Return them to the dockage-free sample. Threshed kernels of rye are kernels with either no glumes attached or not more than one glume attached.
- Consider unthreshed kernels of rye that pass over the riddle as dockage. Unthreshed kernels are kernels with glumes attached.
- Material that passed through the bottom sieve is dockage.
- Material passing over the bottom sieve is dockage if it contains less than 50 percent by weight of rye. When the material consists of more than 50 percent by weight of rye, return it to the cleaned rye.
- When performing the dockage determination, check the material that passes over the riddle for threshed and sprouted kernels of rye.



$$\text{Total DKG} = \text{DKG } 1+2+3+4$$

Recording Dockage

When the sample contains 1 percent or more dockage, record the percentage of dockage on the certificate in whole percent with fractions of a percent disregarded.

For example:

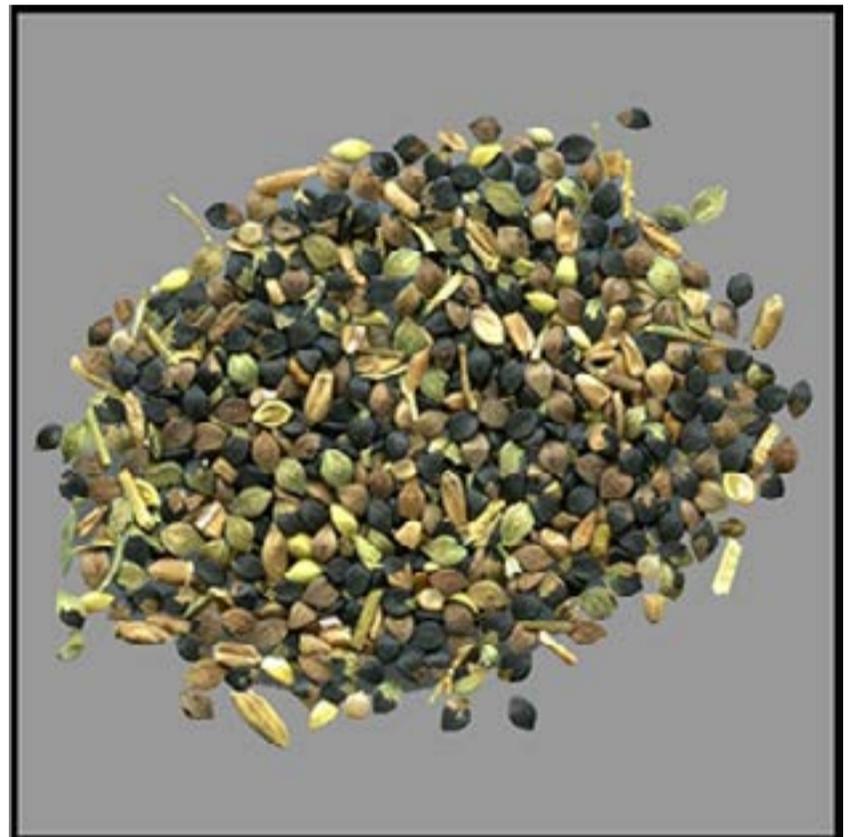
1.00 to 1.99 percent is expressed as 1.0 percent

2.00 to 2.99 percent is expressed as 2.0 percent, etc.

To save time, many inspectors check the dockage for garlic bulblets, infestation, and U.S. Sample grade factors; except stones.

Rye Containing Wild Buckwheat

If it appears that the sample contains more than 0.5 percent of wild buckwheat or similar seeds, analyze a portion of approximately 50 grams of the original sample before the removal of dockage. If the portion contains more than 0.5 percent of wild buckwheat or other similar sized seeds, proceed as follows. First, set up the Carter dockage tester by setting the air control at 4; setting the feed control at 6; inserting a number 25 riddle in the riddle carriage, using no sieve in the top sieve carriage; inserting a Number 6 sieve in the middle sieve carriage, and inserting a number 2 sieve in the bottom sieve carriage.



When the sample has been run, place approximately 50 grams of the material that passed over the Number 2 sieve on the upper edge of a 5/64, or 1.984 millimeter equilateral triangular 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.

Repeat the previous step on additional 50 gram portions until all material that passed over the Number 2 sieve has been sieved.

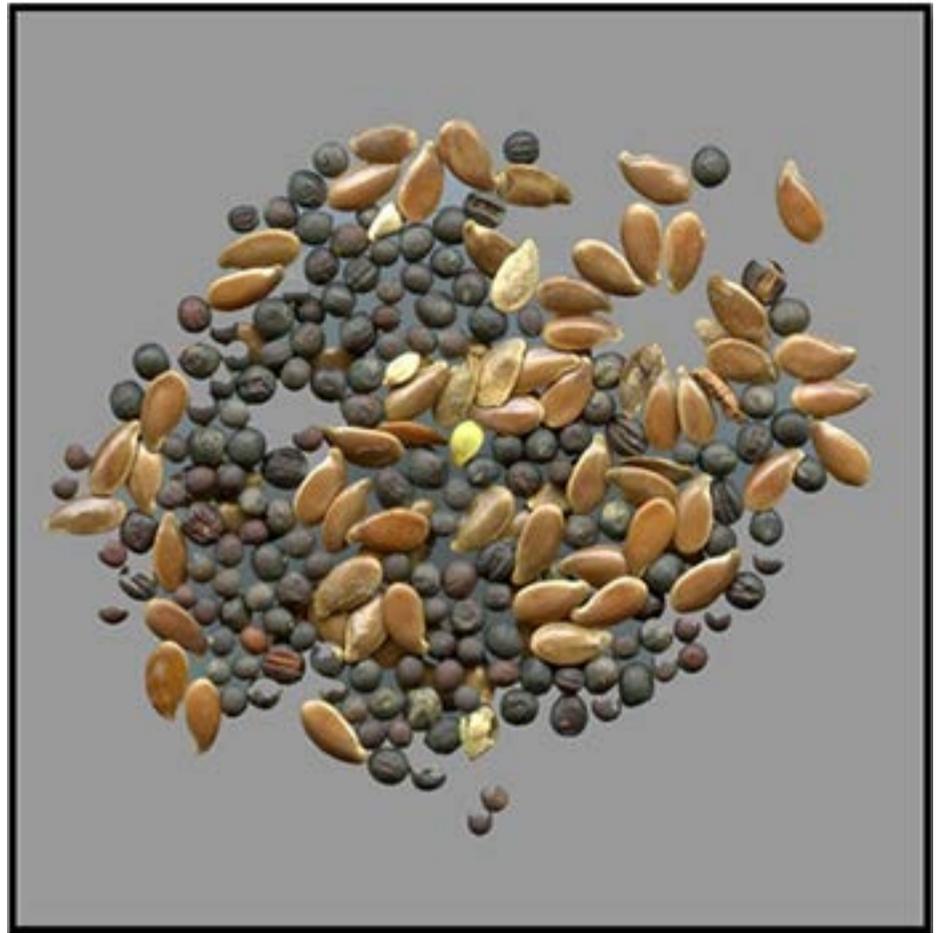
If the material remaining on top of the sieve consists of 50 percent or more of whole or broken kernels of rye, return it to the sieved sample. Otherwise, add it to the dockage.

Examine the material that passed through the sieve. If the material consists of 50 percent or more by weight of whole or broken kernels of rye, repeat the sieving process on 50 gram portions of all the material that passed through the sieve. Do not perform this hand sieving process more than twice.

Rye Containing Canola-Flaxseed

There are occasional samples that will contain canola or flaxseed after the dockage is removed. In such cases, separate the canola or flaxseed from the cleaned rye.

If it appears that the sample contains 0.1 percent or more of canola/flaxseed, analyze a dockage-free portion of 50 grams. If the representative portion contains 0.3 percent or more of canola/flaxseed, sieve the entire dockage-free sample with either a 3/64 x 3/8 hand sieve or a 0.064 x 3/8 hand sieve, depending on which sieve is more appropriate in relation to the size of the rye and canola/flaxseed kernels in the sample.



To remove the canola/flaxseed, use the following procedure:

- Mount the sieve and a bottom pan on an approved mechanical sieve shaker.
- Place one fourth of the dockage free portion on the sieve.
- Set the stroke counter at 30 strokes.
- When the shaker has stopped, return the material lodged in the perforations to the rye remaining on top of the sieve.
- Clean the sieve and repeat this procedure with the three remaining similar sized portions.

Check for Stones

Determine stones on the dockage-free portion. Grade the sample “Sample Grade” if it contains 8 or more stones or any number of stones in excess of 0.2% by weight.

Test Weight

Test weight is the weight per Winchester bushel, 2,150.42 cubic inches. Determine test weight on a dockage-free portion of sufficient quantity to overflow the kettle.

Position the hopper over the center of the kettle, making sure the hopper valve is closed. Pour grain into the hopper.

Open the valve allowing the grain to overflow the kettle. Once the hopper is clear of grain move the hopper to the side.

With a rounded edge striker, place it on the edge of the kettle and move the striker in three zigzag motions across the kettle leveling the grain.

Move the kettle to a scale and record the test weight measurement.

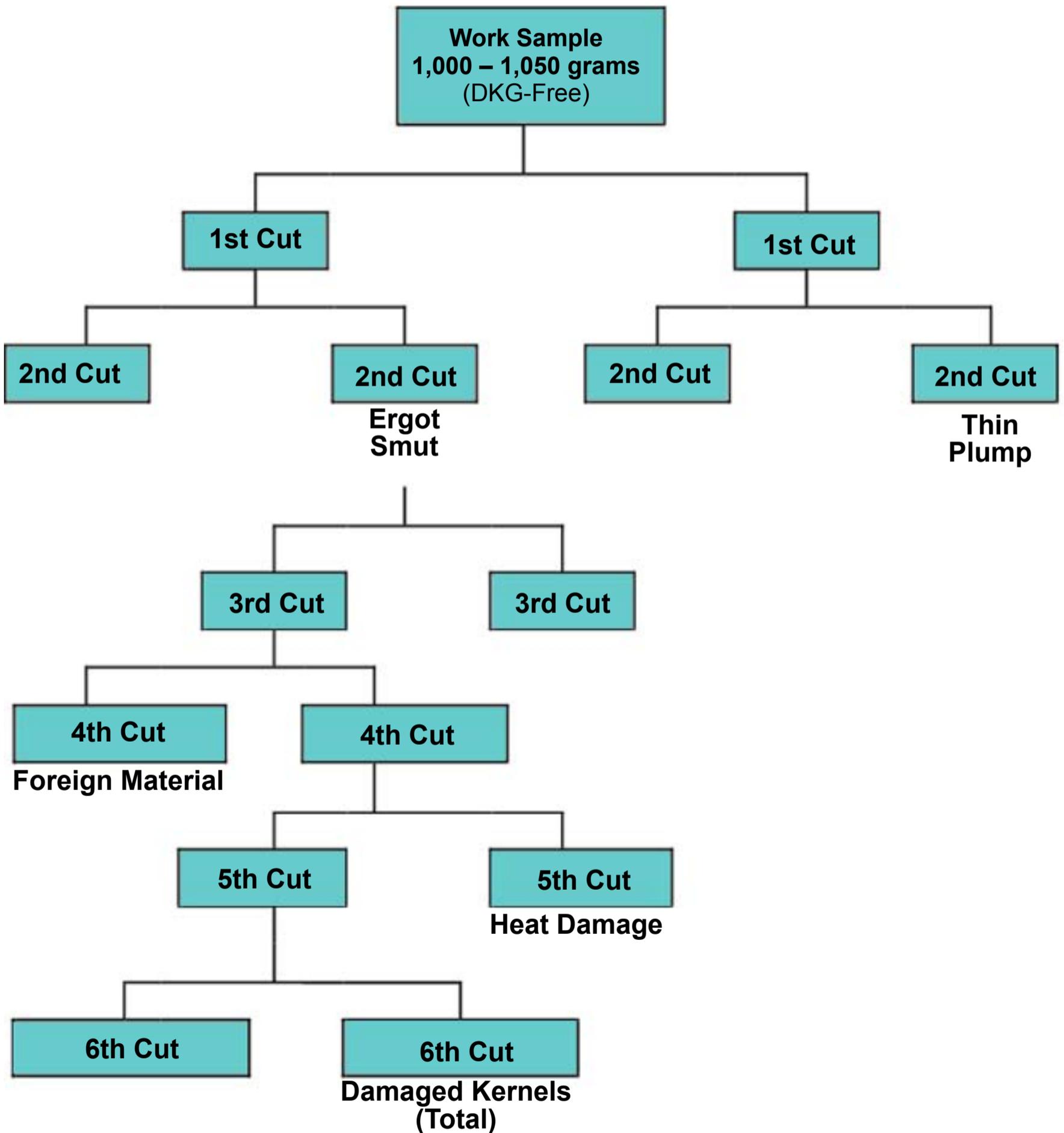
Record the test weight on the certificate in whole and tenth pounds to the nearest tenth pound. If requested, convert the pounds per bushel result to kilograms per hectoliter using the following formula: pounds divided by bushels times 1.287 = kg/hl and record in the "Remarks" section in whole and tenths.

$$\text{lbs/bu} \times 1.287 = \text{kg/hl}$$



Processing the Work Sample

At this point, determinations have been made for odor, test weight, moisture, dockage, infestation, and sample grade factors. Now divide the dockage-free work sample into fractional portions for determination of thin, plump, smut, ergot, foreign material, heat damage, and damaged kernels total.



Thin and Plump Rye

Thin rye is rye and other matter that passes through a 0.064 x 3/8 oblong hole sieve.

Plump rye is rye that contains not more than 5.0 percent of rye and other matter that passes through a 0.064 X 3/8 oblong-hole sieve.

Determine thin and plump on a dockage-free portion of 250 grams using the following procedure.

- Mount a 0.064 x 3/8 inch oblong hole sieve and a bottom pan on the mechanical sieve shaker. Set the stroke counter for 30 strokes. When the shaker has stopped, return the material lodged in the perforations to the rye remaining on top of the sieve.
- Consider all material passing through the sieve as thin rye. Consider all material remaining on top of the sieve as plump rye. Return the material lodged in the perforations to the rye on top of the sieve.



When applicable, record the percentage of thin rye on the certificate to the nearest tenth percent. When applicable, plump becomes a part of the grade designation and is included in the grade designation.

For example: U.S. No. 1 Plump rye.

Smutty and Light Smutty Rye

Smut is a plant disease characterized by the appearance of smut balls or smut spores.

Determine “Smutty” on a dockage-free portion of 250 grams. Smutty Rye is rye that contains in a 250-gram portion smut balls, portions of smut balls, or spores of smut in excess of a quantity equal to 30 smut balls of average size.

Determine “Light smutty” on the sample as a whole or on a dockage free portion of 250 grams.

Light Smutty Rye is Rye that has an unmistakable odor of smut, or that contains in a 250-gram portion smut balls, portions of smut balls, or spores of smut in excess of a quantity equal to 14 smut balls but not in excess of a quantity equal to 30 smut balls of average size.

Smut balls also function as foreign matter other than wheat. When applicable, record the words “Smutty,” or “Light smutty” on the certificate.



Ergoty Rye

Determine ergoty on a dockage-free portion of 250 grams. Ergot is a hard, reddish-brown or black grain-like mass of certain parasitic fungi that replaces the kernel of rye. Ergoty rye is rye that contains more than 0.30 percent of ergot.

Ergot applies in the determination of ergoty but also functions as foreign matter other than wheat.

When applicable, record the word “Ergoty” on the certificate.



Foreign Material

Determine foreign material on a dockage-free portion of 50 grams.

Foreign material is all matter other than rye that remains in the sample after the removal of dockage. In rye, the factor foreign material is divided into foreign matter other than wheat and foreign material.

Remove all matter other than rye from the representative portion and determine the percentage of foreign material.

Remove the wheat from the total foreign material separation. The percentage of foreign matter other than wheat is then based on the remaining foreign material after the removal of the wheat.

Record the percentages of foreign matter other than wheat and foreign material (total) on the certificate to the nearest tenth percent.



Damaged Kernels

Determine damaged kernels on a dockage-free portion of 15 grams.

In general, kernels of rye and other grains are considered damaged for inspection and grading purposes only when the damage is distinctly apparent and of such character as to be recognized as damaged for commercial purposes.

Damaged kernels includes kernels, pieces of rye kernels, and other grains 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.

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



Germ-Damaged Kernels



Kernels in which the germ is discolored or moldy as a result of microbial activity are damaged.

The bran coat should be removed carefully because scraping too deeply could remove the damage.

Sprout-Damaged Kernels



Kernels that have the germ end broken open from germination and show a sprout and kernels that have sprouted but which have the sprouts broken off are damaged.

Exposed Germs Not Damaged



At times, rye can present a ragged appearance, particularly after excessive handling. In many cases, the germ ends are slightly rubbed off, giving these kernels the appearance of having been sprouted. Close examination, however, usually indicates that the kernels have not sprouted but that the ends have merely been rubbed off through excessive handling. Such kernels, unless otherwise damaged, are considered sound.

Insect Chewed & Sprout Sockets



Do not confuse insect-chewed germs with sprout sockets. Kernels from which the germs have been chewed are considered sound kernels unless otherwise damaged (kernel A). However, “sprout sockets” which are kernels from which the sprouts have broken off are considered damaged (kernel AB).

Insect-Bored Kernels



Kernels which have been bored or tunneled by insects are damaged.

Other Damaged Kernels



Kernels which have cracks, breaks, are chewed, contain mold or fungus, or are diseased are also damaged.

Heat-Damaged Kernels

Determine heat-damaged kernels on a dockage-free portion of 30 grams. Heat-damaged kernels are kernels, pieces of rye kernels, and other grains that are materially discolored and damaged by heat. In most cases, it is necessary to cross-section the kernels to determine if they are heat-damaged. Heat-damaged kernels are kernels which are reddish-brown, mahogany, or creamy in cross-section.



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

Grade Designation

After completing the analysis, assign a grade by comparing the results with the limits for each grade factor specified in the grade chart. The factor with the lowest grade designation determines the grade assigned to the sample.

Location Kansas City		Field Office TSD		Identification 4567	
1 Supervision 2 Sustained Appeal 3 Not Sustained Appeal	Inspection Point Code	Grain Code 05	01 Wheat 02 Corn 03 Barley 04 Oats	05 Rye 06 Sorgh 07 Flax 08 Soyb	09 Mixed 10 Triticale 11 Sunflower 12 Canola
06 HOPPER 07 TRUCK		08 BOXCAR 09 SHIP	10 BARGE 11 SEA VAN	12 OTHER	99 Not Stdr.
01 MECH 02 PELICAN		03 CUP 04 PROBE		1 IN 2 OUT	
01 FILE 02 ORIGINAL 03 F&I					
8952	OIS <input checked="" type="checkbox"/>	Date Supv./Appeal	Code	ORIGINAL INSP.	SUPV./APPEAL INSP.
Sampled By	Date Sampled	BNS	Date Name	BAR INSP. B-	
Appeal No.	To BAR (Date)	Quantity	Date		
Remarks					

Code	Factor	Original	Supv/Appeal	Initials	BAR	Code	Factor	Original	Supv/Appeal	Initials	BAR
	CL					24	FBYM				
02	DKG	0.36				25	MSM				
03	TW	56.2				26	BHFM				
04	M	12.2				33	SKBN				
05	ODOR	OK				36	OCOL SIBD				
06	HT	0.0				60	LW				
07	ODK					62	STON				
08	SKD					32	Thin	5.7			
09	DKT	1.8									
10	CRSE										
11	FINE										
12	FM	0.8									
13	SHBN										
14	DEF										
15	CCL										
16	WOCL										
17	DHV										
18	HVAC										
19	WHCB										
20	EMOD FMOR	0.4									
21	SPL										
23	BCFM										

Grade	Minimum test weight per bushel (pounds)	Maximum limits of--				
		Foreign material		Damaged kernels		
		Foreign matter other than wheat (%)	Total (%)	Heat damaged (%)	Total (%)	Thin rye (%)
U.S. No. 1	56.0	1.0	3.0	0.2	2.0	10.0
U.S. No. 2	54.0	2.0	6.0	0.2	4.0	15.0
U.S. No. 3	52.0	4.0	10.0	0.5	7.0	25.0
U.S. No. 4	49.0	6.0	10.0	3.0	15.0	---

WORK SAMPLE SIZE		GRADE U.S. NO.	CLASS AND SPECIAL GRADE
SUPV./APPEAL	BAR	1	Rye DKG 0.4%
SEAL(S) BROKEN			
SEAL(S) APPLIED			

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

Documenting the Grade

Use the following guidelines when documenting grades on work records and certificates.

- First write the letters “U.S.”, then the abbreviation “No.” and the number of the grade or the words “Sample Grade”,
- Next the words “or better” when applicable, and the special grade “Plump” when applicable,
- Followed by the word “rye”, the applicable special grade in alphabetical order, and lastly the word “dockage” (when applicable) and the percentage thereof.

Example: U.S. No. 1 Plump rye, Ergoty, Dockage 2.0%

Grain Grading Primer

Chapter 7

Sorghum



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Sorghum Definition

Sorghum is defined as grain that, before the removal of dockage, consists of 50 percent or more of whole kernels of sorghum, excluding nongrain sorghum, and not more than 10.0 percent of other grains for which standards have been established under the United States Grain Standards Act.

Normally, a visual appraisal of the sample is sufficient to determine if it meets the definition of sorghum. However, if an analysis is necessary, make the determination before the removal of dockage on a portion of 30 grams.

Classes

Sorghum is divided into four classes: Sorghum, Tannin sorghum, White sorghum, and Mixed sorghum. There are no subclasses in sorghum.



Sorghum

The class Sorghum is sorghum which is low in tannin content due to the absence of a pigmented testa or subcoat and contains less than 98.0 percent White sorghum and not more than 3.0 percent Tannin sorghum. The pericarp color of this class may appear white, yellow, pink, orange, red, or bronze. The pericarp is the outer layers of the sorghum grain and is fused to the seedcoat.



Tannin Sorghum

The class Tannin Sorghum is sorghum which is high in tannin content due to the presence of a pigmented testa or subcoat and contains not more than 10.0 percent non-Tannin sorghum. The pericarp color of this class is usually brown, but may also be white, yellow, pink, orange, red, or bronze.



