

Grain sampling guide



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Why sample grain?

Accurate sampling is essential if you are to understand the quality of your grain. It informs your grain management, and provides a robust record of all the grain that leaves the farm.

Be in control

Put simply, sampling puts you in control of your product. Retained and documented representative grain samples give you a robust record of everything that leaves your farm, which is essential for three reasons:

1. Grain sampling has long been required to **measure key quality parameters** (e.g. Hagberg Falling Number, nitrogen content and specific weight) and help your grain reach the right market.
2. More recent challenges (e.g. monitoring of mycotoxins) require the industry to **demonstrate due diligence**, and samples of grain traded form part of that evidence. Additionally, sampling requirements increasingly feature within grain contracts.
3. Following good grain sampling and storage practice helps to **reduce waste and minimise charges, claims and rejections**.

Grain sampling opportunities

Best practice is to sample at every step of the grain chain (see Figure 1). Merchants may also take samples from ex-harvest aggregate samples or from on-farm stores for an indication of market suitability.

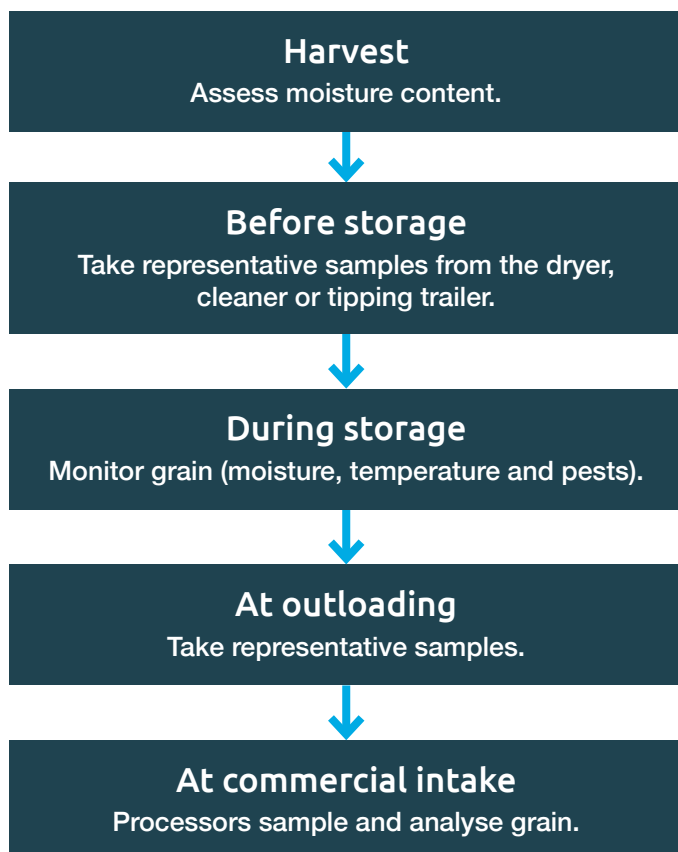


Figure 1. Opportunities to sample grain during stages of the grain chain

Grain storage guide

Good storage practice minimises risk throughout the supply chain and safeguards food safety for consumers. Download our grain storage guide or read it online at ahdb.org.uk/grain-storage

How to sample grain

Grain samples provide a powerful record of grain quality when taken and stored correctly. Central to success is the determination of different grain qualities, and the extraction of representative samples (with the appropriate equipment).

If you take just one sample from a single point in a grain lot its characteristics are unlikely to be representative of the total lot. To capture the variability and provide a valid representation of the total lot, it is important to take a sufficient number of samples.

Best practice is to take a series of incremental samples, from different parts of any given lot, blend them thoroughly and then take a subsample for analysis. This is explained in more detail below. The results produced indicate the average quality characteristics of the lot. The number of incremental samples required depends on the variability of the characteristic being measured.

Note: Mycotoxin tests require a particularly demanding sampling regime – especially for the storage mycotoxin, ochratoxin A (10 kg sample required).

Grain sampling stages

The best approach to grain sampling depends on the sampling step. However, there are three broad sampling stages used to build a final sample, suitable for a wide range of analyses.

Stage 1. Take incremental samples

An incremental sample is any single, relatively small sample. This primary sample may be taken by spear, jug or other means. They are taken at one point in the grain chain, from grain with similar qualities.

