Chapter 4

Grain Quality
U.S. Grades and Standards

The international grain trade is built on the ability to deliver a high quality product worldwide. Achieving this goal requires effective management of grain quality along the supply chain from farm gate to end user It is essential to the satisfaction of all customers, with the ultimate customer being the retail consumer.

In many exporting countries, grain is delivered at harvest directly from farm to a local storage warehouse, commonly known as a "country elevator" in North America, or as a "silo" in Australia.

Having a process that assesses the many aspects of grain quality after it leaves the farm helps preserve quality and document characteristics that will ultimately help determine its value, and will affect its ultimate selling price. This process ensures that various lots of grain are combined with grain of similar type and quality as it accumulated into larger lots for transport. It will also determines the manner in which the grain is to be segregated, stored, handled and transported along the supply chain.

The U.S. inspection and grading system provides a way to ensure that the grain delivered is of the quality that the customer purchased – a top priority for the quality assessment upon arrival to the end user. As grain arrives at the feed mill, malt house, flour mill or other first stage processor; its quality factors are again tested making sure it is suitable for its intended use.

Again, the grain is likely to be segregated and managed according to quality factors. While the processor would rather not have to make adjustment that are likely to add to costs; if incoming grain is not of adequate quality, the receiving end user will have a final opportunity to adjust the processing methods to help compensate for its inadequacies.

Uniform commodity grades and standards provide a reliable means for

quantifying factors of quality. This allows the market to more easily assign a value to these quality factors, generally in the form of premiums and discounts. Having a widely adopted system of grades and standards can lower costs in the supply chain by creating products of uniform quality that flow through the system.

In the real world, grains are usually not dealt with individually, that is grain by grain, but as a bulk volume of a multitude of grains. This is why we speak of "mass properties", and why we must differentiate between individual properties that are characteristic of particular kernels.

The most important mass properties include purity *(percentage of dockage, broken corn and foreign material - BCFM)*, bulk density (test weight, hectoliter weight, hundred-kernel weight). Moisture content, kernel soundness, hardness and density *(vitreousness)* may also be included. These characteristics are the primary assessment of quality. For the commercial trade, the effects of pests and pathogens also need to be considered.

Apart from observable physical properties, some quality factors are so complex that laboratory tests may also be required. Knowledge of nutritional value *(energy, crude protein, amino acid profile)* is also important, especially when there are several end use objectives may be involved. This is the reason why a detailed quality assessment is necessary to ensure a uniform and high-quality supply for the processing industry.

Moreover, there is no such thing as 'absolute quality'. As such, various methods are used to determine grain quality, as no single quality factor is sufficient for all possible uses. 'Fitness for purpose' is probably the best definition for grain quality.

The proper management of grain quality as it move through the supply chain, can save additional costs or add significant value to the process. Knowledge and understanding of grain quality will assist in merchandising decisions, determining how a specific lot of grain may be stored, to where it may be shipped, how it might be best utilized, negotiating it highest value, and to what final market it will be sold and delivered. These market dynamics provide the basis for domestic and international trade while promoting efficiency in merchandising and procurement.

Across the U.S. supply chain and marketing system, quality requirements for grain exports are governed by both contract specifications and a set of government-regulated standards that govern

the inspection, sampling, grading and weighing of grain. These grain standards are designed to ensure that the processes and procedures for assessing weights and quality grades result in a uniform product that facilitates the trading and marketing of U.S. grain. The grades and standards in this respect are contained in the regulations of national authorities and organizations.

One of the major strengths of the U.S. marketing system is its long established quality inspection process based on an underlying set of federal grades and standards. This process supports the price and delivery of quality grain across a number of agricultural commodities to both domestic end users and export customers around the world.

USDA has developed strict measures for quality grading based on standards developed for each commodity type or product providing a common language among buyers and sellers, which in turn assures consistent quality for consumers. These objective, quantifiable, and verifiable standards is a major reason for the high level of confidence importers have in the quality of U.S. grain they purchase.

A Short History of Grain Inspection, Grades and Standards

The economic value of grain is based upon its physical and/or chemical characteristics. This is because different grain-based products (e.g., food, feed, ethanol or industrial) often requires grain with different characteristics. To help processors identify grains that will provide the best "end use quality factors," grading standards and tests have been developed that measure grains' key physical and chemical characteristics, i.e., test weight, moisture, purity, damage, protein, starch, oil, etc. Buyers purchase grain based on these quality factors that indicate how these grains may perform or function in their intended end use. Use of these grains may vary from an animal feed ingredient to a food ingredient after milling, malting or other types of processing

The rapid expansion of the U.S. grain industry in the early twentieth century created a need for a uniform system of measuring certain quality factors and establish a grading system in order to better facilitate commercial trade. Independent attempts by local Chambers of Commerce, boards of trade, and major grain corporations to develop standards had resulted in inequalities among markets. These disparities highlighted the need for nationally uniform standard to reduce confusion that characterized the trade during that period.

This decentralized and chaotic system led farmers, end users, the commercial trade and local governments to propose a national inspection program, and a national weighing program. As a result, the Department of Agriculture established laboratory tests and conducted numerous interviews and hearings to identify the most urgent needs of the grain industry. This information became the basis for the federal legislation that was eventually adopted.

U.S. Grain Standards Act

At the request of the industry, Congress passed the United States Grain Standards Act (P.L. 64-190 or USGSA) on August 11, 1916. The first standards established under the Act were for corn and became effective December 1, 1916. It was the culmination of 25 years of investigation, public hearings, and debate.

Several decades later, the Agricultural Marketing Act of 1946 authorized similar inspection and weighing services for rice, pulses and certain other commodities. Other major changes to the law were adopted in the USGSA Amendments of 1968, the USGSA of 1976 (P.L. 94-582), and the Grain Quality Improvement Act of 1986 (P.L. 99-641).

The U.S. Grain Standards Act provides for the establishment of official U.S. grain standards that are used to measure and describe the physical and biological properties of the grain at the time of inspection. The grades, classes and conditions reported on official certificates are determined according to the quality factors defined in the standards.

The U.S. Grain Standards Act, with few exceptions, requires official certification of all grains and oilseeds exported from the United States. It requires these products to be officially weighed and inspected for quality. These official services can also be provided, upon request, for domestic commercial grain transactions.

USDA standards exist for twelve grains (listed from largest to smallest volume inspected): corn, soybeans, wheat, grain sorghum, barley, oats, rye, flaxseed, sunflower seed, canola, triticale and mixed grain. Commodities such as rice, pulses and hops have similar standards for grade and quality factors.

Other commodities, along with a wide range of processed products, including; feed stuffs, meals, flour, food mixes, edible oils and other cereal food products, have no official USDA standards.

All government agencies involved in the grading and inspection of grains are strictly guided by the United States Grain Standards Act. This ensures consistency of test results and services, from elevator to

elevator, and state to state. Official inspections of grains, oilseeds, and other agricultural and processed commodities are based on established standards, and on sound, proven, and standardized procedures, techniques, and equipment.

Federal Grain Inspection Service (FGIS)

FGIS was created by Congress in 1976 to manage the national grain inspection system, which was initially established in 1916, and to institute a national grain weighing program.

Today FGIS facilitates the marketing of U.S. grain and related products by establishing standards for quality assessments, regulating handling practices, and managing a network of Federal, State, and private laboratories that provide impartial official inspection and weighing services. [i]

With a few exceptions, the official inspection of export grain is mandatory. Only the partners of the official system, FGIS field offices and state and private agencies authorized by FGIS can provide an official grain inspection certificate. Official personnel employed or licensed by FGIS obtain representative samples using approved methods and equipment.

Changes in U.S. grain standards

Grain Quality Improvement Act of 1986

The Grain Quality Improvement Act of 1986 required FGIS to revise certain procedures in order to enhance the quality of U.S. grain exports. The act addressed three primary areas: grain handling practices, insect tolerances, and the usefulness of grain standards. More stringent insect tolerances became effective in May 1988.

Before the implementation of this act, some elevator operators removed and stored dust, dockage and foreign material during grain handling to reduce dust levels in the elevator, then recombined it before loading the vessel. This practice is no longer permitted. While the act prohibits recombining dust that has been removed and stored, it does not require dust to be removed.

FEDERAL GRAIN INSPECTION SERVICE - FGIS

The Federal Grain Inspection Service (FGIS) is part of the U.S. Department of Agriculture's (USDA) Grain Inspection, Packers and Stockyards Administration (GIPSA).

Under the United States Grain Standards Act (USGSA) and the Agricultural Marketing Act of 1946 (AMA), FGIS:

- Establishes and maintains official U.S. grain standards for barley, canola, corn, flaxseed, oats, rye, sorghum, soybeans, sunflower seed, triticale, wheat, mixed grain, rice, and pulses;

- Inspects and weighs grain and related products for domestic and export trade;

- Establishes methods and procedures, and approves equipment for the official inspection and weighing of grain;

FGIS

- Supervises the official grain inspection and weighing system. The official system is a network of FGIS field offices, and State and private grain inspection and weighing agencies across the nation that are authorized by FGIS to provide official inspection and weighing services.

- Provides international services and outreach programs and protects the integrity of the official inspection system and the market at large to ensure markets for grain and related products are fair and transparent.

