

# Hazard Analysis and Critical Control Points

# Introduction

This module is part of a training program on General Food Safety Requirements for the Food Industry.

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# Module Overview

Implementing an effective food safety management system is critical to the production of safe food. Management systems based on Hazard Analysis and Critical Control Points (HACCP) are the international standard as recognized by the Codex Alimentarius Commission. HACCP systems build upon effectively designed and implemented prerequisite food safety programs, and focus on three key concepts: 1) identifying significant food safety hazards, 2) controlling these significant hazards, and 3) documenting the system.

This learning module focuses on requirements for implementing HACCP systems as described in the Codex Alimentarius General Principles of Food Hygiene. The following topics will be discussed:

- Introduction to HACCP
- Preliminary Steps
- Principle 1 – Conduct a Hazard Analysis
- Principle 2 – Identify Critical Control Points
- Principle 3 – Determine Critical Limits
- Principle 4 – Determine Monitoring Procedures
- Principle 5 – Determine Corrective Actions
- Principle 6 – Determine Verification Procedures
- Principle 7 – Record-Keeping Procedures

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# Section 3-1: Introduction to HACCP

## Section Overview

This section will introduce the reader to general concepts regarding the Hazard Analysis and Critical Control Point system for food safety management. HACCP systems are internationally recognized as the “Gold Standard” for risk-based management of food safety hazards. The following topics will be discussed:

- Definition of HACCP
- Origins of HACCP
- Process control versus testing
- Food safety hazards
- Prerequisite programs and HACCP
- HACCP plans
- HACCP plans – getting started
- The seven HACCP principles

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# Learning Objectives

At the conclusion of this section, the learner will be able to:

- define HACCP and list the five preliminary steps and seven principles that form the basis for HACCP systems,
- discuss the origins and history of HACCP systems,
- discuss the merits of process control versus end-product testing for management of food safety hazards,
- define a food safety hazard and list examples of biological, chemical and physical hazards,
- list common prerequisite programs and discuss their importance in overall food safety management, and
- describe HACCP plans and considerations in their development.

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## Introduction

# Definition of HACCP

**Hazard Analysis and Critical Control Points (HACCP)** is “a systematic approach to the identification, evaluation, and control of food safety hazards.” Proper implementation of HACCP systems provides the framework to produce foods safely and to prove they were produced safely.

HACCP systems:

- specifically focus on food safety, not all attributes constituting food quality,
- are applicable to all phases of food production,
- focus on prevention and control of potential food safety hazards rather than inspection, and
- emphasize the use of science and technology to ensure the production of safe food.



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## Origins of HACCP

Food safety management systems, including HACCP, have evolved from total quality management systems developed by W.E. Deming in the 1950s. Deming emphasized a systems approach to manufacturing which managed all aspects of product quality.

HACCP food safety systems also trace their origins to work by the Pillsbury Company, United States Army, and the U.S. National Aeronautics and Space Administration (NASA) on food safety for manned space flights in the 1960s. Given the critical importance of food safety for the astronauts, a “zero defects” program was developed for space foods which emphasized process control as opposed to end-product testing. This emphasis on process control is a defining characteristic of modern HACCP systems.

HACCP was officially adopted as a recommended approach for food safety management by the Codex Alimentarius Commission in 1993. The document “Hazard Analysis and Critical Control Point (HACCP) System and Guidelines for its Application” was included as Annex A to the Codex General Principles of Food Hygiene in 1997.



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# Process Control versus End-Product Testing

HACCP systems emphasize identification of significant hazards in a food process and implementation of systems to control these significant hazards. For example, thermal processes such as pasteurization are designed to control microbiological hazards in dairy and juice products.

End-product testing can be an ineffective method to ensure food safety. The potential efficacy of end-product testing to ensure food safety depends upon many factors, including:

- specificity, sensitivity, and speed of the testing methodology,
- likelihood of occurrence of the hazard being detected, and
- ability of the sampling and testing protocols to recover and identify the hazard in question.

Because of these limitations, end-product testing typically is not relied upon as a sole indicator of food safety. Rather, testing generally is used as an adjunct to verify that effective processes have been implemented to achieve the appropriate level of food hazard control.



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# Process Control versus Testing End-Product Testing

Here is an example to illustrate the challenges associated with the use of end-product testing to ensure food safety.

### Assume:

- We are using end-product testing to detect Salmonella contamination in a finished food product.
- Salmonella contamination is not prevalent in this product – e.g. one pack in every 1,000 packs produced is contaminated with Salmonella.
- The laboratory randomly samples and tests 60 packs from every 1,000 packs.

### Then:

- In this scenario, the probability of detecting the defective pack (one positive test for Salmonella) is 6%.
- Conversely, the probability of accepting the entire lot as being free of Salmonella is 94% (all samples test negative for Salmonella).

