

# HACCP explained: a supplement to the HGCA Grain storage guide



# Hazard Analysis and Critical Control Point (HACCP)

The safety and quality of grain is an important and high profile subject. As grain storage is an integral part of the food and feed supply chain, grain storage operations must satisfy their customers the grain is:

- produced according to good practice and relevant standards
- of the required quality and suitable for the intended use
- above all, safe for the consumer

This is underpinned by legislative requirements (eg EU Regulations for food and feed hygiene, and maximum residue levels for pesticide and food contaminants) and private voluntary standards for the production of safe food and feed.

The Codex Alimentarius Commission ([www.codexalimentarius.net](http://www.codexalimentarius.net)) promotes the practical implementation of HACCP in the food supply chain. Codex has documented a standardised approach to HACCP and the Codex work has become the reference for international food safety, including HACCP.

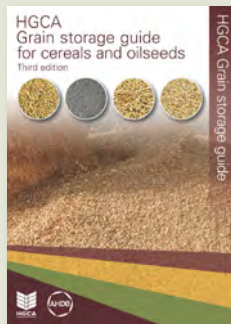
Within Europe, systems based on HACCP principles (as defined by Codex) have been incorporated in to the EU food and feed hygiene regulations. HACCP also has a fundamental role to play within private voluntary standards adopted by the agri-food industry.

The HACCP system is an instrument to help businesses attain a higher standard of food safety. It is often a misconception that HACCP is difficult, complicated and bureaucratic, and requires a high degree of expertise. Knowledge of HACCP is necessary in carrying out a HACCP study, but the main requirement is for a thorough understanding of the product and production process, including those factors that have regulatory relevance and those which cause concern to customers.

HACCP is a management tool which can be applied to a wide range of simple and complex operations and is not restricted to large organisations. The adoption of HACCP is not restricted to food business operations; it can be used to assure food safety at all stages of the food chain including on farm. The aim of this guide is to outline the principles of HACCP and provide guidance on how HACCP systems may be developed and implemented, with special reference to grain storage.

This publication was produced to complement the HGCA Grain Storage Guide, 3rd edition

[www.hgca.com/grainstorage](http://www.hgca.com/grainstorage)



# How to set up and conduct a HACCP study

The guidance on HACCP in this publication is based on the procedures published by the Codex Alimentarius Commission (2009) Food Hygiene Basic Texts (Fourth Edition), as exemplified in Campden BRI's Guideline nos. 10, 42 and 64 ([www.campden.co.uk/publ/pubs.asp](http://www.campden.co.uk/publ/pubs.asp)), but adapted to meet the specific circumstances in the storage of grain for food and feed.

HACCP systems in grain storage are underpinned by adherence to the general principles of good storage practice and good hygiene practice as exemplified by the guidance in the HGCA Grain Storage Guide, 3rd edition. These good practice programmes (alternatively referred to as PRP: prerequisite programmes) provide the basic environmental and operating conditions for grain storage and should be in place before the application of the principles of HACCP.

When conducting a HACCP study for grain storage, the seven principles of HACCP (Codex 2009) may be applied as fourteen stages as shown in the figure below (Campden BRI 2009). These include both essential preparation tasks to enable hazard analysis (stages 1 to 7 described here) and establishing the HACCP plan (stages 8 to 14).

## Stages in applying the principles of HACCP

### Preparatory Stages

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### HACCP Principles

Stage 8: List all potential hazards associated with each process step, conduct a hazard analysis and determine the measures to control identified hazards (*HACCP Principle 1*)

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Stage 9: Determine the Critical Control Points (CCP) (*HACCP Principle 2*)

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Stage 10: Establish critical limits for the control measures for each CCP (*HACCP Principle 3*)

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# Prerequisite programmes (PRPs)

Within grain storage operations there will be many hazards associated with the basic environmental and operating conditions of the production process. These are associated with the process, ie site wide, and are often lower risk hazards. The control of these hazards is normally part of good storage practice (GSP) or good hygiene practice (GHP). They are a pre-requirement to HACCP and should be in place to underpin the HACCP system.

The term 'prerequisite programme' has found widespread use to describe these measures that are necessary for the safe production of food and feed. The prerequisite programmes cover a number of basic areas: personnel, the equipment, the production environment and materials used. Typical examples include:

- Hygiene and housekeeping
- Equipment maintenance and calibration
- Glass control
- Pest control
- Transport control
- Training

Effective prerequisite programmes enable the HACCP system to be focussed on the significant product and process food safety hazards that require specific control measures. By 'screening-out' the lower risk hazards, the identification of true critical control points is made easier and may result in the identification of a relatively small number of critical control points that can be effectively managed and where resources are targeted.

