



United States
Department of
Agriculture

Grain Inspection,
Packers and
Stockyards
Administration

Federal Grain
Inspection Service

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Inspecting Grain

Practical Procedures for Grain Handlers

Preface

Across America, U.S. grain flows from farm to elevator to destinations around the world. The Grain Inspection, Packers and Stockyards Administration, an agency of the United States Department of Agriculture (USDA), helps move that grain into the marketplace by providing farmers, grain handlers, processors, exporters, and international buyers with information that accurately and consistently describes the quality and quantity of grain being bought and sold.

The official inspection and weighing system is a unique public-private partnership overseen by the Federal Grain Inspection Service (FGIS). The system includes Federal offices and States and private agencies authorized by FGIS to provide official inspection and weighing service to the domestic and export grain trade. While the composition of the official system is diverse, the results are not. Every customer--whether on the East Coast, the Gulf of Mexico, the Midwest, or the Pacific Northwest--receives consistently accurate service. That's because every official service provider operates under uniform, official U.S. grain standards and procedures.

Private companies and in-house inspectors can provide grain quality analyses, too. But, only the partners of the official system--FGIS field offices and State and local agencies authorized by FGIS--can provide an official grain inspection certificate. The official system provides more than just information about the quality and quantity of grain inspected. It assures:

Consistency--Official inspections are based on established standards and on sound, proven and standardized procedures, techniques, and equipment.

Verifiable Accuracy--The work of official personnel is reviewed and monitored by an extensive quality assurance program. And, every official State and private agency is backed by the resources and expertise of the FGIS' Technical Center in Kansas City, Missouri.

Information--Official tests provide a wealth of information about sanitary, physical, food safety, and intrinsic quality characteristics.

Responsiveness--New tests and procedures are continually being developed.

Professionalism and Integrity--Official personnel pass rigorous tests and undergo extensive and continuous training.

Credibility--U.S. and international buyers rely on official inspection certificates to provide accurate descriptions of the grade, class, and condition of grain.

But, not everyone can or should always have their grain officially inspected. That's why FGIS wrote this guide. Its specifically designed for producers, warehouse managers, elevator operators, and all others who market or store grain at country points and who want to learn more about inspecting grain.

The guide was developed to:

Identify and encourage the use of practical, cost-effective procedures for conducting commercial grain inspections. It provides grain handlers with simple, inexpensive, easy-to-use procedures for inspecting grain--methodology that can be used at country elevators and other first-point-of-delivery points.

Provide the Commodity Credit Corporation (CCC) with approved procedures for inspecting grain acquired from producers. CCC utilizes these procedures to inspect and evaluate the condition of grain acquired from producers at country/terminal elevators and other facilities operating under Uniform Grain Storage Agreement (UGSA) contracts. For UGSA purposes, "authorized grain evaluation procedures" are considered to be the procedures identified herein or any other procedures that will provide comparable results.

Establish uniform procedures for testing grain for aflatoxin. These simple testing procedures and sampling techniques may be used by processors, refiners, grain elevator and terminal operators, and others to accurately detect and quantify the amount of aflatoxin in corn.

This guide was not designed for the official inspection system. Consequently, many of the procedures contained herein are not appropriate for use by official inspection personnel.

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Introduction

INSPECTING GRAIN IN THE UNITED STATES

Nationally accepted grain standards and inspection procedures provide producers, elevator operators, and others who trade grain with common terms for describing grain; a means for determining storability and end-product yield; and a framework for improving grain quality.

Grain traders in the United States have not always had the benefit of established standards and procedures. In 1856, the Chicago Board of Trade enacted the first grain grading rules for U.S. grain. In the following years, grain trading organizations in Detroit, Milwaukee, St. Louis, Cleveland, Toledo, and New Orleans followed Chicago's lead and developed their own grading standards.

By 1871, 73 different grain inspection systems were being used in the United States, each with its own grades and grading rules. This led to chaotic market conditions. Traders buying grain under the standards in one area could not depend on the grain being designated an equivalent grade in any other area.

Around the turn of the century, the Grain Dealers National Association (now known as the *National Grain and Feed Association*) and several other trade groups vigorously campaigned for the adoption of voluntary, national grade standards. In response, Congress authorized the Secretary of Agriculture to organize the Division of Grain Standardization to establish uniform grades.

Finally, in 1916, the 64th Congress passed the *United States Grain Standards Act* ". . . to provide for the establishment of Official United States Standards for Grain, to promote the uniform application thereof by official inspection personnel . . . with the objectives that grain may be marketed in an orderly and timely manner and that trading in grain may be facilitated."

Over the years, a number of minor amendments made the Act and standards more meaningful. In 1968, Congress significantly broadened the scope of the Act and eliminated the mandatory interstate inspection requirement. Then, in 1976, the Act was strengthened by an amendment which established a new USDA agency--the **Federal Grain Inspection Service (FGIS)**--to oversee the national grain inspection and weighing system.

In October 1994, President Clinton signed the Department of Agriculture Reorganization Act of 1994 into law. As a result, FGIS was merged with the Packers and Stockyards Administration to form a new agency--the **Grain Inspection, Packers and Stockyards Administration (GIPSA)**. This merger combined many administrative functions, but FGIS is continuing program delivery activities as a separate program within GIPSA.

OFFICIAL UNITED STATES STANDARDS FOR GRAIN

The Official United States Standards for Grain provide the criteria for determining the kind, class, and condition of grain and oilseeds. The standards also define quality and condition factors and set grade limits based on factor determinations. Quality factors, which vary by grain, include test weight, damaged kernels, and foreign material. Condition factors include heating, objectionable odor, and insect infestation. It is important to note that the Official United States Standards for Grain are not seasonally adjusted, regardless of average new crop quality.

Presently, there are Official United States Standards for:

BARLEY	MIXED GRAIN	SOYBEANS
CANOLA	OATS	SUNFLOWER SEED
CORN	RYE	TRITICALE
FLAXSEED	SORGHUM	WHEAT

Refer to Appendix II, Grades and Grade Requirements, for a complete listing of the grades, factor requirements, and other related information for each grain or oilseed.

FEDERAL GRAIN INSPECTION SERVICE

The Federal Grain Inspection Service (FGIS) was established to facilitate the marketing of U.S. grain by ensuring constancy in the U.S. grain inspection system. To fulfill this mandate, FGIS:

- * Provides official inspection and weighing services through its field offices and FGIS-designated/delegated agencies located across the United States;
- * Continuously evaluates and updates the procedures and equipment used to officially inspect and weigh grain;
- * Monitors the performance of FGIS-licensed and authorized inspectors;
- * Investigates complaints about official inspections; and
- * Works closely with other USDA agencies, congressional offices, industry groups, and land-grant colleges and universities to improve grain quality and develop new grain inspection methodologies.

For more information about FGIS, visit an FGIS field office or contact:

USDA, GIPSA, Public Affairs Phone - (202) 720-5091
STOP 3601 E-mail - dstewart@gipsadc.usda.gov
1400 Independence Ave., S.W. Webpage - www.usda.gov/gipsa
Washington, DC 20090-3601

FGIS offices are located in the following cities:

Baltimore, Maryland	Grand Forks, N. Dakota
Olympia, Washington	Beaumont, Texas
Jonesboro, Arkansas	Portland, Oregon
Cedar Rapids, Iowa	Kansas City, Missouri
Sacramento, California	Corpus Christi, Texas
League City, Texas	Stuttgart, Arkansas
Crowley, Louisiana	Minneapolis, Minnesota
Toledo, Ohio	Duluth, Minnesota
Montreal, Quebec	Wichita, Kansas
Moscow, Idaho	Greenville, Mississippi

OFFICIAL GRAIN INSPECTIONS

Those who do not have the skills, resources, or time needed to inspect grain may--for a nominal fee--request that the grain be officially inspected by a State or privately owned official agency. Official grain inspection services are available nationwide to all segments of the grain industry, from farmer to exporter.

Official Agencies

Only official agencies that have been designated or delegated by FGIS may provide official inspection services. To ensure that the agencies provide reliable service, all inspection personnel must be licensed by FGIS. In addition, official agencies may use only FGIS-approved equipment and inspection procedures.

Inspection Services

Official agencies offer many types of inspection services. The most common is the **official sample-lot inspection service**. When this service is requested, a licensed sampler draws a representative sample from the grain and then takes it to an FGIS-approved laboratory for analysis by a licensed inspector. Another service offered by official agencies, the **submitted sample inspection service**, allows producers and grain handlers to draw their own samples and submit them to the nearest official agency. Many official agencies also test grain for end-use qualities, such as protein and oil content.

Review Inspections

If you question the grade or factor results assigned to a lot of grain, you may either request that the official agency reinspect the grain or ask FGIS to perform an appeal inspection.

For further information about official inspection services, contact the FGIS field office or official agency nearest you.

Section I

Sampling Grain

THE IMPORTANCE OF PROPER SAMPLING

Sampling is an essential part of the inspection process and one that is critical to the accuracy of the final inspection results. If a sample is not representative of the lot, the inspector's final grade will not reflect the true grade of the lot.

To ensure that a sample is representative:

1. **Use appropriate equipment.** When grain is sampled at rest in a carrier or container, use a hand probe or a mechanical probe to draw the sample. For sampling moving grain, use a diverter-type or Woodside-type mechanical sampler, a pelican, a truck (tailgate) sampler, or an Ellis cup.
2. **Take two or more samples at random locations or at random intervals.** Grain is nonhomogeneous. That is, the whole kernels, broken kernels, and foreign material that are present in any lot of grain segregate whenever grain is handled or transported. Fine particles tend to concentrate in a region near the center of the container and coarse particles in the outer perimeter. For this reason, avoid probing in the "spout-line" (i.e., that area of the container directly below the loading spout where fines accumulate).
3. **Handle samples carefully.** Make sure the sample containers are completely clean. Do not drop samples and do not allow them to become wet.

NEVER TAKE A HAND-GRAB OR SCOOP SAMPLE.

SAMPLING GRAIN AT REST

Grain shipped in trucks, railcars, and barges and grain stored in bins must often be sampled while it is at rest in the carrier or bin. The only effective method of obtaining representative samples from stationary grain is with either a hand probe (sometimes referred to as a trier) or a mechanical probe.

Hand Probes

Hand probes are made of brass or aluminum and consist of two tubes, one inside the other. There are two types of hand probes:

Compartmented probes. These have an inner tube that is divided into compartments. The outer tube has slots which match the compartment openings of the inner tube. When the tubes are aligned, grain flows into the compartments.

Open-throat probes. These have an inner tube that is open as is the probe handle. This feature allows the sample to be poured from the probe directly into the sample container.

NOTE: Open-throat probes tend to draw more of their sample from the top portion of the grain in the lot than compartmented probes. Therefore, the composition of a sample obtained with an open-throat probe may differ slightly from that of a sample drawn with a compartmented probe.

Hand probes come in 5-, 6-, 8-, 10-, and 12-foot lengths. Use a probe long enough to reach the bottom of the carrier. The better access you have to all portions of the grain, the better sample you will obtain.

Carrier	Probe Length
Barges and Bay Boats	12-foot
Bins	12-foot
Boxcars	6-foot
Flat-Bottom Trucks, Trailers, and Wagons	5- or 6-foot (as needed)
Hopper-Bottom Trucks, Trailers, and Wagons	6- to 10-foot (as needed)
Hopper Cars	10- or 12-foot (as needed)

To draw a sample with a hand probe:

1. First, determine the specific locations in the carrier that must be probed. Figures 1 - 3 show the locations for drawing probe samples (manual and mechanical) from barges, bay boats, hopper cars, trailers, trucks, and wagons.
2. At each probe location, insert the probe into the grain at a slight angle, with the slots closed.
3. Then, with the slots facing upward, open the probe and move it up and down in two short motions.
4. Next, close the probe, withdraw it from the grain, and empty the sample onto a canvas sheet or pour it into a sample container.