White Sorghum

The class White Sorghum is sorghum which is low in tannin content due to the absence of a pigmented testa or subcoat and contains not more than 2.0 percent sorghum of other classes. The pericarp color of this class is white or translucent and includes sorghum containing spots that, singly or in combination, cover 25.0 percent or less of the kernel.

The class Mixed Sorghum is sorghum which does not meet the requirements for any of the classes Sorghum, Tannin sorghum, or White sorghum.



Mixed Sorghum

Each class is divided into four numerical grades and U.S. Sample grade.

Grades and Grade Requirements

SORGHUM					
Grade	Minimum Limits of -	Maximum Limits of -			
	Test weight per bushel (pounds)	Damaged Kernels		Broken Kernels and foreign material	
		Heat (percent)	Total (percent)	Foreign material (part of total) (percent)	Total (percent)
U.S. No. 1	57.0	0.2	2.0	1.0	3.0
U.S. No. 2	55.0	0.5	5.0	2.0	6.0
U.S. No. 3 ¹	53.0	1.0	10.0	3.0	8.0
U.S. No. 4	51.0	3.0	15.0	4.0	10.0

¹ Sorghum which is distinctly discolored shall not grade any higher than U.S. No. 3.

U.S. Sample Grade

U.S. Sample grade is sorghum that does not meet the requirements for the grades U.S. Nos. 1, 2, 3, or 4; or contains:

- 8 or more stones which have an aggregate weight in excess of 0.2 percent of the sample weight,
- 2 or more pieces of glass,
- 3 or more crotalaria seeds,
- 2 or more castor beans,
- 4 or more particles of an unknown foreign substance or a commonly recognized harmful or toxic foreign substance,
- 8 or more cocklebur (*Xanthium* spp.) or similar seeds singly or in combination,
- 10 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth in 1,000 grams of sorghum;
- or has a musty, sour, or commercially objectionable foreign odor, except smut odor;
- or is badly weathered, heating, or otherwise of distinctly low quality.

Heating

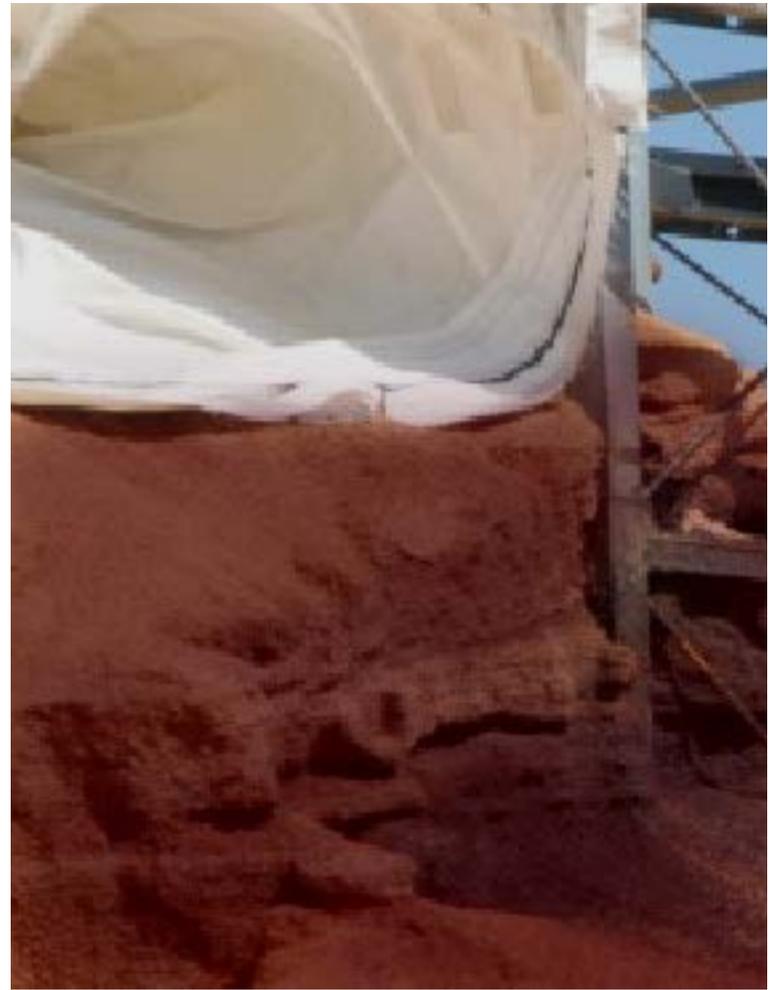
Sorghum developing a high temperature due to microbial activity (fermenting), insect infestation, or sprouting is considered heating.

As heating progresses, sorghum will usually have a sour or musty odor.

Care should be taken not to confuse sorghum that is heating with sorghum that is warm because of storage in bins, railcars, or other containers during hot weather.

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

Grade sorghum that is heating U.S. Sample Grade and record the word “Heating” in the “Remarks” section of the certificate.



Heating Sorghum

Distinctly Low Quality

Consider sorghum distinctly low quality when it is obviously of inferior quality and the existing grade factors or guidelines do not accurately reflect the inferior condition. Use all available information to determine whether the sorghum is of distinctly low quality. This includes a general examination of the sorghum during sampling and an analysis of the obtained sample.

Sorghum 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.

Sorghum that is obviously affected by other unusual conditions which adversely affect the quality of the sorghum and cannot be properly graded by use of the grading factors specified or defined in the standards is considered distinctly low quality.

Grade distinctly low quality sorghum as U.S. Sample Grade. Record the words “Distinctly Low Quality” and the reason why in the “Remarks” section of the certificate.

General Appearance

Distinctly Discolored

Distinctly Discolored Sorghum is sorghum that has been discolored by adverse weather conditions to a point where a sample has a slightly gray and/or blackened appearance and shall be graded not higher than U.S. No. 3.



Badly Weathered

Badly Weathered Sorghum is sorghum that has been discolored by adverse weather conditions to a point where many of the kernels are badly discolored and shall be graded U.S. Sample grade.



Special Grades

Special grades identify unusual conditions in grain and are part of the grade designation. They do not affect the numerical or sample grade designation. The sorghum standards include two special grades:



Infested Sorghum

Infested Sorghum is sorghum that is infested with live weevils or other live insects injurious to stored grain.



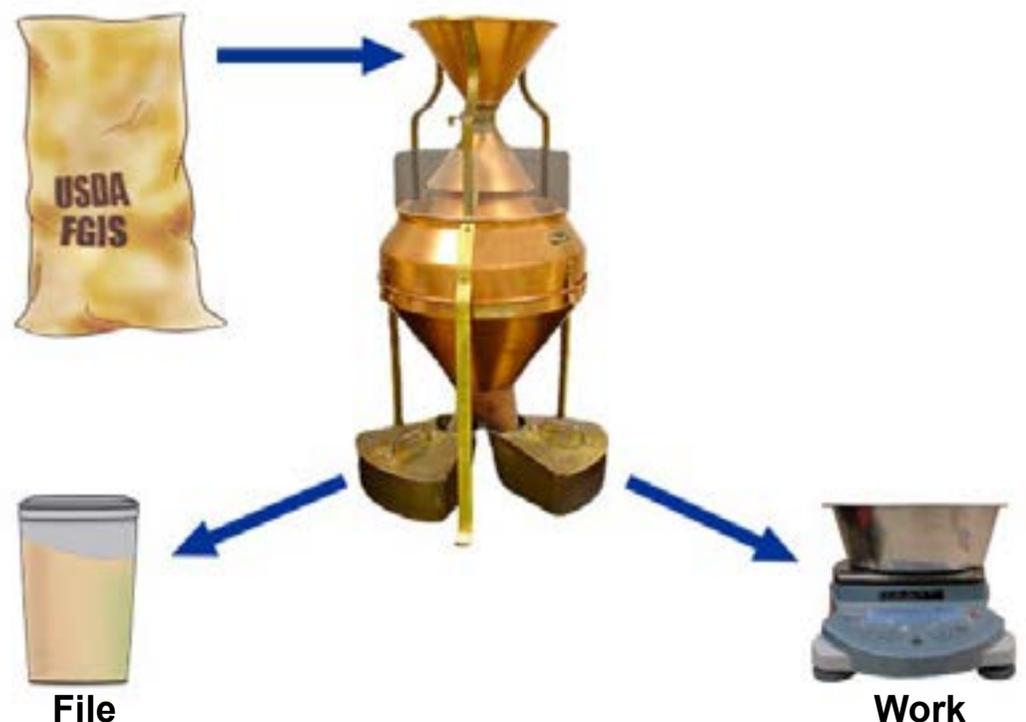
Smutty Sorghum

Smutty Sorghum is sorghum that has kernels covered with smut spores to give a smutty appearance in mass or contains 20 or more smut balls in 100 grams of sorghum.

Processing the Original Sample

The first step in grading a sorghum sample is to use a Boerner divider to reduce the original sample into:

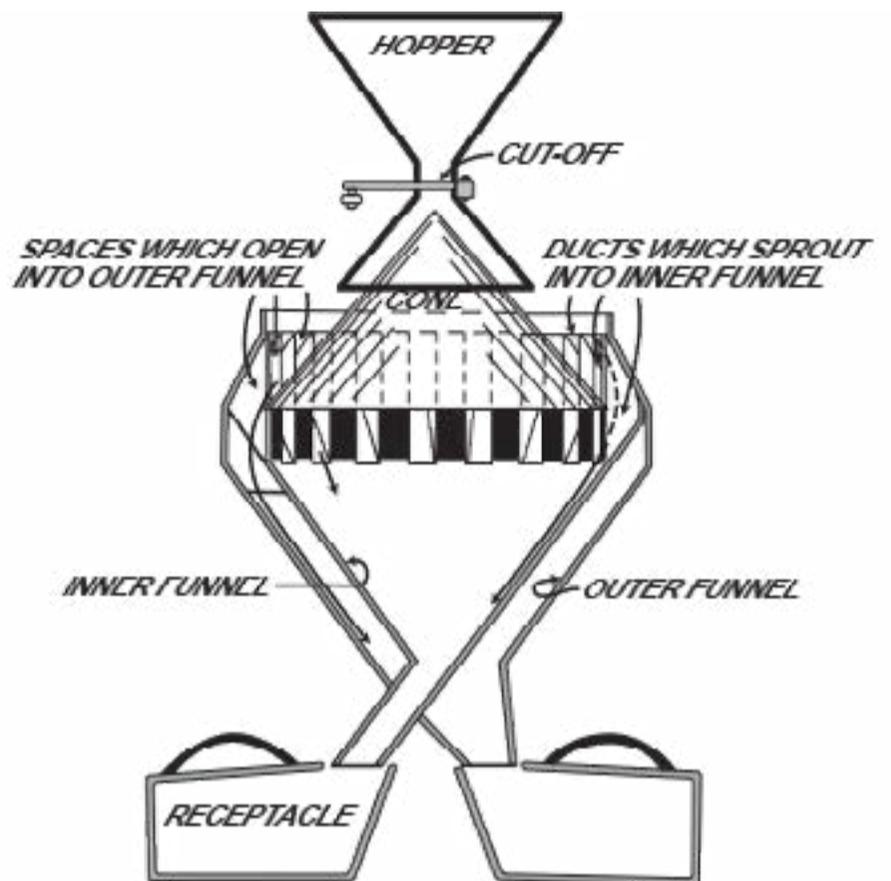
- A file sample of approximately 1400 grams
- A Work portion of approximately 1000 grams.



Boerner Divider

The Boerner divider reduces the size of a grain sample while maintaining its representativeness. Each pass of the sample through the divider splits the sample into two equal portions.

The Boerner Divider, consists of a hopper, inverted cone, and a series of baffles directing the grain into two collection pans. As the valve or gate at the base of the hopper is opened, gravity carries the grain over the cone, which serves as a surface by which the kernels can separate into a single layer.



Arranged in a circle at the base of the cone are a series of baffles forming alternate channels and spaces of equal width. They are arranged in a circle at their summit and are directed inward and downward, the channels leading to one spout and the spaces to an opposite spout.

Each kernel has an equal chance of falling into a channel or a space, resulting in two nearly identical portions of the original sample.

When Operating the Boerner Divider:

- Check the divider for condition and cleanliness.
- Close the hopper valve.
- Place empty collection pans under the discharge spout.
- Pour the sample into the hopper.
- Open the valve quickly.

For larger samples, feed more grain into the hopper during the dividing process.



File Sample

A “file sample” is a representative sample or representative portion of a sample that is retained for a specified period of time for reference or review purposes.

File samples should be of sufficient size to accommodate subsequent examinations or analysis.

The file sample shall be an unworked portion (if available) of the representative sample used for the inspection.

The worked portion may be retained as the final file only when insufficient sample is available for an unworked file sample.



Use Moisture Proof Containers

Keep all samples in sealed moisture proof containers if they cannot be tested within approximately 15 minutes.

Do not use paper bags, fiber cartons, or similar containers that allow moisture losses.

Use metal cans, plastic containers, and plastic bags to preserve the sample integrity.

Do not file samples with paper identification inserted in the grain.



Determine Moisture

Moisture is the water content of sorghum as determined by an approved device before the removal of dockage. Record the percent of moisture on the certificate to the nearest tenth percent.

The DICKEY-john GAC2500-UGMA and the Perten AM5200-A are the designated official moisture meters for performing moisture analysis in grains.



DICKEY-john GAC2500



Perten AM5200-A

Basically, the instruments measure the change in capacitance of two parallel plates when grain is placed between them. As the moisture content within the grain increases or decreases so does its contribution to capacitance, known as its dielectric constant.

The instruments also measure sample density and temperature and perform automatic corrections for those parameters.

Calibration equations have been developed to convert these properties into precise moisture percentages for each grain measured by the instruments.

The test they perform takes about 30 seconds to complete and is a simple and accurate way to obtain moisture analysis in the field.

Dockage

All matter other than sorghum that can be removed from the original sample by use of an approved device according to procedures prescribed in FGIS instructions. Also, underdeveloped, shriveled, and small pieces of sorghum kernels removed in properly separating the material other than sorghum.

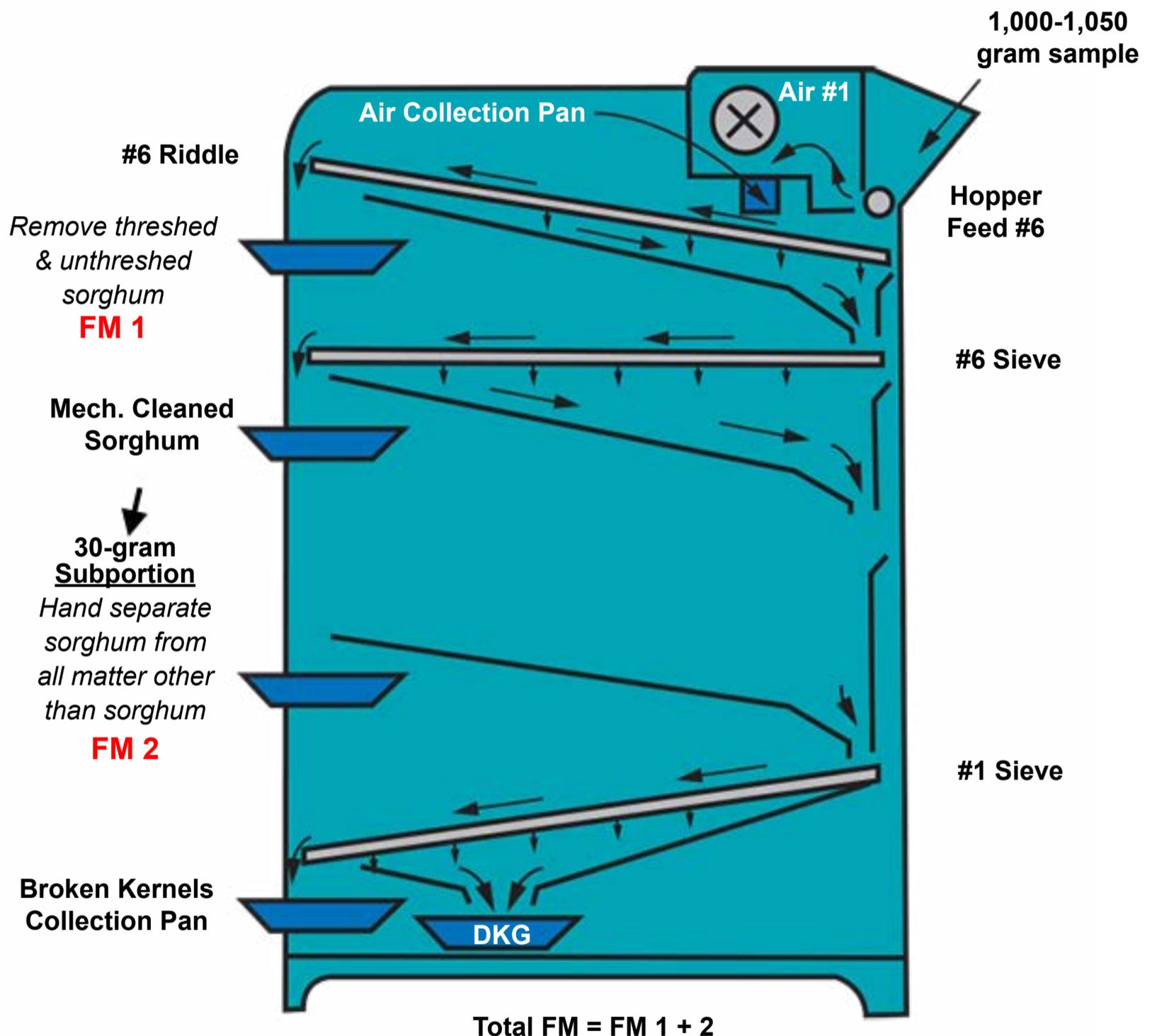
Basis of Determination. Determine dockage on a portion of 1,000 to 1,050 grams of the original sample.



Carter Dockage Tester

To mechanically clean the sample on the Carter dockage tester:

- Set the air control to 1.
- Set the feed control to 6.
- Insert a No. 6 sieve in the top sieve carriage.
- Insert a No. 1 sieve in the bottom sieve carriage.
- Insert the No. 6 riddle in the riddle carriage.
- Run 1,000-1,050 grams through the dockage tester.



Removed threshed, unthreshed, and clumps of sorghum from the material that passed over the riddle and add to the cleaned sorghum. Dockage is all matter passing through the #1 Sieve.

Record the word "Dockage" and the percentage on the work record in hundredths. When the sample contains 1 percent or more dockage, record the percentage of dockage on the certificate in whole percent with a fraction of a percent disregarded.

For example:

1.00 to 1.99 percent is recorded as 1.0 percent

2.00 to 2.99 percent is recorded as 2.0 percent

Test Weight per Bushel

The weight per Winchester bushel is determined using an approved device according to procedures prescribed in FGIS instructions. A Winchester bushel is 2150.42 cubic inches or 35.24 liters.

Test weight per bushel for sorghum is determined on the original sample before the removal of dockage on a portion of sufficient quantity to overflow the kettle.

Record test weight results on the work record as displayed on the electronic scale or in whole and half pounds. Disregard fractions of a half pound.

Record the test weight on the certificate in whole and half pounds.

Test weight per bushel can be converted to kilograms per hectoliter by multiplying the pounds per bushel result by 1.287. Upon request, record the kilograms per hectoliter result in the "Remarks" section of the certificate in whole and tenths.



Filling the hopper

TW Procedure

Position the hopper over the center of the kettle, making sure the hopper valve is closed. Pour grain into the hopper.

Open the valve allowing the grain to overflow the kettle. Once the hopper is clear of grain move the hopper to the side.

With a rounded edge striker, place it on the edge of the kettle and move the striker in three zigzag motions across the kettle leveling the grain.

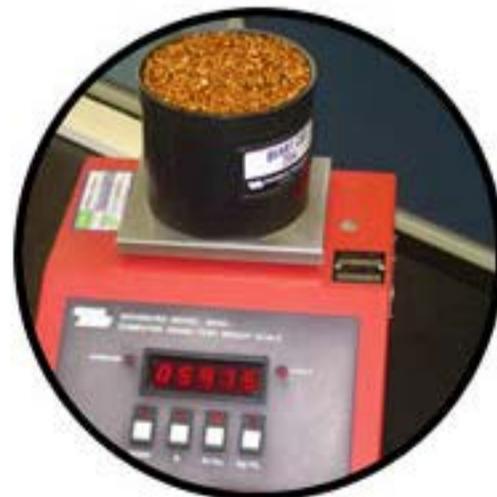
Move the kettle to a scale and record the test weight measurement.



