The Brewers of Europe

Market & Technology

Managing Food Safety in the European Brewing Industry through the Application of HACCP Principles

2004

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APPENDICES

Note: *This document is a guide. It is not a definitive list of all possible hazards. It should be read with, and is not a substitute for, the relevant legislation. It includes interpretations of legislation that are an opinion and are only a summary of the wording prescribed.*

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1. INTRODUCTION

The European brewing industry is morally and legally obliged to provide safe and wholesome products and to ensure food safety throughout the supply chain. Whilst beer is an inherently safe product it may, nevertheless, be contaminated by foreign bodies and chemicals at various stages within the process. Adopting a Hazard Analysis and Critical Control Point (HACCP) approach to food safety can control this possibility. The HACCP programme is recognised worldwide as a systematic and preventative approach to food safety that addresses risks through prevention rather than finished product inspection.

This generic European HACCP guide encompasses a set of minimum standards for food safety. The purpose of this guide is to:

- assist member organisations in the development of HACCP guidance,
- be a practical guide for the prevention of hazards to food safety that might occur during the brewing and packaging of beer,
- recommend systems and practices (pre-requisite programmes) that are required for the successful implementation of HACCP in the preparation processing and packaging of beer.

1.1. Scope

This guide applies to the brewing of beer from malt, hops and other materials permitted in the EU for the production and packaging of beer into cans, bottles, kegs and casks for human consumption and the production of feed for animal consumption. The hazards considered are those that relate to consumer health. Hazards to beer quality that have no consumer safety implications are not considered. This guide incorporates the principles of HACCP, identifies the hazards from processes and materials and suggests typical control measures.

This guide carries no legal force and its use is voluntary.

1.2. Regulatory framework

Regulation (EC) No. 852/2004 of the European Parliament and of the Council of 29th April 2004 on the hygiene of foodstuffs requires all food business operators (except primary producers e.g. farmers) to put in place, implement and maintain a permanent procedure or procedures, based on HACCP principles. This regulation replaces Directive 93/43/EC of June 14th, 1993 on the Hygiene of foodstuffs[1].

Brewing Companies selling brewers' grains and yeast have to apply the HACCP principles also for these products according to Regulation (EC) No 183/2005.

The HACCP requirements should take account of the principles contained in the Codex Alimentarius. These principles prescribe a certain number of requirements to be met throughout the cycle of production, processing and distribution in order to permit, via hazard analysis, identification of the critical points, which need to be kept under control in order to guarantee food safety. The principles are described in section 3.4.

As part of the revision of legislation on the hygiene of foodstuffs, this Regulation focuses on defining the food safety objectives to be achieved, leaving the food operators responsible for adopting the safety measures to be implemented in order to guarantee food safety.

Registration or approval of food businesses

Food businesses operators shall cooperate with the competent authorities and in particular ensure that all establishments under their control are registered with the appropriate authority and keep this authority informed of any changes. It is the responsibility of company management to ensure that all legislative requirements regarding food safety and hygiene, including those relating to ingredients and packaging, are complied with. Companies must ensure that they are kept informed of all relevant legislative changes. Brewers must adhere to EU and National legislation.

2. PRE-REQUISITE PROGRAMMES

For the successful development and implementation of a HACCP system in a brewery there are a number of requirements and systems that must be in place. These requirements and systems are usually activities that result in reduction/elimination of certain food safety hazards, thus reducing the number of Critical Control Points in the HACCP plan or they are processes that are required to operate the HACCP system effectively. Examples include the way in which the building is designed, operated and maintained, hygiene requirements for staff working in the brewery and pest control programmes. In HACCP these requirements and systems are called “pre-requisite programmes”. Appendix 1 identifies typical pre-requisite programmes for breweries and gives advice on their content.

3. HACCP

3.1. Definitions & abbreviations

Audit	A systematic examination of the HACCP system to determine its effectiveness.
Cleaning in place (CIP)	The removal of residues and foreign material including dirt, grease, waste product or other, from process plant by a process of automated cleaning.
Contamination	The presence of a hazard in food.
Corrective action	The action to be taken when the results of monitoring indicate that a control has exceeded its critical limit.
Critical Control Point (CCP)	A step or procedure where control can be applied and is essential to prevent, eliminate or reduce a hazard to an acceptable level.
CCP Decision Tree	A series of questions that can be applied to a process step to determine whether the process step is a CCP.
Critical limit	A criterion that defines a safe process from an unsafe process.
Good Manufacturing Practice (GMP)	A set of rules put in practice by the industry to ensure that manufactured foodstuffs are sound and safe for the consumer and of good quality.
Hazard	An agent which, when present in food, renders it unsafe.
Impact	In this document to describe the consequence/effect the hazard could inflict on consumers.
Likelihood	*A term to describe whether something is probable. In this document it is used to describe the probability of a hazard occurring.*
Monitoring	Planned, recorded observations or measurements to assess whether a control point is within its defined critical limits.
Pests	Any animal capable of contaminating food products, directly or indirectly, such as: insects, rodents, spiders,

	etc.
Potable water	Water that meets the requirements of Council Directive 98/83 of 20 December 1998.
Preventative action	Action taken before a critical limit is exceeded to prevent a process deviation.
Preventative or/control measures	An action or an activity that eliminates a hazard or reduces it to an acceptable level.
Primary packaging	Any container (glass, plastic, metal, refillable or non-refillable) and its closure system in direct contact with beer.
Process water	Potable water treated to meet the requirement of a process.
Risk	A measure of the impact of a hazard and the likelihood that it will occur.
Secondary packaging	Any materials such as labels, cartons, boxes, cases, crates or wrapping and covering material such as foil, film and cardboard, not in direct contact with the product.
Traceability	Ability to trace and follow the product or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution. This can be accomplished manually using lot marking and lists of suppliers and vendors.
Verification	The process of determining, cross checking a set of established requirements, evidence.

3.2. Background to HACCP

The World Health Organisation (WHO) Codex Alimentarius Commission developed the seven HACCP principles. The HACCP system is the standard used throughout the EU Food Industry and is recognised by several legislative bodies.

3.3. The purpose of HACCP

To identify hazards that can occur at any stage in the production of the food, to determine their severity, to put in place control measures with limits outside which the process should not be operated, to monitor these control points and identify corrective action to be taken when limits are exceeded.

3.4. Principles of the HACCP system

The HACCP system consists of the following seven principles:

Principle 1 Conduct a hazard analysis
Principle 2 Determine the Critical Control Points (CCPs)
Principle 3 Establish critical limit(s)
Principle 4 Establish a system to monitor control of the CCP
Principle 5 Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control
Principle 6 Establish documentation concerning all procedures and records appropriate to these principles and their application
Principle 7 Establish procedures for verification to confirm that the HACCP system is working effectively

3.5. Stages of HACCP implementation

The HACCP Principles are implemented in a series of stages outlined in the diagram below.

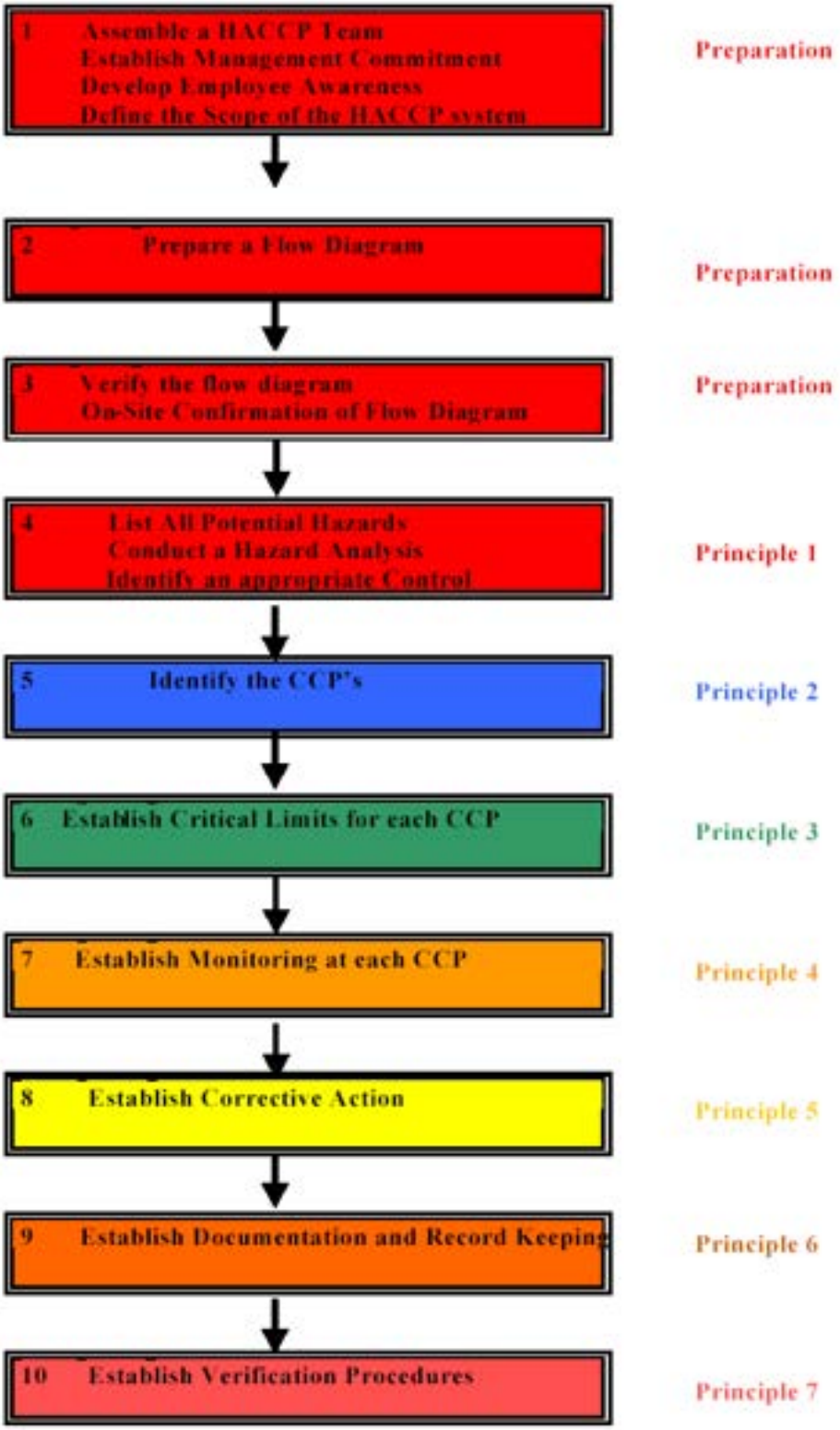


Figure 1 Stages of HACCP Implementation & HACCP Principles

4. GUIDE TO THE IMPLEMENTATION OF HACCP

Stage 1

4.1. HACCP Preparation

4.1.1. Assemble a HACCP team

Management support is essential for the effective implementation of HACCP. A multidisciplinary group of individuals at each site needs to be established to carry out HACCP studies. Ideally, the team should comprise a minimum of two people qualified in application of the HACCP principles. Some large companies use central teams or have a person responsible for overall HACCP policy and implementation or team leader. The team leader of a HACCP study should have technical knowledge of the process and plant covered by the HACCP study, expert knowledge of hazards associated with brewing and experience within the scope of hazard analysis, developing HACCP plans and implementing and reviewing HACCP.