While drawing the sample, observe the general condition of the grain and check it for objectionable odors, insect infestation, large stones, pieces of metal or glass, and any other potentially harmful condition.

Draw at least two probe samples from any point in the shaded area for lots that are 600 bushels or less. For larger lots, draw at least three probe samples.

Front

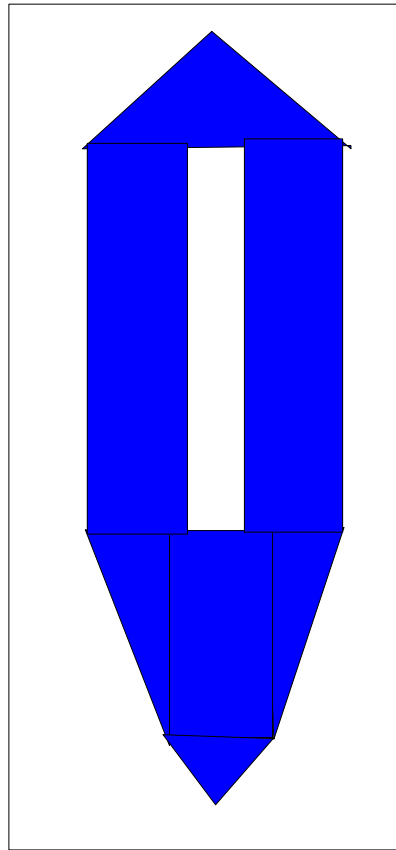


Figure 1. Probe Pattern for Sampling Trucks, Trailers, and Wagons.
(Courtesy: Charles R. Hurburgh, Jr., Iowa State University)

Draw probe samples from the points marked with an **X**. Avoid probing in the spout-lines.

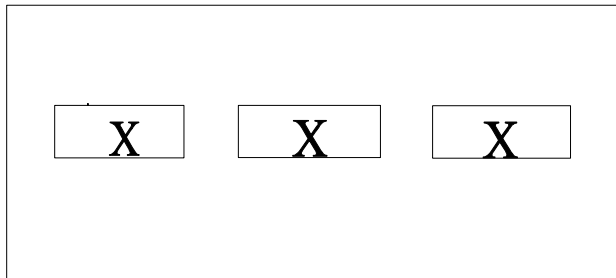


Figure 2. Probe Pattern for Sampling Hopper Cars.

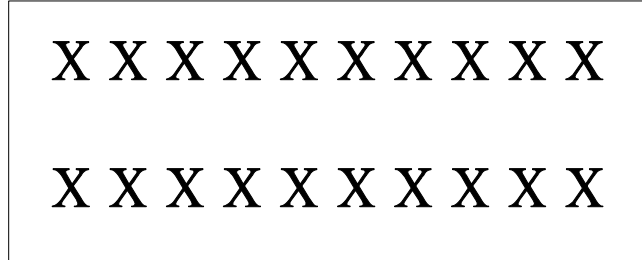


Figure 3. Probe Pattern for Sampling Barges and Bay Boats.

Mechanical Probes

Mechanical probes, like hand probes, are used to sample stationary lots of grain in trucks and in other open-top carriers. There are two types of mechanical probes that may be used: the gravity-fill probe and the core probe. A third type, the in-load suction probe, tends to overestimate foreign material and should not be used for trade.

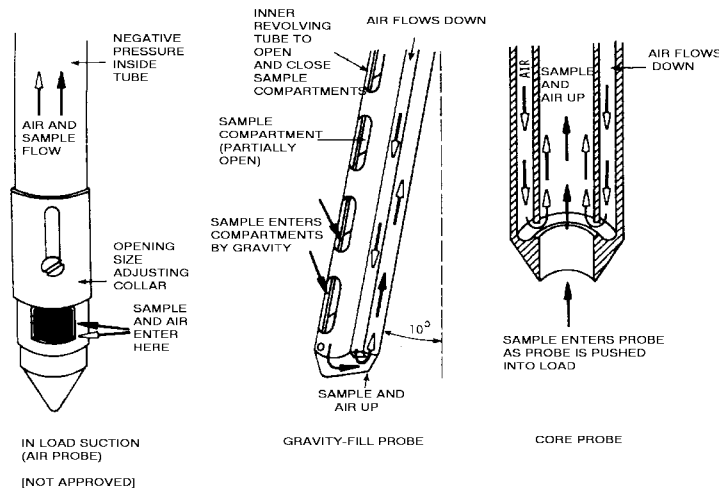


Figure 4. Types of Mechanical Probes

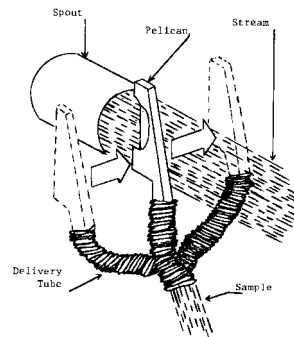
Before using a mechanical probe,

1. Make sure that it is working properly and does not have grain from a previous carrier in its system.
2. Then, use Figures 1 - 3 to determine the specific locations that must be probed.

At each probe location, insert the probe vertically into the grain and draw a sample.

SAMPLING MOVING GRAIN

Diverter-Type Mechanical Samplers



Diverter-type (D/T) mechanical samplers are used to draw samples of grain moving through grain spouts or off of the end of conveyor belts. D/T's draw their sample by periodically moving a pelican-like device through the entire grain stream. The movement of this device is electrically timed and powered by an air cylinder or electric motor.

Figure 5. Cross-Section of a D/T Mechanical Sampler.

Before using a D/T, be sure that:

1. It is working properly and not clogged with old grain or dust.
2. The timer is correctly set. If the flow-rate is 4,000 bushels or less per hour, set the timer so that the diverter crosses the sampling area at least once every 3 minutes. If the flow-rate is more than 4,000 bushels per hour, set the timer for one diverter cut for every 200 bushels loaded.

Woodside-Type Mechanical Samplers

Woodside samplers are used to sample grain moving along conveyor belts. A Woodside sampler is comprised of small sample buckets attached to chains which are connected between an upper and a lower sprocket. A metal frame supports the upper and lower shafts on which the sprockets turn. The sampler has a special roller, located approximately 10 inches upstream from the lower sprocket, which serves as the machine's drive shaft.

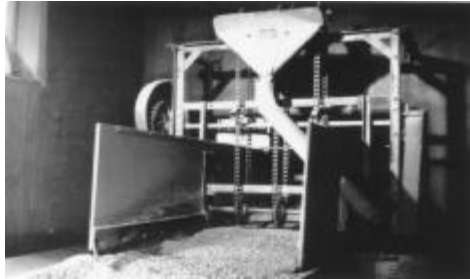


Figure 6. Woodside-Type Mechanical Sampler.

Before using a Woodside sampler, be sure that:

1. The apparatus is clean and the area around it is well lighted and free of spilled grain or other debris.
2. Each chain contains the same number of sample buckets and that they are evenly spaced on the chain. Examine the sample buckets for wear. Any bucket worn in excess of $3/16$ inch (in the center) should be replaced. When the bucket is in the extreme downward position, the clearance between it and the belt should be approximately $3/8$ inch. Make sure the tension of the chains is snug, but not tight.

Pelican Samplers

Pelican samplers are used to sample grain in a falling stream. A pelican is a leather pouch, approximately 6 inches deep, 2 inches wide, and 18 inches long, attached to a long pole. A metal band along the edge of the pouch holds it open. The number of samples that should be drawn with a pelican depends on the amount of sample that is needed and the amount of grain being loaded into the carrier. Regardless, draw at least two samples from each carrier.

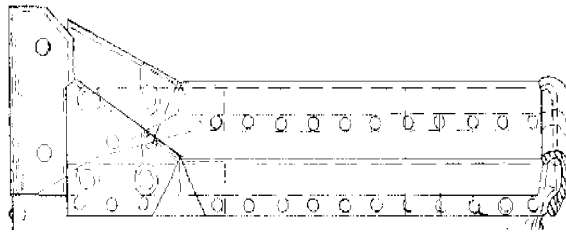


Figure 7. Pelican Sampler.

Take samples at random intervals in the following manner:

1. Make sure the loading spout is positioned so that the pelican will swing easily through the entire falling stream.
2. Hold the pelican so that its pouch is next to the stream.
3. Grasping the pelican firmly, swing it completely through the stream in one continuous motion. Do not allow it to overflow.
4. Pour the contents of the pelican into a sample container.

Truck (Tailgate) Samplers

Truck samplers, which are simple metal containers attached to wooden handles, are used to sample grain being unloaded from trucks. A truck sampler is used in the same manner as a pelican sampler (i.e., pulled or swung through the falling stream of grain). And, like pelicans, truck samplers work best when the grain is falling at a moderate rate. The number of samples that should be drawn with the truck sampler depends on the amount of sample that is needed and the amount of grain being discharged from the truck. Regardless, draw at least two samples from each truck.

Take samples at random intervals in the following manner:

1. Hold the truck sampler so that it is next to one side of the falling stream.
2. Pull it through the grain stream in one continuous motion.
3. Pour the contents of the sampler into a container.

Ellis Cup Samplers

Ellis cup samplers, which are manual sampling devices made of light-weight aluminum, are used to sample grain moving on conveyor belts. The number of samples that should be drawn with an Ellis cup depends on the amount of sample needed and the amount of grain being loaded into or unloaded from the carrier. Regardless, draw at least two samples from each carrier.

Take samples at random intervals in the following manner:

1. Grasp the Ellis cup firmly in both hands and stand as close as possible to the point where the grain is delivered to the conveyor belt. Face "upstream" holding the Ellis cup over the grain.

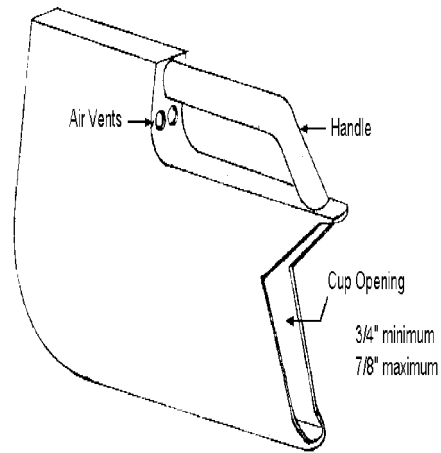


Figure 8. Ellis Cup Sampler.

2. Insert the heel (curved part) of the cup, with the opening facing in the opposite direction from the flow, into the center of the grain stream. Push the open end downward through the grain until the bottom of the cup is parallel to the belt. (Avoid catching the cup on the belt splice that connects the belt ends. Ripples usually occur in the grain stream over the belt lacing.)
3. When the cup is full, move the open end of the cup upward and remove the cup from the stream. Pour the contents into a sample collection container.
4. Draw two more portions, one from halfway between the center and the right-hand edge of the stream and the other from halfway between the center and left-hand edge. Pour each cup into the sample container.

Section II

Inspecting Grain

THE INSPECTION PROCESS

The process of inspecting grain begins when the sample is drawn and usually follows a prescribed path whether the grain is being inspected for grade or for factors only. First, the sample is examined for objectionable odor, insect infestation, and other potentially harmful or unusual conditions. Then, a representative portion of grain is divided out from the sample and its moisture content determined. The sample may next be tested for dockage, followed by a test weight per bushel determination. For some grains, test weight is determined before dockage. After this, the sample is divided into smaller portions that are examined for factors such as damaged kernels and foreign material.