Stage 2. Create a mixed aggregate sample

Incremental samples are combined to form a large aggregate sample. These should be held in a clean dustbin or similar container. Aggregate samples include grains of various sizes and quality. It is important that all grains have an equal chance of being included in any subsample drawn from it. This requires a thorough pre-mixing of the sample, with a drum mixer or by hand.



How to mix aggregate samples with a drum mixer

- Do not fill drum mixers more than half full
- Secure contents with a tight-fitting lid
- Roll the drum along its axis
- Invert drum at least five times

How to mix aggregate samples by hand

- Tip the aggregate onto a clean floor area
- Mix thoroughly with a shovel or scoop

Stage 3. Make representative samples

A thoroughly pre-mixed aggregate sample can be used as the source for representative subsamples. Such samples are most suitable for laboratory analysis. The extraction of subsamples requires further mixing of the grain. There are several methods (of varying complexity) that produce optimally mixed grain. A simple method is coning and quartering.

The coning and quartering method

1. A heap of tipped grain will take the rough form of a cone – it can be described as having four quarters (e.g. A, B, C and D).
2. Select two opposite corners (e.g. A+D). Remove the other two quarters (e.g. B+C) and return them to the original aggregate container.
3. Mix the selected samples (e.g. A+D) to form a new cone of grain.
4. Repeat until the size of one of the quarters is the equivalent weight of the final sample required (e.g. 1 kg).

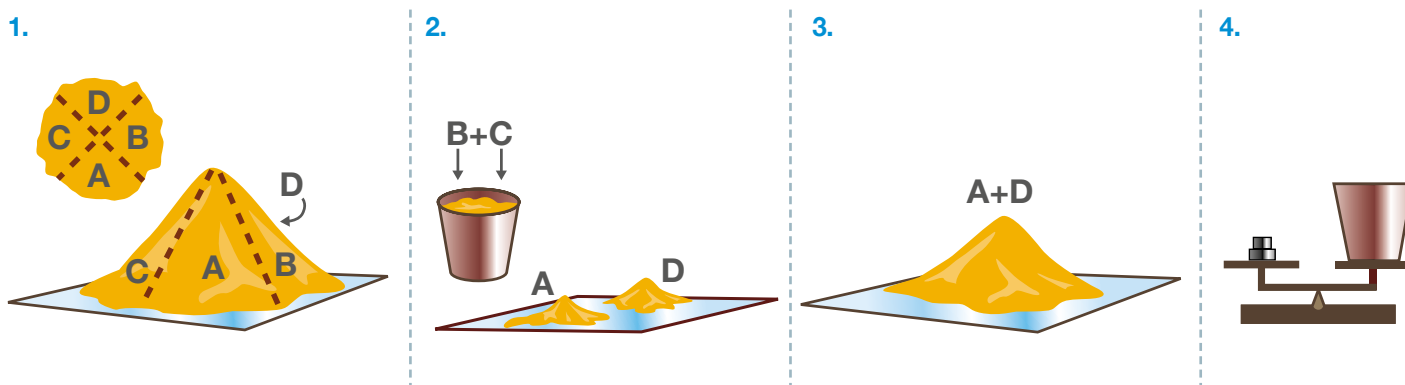


Figure 2. Using the coning and quartering method

Other methods

Other methods for making representative samples use dividers, such as a cone-shaped divider, a rotary mechanical divider or a riffle divider. Details for using such equipment are given in ISO 24333. Note: Do not use riffle dividers for samples of less than 2 kg.

Grain sampling and monitoring equipment

Ahead of harvest, ensure that all equipment is maintained (e.g. serviced and calibrated), clean and ready for use. Equipment includes:

- Sampling spears
- Measuring jugs
- Weighing devices
- Sealable plastic sample bags (1 kg grain capacity)
- Sealable containers (5–10 kg grain capacity)
- Suitable labels (to apply to bags and containers)
- Indelible pens (ballpoint ink may fade in a matter of months)
- Moisture meters
- Temperature probes (consider using automated systems)
- Insect traps
- Record sheets



Figure 3. A selection of grain sampling and monitoring equipment

Top tip

Sealable containers help to minimise moisture loss, prevent rodent access, and avoid contamination by dust and other grain.

Grain sampling spears

Spears use chambers to sample grain. A single chamber sampler (or 'deep bin probe' or 'Neate sampler') collects one primary sample at a time. If the depth of grain in the bulk is greater than the length of the sampler, use screw-on extensions. A multi-chamber sampler usually has three or more chambers. Seed collected in a single sampling action constitutes one primary sample. Suitable for most trailers, use it to sample grain up to 2 m deep. A piece of plastic guttering is useful for collecting samples from this type of sampler.