4.1.2. Establish management commitment

All management including senior management need to be aware that HACCP is necessary to comply with legislative requirements. The HACCP team must gain support and commitment from top management. It must be part of their job description to undertake HACCP studies, set up a HACCP plan and conduct ongoing reviews for maintaining the system. Management should also be aware that some costs might be involved. If the system highlights a potential safety hazard to the consumer then expenditure may be required to address the hazards control.

4.1.3 Development employee awareness of HACCP

Employees need to understand the purpose of HACCP and why a system is being introduced into the company. This will help the HACCP team obtain information in the setting up stage.

4.2. Define the scope of the HACCP system

The HACCP team need to establish and document the scope of the HACCP system. The scope needs to include:

1) a description of the product,
2) the product's intended end use,
3) the process to be studied
4) the hazards considered,
5) any hazards that are controlled outside the HACCP system e.g. by pre-requisite programmes.

Stage 2

4.3. Prepare a flow diagram

The purpose of the flow diagram is to provide a detailed description of the process to help the HACCP team carry out the hazard analysis. The flow diagram is an essential aid to the HACCP team when identifying hazards in the process. The flow diagram should be an activities diagram showing each process step in the order in which it is carried out, including re-work routes. All material additions and services should be shown in the diagram. The flow chart should not be an equipment diagram e.g. engineering drawing, because this may omit essential process steps e.g. addition of ingredients, which may have specific hazards associated with it.

Stage 3

4.4. Verify the flow diagram

Before starting the hazard analysis the HACCP team should confirm that the on-site process matches the diagram. This should be done by walking the process and interviewing employees responsible for process activities.

Stage 4

4.5. Conduct a hazard analysis and identify appropriate controls (Principle 1)

A hazard is a biological, chemical or physical agent that may cause the finished product to be unsafe for human consumption or cause injury to a consumer during handling.

Appendix 2 gives a list of some potential hazards that could occur at each process step during the production and packaging of beer and suggests an appropriate control measure for the hazard. This is provided as a guide to help identify hazards that may potentially occur, and identify methods of eliminating or reducing the hazards. This may not identify all hazards that need to be controlled, and it is the ultimate responsibility of the HACCP team to identify all hazards that are reasonably likely to occur and all appropriate controls for such hazards. Other hazards may exist depending on the design of the process, the nature of the product and the manner in which the process is operated.

During this hazard analysis stage it is useful to rank the hazards in terms of their risk to the consumer and to exclude from the HACCP plan any hazards that do not pose a serious/real risk. A workable risk ranking system is given below:

Table 1 **Consumer Impact Rating**

Impact rating	Impact	Definition
1	Low	Consumption of the hazard might cause a consumer disgust, but will not have any significant adverse physical health effect.
3	Moderate	Consumption of the hazard might cause mild advers physical health effect or a health effect if th consumer was consistently exposed to the hazar over a long period of time.
5	Severe	Consumption of the hazard might cause severe physical problems in some/all people.

Table 2 **Occurrence /Likelihood rating**

Likelihood rating	Likelihood	Definition
1	Low	The hazard is present intermittently and if control of the product was absent at this point the hazard would be present in only one part of one batch of product.
3	Moderate	The hazard is present intermittently and if control of the product was absent at this point the hazard would be present in the whole of one batch of product.
5	Severe	The hazard is present continuously and if control of the product was absent at this point the hazard would affect several batches of product.

RISK RATING = Impact x Likelihood

The impact on consumers and the occurrence of the hazard are defined above. Any hazard scoring 5 or more is a significant one. For each hazard scoring 5 or more the HACCP team should identify the appropriate control to eliminate the hazard or reduce it to an acceptable level and document the control in the HACCP study, either in the pre-requisite program or as a CCP.

Appendix 3 lists potential contaminants that can occur during brewing/packaging of beer with information to assist in the impact ranking.

Stage 5

4.6. Identify the CCP'S (Principle 2)

A Critical Control Point (CCP) is a step or procedure in the brewing process where control is essential to prevent, eliminate or reduce a hazard to an acceptable level. The World Health Organisation (WHO) recommend that CCP's should be determined using the HACCP Decision Tree below:

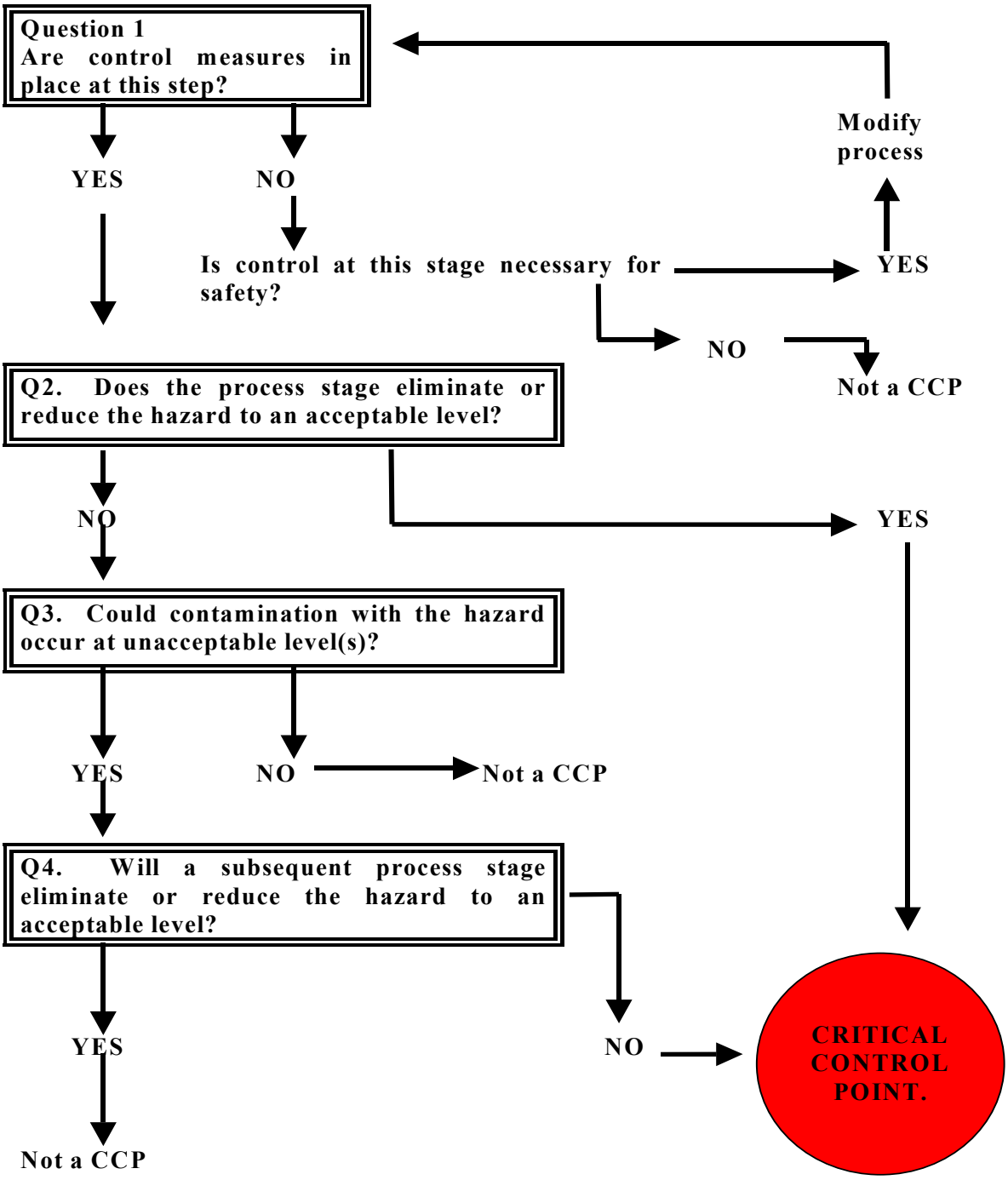


Figure 2 The 'Decision Tree' for CCP's

For each control identified the HACCP team should assess whether the control is a Critical Control Point by applying the above decision tree.

Stage 6

4.7. Establish critical limits for the CCP (Principle 3)

Critical limits must be set for each identified CCP. The critical limits define the difference between a safe and unsafe process. The critical limit is not necessarily the legal limit of the contaminant in the product. The limit applies to the control measure and not the hazard e.g. a common mistake is to think that the critical limit for the EBI (empty bottle inspector) is “no glass”. Although that is the aim, the critical limit is “e.g. six test bottles rejected”. The critical limit must be able to be measured quickly and simply to enable prompt corrective action.