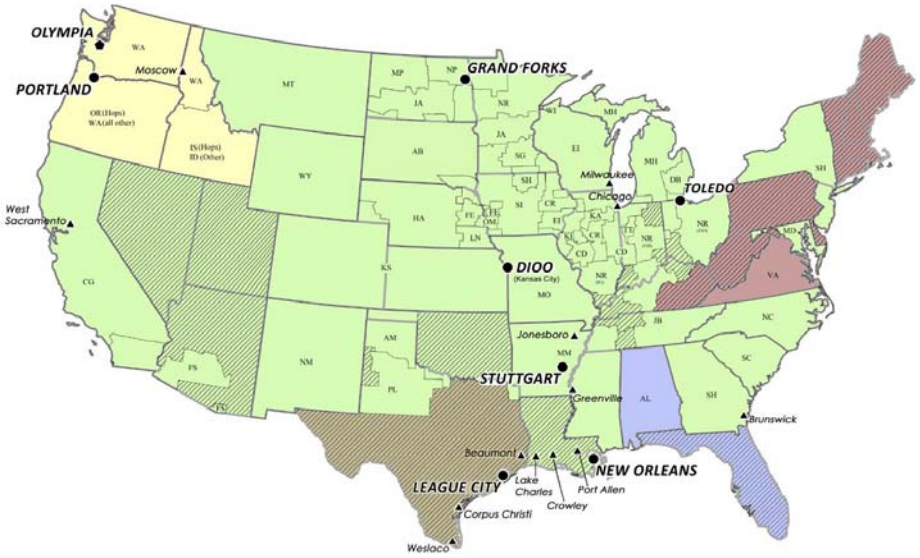
FGIS and the official agencies that comprise the official system provide services under both the USGSA and the AMA on a fee basis for both export and domestic grain shipments. The official system is a unique public-private partnership overseen by FGIS. The system includes Federal offices and State and contracted private agencies authorized by FGIS to provide official inspection and weighing services for the domestic and export grain trade.

FGIS administers the U.S. inspection and weighing system for grains and other commodities through field offices and two federal/state offices in the United States and Canada. FGIS field offices also oversee the work of state and private agencies which provide official services at other domestic grain markets. Eight of these state agencies are also authorized to perform official export services at ports.

While the composition of the official system is diverse, its results are not. Every customer, whether on the East Coast or the Gulf of Mexico, or in the Midwest or the Pacific Northwest, receives consistent, accurate service. That's because every official service provider operates under uniform, official U.S. grain standards and procedures.

FGIS

The official grain inspection and weighing system serves producers, handlers, processors, exporters, importers, and end-users of American grain by providing consistent and professional grain inspection and weighing services. The FGIS is required by law to collect fees that cover the cost of these services.



Source: USDA AMS FGIS "Official Agency Directory"
https://www.ams.usda.gov/sites/default/files/media/2019OADirectory.pdf

The quality grade is reported on a "FGIS Official Export Grain Inspection Certificate" which represents the entire cargo or lot submitted for inspection. U.S. and international buyers rely on official inspection certificates to provide accurate, official descriptions of the grade, class, and condition of grain. Official grain inspection certificates are legal documents that are admissible in court.

The FGIS has the capacity to perform physical, chemical and microbiological tests – using the official laboratory methods of the Association of Official Analytical Chemists – requested in laboratory specifications.

Every official State and private agency is backed by the resources and expertise of the FGIS National Grain Center located in Kansas City, Missouri. The accuracy of officially approved equipment is verified, and re-verified, by FGIS technicians using finely calibrated master instruments and official reference methods. Official personnel pass rigorous tests and undergo extensive and continuous training. System-wide quality control requirements ensure that official personnel consistently provide high-quality, accurate services and information. The work of official personnel is reviewed and monitored by an extensive quality assurance program.

The quality factors that can be determined by the FGIS may include; test weight (bulk density) and percentages, by weight, of damaged kernels, broken kernels, foreign material, and other factors. The grade certificate may also note specific conditions of the grain, such as moisture content, odor and infestation. No seasonal adjustments are made on U.S. grades, nor is the cropping year of production noted.

Other quality assessment services provided by FGIS, and available upon request, include; the determination of protein and falling numbers in wheat, oil content in canola and sunflower seed, and aflatoxin in corn.

FGIS also performs stowage examinations within 24 hours prior to loading to assure that carrier's vessels are clean, dry and fit for loading.

FGIS

FGIS also works closely with other U.S. government agencies. For example, if FGIS were to find excessive levels of aflatoxin in corn, this would be reported to the Food and Drug Administration (FDA) for action to prevent the cargo from entering commercial channels. FGIS also works closely with the Animal and Plant Health Inspection Service (APHIS) to report insects found during inspection when the importing country has specified phytosanitary restrictions. The cooperation between U.S. government agencies is designed to assure that overseas customers receive the quality of grain desired.

There are a number of private companies and commercial business providing unofficial inspection services and quality analysis information. FGIS does not have any authority over unofficial agencies, and the certificates issued by these agencies are not "official" FGIS certificates. These other inspection companies can provide services such as; trace metal analysis, mycotoxin testing for other than aflatoxin, and testing for zearalenone and T-2 toxin using methods governed by the American Association of Cereal Chemists and other similar entities.

FEDERAL REGISTER – GRADES AND STANDARDS

The standards represent currently accepted market practices for the various grains and have been revised or amended from time to time through public rule-making procedures. Before FGIS can establish, revise or repeal any of its standards, rules and regulations, it is required by law to announce its intentions in the *Federal Register*.

The *Federal Register* is a publication that records all changes or proposed changes in federal regulations. These changes must be published and the public offered opportunity for comment before they go into effect. FGIS sends copies of FGIS *Federal Register* notices and proposals electronically to the agricultural offices of U.S. embassies worldwide, and will send any of its *Federal Register* announcements to anyone who requests them. The agency also publishes its *Federal Register* actions in news releases.

A *Federal Register* announcement includes a description of the action, rules the action would replace or affect, the effective date, reasons for taking action, objectives and effects of the action and an impact analysis (for major regulations). The announcement also includes the identification and addresses of FGIS contacts, a summary of the comments received on previous announcements and text or amending language to be used as text of the regulation or action. The final rule includes exact language amending the regulation.

Changing the grain standards is a lengthy process, requiring at least one year from initiation until implementation. The public is given the chance to comment throughout the rule-making process, including:

1. Before rule-making at preliminary public and private meetings, or in writing to agency officials whenever an individual, company or group has a concern;
2. During the comment period published in the *Federal Register* notice to change or establish a standard;
3. During the comment period published in the *Federal Register* "Proposed Rule."

FGIS usually allows a 60-day comment period for *Federal Register* actions that would change or establish a standard, and FGIS may allow additional time for comment to parties who request an extension. Oral and written comments should be addressed to the contact identified in the *Federal Register*. FGIS has a special e-mail address, published in the *Federal Register*, which can be used for submitting comments. Changes to the standards usually take effect one year after publication.

HOW GRAIN IS SAMPLED, INSPECTED AND GRADED

In order to be officially inspected, grain must be weighed and graded according to the provisions of the U.S. Grain Standards Act. This means that the equipment and procedures used must be approved and checked regularly for accuracy and that inspectors must be tested for proficiency

in carrying out their inspection duties. The U.S. Congress has given FGIS responsibility for carrying out this work.

There are seven basic operations that are performed follow a prescribed path when officially inspecting and grading grain before it is loaded aboard carrier or vessel.

Official Inspection Procedures

1. Obtain a representative sample.
2. Examine the sample for objectionable odors, insect infestation, heating, or other harmful conditions.
3. Divide out am appropriate size sub lot of the sample and determine the moisture content.
4. Recombine the sample portion used for the determination of moisture, determine the test weight.
5. Divide out an appropriate size sub lot of the sample (typically 250 grams) and determine the percentage of foreign material and broken corn (BCFM) in the sample.
6. Divide out an appropriate size sub lot of the sample (typically 125 grams) and determine the percentage of damaged kernels and class (i.e. flint corn, dent corn, or waxy corn).
7. Record all the required information relating to the required quality factors, and determine the applicable USDA quality grade.

In addition, before a carrier of vessel can be loaded for export it must be inspected to determine that it is "fit for purpose". The carrier or vessel stowage area must be clean, dry, free of odor and infestation and otherwise suitable for receiving or storing grain, insofar as the suitability may affect the quality, quantity or condition of the grain.

HOW GRAIN IS SAMPLED

The first and critical step in conducting any test is representative sampling. If this initial step is not conducted with the necessary diligence, there may be serious mistakes. Without a representative sample, the final grade will not reflect the true grade or value of the grain.

In order for a sample to be considered representative, it must:

- be obtained in accordance with recommended USDA FGIS procedures;

- be of the prescribed size (at least 1000 grams or approximately 1¼ quarts);

- be packages and handled appropriately and securely, protected from contamination, manipulation, substitution, and careless handling.

For more information on grain sampling, please refer to USDA AMS publication: "Grain Inspection Handbook – Book 1 Sampling, https://www.ams.usda.gov/sites/default/files/media/Book1.pdf

Preliminary Examination

Official Sampling Procedures

Upon the initial sampling and inspection the sampler must:

1. Observe the uniformity of the grain as to class, quality and condition;

2. Make preliminary determinations for "Heating, Infestation, and/or Odor";

3. Draw the representative sample; and

4. Report relevant information to the inspector.

The inspector must review the sampler's remarks/information.
If the inspector suspects the sample is not representative, the inspector will consult the sampler and, if necessary, dismiss the inspection or arrange to obtain another sample.

Probing and Collecting a Sample

A large percentage of grain is sampled with a grain probe. Probe sampling is the only approved method for obtaining samples from stationary lots. If probe sampling is performed correctly, the samples drawn will consistently be representative.

To obtain a proper sample, the proper equipment should be utilized,

Hand Probe: This standard piece of equipment, sometimes referred to as a "trier", is constructed of brass or aluminum. Probes come in various

sizes with standard lengths of 5, 6, 8, 10, and 12 feet. The type and size of carrier dictates which probe length to be used.

There are two types of hand probes: 1) compartmented probes, in which slots in the outer tube match compartments in the inner tube, and 2) open throat probes, in which the inner tube is open. Open-throat probes tend to draw more of their sample from the top portion of the grain, while compartmented probes draw a representative sample from each layer. All official grain probes are compartmented probes with an outer tube that is 1 3/8-inches in diameter.

Mechanical Probe: There are two types of mechanical probes which are recommended for sampling stationary lots of grain in trucks, railcars, or other open-top carriers.

The gravity-fill probe function is similar to compartmented hand probes except that after the compartment is filled it rotates to an inner tube where it is forced up by air.

Official Sampling Procedures

The core probe functions by forcing the sample up into the core as the probe is pushed down and then using air to transport the sample to the output point.

A third type, the in-load suction probe, which uses negative air pressure to suck the sample into the bottom of the probe, is not recommended since it tends to overestimate foreign material.