Open the valve



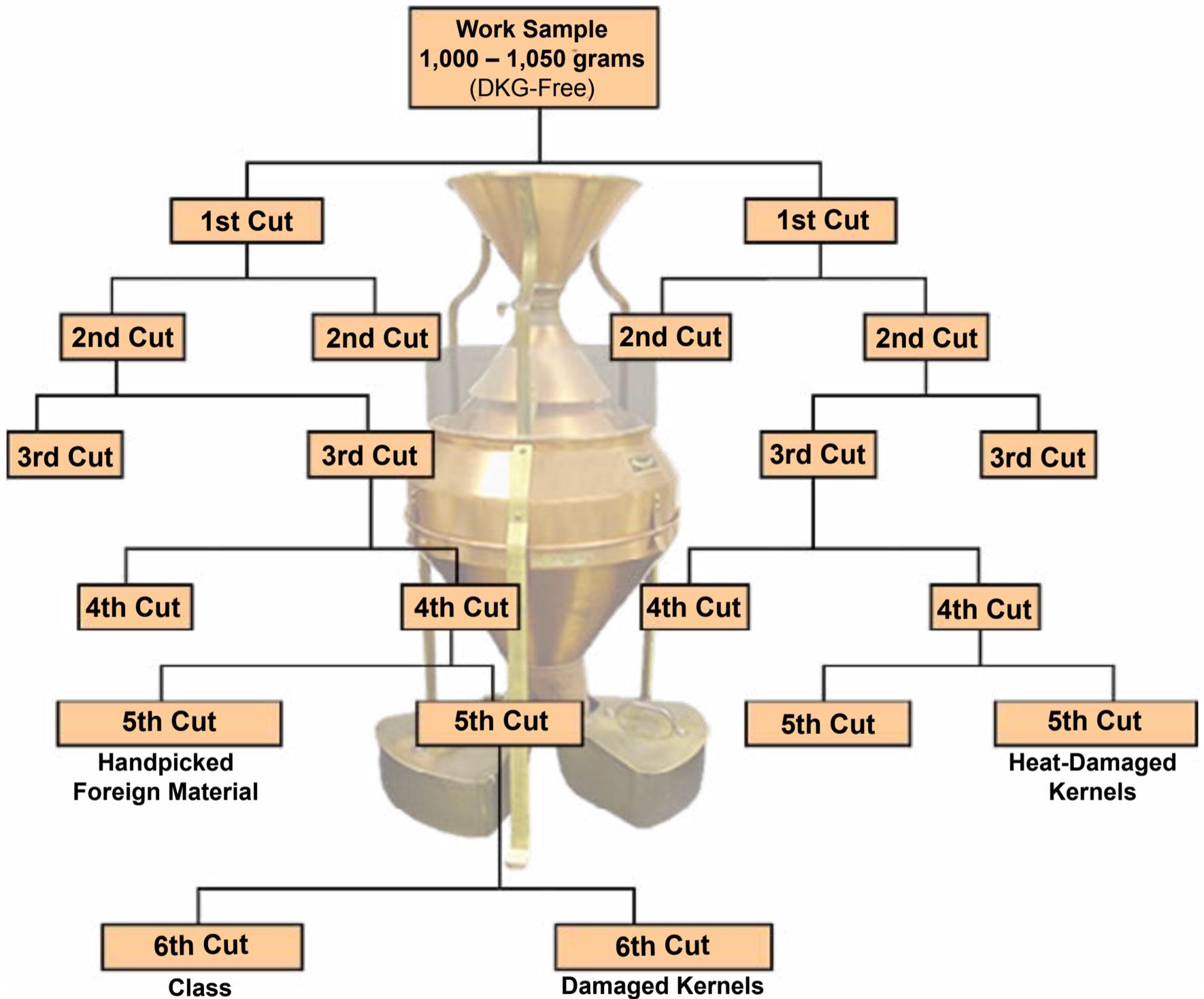
Level the grain



Weigh the kettle

Processing the Work Sample

At this point all other tests required to be performed prior to the removal of dockage have been made and the percentage of dockage has been determined. Now the work sample is ready to be divided into fractional portions for those factors determined after the removal of dockage, broken kernels, and foreign material. This chart illustrates how the sample is divided into fractional parts using the Boerner divider.



Foreign Material

Foreign material or FM is all matter except sorghum, which passes over the number six riddle and all matter other than sorghum that remains on top of the number six 5/64 inch or 1.98mm triangular-hole sieve.



Handpicked FM

From the mechanically cleaned sample, obtain approximately a 30-gram representative portion.

Handpick the 30 gram portion for matter other than sorghum.

Broken Kernels



Broken Kernels

Broken kernels or BK is all matter that passed through the number six 5-64th inch triangular-hole sieve and over the number one 2.5-64th inch round-hole sieve.

5/64 inch = 1.98 mm

2.5/64 = 0.99 mm

Broken Kernels and Foreign Material

Broken Kernels and Foreign Material or BNFM is the combination of broken kernels and foreign material. The mechanically separated broken kernels and foreign material used to make this calculation are in the bottom collection pan and the riddle collection pan.

Obtain the total percentage of broken kernels and foreign material by adding the percentage of broken kernels, mechanically cleaned foreign material, and handpicked foreign material.



When adding these portions, as shown in the following example add the results in hundredths and round the sum to the nearest tenth percent.

Computing BNFM

Compute BNFM as follows:

- STEP 1.** Determine the Percent of dockage by dividing the Weight of dockage by the weight of the original sample and multiplying the result by 100.
- STEP 2.** Determine the weight of the dockage-free sample by subtracting the weight of dockage from the weight of original sample.
- STEP 3.** Determine the Percent of broken kernels or BN by dividing the Weight of broken kernels by the weight of the dockage-free sample and multiplying the result by 100.
- STEP 4.** Determine the Percent of mechanically separated foreign material or FM by dividing the weight of FM removed by the No. 6 riddle by the weight of the dockage-free sample and multiplying the result by 100.
- STEP 5.** Determine the Percent of handpicked FM by dividing the weight of handpicked FM (including other grains) by the weight of the handpicked portion and multiplying the result by 100.
- STEP 6.** Determine the Total percent of FM by adding the Percent of handpicked FM to the percent of mechanically separated FM.
- STEP 7.** Determine the Total percent of broken kernels and foreign material or BNFM by adding the Percent BN to the total percent FM.

BNFM Example

Original sample	= 1,007 grams
Dockage	= 3.81 grams
Mechanically separated broken kernels	= 54.11 grams
Foreign material removed by the No. 6 riddle	= 4.33 grams
Handpicked portion	= 29.70 grams
Handpicked separation	= 0.37 grams

Step 1. Percent dockage = $3.81 / 1,007 \times 100 = 0.37$

Step 2. Dockage-free sample weight = $1,007 - 4$ (3.8 rounded) = 1,003

Step 3. Percent broken kernels = $54.11 / 1,003 \times 100 = 5.39$

Step 4. Percent mechanically separated FM = $4.33 / 1,003 \times 100 = 0.43$

Step 5. Percent handpicked FM = $0.37 / 29.7 \times 100 = 1.24$

Step 6. Percent total FM = $1.24 + .43 = 1.67$ (1.7 rounded)

Step 7. Percent total BNFM = $5.39 + 1.67 = 7.06$ (7.1 rounded)

Unattached Hulls

Unthreshed kernels of sorghum are not considered as broken kernels and foreign material.

Unattached hulls are considered as broken kernels and foreign material.

Unattached hulls with a sliver or more of a kernel inside are not considered as broken kernels and foreign material.



Non-grain Sorghum



Kernels of non-grain sorghum are small and have tightly clasped hulls that are shiny red, black, lemon yellow, or buff in color but are very rarely white in color. Kernels of non-grain sorghum are usually more elongated than kernels of sorghum and range in size from a large mustard seed to a large cockle seed.

Damaged Kernels

Determine damaged kernels on a portion of 15 grams after the removal of dockage and broken kernels, foreign material, and other grains removed by the 5/64 inch or 1.984 mm triangular hole sieve.

In general, a kernel of sorghum is considered damaged for inspection and grading purposes only when the damage is distinctly apparent and of such character as to be recognized as damaged for commercial purposes.

Damaged Kernels consists of kernels, pieces of sorghum kernels, and other grains that are:

- badly ground-damaged
- badly weather-damaged
- diseased
- frost-damaged
- germ-damaged
- heat-damaged
- insect-bored
- mold-damaged
- sprout damaged
- otherwise materially damaged

Visual Reference Images



Because of the subjectivity involved in determining damage, and other subjective criteria, it is critical that visual references are available to ensure that interpretations are uniformly and consistently applied throughout the national system.

Color images provide a basis for communicating the minimum “line” for various types of damage and other visually determined criteria such as badly weathered, distinctly discolored, and class.

Ground/Weather Damage



Kernels of sorghum which have dark stains or discolorations and a rough cake-like appearance caused by ground and/or weather conditions are considered damaged.

Insect Bored Damage



Kernels and pieces of kernels of sorghum which have been bored or tunneled by insects are considered damaged.

Surface Mold Damage



Kernels and pieces of kernels of sorghum with surface mold are considered damaged. Do not confuse mold with dark stains or discolorations caused by ground and/or weather conditions.

Internal Mold Damage



Kernels and pieces of kernels invaded by mold, usually in the germ area under the bran layer are considered damaged. The bran coat should be removed carefully because scraping too deeply could remove the damage.

The determination may be performed on a pre-bleached, or in the case of weathered sorghum, bleached portion. Bleaching turns penetrating molds black. Sorghum germs which have a distinctive black spot(s), or any other color associated with mold, are considered damage.

Sprout Damage



Kernels and pieces of kernels of sorghum in which the sprout definitely protrudes from the germ are considered damaged.

The illustration shows from left to right:

- Kernel 1: The germ cover is broken open with a sprout protruding from the bottom.
- Kernel 2: The germ cover is broken open with a sprout showing at the bottom and the sprout has lifted upward extending beyond the surface plane of the germ area.
- Kernel 3: The germ cover is broken open with a sprout protruding from the top.

Split Germ (sound)



Kernels and pieces of kernels of sorghum which have a split over the germ area, but which have no sprout protruding, are considered sound unless otherwise damaged.

Purple Pigment Damage



Kernels and pieces of kernels which are materially discolored by purple pigment are considered damaged.

Germ Damage



Kernels and pieces of kernels of sorghum which, after bleaching, contain dark colored germs are considered damaged. Sorghum containing germ damage or suspected of containing germ damage must be bleached to make this determination.

Bleach Procedure

- When bleaching sorghum to determine germ damage place approximately 15 grams of sorghum in the mixing jar.
- Add 40 milliliters of bleach.
- Add 15 grams of KOH pellets.
- Set the stirring head on the jar, place the jar on the mixer, and mix for 3 minutes.
- Pour the sorghum from the mixing jar into the tea strainer and rinse with warm tap water to remove the KOH-bleach solution.
- After rinsing, lightly tap the tea strainer against the edge of the sink to remove excess water then gently press the bottom of the tea strainer on a dry paper towel to remove additional water.
- Place the sorghum on the dryer sieve and dry for one to one and a half minutes or until the kernels are not tacky when picked up with a pair of tweezers.
- Remove the sorghum from the drying sieve and weigh the portion.



Bleaching Safety Precautions

Safety equipment should be worn while the bleach operation is in progress and the lab area thoroughly cleaned once bleaching is complete.

Accidental spills should first be neutralized with vinegar before the liquid is wiped up.

Avoid mixing the potassium hydroxide KOH-bleach solution used in this test with chemical reagents or waste solutions associated with other tests.

When disposing of the KOH-bleach solution, wash the solution down the sink drain with large quantities of water.

Computing Damaged Kernels

Obtain the percentage of damaged kernels by adding the percentage of germ-damaged kernels, other damaged kernels, and damaged kernels of grain removed by the No. 6 riddle. Add the results in hundredths and round the sum to the nearest tenth percent.

- STEP 1.** The weight of other type damaged kernels divided by the weight of sample before bleaching times 100 equals the percent of other type damaged kernels.
- STEP 2.** 100 minus the percent of other type damaged kernels divided by 100 equals the change of base factor. Do not round this result.
- STEP 3.** The weight of the germ damaged portion divided by the weight of the damaged portion after bleaching times 100 equals the percent of germ damaged kernels.
- STEP 4.** The percent of germ damaged kernels times the change of base factor equals the adjusted percent of germ damaged kernels.
- STEP 5.** The weight of damaged kernels of corn & soybeans removed by No. 6 riddle divided by the weight of mechanically cleaned sample equals the percent of damaged corn & soybeans.
- STEP 6.** The percent of other damaged kernels plus the adjusted percent of germ damaged kernels plus the percent of damaged corn & soybeans equals the percent of damaged kernels.

Damaged Kernels Example

Weight of mechanically cleaned sample	= 949 grams
Original weight of damaged portion	= 16.10 grams
Weight of other type damaged kernels	= 2.40 grams
Sample weight before bleaching	= 13.70 grams
Sample weight after bleaching	= 11.95 grams
Weight of germ damaged kernels	= 4.33 grams
Weight of damaged kernels of corn/soybeans removed by No.6 riddle	= 2.50 grams

STEP 1. $(2.40\text{g} / 16.10\text{g}) \times 100 = 14.90\%$ of other type damaged kernels

STEP 2. $(100\% - 14.90\%) / 100 = 0.85$ change of base factor

STEP 3. $(4.33\text{g} / 11.95\text{g}) \times 100 = 36.23\%$ germ damaged kernels

STEP 4. $0.85 \times 36.23 = 30.79$ adjusted percent of germ damaged kernels

STEP 5. $(2.50\text{g} / 949) \times 100 = 0.26$ percent damaged kernels of corn/soybeans

STEP 6. $(14.90\% + 30.79\% + 0.26\% = 45.95$ (46.0 rounded) percent damaged kernels

Heat Damage



Kernels and pieces of kernels of sorghum which are materially discolored and damaged by heat are considered heat damaged. Determine heat-damaged kernels after the removal of dockage and machine-separated broken kernels and foreign material on a portion of 30 grams. It is necessary, in most cases, to cross-section the kernels to determine if the color is creamy.

The percent of heat-damaged kernels of corn and/or soybeans removed by the Number 6 riddle during the determination of dockage, broken kernels, and foreign material is added to the percent of heat-damaged kernels removed from the 30-gram portion. Compute the percent of heat-damaged kernels of corn and/or soybeans on the basis of the weight of the sample after the removal of dockage and mechanically cleaned broken kernels and foreign material.

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

Determining Class

Determine the class of sorghum by the color characteristics of the pericarps and/or subcoats of the kernels.

Similarities in the bleaching methods used in the determination for sorghum germ damage and class determination allow inspectors to effectively use the germ damage portion to screen samples for class. If the bleached damage portion contains darkened kernels bleach a separate portion for classing purposes.

Determine the percentage of White sorghum present in a mixture before bleaching due to the difficulty of distinguishing between White sorghum and Sorghum after bleaching. Recombine the sample before proceeding.



Tannin Sorghum Not Bleached



Tannin Sorghum Bleached

The bleach method for class determination is identical to that used for germ damage determinations, with the following exception: Use 5 grams of potassium hydroxide (KOH) pellets instead of 15 grams.

For Mixed sorghum, record the name and percentage of each class to the nearest tenth percent in the order of predominance in the “Remarks” section of the certificate.

Tannin Sorghum (Bleached)

Presence of a pigmented testa or subcoat in tannin sorghum kernels allows for the separation of black or dark brown tannin kernels from light colored non tannin kernels.

After bleaching, Sorghum and White sorghum kernels remain light in color while Tannin sorghum kernels which have a brown subcoat turn black or dark brown.



Do not confuse field damaged Sorghum or White sorghum kernels with Tannin sorghum. Field damage may discolor/stain the kernel making it difficult to distinguish the bleached Tannin sorghum from the damaged Sorghum or White sorghum.

Do not confuse Tannin sorghum having a bluish-white pericarp with damaged Sorghum or White Sorghum kernels. When bleached, this type of Tannin sorghum is partially discolored similar to damaged Sorghum or White Sorghum kernels. If necessary, quickly review an unbleached portion for the presence of kernels having pericarps with a bluish-white cast. If this type of sorghum is not present, consider the sorghum in question as Sorghum.

Sorghum with White Pericarps and Brown Subcoats have a somewhat bluish-white appearance. To determine the presence or absence of brown subcoats with white pericarps, it may be necessary to scrape small areas of the pericarp.

Other Official Criteria

Other tests that can be performed on sorghum include mycotoxin analysis and pesticide residue analysis.



Mycotoxin Analysis



Pesticide Residue Analysis

Grain Grading Primer

Chapter 8

Soybean



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Definition of Soybeans

Soybeans are defined as:

*Grain that consists of 50 percent or more of whole or broken soybeans (*Glycine max (L.) merr.*) that will not pass through an 8/64 round-hole sieve and not more than 10.0 percent of other grains for which standards have been established under the United States Grain Standards Act.*



Soybean Classes

Soybeans are divided into two classes based color:

Yellow soybeans and ***Mixed soybeans***. There are no subclasses.

Grade Requirements

Each class is divided into four numerical grades and U.S. Sample Grade.

Special grades are provided to emphasize special qualities or conditions affecting the value and are added to and made a part of the grade designation. They do not affect the numerical or sample grade designation.

Grades and Grade Requirement Chart

SOYBEANS					
Grade	Maximum Limits of -				
	Damaged Kernels		Foreign Material (percent)	Splits (percent)	Soybeans of other colors ¹ (percent)
	Heat (part of total) (percent)	Total (percent)			
U.S. No. 1	0.2	2.0	1.0	10.0	1.0
U.S. No. 2	0.5	3.0	2.0	20.0	2.0
U.S. No. 3	1.0	5.0	3.0	30.0	5.0
U.S. No. 4	3.0	8.0	5.0	40.0	10.0

U.S. Sample Grade:

U.S. Sample Grade is soybeans that:

- Do not meet the requirements for grades U.S. No.1, 2, 3, or 4; or
- Contains 4 or more stones which have an aggregate weight in excess of 0.1 percent of the sample weight, 1 or more pieces of glass, 3 or more crotalaria seeds (*Crotalaria* spp.), 2 or more castor beans (*Ricinus communis* L.), 4 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), 10 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth in 1,000 grams of soybeans, or
- Contain 11 or more animal filth, castor beans, crotalaria seeds, glass, stones, or unknown foreign substance(s) in any combination, or
- Have a musty, sour, or commercially objectionable foreign odor (except garlic odor); or
- Are heating or otherwise of distinctly low quality.

¹ Disregard for Mixed Soybeans

Special Grades

Special grades identify unusual conditions in grain and are part of the grade designation.

The soybean standards include three special grades:

- **Garlicky Soybeans.** Soybeans that contain five or more green garlic bulblets or an equivalent quantity of dry or partly dry bulblets in a 1,000-gram portion.

Example: U.S. No. 3 Yellow Soybeans, Garlicky

- **Infested Soybeans.** Soybeans that are infested with live weevils or other insects injurious to stored grain.

Example: U.S. No. 2 Yellow Soybeans, Infested

- **Purple Mottled or Stained Soybeans.** Soybeans that are discolored with pink or purple seed coats, dirt or a dirt-like substance, or pokeberry stains, as determined on a portion of 400 grams with the use of an FGIS Interpretive Line Print.

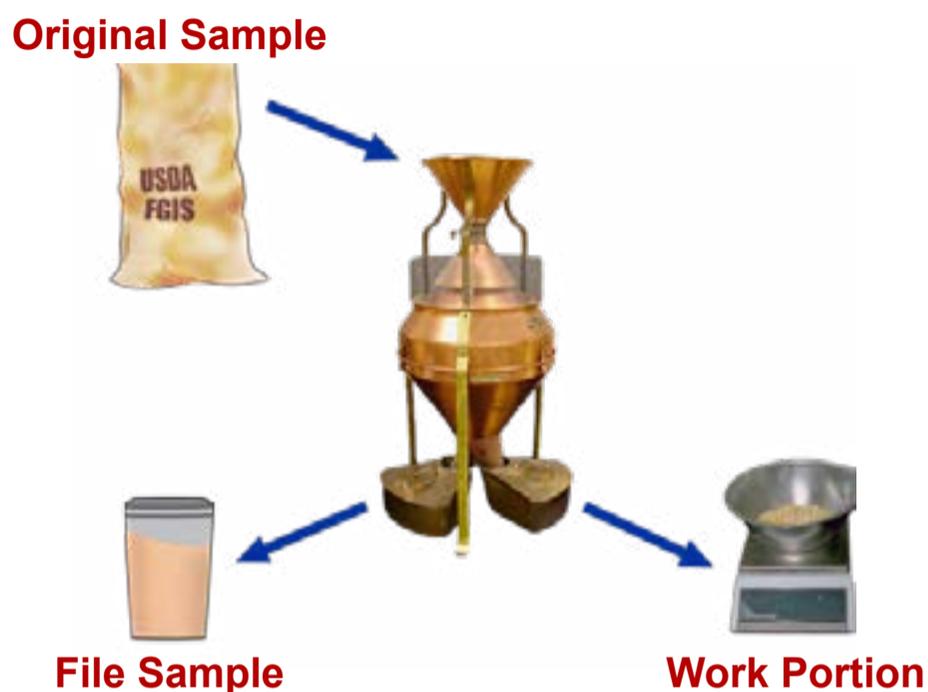
Example: U.S. No. 2 Yellow Soybeans, Purple Mottled or Stained

Processing the Original Sample

The Boerner Divider reduces the size of a grain sample while maintaining the representativeness of the original sample. Use the Boerner divider, or a divider that gives equivalent results, when reducing a sample to the portion size required for a specific test/analysis.

When dividing the original sample the first pass through the divider will result in two equal portions.

- One portion is set aside as a “file sample”.
- One portion is the “work portion” which is reduced down to smaller work portions for use in determining required tests and analysis specific to the type of grain being graded.



Operating Procedures

- Check the divider for condition and cleanliness
- Close the hopper valve
- Place empty collection pans under the discharge spouts
- Pour the sample into the hopper
- Open the valve quickly. For large samples, feed more grain into the hopper during the dividing process

File Sample

A “file sample” is a representative sample or representative portion of a sample that is retained for a specified period of time for reference or review purposes. File samples should be of sufficient size to accommodate subsequent examinations or analysis. The file sample shall be an unworked portion (if available) of the representative sample used for the inspection. The worked portion may be retained as the final file only when insufficient sample is available for an unworked file sample.

Keep all samples in sealed moisture proof containers if they cannot be tested within approximately 15 minutes. Do not use paper bags, fiber cartons, or similar containers that allow moisture losses. Use metal cans, plastic containers, and plastic bags to preserve the sample integrity. Do not file samples with paper identification inserted in the grain. Paper absorbs moisture and lowers the moisture of the grain.



Basis of Determination

The “Basis of Determination” establishes the rules for testing/analyzing all factors. ***Do not analyze any factor until the basis for making the determination is known.***

BASIS OF DETERMINATION		
Lot as a Whole	Factors Determined Before the Removal of Foreign Material	Factors Determined After the Removal of Foreign Material
Distinctly low quality Heating Infested Odor	Distinctly low quality Garlicky Heating Infested Kind of Grain Moisture Odor Purple Mottled or Stained Stones Test Weight U.S. Sample Grade factors	Heat-damaged kernels Damaged kernels Odor Soybeans of other colors Splits

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, castor beans, cockleburs, crotalaria seeds, 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 class, heat-damaged kernels, damaged kernels, splits, and soybeans of other colors is made on the basis of the grain when free from foreign material. Other determinations not specifically provided for under the General Provisions are made on the basis of the grain as a whole.

Consider soybeans distinctly low quality when they are obviously of inferior quality and existing grade factors or guidelines do not accurately reflect the inferior condition.

Large Debris. Soybeans containing two or more stones, pieces of glass, pieces of concrete, or other pieces of wreckage or debris which are visible to the sampler and too large to enter the sampling device are considered distinctly low quality.

Other Unusual Conditions. Soybeans that are obviously affected by other unusual conditions which adversely affect the quality of the soybeans and cannot be properly graded by use of the grading factors specified or defined in the standards are considered distinctly low quality.