To ensure the accuracy of inspections, always use dependable, well-maintained equipment. Install, align, standardize, calibrate, and maintain inspection equipment according to the manufacturer's and/or FGIS' recommendation. Test all equipment at least twice a year against a known standard and make adjustments as needed.

In addition, scales used to weigh samples and factor portions should be National Type Evaluation Program (NTEP)-certified and tested by the local State weights and measures agency. Also, use only scales that have the proper division size for the size of the portion being weighed. For example: if the portion size is 120 grams or less, the maximum allowable division size is 0.01 gram; if more than 120 grams, the maximum allowable division size is 1 gram; and if used to determine moisture, the maximum allowable division size is 0.1 gram.

It is also important that factor portions be adequate in size. The portion size needed to determine a particular factor depends on the nature of that factor, the equipment that is required, and the degree of accuracy that is desired. For most factor determinations, the larger the portion analyzed, the more accurate the results.

Lastly, when reducing samples in size or dividing out factor portions from samples, always use a Boerner divider or any other device that gives equivalent results.

PORTION SIZES

The recommended minimum portion sizes are as follows:

	Barley	Corn	Oats	Sorghum	Soybeans	Wheat
	(Portion weights in grams)					
<i>Damage</i>	15	125	30	15	125	15
<i>Dockage</i>	250	NA	NA	250	NA	250
<i>Foreign material</i>	30	250	30	250	125	30

Heating The lot as a whole.

Infestation The original sample or lot as a whole.

Moisture The amount recommended by the instrument manufacturer.

Objectionable odors The original sample or lot as a whole.

Oil The amount recommended by the instrument manufacturer.

Other factors Refer to the "Other Factors" section.

Protein The amount recommended by the instrument manufacturer.

Test weight An amount sufficient to cause grain to overflow the kettle.

NOTE: For other kinds of grain, use the portion sizes recommended for a grain of similar size.

HARMFUL SUBSTANCES

Grade grain that is contaminated by harmful substances as "U.S. Sample grade." To be considered "contaminated," the original sample must contain:

Substance	Grain	Amount
<i>Animal Filth</i> (e.g., excreta)	Corn	Animal filth in excess of 0.20 percent.
	Barley, Flaxseed, Oats, Sorghum, Soybeans, and Sunflower seed	10 or more rodent pellets, bird droppings, or an equal quantity of other animal filth.
	Rye, Triticale, and Wheat	2 or more rodent pellets, bird droppings, or an equal quantity of other animal filth.
	Canola	4 or more rodent pellets, bird droppings, or an equal quantity of other animal filth.
<i>Castor Beans</i>	All Grains, except Canola	2 or more castor beans.
<i>Cocklebur</i> s	Barley, Corn, Flaxseed, and Sorghum	8 or more cockleburs or similar seeds.
<i>Crotalaria Seeds</i>	All Grains, except Canola	3 or more crotalaria seeds.

Substance	Grain	Amount
<i>Distinctly Low Quality</i>	All Grains	When a lot of grain is of inferior quality because of an unusual state/condition and it cannot be graded properly using the grading factors in the standards.
<i>Glass</i>	All Grains, except Wheat, Soybeans, and Canola	2 or more pieces of glass.
	Wheat, Soybeans, and Canola	1 or more pieces of glass.
<i>Stones</i>	Barley, Rye, and Triticale	8 or more stones or any number of stones which have an aggregate weight in excess of 0.2 percent of the sample weight.
	Flaxseed, Oats, Sorghum, Soybeans, and Sunflower seed	8 or more stones which have an aggregate weight in excess of 0.2 percent of the sample weight.
	Corn	1 or more stones which have an aggregate weight in excess of 0.1 percent of the sample weight.
	Wheat	4 or more stones or any number of stones which have an aggregate weight in excess of 0.1 percent of the sample weight.

Substance	Grain	Amount
<i>Unknown Foreign Substance</i>	All Grains, except Canola	4 or more particles of an unknown foreign Substance, including rock salt or crystalline substances, or a commonly recognized harmful or toxic substance, including so-called "pink wheat."
	Canola	2 or more particles of an unknown foreign substance, including rock salt or crystalline substances, or a commonly recognized harmful or toxic substance.

NOTE: Wheat that contains a total of 5 or more particles of any harmful substance and soybeans that contains 10 or more particles of any harmful substance (i.e., animal filth, caster beans, crotolaria seeds, glass, stones, or unknown foreign substances) should be considered "contaminated" and graded "U.S. Sample grade."

OBJECTIONABLE ODORS

Grade grain that has a musty, sour, or commercially objectionable foreign odor (except smut or garlic) as "U.S. Sample grade." Determine whether grain has an objectionable odor on the basis of an examination of the original sample or the lot as a whole.

Odor	Characteristics
<i>Musty</i>	Earthy, moldy, and ground-like (not to be confused with a burlap bag odor).
<i>Sour</i>	Rancid, sharp, or acrid, e.g., elevator boot-, insect waste-, and fermenting grain-odor.
<i>Commercially Objectionable Foreign Odor</i>	Any odor not normal to grain which, because of its presence, renders the grain unfit for normal commercial usage, e.g., odor of fertilizer, hides, oil products, skunks, smoke, burnt grain, and decaying animal and vegetable matter.

Fumigant or insecticide odors are not considered commercially objectionable foreign odors, unless they are caused by a fumigant or insecticide that does not dissipate quickly. If a grain sample contains a very strong fumigant or insecticide odor, allow the sample to aerate for up to 4 hours before making the odor determination.

HEATING

Heating is a condition common to grain that is spoiling. It may be caused by insect infestation or, more usually, by the action of micro-organisms in grain with a high moisture content. In addition to its high temperature, heating grain often gives off a sour odor. Grade grain that is heating as "U.S. Sample grade."

Be careful not to confuse grain that is heating with sound grain that is warm due to storage in bins or other containers during hot weather.

INSECT INFESTATION

The presence of any live weevil or other live insects injurious to stored grain^{1/} indicates probable infestation. Apply the special grade "Infested" if the inspection of the original sample or the lot as a whole reveals:

Grain	Number and Type of Insects
<i>Wheat, Triticale, and Rye</i>	Two or more live weevils, one live weevil and one other live insect injurious to stored grain, or two other live insects injurious to stored grain.
<i>All Other Grains</i>	Two or more live weevils, one live weevil and five other live insects injurious to stored grain, or ten other live insects injurious to stored grain.

^{1/} "Live weevils" include broadnosed grain weevils, rice weevils, granary weevils, and lesser grain borers. "Other live insects injurious to stored grain" include grain beetles, moths, meal worms, and larvae, except for sunflower seed weevil larvae.

MOISTURE

Moisture is an essential measure of a grain's storability and value. It is usually determined on all grain at the time of inspection.

Except for flaxseed, determine moisture on a sample before the removal of dockage. Use any device that has been tested and approved by the local State weights and measures agency.

Regardless of the device used, it is essential that it be adjusted, maintained, and operated in strict adherence to the manufacturer's recommendation.

TEST WEIGHT

Test weight is the weight of the volume of grain that is required to fill a Winchester bushel (2,150.42 cubic inches) to capacity. Since test weight tends to increase as moisture content decreases, determine it as quickly as possible after the grain is sampled.

For the following grains, determine test weight before the removal of dockage and/or foreign material:

Corn Mixed Grain Oats Sorghum Soybeans

For the following grains, determine test weight after the removal of dockage:

Barley Flaxseed Rye Sunflower Seed Triticale Wheat

Several devices may be used to determine test weight; all of these devices operate in a similar manner.

- Step 1. Pour the sample through a funnel into a kettle until the grain overflows the kettle.
- Step 2. After pouring the grain into the kettle, level it off by making three, full-length, zigzag motions with a stoker.
- Step 3. Then weigh the filled kettle on either (1) a special beam scale attached to the funnel stand, (2) an electronic scale programmed to convert gram weight to test weight per bushel, or (3) a standard laboratory scale. If a standard laboratory scale is used, the gram weight must be manually converted to test weight per bushel by using a special conversion chart.

DOCKAGE

Dockage is material other than the predominant grain that can be easily removed with sieves and cleaning devices. Determine dockage using either a mechanical dockage tester or hand sieves.

Determining Dockage With a Mechanical Dockage Tester

- Step 1. Thoroughly clean the dockage tester. Insert the appropriate sieves and riddles and make the adjustments recommended by the manufacturer which give results comparable to FGIS standard equipment.
- Step 2. Turn on the tester and pour the sample into the hopper.

Step 3. After the sample has cleared the last sieve, turn the tester off.

Step 4. Remove the dockage.

For barley, rye, safflower seed, triticale, and wheat, consider dockage to be all material--other than the predominant grain--that was removed by the aspirator, all coarse material (e.g., sticks) that passed over the riddle or top sieve, and all material that passed through the bottom sieve.

For sorghum, consider dockage to be all material that passed through the bottom sieve.

For canola, rapeseed, and mustard seed, consider dockage to be all material--other than the predominant grain--that was removed by the aspirator, all coarse material that passed over the riddle or top sieve, and all material that passed through the bottom sieve, except for small whole and broken pieces of the predominant grain that can be reclaimed by handsieving and handpicking.

Determining Dockage With Hand Sieves

Step 1. Nest the appropriate sieve(s) on top of a bottom pan.

Barley	Use a 5/64-inch triangular-hole sieve.
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Canola, Mustard Seed, and Rapeseed	Place a 0.064-inch x 3/8-inch oblong-hole sieve on top of a 3/64-inch x 3/8-inch oblong-hole sieve.
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Step 1. (Continued from the previous page.)

Safflower Seed	Place a 0.089-inch inscribed circle triangular-hole sieve on top of a 4.5/64-inch round-hole sieve.
Sorghum	Use a 2.5/64-inch round-hole sieve.
Wheat, Rye, and Triticale	Place a 12/64-inch round-hole sieve on top of a 5/64-inch or 4.5/64-inch round-hole sieve.

Step 2. Pour the sample into the center of the top sieve, place the sieve(s) in a mechanical grain sizer, set the sizer's timer to 20, and turn it on.

If a mechanical sizer is not available, hold the sieves and bottom pan level. Then, using a steady motion, move the sieve from right to left approximately 10 inches and then return from left to right. Repeat this operation 20 times.

Step 3. Remove the dockage.

For barley, rye, safflower seed, triticale, and wheat, consider dockage to be all coarse material that remains on top of the top sieve and all material that passed through the bottom sieve.

For sorghum, consider dockage to be all material that passed through the sieve.

For canola, rapeseed, and mustard seed, consider dockage to be all coarse material that remains on top of the top sieve and all material that passed through the bottom sieve, except for small whole and broken pieces of the predominant grain that can be reclaimed by resieving with smaller holed sieves and handpicking.

FOREIGN MATERIAL ^{1/}

Grain	Definition of Foreign Material
Barley	All matter other than barley, other grains, and wild oats that remains in the sample after the removal of dockage. Determine the amount of foreign material in barley by handpicking.
Corn	All matter that passes readily through a 12/64-inch round-hole sieve and all matter other than corn that remains in the sample after sieving. Determine the amount of broken corn and foreign material in corn by using either a mechanical dockage tester or a hand sieve.
Oats	All matter other than oats, wild oats, and other grains. Determine the amount of foreign material in oats by using a hand sieve and handpicking.
Rye and Triticale	All matter other than rye (or triticale) that remains in the sample after the removal of dockage. Determine the amount of foreign material in rye or triticale by handpicking.

^{1/} Includes "broken corn and foreign material" (BCFM) in corn and "broken kernels and foreign material" (BNFM) in sorghum.

Grain**Definition of Foreign Material**

Sorghum

All matter, other than dockage, that passes through a 5/64-inch triangular-hole sieve (i.e., broken kernels) and all matter other than sorghum that remains in the sample after sieving (i.e., foreign material). Determine the amount of broken kernels and foreign material in sorghum by using either a mechanical dockage tester or hand sieves, and handpicking.