Stage 7

4.8. Establish monitoring at each CCP (Principle 4)

A monitoring procedure could be in-line, on-line or off-line. The monitoring procedure must state the frequency of monitoring, person responsible for carrying out the monitoring and the monitoring procedure. The monitoring activity must relate to the control and be timely. Online/offline automation with recording/alarm is the best monitoring system. If any one of the critical limits is exceeded as determined by the monitoring system, the CCP is out of control and will result in a potential hazardous or unsafe product. Validate the control measures of the CCP’s and demonstrate that control measures do eliminate or reduce the hazard to an acceptable level. Records must be kept of the results of monitoring and proof of the correct effective control measures should be documented. An example is given in Appendix 5, example 6, process step 6.

Stage 8

4.9. Establish corrective action (Principle 5)

When a critical limit is exceeded appropriate corrective action must be taken to put the CCP back in control. The corrective action must state what to do to put the CCP back in control and what to do with the affected product produced since the last monitoring was carried out. Records must be kept of corrective actions.

Stage 9

4.10. Establish documentation and records (Principle 6)

The outcome of a HACCP study (principles 1 to 5) is a "HACCP plan" which defines hazards, cause, risk rating, control, monitoring and corrective actions. This can be used as a work instruction for people carrying out monitoring and corrective actions at CCPs and as a training document during the implementation stage of HACCP. As a minimum the HACCP system documents should include the process flow diagram, HACCP plan, additional work instructions for CCPs, records of monitoring and corrective actions and training records. These are all required as evidence of due diligence.

4.11. Implement the HACCP plan

Once all the critical limits, monitoring and corrective actions have been documented the plan needs to be implemented. This is achieved by training those responsible for monitoring and corrective actions in their tasks and providing a means to record results of monitoring and corrective action taken.

Stage 10

4.12 Establish verification procedures (Principle 7)

4.12.1. Verification

Once the HACCP plan has been implemented verification procedures must be established to verify that the controls introduced are effective in managing the risks identified. Evidence should be documented to demonstrate that control measures eliminate or reduce the hazard to an acceptable level. Examples of verification procedures are:

1) Extra product testing on selected parameters,
2) Review of consumer complaints,
3) Auditing to verify that monitoring and corrective action is being carried out and recorded as stated in the plan,
4) Auditing of the pre-requisite programmes to verify compliance.

4.12.2. Review

A review of the HACCP plan should take place whenever the process changes or new products are introduced. Also, a periodic review of HACCP should be undertaken to review the results of audits, results of due-diligence monitoring, any new food safety legislation, consumer complaints relating to food safety and changes to products and processes. Periodically the entire HACCP system should be verified by audit, using a checklist similar to the one given in Appendix 4. This will ensure that the system continues to operate in accordance with the principles of HACCP.

5. CONDUCTING A HACCP STUDY – WORKED EXAMPLE

A worked example showing correct application of principles 1 to 5 is shown in Appendix 5. Blank forms are provided at the end of this guide (5.6/5.7) that can be copied and completed by brewery HACCP teams when conducting and documenting the HACCP study and developing the HACCP plan.

Appendix 1

HACCP Pre-requisites

Appendix 1 HACCP PRE-REQUISITES

1.0. Legislation

It is not so much a HACCP pre-requisite but imperative that brewers produce beer in accordance with the law. Brewers must comply with all EU and National legislation and regulations.

Allergen Labelling requirements

Legislation in the EU requires foods (including alcoholic beverages) to be labelled if they contain recognised allergens. Added sulphur dioxide resulting in excess of 10mg/litre needs to be labelled on beer bottles. The cereal source also needs to be declared on the label. The Brewers of Europe have prepared guidance available in a separate document[2].

HACCP plans should extend to allergen labelling. This should include a control to prevent cross contamination e.g. a product containing a cereal not being declared on the label, which could result in a costly product recall. All reasonable precautions to avoid cross-contamination should be identified when brewing a variety of beers with several cereal sources.

HACCP requirements extended to animal feed production

The Feed Hygiene Regulation[3] came into force on 1st January 2006, which applies to feed businesses at all stages. This applies to malting and brewing companies, which supply co-products for animal feed. It requires feed businesses to implement written procedures based on HACCP principles, including the identification of hazards and critical control points, establishment of critical limits and where, necessary, corrective actions, as well as implementation of effective monitoring programmes and verification procedures.

Feed business operators must be registered with the relevant authority in their country and must notify that authority of any significant changes in their operations. Requirements and procedures for registration are set down in the regulation.

1.1. Food safety policy

Companies should have their own specific food safety policy that specifies the extent of the organisation's commitment to meet the safety needs of its products. All staff should be aware and of this.

1.2. Location

The site shall be so located, or sufficiently protected, in order to minimise the chances of contamination from surrounding industries, etc. Site boundaries shall be clearly defined and sufficiently protected to prevent either accidental or malicious contamination. The security of the site shall be maintained and

access to the site controlled. Procedures for site protection should be periodically reviewed.

1.3. Categorisation of risk areas

A risk assessment should be carried out in order to establish the extent of control required in each area of site to protect the product against contamination. High risk areas will require more stringent controls than low risk areas. A guide for identifying and categorising areas in terms of risk is given below,

Higher Risk Areas Category A	Open product, package, process or raw material under normal circumstances
	<u>Controls Required</u>
	Segregated or protected from the outside (enclosed). All areas for eating, drinking and smoking shall be separated via a physical barrier from all process areas.

Low Risk Areas Category B	Product, process, package or raw material that may become exposed occasionally.
	Controls Required
	Segregated or protected from the outside (enclosed) or vessel/plant that is sealed from the environment. ll areas for eating, drinking and smoking shall be separated via a physical barrier from all process areas.
No Risk Areas Category C	Non product or process area
	Controls Required
	Undefined area with no direct access from areas used for smoking. Eating and drinking at discretion of site.

1.4. Fabrication/Equipment

Buildings should be fit for their purpose, adequately maintained and cleaned. Equipment should be designed for purpose intended and easily cleaned. Planned maintenance programmes should be in place.

1.5. Supplier quality assurance

Most breweries do not have the resources to carry out comprehensive analysis of materials on receipt. It is important that breweries understand their supplier and that they purchase supplies from a reputable supplier against an agreed specification. Products shall be bought to an agreed specification that should cover all relevant food legislation. On receipt, deliveries should be checked that the correct grade has been delivered and the packaging is intact. Producers have a responsibility to prevent the occurrence of an incident. Part of a supply contract should be that suppliers have a HACCP system in place and audits are regularly carried out.

1.6. Housekeeping and hygiene

Procedures for cleaning both plant and building fabric, to a schedule defined by risk assessment, shall be in place. The effectiveness of cleaning and the removal of cleaning agents from plant and packaging materials shall be verified. The risks related to the cleaning materials used shall be documented and procedures be put into place to deal with accidental spillage which would result in contamination of product with these materials. A policy on housekeeping standards shall be set and communicated to all staff. Schedules shall be laid down for routine housekeeping.

1.7. Staff facilities and hygiene

Toilets and hand washing facilities should be available, but not open directly into production areas. Staff should be trained to wash their hands before entering production areas after eating, smoking, drinking and visiting the toilet.

1.8. Pest control

The risk of pest infestation on site and consequent, potential product contamination must be minimised. Any materials used in pest control shall be used in such a way as to prevent the materials themselves from presenting a risk of product contamination. Pest control shall either be subcontracted to a competent pest control company or conducted by suitably trained internal personnel. In either case the procedures used shall be documented and records of findings maintained.

1.9. Glass policy

Use of glass in production should be minimised and precautions should be taken to prevent product contamination.

1.10. Transport

All vehicles used for the transport of raw materials, rough and finished products shall be suitable for the purpose to which they are put, be capable of transporting the materials involved without deterioration and shall be maintained in good repair and hygienic condition.

Loading and unloading of the vehicles should be conducted in such a way as to prevent raw material or product contamination or deterioration.

1.11. Training

All staff, including temporary staff, shall be adequately trained to conduct a task before they begin to conduct it. Records of training shall be kept.

1.12. Quality management system

The implementation of an accredited QMS ensures the following processes are in place:

- document control,
- the retention of appropriate records of relevant testing,
- training,
- systems for establishing and maintaining instrument calibration,
- systems for auditing,
- traceability of product, both forwards to the customer or backwards to each of the raw materials, additives or processing aids used in its production,
- review activities,

- corrective action.

These systems support the effective implementation and maintenance of the HACCP system. The HACCP system can be part of a certified management system.

1.13. Product recall

Regulation (EC) No. 178/2002 states that managers should ensure effective procedures are in place to deal with any food safety hazard and to enable a targeted, rapid recall of any implicated lot of the finished food from the market. Where a product has been withdrawn because of an immediate health hazard, other products which are produced under similar conditions, and which may be present a similar hazard to public health, should be evaluated and may need to be withdrawn. The need for public warnings should be considered.

Recalled products should be held under supervision until they are destroyed, used for purposes other than human consumption, determined to be safe for human consumption, or reprocessed in a manner to ensure their safety.

The written recall procedure should include the following[2]:

1) legally, products must be identified with a production date or a code identifying each lot. Product coding should be used and explained in the written recall program to allow positive identification for an effective recall,

2) finished product distribution records should be maintained for a period of time which exceeds the shelf life of the product and is at least the length of time specified by regulations. Records should be designed and maintained to facilitate the location of product in the event of a recall,

3) records documenting all Health and Safety related complaints should be maintained and action taken must be filed.

4) responsible individuals should be part of the recall team. The roles and responsibilities of every member should be clearly defined,

5) step by step procedures in the event of a recall should be described including extent and depth of recall (i.e. consumer, retailer etc.),

6) the channels of communication should be clearly defined to notify the affected customers in a manner appropriate to the type of hazard defined,

7) control measures for the returned product.

1.14. Traceability

In accordance with Regulation (EC) No.178/2002/EC food business operators shall set up traceability systems and procedures for ingredients and foodstuffs. This requires traceability at all stages of the food chain, from "farm to glass". All food and feed businesses within the EU will be required to be able to identify the suppliers of food, feed, food-producing animals and ingredients to their businesses and the businesses to which products have been sold. In simple terms, companies will need to identify "one step forwards, one step back". Such information must be made available to enforcement authorities on demand.