Diverter Type Sampler: In most large grain terminals and export facilities a "Diverter Type" sampler" is used. Within the grain patch, they are located either before or after the scale, and sweeps a sampling container, called a pelican, through the grain stream once every sampling period, which is usually set between 12 and 25 seconds. The grain sample then flows through a pipe to the inspection lab, where it is inspected and graded. Regulations also requires grain arriving by barge at an export elevator to be officially weighed; however, official inspection of this grain is optional.

Sampling Canvas: Heavy canvas cloth or similar material can be used to display the sample from the compartmented probe. Another alternative is a short section of rain gutter or half section of pipe. The sampling canvas or other material should be at least 6 inches longer than the probe used to draw the sample. This size is necessary so that the grain from the entire length of each probe will not spill off the ends of the canvas. Always keep sampling canvases clean, dry, and free of holes.

Sampling Containers: Containers such as heavy cloth or canvas bags and metal buckets or plastic cans may be used to transport the sample to the inspection station. Sample containers should be free of all old grain, insects, and other waste material prior to use. Use air-tight containers or bags lined with a polyethylene liner to store grain in order to prevent loss of moisture and to protect the sample from adverse environmental conditions such as rain or humid weather.

Where to Probe: Where to probe is determined by the size and configuration of the carrier. Recommended probe sites are anywhere in the carrier except the corners and the center of the load, which typically sits directly underneath the loading spout. It is also recommended to vary the probe sites between loads in a random manner. Receiving locations which routinely sample carriers in the same location have found that bad grain seems to migrate to the areas in the load which are not sampled.

HOW GRAIN IS INSPECTED AND GRADED

The effectiveness of the official U.S. grain inspection system is its ability to obtain consistent, accurate, and repeatable results. This depends not only on the official inspector's ability, but other operators across the industry, to sample, inspect, and grade certify the various grains for which standards have been established.

In view of this fact, the Federal Grain Inspection Service (FGIS) has published the Grain Inspection Handbook.

For more information on grain grading procedures, please refer to USDA AMS publication: "Grain Inspection Handbook – Book 2 Grain Grading Procedures: https://www.ams.usda.gov/sites/default/files/media/Book2.pdf

The four considered major quality factors are:

I. Moisture
II. Bulk Density - Test Weight
III. Purity – Dockage, Foreign Material, BCFM
IV. Soundness - Damaged Kernels

Although moisture, protein, and oil contents are not part of the quality factors that determine the "official USDA numerical quality grade", they are important quality factors and are often specified on contracts for many markets. NIT is used for rapid estimation of moisture, protein, and oil contents.

The following is only meant to be a general overview.

Preliminary Examination

Upon the initial sampling and inspection the sampler must:

5. observe the uniformity of the grain as to class, quality and condition;

6. make preliminary determinations for "Heating, Infestation, and Odor";

7. draw the representative sample; and

8. report relevant information to the inspector.

The inspector must review the sampler's remarks/information.
If the inspector suspects the sample is not representative, the inspector will consult the sampler and, if necessary, dismiss the inspection or arrange to obtain another sample.

Official Inspection and Grades

Moisture

Moisture content is an important consideration as it significantly affects storability of the grain. The desired moisture content must be such that the grain quality will be maintained during storage, transportation and delivery, as well as long periods of time the grain may be stored in a warehouse.

Moisture content also affects both the test weight and bulk density. Consequently, these measures should only be referenced on an agreed standardized moisture content. For example, the specific gravity of corn is 1.3, while that of water is 1.0. When the moisture content of corn increases, the test weight of the corn will decreases.

For corn, the determination of moisture content is especially important as there is special emphasis on drying as the grain as it is brought into the warehouse at harvest. Proper management of moisture at harvest and through the drying process can help to avoid corn kernels developing microscopic stress cracks (i.e. checking) in their pericarp. Later, in the course of handling, these stress crack kernels will break up into several parts and the original value will decrease. These broken kernels will initiate the decomposition processes and promote the growth of storage molds and infestation of insects. Heating of the grain mass may occur, possibly resulting in heat damaged and further loss of

grain quality.

Moisture meters are used to determine the amount of moisture within grain presented for sale, a critical assessment of quality that affects the value and storability of the grain. As of 2022, the Agricultural Marketing Service (AMS), FGIS uses the DICKEY-JOHN GAC 2500-UGMA and Perten AM 5200-A as the official moisture meters for all officially inspected grains and commodities.

Handle all cold samples quickly to reduce the possibility of condensation in a warm room. Samples on which snow or ice has melted or which contain snow or ice, are unsuitable for moisture testing.

The sample temperature range limit is between 0 - 40 degrees Celsius (32-104 degrees Fahrenheit). The sample-to-instrument temperature difference limit is 20 degrees Celsius (36 degrees Fahrenheit). If the instrument finds any of these limits exceeded, it will not display moisture results.

Official Inspection and Grades

Because of wide variations between room and grain temperatures throughout the year, it is not possible to predict exactly how long after the thermometer has been inserted into the grain that the temperature should be read. Generally, three to five minutes is sufficient to obtain an accurate temperature.

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

Paper bags, fiber cartons and so forth are not used as moisture sample containers. Containers found to be the most practical for use in determining moisture are moisture-proof, plastic 475-ml containers with openings of approximately 45 mm. Paper identification should not be inserted in the grain samples.

Bulk Density - Test weight per bushel

Test weight, which in the U.S. is the weight in pounds of grain per Winchester bushel (35.2 l), is determined on a 1 quart (1.18 l) sample If the test weight is extremely low, the soybeans may contain less oil.

The bulk density or “Test Weight”, which in the United States is measured per bushel, is the weight of the grain required to fill a level

Winchester bushel measure (approximately 35.2 liter capacity).

The factor "test weight per bushel" is determined using an approved apparatus which has a kettle capacity of 1 dry quart (approximately 1.1 liters). This determination is made on a representative portion of grain, not less than 1 1/8 to 1 1/4 quarts (1.2 to 1.4 liters) cut from the representative sample using a Burner divider, before removing foreign material using an official test weight apparatus..

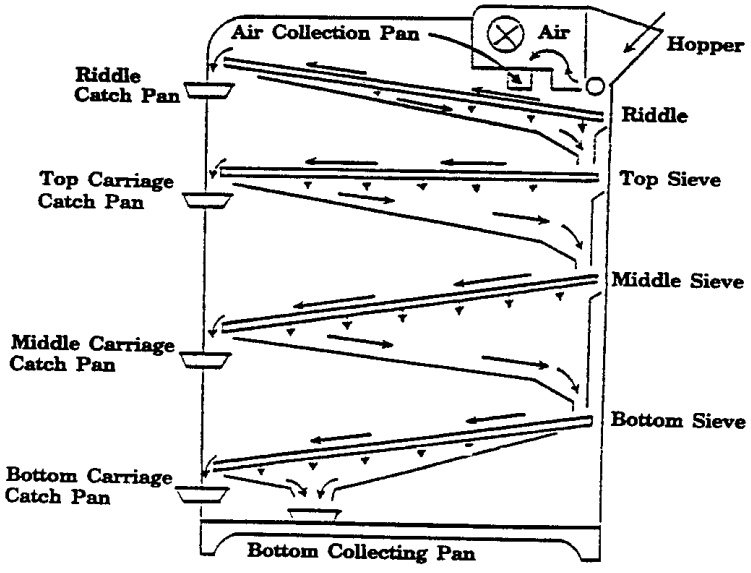
Test weight per bushel is a grading factor. Generally, it is expressed in pounds per Winchester bushel, but upon request it will be converted to kilograms per hectoliter.

To determine test weight, the work sample is poured into the closed hopper which is centered over the kettle. The valve is opened to allow the grain to fill the kettle. A standard stoker held in both hands with the flat sides in a vertical position is used to remove the excess grain from the top of the kettle with three full-length, zigzag motions. The kettle is hung on the beam, and the beam weights are moved until the beam is perfectly balanced. Then the test weight per bushel is read.

Official Inspection and Grades

Dockage

Dockage is a factor determined for barley, flaxseed, rye, sorghum, triticale and wheat, but not for other grains. Dockage consists of material which can be easily removed by machine and includes material lighter than, larger than and smaller than the grain.



Dockage is determined with a special machine called the Carter Dockage Tester. The dockage tester uses aspiration (air) and a

combination of riddles and sieves to prepare samples for grading by removing the readily separable foreign matter. Generally, the foreign material removed consists of all matter lighter, or of a different size than the grain. Like moisture, dockage does not influence the numerical grade of the grain, but it always is determined and reported on the certificate.

After dockage is removed, a portion of the sample is manually examined for foreign material, which is all material remaining in the sample other than the predominant grain. Foreign material includes materials which could not be separated mechanically, such as seeds and other grains similar in size and weight to the grain.

The Dockage Tester can also be used to determine the percentage of broken corn and foreign material in corn. Broken corn and foreign material is a grading factor in corn.

Foreign Material

A test used to determine the "purity" of the sample is to measure the foreign material. Foreign matter includes all material other than the grain that is being specified for testing, including; other grains, weed seeds, pods, leaves, stems, etc.

When determining "broken corn and foreign material" (BCFM) for corn, all the components that are foreign to the corn kernels are isolated from the corn sample, especially material that will have unfavorable effects on its utilization and storage life. The mass of this material is weighed. In the USA, sieves having 4.8 mm (14/64 in.) and 2.4 mm (6/64 in.) round-hole are used for this purpose.

Soundness - Damage Kernels

Grain quality, and as it applies in the context of "damage" is a very broad term. More specifically, grain damage is any degradation in the quality of grain; specifically that impacts the soundness of the whole grain kernel. It can relate to many issues such as mechanical damage, change in chemical compositions, insect infestations, and many others. Damage to grain will impact its economic value, price, feed quality, and food product quality, as well as its susceptibility to pest contamination.

Damage to grain can be divided into two general categories; 1) Field Damage, and 2) Storage Damage

Field Damage: Field damage is caused by events that happen to the grain crop while growing and standing in the field. This may include

such things as damage to the grain from plant diseases, field insects, field fungus, molds and mycotoxins, as well as frost damage, etc.