Soybeans

All matter that passes through an 8/64-inch round-hole sieve, and all matter other than soybeans that remains in the sample after sieving. Determine the amount of foreign material in soybeans by using a mechanical soybean FM tester, or hand sieves and handpicking.

Sunflower Seed

All matter other than whole sunflower seed containing kernels. Determine the amount of foreign material in sunflower seed by using a mechanical dockage tester and handpicking.

Wheat

All matter other than wheat that remains in the sample after the removal of dockage and shrunken and broken kernels. Determine the amount of foreign material in wheat by hand-picking.

The percent of foreign material in canola, flaxseed, mixed grain, mustard seed, rapeseed, or safflower seed is not usually determined.

Determining Foreign Material With a Mechanical Dockage Tester

- Step 1. Thoroughly clean the dockage tester. Then, insert the appropriate sieves and riddles and make the adjustments recommended by the manufacturer which give results comparable to FGIS standard equipment.
- Step 2. Turn the tester on and pour the sample into the hopper.
- Step 3. After the sample has cleared the last sieve, turn tester off.
- Step 4. Remove the foreign material.

For corn, consider BCFM to be all material--other than corn--that passed over a 12/64-inch round-hole sieve and all material that passed through the sieve.

For sorghum, consider "foreign material" to be all coarse material that passed over the riddle and all material--other than sorghum--handpicked from the mechanically cleaned sample; and consider "broken kernels" to be all material--other than dockage--that passed through a 5/64-inch triangular-hole sieve.

For sunflower seed, consider foreign material to be all material--other than sunflower seed--that was removed by the aspirator, all coarse material that passed over the riddle or top sieve, all material that passed through the bottom sieve, and all matter--other than sunflower seed--handpicked from the mechanically cleaned sample.

Determining Foreign Material With Hand Sieves

Step 1. Nest the appropriate sieve(s) on top of a bottom pan.

Corn Use a 12/64-inch round-hole sieve.

Oats Use a 5/64-inch triangular-hole sieve.

Sorghum Place a 12/64-inch round-hole sieve on top
of a 5/64-inch triangular-hole sieve.

Soybeans Place a 10/64-inch x 3/4-inch slotted-hole
sieve on top of an 8/64-inch round-hole
sieve.

Step 2. Pour a sample portion into the center of the top sieve.

Corn 250 grams.

Oats 30 grams.

Sorghum 250 grams.

Soybeans 125 grams.

Step 3. Place the sieve(s) in a mechanical grain sizer, set the sizer's timer (20 for corn and sorghum, and 5 for oats and soybeans), and then turn it on.

If a mechanical sizer is not available, hold the sieves and bottom pan level, and, using a steady motion, move the sieve from right to left approximately 10 inches. Return from left to right to complete one sieving operation. Repeat this operation 20 times for corn and sorghum, and 5 for oats and soybeans.

Step 4. For corn, consider BCFM to be all material that passed through the 12/64-inch round-hole sieve and all material-- other than corn--that remains on top of the sieve.

For oats, consider foreign material to be all material-- other than oats, other grains, and wild oats--that passed through the 5/64-inch triangular-hole sieve and all coarse material (e.g., sticks) that remains on top of the sieve.

For sorghum, consider "foreign material" to be all material --other than sorghum--that remains on top of the 5/64-inch triangular-hole sieve and all coarse material that remains on top of the 12/64-inch round-hole sieve; consider "broken kernels" to be all material that passed through the 5/64-inch triangular-hole sieve.

For soybeans, consider foreign material to be all material which passed through the 8/64-inch round-hole sieve, all material--other than soybeans--that remains on top of the 8/64-inch round-hole sieve, and all coarse material that remains on top of the 10/64-inch x 3/4-inch slotted-hole sieve.

DAMAGED KERNELS

The most common types of kernel damage are germ-, frost-, immature-, heat-, mold-, scab-, sprout-, insect-, ground-, and cob rot-damage. Most of these types of damage result in some sort of discoloration or change in kernel texture.

Determine the percent of damaged kernels in the sample by hand-picking a dockage-, foreign material-, and/or shrunken and broken-free portion. To determine whether an individual kernel is damaged, examine the entire surface of the kernel.

Interpretive line slides have been developed to help inspectors with this determination. These are photographic slides of actual kernels. Each slide shows the minimum amount of discoloration or deterioration necessary for a kernel to be considered damaged. In addition, several land-grant universities have prepared brochures that provide color photographs depicting the various types of kernel damage.



Figure 9. Interpretive Line Slides and Viewer.
(Courtesy: Seedbuco Equipment Co., Chicago, Illinois)

Type of Damage	Grain	Characteristics
Bee's Wings-Damaged Kernels	Corn and Flaxseed	Kernels that are very thin, whitish, and paperlike.
Black Tip Fungus-Damaged Kernels	Wheat	Kernels with black tip fungus growth on the germ and in the crease of the kernel.
Blue-Eye Mold-Damaged Kernels	Corn	Kernels with blue mold in the germ. Blue-eye mold should not be confused with purple plumule, which is not a type of damage. Purple plumule is generally purple in color and is always found in the center of the germ.
Cob Rot-Damaged Kernels	Corn	Kernels that are distinctly discolored or rotting as a result of a fungus that attacks corn ears.
Drier-Damaged Kernels	All Grains	Kernels that are discolored, wrinkled, and blistered; or are puffed or swollen and slightly discolored, and often have damaged germs; or whose seed coats are peeling off or appear fractured.

Type of Damage	Grain	Characteristics
Frost-Damaged Kernels	All Grains	Kernels that are discolored, blistered, or have a slightly flaked-off bran coat; or kernels with a distinctly wax-like or candied appearance due to frost.
Germ-Damaged Kernels	All Grains	Kernels that are discolored by heat or mold resulting from respiration.
Ground- or Weather- Damaged Kernels	All Grains	Kernels with dark stains or discolorations and rough cake-like appearance caused by ground and/or weather conditions.
Heat-Damaged Kernels	All Grains	Kernels that are materially discolored and damaged by external heat or as the result of heating caused by fermentation.
Immature- or Green-Damaged Kernels	All Grains	Kernels that are intensely green in color.
Malt-Damaged Kernels	Barley	Kernels that have undergone the malting process and show any degree of sprout.
Mold-Damaged Kernels (External)	All Grains	Kernels that have <u>considerable</u> evidence of mold.

Type of Damage	Grain	Characteristics
Mold-Damaged Kernels (Internal)	All Grains	Kernels that have <u>any</u> evidence of mold.
Purple Pigment- Damaged Kernels	Sorghum	Kernels materially dis- colored by purple pigment.
Scab-Damaged Kernels	Wheat	Kernels having a dull, lifeless, and chalky appearance.
Sprout-Damaged Kernels	All Grains	Kernels that are sprouted.
Stinkbug Stung- Damaged Kernels	Soybeans	Kernels that, in cross- section, show damage caused by stinkbugs. Score stinkbug stung- damaged kernels at the rate of one-fourth of the actual percentage.
Weevil- or Insect-Damaged Kernels ^{1/}	All Grains	Kernels which bear evidence of boring or tunneling by insects.

^{1/} If two or more insect-damaged kernels are found in a 15-gram portion of wheat, examine a second 15-gram portion. If two or more insect- damaged kernels are found in the second portion, examine a 70-gram portion and then combine the number of insect-damaged kernels found in all three portions. If 32 or more insect-damaged kernels are found in the combined portions (i.e., 100 grams) grade the wheat "U.S. Sample grade." If fewer than two insect-damaged kernels are found in either the first or second portion, discontinue the examination.

PROTEIN, OIL, AND OTHER INTRINSIC CHARACTERISTICS

Determine the percent of protein, oil, and other intrinsic characteristics by using American Oil Chemists' Society- (AOCS), American Association of Cereal Chemists- (AACC), or FGIS-approved methods, or by using any other methods which yield comparable results.

Factor	Grain
Oil Content	Canola, Corn, Flaxseed, Rapeseed, Safflower Seed, Soybeans, and Sunflower Seed.
Protein	Corn, Soybeans, and Wheat.
Starch	Corn.
Free Fatty Acid	Safflower Seed.
Iodine Value	Safflower Seed.
Erucic Acid	Canola and Rapeseed.
Glucosinolates	Canola.

Regardless of which method is used, once a month submit samples to a commercial testing laboratory, official inspection agency, or FGIS for direct comparison testing against a standard method. Submit at least one sample for each type and class of grain that is normally tested.

SINGLE KERNEL HARDNESS TEST

Towards an Objective Wheat Classification System

Over the years, a number of factors have emerged that make wheat classing that is based on visual examination increasingly difficult: (1) the number of wheat varieties has significantly increased, which requires inspectors to recognize more varieties within their markets; (2) some varieties share common physical characteristics, which makes it difficult to identify individual varieties; (3) new varieties developed through cross-breeding programs may, on occasion, exhibit non-traditional kernel characteristics; and (4) grain handlers blend varieties from different sources to meet supply demands, which further challenges inspectors.

To address the challenges associated with the visual (subjective) classification method, FGIS and the Agricultural Research Service (ARS), in cooperation with the Wheat Classification Working Group (WCWG), began investigating alternative wheat classing methods. These groups determined that wheat hardness would be a useful and reliable method for distinguishing soft and hard wheats. In 1989, the ARS Grain Research Laboratory in Manhattan, Kansas, developed a prototype Single Kernel Hardness Tester (SKHT) that met the goals developed by FGIS, ARS, and WCWG. SKHTs are now in place at all FGIS field offices and many other locations.

The SKHT analyzes exactly 300 kernels from a 15-20-gram portion of wheat which is free from dockage, shrunken and broken kernels, and foreign material. Individual kernel size, weight, crushing profile (hardness), and moisture are measured by the instrument, which then generates a histogram of values, including the range, average, and standards deviation for each of the four factors. These data are used to determine single kernel hardness and establish distribution ranges. The SKHT measures not only the average hardness, but also sorts the hardness results into four distinct hardness ranges within a sample set: soft, semi-soft, semi-hard, and hard. Knowing the average hardness and the distribution of kernels within the four hardness categories will allow users to classify samples as Soft, Hard, or Mixed.

STRESS CRACK ANALYSIS IN CORN

Stress cracks are an undesirable physical attribute in corn. Stress cracks are internal narrow cracks in the endosperm of the kernels. Typically, stress cracks are induced by excessive heat during drying. Kernels of corn having stress cracks are more susceptible to breakage and quality degradation during handling and also indicate potential processing problems to corn millers.

Stress crack analysis involves a visual inspection of whole corn kernels on a backlighted lightboard. This “candling” inspection process transmits lights through the kernel, which makes internal cracks in the endosperm visible for detection.

Step 1. Using a divider, obtain an approximately 25-gram portion of corn. Select 50 whole kernels from the portion for analysis.

Do not select kernels that are broken, chipped, cracked, or those which would limit the inspector’s ability to identify stress cracks, e.g., waxy or discolored kernels.

Step 2. Place the kernels on a light board with the germ side down. Visually inspect each kernel for stress cracks and separate out stressed kernels.

Step 3. Turn the remaining kernels germ side up. Visually inspect each kernel for stress cracks and separate out stressed kernels.

Upon request, sort the stress cracked kernels into three categories: single, double, and multiple stress cracks.

Step 4. Count the total number of stress cracked kernels. Multiply the number of stressed kernels by two before reporting. Then, calculate the percentage of stress cracks to the nearest whole percent.