Heating

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

Infested

Infested soybeans are soybeans that are 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 indicates the probability of infestation and warns that the soybeans must be carefully examined to determine if they are infested. In such cases, examine the work sample and the file sample before reaching a conclusion as to whether or not the soybeans are infested. Do not examine the file sample if the work portion is insect free.

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 ¹ (+ file sample if needed)	Lot as a Whole (Stationary)	Online Sample (In-Motion) ²
Submitted samples	Probed lots (at time of sampling)	Railcars under the Cu-sum
Probed lots		Subsamples for Sacked Grain lots
D/T sampled land carriers		Components for Bargelots ³ Components for Shiplots ³
¹ Examine work portion and file sample if necessary. Do not examine file sample if work portion is insect free. ² Minimum sampling rate is 500 grams per 2,000 bushels. ³ Minimum component size is 10,000 bushels. Key: lw = live weevil, oli = other live insects injurious to stored grain		

Live weevils include rice weevils, granary weevils, cowpea weevils, maize weevils, and lesser grain borers. Other live insects injurious to stored grain shall include grain beetles, grain moths, and larvae.

Odor Determination

Basis of Determination. Determine odor on evidence obtained at the time of sampling or on the sample either before or after the removal of foreign material.

Odors from Heat-Damaged Soybeans. When heat-damaged kernels are present, soybeans give off an odor very similar to smoke. Soybeans containing a “smoke” odor are 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 Odor (COFO) are odors, except smut and garlic odors, foreign to grain that render it unfit for normal commercial usage. Sources of COFO include fumigants, oil products, smoke, fertilizer, weeds, decaying animal or plant matter, etc.

Moisture Determination

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 650 grams.*

The user interfaces are slightly different for the two UGMA compatible moisture meters. Use the keypad to choose the type of grain to analyze.

Fill the hopper and press the load key to start the test cycle. After the moisture analysis is complete observe the result on the display, record it and reclaim the sample from the discharge tray.

For additional information, refer to the GIPSA Moisture Handbook.

GAC2500-UGMA



Perten AM 5200-A



Test Weight

Test weight per bushel is the weight per Winchester bushel (2,150.42 cubic inches) as determined using an approved device. The determination for test weight is made on a portion of sufficient quantity to overflow the kettle.

General Operating Procedures

1. Level and balance the test weight per bushel apparatus.
2. Close the hopper valve.
3. Pour the work sample into the hopper.
4. Center the hopper over the kettle.
5. Fill the kettle by opening the hopper valve quickly.
6. Move the hopper all the way to the left before proceeding. Do not jar the apparatus. Jarring could cause inaccurate results.
7. Using a standard stoker, stroke the kettle by holding the stoker in both hands with the flat sides in a vertical position. Level the grain in the kettle by making three full length, zigzag motions with the stoker.
8. Place an empty sample pan or the test weight kettle on the scale and zero the scale. Pour the sample from the kettle into the sample pan or place the filled kettle onto the scale as appropriate. Read the result from the test weight mode selected.
9. Record the test weight per bushel on the work record.



Garlicky Soybeans

Soybeans that contain five or more green garlic bulblets or an equivalent quantity of dry or partly dry bulblets in a 1,000-gram portion.

Green garlic bulblets are bulblets which have retained all of their husks intact.



Dry or partially 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.

Purple Mottled or Stained

Soybeans with pink or purple seed coats as determined on a portion of approximately 400 grams with the use of an FGIS Interpretive Line Print.

Purple mottled or stained is an appearance factor in soybeans and when sufficient amounts of discolored soybeans are found, the soybeans are considered purple mottled or stained.

Soybeans Discolored by the Growth of a Fungus

Soybeans discolored by a fungus have seed coats that are discolored pink or purple. This type of discoloration is caused by the growth of a fungus and may cover all or part of the kernel. Soybeans exhibiting this type of discoloration shall be considered purple mottled or stained.



Soybeans Discolored by Dirt or a Dirt-Like Substance

This type of discoloration is caused by dirt or similar matter and includes nontoxic substances. Dirt, dirt-like substances, or other nontoxic substances are substances which can be readily removed by water. Soybeans exhibiting this type of discoloration shall be considered purple mottled or stained.



Soybeans Purple Mottled or Stained by Pokeberry Stain

Soybeans with seed coats discolored by pokeberry stain are considered purple mottled or stained.



U.S. Sample Grade Factors

Basis of Determination. *Determine additional U.S. Sample Grade criteria before the removal of foreign material based on a work portion of 1,000 - 1,050 grams.*

Consider identifiable pieces of grain, processed grain products such as 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".

**Toxic Seeds
(Crotalaria)**



Animal Filth



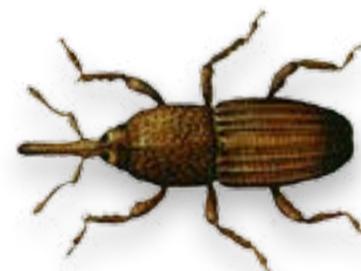
Soybeans inoculated with a seed treatment which is toxic should not be confused with soybeans stained by pokeberry juice which is not toxic.

If it is difficult to visually determine soybeans stained by pokeberry juice from those stained by a seed treatment, the following procedures may be used:

- Place discolored soybean kernels into a 100 x 15 mm petri dish.
- Use an eyedropper to add enough hydrochloric acid (HCL) to cover the soybeans. Care should be taken not to get HCL in the eyes or on the skin.
- If the soybeans are stained with pokeberry juice, the HCL solution (0.1 N) will remove the stain from the seed coat and the soybeans are not graded U.S. Sample Grade. If the soybeans are stained with a toxic seed treatment, the HCL solution will not remove the stain from the seed coat and the soybeans are graded U.S. Sample Grade.

Infested Soybeans

Infested soybeans are soybeans that are 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 indicates the probability of infestation and warns that the soybeans must be carefully examined to determine if they are infested. In such cases, examine the work sample and the file sample before reaching a conclusion as to whether or not the soybeans are infested. Do not examine the file sample if the 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 shall include grain beetles, grain moths, and larvae.

Foreign Material

All matter that passes through an 8/64 round-hole sieve and all matter other than soybeans remaining in the sieved sample after sieving according to procedures prescribed in FGIS instructions.

Coarse Foreign Material consists of the following:

- Whole kernels of corn. Whole kernels of corn are kernels with one-fourth or less of the kernel removed.
- Cockleburs.
- Sticks if the following criteria are met:
 - (a) Approximately 1 inch or more in length.
 - (b) Approximately 1/2 inch or more with a thickness of 5/32 of an inch (width of the largest soybean slotted sieve).
- Pods (one-half pod or more). If pods contain soybeans, remove the soybeans and return to sample.
- Other coarse foreign material may include but is not limited to corn cobs, large feed pellets, pieces of dirt larger than soybeans, sweet corn, and edible beans that are generally larger than soybeans.



Fine Foreign Material consists of the following:

- Broken kernels of corn with more than one-fourth of the kernel removed.
- Popcorn, sunflower seed, and edible beans that are generally equal to or smaller than soybeans.
- Star thistles, star burs, sandburs, morning glory, and kinghead seeds.
- Sticks not meeting the criteria for coarse foreign material.
- Soybean pods less than one-half the total pod. Any other material too small to function as coarse foreign material.



Soybean hulls which are not removed by the 3.175 mm (8/64) round-hole sieve are not considered foreign material

Procedure for Determining Foreign Material

Step 1: Coarse Foreign Material

Handpick the 1,000 – 1,050 gram portion for coarse foreign material.



Step 2: Fine Foreign Material

- Cut down the cleaned sample (free of coarse foreign material) to a portion of 125 grams.
- Using an approved shaker or hand sieve, sieve (5 strokes) the 125-gram portion with an $\frac{8}{64}$ " (3.175 mm) round-hole sieve.
- Handpick the material other than soybeans from the material remaining on the $\frac{8}{64}$ " sieve and add it to the fine foreign material.



Soybean hulls which remain on the 8/64” sieve are not considered foreign material.

NOTE: An 8/64 x 3/4 (3.175 x 19.050 mm) or 9/64 x 3/4 (3.572 x 19.050 mm) oblong-hole sieve, or 10/64 x 3/4 (3.969 x 19.050 mm) oblong-hole sieve may be mounted on top of the 8/64” round-hole sieve and used as an aid in separating splits. When a sieve is used as an aid, the material remaining on top of the 8/64” round-hole sieve and the material remaining on top of the sieve used as an aid is analyzed for additional fine foreign material.



Processing the Work Sample

At this point, determinations have been made for those tests that are performed prior to the removal of foreign material and the percentage of foreign material has been determined.

Using the Boerner Divider divide the work sample into the following fractional portions for those determinations required *after* the removal of the foreign material.

APPROXIMATE ANALYTICAL PORTION SIZES

Factors	Grams
Damaged kernels	125
Foreign material	125
Heat-damaged kernels	125
Kind of grain ¹	125
Soybeans of other colors	125
Splits	125

¹ Factor determined before the removal of foreign material.

Class

Determine class by the color characteristics of the kernels on a portion of 125 grams after the removal of foreign material. There are two classes of soybeans:

Yellow Soybeans are soybeans that have yellow or green seed coats and which in cross section are yellow or have a yellow tinge, and may include not more than 10.0 percent of soybeans of other colors.

Mixed Soybeans are soybeans that do not meet the requirements of the class Yellow soybeans.

Soybeans of Other Colors

Soybeans of other colors is not a class of soybeans.

Soybeans that have green, black, brown, or bicolored seed coats. Soybeans that have green seed coats will also be green in cross section. Bicolored soybeans will have seed coats of two colors, one of which is brown or black, and the brown or black color covers 50 percent of the seed coats. The hilum of a soybean is not considered a part of the seed coat for this determination.

Soybeans of Other Colors



Soybeans with green seed coats that are yellow when cross sectioned are considered Yellow soybeans.

Yellow or Green soybeans with distinct black or brown pigmented streaks or splotches covering 50 percent or more of the seed coat are considered bicolored soybeans.

Black or Brown soybeans with distinct yellow or green pigmented streaks or splotches covering 50 percent or more of the seed coat are considered bicolored soybeans.

Splits

Soybeans with more than one-fourth of the bean removed and that are not damaged.

Note: A smaller portion size (approximately 60 grams) may be used for the analysis of splits when a sample contains approximately 50 percent or more of whole soybeans that pass through a 10/64 oblong-hole sieve.

The following sieves are used to determine splits:

- 8/64 x 3/4 (3.175 x 19.050 mm) or 9/64 x 3/4 (3.572 x 19.50 mm) oblong-hole; or
- 10/64 x 3/4 (3.969 x 19.50 mm) oblonghole hand sieve

Use these sieves in conjunction with the 8/64 inch round-hole sieve used to determine foreign material.

All splits are not separated by sieving. Therefore, the material remaining on top of the sieve and the material that passed through the sieve have to be examined for splits.

Since splits are normally separated during the determination of foreign material, the weight of the foreign material must be subtracted from the weight of the representative portion before calculating the percentage of splits.

Visual Reference Images (VRI)

Because of the subjectivity involved in determining damage and other criteria, it is critical that visual references are available to ensure that interpretations are uniformly and consistently applied throughout the national system.

Visual Reference Images provide a basis for communicating the minimum “line” for various types of damage and other visually determined criteria.

For complete inventory and description of the VRI visit GIPSA’s website.

SB-3.0 GREEN DAMAGE



Portion for Analysis: Approximately 125 grams

Soybeans and pieces of soybeans that are discolored green with an area of coverage and intensity equal to or greater than shown. Cross-sectioned or pieces of soybeans that have a discolored area(s) which does not meet the minimum coverage requirement may be considered damage provided the degree of discoloration is greater than shown and the overall “prorated” appearance meets the minimum coverage and intensity level depicted. For example, when the degree of discoloration is twice that shown, only half of the surface area needs to be discolored.

NOTE: Only half of the cross-sectioned soybean must meet the VRI. Do not cross-section splits and pieces of soybeans. Examine the flat side of the split.

11/02



Damaged Kernels

Soybeans and pieces of soybeans that are badly ground-damaged, badly weathered damaged, diseased, frost-damaged, germ-damaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, stinkbug-stung, or otherwise materially damaged. Stinkbug-stung kernels are considered damaged kernels at the rate of one-fourth of the actual percentage of the stung kernels.

Note: A smaller portion size (approximately 60 grams) may be used for the analysis of damaged kernels when a sample contains approximately 50 percent or more of whole soybeans that pass through a 10/64 oblong-hole sieve.

Types of Soybean Damage

A soybean 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.

Badly Ground and/or Weather Damage



Soybeans and pieces of soybeans in which the seed coats are discolored to the extent that the area of coverage and intensity is equal to or greater than shown.

Weather Damage (Gray/Black)



Soybeans that contain gray/black discoloration on the seed coat with the area of coverage and intensity equal to or greater than shown are considered damaged.

Damaged by Heat



Soybeans and pieces of soybeans which have been damaged by heat and the area of coverage and intensity is equal to or greater than shown.

Green Damage



Soybeans and pieces of soybeans that are discolored green with an area of coverage and intensity equal to or greater than shown.

Frost Damage (Waxy)



Soybeans and pieces of soybeans which have a glassy, wax-like appearance.

Immature (Wafer)



Soybeans and pieces of soybeans which are immature and have a thin, flat, wrinkled, or wafer like appearance. Immature soybeans are considered sound unless otherwise damaged.

Insect Bored Kernels



Soybeans and pieces of soybeans with obvious weevil bored holes indicating the possible inner presence of insects, insect webbing, or insect refuse.

Mold Damage



A. Invaded by Mold: Soybeans that are discolored, elongated, or misshapen, and contain white or gray mold on the seed coat equal to or greater than combined amounts shown.

B. Surface Mold Growth: Soybeans with little or no apparent deterioration having a milky white or grayish crusty growth caused by downy mildew.

Mold Damage (Pink)



Soybeans and pieces of soybeans that exhibit a pink discoloration (caused by fungal activity) on the seed coat with an area of coverage and intensity equal to or greater than shown.

Sprout Damage



Soybeans and pieces of soybeans in which the sprout protrudes from the seed coat equal to or greater than shown are considered damage.

Stinkbug or Insect Stung Kernels



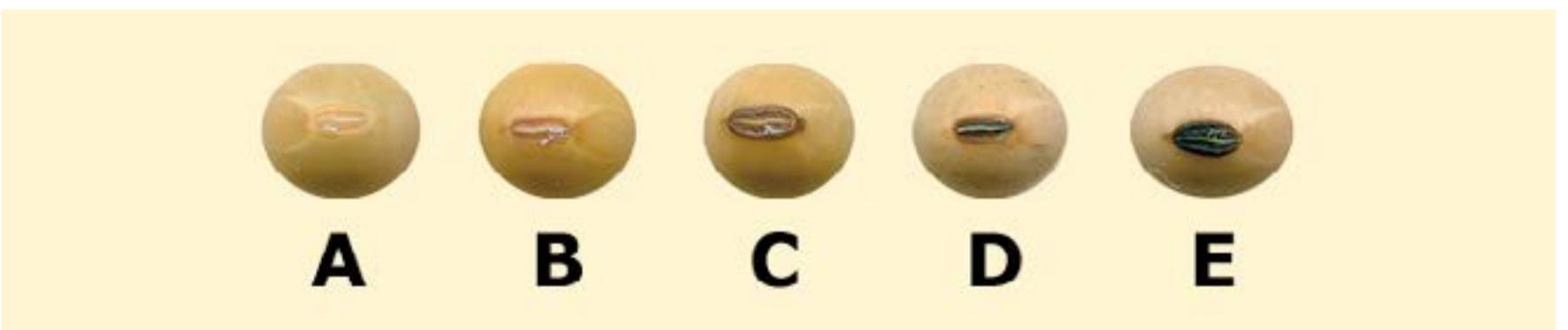
Soybeans or pieces of soybeans which show an indentation or discoloration on the seed coat. To determine the extent of damage, it is generally necessary to cross-section the soybean.

Shriveled and Wrinkled



Whole, sound soybeans passing through a 10/64" x 3/4" slotted sieve, and remaining on top of a 8/64" round-hole sieve that are wrinkled to the minimum extent shown are considered shriveled and wrinkled.

White Hilum



Hilum color: **A.** white, yellow, clear*; **B.** buff; **C.** brown; **D.** imperfect black; **E.** black

*These descriptors are used interchangeably and represent the only hilum color considered a "white hilum" soybean.

NOTE: For information purposes only.

Heat-Damaged Kernels

Soybeans and pieces of soybeans which are materially discolored and damaged by heat with an area of coverage and intensity equal to or greater than shown.

SB-5.0 Heat Damage (Materially Damaged/Heating)



Official Criteria

Official criteria factors are determined only on request and do not affect the grade designation. For complete instructions on analyzing and/or determining official criteria refer to

- **Oil and/or Protein.** An applicant may request analysis for oil, protein, or oil and protein content.

Basis of Determination. For complete instructions on analyzing oil and/or protein content refer to GIPSA's NIRT Handbook.

- **Sclerotinia Sclerotiorum.** The fungus *S. sclerotiorum* causes a stem disease (stem rot) in soybeans which results in large black growths (sclerotinia) on the stem and pods. Seeds may occasionally become infected within diseased pods. If infected early, the seeds are flattened and badly shriveled and are sometimes replaced by sclerotinia.

Basis of Determination. Examine the work portion, 1,000 – 1,050 grams, for the presence of sclerotinia.

- **Black Soybeans.** Soybeans that have black seed coats.

Basis of Determination. Determine the percentage of black soybeans on the color characteristics of the kernels on a 125-gram portion after the removal of foreign material.

- **Seed Sizing.** Consists of a measurement of soybeans passing through or remaining on top of a sieve(s) size specified by the applicant for service.

Basis of Determination. Determine seed sizing on a portion of 125 grams after the removal of foreign material, using the Mechanical Sieving Method or Hand Sieving Method. Refer to GIPSA's *Grain Inspection Handbook II - Soybeans* for complete instructions.

- **Seed Count.** A measurement of the number of soybeans contained in a specified weight

(i.e., number of soybeans per 1,000 grams, one pound, etc.)

Basis of Determination. For complete instructions on analyzing oil and/or protein content refer to GIPSA's NIRT Handbook.

- **White Hilum.** A test to determine the percent of whole soybeans with clear white hilum. Upon request, tests for other hilum colors (buff, brown, etc.) can be provided.

Basis of Determination. Determine the percentage of clear white hilum on a portion of 125 grams after the removal of foreign material and non-whole soybeans (soybeans with more than one-fourth of the bean removed).

- **Cracked Seedcoats.** A test to determine the percent of cracked seedcoats of sound soybeans.

Basis of Determination. Determine the percentage of cracked seedcoats on a portion of 125 grams after the removal of foreign material and damaged kernels. Soybeans with cracked seedcoats shall be whole (three-fourths or more of a whole soybean) sound soybeans which have readily discernable cracked seedcoats, or have all or part of the seedcoat removed.

- **Shriveled and Wrinkled Soybeans.** Whole non-damaged soybeans with an atypical size and appearance that pass through a 10/64" x 3/4" oblong-hole sieve and remain on top of the 8/64" round-hole sieve.

Basis of Determination. Determine shriveled and wrinkled soybeans after the removal of foreign material on a representative portion of 125 grams.

Grade Designations

After completing the analysis, compare the results with the limits for each grade factor specified in the *Grades and Grade Requirement Table for Soybeans*.

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, shall be shown next;
- The name of the class; and
- The applicable special grades in alphabetical order.

For Mixed soybeans, record the percentage of Yellow soybeans and soybeans of other

colors to the nearest tenth percent on the work record and in the "Remarks" section of the certificate.

Example: U.S. No. 2 Yellow Soybeans

U.S. No. 3 Mixed Soybeans
 In "Remarks": Yellow Soybeans 75.4%
 Soybeans of other colors 24.6%

U.S. No. 2 or better Yellow Soybeans

Work Record

FGIS personnel use Forms FGIS-920, "Grain Sample Ticket," (example below) FGIS-918, "Sample Pan Ticket," FGIS-919, "Sampling Ticket," or FGIS-921, "Inspection Log," to record all sampling and inspection information.

Location		Field Office		Identification	
1 Supervision	Inspection Point Code	Grain Code	01 Wheat 02 Corn 03 Barley 04 Oats	05 Rye 06 Sorgh 07 Flax 08 Soyb 09 Mixed 10 Indigo 11 Sunflower 12 Rapese	99 Not Sldr
2 Sustained Appeal					1 IN 2 LOC 3 CUP
3 Not Sustained Appeal					4 SUB
06 HOPPER	08 BOXCAR	10 BARGE	12 OTHER	1 MICH 3 CUP	1 FILE 2 ORIGINAL
07 TRUCK	09 SHIP	11 SEA VAN		2 PELICAN 4 PROBI	3 FILE
4444	015 <input checked="" type="checkbox"/>	Date Supv Appeal		ORIGINAL INSP.	SUPV/APPEAL INSP
Sampled By	Date Sampled	SNV	Grade Name Code		BAR INSP
Appeal No.	To BAR (Date)	Quantity			
Remarks					
Code	Factor	Original	Supv Appeal	Initials	BAR
	CL				
02	DWG				
03	TW				
04	M				
05	ODOR				
06	HT				
07	CHK				
08	SAD				
09	DKT				
10	CRSE				
11	FINE				
12	FM				
13	SHDN				
14	DEF				
15	COL				
16	WOCL				
17	DHY				
18	HVAC				
19	WHCB				
20	JSDM TARD				
21	SPL				
23	BCFM				
WORK SAMPLE SIZE		GRADE U.S. NO.		CLASS AND SPECIAL GRADE	
SUPV/APPEAL	BAR	Original			
		Bar			
Previous edition obsolete. GRAIN SAMPLE TICKET USDA-FGIS					

Grain Grading Primer

Chapter 9

Sunflower Seed



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Sunflower Seed Definition

Sunflower seed is defined as: Grain that, before the removal of foreign material, consists of 50.0 percent or more of cultivated sunflower seed, and not more than 10.0 percent of other grains for which standards have been established under the United States Grain Standards Act.

There are no classes or subclasses in sunflower seed. Normally, a visual appraisal of the sample is sufficient to determine if it meets the definition of sunflower seed. However, if an analysis is necessary, make the determination before the removal of foreign material, on a portion of 75 grams.