Traceability is defined in EU food law as "the ability to trace and to follow a food, feed, food-producing animal or substance through all stages of production, processing and distribution".
How any traceability system is operated is a business decision. The law does not require a particular system to be in place. However, robust traceability systems within food businesses are considered to be good practice because they can assist in the management of business risk and bring business and consumer benefit.

How traceability is implemented in individual food businesses remains a decision likely to be justified on an individual basis and shall comply with national interpretations of Regulation 178/2002/EC.

Appendix 2

Potential Hazards and Suggested Control

Appendix 2 POTENTIAL HAZARDS AND TYPICAL CONTROL

Note that CCPs have not been identified. CIP is considered in a separate section to avoid repetition. Only the process stages that have an identified hazard are shown although all process stages have been considered.

Process Stage	Hazard and Source	Typical Control Measure
Raw materials, processing aids, additives and all food contact materials procurement	Agricultural residues such as pesticides and herbicides, heavy metals	Supplier QA Purchase to defined specification from approved supplier to current legislation and industry guidelines – Appendix 1 Potential contaminants from raw materials are detailed in Appendix 3
	Microbiological contamination from microbial growth	
	Chemical contamination introduced during process	
	Contamination with undeclared cereals which are allergenic	
Raw material storage	Chemical contamination from hazardous chemicals stored in close proximity	Pre-requisite programme. Segregation of raw material and hazardous chemical storage areas. Separate, locked chemical storage. Intake points for bulk storage of chemicals should be clearly labelled and should be capped and locked when not in use
	Chemical, physical micro contamination during storage	Covered storage, clean vessels stock rotation
	Contamination with other cereals which are allergenic	Segregation of raw material storage areas
Material intake	Oil from delivery vehicles	Raised covers at tipping bay with stops for vehicle. Covered intake area/pit Vehicle reverses into bay rather than drives over it

Water intake	Refer to Appendix 3 potential contaminants of brewing liquor	Water must comply with the Water Quality Directive. Supply source complies with water Regulations De-ionisation in high nitrate areas Carbon filtration if analysis show high levels of halogenated material pesticide etc
Malt conveying/All points of lubrication	Chemical contamination e.g. oil from conveyor motor oil	Covered conveyors Use of oil approved for incidental food contact Catch trays under conveyor motor gearboxes
Sieving/Dust removal/Destone	Foreign bodies in malt e.g. pests, stones, metal	Beer Filtration removes
Addition of salts to grist case	Addition of potentially hazardous material Over addition of material with a legal limit	All hazardous materials to be stored separately from brewing ingredients Controlled addition e.g. metered pump, calibrated scale
Liquor heating	Chemical contamination e.g. from boiler treatments (only if direct steam injection is used)	Use boiler treatment approved for use in the food industry
Wort mashing & separation	Damage to vessel may allow bacteria to grow in cracks and lead to ATNC production	Cleaning of mash vessel
Wort boiling	Chemical contamination from boiler treatment (only if direct steam injected)	Use boiler treatment approved for use in the food industry
Copper additions	Over addition/addition of hazardous material	All hazardous materials to be stored separately from brewing ingredients Controlled addition e.g. metered pump or calibrated scale
Trub separation	ATNC (Apparent Total Nitroso Compounds) formation due to microbiological growth	Store above 60°C and no longer than 72 hours

Wort cooling	Hazardous coolant leakage into product due to damaged plate heat exchanger e.g. glycol, methanol	Product pressure higher than coolant pressure during all operational conditions Use of duoplate or tertiary chiller Regular maintenance and pressure testing of plate heat exchanger
Addition of yeast nutrients	Over addition above safe limits of Zinc sulphate	Weighing on calibrated scale
Brewers' grains storage and transfer	Salmonella due to bacterial growth from contamination by pests/birds/foreign bodies	Cleaning of storage vessel Covered vessel Vessel emptied regularly Pest control measures
Fermentation	Over addition of antifoam above the legal limit Detergent from cleaning Chemical contamination – propylene glycol, coolant from coolant jacket due to damaged vessel wall	Measured metered addition A process in place that precludes cleaning whilst a tank is full Design of vessel & pressure testing of system and vessel wall
Post – fermentation hopping	Addition of potentially hazardous material	All hazardous material to be stored separately from brewing ingredients
Chilling	Chemical contaminant from secondary coolant due to damaged plate heat exchanger plate	Product pressure higher than coolant pressure during all operational conditions Use of duoplate or tertiary chiller Regular maintenance and pressure testing of plate heat exchanger
Filtration	Foreign bodies introduced from previous process steps	This process step

Tanker loading	Chemical from cleaning agents Chemical contamination from previous tanker load Physical contamination from flexible hoses	Final rinse post cleaning Dedicated road tanker and road tankers cleaned before use Hoses maintained in good repair and capped when not in use
CASK RACKING		
Empty cask receipt and storage	Foreign objects and/or substances in returned casks/new casks Risk of getting aluminium in the product due to ineffective resin lining.	All casks are washed internally Bung & keystone in place preventing entry to the cask during storage Casks purchased from approved suppliers and to a defined specification for internal lacquering
Internal cask washing	Foreign bodies or chemical agents from mis-use in trade	This process step
Products weighed labelled & transferred to warehouse.	Wrong or more than one label on cask indicating the wrong strength of alcohol	Set up and operation of labeller Label removal process stage
Product stored in warehouse until required.	Insects and other pests crawling over casks leaving traces of urine/faeces	Pest control programme in place
KEGGING		
Empty keg storage	Foreign body from spearhead	External surfaces of keg are washed prior to filling
Internal keg washing	Chemicals/micro from misuse of keg in trade	This process step. Tamper proof seals
Pasteurisation	Contamination of beer (with steam/liquor/IMS/glycol) due to leaks in pasteuriser plates	Beer pressure higher than coolant pressure under all conditions of operation. Liquor flush of pasteuriser at start up

Fob beer recovery.	Recovered beer contaminated (microbiological &/or chemical) by blowing contents of keg wash rejects into fob tank in error	Keg wash rejects will still be hot. Operators trained not to recover product from hot kegs
CIP		
Identify plant to be cleaned.	Contamination of product with CIP detergents through cleaning vessel containing wort or beer	Interlocks or other means of preventing a CIP cycle from being switched on to a tank containing wort or beer
Cleaning in place.	Product is contaminated with CIP detergent through inadequate rinsing	Final rinse cycle. Detergent strength controlled within set limits prior to use or with conductivity detectors
Manually cleaned plant	Product is contaminated with CIP detergent through inadequate rinsing	Clearly defined cleaning instructions including rinsing volume
BEER SUPPLY TO PACKAGING		
Connect pre-packaging buffer tank to transfer line	Foreign bodies in the detachable process plant	Detachable process plant stored off the floor. Use of soak baths Hoses stored capped In-line beer strainer prior to filler
Pump beer to filler inlet	Detergent contamination due to failed valves between the product main and an adjacent, active, CIP route	Double valves at product/CIP interfaces
Chill beer (after pre-package buffer tank - prior to filling)	From refrigerant due to leaking heat exchanger	Design of the chiller - product pressure always higher than coolant pressure, tertiary chiller or chiller with an air inertspace between the coolant and the product
Strain foreign bodies from the beer	Foreign bodies from previous process steps or open vessels	Pre filler beer strainer (size 1000µ maximum)
CANNING		
Receive cans	Foreign body ingress, e.g. insects, glass, jewellery from supplier or during depalletisation and conveying to rinses	Supplier transit packaging and protection Pest control (pre-requisite) Can rinser

Blow can internally with air	Foreign bodies in can Foreign bodies from the air supply Chemical contamination e.g. oil from the air supply	This process step, rinser Air filter
Rinse can with water and drain	Foreign bodies in can Foreign bodies from the rinse water	This process step Filter in rinse water line
Conveyors post-rinser	Foreign body ingress, e.g. glass, insects	Covers over conveyor system
Convey can to filler	Foreign body ingress into empty cans	Filler cover in place Any lights in vicinity to be of toughened glass
Purge can with CO2	Product contamination due to foreign bodies in gas supply	In-line gas filters
Fill can with beer	Can filling tube falls into can Foreign bodies from the gas supply used to fob up the beer surface	Tightness and security of filler tubes Gas filter < 0.2 μ pore size
'Full can' transfer to seamer	Foreign body ingress	Cover in place between filler and seamer
'End' feed and seaming	Foreign body ingress Grease on 'ends' or from the seamer	Cover on feed-line Use of grease approved for incidental food contact
BOTTLING – NON RETURNABLE BOTTLES		
Receive bottles	Physical contamination due to foreign body ingress, e.g. insects, glass, jewellery or critical defects e.g. fractures, chipped neck	On line inspection or proof of inspection from manufacturer Supplier's transit packaging and make good part pallets in use Pest control in warehouse Bottle rinser and EBI Supplier specification

De-palletise bottles	Foreign body ingress e.g. insects, glass	Cover/canopy over depalletiser area Depalletiser designed for gentle handling EBI and bottle rinser
Convey bottles to rinser	Internal glass chips due to bottle collisions	Design standards and maintenance of conveyor to ensure gentle conveyance Conveyor lubrication Bottle rinser and EBI
Rinse bottles	Foreign bodies in empty bottles	This process step
Inspect empty bottles (EBI)	Foreign bodies from damaged bottles e.g. chipped necks or glass	This process step
Convey bottles to filler	Foreign body ingress e.g. glass, insects	Covers over conveyor system
RETURNABLE BOTTLES		
Store returnable bottles	Foreign body ingress e.g. insects, glass	Pest control policy Bottle washing
Decrate bottles	Foreign body ingress Glass chips due to decrator malfunction	Cover/canopy over decrate area Bottle washer
Sort bottles	Physical contamination from shards of broken glass due to non removal of chipped or broken bottles due to poor sorting	Bottle washer and EBI
Wash bottles	Detergent retention post wash due to poor rinsing Foreign bodies in bottles Residual detergent left in bottle due to blocked bottle neck (by crown still in place, foreign body etc)	Bottle washer final rinse Empty bottle inspector
Inspect washed bottles (EBI)	Glass damage, inclusions and liquid residues in washed bottles	This process step