Storage Damage: Storage damage is caused by events that happen between the field and its final end use. Grain may go through any number of storage and handling operations as it moves through the supply chain, each of which can each contribute to grain damage. For example, grain might encounter damage from:

- Breakage due to free fall, conveyors, spouts, grain throwers, elevators, hoppers, dryers, etc…
- Damage from excessive moisture and/or excessive heating during storage or mechanical drying.
- Damage from storage fungus, molds, and associated mycotoxins.
- Damage from storage insects.
- Damage from contamination by foreign materials, animal filth, chemicals, etc…

Official Inspection and Grades

Assessing grain damage is a very broad topic. In order to quantify grain damage, one must also possess a deep understand grain quality. In addition, many of the factors that need to be assessed are not easily measured. Many common methods for determining grain damage levels include some type of visible inspection, which can carry with it a large amount of error.

To one extent, damaged grain can be characterized by the extent to which it reduces its storage time. For example, cracked or broken kernels are more susceptible to insect or bacteria as well as chemical degradation.

To another extent, the damage to the actual grain is only one example of losses incurred after harvest. Damage to grain can also occur from contamination by foreign materials, animal filth, chemicals, etc

It can be difficult to address many of the factors that can be considered damage. It is not the purpose of the space available in this manual to address the topic in great detail. As such, we would direct you to the USDA website which contains the most current information on the subject for each type of grain.

USDA AMS – "Grain Inspection Hand Book II – Grain Grading Procedures"

- Chapter 2 Barley: https://www.ams.usda.gov/sites/default/files/media/Book2.pdf
- Chapter 4 Corn: https://www.ams.usda.gov/sites/default/files/media/Book2.pdf
- Chapter 9 Sorghum: https://www.ams.usda.gov/sites/default/files/media/Book2.pdf

A summary of the USDA standards for barley, corn, sorghum and other grains and oilseeds are listed in this hand book. The USDA also provides other materials to support the interpretation and application of these standards in the field.

INTERPRETIVE FACTORS – VISUAL GRADING AIDS

The visual grading aids system represents the foundation for the national inspection system's subjective quality control program, providing an effective management tool for aligning inspectors and assisting them in making proper and consistent subjective grading decisions.

The visual grading aids system was developed to assist inspectors in making subjective grading decisions and to reduce intermarket differences in inspection results.

Official Inspection and Grades

These images are approved by the FGIS Board of Appeals and Review (BAR) for use in the Official inspection program and referenced throughout the multiple volumes of the Grain Inspection Handbook. The visual grading system consists of the following:

a. **Visual Reference Images (VRI):** Image guides used to ensure consistent and uniform application of grading interpretations and illustrate types of damage in conjunction with written descriptions.

   The system consists of a series of commodity specific VRI and descriptive text which help reduce the impact of normal perceptional differences between inspectors. To view individual VRI: https://www.ams.usda.gov/book/visual-reference-images

b. **Interpretive Line Prints (ILP):** Appearance images used as an aid in making subjective grade determinations on general appearance with written descriptions.

   Interpretive Line Prints are photographs exhibiting a particular attribute. These prints allow a more uniform application of the general appearance factors. Both the Interpretive Line Slides and Prints are available for viewing at every FGIS Field Office and are available for purchase from the manufacturer.

The Interpretive Line Slide System consists of a portable table-top viewer and photographic slide transparencies. The portable viewer uses a precisely controlled light source of desired intensity and quality. The Interpretive Line Slides are placed on the viewer at the inspection table to aid the inspector in making grading decisions.

The slides are designed for use with the special viewer only. If they are used in a normal slide projector, they will become bleached by the high intensity light, rendering them unusable for the comparative purposes for which they were intended.

c. **Other Factors (OF):** Visual aids used in identifying other factors that are not considered damage, such as: foreign substances, weed seeds, toxic substances, types of commodities, and insects injurious to stored grain. To view reference images (VRI): https://www.ams.usda.gov/book/other-factors

Official Inspection and Grades

d. **Miscellaneous Aids:** Inspectors may use a magnifying glass or similar device for visual identification of small objects

Requirements: All Official Service Providers (OSP), including both FGIS Field Offices and Official Agencies, are required to ensure access to current FGIS generated VRI-ILP for the commodities inspected by the OSP at every inspection location. The OSP is not required to have every VRI available at all times, just the VRIs that apply to the commodity for which they are providing official inspections at that time. (I.e., if the OSP is inspecting Corn, the Corn VRIs must be on-site and accessible to the inspector.)

OFFICIAL CERTIFICATES

Official inspections result in the issuance of official certificates. Certificates report the grade of the grain inspected based on characteristics such as test weight, moisture, cleanliness, and damage. Certificates are issued for the various grains for which standards exist under the U.S. Grain Standards Act and Agricultural Marketing Act of 1946.

Certificates are the final product in the chain of official inspection services. They document the official procedures followed; date, location of the inspection or weighing process, and provide specific service results factor-by-factor or by service requested.

Types of Certificates

- **Class A Official Inspection *(White Certificate)*** is an inspection and certification by an official inspector employed by an official inspection agency of an official sample taken by an official sampler employed by an official inspection agency.

- **Class B Official Inspection *(Yellow Certificate)*** is an inspection and certification by an official inspector employed by an official inspection agency of an official sample taken by a grain elevator or warehouse employee licensed under the U.S. Grain Standards Act.

- **Class C Official Inspection *(Pink Certificate)*** is an inspection and certification by an official inspector employed by an official inspection agency of any submitted sample.

- **Class D Official Commercial Inspection *(Green Certificate)*** is an inspection and certification (if requested) by an official inspector employed by an official inspection agency of a sample-lot of grain obtained by an official sampler employed by an official agency in accordance with the procedures mutually agreed to between the person requesting the service and the official agency.

- **Class E Official Commercial Inspection *(Blue Certificate)*** is an inspection and certification (if requested) by an official inspector employed by an official inspection agency of any submitted sample in accordance with the procedures mutually agreed to between the person requesting the service and the official agency.

An FGIS official Export Inspection Certificate is mandatory for all exported grain. What the importer will require is a Class A Official Inspection (White Certificate).

An FGIS official Weight Certificate is mandatory for all export grain. In addition the importer may require a Supervision of Grain Weight Certificate that shows the grain loaded and weighed by approved elevator weighing personnel using approved equipment and official procedures for domestic grain weighing.

The exporter should also require am FGIS official Stowage Examination Certificate that certifies the results of an official stowage examination.

HOW GRAIN IS WEIGHED

With few exceptions, official weighing is mandatory for all grain exported from the United States. During weighing operations, technicians employed or licensed by FGIS observe and verify the weighing and loading of grain and monitor scales and grain flow security. The weight may be certified separately or included on the official inspection certificate. "Class X," or official supervision of 100 percent of the weighing process, is required on export grain.

Official Weighing Class "X"

Official Weighing is when official personnel (GIPSA, State, or private employees licensed by GIPSA) determine and certify the quantity of a lot of grain. The official agency in the elevator's area weighs or observes the weighing by physical supervision and monitors the discharge of grain through the scales, out of the elevator, into a carrier. [ii]

Official Weighing Procedures

Class X weighing is 100 percent supervised by licensed official personnel, who then issue an official "white" certificate.

Supervision of Weighing Class "Y"

Domestic shipments may be Class X or Class Y weighed. Upon request of an applicant, GIPSA can provide Class Y (Official) weighing service under the United States Grain Standards Act (Act). Approved elevator weighing personnel perform the weighing using GIPSA approved scales under GIPSA supervision. Supervision is provided by GIPSA employees or a designated agency in an elevator's area. They (designated agencies) establish the cost for this service and submit their fees to GIPSA for approval. [iii]

Class Y weighing is performed by elevator personnel who do the weighing and issue "yellow" certificates.

Scales and Weighing

The scales used for the official weighing of grain and commodities must be installed and operated under FGIS guidelines.

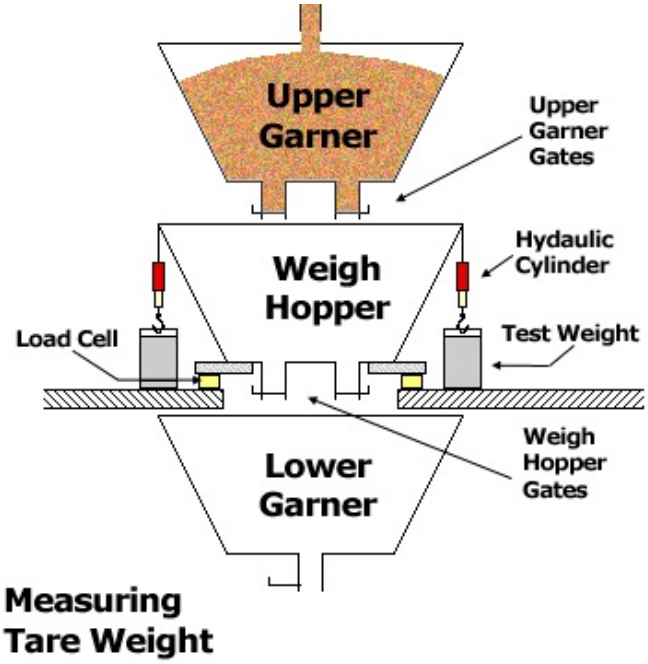
Scales at export elevators are tested every six months and must remain accurate to the nearest one pound per 1,000 pounds. Accuracy of the standard weights used to calibrate scales is verified every three years, or as needed.

In addition to scale testing, FGIS calibrates 13 railroad master track scales to the National Bureau of Standards' official track scale under an agreement with the American Association of Railroads. These master scales calibrate track scales across the United States.

Most U.S. grain is weighed via an electronic weighing system. The system consists of a load receiving element (i.e., weigh hopper, platform, etc., with load cells), an indicating element (i.e., digital instrument), a printer and the associated material handling equipment. The load cell senses the amount of the applied load in the load receiving element and produces an output voltage that is sent to the digital instrument. The digital instrument converts the output voltage into a digital display. The tape printer records the digital display onto a tape or ticket for a permanent record.