AFLATOXIN

Aflatoxin is a naturally occurring mycotoxin produced by two types of mold: Aspergillus flavus and Aspergillus parasiticus. Aspergillus flavus is common and widespread in nature and is most often found in corn and sorghum grown under stressful conditions, such as drought. While the presence of Aspergillus flavus does not always indicate harmful levels of aflatoxin, it does mean that the potential for aflatoxin production is present.

Aflatoxin, unlike most other factors, may concentrate in only a few kernels, and the contaminated kernels are not likely to be evenly distributed throughout the lot. Additionally, some contaminated kernels may contain many times the aflatoxin level of other contaminated kernels. Therefore, samples must be representative and sufficiently large (recommended size - 10 pounds) to compensate for the uneven distribution of the contaminant.

Methods of Analysis

Grain may be tested for aflatoxin using any of several methods. Some of these methods provide screening information; others provide quantitative data.

Test Kits. Several types of test kits have been developed for the analysis of aflatoxin. There are a number of test kits and systems commercially available that use enzyme link immunosorbent assay (ELISA), immuno-affinity, or fluorescence technology. These kits are highly specific, sensitive, and simple to perform. FGIS found that these kits and systems don't all operate at the same level of accuracy. Of those tested by FGIS to date, several kits and systems have been approved for qualitative (screening) purposes or for providing quantitative information.

TLC Method. Thin-layer chromatography (TLC) was the first method developed to measure aflatoxin, and it is still widely used. The TLC method extracts aflatoxin from a sample with a solvent. The extract is then filtered, purified, and placed on plates along with known amounts of pure aflatoxin. The plates are then placed in a darkened chamber and exposed to long-wave ultraviolet light. A comparison of the fluorescence of the aflatoxin in the extract with that of the aflatoxin in the standard is made either visually or with a densitometer to determine the quantity of aflatoxin.

Minicolumn Method. This is a semi-quantitative form of chromatography that is widely used as a screening tool. This method, like the TLC method, extracts aflatoxin from grain with a solvent and then partially purifies the extract. The extraction is passed through a small glass tube that contains at least two absorbent materials. The glass tube or minicolumn is then placed under a long-wave ultra-violet light and its fluorescence compared to known levels of aflatoxin.

HPLC Method. High performance liquid chromatography (HPLC) is the most sensitive and technologically advanced, quantitative method available for aflatoxin analysis. As the name indicates, aflatoxins are separated from each other and from interfering compounds chromatographically. In this case, the separation takes place as a liquid flows through a column that is packed with a material similar to that which is applied in a thin layer to a TLC plate. It then passes through a fluorescence detector.

BGYF or Black Light Method. This method involves examining ground grain under a long-wave ultraviolet (black light) lamp. Aspergillus flavus-contaminated kernels will "glow" a bright greenish-yellow fluorescence (BGYF) when placed under a black light. Unfortunately, many grain samples may appear fluorescent without being contaminated with aflatoxin. This creates false positive results. For this reason, the BGYF method should be used for preliminary screening purposes only.

DON

Deoxynivalenol (DON), also referred to as Vomitoxin, is a naturally occurring mycotoxin produced by several species of Fusarium. Wet and cool weather from flowering time on to maturity promotes infection, resulting in scab or head blight in barley, wheat, oats, and rye. Wheat infected with scab has a tendency to have lighter weight kernels, some of which are removed during normal harvesting and cleaning operations.

Grain may be tested for DON using:

Test Kits. Several types of test kits have been developed for the analysis of DON. The test kits and systems that are currently approved by FGIS use either enzyme linked immunosorbent assay (ELISA) or fluorescence technology. These kits are highly specific, sensitive, and simple to perform.

HPLC Method. High performance liquid chromatography (HPLC) is the most sensitive and technologically advanced quantitative method available for DON analysis.

OTHER FACTORS

Determine the percent of "other factors" in the sample by hand-picking or hand-sieving a dockage-free factor portion, as required.

Factor	Grain	Characteristics
Admixture	Sunflower seed	All foreign material, except whole and broken sunflower seed hulls. (Minimum portion size = 60 grams.)

Factor	Grain	Characteristics
Broken Kernels	Barley	Barley with more than $\frac{1}{4}$ of the kernel removed. (Minimum portion size = 25 grams.)
Conspicuous Admixture	Canola, Mustard seed, and Rapeseed	All matter other than the pre-dominant grain which is readily distinguishable. (Minimum portion size = 10 grams.)
Defects (Total)	Wheat	Computed total amount of damaged kernels, foreign material, and shrunken and broken kernels. (Minimum portion size = 250 grams.)
Dehulled Seed	Sunflower seed	Hull has been completely removed from the kernel. (Minimum portion size = 30 grams.)
Distinctly Green Kernels	Canola, Mustard seed, and Rapeseed	Kernels and pieces of kernels which, after being crushed, are a distinct green throughout. (Minimum portion size = 5 grams.)
Ergot	Canola, Mustard seed, and Rapeseed	Hard, reddish-brown or black grain-like mass of parasitic fungi. (Minimum portion size = 10 grams.)
Inconspicuous Admixture	Canola, Mustard seed, and Rapeseed	Any seed which is difficult to distinguish from the grain. (Minimum portion size = 5 grams.)

Factor	Grain	Characteristics
Other Grains	Barley	Kernels and pieces of kernels of black barley, corn, cultivated buck-wheat, 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/or wheat. (Minimum portion size = 25 grams.)
Plump	Barley	Barley that remains on top of a 6/64-inch x 3/4-inch slotted-hole sieve after sieving. (Minimum portion size = 250 grams.)
	Rye	Rye that remains on top of a .064-inch x 3/8-inch slotted-hole sieve after sieving. (Minimum portion size = 250 grams.)
Purple Mottled or Stained	Soybeans	Soybeans that are discolored by the growth of a fungus; dirt; a dirt-like substance(s), including nontoxic inoculant; or other nontoxic substances. (Minimum portion size = 400 grams.)
Sclerotinia	Canola, Mustard seed, and Rapeseed	Dark-colored or black resting bodies of the fungi <u>Sclerotinia</u> and <u>Claviceps</u> . (Minimum portion size = 10 grams.)

Factor	Grain	Characteristics
Shrunken and Broken Kernels	Triticale and Wheat	All matter that passes through a 0.064-inch x 3/8-inch oblong-hole sieve. (Minimum portion size = 250 grams.)
Skinned and Broken Kernels	Barley	Barley kernels with one-third or more of the hull removed; with a loose or missing hull over the germ; that are broken; or that are missing all or part of the germ. (Minimum portion size = 25 grams.)
Sound	Barley and Oats	Kernels and pieces of kernels that are not damaged. The percentage of sound grain in any sample is 100 percent minus the sum of the percentage (if any) of wild oats, foreign material, all damaged grain, and all grains other than the predominant grain. (Minimum portion size = 25 grams.)
Soybeans of Other Colors	Soybeans	Soybeans with green, black, brown, or bicolored seed coats. (Minimum portion size = 125 grams.)
Splits	Soybeans	Undamaged soybeans with more than 1/4 of the bean removed. (Minimum portion size = 125 grams.)

Factor	Grain	Characteristics
Stones	Canola, Mustardseed, Rapeseed, and Safflower seed	Concreted earthy or mineral matter and other substances of similar hardness that do not disintegrate in water. (Minimum portion size = 10 grams in canola/rapeseed; 250 grams in mustard/safflower seed.)
Suitable Malting Types	Barley	Varieties of barley that are recommended by the American Malting Barley Association and other malting types used by the malting and brewing industry. (Minimum portion size = 25 grams.)
Thin	Barley	Six-rowed Malting barley (and all barley in the class "Barley") which passes through a 5/64-inch x 3/4-inch slotted-hole sieve and two-rowed Malting barley which passes through a 5.5/64-inch x 3/4-inch slotted hole sieve. (Minimum portion size = 250 grams.)
	Rye	Rye and other matter that passes through a 0.064-inch x 3/8-inch oblong-hole sieve. (Minimum portion size = 250 grams.)
Total Dockage	Canola, Mustard seed, Rapeseed, and Safflower seed	Computed total amount of conspicuous admixture and mechanically separated dockage. (Minimum portion size = 250 grams.)
Wild Oats	Barley and Oats	Seeds of <u>Avena Fatua</u> L. and <u>A. Sterilis</u> L. (Minimum portion size = 30 grams.)

Section III

Grading Grain

GRADES AND GRADE DESIGNATIONS

A grade is assigned to grain based on its factor results. The grade assigned equals the lowest grade determined for any of the factors. For example, if all of the factors were at the U.S. No. 1 level, except for one at the U.S. No. 3 level, then the lot would grade U.S. No. 3.

The Official United States Standards for Grain describe the numerical grades for barley, canola, corn, flaxseed, mixed grain, oats, rye, sorghum, soybeans, sunflower seed, triticale, and wheat. The lowest grade that may be assigned to any of these grains is "U.S. Sample grade." This grade is applied to grain that:

1. Does not come within the grade requirements of any of the numerical grades;
2. Has a musty, sour, or commercially objectionable foreign odor;
3. Is heating;
4. Contains 32 or more insect-damaged kernels per 100 grams (wheat only);
5. Is contaminated with stones, pieces of glass, toxic seeds, unknown or toxic substances, animal filth, crotalaria seeds, or castor beans; or
6. Is otherwise of distinctly low quality.

SPECIAL GRADES AND SPECIAL GRADE DESIGNATIONS

The commercial value of grain is not always reflected in its numerical grade. Therefore, the Official United States Standards for Grain also define special grades for most grains.

Special grades denoting grain of superior quality, such as "heavy" and "bright," usually appear in the complete grade designation immediately after the numerical grade, e.g., U.S. No. 1 Extra-Heavy Bright Oats. Other special grades usually are shown following the name of the class or subclass, e.g., U.S. No. 1 Amber Durum Wheat, Smutty, Dockage 0.7 percent.

Special Grade	Grain	Characteristics
Bleached	Oats	Treated with sulfurous acid or any other bleaching agent.
Blighted	Barley	Contains more than 4.0 percent of fungus- and/or mold-damaged kernels.
Bright	Oats	Has a good natural color.
Ergoty	Barley, Mixed Grain, Oats, and Triticale	Barley, mixed grain (<u>not</u> predominantly rye, triticale, or wheat), oats, or triticale that contains more than 0.10 percent ergot.
	Mixed Grain and Rye	Mixed grain (predominantly rye, triticale, or wheat), or rye that contains more than 0.30 percent ergot.
	Wheat	Wheat that contains more than 0.05 percent ergot.
Extra-Heavy	Oats	Test weight of 40 pounds or more.

Special Grade	Grain	Characteristics
Flint	Corn	Consists of 95 percent or more of flint corn.
Flint and Dent	Corn	Consists of a mixture of flint and dent corn which contains 5 to 95 percent of flint corn.
Garlicky	Barley	Contains three or more green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets ^{1/} , in 500 grams.
	Mixed Grain	Mixed grain (predominantly <u>rye, triticale, or wheat</u>) that contains two or more green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets ^{1/} , in 1000 grams.
	Mixed Grain	Mixed grain (not predominantly <u>rye, triticale, or wheat</u>) that contains four or more green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets ^{1/} , in 500 grams.
	Oats	Contains four or more green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets ^{1/} , in 500 grams.

^{1/} Three dry or partly dry garlic bulblets are equal to one green bulblet.

Special Grade	Grain	Characteristics
Garlicky	Soybeans	Contains five or more green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets ^{1/} , in 1,000 grams.
	Rye or Triticale	Contains seven or more green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets ^{1/} , in 1,000 grams.
	Wheat	Contains three or more green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets ^{1/} , in 1,000 grams.
Heavy	Oats	Test weight of between 38 and 40 pounds.
Infested	All Grain, except Flaxseed	Contains live weevils or other live insects injurious to stored grain.
Light Garlicky	Rye or Triticale	Contains two or more, but not more than six, green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets ^{1/} , in 1,000 grams.