Prerequisite programmes need to be documented and records maintained. Their effectiveness should be checked and remedial action taken if necessary.

## Example of a grain store PRP plan

Good Practice Programme (GPP)	Hazard(s) controlled by the GPP programme	Checking procedures	Remedial actions
<p><b>Hygiene and housekeeping procedures</b> All key equipment, store structures and environment are cleaned to a defined schedule and documented procedures to minimise the risk of product contamination.</p> <p>Storage facilities must be clean, dry and fit for purpose.</p>	<p>Introduction of Salmonella and other pathogenic bacteria, storage pests and fungi from equipment and the store environment (the store structure and previous crop debris).</p>	<p>Planned visual inspection to observe hygiene standards (eg before loading with grain and at regular intervals during the storage period).</p> <p>Check stores for pests with traps prior to loading.</p>	<p>Take action to remedy defects and re-establish a hygienic environment.</p> <p>Consider whether additional cleaning, trapping and treatment is required.</p> <p>Review procedures to ensure appropriate hygiene standards are maintained.</p>

# Planning stages to enable hazard analysis

## Preparatory Stage 1: Obtain senior management commitment

Before the HACCP study begins it is essential there is full commitment at every level of the business to ensure the necessary resources, including relevant personnel, are provided to develop, implement and maintain the HACCP system.

This commitment must be in place whether it is a large operation with a defined management structure and defined responsibilities for the HACCP study, or a small or medium sized enterprise where the management is directly involved in the HACCP system, possibly as a member of the HACCP team.

## Preparatory Stage 2: Define the terms of reference/scope of the study

Terms of reference or study scope should be defined clearly to help the HACCP team focus on the key issues. A HACCP study should be carried out on a clearly defined product, process operation or a specific range of activities. In order for the study to proceed quickly and be fully effective it is essential that the terms of reference are agreed and stated clearly at the outset.

It is therefore necessary to define factors such as:

- The product the study applies to (grain types)
- The process the study applies to (start and end points)
- The hazards considered (biological, chemical, physical agents)

## Preparatory Stage 3: Select the HACCP team

A HACCP study will require the collation and evaluation of technical data, and is best carried out by a multi-disciplinary team. The use of such a team is recognised to improve the quality of the data considered and therefore the quality of the decisions made.

Ideally development and implementation of the system should, wherever possible, be undertaken by a team who have adequate knowledge and expertise in order to conduct the study. This should include an understanding of HACCP principles and their application and knowledge of the product, production process and hazards considered.

# Planning stages to enable hazard analysis

## Preparatory Stage 4: Describe the product and process

A full description of the product(s) under study should be prepared. Key parameters which influence the safety and/or quality of the product should be defined (these will be used in stage 7).

This stage is designed to identify and record salient details about the production process and product. The essential product characteristics to be considered in a grain storage operation include:

- Product types (milling wheat, oilseed rape, malting barley)
- Treatments (grain conditioning, pesticide treatments)
- Storage conditions

## Preparatory Stage 5: Identify the intended use of the product

The intended use of the product by the customer should be defined, eg whether it is intended for marketing for further processing as a food or feed.

Completing stages 5 and 6 will help to establish a good understanding of the product and help to identify hazards.

## Preparatory Stage 6: Construct a process flow diagram

Prior to the hazard analysis beginning it is necessary to carefully examine the product/process operations under study and produce a flow diagram around which the study can be based. There are no rules for the format of the flow diagram; presentation is a matter of preference. However, each operational step in the process to store grain, from the start point through to dispatch of the finished product, should be clearly outlined in the correct sequence.

The flow diagram should provide sufficient technical detail for the study to proceed. The amount of detail shown in the flow diagram in respect of the identification of the steps in the process will depend on the objectives of the study and nature of the production operation.

## Preparatory Stage 7: On-site confirmation of a process flow diagram

It is important to ensure the flow diagram is an accurate representation of the production operation, as it is the basis on which the hazard analysis is undertaken.

Typically confirming the flow diagram is correct should involve a physical check of the process. If this is not possible it is important to use the knowledge and expertise of the people involved in the HACCP study to ensure the flow diagram represents the most likely production options.

# Establishing the HACCP plan

## Stage 8: Hazards and controls (Principle 1)

### 8.1 List all hazards

Using the flow diagram (see Preparatory Stage 6) as a guide, identify and list all the potential hazards, as defined in the scope of the study (see Preparatory Stage 1), that may reasonably be expected to occur at each process step.

The consideration should include hazards that may be:

- Present in materials used (introduced at steps preceding the operation, (eg in crop production)
- Hazards that may be introduced from people, equipment or the environment
- Hazards that may change (eg increase or be produced in some way)

Identification of the cause or source of the hazard will help to determine appropriate control measures.