Bulk Weighing Scales: In large grain elevators, terminals and export facilities, all official weighing of loose grain is performed on "Bulk Weighing Scales". This is automated and located within the grain path just prior loading on the carrier or a shipping bin.

Official Weighing Procedures



Source: USDA AMS "Operation of a Bulk Weighing Scale Overview"
https://www.ams.usda.gov/resources/operation-bulk-weighing-scale

A bulk weighing scale weighs a batch of grain in a "Weigh Hopper" which sits on load cells or levers. Grain cannot flow into or out of the Weigh Hopper while the scale is recording a weight. During this time, grain flowing to the scale accumulates in another hopper, the "Upper

Garner", directly above the Weigh Hopper. After the weight is recorded, the Weigh Hopper dumps its grain into a "Lower Garner", which releases it at a rate which will not overload the conveyor belts underneath. Grain enters the Weigh Hopper through slide gates at the bottom of the Upper Garner and leaves through slide gates at the bottom of the Weigh Hopper. The operation of the gates is controlled by a computer "Scale Controller", which also records weights and generates an alarm if it detects a malfunction.

Levertronic Scales

There are two types of electronic scales: levertronic and full electronic. Levertronic scales are mechanical scales that have been converted to electronic scales by inserting a load cell into the lever system. The dial used to obtain and print a weight is replaced with a digital instrument and printer.

Full Electronic Scales

Official Weighing Procedures

In full electronic scales, the load receiving element is either supported by, or rests on, the load cells.

Digital Instrument with Printer

Digital instruments, printers and control boards are located in the control room. The control room is the operations control center for the export elevator. It may be located in the elevator or in a building separated from the elevator.

A digital instrument may have some sort of control that allows the operator to manually or automatically operate the gates of the garners and the scale. In the manual mode, the operator controls the operation of each cycle; in the automatic mode, the scale cycle repeats in succession.

Elevator personnel control equipment with computer graphical displays interfaced to equipment in the elevator. FGIS monitors grain flow with these same graphical displays. Elevator personnel can control bin selection, tripper movement, diversion points, legs, conveyor belts, slides and gates from this board. Official weighing personnel monitor export grain flow after weighing and sampling to assure that all of the grain weighed and sampled is actually delivered to the vessel.

Scale Tapes

In supervising manually operated electronic weighing systems, the official weighmaster continually verifies that the weight value displayed

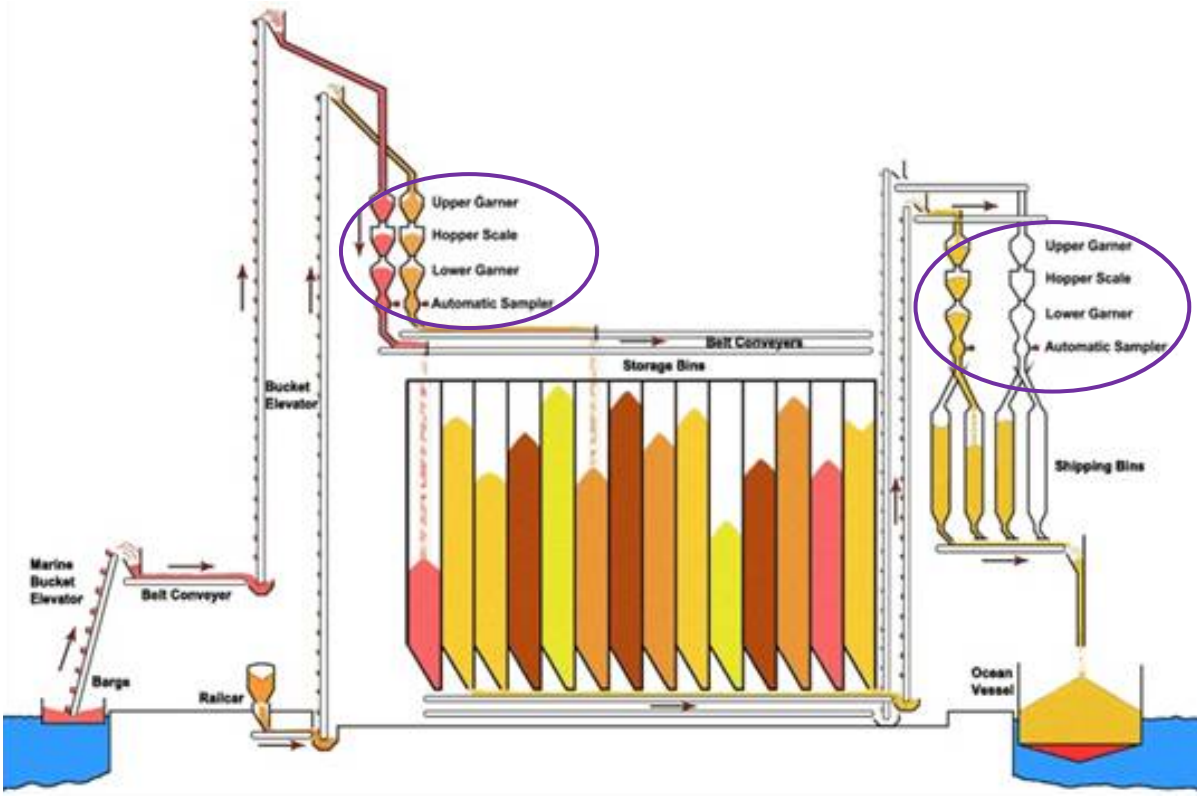
on the digital instrument is the same as the printed value on the scale tape of the ticket to assure proper system operation and to detect any printer malfunction.

Official Weighing Procedures

The weight of each draft is added to determine the sub lot total. The official weighmaster records the number of the sub lot on the tape and initials the total weight. When the tape is removed from the printer, the official weighmaster records the time, carrier identification, kind of grain, tape number and scale numbers. If this information is printed on the tape automatically, the weighmaster verifies the accuracy of the information and initials it.

AUTOMATED WEIGHING AND SAMPLING SYSTEMS

Since 1989, FGIS has been encouraging export elevators to install automated systems to monitor grain flow paths, maintain weight records, and activate alarms and shut-down devices, if necessary.



Source: USDA AMS "Export Elevator Overview"
https://www.ams.usda.gov/resources/export-elevator-overview

Such systems can monitor flow paths more diligently than humans and are less likely to record erroneous weights. In addition, they can prompt

personnel to perform scale checks and reduce the need for inspection personnel to visit sites inside the elevator. Additionally, as entering an operating elevator always involves some risk, an automated system can improve safety.

An export elevator can load a ship with 60,000 tons of grain, worth over $30 million, in less than two days. The weight certificate must be very accurate, due to the large sums of money involved. GIPSA typically has teams of 3-5 people to inspect and weigh that grain: a shift supervisor, a weigh master, a sampler, a grader, and protein analyst or mycotoxin tester.

Official Weighing Procedures

An order of grain to be loaded aboard a ship, referred to as a "lot", is divided into smaller units called "sub lots" for inspection purposes. A sub lot which does not pass inspection, referred to as a "material portion," is not allowed to be loaded onto the ship. Grain is Inspected by sub lots rather than waiting for the entire lot to be loaded so the lot will be of uniform quality. A lot is often divided among several customers at its destination, so it is important for no customer to be stuck with a pocket of bad grain. Also, a pocket of bad grain could spoil during the voyage and contaminate the rest of the shipment.

Every elevator has a different layout. The grain is weighed, sampled, and held in a shipping bin while it is being graded. Grain which has passed inspection is loaded onto a ship.

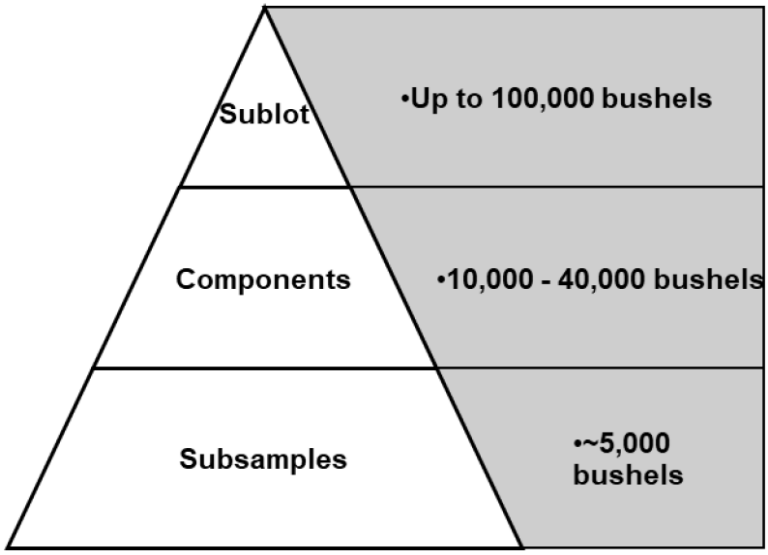
The elevator is responsible for contracting for the design and installation of the official automated system because it must be integrated with the elevator's own control system. Repairs and upgrades are made by the elevator's automation contractor, but must be approved beforehand and checked out afterward by FGIS.

The inspection process requires continuous sampling during loading or unloading. Grain is sampled and accumulated in a systematic process for examination. The elevator benefits because a properly functioning automation system allows FGIS to operate with a smaller inspection team, and hence charge smaller fees.

FGIS advises the elevator and contractors during the development of the system, and carefully checks out the system for security and functionality before approving its use. FGIS assumes control of the automated system after its approval.