General grain storage health and safety

When handling grain and working in stores:

- Make sure equipment is suitable for purpose and fit for use
- Provide appropriate training
- Ensure those involved in sampling are aware of the risks
- Check staff and visitors are aware of the vehicular movements
- Wear hi-vis clothing when working around loading lorries
- Do not climb on top of lorries, unless there is special provision
- Ensure people sampling from a grain bulk are accompanied
- Minimise exposure to grain dust
- Never enter a closed silo

For detailed information see the agriculture section of the Health and Safety Executive website at: hse.gov.uk/agriculture

Grain sampling before storage



The best opportunity to generate representative grain samples is while stores are being filled. Analysis of samples will confirm if grain meets the proposed market criteria, and help determine the optimum storage strategy.

Why sample grain before storage?

Grain quality is variable – even across an individual ear. Samples taken as the grain goes into the store will be more representative than those taken from the bulk, once the grain is in store. The only exception is sampling for any contaminant produced during storage (e.g. insects or storage mycotoxins).

Numerous factors influence grain variability going into store, including:

- Soil type
- Field-boundary effects (e.g. hedges)
- Weather
- Varieties
- Sowing date
- Nutrient availability
- Tillering period

The way grain is harvested, moved and stored also affects the variation.

The initial priorities are to:

- Keep grain from different varieties separate
- Identify areas likely to produce grain of different quality and keep it separate
- Sample loads from each trailer and measure moisture content to determine drying requirements
- Analyse samples to indicate market potential
- Store grain in the smallest possible identifiable units

The use of relatively small storage units (e.g. 60 t capacity bins) makes it easier to track grain to samples taken at harvest.

If a risk assessment indicates that field mycotoxins may be a problem or if the buyer has a requirement for confirmatory analysis of toxin levels, it is particularly important to take representative samples at this stage. For further information, visit ahdb.org.uk/mycotoxins

Safe storage time calculator

Use our calculator to assess the risks from mould and mycotoxin development, loss of germination and the potential risk of attack by insects and mites. You enter the moisture and temperature levels for stored grain, and it will tell you the level of risk for a particular period.

ahdb.org.uk/safe-storage-time-calculator

How to sample before storage

Step 1. Take incremental samples

Samples taken should represent identifiable units (e.g. store bay, silo section or individual bin) in the grain store.

When grain is not cleaned or dried before going into store

As grain is tipped, take two 500 g incremental samples from each trailer. Ideally, sample a quarter and three-quarters of the way through tipping. If grain is wet (moisture content over 16%), spread samples thinly on a large sheet of paper or polythene then leave overnight in a warm place. However, if grain is very wet (i.e. when on-floor drying is likely to be insufficient), pass it through a dryer.

When grain is cleaned or dried before going into store

Take frequent, small (250 g) incremental samples from the cleaner/dryer outlet, so that at least 10 samples represent each 100 t (i.e. sample every 10 t passing through the dryer). Be aware that high-temperature drying, to reduce moisture and moisture variability, will require more urgent cooling. After grain conditioning, if a bucket loader is used to move grain into a bulk, samples can be taken using an automatic bucket sampler.

Step 2. Create an aggregate sample

Mix the incremental samples to form an aggregate grain sample, which represents no more than 100 t. If the 100 t lot is part of a flat store heap larger than 100 t, ensure that the aggregate sample can be traced to the relevant part of the store.