### 8.2 Conduct a hazard analysis

Having identified all potential hazards the next step is to conduct a hazard analysis to determine which of the hazards are of such a nature that their elimination or reduction to acceptable levels is essential for the production of safe products. The significance of any hazard to the safety (or quality) of the final product will need to be assessed, particularly when deciding on the control measures to be implemented.

In practice, the decision process will need to take into account the risk associated with any hazard identification, ie the likelihood of the hazard causing an adverse effect taking into account the likely severity of that effect. This may involve the team assessing the significance based on their experience and judgement. A number of tools have been developed to help the HACCP team quantify and rank risk, including, for example, 'scoring systems' and 'logic tables' (Campden BRI Guideline No 42 [www.campden.co.uk/publ/pubs.asp](http://www.campden.co.uk/publ/pubs.asp)). The purpose of these tools is to make the hazard analysis stage more structured and logical and provide evidence of how hazard significance was determined.

With the scoring system approach, scores are assigned for the severity and the likelihood for every hazard; the scores are multiplied together to denote the significance of the hazard. It is critical that the meaning of the scores is clearly defined.

### 8.3 Identify appropriate control measures

The next step is to consider what control measures can be applied for each identified hazard. Control measures are actions or activities required to prevent hazards, eliminate hazards or reduce their occurrence to an acceptable level.

## Stage 9: Determine Critical Control Points (Principle 2)

Critical Control Points (CCPs) are the process steps where control is necessary to prevent or eliminate a hazard or reduce it to an acceptable level. In grain storage the focus is on prevention, ie reducing the likelihood of occurrence of a hazard.

The identification of CCPs for the control of a hazard requires a logical approach and professional judgement; this may be aided by the understanding of hazard risk and/or the use of a decision tree (Campden BRI Guideline No 42 [www.campden.co.uk/publ/pubs.asp](http://www.campden.co.uk/publ/pubs.asp)).

# Establishing the HACCP plan

## Stage 10: Establish critical limits (Principle 3)

Having determined all the CCPs the team should identify the critical limits for the control measure(s) at each CCP. The critical limit is the value which separates acceptability from unacceptability (eg safe from potentially unsafe).

The critical limit should represent some measurable or observable parameter related to the CCP which can be quantified. Parameters that can be measured or observed in a timely manner, and ideally which can be assessed quickly and easily, are generally preferred.

For practical purposes, a target level may be specified which is a pre-determined operational value for the control measure that is more stringent than the critical limit. The difference between the two is the tolerance.

## Stage 11: Establish a monitoring system (Principle 4)

CCPs must be monitored to show that the control measure(s) being applied are successfully meeting the critical limits set, and to enable timely corrective action to be taken if they are not.

Monitoring is a planned sequence of observations or measurements of CCP control measures. Monitoring must also be able to detect loss of control at the CCP so that corrective action can be taken to regain control (stage 12).

The monitoring system should preferably address four issues:

- *How* the monitoring is to be carried out – that is, what measurement or observation is being carried out, and what record is taken
- *When* the monitoring is to be carried out – that is, at what frequency the measurement or observation is being undertaken
- *Who* has responsibility for carrying out the monitoring
- The *record* to be taken



# Establishing the HACCP plan

## Stage 12: Establish a corrective action plan (Principle 5)

The actions to be taken when monitoring shows there has been a failure to meet the critical limit (at a CCP), or, preferably, when monitoring indicates a trend towards loss of control, should be specified.

If, in the process of monitoring (or checking of prerequisite programmes) it is found that there is a loss of control, it is important that appropriate and timely action is taken. Corrective actions should aim to bring the production process back under control and deal with any potentially non-conforming product where appropriate.

All corrective actions must be practical and achievable and should involve a thorough review to determine what necessary action needs to be taken. One objective should be to prevent the same issue occurring in the future.

### Example hazard analysis table (significant hazards)

Process step	Hazard and cause	Control measures	CCP	Critical limit	Monitoring procedures	Corrective action
<b>6. Long term storage</b>  Storage of conditioned grain, including cooling, monitoring and pesticide treatment	<b>6.1</b> Introduction of ochratoxin A due to mould growth when conditions are favourable to growth	Store grain dry and cool  Reduce temperature by low volume aeration  GSP of store design and maintenance procedures	CCP	$\leq 15\%$ moisture content (mc) <sup>†</sup> <i>Target: 14.5% mc</i>  $\leq 15^{\circ}\text{C}^{\dagger}$ <i>Target: <math>&lt; 15^{\circ}\text{C}</math> within 2 weeks of harvest, <math>&lt; 12^{\circ}\text{C}</math> within 3-4 months of harvest and <math>&lt; 5^{\circ}\text{C}</math> by end December (minimum <math>10^{\circ}\text{C}</math> for malting barley)</i>  Refer to the HGCA safe storage time calculator for a safe storage risk assessment ( <a href="http://www.hgca.com/grainstorage">www.hgca.com/grainstorage</a> )	Check temperature regularly (at least every 2-3 days) until target temperatures are reached and then weekly  Check mc each week until grain temperature stabilises; check monthly thereafter	<ul style="list-style-type: none"> <li>– Investigate any significant rise in mc or temperature</li> <li>– Review grain condition and consider need to remedy defects</li> <li>– Review storage and drying practices</li> </ul>