^{1/} Three dry or partly dry garlic bulblets are equal to one green bulblet.

Special Grade	Grain	Characteristics
Light Smutty	Rye or Triticale	Contains an unmistakable odor of smut, or contains more than 14 average size smut balls, or an equivalent quantity of smut spores in 250 grams, but not more than 30 smut balls or an equivalent quantity of smut spores.
	Wheat	Contains an unmistakable odor of smut, or contains more than 5 average size smut balls, or an equivalent quantity of smut spores in 250 grams, but not more than 30 smut balls or an equivalent quantity of smut spores.
Plump	Rye	Contains not more than 5 percent of rye or other matter that passes through a 0.064-inch x 3/8-inch oblong-hole sieve.
Purple Mottled or Stained	Soybeans	Soybeans with pink or purple seed coats.
Smutty	Barley, Mixed Grain, and Oats	Barley, mixed grain (not predominantly rye, triticale, or wheat), or oats whose kernels are so covered with smut spores as to appear smutty in mass, or which contain more than 0.20 percent smut balls.

Special Grade	Grain	Characteristics
Smutty	Mixed Grain	Mixed grain (predominantly rye, triticale, or wheat) that contains 15 or more average size smut balls, or an equivalent quantity of smut spores in 250 grams.
	Sorghum	Sorghum that contains 20 or more average size smut balls, or an equivalent quantity of smut spores in 100 grams.
	Rye, Triticale, or Wheat	Rye, triticale, or wheat that contains more than 30 average size smut balls, or an equivalent quantity of smut spores in 250 grams.
Thin	Oats	Contains more than 20.0 percent of oats and other matter, except fine seeds, that pass through a 0.064-inch x 3/8-inch oblong-hole sieve but remain on top of a 5/64-inch triangular-hole sieve after sieving.
Treated	Mixed Grain or Wheat	Scoured, limed, washed, sulfured, or treated so that its grade designation does not reflect its true quality.
Waxy	Corn	Consists of 95 percent or more waxy corn.

BARLEY

Barley is grain that, before the removal of dockage, consists of 50 percent or more of whole kernels of cultivated barley (Hordeum vulgare L.) 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 this context, does not include hull-less barley or black barley.

Barley is divided into two classes based on kernel characteristics: Malting barley and Barley. The class Malting barley is divided into three subclasses: Six-rowed Malting barley, Six-rowed Blue Malting barley, and Two-rowed Malting barley. The class Barley is divided into three subclasses: Six-rowed barley, Two-rowed barley, and Barley.

All subclasses of the class Malting barley are divided into four numerical grades. All subclasses of the class Barley are divided into five numerical grades and U.S. Sample grade. Refer to appendix II and the U.S. Standards for Barley for specific grade requirements.

Grade barley as follows:

- Step 1. Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, garlic, glass, insect infestation, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. Determine the percentage of dockage in the sample.
- Step 4. Examine the dockage-free sample for ergot, smut, stained barley, and stones.
- Step 5. Determine the test weight of the dockage-free sample.
- Step 6. When deemed necessary, divide out representative portions from the dockage-free sample. Pearl one portion and determine its percentage of heat-damaged kernels. Partially pearl another portion and determine its percentage of injured-by-heat kernels.
- Step 7. Also, when deemed necessary, divide out representative portions from the dockage-free sample and determine the percentage of blighted kernels, broken kernels or skinned and broken kernels, class, damaged kernels, foreign material, injured-by-frost, injured-by-mold, other grains, plump, sound barley, subclass, suitable malting types, thin barley, and wild oats.

CORN

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

Corn is divided into three classes based on color: Yellow corn, White corn, and Mixed corn. There are no subclasses of corn.

Each class is divided into five numerical grades and U.S. Sample grade. Refer to appendix II and the U.S. Standards for Corn for specific grade requirements.

Grade corn as follows:

- Step 1. Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, glass, insect infestation, stones, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. Determine the test weight of the sample.
- Step 4. Determine the percentage of broken corn and foreign material (BCFM) in the sample.
- Step 5. When deemed necessary, divide out representative portions from the BCFM-free sample and determine the percentage of class, damaged kernels, flint corn, flint and dent corn, heat-damaged kernels, and waxy corn.

FLAXSEED

Flaxseed is a grain that, before the removal of dockage, consists of 50 percent or more of common flaxseed (Linum usitatissimum L.) 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.

There are no classes or subclasses of flaxseed.

Flaxseed is divided into two numerical grades and U.S. Sample grade. Refer to appendix II and the U.S. Standards for Flaxseed for specific grade requirements.

Grade flaxseed as follows:

- Step 1. Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, glass, unknown foreign substances, and other unusual conditions.
- Step 2. Determine the percentage of dockage in the sample.
- Step 3. Examine the dockage-free sample for stones.
- Step 4. Divide out a representative portion from the dockage-free sample and determine its moisture content.
- Step 5. Determine the test weight of the dockage-free sample.
- Step 6. When deemed necessary, divide out representative portions from the dockage-free sample and determine the percentage of damaged kernels, heat-damaged kernels, and oil content.

CANOLA, MUSTARD SEED, AND RAPESEED

Canola (Brassica spp.), mustard seed (Brassica hirta and B. juncea), and rapeseed (Brassica campestris and B. napus) are oilseeds that consists of 50.0 percent or more of whole canola, mustard seed, or rapeseed, as applicable, before the removal of dockage.

Inspect canola, mustard seed, and rapeseed as follows:

- Step 1. Examine the sample for heating, odor, animal filth, garlic, glass, insect infestation, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. Divide out another representative portion from the sample and determine the percentage of mechanically separated dockage.
- Step 4. (Canola and rapeseed only.) When deemed necessary, divide out representative portions from the mechanically separated dockage-free portion and determine the percentage of conspicuous admixture, ergot, erucic acid, glucosinolates (canola only), oil content, sclerotinia, and stones. Then, compute the percent of total dockage (mechanically separated dockage and conspicuous admixture).

(Mustard seed only.) When deemed necessary, divide out representative portions from the mechanically separated dockage-free portion and determine the percentage of class (Oriental, Yellow, and Brown mustard seed), conspicuous admixture (buckwheat, other weed seed, and other material), ergot, sclerotinia, and stones.

- Step 5. When deemed necessary, examine the mechanically separated dockage-free and conspicuous admixture-free portion and determine the percentage of other-damaged kernels.
- Step 6. When deemed necessary, divide out representative portions from the mechanically-separated dockage-free and conspicuous admixture-free portion and determine the percent of heat-damaged kernels, distinctly green kernels, and inconspicuous admixture.

Then, compute the percentage of total damaged kernels (other-damaged kernels, heat-damaged kernels, and distinctly green kernels).

MIXED GRAIN

Mixed grain is any mixture of grains for which standards have been established under the United States Grain Standards Act, provided that such mixture does not come within the requirements of any of the standards for such grains and that such mixture consists of 50 percent or more of whole kernels of grain and/or whole or broken soybeans which will not pass through a 5/64-inch triangular-hole sieve and/or whole flaxseed that passes through such a sieve after sieving.

There are no classes or subclasses of mixed grain. The standards for mixed grain provide two grades for mixtures of grain: U.S. Mixed grain and U.S. Sample grade. Refer to appendix II and the U.S. Standards for Mixed Grain for specific grade requirements.

Grade Mixed grain as follows:

- Step 1. Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, ergot, garlic, glass, insect infestation, smut, stones, treated seeds, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. Determine the test weight of the sample.
- Step 4. When deemed necessary, divide out a representative portion from the sample and examine it for blighted barley kernels.
- Step 5. Determine the percentage of foreign material (FM) and fines.
- Step 6. When deemed necessary, divide out representative portions from the FM and fines-free sample and determine the percentage of damaged kernels, heat-damaged kernels, and kinds of grain.

OATS

Oats are grain that consists of 50 percent or more of oats (*Avena sativa* L. and *A. byzantina* C. Koch) and may contain, singly or in combination, no more than 25 percent of wild oats and other grains for which standards have been established under the United States Grain Standards Act. There are no classes or subclasses of oats.

Oats are divided into four numerical grades and U.S. Sample grade. Refer to appendix II and the U.S. Standards for Oats for specific grade requirements.

Grade oats as follows:

- Step 1. Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, ergot, garlic, general appearance, glass, insect infestation, smut, unknown foreign substances, and other unusual conditions.
- Step 2. Determine the test weight of the sample.
- Step 3. Divide out a representative portion from the sample and determine its moisture content.
- Step 4. Determine the percentage of coarse foreign material and coarse other grains in the sample.
- Step 5. When deemed necessary, divide out representative portions from the coarse foreign material and coarse other grain-free sample and determine the percentage of fine foreign material, fine other grains, heat-damaged kernels, other damaged kernels, sound oats, and wild oats.
- Step 6. Compute the percentage of total foreign material (coarse foreign material and fine foreign material) and the percentage of total other grains (coarse other grains and fine other grains).

RYE

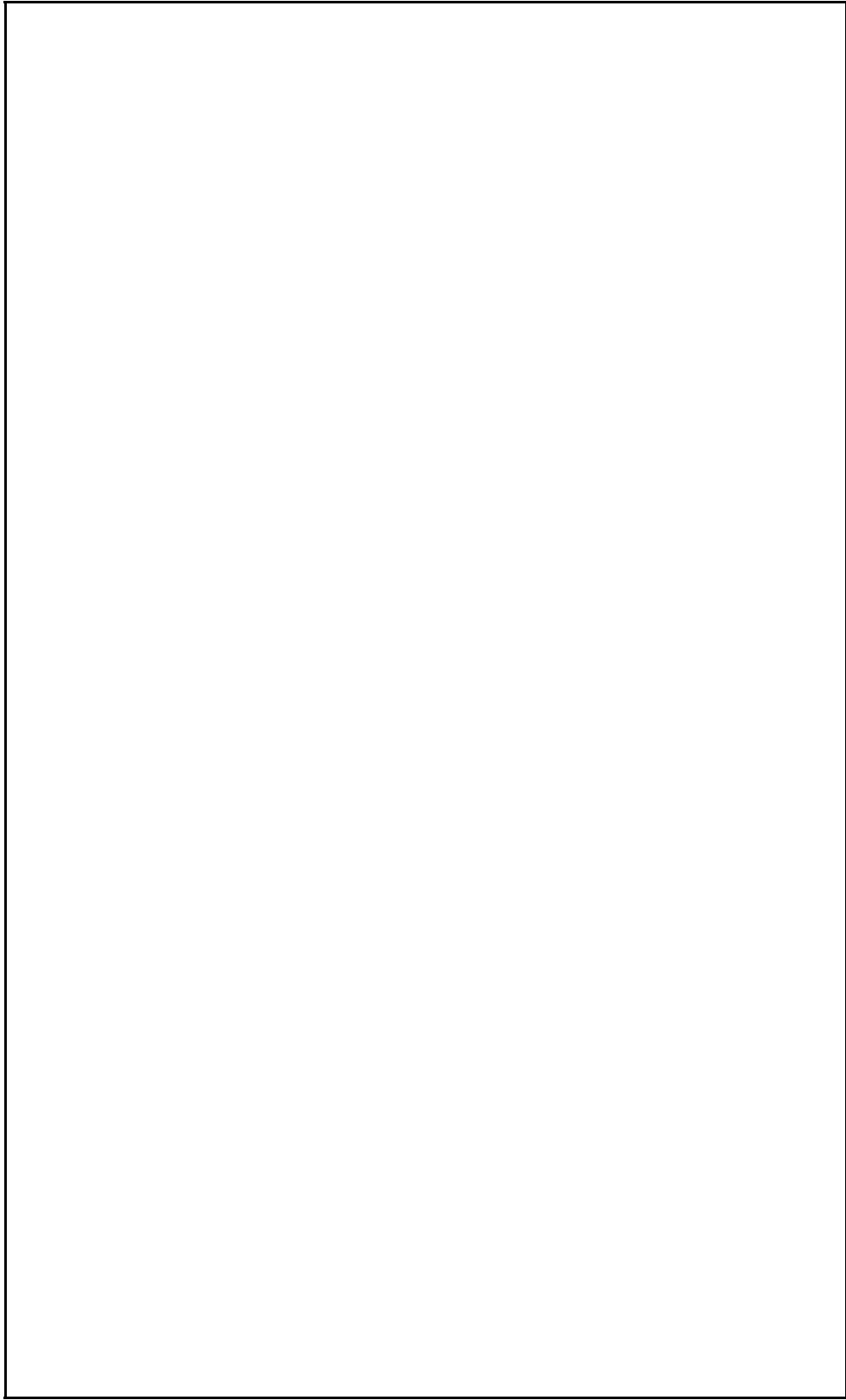
Rye is a grain that, before the removal of dockage, consists of 50 percent or more of common rye (Secale cereale L.) and not more than 10 percent of other grains for which standards have been established under the United States Grain Standards Act and that, after removal of dockage, contains 50 percent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

There are no classes or subclasses of rye.