Step 3. Make representative samples

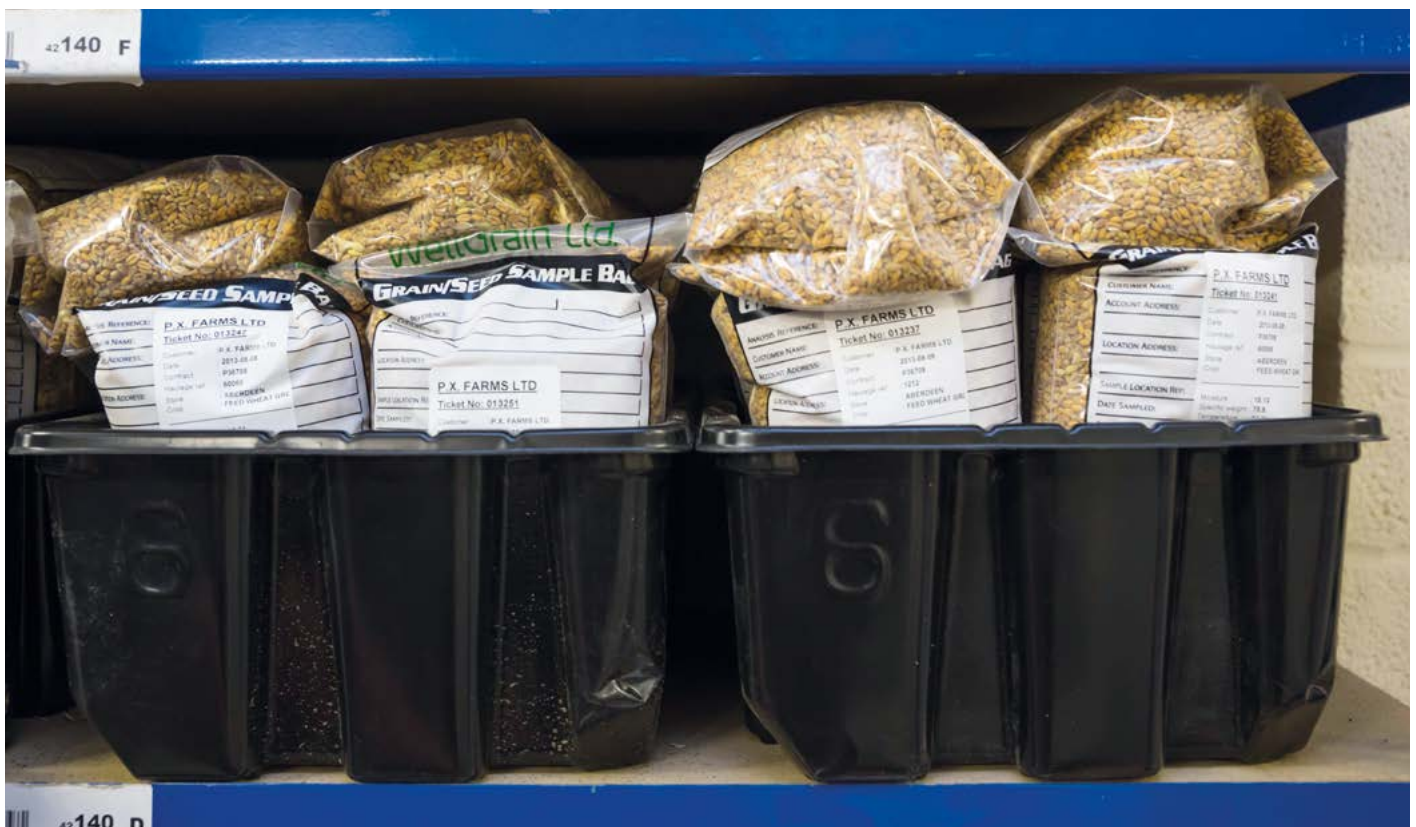
Ensure the aggregate sample is well mixed. Then, take five 200 g subsamples from across the aggregate sample to form a 1 kg representative sample. Make at least two representative samples – one for the buyer/merchant and one for retention by the seller.

Step 4. Label and store samples

Put samples in clearly labelled sealable plastic bags with the following information:

- Date sampled
- Grain owner
- Farm name
- Store name
- Position in store (e.g. back left corner) or bay/bin identification number/code
- Quantity represented
- Variety
- Moisture content (in store)
- Mycotoxin (DON and ZON) risk assessment score (wheat only)
- Origin (name of field) – optional

Ensure samples are sufficiently dry and kept in rodent-proof containers. Retain samples until payment has been received.



Grain sampling and monitoring during storage



Grain remains a 'living' crop – it respire and is susceptible to infection by moulds and infestation by pests. It is important to monitor temperature and moisture content during storage, and to use targets to inform store management.

In-store grain quality

Key quality parameters of stored grain are assessed by trade-assured testing facilities, which are sometimes provided by a merchant or other independent testing laboratory. Parameters may include (depending on the market):

- Protein/nitrogen quantity
- Specific weight
- Hagberg Falling Number
- Germination capacity

Most quality parameters do not change during storage. If effective sampling occurred at intake and the location of individual sampled loads (or lots) can be accurately identified within the store, such samples are sufficient for quality assessments.