Convey to filler	Foreign body ingress e.g. glass, insects	Covers over conveyor system
Clean filler	Detergent contamination due to residual detergent after CIP	Final rinse, scavange pump. Start up/change over procedures (ullage, 1st round reject)
Purge bottle with CO2	Physical contamination from foreign bodies or contamination with oil from process gases (top pressure gases)	In line filter on gas line 0.2 µ pore size
Fill bottle with beer	Glass ingress into empty bottles due to glass bottle breakage during filling operation Bottle filling tube falls into bottle	Filler flush and neighbouring bottle reject system operational Physical cover on conveyor between filler/crowner and partition between filler/crowner Maintenance of filler tube tightness
Convey bottle to crowner	Foreign bodies, particularly glass fragments due to accumulation on ledges under conveyor covers or adhering to internal surfaces of covers	Design for accessibility and visibility of interior of cover. Regular cleaning to avoid build up of debris
Create fob on beer surface	Foreign bodies from gas supply	Filters on gas lines
Store crowns	Foreign body ingress due to boxes left open	Part boxes closed and returned to store
Feed crowns	Foreign body ingress into the crown hopper	Crown hopper covered
Add crown to bottle	Glass particles in product due to too tight a crown	Crowner crimp tightness within specification
Decant underfills	Glass particles due to glass bin located too close to filler/crowner, empty bottle conveyors and lack of care in handling causing fragments of flying glass	Glass bins covered at all times

Appendix 3

Examples of Potential Contaminants

Appendix 3

POTENTIAL CONTAMINANTS IN THE EUROPEAN BREWING INDUSTRY

Please note this Appendix outlines possible contaminants it is unlikely that these will be found but it is important that they are considered to ensure procedures are in place to avoid them. This Appendix is to assist the brewer establish an impact rating. It should be noted that this is not an exhaustive list. In the future, as analytical capabilities improve further potential contaminants may be discovered. It is for the HACCP team to ensure all potential contaminants have been considered. Beer is an inherently safe product.

Potential contaminants

Biological contamination	Micro-organisms present, or toxins produced from moulds and bacteria. Human contact with the process can cause bacterial contamination[1].
Chemical contamination	Chemicals introduced deliberately or by accident: cleaning chemicals, pesticides, or actually produced by the brewing process e.g. ethyl carbamate
Physical contamination	Physical objects present in raw materials (e.g. stones, glass and metal), or picked up from the brewing or packaging plant, or accidentally dropped in by process operator/contractors (e.g. pens/tools).

Potential Contaminants	*Impact*	*Source*	Recommended Limits/ Legal Limits if any
Cryptosporidium	*5*	Water	No numerical limits. Recommendation is a treatment not a limit e.g. to boil water if there is an outbreak
Coliforms	*5*	Water, Malt, adjunct, kegs, filter aids	Should be undetectable in 100ml water

[1] Whilst most common food pathogens will not grow in beer, as a precautionary measure pathogens have been included in this list, to be considered in a risk assessment approach for low alcohol beers, should correct procedures (i.e. pasteurisation) fail.

Toxigenic Moulds	5	Formed in materials when wet	No visible mould. This indication should be included in sampling protocol. Direct relationship between mould and toxin is unclear. Limits would depend on mould.
Mycotoxins (excl. aflatoxins)	3	Results from mould infection of cereals, spices and additives e.g. asperigillus, penicillium, fusarium	EU regulation prescribes maximum limits for some mycotoxins in raw materials
Aflatoxins	3	Largely confined to tropical crops, maize, where climate favours mould growth	4μg/kg in cereals and no more than 2μg/kg of aflatoxin B_1
Polycyclic aromatic hydrocarbons	3	Formed mainly as a result of pyrolytic processes, especially during the incomplete combustion of organic material	EU limit of 0.1μg/l for total PAHs and 0.01μg/l for benzo(α)pyrene in water
Nitrosamine	*3*	Potential sources are water treated with ion exchange resins and malts	Recommended limits for NDMA set at 5μg/kg for malt and < 0.5μg/litre for beer
Heavy metals	*3*	Taken up from minerals in the soil from water and from some raw materials	EU regulations set maximum limits for specific heavy metals in water, cereals, additives and processing aids.
Pesticides/ Agrochemicals	3	Water and raw materials	EU Limits of 0.5μg/l for total pesticides in water. 0.1μg/l for individuals. EU regulations set limits for cereals and hops.
Trihalomethanes	3	Reaction between water chlorination by products and organic compounds.	Limits in water 100μg/l
Chlorinated solvents	3	Degreasing solvents output from dry cleaning and motor trade can be found in water	EU limit of 10μg/l for Trichloroetheneand Tetrachloroethene in water

Coolants	3(at high conc.)	Used as a coolant. Propylene glycol is an accepted food additive. It is not approved for addition to beer.	EU 1g/kg is the limit in food
Chloropropanols	3	A Dark malts and dark malt extracts contain detectable quantities of 3-MCPD. It is formed by reaction between endogenous chloride ions and lipids in foodstuffs. Also reported in some food contact materials such as filter sheets.	Should be reduced as far as technically possible. One method of control is via proportion of dark malts and malt extract in the grist. Processing stages should not impart additional 3-MCPD
Benzene	3	Environmental contaminant, carbon dioxide is a potential source.	EU 1μg/l benzene in water
Cleaning Agents	5 (at high conc.)	Cleaning fluids	Requirements for drinking water EEC Requirements pH 6.6-8.5 WHO standards pH 6.5-9.2 Check COSHH details supplied by manufacturer. Legal required product information, instructions for use.
Acrylamide	3	Reaction at high temperatures between amines and sugars in cereals	EFSA states that levels in foods should be as low as reasonably achievable
Furan	3	Formed when carbohydrates are heated during malt kilning but significant losses during brewing	Advisable to keep levels in beer as low as reasonably achievable
Lubricants	1	Pumps	No legal limits. Should be food grade
Foreign bodies	5	Glass	USA's FDA Health Hazard Evaluation Board for glass inclusions in food states a no hazard rating <5mm

Foreign bodies	3	Metals, rubber, plastics, wood etc	USA's FDA Health Hazard Evaluation Board for metal/plastics inclusions in food states a no hazard rating <5mm for metal and <4.2mm for plastic[4]

Appendix 4

Checklist

Appendix 4 CHECKLIST

HACCP Principle	Checklist
Preparation	What evidence is there of management commitment to HACCP use? *HACCP Team* - Who was on the team? - Are all appropriate disciplines represented? - What is the likely knowledge level of the individuals? (Evidence of training, qualifications, experience etc.) - Has external expertise been sought where necessary? - What is the decision making leverage of the HACCP team leader? *HACCP System* - How does the system fit with the overall food safety control programme? - Does the company have a food safety policy? - Has the scope been clearly defined? - How is the system structured?

Principle 1 *"Conduct a hazard analysis "*	Has the product been properly described? - Are intrinsic control measures identified? Is the process flow diagram (PFD) comprehensive? - How was the PFD verified for accuracy and by whom? - Are all raw materials and process/storage activities included in the flow diagram? (Rework can be included as an ingredient.) - Have all activities been included? - Is the PFD correct? - Have changes been made since the PFD was drawn up? - How does the HACCP Team get notified of changes to the process or product parameters? - How were the changes recorded and approved? - Were any changes discussed with HACCP Team before implementation? - Are there rework opportunities and have they been included? How was the hazard analysis conducted? - Were only significant hazards identified? - Have all raw materials (including rework) been included? - Have all process steps been considered? - Have the hazards been specifically identified by type/source or have they been generalized? - How did the team assess the likelihood of occurrence? - What information sources were utilized? Have appropriate control measures (CMs) been identified for each hazard? - Will the CMs control the hazards and how was this validated? - Are all the CMs in place at the plant level?

Principle 2 *"Determine the Critical Control Points (CCPs)"*	How were the CCPs identified? - By expert judgement? - By the use of a decision tree? (has the decision tree been used correctly?) - By the use of consultants? - Have all necessary CCPs been identified? Did each identified hazard undergo a systematic consideration? How are the hazards which are not controlled by CCPs addressed?
Principle 3 *"Establish critical limits"*	How were the critical limits established? - Is there evidence (experimental data, literature references etc.)? - What validation exists to confirm that the critical limits control the identified hazards? - Have critical limits been established for each CCP? How do they differ from operational limits?
Principle 4 *"Establish a system to monitor the control of the CCP"*	Have realistic monitoring schedules been established? - Do they cover all CCPs? - Has the reliability of monitoring procedures been assessed where appropriate? - What is the status of monitoring equipment? - Is it evidenced as being in place and calibrated appropriately? - Are the CCP log sheets being used at all CCPs? - Have CCP log sheets been filled out correctly? - Is there any evidence that procedures are not being followed consistently? - Does the frequency of monitoring adequately confirm control? - Are the sampling plans statistically valid? - Are statistical process control records being used to demonstrate that the process is in control on a day-to-day basis? - Check that records agree with stated activities.

	Are monitoring personnel and their deputies properly identified and trained? - How was the training undertaken? - Are the monitoring records being reviewed by designated appropriate reviewers?
Principle 5 *"Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control"*	Have the corrective actions been properly defined such that control is regained? - What evidence is there to demonstrate that this is being done in the event of a CCP deviation? - Has corrective action been recorded and how is the effectiveness being verified? How has the authority for corrective action been assigned? How is non-conforming product controlled and is this clearly recorded? Are there clear disposition actions listed?
Principle 6 *"Establish documentation concerning all procedures and records appropriate to these Principles and their application"*	What format is being used to document the system? - Does the documentation cover all of the HACCP system operation? - How is the documentation controlled with regard to update and issue etc.? - Are the records accessible? - Are the HACCP records clearly identified by unique reference numbers? - Are all documents accurate and current? - Are verification procedures documented? - How is change control managed?
Principle 7 *"Establish procedures for verification to confirm that the HACCP system is working effectively"*	Have verification procedures been clearly and appropriately established? - How are these procedures communicated through the business? - Have responsibilities for verification procedures been allocated? - Are they being carried out effectively? - Are all CCPs covered by the verification programme? - Is the information on the HACCP Control Chart up to date?