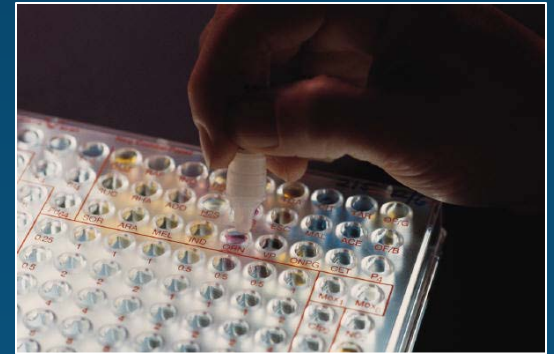


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# Process Control versus Testing End-Product Testing

Other scenarios where end-product testing is not reliable to ensure food safety are instances where:

- Characteristics of the product and non-homogeneous distribution of the hazard make detection difficult (e.g. detection of Enterohemorrhagic *E. coli* in combo bins of beef trimmings).
- The product is highly perishable and end-product testing methodologies may not be completed prior to distribution and consumption of the product (e.g. detecting hazards in highly perishable fresh food items).
- Testing methodologies are not sufficiently sensitive to detect the hazard in question (e.g. detection of certain viruses in foods).

Despite these limitations, it is important to note that there are many scenarios where end-product testing is an excellent verification step or primary control for specific food safety hazards.



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# Food Safety Hazards

A food safety hazard is defined by the Codex Alimentarius as “a biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect.”

Examples of compounds that could be food safety hazards include the following:

### Biological Hazards

#### Bacterial Pathogens

(e.g. pathogenic *Escherichia coli* strains, *Salmonella*)

#### Parasites

(e.g. *Cryptosporidium parvum*, *Cyclospora cayetanensis*)

#### Viruses

(e.g. Norovirus, Hepatitis A virus)

### Chemical Hazards

#### Natural Toxins

(e.g. shellfish toxins, mushroom toxins)

#### Allergens

#### Heavy Metals

(e.g. Mercury, Cadmium)

#### Drugs

(e.g. used in aquaculture or animal husbandry)

Insecticides, Fungicides, etc.

### Physical Hazards

#### Metal

#### Glass

Bone (when not expected)

Hard or sharp foreign objects

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# Prerequisite Programs and HACCP

Before a HACCP system can be implemented, the company must be operating in accordance with good hygiene and good manufacturing practices. These prerequisite programs (PRPs), which are discussed elsewhere in this curriculum, provide the strong foundation which is necessary to ensure the food facility is capable of producing safe food. These PRPs must be in place before effective HACCP programs can be implemented.

The importance of effective PRPs cannot be overstated, as they are the foundation of the HACCP plan. Inadequate PRPs may lead to additional critical control points that would have to be identified, monitored and maintained under the HACCP plan.



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# Prerequisite Programs and HACCP

The following are examples of common prerequisite programs :

- Building and equipment design, fabrication and maintenance
- Production line design and product flow
- Cleaning and disinfection programs
- Equipment calibration
- Management commitment
- Supplier approval
- Product Specifications
- Water quality
- Staff hygiene practices
- Staff training
- Staff health
- Pest control
- Waste control
- Storage and Distribution
- Product recall



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# HACCP Plans

As stated previously, HACCP is “a systematic approach to the identification, evaluation, and control of food safety hazards.”

Key to the effective implementation is the written HACCP Plan, which is a document prepared in accordance with the principles of HACCP to ensure control of hazards that are significant for food safety in the segment of the food chain under consideration.

It is important to note that HACCP plans are specific to a food product and process. The plan is written by the HACCP team at the firm based upon the specific conditions in that facility. Any changes in product characteristics or processing steps will likely necessitate re-evaluation of the written HACCP plan.

The written HACCP plans at two facilities that are producing the same food product are likely to be different due to a variety of reasons including differences in types of equipment used, management of prerequisite programs, and other factors.



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# HACCP – Getting Started

Design and implementation of effective HACCP systems requires systematic planning and execution. The preliminary steps necessary before implementing a HACCP plan include the following:

1. Assemble the HACCP Team
2. Describe the Food and its Distribution
3. Describe the Intended Use and Consumers of the Food
4. Develop a Flow Diagram Which Describes the Process
5. Verify the Flow Diagram

These steps must be completed prior to beginning work on HACCP Principle 1. Preliminary steps will be discussed in the following section.



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# The Seven HACCP Principles

Following the effective completion of the HACCP preliminary steps, the team is ready to begin the process of writing the HACCP Plan. Writing the plan is a seven-step process which must occur in the following sequence.

1. Conduct a hazard analysis
2. Determine the CCPs
3. Establish critical limits
4. Establish monitoring procedures
5. Establish corrective actions
6. Establish verification procedures
7. Establish record keeping and documentation

In the following sections of this module, we will cover the basic concepts of each of these HACCP principles in sequence.



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