In-store mycotoxin management

If grain has been harvested 'dry' or has been dried quickly, and is kept sufficiently dry in the store, storage mycotoxins (such as ochratoxin A) should not be a risk.

Legally, all producers must know whether grain destined for human consumption meets the food safety standards for the presence of the fusarium mycotoxins DON, ZON, T2 and HT2.

Many processors require this information, especially at the start of each new harvest year. Samples taken in store may be used to provide this information.

Read about risk assessment for fusarium mycotoxins in wheat at ahdb.org.uk/mycotoxins

Management of storage pests

Although it is possible to draw physical samples from a bulk or bin for examination for storage pests, it is a laborious process. Traps are more than ten times more effective than sampling, especially at detecting low numbers of insects and mites. For information on trapping, download the grain storage guide at ahdb.org.uk/grain-storage

Grain sampling from static bulks

The best opportunity to generate representative grain samples is as stores are filled, or from a dryer. However, this is not always practical. As a result, it is sometimes necessary to sample grain bulks in flat stores. As always, it is important to follow best practice to ensure that final samples are representative of the bulk.

How to take incremental grain samples from static bulks

Based on examples of industry practice and the relevant ISO standard (13690), a suggested minimum of 5 x 500 g incremental samples should be used to form a single (composite) final sample that represents no more than:

- 50 t for grain destined for human consumption (milling wheat, malting barley and food oats)
- 100 t for grain destined for feed

Use grain sampling spears to extract incremental samples from a static (i.e. not being moved by stirrers) bulk.

- Ideally, use a two-metre, multiple-aperture, spear capable of drawing a 500 g incremental sample
- Set the spear so apertures open in sequence, starting from the bottom compartment
- Insert the spear into the grain, at a slight angle from vertical with the slots facing upwards
- Turn the spear's inner tube through 180° (which opens and closes the intake apertures) to collect a sample
- Use a grid system to take incremental samples that best represent the bulk. For example, from the front, middle and back of the heap or bay



Figure 4. Grain sampling spear

How to make a representative grain sample from static bulks

Good distribution of the incremental samples and thorough mixing of the composite sample is essential, so it is representative of the bulk. Place each final sample in a well-filled, clearly labelled and sealable bag. Analysis of such samples will provide growers and merchants with the most accurate view of the grain. Consult grain merchants for further guidance on how to sample grain accurately and safely.

Monitoring moisture and temperature in stored grain

It is important to monitor the moisture content during storage. High moisture in stored grain promotes the development of moulds and mites. Certain degrees of moisture content and temperature also encourage the production of a storage mycotoxin – ochratoxin A. It is also critical to take regular recordings of grain temperature as part of efforts to keep temperature/time targets on track, and identify hot spots associated with insect activity or water leaks.

Download our grain storage guide at ahdb.org.uk/grain-storage



Figure 5. Monitoring grain

Record keeping

Keep records of each monitoring activity to provide evidence of due diligence. As an alternative to time-consuming probing or sampling grain, fixed probes/sensors can be installed to monitor in-store conditions. The most modern installations enable constant remote monitoring (e.g. via a smartphone). Electronically recorded data also allows trends to be observed more easily.

Grain sampling at outloading



To keep control of your grain quality, best practice is to take and retain a representative sample from each lorry load, before it leaves the farm.

Why take samples at outloading?

Although unlikely to be a condition of a grain contract, taking samples of grain from each load that leaves the farm is a requirement of some assurance schemes.

Modern specialist equipment often pushes tipped grain up the grain face. This mixes grain, and results in large bulks (depths of around 6–8 m). Mixing is compounded during outloading and some quality aspects change during storage. As a result, analytical results from samples drawn before storage can only be used to indicate marketing potential and whether any action is needed during storage.

Representative samples at outloading provide the best record of what has been dispatched.

Top tip

Check the contract, merchant annual terms or confirmation note for any special terms relating to sampling.

How to sample at outloading

Sampling methods vary, depending on the equipment used. However, always follow standard protocols to maximise sample validity.

For a 30 t lorry-load of grain, take at least 10 incremental samples of 200 g, as the grain is loaded. This provides a 2 kg aggregate sample. Once mixed, the aggregate sample can be the source of the retained representative (2 x 1 kg) samples.

Sampling from the loading bucket

The best method is to take incremental samples from a loading bucket.