	- Is there a formal system to trigger amendments? - Are control parameters being achieved? Have process capability studies been carried out? How is the data from HACCP being used to improve the system? How is consumer complaint data being used within the verification system? Is there a regular review of CCP failure and product dispositions? Are prerequisite support systems included within the verification programme?

Appendix 5

Worked Example

Appendix 5 WORKED EXAMPLE Bottling process

It is important to note that this is a worked example and the results and control measures will be different in all breweries. HACCP Teams will have to look at procedures and processes in each plant.

5.1 PRINCIPLE 1 - Conduct a hazard analysis, prepare a flow diagram. Identify the hazards and specify the control measures.

Using the flow diagram to help them the HACCP team walk the process, identifying hazards and their source and at the same time considering what controls are in place or are needed to prevent the hazard or reduce it to an acceptable level (a flow diagram is illustrated at the end of this example). The HACCP team complete columns 1, 2, 3 and 5 of the checklist. If no controls are in pace for a hazard they will make a recommendation to management for a control to be implemented.

No	Process Step	Hazard and potential causes	Risk Ranking Impact x Likelihood	Control Measures	Q1	Q1A	Q2	Q3	Q4	Y/ N
1	Connect BBT to transfer line	**Physical** Foreign bodies from flexible hoses or process pipe work		Flexible hose management- hoses stored off the floor and capped when not in use The strainer in the beer line pre-filler with remove foreign bodies						
2	Clean transfer line	**Chemical** From residual CIP liquor due to inefficient final rinse, failure in the CIP cycle or inadequate scavenge pump		Automatic detergent dosing, followed by final rinse and scavange pump						
3	Purge transfer line with water	**Chemical** From residual CIP liquor due to inefficient final rinse, failure in the CIP cycle or inadequate scavenge pump		This process step						

4	Pump beer to filler inlet	**Chemical** Chemical contamination from detergent due to failed valves at CIP and product main interfaces from CIP of neighbouring BBT		Double valves on product/CIP main interfaces						
		Chemical Chemical contamination from detergent due to incorrect routing of the CIP of an adjacent process by operator whilst beer is transferring to packaging		Interlocks on CIP sets						
5	Chill beer	**Chemical** Chemical contamination from secondary refrigerant due to leaking heat exchanger		Product pressure higher than coolant pressure during beer transfer						
6	Strain foreign bodies from beer	**Physical** Physical contamination e.g. glass, metal, plastic (impeller bits, valve/pump seals, sight glasses) present in the beer		Trap filter/sieve pore size no greater than 2000μ						

Using the risk analysis provided the team can allocate a risk ranking to each of the hazards identified, documenting the result in column 4 e.g. for process step 1 the foreign body could be glass, which, if swallowed could cause a severe physical injury and therefore has an impact of 5, according to the Risk Ranking Table (previously described). It is present only intermittently and it would only affect one part of a batch of product and therefore scores only 1 for likelihood. This makes a ranking score of 5 x 1 = 5, which means it must be considered as a hazard in HACCP. The team complete the risk column for the remaining hazards in a similar manner, before proceeding to Principle 2.

No	Process Step	Hazard and potential causes	Risk Ranking (Impact x Likelihood	Control Measures	Q1	Q1 A	Q2	Q3	Q4	Y/ N
1	Connect BBT to transfer line	**Physical** Foreign bodies from flexible hoses or process pipe work	5 x 1	Flexible hose management- hoses stored off the floor and capped when not in use The strainer in the beer line pre-filler with remove foreign bodies						
2	Clean transfer line	**Chemical** From residual CIP liquor due to inefficient final rinse, failure in the CIP cycle or inadequate scavenge pump	5 x 3	Automatic detergent dosing, followed by final rinse and scavange pump						
3	Purge transfer line with water	**Chemical** From residual CIP liquor due to inefficient final rinse, failure in the CIP cycle or inadequate scavenge pump	5 x 3	This process step						
4	Pump beer to filler inlet	**Chemical** Chemical contamination from detergent due to failed valves at CIP and product main interfaces from CIP of neighbouring BBT	5 x 3	Double valves on product/CIP main interfaces						
		Chemical Chemical contamination from detergent due to incorrect routing of the CIP of an adjacent process by operator whilst beer is transferring to packaging	5 x 3	Interlocks on CIP sets						

5	Chill beer	**Chemical** Chemical contamination from secondary refrigerant due to leaking heat exchanger	3 x 5	Product pressure higher than coolant pressure during beer transfer						
6	Strain foreign bodies from beer	**Physical** Physical contamination e.g. glass, metal, plastic (impeller bits, valve/pump seals, sight glasses) present in the beer	5 x 1	Trap filter/sieve pore size no greater than 2000μ						

5.2 PRINCIPLE 2 - Identify the CCPs in the process using a decision tree.

By application of the decision tree the HACCP team determine which of the process steps is a critical control point.

Example 1: Process step 1:

Q1 Are control measures in place at this process step?
The team have established that there is a documented procedure for hose management and that there is compliance to it so they answer Yes to Q1.

Q2 Does the process stage eliminate or reduce the hazard to an acceptable level?
The activity of connecting the BBT to the transfer line introduces the foreign body hazard - it certainly does not eliminate or reduce the hazard to an acceptable level so the HACCP team answer No to Q2.

Q3 Could contamination with the hazard occur at unacceptable levels?
The risk ranking of 5 has established that the hazard could occur at an unacceptable level so answer Yes to Q 3

Q4 Will a subsequent process stage eliminate or reduce the hazard to an acceptable level?
Yes, there is an in-line strainer prior to the filler, so the answer is yes to question 4.

From the decision tree diagram we can therefore determine that the process step of connecting the transfer line to the BBT is NOT a CCP.

No	Process Step	Hazard and potential causes	Risk Ranking Impact x Likelihood	Control Measures	Q1	Q1A	Q2	Q3	Q4	Y/ N
1	Connect BBT to transfer line	**Physical** Foreign bodies from flexible hoses or process pipe work	5 x 1	Flexible hose management- hoses stored off the floor and capped when not in use The strainer in the beer line pre-filler with remove foreign bodies	Y		N	Y	Y	N

Example 2 - Process Step 2

Q1 Are control measures in place at this process step?
The team have established that the CIP is automatically controlled by a plc and that in correct operation the final rinse is adequate to remove all traces of detergent so they answer Yes to Q1.

Q2 Does the process stage eliminate or reduce the hazard to an acceptable level? The activity of cleaning the transfer line introduces the hazard of detergent contamination so the HACCP team answer No to Q2.

Q3 Could contamination with the hazard occur at unacceptable levels?
The risk ranking of 6 has established that the hazard could occur at an unacceptable level so answer Yes to Q 3

Q4 Will a subsequent process stage eliminate or reduce the hazard to an acceptable level?
Yes, after cleaning the lines are filled with water to reduce oxygen pick up, the water is then flushed to drain. This activity, although not specifically designed to remove detergent, will do so, so the answer is yes to question 4.

From the decision tree diagram we can therefore determine that the process step of cleaning the transfer line is NOT a CCP.

No	Process Step	Hazard and potential causes	Risk Ranking Impact x Likelihood	Control Measures	Q1	Q1A	Q2	Q3	Q4	Y/N
2	Clean transfer line	**Chemical** From residual CIP liquor due to inefficient final rinse, failure in the CIP cycle or inadequate scavenge pump	5 x 3	Automatic detergent dosing, followed by final rinse and scavange pump	Y		N	Y	Y	No

Example 3 - Process Step 3

Q1 Are control measures in place at this process step?
The team have established that this process step, the liquor flush will remove any residual detergent left behind after a failed CIP at process step 2 so they answer Yes to Q1.

Q2 Does the process stage eliminate or reduce the hazard to an acceptable level?
The liquor flush removes the hazard of detergent contamination so the HACCP team answer Yes to Q2.

From the decision tree diagram we can therefore determine that the process step of liquor flush of the transfer line is a CCP.

No	Process Step	Hazard and potential causes	Risk Ranking Impact x Likelihood	Control Measures	Q1	Q1A	Q2	Q3	Q4	Y/N
3	Purge transfer line with water	**Chemical** From residual CIP liquor due to inefficient final rinse, failure in the CIP cycle or inadequate scavenge pump	5 x 3	This process step	Y		Y			Yes

The HACCP team use the decision tree to determine whether the remaining process steps are CCPs in the same way and complete the table as follows:

No	Process Step	Hazard and potential causes	Risk Ranking Impact x Likelihood	Control Measures	Q1	Q1A	Q2	Q3	Q4	Y/N
4	Pump beer to filler inlet	**Chemical** Chemical contamination from detergent due to failed valves at CIP and product main interfaces during CIP of neighbouring BBT	5 x 3	Double valves on product/CIP main interfaces	Y		N	Y	N	Yes
		Chemical Chemical contamination from detergent due to incorrect routing of the CIP of an adjacent process by operator whilst beer is transferring to packaging	5 x 3	Interlocks on CIP sets	Y		N	Y	N	Yes
5	Chill beer	**Chemical** Chemical contamination from secondary refrigerant due to leaking heat exchanger	3 -x 5	Product pressure higher than coolant pressure during beer transfer	Y		N	Y	N	Yes
6	Strain foreign bodies from beer	**Physical** Physical contamination e.g. glass, metal, plastic (impeller bits, valve/pump seals, sight glasses) present in the beer	5 x 1	Trap filter/sieve pore size no greater than 2000µ	Y		Y			Yes

5.3 PRINCIPLE 3 - Establish target level and critical limits which will determine that the CCP is under control

5.4 PRINCIPLE 4 - Establish monitoring to ensure control of the CCP

5.5 PRINCIPLE 5 - Establish corrective action to be taken when monitoring indicates that the CCP is out of control

The Process step, hazard and cause and the control measure are transferred onto the "HACCP plan" form. The process steps that are NOT CCPs are not transferred into the HACCP plan.
The HACCP team then consider what limits should apply to the control and how they can monitor that the control stays within these limits.

Example 1: process step 3
The team decides that the best way to check that the purge water has removed all residual detergent is to check its pH at the drain point. They set a limit of 6.0 to 8.0 for the pH of the purge water.
Corrective action should state what to do to put the process back in control and what to do with any product produced since the last monitoring check. Since the check is done after every CIP before any product passes down the line it is not necessary, in this example to state corrective action for the product. Monitoring and corrective action must always state who is responsible for carrying it out.