<sup>†</sup>15°C is on the edge of safe storage, ideally grain should be stored cooler depending on storage period and market requirements. Commercial grain is traded at moisture contents of 15% and above. The food safety risk is partly dependent on temperature, but begins to increase above 14.5% mc. The impact of any particular temperature and mc combination can be assessed using the HGCA safe storage time calculator ([www.hgca.com/grainstorage](http://www.hgca.com/grainstorage)).

# Establishing the HACCP plan

## Stage 13: Establish verification procedures (Principle 6)

Verification comprises three distinct activities: validation, verification and review.

### 13.1 Validation

The contents of the HACCP plan must be validated. Validation aims to show it is scientifically and technically correct and that safe product can be produced.

In practice in a grain storage operation there is little if any opportunity for validation by testing; conformation of the effectiveness of the HACCP plan relies on the knowledge and experience of the HACCP team by reference to industry norms and good practice, such as that described in the HGCA Grain Storage Guide, 3rd edition.

Validation should include a formal sign-off of the HACCP plan by the person ultimately responsible for food safety management at the business. Records of validation activities must be maintained.

### 13.2 Verification

The HACCP team should put procedures in place that can be used to demonstrate compliance with the validated HACCP plan and to determine its effectiveness once in use.

Verification activities may include internal or external auditing systems, product examinations (by the business or customer), and analysis of customer satisfaction.

#### Examples of verification activities to demonstrate a grain storage HACCP is working in practice include:

Internal auditing of CCPs and relevant prerequisite programmes	Using the findings of customer and third party audits, including verifiers of certification schemes, particularly where these examine the HACCP systems and prerequisite programmes	External auditing programmes (eg supplier audits)	Monitoring customer satisfaction, ie analysis and trending of customer complaints	Product testing (for example, microbiological and chemical examinations of product samples): this may be undertaken by the producer or producer's customer or through participation in a third party monitoring system
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### 13.3 Review

The HACCP team should perform a formal scheduled review of the HACCP system. Typically for a grain storage HACCP this may be performed annually, eg prior to the new season crop.

It is essential to have mechanisms in place that will automatically "trigger" a review of the HACCP system. This review should be performed by the HACCP team and prior to the implementation of any changes that may affect product safety. These changes may be due to internal factors or due to some external factor.

Review is the mechanism that drives the vital maintenance of the HACCP system, keeping it up-to-date and relevant.

# Establishing the HACCP plan

## Stage 14: Establish documentation and record keeping (Principle 7)

Efficient and accurate record keeping is essential to the successful application of HACCP. It is important for the operation to be able to demonstrate the principles of HACCP have been applied correctly, and that documentation and records have been kept in a way appropriate to the nature and size of the business.

Examples of HACCP documentation include:

- Documentation of the system (eg the HACCP plan)
- Supporting information, eg associated procedures and work instructions, and records (from monitoring, corrective action and verification activities)

The HACCP system must also be supported by records. Records provide evidence that systems operate as specified.

Examples of supporting records include:

- Operational control records (eg staff training, pesticide application and pest control records)
- Monitoring data
- Corrective actions taken
- Data from verification, validation and review activities

A working HACCP system can generate many records, particularly of monitoring activities. The method of recording may be using purposely designed record forms, utilising existing systems including electronic recording systems, or a simple daily diary.

The chosen method will depend on the nature and size of the grain store operation. For small businesses it may be appropriate for record keeping to be limited to recording by exception. For example, it may not be necessary to record the results of all checks, only that they have been completed (eg in a diary). However, if anything different happens or something goes wrong a note should be made including what remedial action was taken and the justification for it.

### Further Information

HGCA Grain Storage Guide 3rd edition – [www.hgca.com/grainstorage](http://www.hgca.com/grainstorage)

Campden BRI – [www.campden.co.uk/publ/pubs.asp](http://www.campden.co.uk/publ/pubs.asp)

Codex Alimentarius – [www.codexalimentarius.net](http://www.codexalimentarius.net)

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