Manual bucket sampling

- From a safety perspective, ideally, have two people present
- Scoop incremental samples from each bucket loaded

Automatic bucket sampler

- Automatic samplers are faster and safer than manual sampling
- They extract a small amount of grain from each bucket as the lorry is loaded
- These are mixed in the sampler to form an aggregate sample
- Choose a sampler that can deliver 2 x 1 kg representative samples for each lorry-load
- The operator should empty the sampler after each lorry has been loaded and bag the samples

AHDB research shows that bucket samples at outloading were consistent with samples collected from lorries at delivery, when best practice recommendations were followed (by both the farmer and the receiver).

Sampling from spout loading

For grain being loaded into a lorry from a conveying system it is best to sample that grain at a point close to the loading location, where samples may be drawn safely. In some cases, an 'interrupter' plate can be inserted into conveying tubes.

Sampling from a grain heap

When loading bulk/on-floor stored grain, position the grain for the next lorry into a separate heap. This can be sampled with a conventional (preferably, multi-aperture) grain spear.

How to label and store samples at outloading

All samples must be labelled with basic information, including:

- Farm name
- Store name/number
- Bin number
- Variety
- Date
- Time
- Vehicle registration and trailer number

Store samples in airtight containers (e.g. polythene bags or plastic boxes) in a place that is cool and dry, and safe from rodent attack.

Grain sampling at commercial intake



Most buyers sample and analyse grain at intake to determine its final quality and whether it has met the agreed contractual requirement and specifications.

What do grain processors test for?

Processors conduct both quantitative (e.g. moisture content, protein level, presence of mycotoxins and Hagberg Falling Number) and qualitative (e.g. visual appearance) tests on grain.

The type of tests required depend on the delivery points in question. These vary widely (e.g. animal feed manufacturers, millers, maltsters, breakfast cereal manufacturers and exporters), but sampling methods tend to be similar.

Managing variability in grain loads

The provision of a representative grain sample to the merchant or processor could suffice for quality assessments on delivery. However, unless a vendor assurance programme is in place, all loads delivered to store or to a processor will be sampled. There are several reasons for this, including:

- Stored grain sources may not be uniformly mixed
- Sometimes, grain is taken from various points in the grain store
- A lack of uniformity across a delivered load*

*For example, heaping in the vehicle, caused by bucket loading, may not level out during haulage.

Top tip

Check the contract, merchant annual terms or confirmation note for any special terms relating to sampling.

AIC grain contracts

The AIC No. 1 contract states that deliveries shall be sampled by the receiver at the final consignment point in accordance with the procedure laid down in the ISO 24333 standard, or any amendments to it. For further information, visit agindustries.org.uk

To achieve good representation of the quality of a 30-tonne lorry load, AHDB research (project report 339) found that eight samples are required. Six samples were less likely to be representative, with some characteristics, such as protein, more sensitive to sample-size reduction (Figure 6).

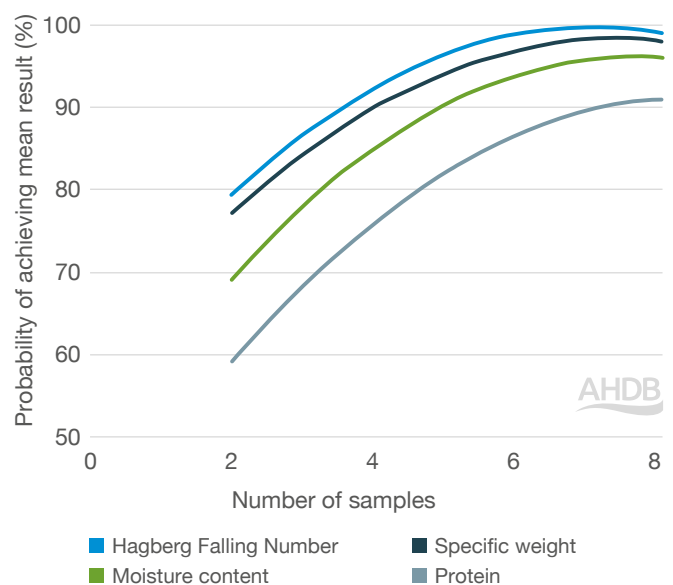


Figure 6. As the number of samples taken from a grain lorry increases, the more representative the samples are of the entire load

Sampling example: 30-tonne grain lorry

For a 30 t bulk vehicle load of cereal grain at an intake point, the recommended (ISO 24333:2009) sampling method involves:

- Using a spear long enough to sample the whole depth of grain
- Ideally*, taking eight samples (Figure 7), each weighing at least 400 g
- Positioning the lorry so most of the load is accessible
- Thoroughly mixing aggregate samples and taking representative samples for testing

*Sample position is more important than the number of samples taken. For lorries of 15 t or less, three samples are usually sufficient

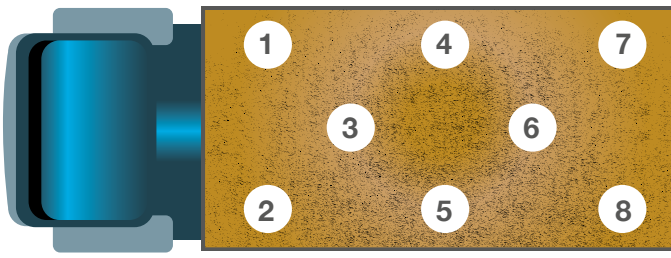


Figure 7. A 30-tonne grain lorry should have 8 evenly spaced samples taken

Automatic samplers

Most medium-to-large processors use a mechanised spear that is programmable or controlled from the laboratory or intake office. The spear senses the bottom of the trailer and draws up a sample through the core of the load. Most produce an aggregate sample of 6–8 kg.

In flight, from the lorry to the laboratory, separation of the grain may occur. This means that smaller grains and screenings are likely to arrive quicker than the larger grains. Therefore, the complete sample is mixed thoroughly before samples for testing are taken.



Handheld samplers

Some processors use handheld manual spears, especially if the business is small or automatic samplers are offline. The spears used should collect samples from different depths, with about 500 g taken at each sampling point. This approach may require more than one insertion per sampling point.

Grain cleaning and grinding

The company's policy on grain cleaning (e.g. dealing with screening and admixture) prior to testing should be detailed in the grain contract.

The policy will take into account whether the calibrations for specific tests were developed using clean samples and whether admixture could cause damage to or block equipment. Cleaning can be carried out using sieves (e.g. to determine screenings) or more specialist equipment. Samples should be labelled to indicate whether they have been cleaned.

Some methods require whole grains to be ground. This requires the use of a relatively large sample to minimise the influence of any individual grains with extreme values on the final test result. Most grinders cause particle separation. Bran and husk grind at different rates to endosperm, and are often on the surface of the ground sample. Therefore, thorough mixing of the ground sample is essential. To prevent cross-contamination, grinders should be cleaned or flushed between samples and cleaned thoroughly at the end of the day.

Storage and labelling of samples

- Sample containers used must eliminate cross-contamination risks and limit moisture loss
- For storage, containers should be full and plastic bags should have the air expelled from them (to prevent moisture loss and spillage)
- Adequate labelling is essential for tracing purposes
- Labelling of lids should be avoided, as these can be swapped between samples
- The length of time samples are retained will depend on company policy and/or contracts

Laboratory testing of grain

Contracts should specify testing requirements. For some tests, a reference procedure may be used (e.g. ISO 712:2009 for moisture determination). Most millers and maltsters use alternative, more modern, equipment for some tests (such as near infrared spectroscopy). However, these will be traceable to the reference procedures. To ensure conformity of results throughout the year, processors take part in proficiency schemes. These include:

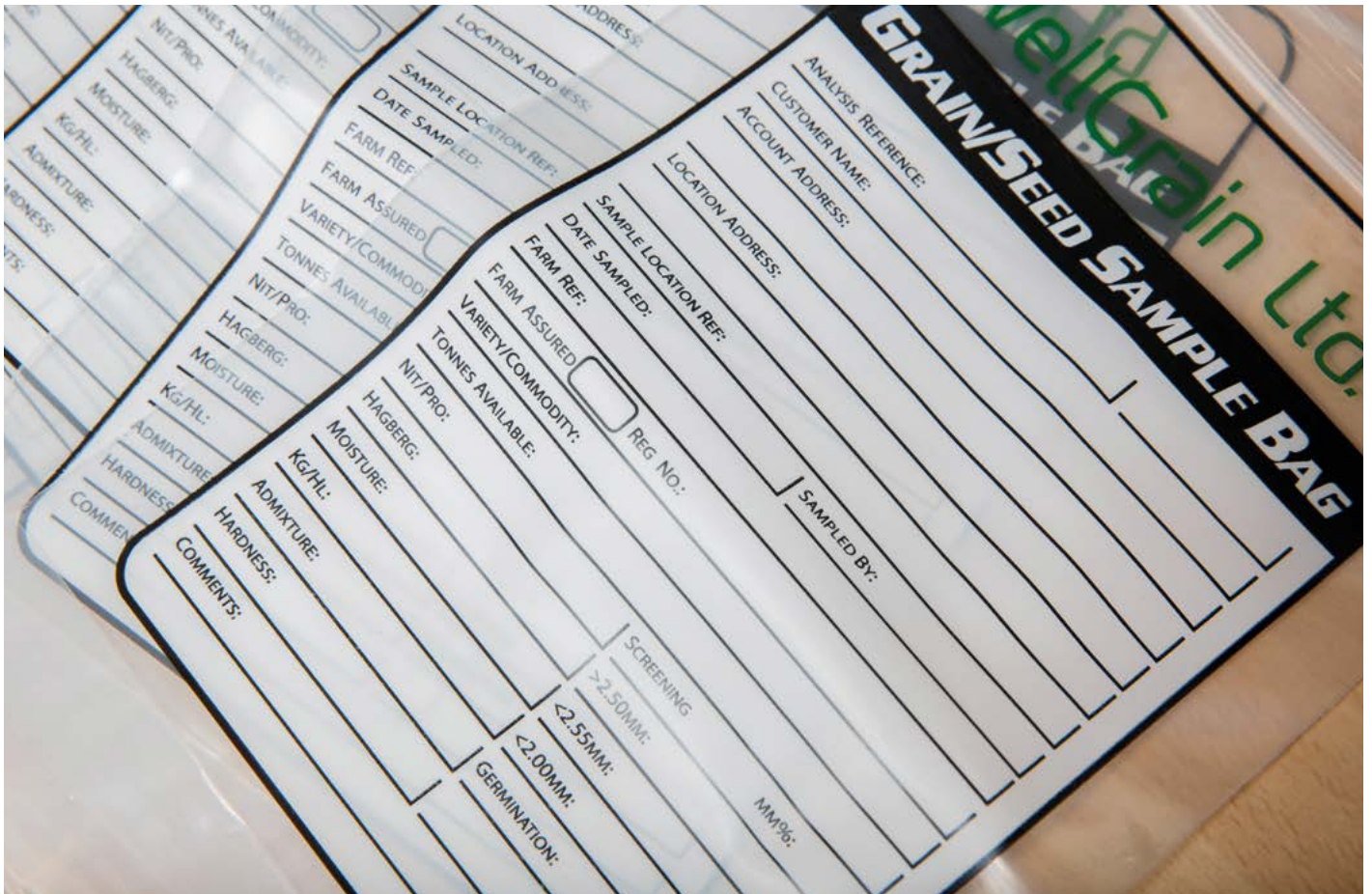
- UK Flour Millers intake proficiency scheme
- Malting Analytes Proficiency Scheme (MAPS)
- TASCC laboratories proficiency schemes

Grain analysts training

The AHDB website hosts modules and information to improve grain testing standards across the UK. The web pages are designed for analysts who test wheat, barley and oilseed rape.

Access our grain testing and guidance and training materials at ahdb.org.uk/grain-analysts

Negotiating a contract



A well-designed contract will pave the way for a smooth transfer of goods (grain) from the seller to the buyer, with the expected price paid in return.

What is a grain contract?

A contract is a legally binding promise – here, between a seller and buyer of grain. The grain contract comprises the key terms and conditions relating to the agreement. These include the expected price, quality, variety, quantity, delivery period, payment terms and any special conditions.

What to consider before the contract stage

- Know and grow for your market – be clear on what you intend to sell and deliver
- Assess your ability to segregate and store different varieties/qualities
- Check the latest assurance scheme requirements, which now cover the majority of crop sales
- Manage price volatility – consider all the options and have a flexible marketing plan
- Develop a long-term business strategy to make it cost-competitive and resilient

Agreeing the contract terms and conditions

It is essential to know what contract is being used and that it is based on clear terms and conditions.

Before agreeing the contract, negotiate, establish and accept all terms and conditions. There are many differences between the requirements of cereals markets and oilseeds markets – and contracts reflect this variation.

Access our guidance on contracts for sellers of cereals and oilseeds at ahdb.org.uk/harvest-toolkit

Top tip

Top tip: Retain samples until payment has been received for the loads to which the samples relate.

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