Identifying Sunflower Seed

Cultivated Sunflower Seed is sunflower seed grown for oil content. Cultivated sunflower seed includes samples or lots comprised of mixtures of confectionery and oil type seeds or pure confectionery seed, provided the mixture or pure confectionery seed are presented for inspection as sunflower seed marketed for oil content.

The term seed in this and other definitions related to sunflower seed refers to both the kernel and hull. The Hull or Husk is the ovary wall of the sunflower seed. The Kernel or Meat is the interior contents of the sunflower seed that are surrounded by the hull. The terms “kernel” and “meat” are used synonymously.

Except for the definition of admixture, a hull does not constitute a sunflower seed. According to the definition, a sunflower seed can be either the hull and the kernel, or just the kernel. Please note that if the hull and kernel together are taken as a sunflower seed, the size of either is irrelevant as long as they are connected.



Cultivated Sunflower Seed



Confectionery Sunflower Seed

Grade Requirements

Sunflower seed is divided into two U.S. numerical grades and U.S. Sample grade. The factors affecting sunflower seed grades include: test weight, heat damaged kernels, total damage, and de-hulled seed.

SUNFLOWER SE ED				
Grade	Minimum Limits of -	Maximum Limits of -		
	Test weight per bushel (pounds)	Damaged Kernels		Dehulled Seed (percent)
		Heat Damaged (percent)	Total (percent)	
U.S. No. 1	25.0	0.5	5.0	5.0
U.S. No. 2	25.0	1.0	10.0	5.0

Sample Grade

Sunflower seed that does not meet the requirements for the grades U.S. Nos. 1 and 2; or contains stones, glass, crotalaria seeds, castor beans, particles of an unknown foreign substance or a commonly recognized harmful or toxic foreign substance, rodent pellets, bird droppings, or other animal filth, or has a musty, sour, or commercially objectionable foreign odor; or is heating or otherwise of distinctly low quality, is sample grade.



Animal Filth



Crotalaria



Castor Bean



Glass



Stones

Special Grade

There is one special grade in sunflower seed. The special grade “Infested” is sunflower seed that is infested with live weevils or other insects injurious to stored grain. Determine infestation on the lot as a whole and/or sample as a whole.



When applicable, the word “Infested” is included in the grade designation.

For example: U.S. No. 1 sunflower seed, Infested

The special grade does not affect the numerical or sample grade designation.

Heating

Sunflower seed developing a high temperature due to microbial activity (fermenting), insect infestation, or sprouting is considered heating. As heating progresses, sunflower seed will usually develop a sour or musty odor.

Care should be taken not to confuse Sunflower seed that is heating with Sunflower seed that is warm because of storage in bins, railcars, or other containers during hot weather.

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

Grade heating Sunflower seed U.S. Sample Grade and record the word “Heating” in the “Remarks” section of the certificate.

Distinctly Low Quality

Consider sunflower seed distinctly low quality when it is obviously of inferior quality and the existing grade factors or guidelines do not accurately reflect the inferior condition. Use all available information to determine whether the sunflower seed is of distinctly low quality. This includes a general examination of the sunflower seed during sampling and an analysis of the obtained sample(s). Sunflower seed 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.

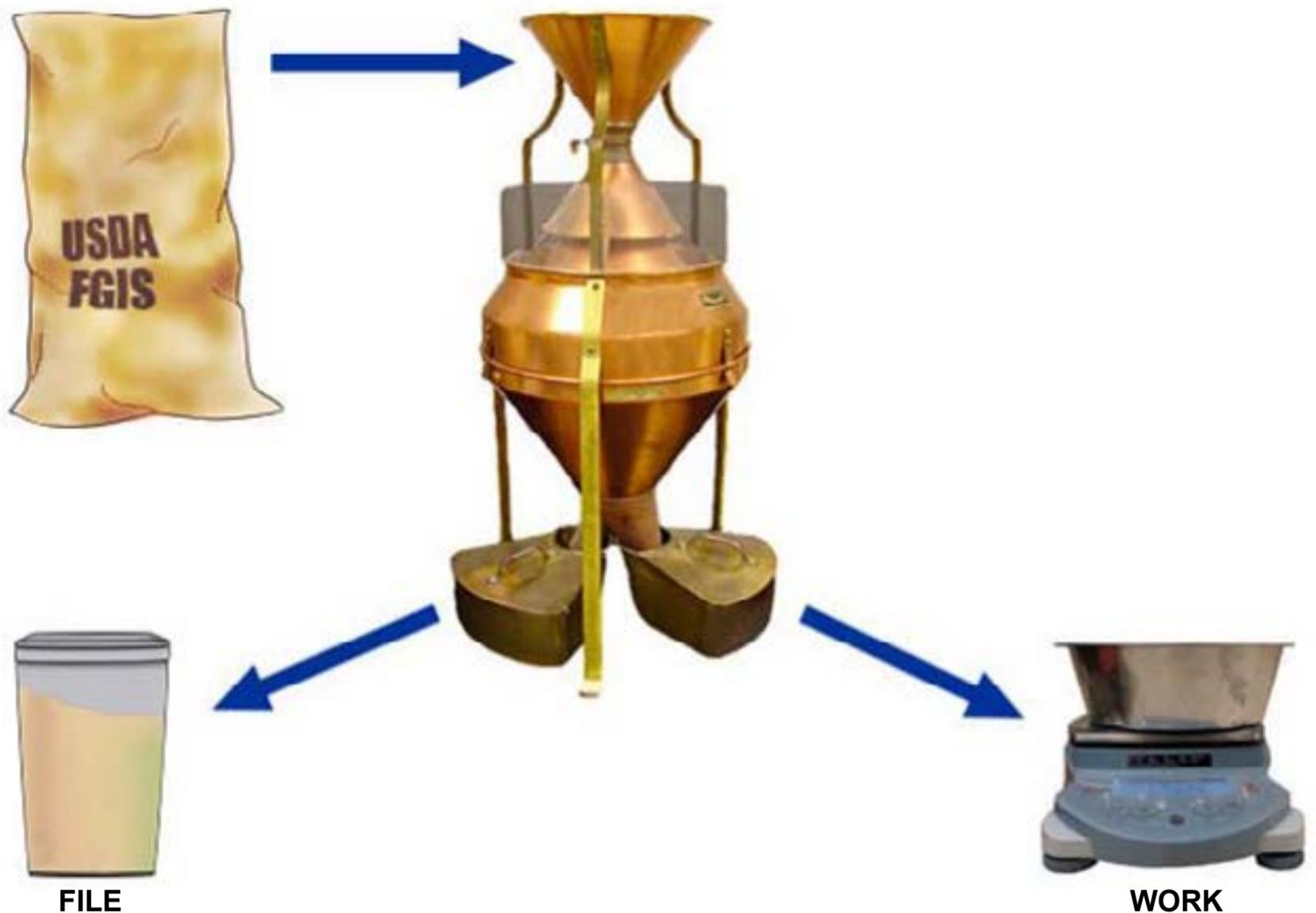
Sunflower seed that is obviously affected by other unusual conditions which adversely affect the quality of the sunflower seed and cannot be properly graded by use of the grading factors specified or defined in the standards is considered distinctly low quality.

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

Processing the Original Sample

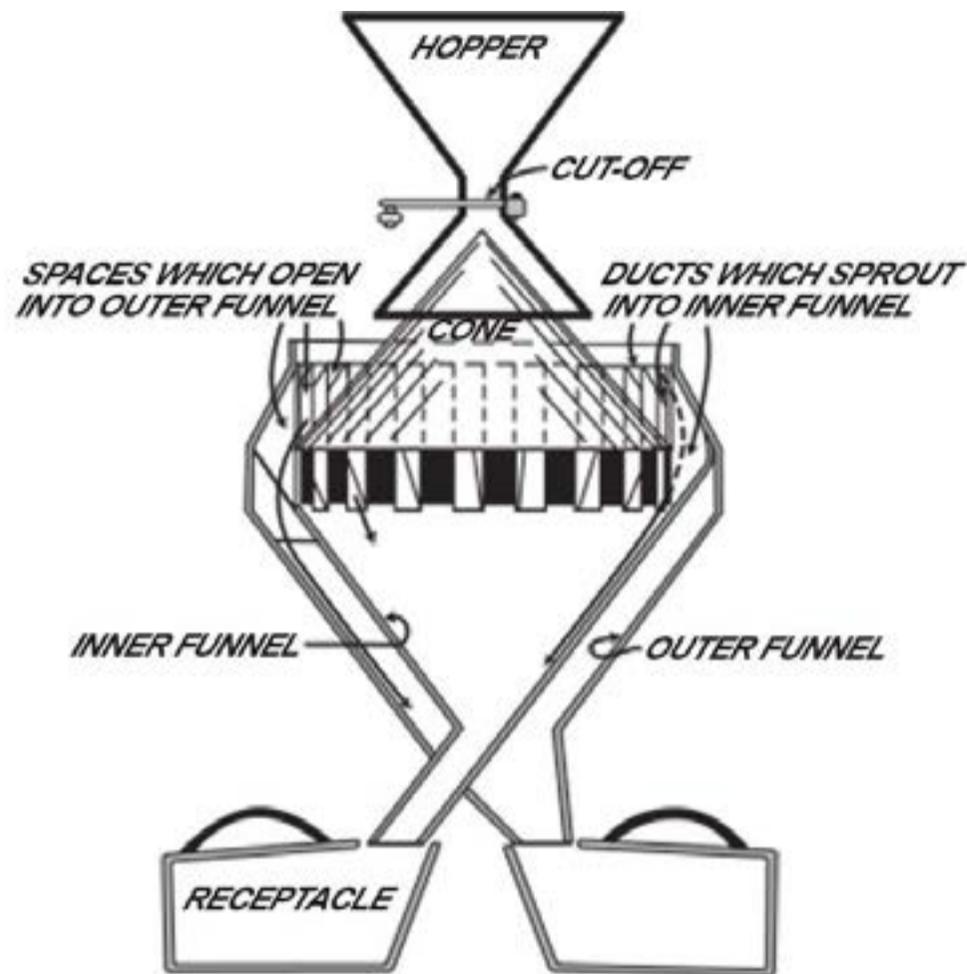
The first step in grading a sunflower seed sample is to use a Boerner divider to reduce the original sample into:

- A file sample of approximately 950 grams.
- A Work portion of approximately 600 grams.



Boerner Divider

The Boerner divider reduces the size of a grain sample while maintaining its representativeness. Each pass of the sample through the divider splits the sample into two equal portions. The Boerner Divider, consists of a hopper, inverted cone, and a series of baffles directing the grain into two collection pans.



As the valve or gate at the base of the hopper is opened, gravity carries the grain over the cone, which serves as a surface by which the kernels can separate into a single layer. Arranged in a circle at the base of the cone are a series of baffles forming alternate channels and spaces of equal width. They are arranged in a circle at their summit and are directed inward and downward, the channels leading to one spout and the spaces to an opposite spout. Each kernel has an equal chance of falling into a channel or a space, resulting in two nearly identical portions of the original sample.

When Operating the Boerner Divider:

- Check the divider for condition and cleanliness.
- Close the hopper valve.
- Place empty collection pans under the discharge spout.
- Pour the sample into the hopper.
- Open the valve quickly.

For larger samples, feed more grain into the hopper during the dividing process.

File Sample

A “file sample,” is a representative sample or representative portion of a sample that is retained for a specified period of time for reference or review purposes.

File samples should be of sufficient size to accommodate subsequent examinations or analysis.

The file sample shall be an unworked portion (if available) of the representative sample used for the inspection.

The worked portion may be retained as the final file only when insufficient sample is available for an unworked file sample.



Use Moisture Proof Containers

Keep all samples in sealed moisture proof containers if they cannot be tested within approximately 15 minutes.

Do not use paper bags, fiber cartons, or similar containers that allow moisture losses. Use metal cans, plastic containers, and plastic bags to preserve the sample integrity.

Do not file samples with paper identification inserted in the grain. Paper absorbs moisture and lowers the moisture of the grain.



Determine Moisture

Moisture is the water content in grain.

Determine moisture before the removal of foreign material on approximately 400 grams.

The DICKEY-john GAC2500-UGMA and the Perten AM5200-A are the designated official moisture meters for performing moisture analysis in grains.



DICKEY-john GAC2500



Perten AM5200-A

Basically, the instruments measure the change in capacitance of two parallel plates when grain is placed between them. As the moisture content within the grain increases or decreases so does its contribution to capacitance, known as its dielectric constant.

The instruments also measure sample density and temperature and perform automatic corrections for those parameters.

Calibration equations have been developed to convert these properties into precise moisture percentages for each grain measured by the instruments.

The test they perform takes about 30 seconds to complete and is a simple and accurate way to obtain moisture analysis in the field.

Certify moisture to the nearest tenth percent.

Odor Determination

Determine odor on evidence obtained at the time of sampling or on the sample either before or after the removal of mechanically cleaned foreign material. Odors are classified as OK, Musty, Sour, or COFO (commercially objectionable foreign odors).

Grade sunflower seed 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.



Musty odors indicate the presence of fungal activity in the grain and are generally characterized as an earthy smell.

Sour odors indicate that the grain is fermenting due to microbial activity. Sour odors are often characterized as an acrid, boot pit or pigpen smell.

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 heat-damaged kernels are present, sunflower seed gives off an odor very similar to smoke. Sunflower seed 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 fire-burnt material is present in the lot or the sample, the smoke odor is considered a commercially objectionable foreign odor.

Check for Insects

Infested sunflower seed is sunflower seed 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 indicates the probability of infestation and warns that the sunflower seed 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 sunflower seed is infested. Do not examine the file sample if the work portion is insect free.

Determine infestation on the lot as a whole and/or sample as a whole. Samples meeting or exceeding any one of these tolerances are infested:

2 live weevils
1 live weevil + 5 other live insects
10 other live insects

When applicable, record the word “Infested” on the certificate.

Live Weevils

Live weevils include rice weevils, granary weevils, maize weevils, cowpea weevils, and lesser grain borers.



**Rice
Weevil**



**Granary
Weevil**



**Maize
Weevil**



**Cowpea
Weevil**



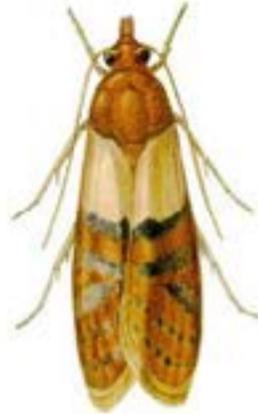
**Lesser Grain
Borer**

Other Live Insects

Other live insects injurious to stored grain include grain beetles, sunflower moths, banded sunflower moths, Indian meal moths, grain moths, and larvae.



**Angoumois
Grain Moth**



**Indian Meal
Moth**



**Red Flour
Beetle**



**Flat Grain
Beetle**

Gray Sunflower Seed Weevil



Larvae of the red or gray sunflower seed weevil are small, white, legless grubs approximately 1/8 inch in size that wander among sunflower seeds. When disturbed, these larvae curl into a ball and remain motionless for minutes. They chew out from inside the sunflower seed and cannot re-infest the seed in storage. Consequently, lots containing sunflower seed weevil larvae are not considered infested. Sunflower seed weevil larvae are considered foreign material.

Check for Sample Grade

Determine U.S. Sample grade criteria before the removal of foreign material based on a work portion of 600 grams. Sunflower seed is graded Sample Grade if it contains:



Animal Filth

Crotalaria

Castor Bean

Glass

Stones

- 8 or more stones which have an aggregate weight in excess of 0.20 percent of the sample weight,
- 2 or more pieces of glass,
- 3 or more crotalaria seeds,
- 2 or more castor beans,
- 4 or more particles of an unknown foreign substance or a commonly recognized harmful or toxic foreign substance,
- 10 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth, per 600 grams of sunflower seed;

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.”

Grade sunflower seed U.S. Sample grade when one or more of the limits are exceeded. Record the reasons why in the “Remarks” section of the certificate. Record count factors to the nearest whole number.

Foreign Material



Foreign Material consists of all matter other than whole sunflower seeds containing kernels that can be removed from the original sample by use of a Carter Dockage Tester and by handpicking a portion of the sample. Determine foreign material on 600 grams of the original sample.

Dockage Tester Calibration

Calibrate each dockage tester that will be used to inspect sunflower seed prior to testing sunflower seed and whenever the internal air-control adjustment is changed. Only dockage testers that are in tolerance for wheat may be calibrated for sunflower seed.

The National Grain Center will provide six sunflower seed calibration samples for calibrating each official field dockage tester. Empty the first sample into a hand sieve bottom pan and mix it thoroughly. The light air dockage may tend to cling to the containers; make an extra effort to retain all components of the sample.

Do not weigh the samples. Calculations shall be based on 600 grams.



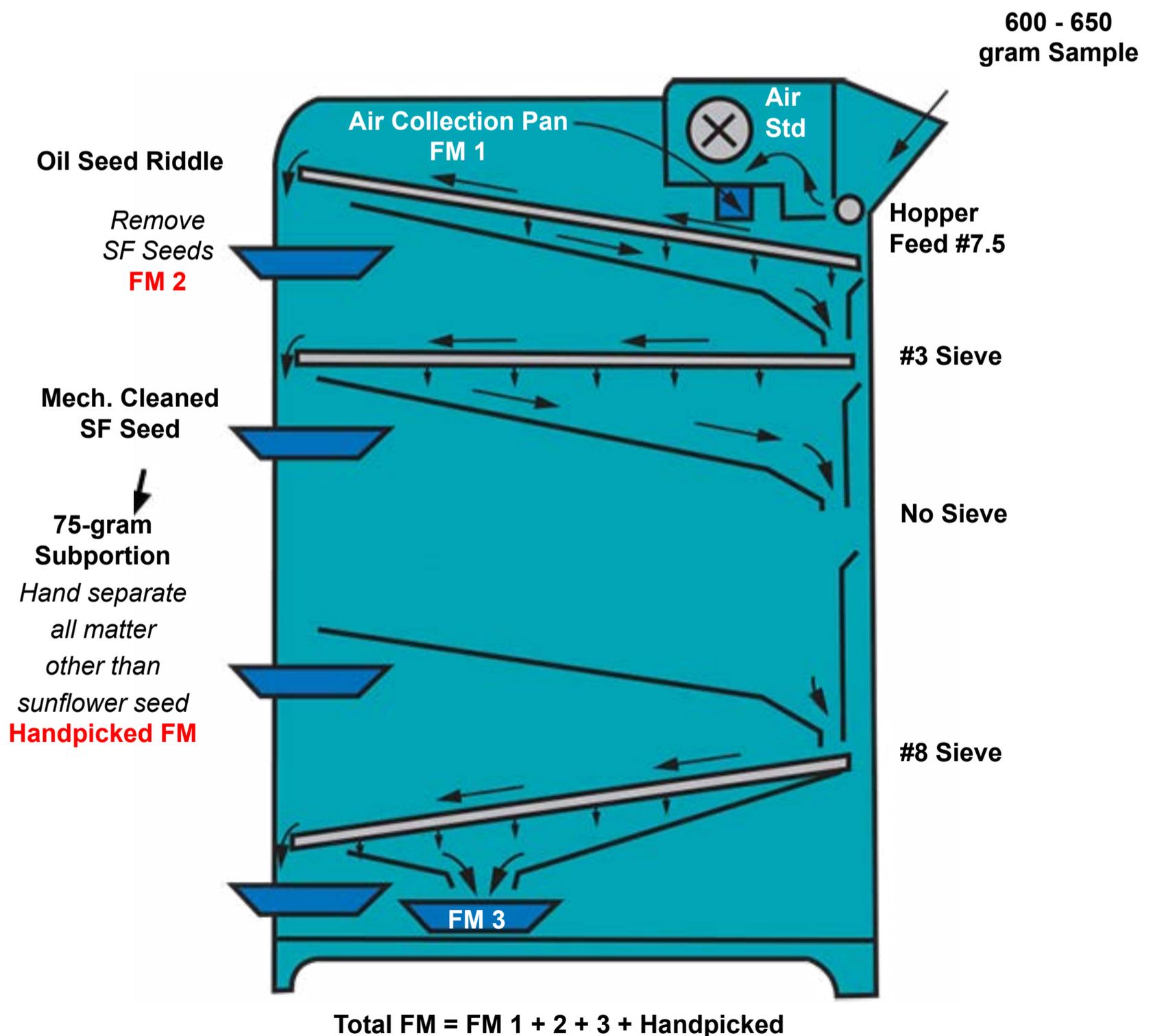
- Turn the tester on. Allow the machine to run until the riddle separation has cleared the riddle. Turn the machine off.
- Clean the riddle and place any material that was lodged in it into its separation pan. Clean the sieves and place any material lodged in them into the clean sample. Put the air, riddle, over-the-bottom sieve, and through-the-bottom sieve separations into individual pans. Weigh each separation and record the results to 0.01 g.
- Compare the weight of the air separation to the known air separation weight for that sample and adjust the air to “0” deviation. Test the second and third samples in the same manner as the first. After each test, correct the air setting as needed.
- After the dockage tester is calibrated, mark the air setting. Test the fourth, fifth, and sixth samples in the same manner as the first three. If the average variation of the test results is within ± 0.5 percent total dockage of TSD’s results, the tester calibration is acceptable.



Mechanical Cleaning

If the percentage of foreign material is requested, use the following procedure. First mechanically clean the sample using the Carter Dockage Tester using the following settings:

- Insert the No. 3 sieve in the top sieve carriage,
- no sieve in the middle carriage,
- the No. 8 sieve in the bottom sieve carriage and
- insert the oilseed riddle.
- Set the air at the standardized setting and the feed control to 7.5.



Run 600 grams through the dockage tester. Remove sunflower seeds from the material removed by the riddle and add to the cleaned sunflower seed.

The aspirated material in the air collection pan is foreign material, the material over the riddle, except for sunflower seeds, is foreign material, and the material in bottom collection pan is foreign material.

Calculate the mechanically separated foreign material.

Handpicking

Cut down the cleaned sample to a portion of 75 grams.

Handpick the 75-gram portion for all matter other than sunflower seed.

Calculate the handpicked foreign material.

Add the percent of mechanically cleaned foreign material and the percent of handpicked foreign material and report to the nearest whole and half percent as follows:

0.00 to 0.24 = 0.0 percent

0.25 to 0.74 = 0.5 percent

0.75 to 1.24 = 1.0 percent, etc.