No	Process step	Hazard and cause	Control measure	Critical limits	Monitoring	Corrective action
3	Purge transfer line with water	**Chemical** From residual CIP liquor due to inefficient final rinse, failure in the CIP cycle or inadequate scavenge pump	This process step	Purge water pH 6.0 - 8.0	pH analysis of purge water at drain point Frequency: Every CIP Responsibility:	Re-purge the line with water. Responsibility: Examine the operation of the CIP set and repair/adjust as appropriate. Responsibility:

Example 2 - Process step 4

The team decides that in order to confirm the integrity of the valves they must be inspected regularly, but that it is only practical to do this every 6 months. This is not frequent enough for HACCP monitoring, because there is potentially 6 months of unsafe product on the market! They therefore decide that an in-package pH check is required and decide to do an hourly check, in order to detect leaks from CIP that could occur at any time during the transfer.

This monitoring, critical limit and corrective action is also appropriate for the second cause of the detergent contamination hazard at this process step.

No	Process step	Hazard and cause	Control measure	Critical limits	Monitoring	Corrective action
4	Pump beer to filler inlet	**Chemical** Chemical contamination from detergent due to failed valves at CIP and product main interfaces during CIP of neighbouring BBT	Double valves at product/CIP interfaces	Valves not leaking Beer pH +/- 0.5	Inspection of valve seals for leaks Frequency 6 monthly Responsibility: PH check of beer in final package Frequency: Hourly Responsibility:	Replace valve seal Isolate product produced since last pH check and check pH. Responsibility: Investigate valves for damaged seal.
		Chemical Detergent due to incorrect routing of the CIP of an adjacent process by operator whilst beer is transferring to packaging	CIP interlocks No manual routing	Beer pH +/- 0.5	PH check of beer in final package Frequency: Hourly Responsibility:	Isolate product produced since last pH check and check pH. Responsibility: Investigate valves for damaged seal.

Example 3 Process step 5
The monitoring here applies to the control of keeping the product pressure higher than the coolant pressure. A differential pressure needs to be defined as the critical limit.

No	Process step	Hazard and cause	Control measure	Critical limits	Monitoring	Corrective action
5	Chill beer during transfer from BBT to filler bowl	**Chemical** Chemical contamination from secondary refrigerant due to leaking heat exchanger	Product pressure higher than coolant pressure during beer transfer.	Pressure differential = x bar	Check coolant inlet pressure and product outlet pressure Frequency: once per hour Responsibility:	Stop beer forward flow. Examine heat exchanger and repair Responsibility: Isolate product produced since last check and analyse for presence of secondary coolant. Responsibility:

Example 6 - Process step 6

The monitoring in this example and the critical limit apply directly to the control - note that the critical limit is NOT stated as "no foreign bodies in product" because this cannot be easily measured.

No	Process step	Hazard and cause	Control measure	Critical limits	Monitoring	Corrective action
6	Trap filter for beer line prior to filler	**Physical** Physical contamination e.g. glass, metal, plastic (impeller bits, valve/pump seals, sight glasses) in the beer supply	Trap filter/sieve pore size no greater than 2000μ	No holes in the filter/sieve	Inspect & clean pre-filler trap filter on Frequency: Daily Responsibility:	Replace trap filter Responsibility: Isolate product produced since the last check - inspect for foreign bodies. Responsibility:

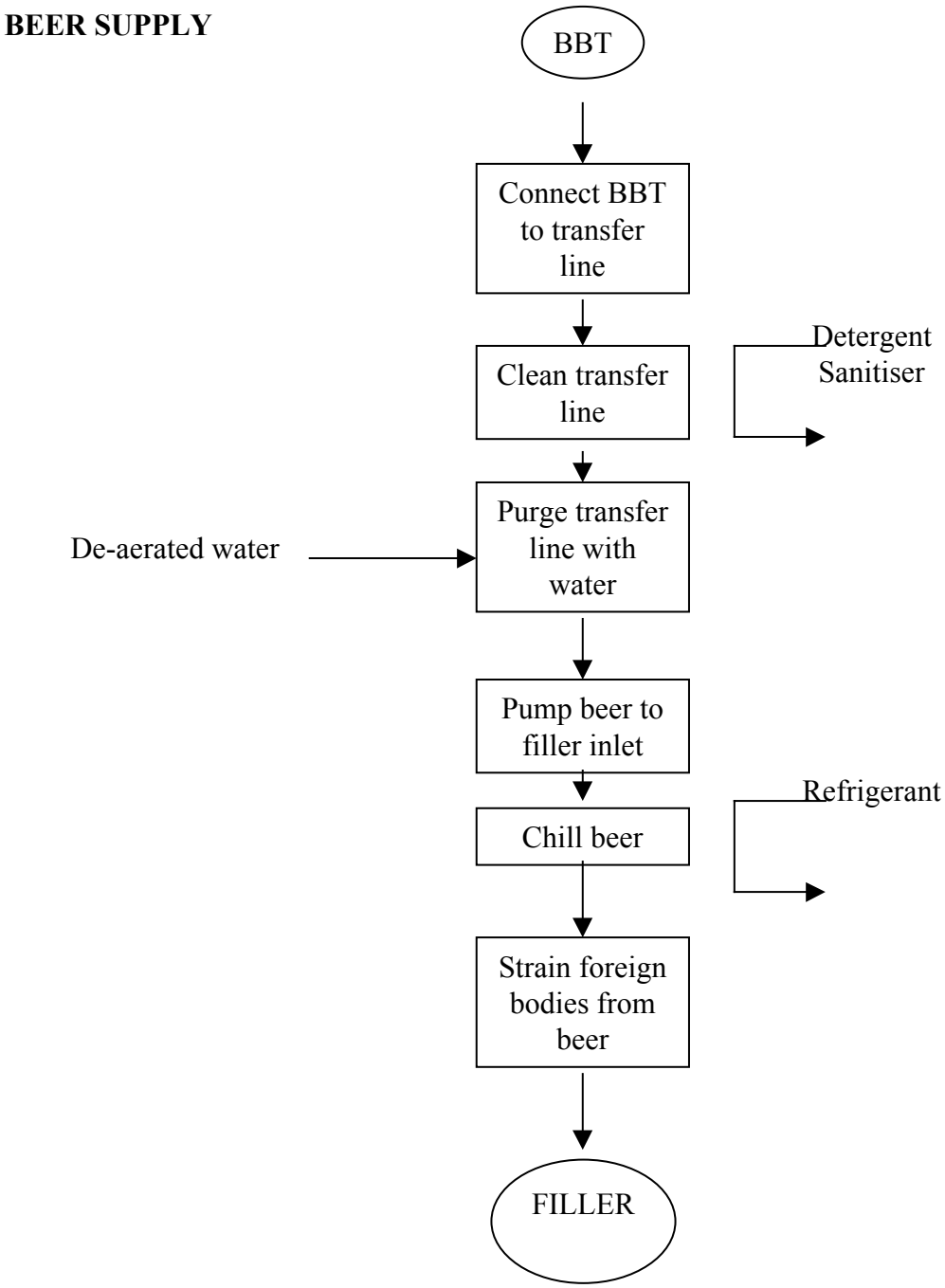
5.6. HACCP study form

Process stage	Hazard and potential causes	Risk Ranking Impact x likelihood	Control Measures	CCP

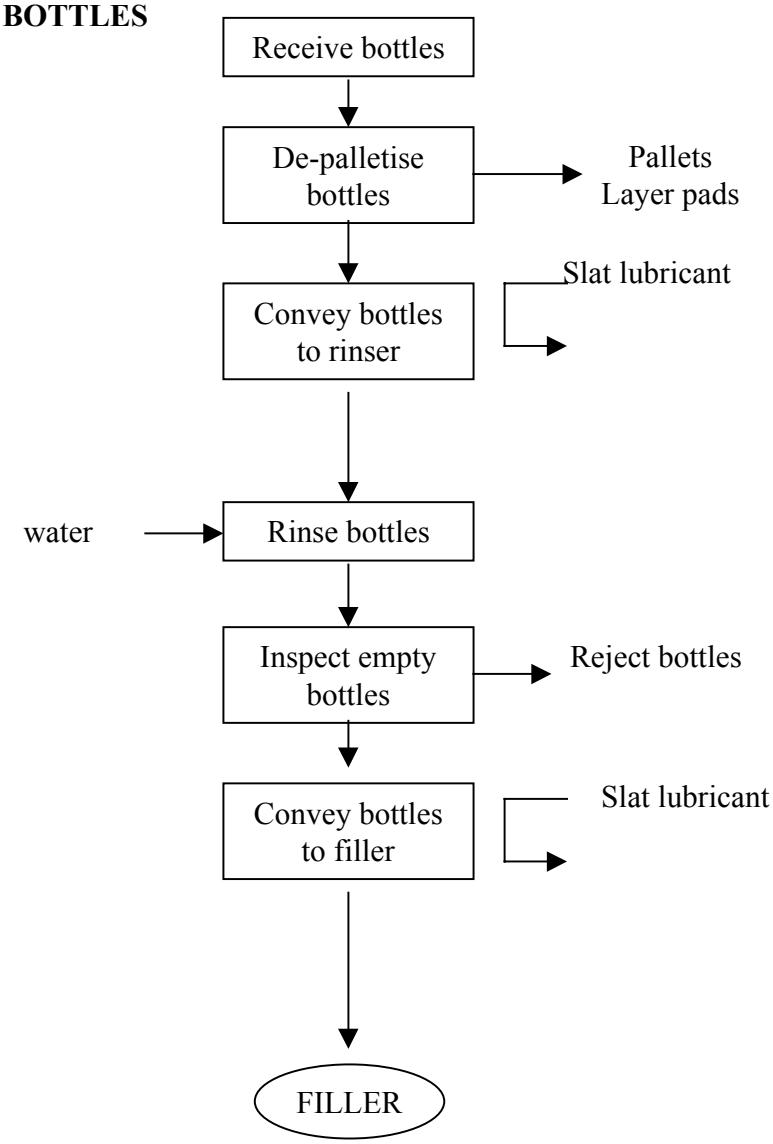
5.7. HACCP plan

Process stage	Hazard and potential causes	Critical limits	Monitoring	Corrective action	Verification procedures