Rye is divided into four numerical grades and U.S. Sample grade. Refer to appendix II and the U.S. Standards for Rye for specific grade requirements.

Grade rye as follows:

- Step 1. Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, garlic, glass, insect infestation, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. Determine the percentage of dockage in the sample.
- Step 4. Examine the dockage-free sample for ergot, smut, and stones.
- Step 5. Determine the test weight of the dockage-free sample.
- Step 6. When deemed necessary, divide out representative portions from the dockage-free sample and determine the percentage of damaged kernels, heat-damaged kernels, foreign material, plump kernels, and thin kernels.



SAFFLOWER SEED

Safflower seed is an oilseed that consists of 50.0 percent or more of whole or broken safflower seed (Carthamus tinctorius) before the removal of dockage.

Inspect safflower seed as follows:

- Step 1. Examine the sample for heating, odor, animal filth, glass, insect infestation, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. Divide out another representative portion from the sample and determine its percentage of mechanically separated dockage.
- Step 4. When deemed necessary, divide out a representative portion from the mechanically separated dockage-free portion and determine the percentage of handpicked dockage and stones.
- Step 5. Compute the percentage of total dockage (mechanically separated dockage and handpicked dockage).
- Step 6. When deemed necessary, divide out representative portions from the mechanically separated dockage-free portion and determine the percentage of damaged kernels (total), heat-damaged kernels, sprout-damaged kernels, other-damaged kernels, oil content, free fatty acid, and iodine value.

SORGHUM

Sorghum is grain that, before the removal of dockage, consists of 50 percent or more of whole kernels of sorghum (Sorghum bicolor (L.) Moench), excluding nongrain sorghum, and not more than 10 percent of other grains for which standards have been established under the United States Grain Standards Act.

Sorghum is divided into four classes based on color: Sorghum, Tannin sorghum, White sorghum, and Mixed sorghum. There are no subclasses of sorghum.

Each class is divided into four numerical grades and U.S. Sample grade. Refer to appendix II and the U.S. Standards for Sorghum for specific grade requirements.

Grade sorghum as follows:

- Step 1. Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, garlic, glass, insect infestation, smut, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. Determine the test weight of the sample.
- Step 4. Determine the percentage of dockage and the percentage of mechanically separated broken kernels and foreign material (BNFM) in the sample.
- Step 5. When deemed necessary, divide the mechanically separated BNFM and dockage-free sample into representative portions and determine the percentage of class, handpicked FM (add to mechanically separated FM to determine total), heat-damaged, damaged kernels, and stones.

SOYBEANS

Soybeans are a 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-inch round-hole sieve and not more than 10 percent of other grains for which standards have been established under the United States Grain Standards Act.

Soybeans are divided into two classes based on color: Yellow soybeans and Mixed soybeans. There are no subclasses in soybeans.

Each class is divided into four numerical grades and U.S. Sample grade. Refer to appendix II and the U.S. Standards for Soybeans for specific grade requirements.

Grade soybeans as follows:

- Step 1. Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, garlic, glass, insect infestation, purple mottled and stained, smut, stones, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. Determine the test weight of the sample.
- Step 4. When deemed necessary, divide the sample into representative portions and determine the percentage of class, damaged kernels, heat-damaged kernels, foreign material, oil, protein, soybeans of other colors, and splits.

SUNFLOWER SEED (CONFECTIONARY-TYPE)

Sunflower seed (confectionary-type) is a grain that consists of 50 percent or more of whole confectionary sunflower seed (Helianthus annuus L.) before the removal of dockage.

There are no classes or subclasses of sunflower seed.

Inspect sunflower seed (confectionary-type) as follows:

- Step 1. Examine the sample for heating, odor, animal filth, glass, insect infestation, stones, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. When deemed necessary, divide out representative portions from the sample and determine the percentage of admixture, purity, and sclerotinia.
- Step 4. Divide out another representative portion from the sample and determine the percentage of mechanically separated dockage and handpicked dockage.
- Step 5. When deemed necessary, divide out representative portions from the mechanically separated dockage-free portion and determine the percentage of dehulled kernels, damaged kernels, off-colored seeds, and seed size.

SUNFLOWER SEED (OIL-TYPE)

Sunflower seed is a grain that, before the removal of foreign material, consists of 50 percent or more of cultivated sunflower seed (Helianthus annuus L.) and not more than 10 percent of other grains for which standards have been established under the United States Grain Standards Act. There are no classes or subclasses of sunflower seed.

Sunflower seed is divided into two numerical grades and U.S. Sample grade. Refer to appendix II and the U.S. Standards for Sunflower Seed for specific grade requirements.

Grade sunflower seed (oil-type) as follows:

- Step 1. Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, glass, insect infestation, stones, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. When deemed necessary, divide out a representative portion from the sample and determine the percentage of admixture.
- Step 4. Determine the percentage of mechanically separated foreign material (FM) in the sample.
- Step 5. Determine the test weight of the mechanically separated FM-free sample.
- Step 6. When deemed necessary, divide out representative portions from the mechanically separated FM-free sample and determine the percentage of dehulled kernels, damaged kernels, handpicked FM (add to mechanically separated FM to determine total FM), heat-damaged kernels, and oil content.

TRITICALE

Triticale is a grain that, before the removal of dockage, consists of 50 percent or more of triticale (X triticosecale Wittmack) 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 removal of dockage, contains 50 percent or more of whole triticale.

There are no classes or subclasses of triticale. Triticale is divided into four numerical grades and U.S. Sample grade. Refer to appendix II and the U.S. Standards for Triticale for specific grade requirements.

Grade triticale as follows:

- Step 1. Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, garlic, glass, insect infestation, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. Determine the percentage of dockage in the sample.
- Step 4. Examine the dockage-free sample for ergot, smut, and stones.
- Step 5. Determine the test weight of the dockage-free sample.
- Step 6. Divide out a representative portion from the dockage-free sample and determine the percentage of shrunken and broken kernels (SHBN).
- Step 7. When deemed necessary, divide out representative portions from the SHBN-free sample and determine the percentage of damaged kernels, heat-damaged kernels, foreign material (other than wheat or rye), and foreign material (total).

WHEAT

Wheat is a grain that, before the removal of dockage, consists of 50 percent or more of 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 removal of dockage, contains 50 percent or more of whole kernels of one or more of these wheats.

Wheat is divided into eight classes based on color and kernel and varietal characteristics: Hard Red Spring wheat, Hard Red Winter wheat, Soft Red Winter wheat, Durum wheat, Hard White wheat, Soft White wheat, Unclassed wheat, and Mixed wheat. The classes Hard Red Spring wheat, Durum wheat, and Soft White wheat are further divided into subclasses:

Class	Subclass
Hard Red Spring	Dark Northern Spring Northern Spring Red Spring
Durum	Hard Amber Durum Amber Durum Durum
Soft White	Soft White White Club Western White

Each class and subclass is divided into five numerical grades and U.S. Sample grade. Refer to appendix II and the U.S. Standards for Wheat for specific grade requirements.

Grade wheat as follows:

- Step 1. Examine the sample for heating, odor, animal filth, castor beans, crotalaria seeds, garlic, glass, insect infestation, unknown foreign substances, and other unusual conditions.
- Step 2. Divide out a representative portion from the sample and determine its moisture content.
- Step 3. Determine the percentage of dockage in the sample.
- Step 4. Examine the dockage-free sample for ergot, smut, stones, and treated seeds.
- Step 5. Determine the test weight of the dockage-free sample.
- Step 6. When deemed necessary, divide out a representative portion from the dockage-free sample and determine the percentage of protein.
- Step 7. Divide out a representative portion from the dockage-free sample and determine the percentage of shrunken and broken kernels (SHBN).
- Step 8. When deemed necessary, divide out representative portions from the SHBN-free sample and determine the percentage of class, contrasting classes, damaged kernels, heat-damaged kernels, foreign material, subclass, and wheat of other classes.

Appendix I

Selected References

For additional information about inspecting grain, refer to one of the following FGIS publications.

FGIS Aflatoxin Handbook.

FGIS NIRT (Protein and Oil) Handbook.

FGIS Grain Inspection Handbook, Book I, Grain Sampling.

FGIS Grain Inspection Handbook, Book II, Grain Grading.

FGIS Equipment Handbook.

FGIS Mechanical Sampling Systems Handbook.

FGIS Directive 9180.42, "Inspection of Rapeseed."

FGIS Directive 9180.52, "Inspection of Mustard Seed."

FGIS Directive 9180.53, "Inspection of Safflower Seed."

FGIS Directive 9180.57, "DON (Vomitoxin) Testing Services."

Official United States Standards for Grain.

Limited quantities of these publications are available free, upon request.
Send request to:

USDA-APHIS, MSD-HSB-PDMS
Room 1A28
4700 River Road
Riverdale, Maryland 20737

These publications are also available on the World Wide Web at:
<http://www.usda.gov/gipsa>

Appendix II
Grades and Grade Requirements

**GRADE REQUIREMENTS FOR SIX-ROWED MALTING
 BARLEY AND SIX-ROWED BLUE MALTING BARLEY**

GRADE	Minimum limits of --			Maximum limits of--				
	Test weight per bushel (lbs.)	Suitable malting type (%)	Sound barley ^{1/} (%)	Damaged ^{1/} kernels (%)	Foreign material (%)	Other grains (%)	Skinned and broken kernels (%)	Thin barley (%)
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

^{1/} Injured-by-frost kernels and injured-by-mold kernels are not considered damaged kernels or scored against sound barley.

NOTE: Six-rowed Malting barley and Six-rowed Blue Malting barley that meet the requirements of U.S. No. 1 to U.S. No. 4, inclusive, for the subclass Six-rowed Malting barley and Six-rowed Blue Malting barley is classified and graded according to this requirement. Other-wise, it will be graded according to the requirements for the class Barley.

**GRADE REQUIREMENTS FOR TWO-ROWED
MALTING BARLEY**

GRADE	Minimum limits of --		
	Test weight per bushel (lbs.)	Suitable malting type (%)	Sound barley ^{1/} (%)
U.S. No. 1	50.0	97.0	98.0
U.S. No. 2	48.0	97.0	98.0
U.S. No. 3	48.0	95.0	96.0
U.S. No. 4	48.0	95.0	93.0

GRADE	Maximum limits of --			
	Wild oats (%)	Foreign material (%)	Skinned and broken kernels (%)	Thin barley (%)
U.S. No. 1	1.0	0.5	5.0	5.0
U.S. No. 2	1.0	1.0	7.0	7.0
U.S. No. 3	2.0	2.0	10.0	10.0
U.S. No. 4	3.0	3.0	10.0	10.0

^{1/} Injured-by-frost kernels and injured-by-mold kernels are not scored against sound barley.