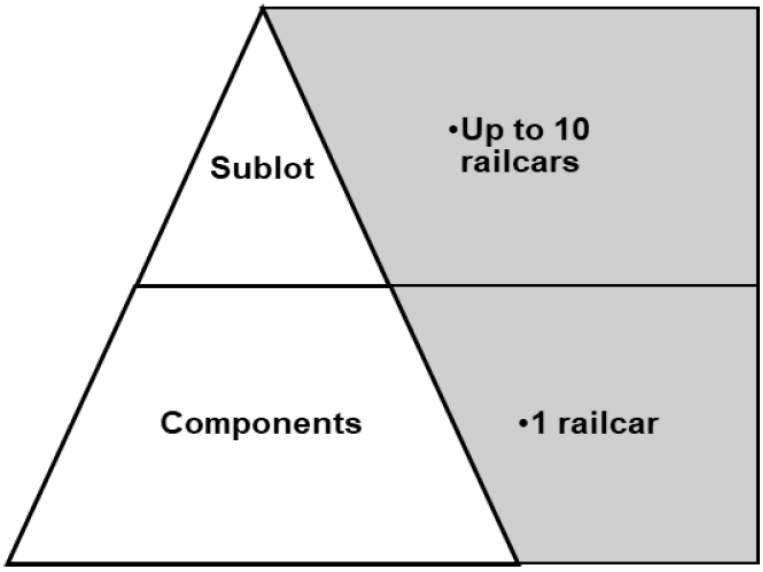
During the loading of an export grain vessel, FGIS follows a uniform plan for sampling and inspection.

Ship Sampling: Ship sublot samples are composed of multiple component and subsamples.



Note: When component ship sample analysis is requested on one or more factors, the maximum sublot size increases to up to 200,000 bushels.

Unit Train Sampling: Unit train sublot samples are composed of multiple component samples.



FGIS Official personnel continuously obtain and examine samples (subsamples, component samples, and sublot samples) during the loading or unloading of ship lots or unit trains to determine uniformity. Official personnel are responsible for determining when to analyze subsamples, component samples, and sublot samples.

Each subsample, component sample, and sublot sample is analyzed for specific quality criteria as per the Official U.S. Standards for Grain, and in accordance with the terms of the underlying contract.

The inspector uses an inspection log to record his findings for each sublot. Each log contains all of the factor results for each sublot, plus any other observations made by the sampler and inspector. It is a complete record of all inspection information concerning the lot.

The record of the Inspection Log is retained by FGIS; however, a buyer can obtain a copy by requesting it in the contract.

The product of all analyzing, grading and monitoring is the Official Export Grain Inspection Certificate. There are two options under which ship lot grain can be loaded and certified. Under Option 1, the exact grade must be loaded; with Option 2, the exact grade or a better grade can be loaded. Option 2 gives the shipper more flexibility and gives the buyer a potentially better quality of grain.

While the grain standards denote a general level of quality, more stringent criteria can be requested in a contract. For example, if a buyer contracts for U.S. No. 2 or better yellow corn and 3 percent BCFM is excessive for the end use, the contract can specify "U.S. No. 2 or better yellow corn, maximum 2.5 percent BCFM." However, more stringent criteria may command a premium price.

It is also important to specify in the contract all of the optional testing services FGIS is to perform, such as "aflatoxin testing to be performed by FGIS." If FGIS is not specified to perform the test, then it may be done by a private laboratory.

For more information on Cumulative Sum Sampling Plan (CUSUM), please refer to USDA FAS publication: "Cumulative Sum Sampling Plan (CUSUM) Attributes Standards Only, October 2017,
https://www.ams.usda.gov/sites/default/files/media/CumulativeSumSamplingPlan.pdf

LOADING ORDER

Every buyer of U.S. grain wants to receive a cargo whose weights and quality are accurate and consistent with the terms of the contract. This can come about due to official services provided by the USDA FGIS and an underlying set of uniform standards and procedures. These processes come together with the creation of a loading order.

Prior to loading and before inspection can begin, the shipper makes an application for inspection providing a loading order to FIGS personnel, reflecting contract requirements for quality and quantity. The loading order document must reflect the same quality and condition factors contained in the sales contract. Specifically, the document must declare the following:

Loading Order

(1) The exact quality grade, percent moisture and dockage, when applicable.

(2) Details on Average, Minimum and/or Maximum or CuSum Quality factors.

(3) The approximate quantity of grain in the lot.

(4) The sublot size.

(5) The destination.

(6) "Option 1" or "Option 2" certification, or the term "or better." (See previous page for explanation…)

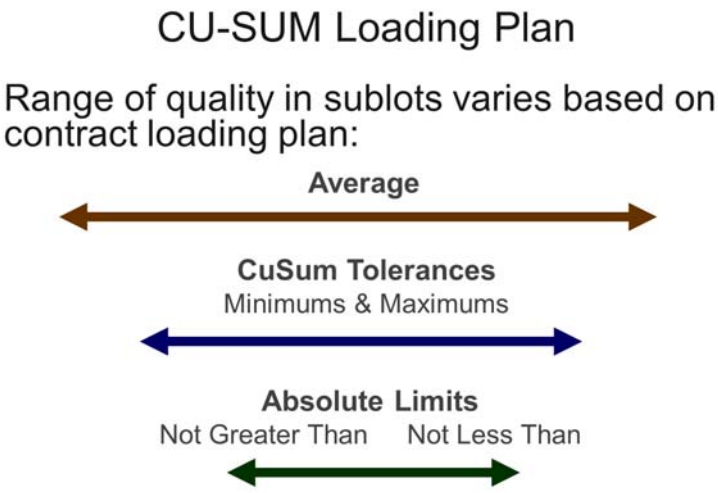
(7) Any official criteria (e.g., protein, oil, starch, mycotoxins, falling number), lower limits on sample grade or special grade factors (e.g., free from stones, ergot, or insects), or other maximum or minimum limits for factor determinations.

(8) Any alternative reporting requirements, such as alternative moisture basis for protein, oil, starch, or falling number or increased precision for certain factors.

(9) Any other specific requirements needed to fulfill contract requirements.

In addition to the Quality Grade, the loading and sampling terms specified within a contract and the resulting load order and loading plan will have an impact on the variability of the quality contained within a single cargo.

Loading Order and Quality Terms



Source: Ronald E. Bundy USDA FGIS

For example, specifying quality is to "Average" No. 2 Yellow Corn, will result in greater variability within the cargo and the related quality factor, than if the quality specification has "maximum or minimum limits" or CuSum. Furthermore, absolute limits of "not greater than and not less than" will result in an even tighter specification and even less variability.

FGIS personnel are advised to use the following guidelines when interpreting contract terms and load order specifications.

Average Quality

When "Average" factor inspection is requested, it is the loading elevator's responsibility to meet the quality level specified in the contract.

If the lot is based on average quality, state the term "Average" after the grade to be loaded; *(e.g., U.S. No. 2 or better YSB – Average).*

The final values indicated on the inspection certificate for "average" factors is based on the final factor average. It will not show the range of results that made up the final average factor values, unless specifically requested.

The "Average" grade will be applied to official criteria factors, and moister; but does not apply to such quality factors such as odor and condition. In addition, aflatoxin results above 20 ppb may not be averaged with results at or below 20 ppb.

Maximum and Minimum Limits

Load orders can specify maximum or minimum limits as quality criteria. Inspection plan tolerances are then applied to a specific factor if the load order indicates a maximum or minimum limit.

If average on most factors and minimum and/or maximum on select factors, the contract and loading plan will state the grade accordingly *(e.g., U.S. No. 2 or better YSB – Average except Moisture maximum 13.0 percent, Foreign Material maximum 2.0 percent)*.

Loading Order and Quality Terms

To express a minimum and/or maximum factor requested at the grade or specified limit per sublot, the applicant should state the term "No sublot to exceed" with "Minimum" or "Maximum" after the grade to be loaded or after a specific factor *(e.g., U.S. No. 2 or better YSB – No sublot to exceed maximum 1.0 percent FM; or U.S. No. 2 or better YSB - No sublot to exceed, all factors minimum or maximum per sublot)*. "No sublot to exceed" is not applicable to Average Quality.

Load orders which specify a quality limit without the term "maximum" or "minimum", are treated as a maximum for factors having maximum limits *(e.g., damaged kernels total (DKT), foreign material, moisture (M))*, or as a minimum for factors having minimum limits *(e.g., test weight per bushel, sound barley)*.

Applicants must indicate on the load order wheat protein as a maximum, minimum, or average amount if a specific wheat protein level is shown on the load order. Consider wheat protein expressed as "ordinary" as an average.

Cumulative Sum (CuSum) Sampling Plan

The CuSum method of sequential analysis was developed by E. S. Page of the University of Cambridge. CuSum methodology was first published in 1954 by the Biometrika, a peer-reviewed scientific journal by Oxford University Press. [iv] The method was designed to manage a quality inspection process on an active production line. In statistical quality control, the CuSum is a sequential sampling and analysis technique. It is typically used for monitoring change detection.

The CuSum inspection process was designed to maintain an output of constant good quality throughout the process, rather than to screen out poor quality after it has been produced. As such, the shipper is requested to establish the desired quality level for loading throughout process. The CuSum sampling will tell whether the production meets or fails the intended grade..

For managing grain quality, the shipper is provided with step-by-step quality report as each sample is pulled from the grain flow and graded. This information may then be used to help the shipper control the quality through the loading process. CuSum values provide evidence of improving or worsening quality and signals the need to make improvements.

If minimum and/or maximum (CuSum) on most factors and average on select factors, state the grade accordingly *(e.g., U.S. No. 2 or better YSB – CuSum except Moisture average 13.0 percent, Foreign Material average 2.0 percent)*.

Note: CuSum values will not be applied to factors requested on an Average Quality or "No sublot to exceed" basis.

Loading Order and Quality Terms

The ability to abuse the CuSum sampling plan by intentionally loading poorer quality grain, after establishing a history of good quality, is limited.

Electing the Certification Option

The applicant for inspection must also select one of two the certification options and indicate this choice on the load order document.

Under **Option 1**, the exact grade of the grain is shown on the certificate.

Under **Option 2**, the lot is certified as being equal to or better than the grade specified by the contract. Option 2 certification is used if the load order specifies "or better" as part of the load order grade, or if Option 2 is specifically requested.

Typically, Option 2 in most frequently selected for grain shipments.

The applicant may change the certification option at a later time, provided the certificates have not been issued or corrected; then, certificates are issued to reflect the new certification option.