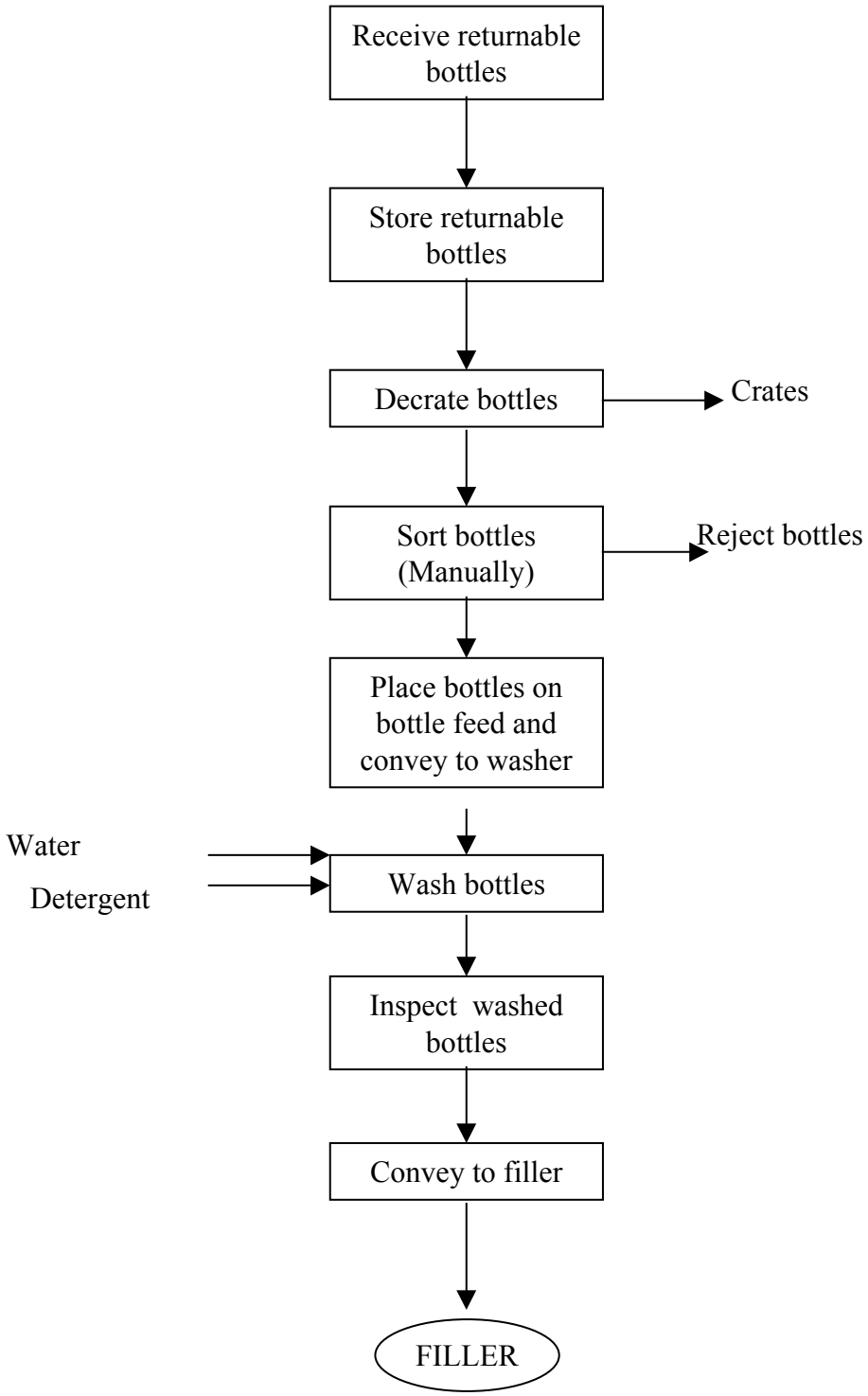
5.8. Flow diagram



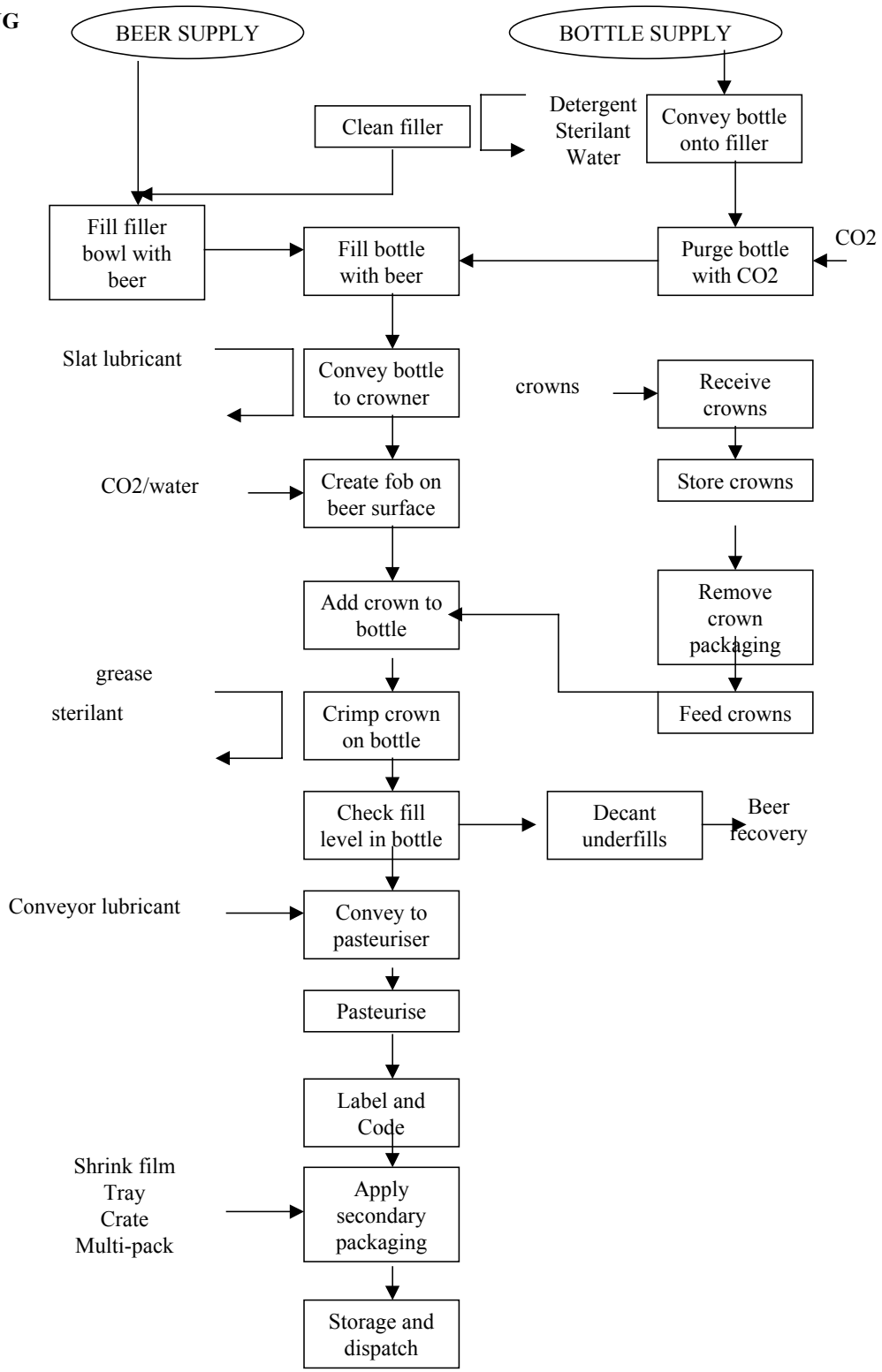
NON RETURNABLE BOTTLES



RETURNABLE BOTTLES



FILLING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BOTTLE SUPPLY
Clean filler
Detergent
Sterilant
Water
Convey bottle onto filler
Fill filler bowl with beer
Fill bottle with beer
Purge bottle with CO2
CO2
Slat lubricant
Convey bottle to crowner
crowns
Receive crowns
CO2/water
Create fob on beer surface
Store crowns
Add crown to bottle
Remove crown packaging
grease
sterilant
Crimp crown on bottle
Feed crowns
Check fill level in bottle
Decant underfills
Beer recovery
Conveyor lubricant
Convey to pasteuriser
Pasteurise
Label and Code
Shrink film
Tray
Crate
Multi-pack
Apply secondary packaging
Storage and dispatch

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USEFUL WEBSITE ADDRESSES

www.codexalimentarius.net	Codex Alimentarius Website
http://cpf.jrc.it/webpack/	Food Contact Materials and Articles Website
http://www.brc.org.uk	BRC Global Standard
http://www.bsi-global.com/Training/Food/index.xalter	ISO 22000:2005 - Food Safety Management System Standard

Commission Guidelines

The European Commission, Health & Consumer Protection Directorate-General published guidance on 16th November 2005 entitled “Guidance document on the implementation of procedures based on the HACCP principles and on the facilitation of the implementation of the HACCP principles in certain food businesses”. This guidance can be accessed from the following link:

http://europa.eu.int/comm/food/food/biosafety/hygienelegislation/guidance_doc_haccp_en.pdf

REFERENCES

1 Council Directive 93/43/EEC, (1993), The Hygiene of Foodstuffs, Official Journal of the European Communities.

2 The Brewers of Europe Guide to Allergen labelling published July 2004, updated February 2005, April 2005, (No.1005LAB)

3 Regulation No 183/2005 12 Jan. 2005 laying down requirements for feed hygiene: Off. J. of the Eur. Union, L 35, Vol. 48, p 1: 8 Feb. 2005

4 Olsen, A.R., of the US Food and Drug Administration Microanalytical Branch, in Regulatory Toxicology and Pharmacology 1998, 28,181-189).

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