Mechanically Separated FM

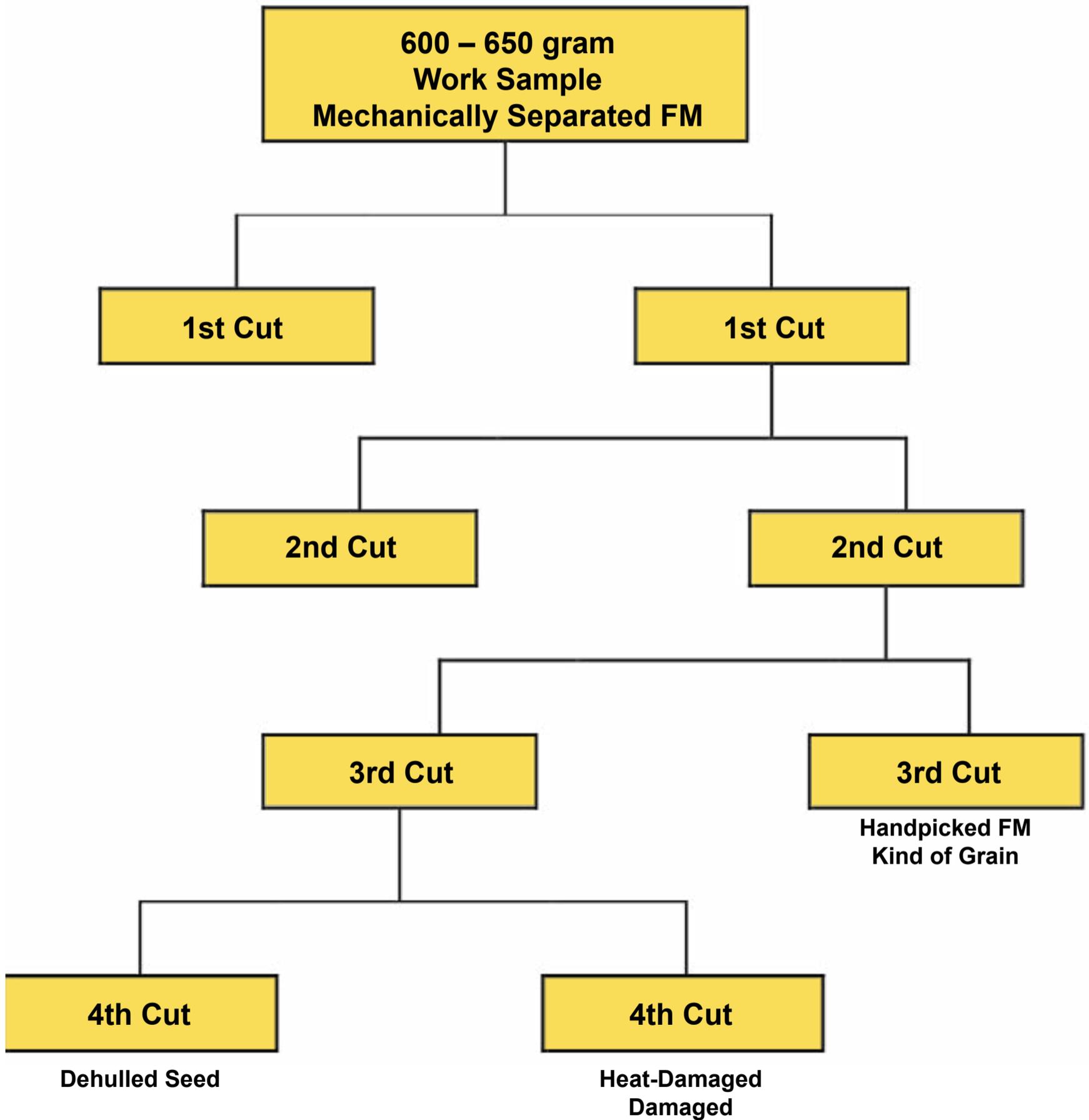


Handpicked FM

Processing the Work Sample

At this point, determinations have been made for those factors determined before the removal of foreign material and the percentage of foreign material has been determined.

Now divide the work sample into fractional portions for those determinations required after the removal of foreign material.



Test Weight per Bushel

The weight per Winchester bushel is determined using an approved device according to procedures prescribed in FGIS instructions. A Winchester bushel is 2150.42 cubic inches or 35.24 liters.

Determine test weight per bushel after the removal of mechanically separated foreign material on a portion of sufficient quantity to overflow the kettle.

Position the hopper over the center of the kettle, making sure the hopper valve is closed. Pour grain into the hopper.

Open the valve allowing the grain to overflow the kettle. Once the hopper is clear of grain move the hopper to the side.

With a rounded edge striker, place it on the edge of the kettle and move the striker in three zigzag motions across the kettle leveling the grain.



Move the kettle to a scale and record the test weight measurement.

Record test weight results on the work record as displayed on the electronic scale or in whole and half pounds. Disregard fractions of a half pound.

Record the test weight on the certificate in whole and half pounds.

If requested, convert the pounds per bushel result to kilograms per hectoliter by multiplying the result by 1.287. Record the result in the "Remarks" section in whole and tenths.

Damaged Sunflower Seed

Damaged sunflower seed is seed and pieces of sunflower seed that are:



- Badly ground damaged
- Badly weathered
- Diseased
- Frost damaged
- Heat damaged
- Damaged-by-heat
- Mold damaged
- Sprout damaged
- Otherwise materially damaged

In general, sunflower seed is considered to be damaged for inspection and grading purposes only 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.

After the removal of mechanically separated foreign material, examine a 30-gram portion (\pm 1.5 gram) and remove all damaged seed except heat-damaged and damaged-by-heat seeds.

Compute the percentage for the damaged seed removed.

Mold Damaged



Sunflower Seeds containing surface mold on one or both sides are considered damaged, if the coverage is equal to or greater than the amount of mold shown on both seeds collectively.

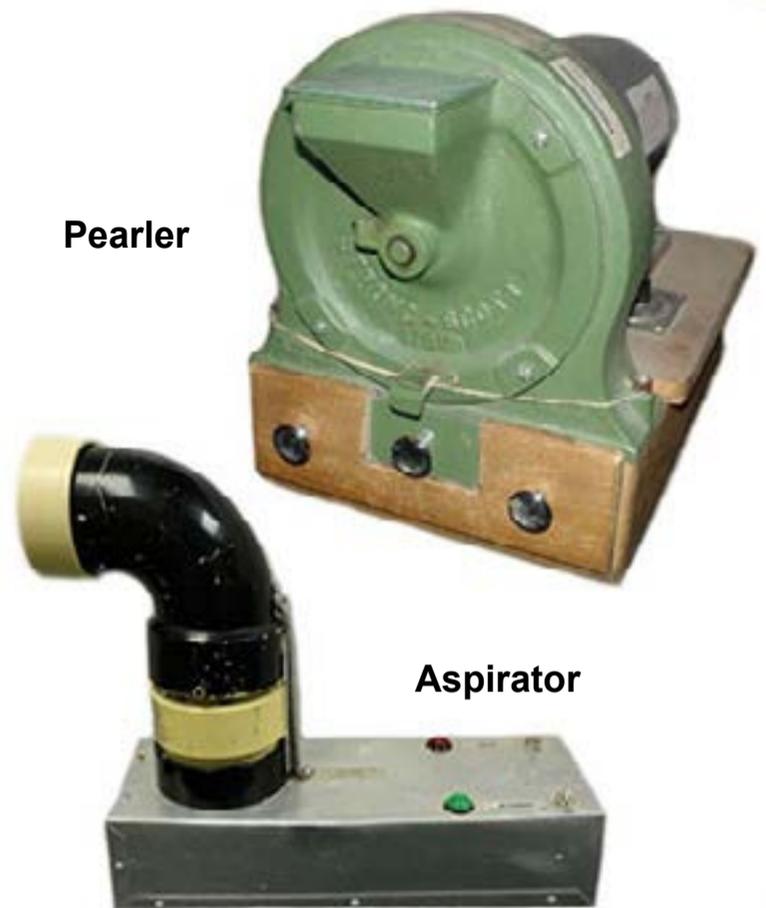
Pearling and Aspiration

Pour the remainder of the 30-gram portion into the barley pearler. Set the timer for a standardized pearl, and pearl the portion.

Remove the hulls from the pearled portion, using the aspirator.

If the hulls are not all removed from the kernels, remove the remaining hulls by hand.

Weigh the pearled portion. After pearling and aspiration, the pearled sample should weigh 14 to 16 grams. If outside this range, reset the timer and pearl another portion.



Heat Damage & Damaged-by-Heat



Separate the heat-damaged kernels and damaged-by-heat kernels from the sound kernels.

Record the percentage of damaged and heat-damaged sunflower seed on the certificate to the nearest tenth percent.

Damaged-by-heat



Kernels and pieces of kernels with both sides as dark or darker than the kernel shown are damaged-by-heat.

Heat Damaged



Seeds damaged by heat usually have a dull dead appearance and are discolored brown or black. Kernels and pieces of kernels with both sides as dark or darker than the kernel shown are heat damaged, and are included in the total percentage for damaged sunflower seed.

Dehulled Seed

Dehulled Seed is sunflower seed that has the hull completely removed from the sunflower kernel.

Determine dehulled seed after the removal of mechanically separated foreign material on a portion of 30 grams.

Record the percent of dehulled seed on the certificate to the nearest tenth percent.



Other Official Criteria

Admixture and oil content are “official criteria factors” and are determined only upon request. They do not affect the grade designation.

Admixture consists of all material other than sunflower seed which can be removed from a test portion by hand sieving and handpicking. Consider empty hulls and parts of seed as sunflower seed.

The major difference between admixture and foreign material is that hulls and pieces of hulls are not included in admixture. Consequently, the percent admixture will usually be lower than the percent foreign material.

The Oil Content of sunflower seed is determined using Nuclear Magnetic Resonance, or NMR technology.



Admixture



NMR Oil Content Determination

Determine Admixture

Determine admixture on a portion of 60 grams before the removal of mechanically separated foreign material as follows:

- Place the 60-gram portion on the upper edge of a 5/64 equilateral triangular hand sieve.
- Hold the sieve at a 10 to 20-degree angle and gently work the material down over the sieve with a side-to-side motion.
- After sieving, handpick all material other than sunflower seed from the material remaining on top of the hand sieve and add it to the material that passed through the hand sieve. Consider empty hulls and parts of seeds as sunflower seed

Admixture consists of all material passing through the sieve, and all material other than sunflower seed, handpicked from the material remaining on top of the sieve.



Foreign Material



Hulls and Partial Seeds

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

Grade Designations

After completing the analysis, assign a grade by comparing the results with the limits for each grade factor specified in the grade chart.

The factor with the lowest grade designation determines the grade assigned to the sample.

Code	Factor	Original	Supv/Appeal	Initials	BAR	Code	Factor	Original	Supv/Appeal	Initials	BAR
	CL					24	HPFM				
02	DKG					25	MSFM				
03	TW	25.0				26	BNFM				
04	M	12.1				33	SKBN				
05	ODOR	OK				36	OCOL SBOC				
06	HT	0.0				60	LW				
07	ODE					62	STON				
08	SKO					54	DH	1.2			
09	DKT						DST	0.7			
10	CHSE										
11	FINE										
12	FM	3.5									
13	SHBN										
14	DEF										
15	CCL										
16	WOCL										
17	DHV										
18	HVAC										
19	WHCB										
20	EMOW FMQR										
21	SPL										
23	BCFM										

Grade	Minimum test weight per bushel (pounds)	Maximum limits of--		
		Damaged sunflower seed		Dehulled seed (%)
		Heat damaged (%)	Total (%)	
U.S. No. 1	25.0	0.5	5.0	5.0
U.S. No. 2	25.0	1.0	10.0	5.0

WORK SAMPLE SIZE		GRADE U.S. NO.		CLASS AND SPECIAL GRADE	
SUPV/APPEAL	BAR	Orig	1	Sunflower Seed	

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, sunflower seed may be certified as U.S. No. 2 or better, U.S. No. 3 or better, etc.

An “or better” grade designation cannot be applied to a U.S. No. 1 grade designation.

Documenting the Grade

Use the following guide for documenting the assigned grade:

- First write the letters “U.S.”,
- Then, the abbreviation “No.” and the number of the grade or the words “Sample grade”, followed by the words “or better”, when applicable.
- The words “sunflower seed”,
- and finally, the special grade designation “Infested” when applicable

For Example: U.S. No. 2 sunflower seed, Infested

Grain Grading Primer

Chapter 10

Wheat



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Wheat is defined as:

*Grain that, before the removal of dockage, consists of 50 percent or more common wheat (*Triticum aestivum* L.), Club wheat (*T. compactum* Host.), and Durum wheat (*T. durum* Desf.) and not more than 10 percent of other grains for which standards have been established under the United States Grain Standards Act and that, after the removal of dockage, contains 50 percent or more of whole kernels of one or more of these wheats.*



Wheat Classes

Wheat is divided into eight classes based on color and kernel and variety characteristics: ***Hard Red Spring, Hard Red Winter, Soft Red Winter, Hard White, Soft White, Durum, Unclassed*** and ***Mixed Wheat***.

Hard Red Spring, Soft White and Durum Wheat are further divided into subclasses.

Hard Red Spring Wheat includes all varieties of Hard Red Spring wheat. This class is divided into three subclasses: *Dark Northern Spring, Northern Spring and Red Spring Wheat*.

Hard Red Winter Wheat includes all varieties of Hard Red Winter wheat. There are no subclasses in this class.

Soft Red Winter Wheat includes all varieties of Soft Red Winter wheat. There are no subclasses in this class.

Hard White Wheat includes all hard endosperm white wheat varieties. There are no subclasses in this class.

Soft White Wheat includes all soft endosperm white wheat varieties. This class is divided into three subclasses: *Soft White, White Club and Western White Wheat*.

Durum Wheat includes all varieties of white (amber) Durum Wheat. This class is divided into three subclasses: *Hard Amber Durum, Amber Durum and Durum Wheat*.

Un-classed Wheat is any variety of wheat which is not classifiable under other criteria provided in the wheat standards. There are no subclasses in this class. This class includes any wheat which is other than red or white in color.

Mixed Wheat is any mixture of wheat which consists of less than 90 percent of one class and more than 10 percent of one other class, or a combination of classes which meet the definition of wheat.

Grade Requirements

Each class and subclass is divided into five U.S. numerical grades and U.S. Sample Grade.

Special grades are provided to emphasize special qualities or conditions affecting the value of wheat and are added to and made a part of the grade designation. Special grades do not affect the numerical or sample grade designation.

Grade Mixed wheat according to the U.S. numerical and U.S. Sample Grade requirements of the predominating class in the mixture. Disregard wheat of other classes.

GRADES AND GRADES REQUIREMENT CHART

WHEAT									
Grade	Minimum Limits of -		Maximum Limits of -						
	Test Weight per bushel		Damaged Kernels		Foreign material (percent)	Shrunken and broken kernels (percent)	Defects ¹ (percent)	Wheat of other classes ²	
	Hard Red Spring Wheat or White Club Wheat (pounds)	All other classes and subclasses (pounds)	Heat damage (part of total) (percent)	Total (percent)				Contrasting classes (percent)	Total ³ (percent)
U.S. No. 1	58.0	60.0	0.2	2.0	0.4	3.0	3.0	1.0	3.0
U.S. No. 2	57.0	58.0	0.2	4.0	0.7	5.0	5.0	2.0	5.0
U.S. No. 3	55.0	56.0	0.5	7.0	1.3	8.0	8.0	3.0	10.0
U.S. No. 4	53.0	54.0	1.0	10.0	3.0	12.0	12.0	10.0	10.0
U.S. No. 5	50.0	51.0	3.0	15.0	5.0	20.0	20.0	10.0	10.0

¹ Defects include damaged kernels (total), foreign material, and shrunken and broken kernels. The sum of these three factors may not exceed the limit for defects for each numerical grade.

² Unclassed wheat of any grade may contain not more than 10.0 percent of wheat of other classes.

³ Includes contrasting classes.

Sample Grade

U.S. Sample Grade is wheat that:

- Does not meet the requirements for grades U.S. No. 1 through 5;
- Contains 4 or more stones or any number of stones which have an aggregate weight in excess of 0.1 percent of the sample weight; 1 or more pieces of glass, 3 or more crotalaria seeds, 2 or more castor beans, 4 or more particles of an unknown foreign substance or a commonly recognized harmful or toxic foreign substance, 2 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth per 1,000 grams of wheat;
- Contains 5 or more animal filth, castor beans, crotalaria seeds, glass, stones, or unknown foreign substance(s) in any combination;

Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor);

- Is heating or otherwise of distinctly low quality;
- Contains more than 31 insect-damaged kernels in 100 grams.

Basis of Determination

The “Basis of Determination” establishes the rules for testing/analyzing all factors. Do not analyze any factor until the basis for making the determination is known.

BASIS OF DETERMINATION			
Lot as a Whole	Factors Determined Before the Removal of Dockage	Factors Determined After the Removal of Dockage	Factors Determined After the Removal of Dockage and Shrunken and Broken Kernels
Distinctly low quality Heating Infested Odor	Distinctly low quality Garlicky Heating Infested Kind of grain Shrunken and broken Moisture Odor Odor (smut) Other unusual conditions U.S. Sample Grade factors	Ergot Kind of grain Odor Protein Shrunken and broken kernels Smut Stones Test weight Treated	Class Contrasting classes Damaged kernels (total) Foreign material Heat-damaged kernels Subclass Wheat of other classes

The determination of Distinctly Low Quality (DLQ) 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.

Each determination of rodent pellets, bird droppings, other animal filth, broken glass, castor beans, cockleburs, crotalaria seeds, 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.

Each determination of heat-damaged kernels, damaged kernels, foreign material, wheat of other classes, contrasting classes, and subclasses is made on the basis of the grain when free from dockage and shrunken and broken kernels. Other determinations not specifically provided for under the General Provisions are made on the basis of the grain when free from dockage, except the determination of odor is made on either the basis of the grain as a whole or the grain when free from dockage.

Distinctly Low Quality

Consider wheat DLQ when it is obviously of inferior quality and the existing grade factors or guidelines do not accurately reflect the inferior condition.

Use all available information to determine whether the wheat is DLQ. This includes a general examination of the wheat during sampling and an analysis of the obtained sample.

Wheat 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 DLQ.

Wheat that is obviously affected by other unusual conditions which adversely affect its quality but which cannot be properly graded by use of the grading factors specified or defined in the standards is also considered DLQ.

Wheat 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 wheat contains diatomaceous earth, then the wheat is not considered distinctly low quality due to diatomaceous earth. Refer to *Program Directive 9180.49*, for additional information regarding diatomaceous earth.



Heating

Wheat developing a high temperature from microbial activity is considered heating. As heating progresses wheat will develop a sour or musty odor. Care should be taken not to confuse wheat that is heating with wheat that is warm because of storage in bins, railcars, or other containers during hot weather.

Odor Determination

Basis of Determination. *Determine odor on evidence obtained at the time of sampling or on the sample either before or after the removal of dockage.*

When grain has a “distinct” odor, it should be graded *musty, sour, or commercially objectionable foreign odor*.

The definition of “distinct”, when it pertains to odor, is not the intensity of the off-odor, but the presence of the off-odor. The consensus approach is not required if no odor, or a distinct odor, is present.

Musty odors indicate the presence of fungal activity in the grain and are generally characterized as an earthy smell.

Sour odors indicate that the grain is fermenting due to microbial activity. Sour odors are often characterized as an acrid, boot pit or pigpen smell.

Commercially Objectionable Foreign Odor (COFO) are odors, except smut and garlic odors, foreign to grain that render it unfit for normal commercial usage. Sources of COFO include fumigants, oil products, smoke, fertilizer, weeds, decaying animal or plant matter, etc.

Special Grades

Special grades are provided to emphasize special qualities or conditions affecting the value of wheat and are added to and made a part of the grade designation. There are six special grades in wheat:

Ergoty wheat is wheat that contains more than 0.05 percent ergot. Ergot is a hard, reddish-brown or black grain-like mass of certain parasitic fungi that replaces the kernels of wheat. Ergot also functions as foreign material.

Garlicky wheat is wheat that contains in a 1,000-gram portion more than two green garlic bulblets or an equivalent quantity of dry or partly dry bulblets. Three dry or partly dry garlic bulblets are equal to one green bulblet. Garlic bulblets also function as dockage or foreign material.

Light Smutty wheat is wheat that has an unmistakable odor of smut or which contains, in a 250-gram portion, smut balls, portions of smut balls, or spores of smut in excess of a quantity equal to 5 smut balls, but not in excess of a quantity equal to 30 smut balls of average size.

Smutty wheat is wheat that contains in a 250-gram portion, smut balls, portions of smut balls, or spores of smut in excess of a quantity equal to 30 smut balls of average size.

Infested wheat is wheat that is infested with live weevils or other live insects injurious to stored grain. Do not examine the file sample if the work portion is insect free. If the work and file samples contain 2 or more live insects injurious to stored grain the sample is infested.