STOWAGE EXAMINATION

The USDA FGIS provides an Official Commercial Inspection Services (OCIS), or stowage examination. This OCIS is performed by official personnel or licensed cooperators who visually inspect an identified carrier or container that has been designated to hold grain or related products are fit for loading.

To be considered fit, the carrier's stowage area must be clean, dry, free of odor and infestation and otherwise suitable for receiving or storing grain, insofar as the suitability may affect the quality, quantity or condition of the grain.

To determine cleanliness, stowage space is examined for:

1. **Previous Cargo**. If the stowage space contains fertilizer, old grain, loose cement, coal, lime, dunnage, refuse or other debris, the space is declared unfit for loading.

2. **Rust Scale and Paint Scale**. Rust scale and paint scale must be checked to see if they could become dislodged from the carrier and contaminate the grain. Loose scale will break when struck with a fist or when light pressure is applied with a knife blade under the edge of the scale. The use of safety goggles is recommended when scraping rust or similar material. Rust scale should not be confused with oxidation rust, which forms on exposed metal surfaces. Oxidation rust will not flake off when light pressure is applied. For ships, the area is declared unfit when a single area of loose rust scale or paint scale is more than 25 square feet (approximately 2.3 square meters), or several patches of loose rust scale or paint scale together exceed 100 square feet (approximately 9.3 square meters).

Stowage Exam

3. **Unsanitary conditions**. If the stowage space contains any animal filth, rodent excreta, bird excreta, decaying animal or vegetable matter, sewage or any other unsanitary conditions, the space is declared unfit for loading. Sites close to the hatch (e.g., ship deck, top side of the hatch cover) also must be clean.

4. **Unknown substances**. If any unknown substances are found, the space is declared unfit for loading. All unknown substances are considered contaminating. FGIS does not try to identify them but, if possible, FGIS will take samples of the substance and show them to the supervisor for future reference.

To determine dryness, the stowage space is examined for hydraulic

fluid, standing water, puddles or any amount of leaking water; if any of these are present, the space is declared unfit for loading. Condensation, commonly called "sweating," can form on bulkheads or lower decks. This is unavoidable and poses no threat to the grain.

If the stowage space is contaminated with the odor of petroleum, an oil-based chemical, decaying animal or vegetable matter, or any other commercially objectionable foreign odor, the space is declared unfit for loading.

Finally, the stowage space is examined for infestations of rodents and/or insects. The discovery of any live rodents or more than two live insects injurious to stored grain will result in the space being declared unfit for loading.

PHYTOSANITARY REQUIREMENT AND CERTIFICATE

The United States is a signatory to the International Plant Protection Convention (IPPC) of the Food and Agriculture Organization (FAO). The IPPC develops and adopts International Standards for Phytosanitary Measures (ISPMs) by which an importing country may require a phytosanitary certificate for certain agricultural products. Under the IPPC, the National Plant Protection Organization (NPPO) of the exporting country is responsible for establishing and maintaining a national export certification system to produce valid and credible phytosanitary certificates.

When an importing country has phytosanitary regulations prohibiting the entry of certain pests. The U.S. government will examine the cargo for the presence of the prohibited pests and issue a phytosanitary certificate.

The FGIS has the authority to provide phytosanitary inspections of grain and processed grain products. In addition to inspecting grain (milled or not), FGIS is authorized to provide phytosanitary inspections for the grain products. The commodity must be produced solely from grain (only the seeds of a plant) and be one of the acceptable species in order for FGIS to conduct the inspections.

This certificate is issued by the USDA's Animal and Plant Health Inspection Service (APHIS), not by FGIS.

Fumigation and Grain Protectants

A fumigant is a gas which penetrates the grain kernels and kills insects at all life stages: eggs, larvae and adults. Also, gas grain protectants are applied to the surface of grain and kill adult insects on contact, but do not kill insect eggs.

When a portion of cargo is graded "infested," the exporter can accept the official certificate with "infested" designation, return the infested cargo to the elevator or continue to load the vessel and then fumigate the cargo while in transit, following procedures specified by FGIS. If the exporter selects the last option, the "infested" designation is not reported on the certificate because the condition is considered remedied.

The fumigation is performed by a registered applicator. FGIS personnel observe the fumigation to assure that it is performed according to correct procedures. FGIS requires the applicator to sign a statement on the applicator's company's letterhead stating that the fumigant was applied according to U.S. government regulations and the manufacturer's instructions.

COMPLAINTS

Complaints

If a discrepancy between grain quality at origin and destination occurs, an importer can register a complaint with the U.S. Embassy's agricultural counselor, attaché or trade officer. The embassy will then notify the USDA's Foreign Agricultural Service (FAS) in Washington, D.C., who in turn will notify the FGIS Office of International Affairs (OIA). The OIA will review the complaint, gather information about the reported discrepancy and respond to the complaint. However, FGIS does not issue a new certificate, nor does it function as an arbitrator between buyer and seller.

File samples are held for 90 days after loading. If they are available when the complaint is filed, they will be re-examined during the investigation. If a receiver chooses to submit a sample from destination, then it will also be examined. The FGIS findings are sent in a report through the U.S. Embassy to the originator of the complaint. The facts in the response are available to any person having financial interest in the grain.

For further information on U.S. inspection, sampling and grading standards, contact:

Federal Grain Inspection Service, USDA/GIPSA
Room 1627 -- South
14th and Independence Avenue, SW
Washington, DC 20250
Phone: (202) 720-9170
FAX: (202) 720-2333
Email: fgis.oda@usda.gov

National Grain Center
USDA, AMS, FGIS
10383 N Ambassador Drive
Kansas City, Missouri 64153
Fax: 816-872-1253

Questions and inquiries: Email FGISASKTSD@usda.gov

BARLEY

Barley - 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 these standards does not include hull-less barley or black barley.

Any barley of a six-rowed or two-rowed type. The class Barley is divided into the following three subclasses:

(i) Six-rowed barley. Any six-rowed barley that contains not more than 10.0 percent of two-rowed varieties.

(ii) Two-rowed barley. Any two-rowed barley with white hulls that contains not more than 10.0 percent of six-rowed varieties.

Official U.S. Standards

(iii) Barley. Any barley that does not meet the requirements for the subclasses Six-rowed barley or Two-rowed barley.

§810.207 Grades and grade requirements for barley.

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

U.S. Sample Grade:
U.S. Sample grade shall be 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.

Malting Barley is divided into the following two subclasses:

(i) Six-rowed Malting barley has a minimum of 95.0 percent of a six-rowed suitable malting type that contains not more than 1.9 percent injured-by-frost kernels, 0.4 percent frost-damaged kernels, 0.2 percent injured-by-heat kernels, 0.1 percent heat-damaged kernels, 1.9 percent injured-by-mold kernels, and 0.4 percent mold-damaged kernels. Six-rowed Malting barley must not be infested, blighted, ergoty, garlicky, or smutty as defined in §810.107(b) and §810.206.

(ii)Two-rowed Malting barley. Barley that has a minimum of 95.0 percent of a two-rowed suitable malting type that contains not more than 1.9 percent injured-by-frost kernels, 0.4 percent frost-damaged kernels, 0.2 percent injured-by-heat kernels, 0.1 percent heat-damaged kernels, 1.9 percent injured-by-mold kernels, and 0.4 percent mold damaged kernels. Two-rowed Malting barley must not be infested, blighted, ergoty, garlicky, or smutty as defined in §810.107(b) and §810.206

Official U.S. Standards

§810.204 Grades and grade requirements for Six-rowed Malting Barley.

SIX-ROWED MALTING BARLEY									
	Minimum Limits of -			Maximum Limits of -					
Grade	Test weight per bushel (pounds)	Suitable malting type (percent)	Sound barley[1] (percent)	Damaged kernels[1] (percent)	Wild oats (percent)	Foreign material (percent)	Other grains (percent)	Skinned and broken kernels (percent)	Thin barley (percent)
U.S. No. 1	47.0	97.0	98.0	2.0	1.0	0.5	2.0	4.0	7.0
U.S. No. 2	45.0	97.0	98.0	3.0	1.0	1.0	3.0	6.0	10.0
U.S. No. 3	43.0	95.0	96.0	4.0	2.0	2.0	5.0	8.0	15.0
U.S. No. 4	43.0	95.0	93.0	5.0	3.0	3.0	5.0	10.0	15.0

[1] Injured-by-frost kernels and injured-by-mold kernels are not considered damaged kernels or considered against sound barley.

Notes: Malting barley must not be infested in accordance with §810.107(b) and must not contain any special grades as defined in §810.206. Six-rowed Malting barley varieties not meeting the requirements of this section must be graded in accordance with standards established for the class barley.

§810.205 Grades and grade requirements for Two-rowed Malting barley.

§ 810.205 Grades and grade requirements for Two-rowed Malting barley.									
	Minimum Limits of -			Maximum Limits of -					
Grade	Test weight per bushel (pounds)	Suitable malting type (percent)	Sound barley[1] (percent)	Damage Kernels[1] (percent)	Wild Oats (percent)	Foreign material (percent)	Other grains (percent)	Skinned and broken kernels (percent)	Thin barley (percent)
U.S. No. 1	50.0	97.0	98.0	2.0	1.0	0.5	2.0	4.0	5.0
U.S. No. 2	48.0	97.0	98.0	3.0	1.0	1.0	3.0	6.0	7.0
U.S. No. 3	48.0	95.0	96.0	4.0	2.0	2.0	5.0	8.0	10.0
U.S. No. 4	48.0	95.0	93.0	5.0	3.0	3.0	5.0	10.0	10.0

[1] Injured-by-frost kernels and injured-by-mold kernels are not considered damaged kernels or considered against sound barley.

Notes: Malting barley must not be infested in accordance with §810.107(b) and must not contain any special grades as defined in §810.206. Two-rowed Malting barley varieties not meet the requirements of this section must be graded in the accordance with standards established for the class barley.

Official U.S. Standards

§810.207 Special grades and special grade requirements.

(a) Blighted barley. Barley that contains more than 4.0 percent of fungus-damaged and/ or mold-damaged kernels.

(b) Ergoty barley. Barley that contains more than 0.10 percent ergot.