NOTE: Two-rowed Malting barley that meets the requirements of U.S. No. 1 to U.S. No. 4, inclusive, for the subclass Two-rowed Malting barley is classified and graded according to this requirement. Otherwise, it will be graded according to the requirements for the class Barley.

GRADE REQUIREMENTS FOR BARLEY

GRADE	Minimum --		Maximum limits of --				
	Test weight per bushel (lbs.)	Sound barley (%)	Damaged kernels ^{1/} (%)	Heat-damaged kernels (%)	Foreign material (%)	Broken kernels (%)	Thin barley (%)
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

U.S. Sample grade

U.S. Sample grade is barley that:

- (a) Does not meet the requirements for the grades U.S. Nos. 1, 2, 3, 4, or 5; or
- (b) Contains 8 or more stones or any number of 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 cocklebur (Xanthium spp.) or similar seeds singly or in combination, 10 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 1-1/8 to 1-1/4 quarts of barley; or
- (c) Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
- (d) Is heating or otherwise of distinctly low quality.

^{1/} Includes heat-damaged kernels. Injured-by-frost kernels and injured-by-mold kernels are not considered damaged kernels.

GRADE REQUIREMENTS FOR CANOLA

GRADE	Maximum limits of --			
	Heat-damaged kernels (%)	Distinctly green kernels (%)	Total ^{1/} damaged kernels (%)	Inconspicuous admixture (%)
U.S. No. 1	0.1	2.0	3.0	5.0
U.S. No. 2	0.5	6.0	10.0	5.0
U.S. No. 3	2.0	20.0	20.0	5.0

GRADE	Maximum limits of --			
	Ergot (%)	Sclerotinia (%)	Stones (%)	Conspicuous admixture ^{2/} (%)
U.S. No. 1	0.05	0.05	0.05	1.0
U.S. No. 2	0.05	0.10	0.05	1.5
U.S. No. 3	0.05	0.15	0.05	2.0

U.S. Sample grade

U.S. Sample grade is canola that:

- (a) Does not meet the requirements for the grades U.S. Nos. 1, 2, or 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), 4 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 500 gram of canola; or
- (c) Has a musty, sour, or commercially objectionable foreign odor; or
- (d) Is heating or otherwise of distinctly low quality.

^{1/} Includes heat-damaged kernels, distinctly green kernels, and other-damaged kernels.

^{2/} All matter other than canola, including ergot, sclerotinia, and stones.

GRADE REQUIREMENTS FOR CORN

GRADE	Minimum Test weight per bushel (lbs.)	Maximum limits of --		
		Heat- damaged kernels (%)	Total damaged kernels (%)	Broken corn and foreign material (%)
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 the grades U.S. Nos. 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.

GRADE REQUIREMENTS FOR FLAXSEED

GRADE	<u>Minimum</u>	<u>Maximum limits of --</u>	
	Test weight per bushel (lbs.)	Heat- damaged kernels (%)	Total damaged kernels (%)
U.S. No. 1	49.0	0.2	10.0
U.S. No. 2	47.0	0.5	15.0

U.S. Sample grade:

U.S. Sample grade is flaxseed that:

- (a) Does not meet the requirements for the grades U.S. Nos. 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 1-1/4 quarts of flaxseed; or
- (c) Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
- (d) Is heating or otherwise of distinctly low quality.

GRADE REQUIREMENTS FOR MIXED GRAIN

Maximum limits of --

GRADE	Heat-damaged kernels (%)	Total damaged kernels (%)
U.S. Mixed grain (Grade)	3.0	15.0

U.S. Sample grade:

U.S. Sample grade is mixed grain that:

- (a) Does not meet the requirements for the grades U.S. Mixed grain (Grade); or
- (b) Contains 8 or more stones that 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, or 10 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth in excess in 1,000 grams; 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.

GRADE REQUIREMENTS FOR OATS

GRADE	<u>Minimum limits</u>		<u>Maximum limits --</u>		
	Test weight per bushel (lbs.)	Sound oats (%)	Heat-damaged kernels (%)	Foreign material (%)	Wild oats (%)
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 is oats that:

- (a) Do not meet the requirements for the grades U.S. Nos. 1, 2, 3, or 4; or
- (b) 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 (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 cockleburrs (Xanthium spp.) or similar seeds singly or in combination, 10 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 1-1/8 to 1-1/4 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 shall be graded not higher than U.S. No. 4.

GRADE REQUIREMENTS FOR RYE

GRADE	Minimum Test weight per bushel (lbs.)	Maximum limits of --					Thin rye (%)
		Foreign matter other than wheat (%)	Total foreign material (%)	Heat damaged kernels (%)	Total damaged kernels (%)		
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:

U.S. Sample grade is rye that:

- (a) Does not meet the requirements for the grades U.S. Nos. 1, 2, 3, or 4; or
- (b) Contains 8 or more stones or any number of 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), 2 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 1-1/8 to 1-1/4 quarts of rye; or
- (c) Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
- (d) Is heating or otherwise of distinctly low quality.

GRADE REQUIREMENTS FOR SORGHUM

GRADE	Minimum	Maximum limits of --			
	Test	Heat-damaged kernels (%)	Total damaged kernels (%)	Broken kernels (BK) & <u>foreign material (FM)</u> FM only (%)	Total (%)
U.S. No. 1	weight per bushel (lbs.)	0.2	2.0	1.5	4.0
U.S. No. 2		0.5	5.0	2.5	7.0
U.S. No. 3 ^{1/}		1.0	10.0	3.5	10.0
U.S. No. 4		3.0	15.0	4.5	13.0

U.S. Sample grade is sorghum that:

- (a) Does not meet the requirements for the grades U.S. Nos. 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 cocklebur (Xanthium spp.) or similar seeds singly or in combination, 10 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 1,000 grams of sorghum; or
- (c) Has a musty, sour, or commercially objectionable foreign odor (except smut odor); or
- (d) Is badly weathered, heating, or otherwise of distinctly low quality.

^{1/} Sorghum which is distinctly discolored shall be graded not higher than U.S. No. 3.

GRADE REQUIREMENTS FOR SOYBEANS

GRADE	Min. Test weight per bushel (lbs.)	Maximum limits of --				
		Heat- damaged kernels (%)	Total damaged kernels (%)	Foreign material (%)	Splits (%)	Soybeans of other colors ^{1/} (%)
U.S. No. 1	56.0	0.2	2.0	1.0	10.0	1.0
U.S. No. 2	54.0	0.5	3.0	2.0	20.0	2.0
U.S. No. 3	52.0	1.0	5.0	3.0	30.0	5.0
U.S. No. 4	49.0	3.0	8.0	5.0	40.0	10.0

U.S. Sample grade:

U.S. Sample grade is soybeans that:

- (a) Do not meet the requirements for the grades U.S. Nos. 1, 2, 3, or 4; or
- (b) Contain 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, or bird droppings, or a total of 11 or more pieces/particles of animal filth, castor beans, crotalaria seeds, glass, stones (regardless of weight), and/or unknown foreign substances; or
- (c) Have a musty, sour, or commercially objectionable foreign odor (except garlic odor); or
- (d) Are heating or otherwise of distinctly low quality.

^{1/} Disregard for Mixed soybeans.

GRADE REQUIREMENTS FOR SUNFLOWER SEED

GRADE	<u>Minimum</u>	<u>Maximum limits of --</u>		
	Test weight per bushel (lbs.)	Heat- damaged kernels (%)	Total damaged kernels (%)	Dehulled seed (%)
U.S. No. 1	25.0	0.5	5.0	5.0
U.S. No. 2	25.0	1.0	10.0	5.0

U.S. Sample grade:

U.S. Sample grade is sunflower seed that:

- (a) Does not meet the requirements for the grades U.S. Nos. 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), or 10 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 600 grams of sunflower seed; or
- (c) Has a musty, sour, or commercially objectionable foreign odor; or
- (d) Is heating or otherwise of distinctly low quality.

GRADE REQUIREMENTS FOR TRITICALE

GRADE	Min. Test weight per bushel (lbs.)	Maximum limits of --					
		Heat damaged kernels (%)	Total ^{1/} damaged kernels (%)	Material other than wheat or rye (%)	Total ^{2/} foreign material (%)	Shrunken and broken kernels (%)	Defects ^{3/} (%)
U.S. No. 1	48.0	0.2	2.0	1.0	2.0	5.0	5.0
U.S. No. 2	45.0	0.2	4.0	2.0	4.0	8.0	8.0
U.S. No. 3	43.0	0.5	8.0	3.0	7.0	12.0	12.0
U.S. No. 4	41.0	3.0	15.0	4.0	10.0	20.0	20.0

U.S. Sample grade:

U.S. Sample grade is triticale that:

- (a) Does not meet the requirements for the grades U.S. Nos. 1, 2, 3, or 4; or
- (b) Contains 8 or more stones or any number of 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), 2 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 1-1/8 to 1-1/4 quarts of triticale; or
- (c) Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
- (d) Is heating or otherwise of distinctly low quality.

^{1/} Includes heat-damaged kernels.

^{2/} Includes material other than wheat and rye.

^{3/} Defects include damaged kernels (total), foreign material (total), and shrunken and broken kernels. The sum of these three factors may not exceed the limit for defects for each numerical grade.

**GRADE REQUIREMENTS FOR ALL CLASSES OF WHEAT,
EXCEPT MIXED WHEAT**

GRADE	<u>Minimum limits of--</u>		<u>Maximum limits of --</u>	
	<u>Test weight per bushel</u>		Heat- damaged kernels (%)	Total ^{2/} damaged kernels (%)
	HRS or White Club wheat ^{1/} (lbs.)	All other classes and subclasses (lbs.)		
U.S. No. 1	58.0	60.0	0.2	2.0
U.S. No. 2	57.0	58.0	0.2	4.0
U.S. No. 3	55.0	56.0	0.5	7.0
U.S. No. 4	53.0	54.0	1.0	10.0
U.S. No. 5	50.0	51.0	3.0	15.0

GRADE	<u>Maximum limits of --</u>				
	Foreign material (%)	Shrunken and broken kernels (%)	Defects ^{3/} (%)	Con- trasting classes (%)	Total ^{4/ 5/} wheat of other classes (%)
U.S. No. 1	0.4	3.0	3.0	1.0	3.0
U.S. No. 2	0.7	5.0	5.0	2.0	5.0
U.S. No. 3	1.3	8.0	8.0	3.0	10.0
U.S. No. 4	3.0	12.0	12.0	10.0	10.0
U.S. No. 5	5.0	20.0	20.0	10.0	10.0

- ^{1/} These requirements also apply when Hard Red Spring wheat or White Club wheat predominate in a sample of Mixed wheat.
- ^{2/} Includes heat-damaged kernels.
- ^{3/} 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.
- ^{4/} Unclassed wheat of any grade may contain not more than 10.0 percent of wheat of other classes.
- ^{5/} Includes contrasting classes.

U.S. Sample grade is wheat that:

- (a) Does not meet the requirements for the grades U.S. Nos. 1, 2, 3, 4, or 5; or
- (b) Contains 32 or more insect-damaged kernels per 100 grams of wheat; or
- (c) 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 (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), 2 or more rodent pellets, bird droppings, or equivalent quantity of other animal filth per 1,000 grams of wheat, or a combined total of 5 or more pieces of animal filth, castor beans, crotalaria seeds, glass, stones, and unknown foreign substance; or
- (d) Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
- (e) Is heating or otherwise of distinctly low quality.