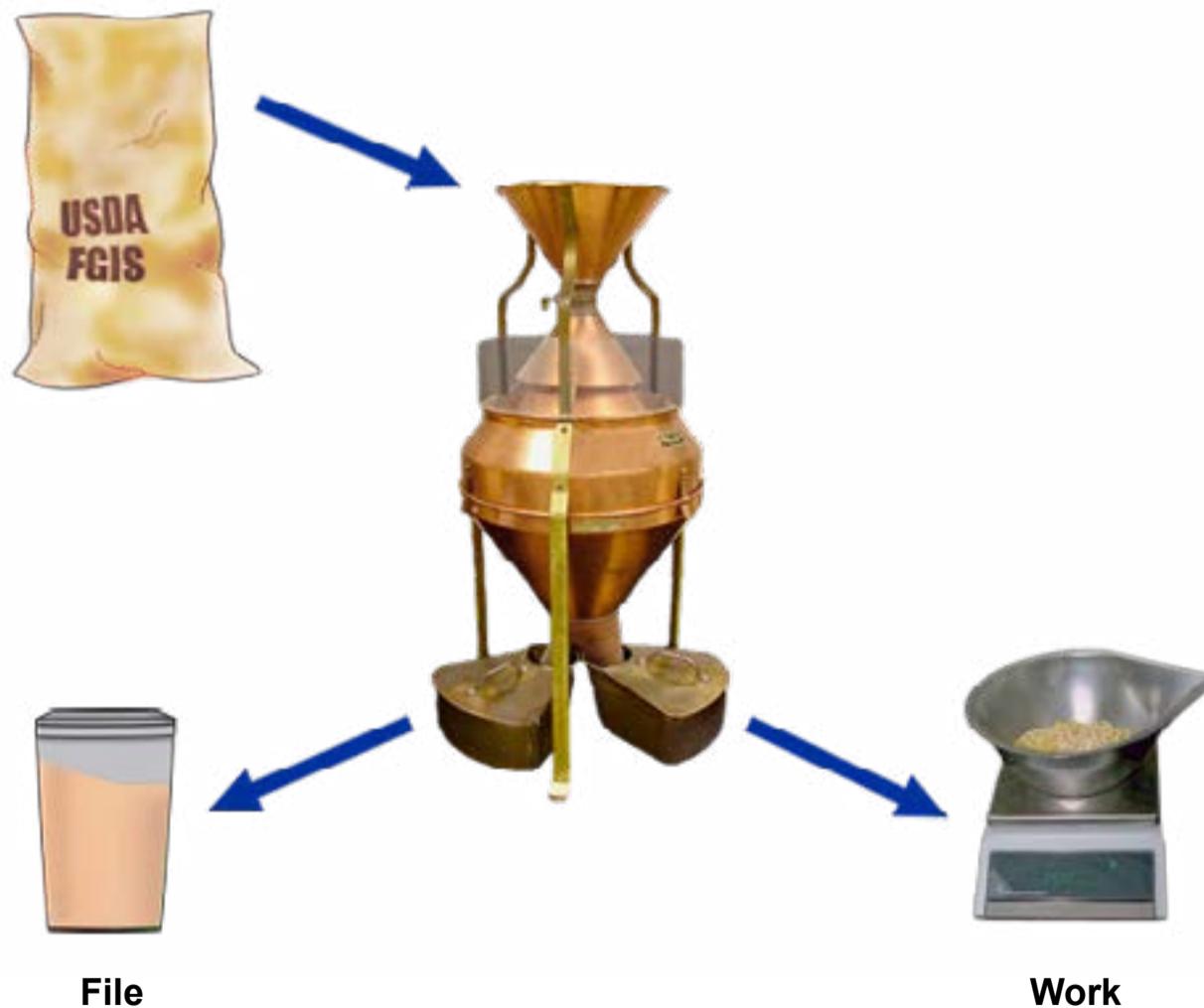
Treated wheat is wheat that has been scoured, limed, washed, sulfured, or treated in such a manner that the true quality is not reflected by either the numerical grades or the U.S. Sample grade designation alone.

Processing an Original Sample

The Boerner Divider reduces the size of a grain sample while maintaining the representativeness of the original sample. Use the Boerner divider, or a divider that gives equivalent results, when reducing a sample to the portion size required for a specific test/analysis.

When dividing the original sample the first pass through the divider will result in two equal portions. One of these portions should be set aside as a “file sample”. The other portion, a “work portion” will be reduced down to smaller quantities or use in determining required tests and analysis specific to the type of grain being graded.

Original Sample



Operating Procedures

- Check the divider for condition and cleanliness
- Close the hopper valve
- Place empty collection pans under the discharge spouts
- Pour the sample into the hopper
- Open the valve quickly. For large samples, feed more grain into the hopper during the dividing process.

File Sample

A “file sample” is a representative sample or representative portion of a sample that is retained for a specified period of time for reference or review purposes. File samples should be of sufficient size to accommodate subsequent examinations or analysis. The file sample shall be an unworked portion (if available) of the representative sample used for the inspection. The worked portion may be retained as the final file only when insufficient sample is available for an unworked file sample.

Keep all samples in sealed moisture proof containers if they cannot be tested within approximately 15 minutes. Do not use paper bags, fiber cartons, or similar containers that allow moisture losses. Use metal cans, plastic containers, and plastic bags to preserve the sample integrity. Do not file samples with paper identification inserted in the grain. Paper absorbs moisture and lowers the moisture of the grain.



Moisture Determination

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 650 grams.*

The user interfaces are slightly different for the two UGMA compatible moisture meters. Use the keypad to choose the type of grain to analyze.

Fill the hopper and press the load key to start the test cycle. After the moisture analysis is complete observe the result on the display, record it and reclaim the sample from the discharge tray.

For additional information, refer to the GIPSA Moisture Handbook.

GAC2500-UGMA



Perten AM 5200-A



U.S. Sample Grade Factors

Basis of Determination. *Determine U.S. Sample Grade criteria, except stones, before the removal of dockage based on a work portion of 1,000-1,050 grams.*

Examine the sample for Sample Grade factors such as animal filth, glass, toxic seeds, and unknown foreign substances.

Consider identifiable pieces of grain, processed grain products such as 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".

Kernels of wheat discolored by treatment with a fungicide or similar substance such as "pink wheat" are considered as being discolored by an unknown foreign substance.

**Toxic Seeds
(Crotalaria)**



Animal Filth



Dockage

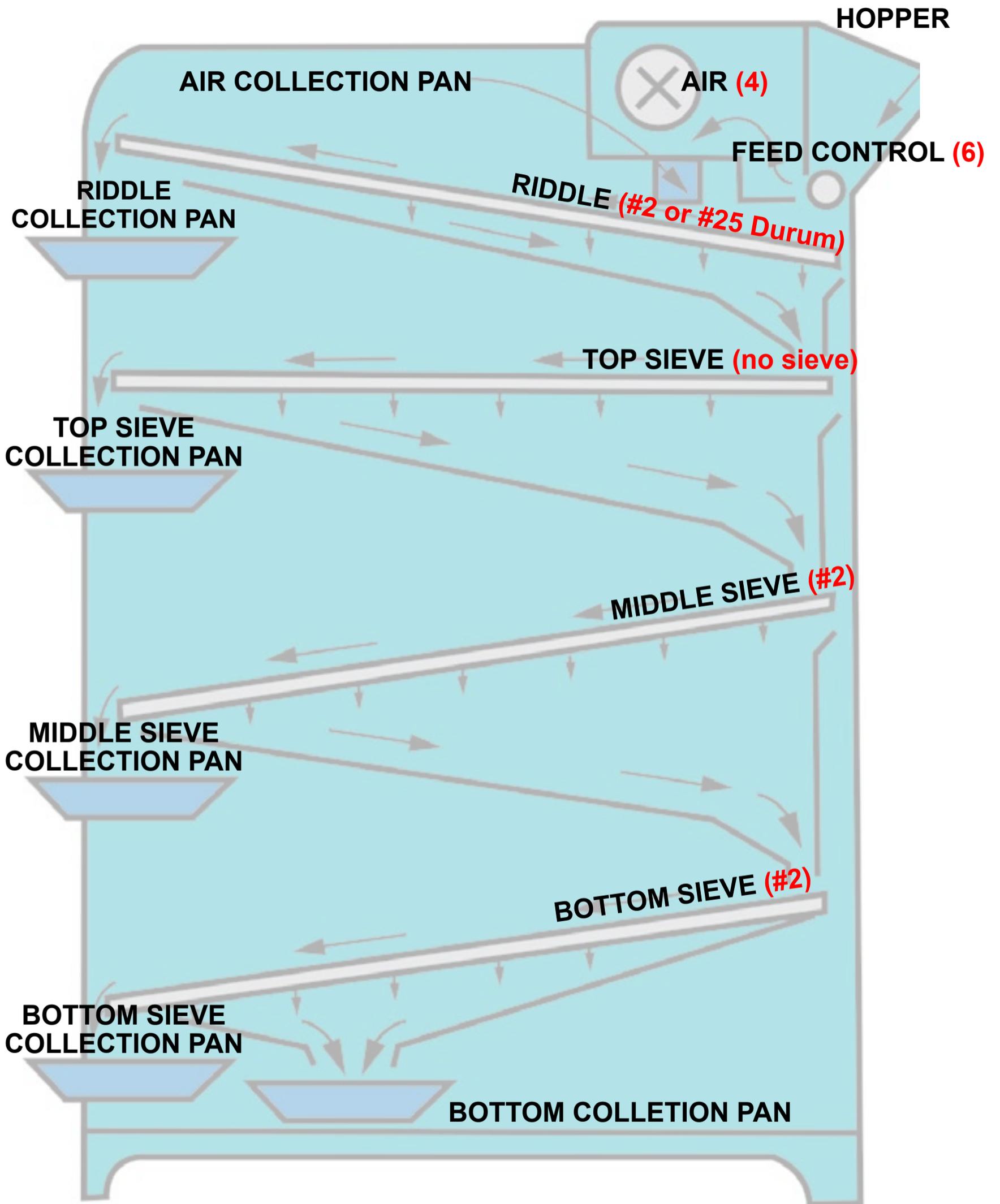
All matter other than wheat that can be removed from the original sample (1,000 to 1,050 grams) by use of an approved device according to procedures prescribed in FGIS instructions. Also, underdeveloped, shriveled, and small pieces of wheat kernels removed in properly separating the material other than wheat and that cannot be recovered by properly rescreening or recleaning.

The Carter Dockage Tester uses aspiration or air and a combination of riddles and sieves to prepare samples for grading by removing the readily separable foreign matter.

Generally, foreign material removed consists of all matter lighter, larger, or smaller than grain.



Carter Dockage Tester



Dockage Tester Operating Procedures

- Air Control: 4
- Feed Control: 6
- Riddle Carriage: #2 riddle for wheat other than Durum or #25 riddle for Durum
- No sieve in the top sieve carriage
- Middle and Bottom Sieve Carriages: #2 sieves
- Check the air collection pan to see if it is empty and place the collection pans in the prescribed locations.
- Start the dockage tester and pour the wheat sample in the feed hopper. When all of the grain has cleared the hopper, riddle, and sieves, turn the tester off. Collect all material separated by the riddle, aspirator, and sieves.

Determine Dockage

Aspirated material in the air collection pan is dockage.

Material over the riddle, except for threshed and sprouted kernels is dockage. Threshed kernels do not have more than one glume attached. Place threshed and sprouted kernels in the cleaned wheat.

Material passing over the bottom sieve is dockage if it contains less than 50 percent (by weight) of wheat kernels. If 50 percent or more of wheat kernels pass over the bottom sieve, return the material to the cleaned wheat.

Material in the bottom collection pan is dockage.

Record dockage to the nearest tenth percent on the work record and the certificate. If dockage is less than one-tenth percent, report as "Dockage 0.0%."

Test Weight

Test weight per bushel is the weight per Winchester bushel (2,150.42 cubic inches) as determined using an approved device. The determination for test weight is made on a portion of sufficient quantity to overflow the kettle.

General Operating Procedures

1. Level and balance the test weight per bushel apparatus.
2. Close the hopper valve.
3. Pour the work sample into the hopper.
4. Center the hopper over the kettle.
5. Fill the kettle by opening the hopper valve quickly.
6. Move the hopper all the way to the left before proceeding. Do not jar the apparatus. Jarring could cause inaccurate results.
7. Using a standard stoker, stroke the kettle by holding the stoker in both hands with the flat sides in a vertical position. Level the grain in the kettle by making three full length, zigzag motions with the stoker.
8. Place an empty sample pan or the test weight kettle on the scale and zero the scale. Pour the sample from the kettle into the sample pan or place the filled kettle onto the scale as appropriate. Read the result from the test weight mode selected.
9. Record the test weight per bushel on the work record.



Shrunken and Broken Kernels

Shrunken and broken kernels consist of all matter that passes through a 0.064 x 3/8 oblong-hole sieve after sieving. Mechanical sieving is preferred over the hand-sieving method because the results are more uniform and accurate in counting the number of strokes. Cut out a 250 gram portion for shrunken & broken kernels using the Boerner Divider.

Mechanical Sieving Procedures

1. Make sure mechanical shaker is level.
2. Mount the 0.064 x 3/8-inch oblong-hole sieve and the bottom pan on the mechanical sieve shaker with the sieve perforations parallel to the direction of movement.
3. Set the stroke counter for 30 strokes.
4. Gently pour the 250-gram portion of Wheat in the center of the sieve. Turn the machine on. After the required number of strokes has been completed, the machine will automatically stop. Carefully remove the sieve and bottom pan.



All material passing through the sieve is considered shrunken and broken kernels. Return the material that is lodged in the perforations to the wheat which remained on top of the sieve. To remove the lodged material from the perforations, rub the sieve bottom gently.

NOTE: Tapping will warp the sieve and lead to inaccurate results in future determinations.

If an approved mechanical shaker is unavailable, inspectors may handsieve the sample. When handsieving, place the 250-gram portion in the center of the sieve, 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.

Dividing the Work Sample

After all tests required to be performed prior to the removal of dockage have been made, the percentage of dockage has been determined and the sample has been test weighed and examined for certain sample grade and special grade factors, divide the work sample into fractional portions for other determinations required after the removal of dockage.

APPROXIMATE ANALYTICAL PORTION SIZES	
Factors	Grams
Ergot	1,000
Shrunken and broken kernels	250
Smut	250
Class	15
Contrasting classes	15
Damaged kernels (total)	15
Foreign material	50
Heat-damaged kernels	50
Insect-damaged kernels	100
Insect-damaged kernels Stage 1	15
Insect-damaged kernels Stage 2	15
Insect-damaged kernels Stage 3	100 – (Stage 1 + Stage 2)
Subclass	15
Wheat of other classes	15

Class Determination

Determine class on a dockage-free and shrunken and broken-free portion of 15 grams. Use kernel and varietal characteristics when making this determination.

Durum wheat is divided into three subclasses:

- **Hard Amber Durum Wheat** is durum wheat with 75 percent or more of hard and vitreous kernels of amber color.
- **Amber Durum Wheat** is durum wheat with 60 percent or more but less than 75 percent of hard and vitreous kernels of amber color.
- **Durum Wheat** is durum wheat with less than 60 percent of hard and vitreous kernels of amber color.

Hard Red Spring wheat is divided into three subclasses:

- **Dark Northern Spring Wheat** is Hard Red Spring wheat with 75 percent or more of dark, hard, and vitreous kernels;
- **Northern Spring Wheat** is Hard Red Spring wheat with 25 percent or more but less than 75 percent of dark, hard and vitreous kernels;
- **Red Spring Wheat** is Hard Red Spring wheat with less than 25 percent of dark, hard, and vitreous kernels.

Hard Red Winter Wheat. All varieties of Hard Winter wheat. There are no subclasses in this class.

Soft Red Winter Wheat. All varieties of Soft Red Winter wheat. There are no subclasses in this class.

Hard White Wheat. All hard endosperm white wheat varieties. There are no subclasses in this class.

Soft White Wheat is divided into the following three subclasses:

- **Soft White Wheat** which is soft endosperm white wheat varieties that contain not more than 10 percent of white club wheat.
- **White Club Wheat** which is soft endosperm white club wheat containing not more than 10 percent of other soft white wheats.
- **Western White Wheat** which is soft white wheat containing more than 10 percent of white club wheat and more than 10 percent of other soft white wheats.

Unclassed Wheat. Any variety of wheat which is not classifiable under other criteria provided in the wheat standards. There are no subclasses in this class. This class includes any wheat which is other than red or white in color.

Mixed Wheat. Any mixture of wheat which consists of less than 90 percent of one class and more than 10 percent of one other class, or a combination of classes which meet the definition of wheat.

Kernel Characteristics. Kernel characteristics include the color, shape, and length of the kernel and the shape of the germ, crease, and brush. Inspection personnel should be familiar with kernel characteristics of all classes of wheat handled in their market.

Varietal Characteristics. Some varieties possess characteristics of two or more classes. Knowledge of distinct varietal characteristics is necessary in making class determinations. Inspection personnel should be familiar with the characteristics of all varieties of wheat handled in their market.

Classification of Recognized Varieties. Hard red varieties of wheat grown during the winter season in Arizona, California, Nevada, New Mexico, and Texas and marketed in these States are classed as Hard Red Winter Wheat.

Distinguishing Between White and Red Kernels in Hard or Soft Wheat. To assist in the detection of white and red wheat kernels in samples of Hard or Soft wheat, official personnel may use the commercially available sodium-hydroxide test kit, or the potassium-hydroxide test method developed by FGIS.

The tests can serve as a useful tool when samples challenge the normal visual inspection method. Due to the resulting similarity in kernel color after the process is completed and the affect these chemical processes may have on kernel morphology, it is necessary to determine whether a sample contains different classes of white or red wheat prior to performing the test.

Sodium-Hydroxide Test. The sodium-hydroxide turns red wheat a dark red in color, and turns white wheat a straw yellow in color. When using the commercially available test kit, follow the procedures as provided by the test kit manufacturer.

Potassium-Hydroxide Test. Use the following procedure:

1. Place approximately 15 grams of wheat in a mixing jar.
2. Add 10 grams of potassium-hydroxide (KOH) pellets.
3. Add 40 ml of bleach.
4. Set stirring head on jar, place jar on mixer, and mix for 1 to 1½ minutes.
5. Pour the wheat from the mixing jar into a tea strainer and rinse with warm tap water to remove the sodium-hydroxide/bleach solution.
6. After rinsing, lightly tap the tea strainer against the edge of the sink to remove the excess water. Gently press the bottom of the tea strainer on a dry paper towel to remove any additional water.
7. Place the wheat on a dryer sieve and dry until the kernels are not tacky when picked up with a pair of tweezers.

8. Remove the wheat from the drying sieve and observe the color. White wheat turns a light straw or amber color. Red wheat turns a dark brownish /red color.

Caution: Too much potassium-hydroxide (step 2) or over mixing (step 4) may remove the bran in red wheat.

Subclass

Subclass is determined on Hard Red Spring wheat, Durum wheat and Soft White wheat.

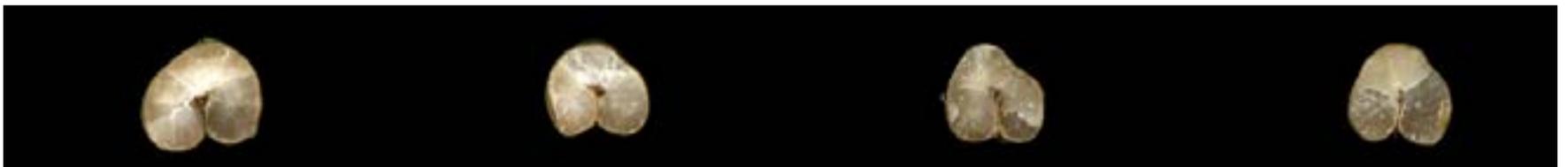
When an analysis is necessary, determine subclass on a dockage-free and shrunken and broken-free portion of 15 grams.

Record the subclass and percentage of Dark Hard And Vitreous kernels (DHV), Hard & Vitreous kernels of Amber Color (HVAC), and White Club wheat kernels on the work record to the nearest tenth percent and on the certificate to nearest whole percent.

Hard Red Spring Wheat

- Consider hard red spring kernels which are bleached but are hard, or hard and vitreous as DHV.
- Consider hard red spring kernels which have cracks or checks that cause a cloudy or shadowy spot on the kernel but are otherwise dark, hard, and vitreous as DHV.
- Consider kernels of Soft Red Winter wheat and Hard Red Winter wheat as DHV when they are dark, hard, and vitreous in texture.
- Kernels which are yellow or contain a mottled spot, regardless of size, distinctly green immature kernels, severely affected by scab, sprouted, foreign material, and kernels of Hard White wheat, Unclassed wheat, Soft White wheat, and Durum wheat are not considered DHV.

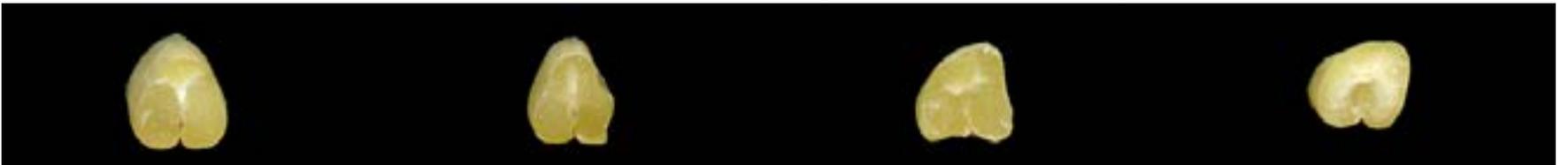
DHV Wheat Kernels (cross-sectioned)



Durum Wheat

- Consider Durum kernels which are bleached but which are hard and vitreous as HVAC.
- Consider Durum kernels which have cracks or checks that cause a cloudy or shadowy spot on the kernel but which are otherwise hard and vitreous as HVAC.
- Kernels with mottled or chalky spots, regardless of size, are not considered HVAC.
- Distinctly green immature kernels, kernels affected by scab, sprouted kernels, foreign material, and all other classes of wheat are not considered HVAC.
-

HVAC Wheat Kernels (cross-sectioned)



Soft White Wheat

- The percentage of White Club wheat is applicable to all subclasses of Soft White wheat.

Determine Damaged Kernels (Total)

Damaged Kernels Total (DKT) is kernels, pieces of wheat kernels and other grains 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.

Determine damaged kernels on a dockage-free and shrunken and broken-free portion of 15 grams.