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

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

For more information on U.S. Grade Standards for barley, please refer to USDA AMS publication: "U.S. Standards Subpart B – United States Standards for Barley"
https://www.ams.usda.gov/sites/default/files/media/BarleyStandards.pdf

CORN

Corn - 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.

§810.404 Grades and grade requirements for Corn

Official U.S. Standards

Grade	Minimum test weight per bushel (pounds)	Maximum limits of:		
		Damaged kernels		Broken corn and foreign material (percent)
		Heat damaged kernels (percent)	Total (percent)	
U.S. No. 1	56.0	0.1	3.0	2.0
U.S. No. 2	54.0	0.2	5.0	3.0
U.S. No. 3	52.0	0.5	7.0	4.0
U.S. No. 4	49.0	1.0	10.0	5.0
U.S. No. 5	46.0	3.0	15.0	7.0
U.S. Sample Grade U.S. Sample grade is corn that: (a) Does not meet the requirements for the grades U.S. Nos. 1, 2, 3, 4, or 5; or (b) Contains stones with 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				

§ 810.405 Special grades and special grade requirements.

(a) *Flint corn*. Corn that consists of 95 percent or more of flint corn.

(b) *Flint and dent corn*. Corn that consists of a mixture of flint and dent corn containing more than 5.0 percent but less than 95 percent of flint corn.

(c) *Waxy corn*. Corn that consists of 95 percent or more waxy corn, according to procedures prescribed in FGIS instructions

For more information on U.S. Grade Standards for corn, please refer to USDA AMS publication: "U.S. Standards Subpart D – United States Standards for Corn"
https://www.ams.usda.gov/sites/default/files/media/CornStandards.pdf

MIXED GRAIN

Mixed Grain - 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 triangular-hole sieve and/or whole flaxseed that passes through such a sieve after sieving according to procedures prescribed in FGIS instructions.

§ 810.805 Special grades and special grade requirements.

(a) *Blighted mixed grain*. Mixed grain in which barley predominates and that contains more than 4.0 percent of fungus-damaged and/or mold-damaged barley kernels.

Official U.S. Standards

(b) *Ergoty mixed grain*.
(1) Mixed grain in which rye or wheat predominates and that contains more than 0.30 percent ergot, or
(2) Any other mixed grain that contains more than 0.10 percent ergot.

(c) *Garlicky mixed grain*.
(1) Mixed grain in which wheat, rye, or triticale predominates, and that contains 2 or more green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets in 1,000 grams of mixed grain; or
(2) Any other mixed grain that contains 4 or more green garlic bulblets, or an equivalent quantity of dry or partly dry bulblets, in 500 grams of mixed grain.

(d) *Smutty mixed grain*.
(1) Mixed grain in which rye, triticale, or wheat predominates, and that contains 15 or more average size smut balls, or an equivalent quantity of smut spores in 250 grams of mixed grain, or
(2) Any other mixed grain that has the kernels covered with smut spores to give a smutty appearance in mass or that contains more than 0.2 percent smut balls.

(e) *Treated mixed grain*. Mixed grain that has been scoured, limed, washed, sulfured, or treated in such a manner that its true quality is not reflected by the grade designation U.S. Mixed Grain or U.S. Sample grade Mixed Grain.

For more information on U.S. Grade Standards for mixed grain, please

refer to USDA AMS publication: "U.S. Standards Subpart F – United States Standards for Mixed Grain"
https://www.ams.usda.gov/sites/default/files/media/MixedGrainStandards.pdf

OATS

Oats - 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, not more than 25 percent of wild oats and other grains for which standards have been established under the United States Grain Standards Act.

Official U.S. Standards

§810.1004 Grades and grade requirements for Oats.

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

U.S. Sample grade--
U.S. Sample grade are oats which:
(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 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 oats; or
(c) Have a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
(d) Are heating or otherwise of distinctly low quality.

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

For more information on U.S. Grade Standards for oats, please refer to USDA AMS publication: "U.S. Standards Subpart G – United States Standards for Oats"
https://www.ams.usda.gov/sites/default/files/media/OatsStandards.pdf

RYE

Rye - 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 the removal of dockage, contains 50 percent or more of whole rye.

§810.1204 Grades and grade requirements for Rye

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

U.S. Sample grade --
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 numbers 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.

Official U.S. Standards

For more information on U.S. Grade Standards for rye, please refer to USDA AMS publication: "U.S. Standards Subpart H – United States Standards for Rye"
https://www.ams.usda.gov/sites/default/files/media/RyeStandards.pdf

SORGHUM

Sorghum - 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 10.0 percent of other grains for which standards have been established under the United States Grain Standards Act.

There are four classes of sorghum: Sorghum, Tannin sorghum, White sorghum, and Mixed sorghum.

(1) *Sorghum*. Sorghum which lacks a pigmented testa (subcoat) and contains less than 98.0 percent White sorghum and not more than 3.0 percent Tannin sorghum. The pericarp color of this class may appear white, yellow, pink, orange, red, or bronze.\

(2) *Tannin sorghum*. Sorghum which has a pigmented testa (subcoat) and contains not more than 10.0 percent non-Tannin sorghum. The pericarp color of this class is usually brown but may also be white, yellow, pink, orange, red, or bronze.

(3) *White sorghum*. Sorghum which lacks a pigmented testa (subcoat) and contains not more than 2.0 percent sorghum of other classes. The pericarp color of this class is white or translucent and includes sorghum containing spots that, singly or in combination, cover 25.0 percent or less of the kernel.

(4) *Mixed sorghum*. Sorghum which does not meet the requirements for any of the classes Sorghum, Tannin sorghum, or White sorghum.

§810.1404 - Grades and grade requirements for Sorghum.

Official U.S. Standards

Grading factors	Grades U.S. Nos. [1]			
	1	2	3	4
Minimum pound limits of				
Test weight per bushel:	57.0	55.0	53.0	51.0
Maximum percent limits of				
Damaged kernels:				
Heat (part of total)	0.2	0.5	1.0	3.0
Total	2.0	5.0	10.0	15.0
Broken kernels and foreign material:				
Foreign material (part of total)	1.0	2.0	3.0	4.0
Total	3.0	6.0	8.0	10.0
Maximum count limits of				
Other material:				
Animal filth	9	9	9	9
Castor beans	1	1	1	1
Crotalaria seeds	2	2	2	2
Glass	1	1	1	1
Stones [2]	7	7	7	7
Unknown foreign substance	3	3	3	3
Cockleburs	7	7	7	7
Total [3]	10	10	10	10
U.S. Sample grade is sorghum that: (a) Does not meet the requirements for U.S. Nos. 1, 2, 3, or 4; or (b) Has a musty, sour or commercially objectionable foreign odor (except smut odor); or (c) Is badly weathered, heating or distinctly low quality.				

[1] Sorghum which is distinctly discolored shall not grade higher than U.S. No. 3.
[2] Aggregate weight of stones must also exceed 0.2 percent of the sample weight.
[3] Includes any combination of animal filth, castor beans, crotalaria seeds, glass, stones, unknown foreign substances or cockleburs.

§810.1405 Special grades and special grade requirements.

Smutty sorghum. Sorghum that has kernels covered with smut spores to give a smutty appearance in mass, or that contains 20 or more smut balls in 100 grams of sorghum.

For more information on U.S. Grade Standards for sorghum, please refer to USDA AMS publication: "U.S. Standards Subpart I – United States Standards for Sorghum"
https://www.ams.usda.gov/sites/default/files/media/SorghumStandards.pdf

TRITICALE

Triticale - 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 the removal of dockage, contains 50 percent or more of whole triticale.

§810.2004 Grades and grade requirements for Triticale.

Official U.S. Standards

Grade	Minimum test weight per bushel (pounds)	Minimum limits of: Damaged kernels: Heat damaged (percent)	Damaged kernels: Total [1] (percent)	Foreign material: Material other than wheat or rye (percent)	Foreign material: Total [2] (percent)	Shrunken and broken kernels (percent)	Defects [3] (percent)
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.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 or 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.

§ 810.2005 Special grades and special grade requirements.

(a) *Ergoty triticale*. Triticale that contains more than 0.10 percent of ergot.

(b) *Garlicky triticale*. Triticale that contains in a 1,000-gram portion more than six green garlic bulblets or an equivalent quantity of dry or partly dry bulblets.

(c) *Light garlicky triticale*. Triticale that contains in a 1,000-gram portion two or more, but not more than six, green garlic bulblets or an equivalent quantity of dry or partly dry bulblets.

(d) *Light smutty triticale*. Triticale that has an unmistakable odor of smut, or that contains in a 250-gram portion smut balls, portions of

smut balls, or spores of smut in excess of a quantity equal to 14 smut balls but not in excess of a quantity equal to 30 smut balls of average size.

(e) *Smutty triticale*. Triticale that contains in a 250-gram portion smut balls, portions of smut balls, or spores of smut in excess of a quantity equal to 30 smut balls of average size.

For more information on U.S. Grade Standards for triticale, please refer to USDA AMS publication: "U.S. Standards Subpart F – United States Standards for Triticale"
https://www.ams.usda.gov/sites/default/files/media/TriticaleStandard.pdf

Chapter Author: Guy H. Allen
Senior Economist – International Grains Program
Kansas State University

Chapter Reviewer: Philip A. Shull
President and Founder, The Philip Shull Group, LLC
Minister Counselor (Ret)
U.S. Department of Agriculture

[i] USDA Agriculture Marketing Service "Federal Grain Inspection Service" https://www.ams.usda.gov/about-ams/programs-offices/federal-grain-inspection-service Sighted 12th March 2022

[ii] USDA Agriculture Marketing Service "Weighing Services" https://www.ams.usda.gov/services/fgis/weighing-services Sighted 12th March 2022

[iii] USDA Agriculture Marketing Service "Weighing Services" https://www.ams.usda.gov/services/fgis/weighing-services Sighted 12th March 2022

[iv] Biometrika. "Continuous Inspection Scheme". E. S. Page, (June 1954). https://academic.oup.com/biomet/article-abstract/41/1-2/100/456627?redirectedFrom=fulltext&login=true Sighted 12th March 2022