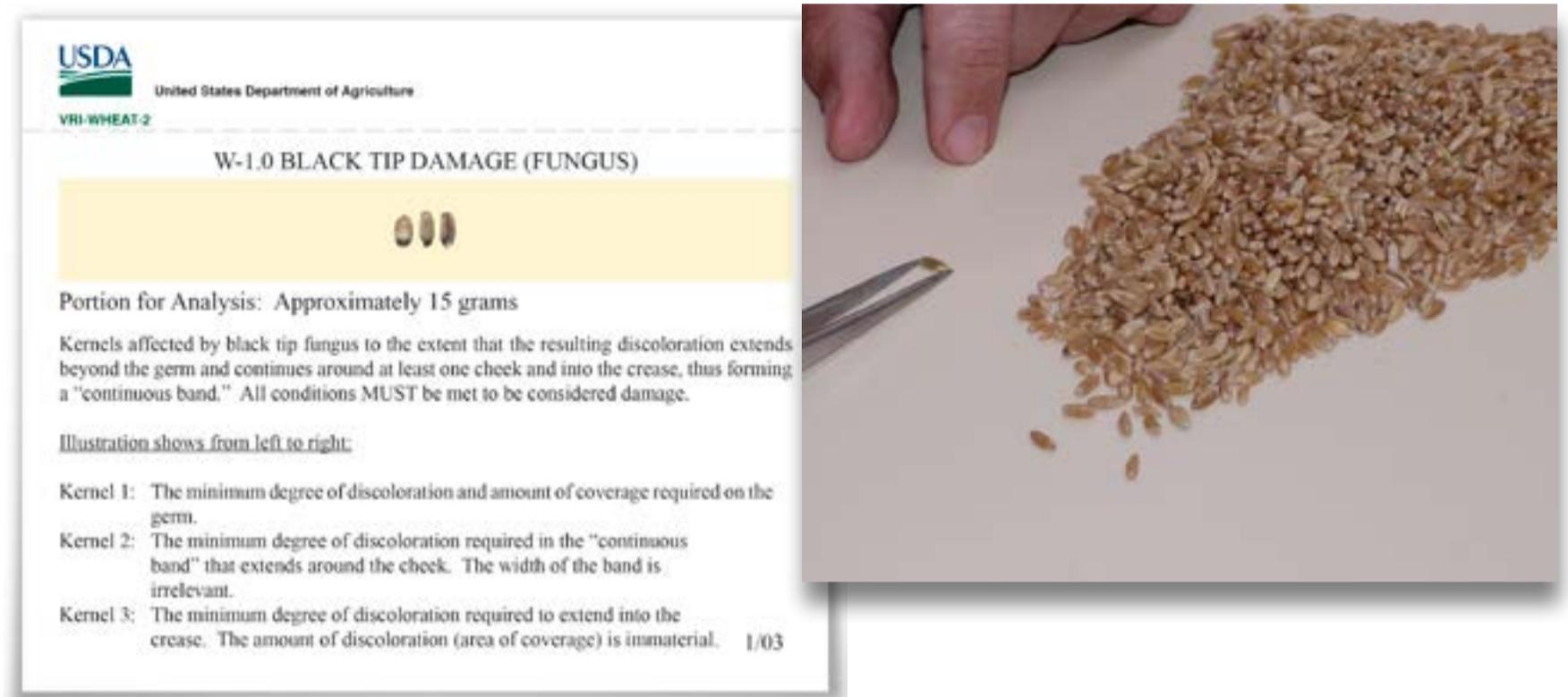
In general, a kernel of wheat and/or kernels of other grains are considered damaged for inspection and grading purposes only when the damage is distinctly apparent and of such character as to be recognized as damaged for commercial purposes.

Visual Reference Images (VRI)

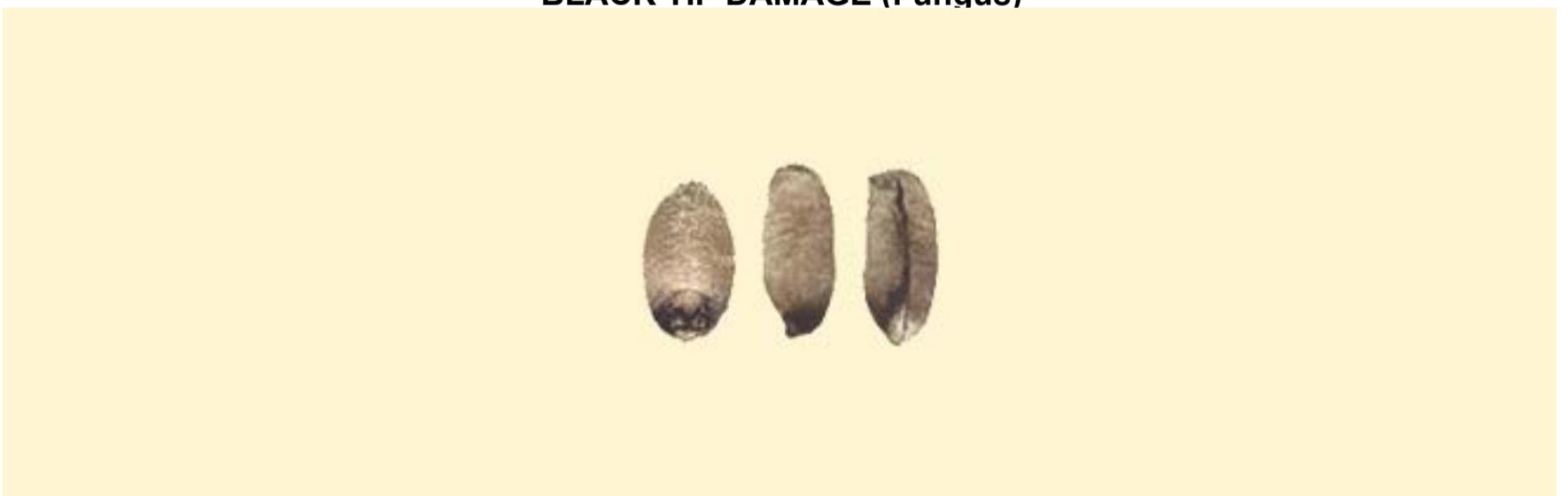
Because of the subjectivity involved in determining damage and other criteria, it is critical that visual references are available to ensure that interpretations are uniformly and consistently applied throughout the national system.

Visual Reference Images provide a basis for communicating the minimum “line” for various types of damage and other visually determined criteria.

For the complete inventory of GIPSA’s VRI visit GIPSA’s website.

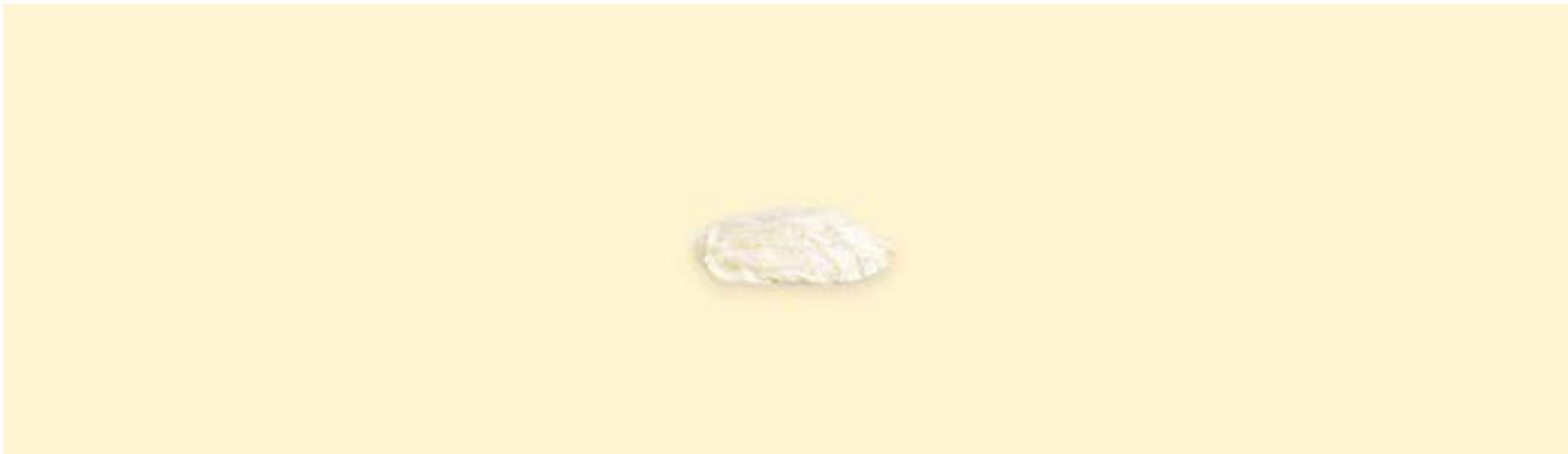


BLACK TIP DAMAGE (Fungus)



Kernels affected by black tip fungus to the extent that the discoloration or fungus growth extends beyond the germ and continues around at least one cheek and into the crease are considered damaged. All conditions MUST be met to be considered damage.

SCAB DAMAGE



Fusarium head blight or head scab is caused by the fungus *Fusarium graminearum*. Kernels with a dull, lifeless and chalky appearance resulting from this disease are considered damaged. The germ and crease may also contain a visible white or pinkish mold.

FROST DAMAGE (Blistered)



Kernels that have blisters due to frost are considered damaged. The illustration shows kernels with distinct frost blisters extending around the back of the kernel and into the crease. The blister and wrinkle effect must be distinct.

FROST DAMAGE (Candied)



Kernels that have a distinctly wax-like or candied appearance are considered damaged. Frost-damaged (candied) kernels can be greenish, greenish yellow, brownish, or blackish in color. They frequently have dark stripes showing through the sides of the kernels.

FROST DAMAGE (Discolored Black/Brown)



Kernels which are completely discolored black or brown and/or have a bleached or blistered appearance with dark lines showing through both sides are considered damaged.

FROST DAMAGE (Flaked)



Kernels that have a slightly flaked-off bran coat due to frost are considered damaged. The flaked area singularly or in combination, must be equal to or greater than depicted by the kernel shown. Evidence of frost must be present on suspect kernels. Do not confuse flaked-by-frost with kernels which have had the bran coat rubbed off because of handling.

GERM DAMAGE



Kernels and pieces of wheat which have discolored germs that are as dark or darker than shown shall be damage. Scrape the germ carefully to avoid scraping too deeply and destroying the evidence of damage. Discolored germs that do not meet the minimum coverage requirement may be considered damage provided the degree of discoloration is greater than shown and the overall “prorated” appearance meets the minimum coverage and intensity level depicted.

GERM DAMAGE (Bleach Method)



Kernels and pieces of wheat which, after bleaching, have discolored germs that are as dark or darker than shown are damaged. Discolored germs that do not meet the minimum coverage requirement may be considered damage provided the degree of discoloration is greater than shown and the overall “prorated” appearance meets the minimum coverage and intensity level depicted. For example, when the degree of discoloration is twice that shown, only half of the germ area needs to be discolored.

MOLD DAMAGE



Kernels containing any amount of mold in the germ or an applicable amount in the crease shall be damage. Mold occurs in many colors. The bran coat covering the germ should be removed carefully as scraping the bran coat too deep could remove the mold.

GREEN DAMAGE (Immature)



Kernels which are green (immature) in color are considered damaged. The green color must meet the minimum intensity shown on both sides of the kernel. Also there should be no yellow cast showing through the green. Do not confuse green damaged kernels with candied kernels.

HEAT DAMAGE (Durum)



Kernels and pieces of kernels of wheat that are materially discolored to the extent shown are considered damaged. Cross-sectioning of whole kernels may be necessary to confirm that the face of both halves are as dark as shown. A kernel with a combination of vitreous and creamy discoloration meeting the VRI shall be heat damage.

HEAT DAMAGE (Other Than Durum)



Kernels and pieces of kernels of wheat that are materially discolored to the extent shown are considered damaged. Cross-sectioning of whole kernels may be necessary to confirm that the face of both halves are as dark as shown. A kernel with a combination of vitreous and creamy discoloration meeting the VRI shall be heat damage.

SPROUT DAMAGE



Kernels with the germ end broken open from germination exhibiting sprout or from which the sprouts have been broken off are considered damaged. The sprout is broken off leaving part of the germ cover over the socket area. Sprout sockets typically have bran around the perimeter of the germ that resembles a “horse collar”

OTHER DAMAGE (Mold)



Kernels which are broken, cracked, or insect chewed and contain distinct mold on the exposed endosperm, regardless of size, are damaged.

WEEVIL OR INSECT-BORED



Kernels and pieces of wheat kernels and other grains which have been bored or tunneled by insects are considered damage. Pin holes in the germ area must be examined further to determine if penetration extends into the endosperm.

INSECT CHEWED WHEAT (Not Damaged)



Kernels which are slightly chewed by insects but are otherwise sound are not considered damaged. Kernels in which the germ has been chewed are sound unless otherwise damaged.

Insect Damaged Kernels (IDK)

To coincide with the Food and Drug Administration's defect action levels, the *U.S. Standards for Wheat* consider wheat containing 32 or more insect-damaged kernels per 100 grams to be U.S. Sample grade. Insect-damaged kernels are kernels bored or tunneled by insects.

Determine insect-damaged kernels or IDK on a representative portion of dockage-free and shrunken and broken-free wheat. A three-stage inspection process has been developed to eliminate the need to always examine 100 grams. This process involves examining up to a total of 100 grams and applying tolerances calculated to duplicate, as near as possible, the 32 insect-damaged kernels per 100 grams limit.



IDK Stage 1: Examine the damaged kernel portion for insect-damaged kernels and apply the result to the following guidelines: For 0 - 1 insect-damaged kernels the lot is not sample grade. For 9 or more insect-damaged kernels the lot is sample grade. For 2 - 8 insect-damaged kernels go to Stage 2.

IDK Stage 2: Examine a second portion of approximately 15 grams, for example the classing portion, for insect-damaged kernels and apply the result to the following guidelines: For 0 - 1 insect-damaged kernels the lot is not sample grade. For 9 or more insect-damaged kernels the lot is sample grade. For 2 - 8 insect-damaged kernels go to Stage 3.

IDK Stage 3: Examine a third portion for insect-damaged kernels. Determine this portion size by subtracting from 100 grams the combined weight of the work portions used in Stage 1 and Stage 2. Add together the total number of insect-damaged kernels found in all three stages and apply the total to the following guidelines: For 31 or less insect-damaged kernels the lot is not sample grade. For 32 or more the lot is sample grade.

Contrasting Classes (CCL)

Contrasting classes are defined as: (1) *Durum wheat, Soft White wheat, and Unclassed wheat in the classes Hard Red Spring wheat and Hard Red Winter wheat;* (2) *Hard Red Spring wheat, Hard Red Winter wheat, Hard White wheat, Soft Red Winter wheat, Soft White wheat, and Unclassed wheat in the class Durum wheat;* (3) *Durum wheat and unclassified wheat in the class Soft Red Winter wheat;* (4) *Durum wheat, Soft Red Winter wheat, and Unclassed wheat in the class Hard White wheat;* and (5) *Durum wheat, Hard Red Spring wheat, Hard Red Winter wheat, Soft Red Winter wheat, and Unclassed wheat in the class Soft White wheat.*

Determine contrasting classes on a dockage-free and shrunken and broken-free portion of 15 grams. Use kernel and varietal characteristics when making this determination.

CONTRASTING CLASSES OF WHEAT	
Class	Contrasting Class
Hard Red Winter and Hard Red Spring wheat	Durum, Soft White, and Unclassed wheat
Durum wheat	Hard Red Spring, Hard Red Winter, Soft Red Winter, Hard White, Soft White, and Unclassed wheat
Soft Red Winter wheat	Durum and Unclassed wheat
Hard White wheat	Durum, Soft Red Winter and Unclassed wheat
Soft White wheat	Durum, Hard Red Winter, Hard Red Spring, Soft Red Winter, and Unclassed wheat

Wheat of Other Classes (WOCL)

Wheat of other classes is the total of all classes of wheat other than the predominating class and which, combined with the predominating class, meets the requirements for any one of the classes except Mixed wheat.

Because all other classes of wheat are considered contrasting classes in durum wheat, the factor wheat of other classes is not applicable to durum.

Determine wheat of other classes on a dockage-free and shrunken and broken-free portion of 15 grams. Use kernel and varietal characteristics when making this determination.

Record the percent of wheat of other classes on the certificate to the nearest tenth percent unless that percentage falls within 10.1 to 10.4 percent. When this occurs, to be consistent with the reporting requirements for Mixed wheat, certify wheat of other classes as 10.0 percent.

Determine Heat Damage (HT)

Kernels, pieces of wheat kernels, and other grains that are materially discolored and damaged by microbial activity that remain in the sample after the removal of dockage and shrunken and broken kernels are considered heat damaged. Determine heat-damaged kernels on a dockage-free and shrunken and broken-free portion of 50 grams. Record the percent of heat-damaged kernels on the certificate to the nearest tenth percent.

Determine Foreign Material (FM)

Foreign material or FM consists of all matter other than wheat that remains in the sample after the removal of dockage and shrunken and broken kernels. Determine foreign material on a dockage-free and shrunken and broken-free portion of 50 grams.

Other grains including oat groats, hull-less oats, glumes on threshed or unthreshed kernels and all matter other than wheat are considered foreign material and removed from the portion. Remove the glumes from the kernels of wheat and add to the foreign material.

Record the percent of FM on the certificate to the nearest tenth percent.

Total Defects

Total Defects is the sum of damaged kernels, foreign material, and shrunken and broken kernels. The sum of these three factors may not exceed the limit for the factor defects for each numerical grade. A percentage for defects cannot be shown when only one or two of the factors defined as defects have been determined.

When one or two factors are determined and their sum would change the numerical grade, or come close to changing the grade, determine the other factor and record the percentage of defects. Record the percent of defects on the certificate to the nearest tenth percent. When the percentages for damaged kernels, shrunken and broken kernels, and foreign material are added together and the total exceeds 100 percent, adjust the percentage of defects by adjusting damaged kernels total.

Official Criteria

Factors, such as protein, mycotoxins, falling number and single kernel hardness are considered as official criteria that are determined upon request and do not affect the grade.

Mycotoxin Testing



Protein Analysis



Work Record

FGIS personnel use Forms FGIS-920, "Grain Sample Ticket," (example below) FGIS-918, "Sample Pan Ticket," FGIS-919, "Sampling Ticket," or FGIS-921, "Inspection Log," to record all sampling and inspection information.

Location		Field Office		Identification							
1 Supervision	Inspection Point Code	Grain Code	01 Wheat	05 Rye	09 Mixed	99 Not Stdr.					
2 Sustained Appeal			02 Corn	06 Sorgh	10 Tribute						
3 Not Sustained Appeal			03 Barley	07 Flax	12 Sunflower	1 In 2 LOC 5 EXP					
			04 Oats	08 Soyb	11 Fabola	2 OUT 4 SUB					
06 HOPPER	08 BOXCAR	10 BARGE	12 OTHER	1 MICH	3 CUP	1 FILE 2 ORIGINAL					
07 TRUCK	09 SHIP	11 SEA VLN		2 PELICAN	4 PNOB	3 FILE					
4444	OTIS	Date Supv Appeal	Code	ORIGINAL INSP.	SUPV APPEAL INSP	BAR INSP					
Sampled By	Date Sampled	DAY				B-					
Appeal No.	To BAR (Date)	Quantity	Date								
Remarks											
Code	Factor	Original	Supv Appeal	Initials	BAR	Code	Factor	Original	Supv Appeal	Initials	BAR
	CL					24	WHM				
02	DRG					25	MSVM				
03	1W					26	BNM				
04	M					33	SABN				
05	ODOR					36	DCCI				
06	HT					60	1W				
07	DBE					62	STON				
08	SAD										
09	DKT										
10	CRSE										
11	FINE										
12	FM										
13	SHSN										
14	DEF										
15	COL										
16	WOOL										
17	DHY										
18	HVAC										
19	WHCB										
20	UNDR										
21	SPL										
23	BCFM										
WORK SAMPLE SIZE		GRADE U.S. NO.		CLASS AND SPECIAL GRADE							
SUPV APPEAL	BAR										
Previous edition obsolete											
GRAIN SAMPLE TICKET										USDA-FGIS	

Grade Designation

After completing the analysis, compare the results with the limits for each grade factor specified the Grades and Grades Requirements table. The factor with the lowest grade designation determines the grade assigned to the sample.

			Grading Factors	U.S. Grade Numbers					
				1	2	3	4	5	
			Minimum pounds/bushel limits of: Test Weight Hard Red Spring wheat or White Club wheat	58.0	57.0	55.0	53.0	50.0	
			All other classes/subclasses	60.0	58.0	56.0	54.0	51.0	
			Maximum percent limits of: Damaged kernels						
			Heat (part of total)	0.2	0.2	0.5	1.0	3.0	
			Total	2.0	4.0	7.0	10.0	15.0	
			Foreign material	0.4	0.7	1.3	3.0	5.0	
			Shrunken and broken kernels	3.0	5.0	8.0	12.0	20.0	
			Total defects	3.0	5.0	8.0	12.0	20.0	
			Contrasting classes	1.0	2.0	3.0	10.0	10.0	
			Wheat of other Classes	3.0	5.0	10.0	10.0	10.0	
Code	Factor	Original							
	CL	HRW							
02	DKG	0.47							
03	TW	57.3							
04	M	11.1							
05	ODOR	OK							
06	HT	0.2							
07	ODK								
08	SKD								
09	DKT	2.8							
10	CRSE								
11	FINE								
12	FM	1.2							
13	SHBN	4.6							
14	DEF	8.6							
15	CCL								
16	WOCL								
17	DHV								
18	HVAC								
19	WHCB								
20	FMOW FMOR								
21	SPL								
23	BCFM								
WORK SAMPLE SIZE			GRADE U.S. NO.	CLASS AND SPECIAL GRADE					
SUPV/APPEAL	BAR		Orig	4	HRW dkg. 0.5				

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 wheat may be certified as U.S. No. 2 or better, U.S. No. 3 or better, etc. An “or better” grade designation cannot be applied to a U.S. No. 1 grade designation.

Certify the Result

Use the following guidelines when documenting the assigned grade. First write the letters “U.S.”, then the abbreviation “No.” and the number of the grade or the words “Sample grade”, the words “or better” when applicable, the subclass or, in the case of Hard Red Winter wheat, Hard White wheat, Mixed wheat, Soft Red Winter wheat and Unclassed wheat, the class.

Next, indicate the applicable special grade in alphabetical order except for treated wheat. The grade designation for treated wheat includes, following the class or subclass and any special grade designations, the word “treated” followed by a statement indicating the kind of treatment, for example, scoured, limed, washed, sulfured, etc. and finally the word “dockage” and the percentage thereof.

Additional Information

Include the following in the “Remarks” section of the certificate:

For Western White wheat, the name and percentage of White Club wheat.

For Unclassed wheat, the color or other characteristics which describe the wheat, together with the percentage thereof.

For Mixed wheat, the name and percentage of the classes that comprise the mixture in the order of predominance.

When applicable, the percentage of protein, falling number value, parts per million of Deoxynivalenol and/or the hardness score.