
**Handling, processing and distribution of
fish — Code of practice —**

Part 2:

Processing of canned fish

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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 46-2 was prepared by Technical Committee RSB/TC 36 on *Fish and fish products*.

In the preparation of this standard, reference was made to the following standard:

CAC/RCP 52-2003, *Code of Practice for Fish and Fishery Products*

The assistance derived from the above source is hereby acknowledged with thanks.

This third edition cancels and replaces the second edition (RS 46: 2014) of which has been technically revised.

DRS 46 consists of the following parts, under the general title *Introductory element — Main element*:

- *Part 1: Aquaculture production*
- *Part 2: Processing of canned fish*
- *Part 3: Retail*

Committee membership

The following organizations were represented on the Technical Committee on *Fish and fish products* (RSB/TC 36) in the preparation of this standard.

Association pour la défense des droits des consommateurs au Rwanda (ADECOR)

Cooperative des Produits Agricoles et vivriers (COOPAVI)

Kibuye Fishing Project

Ministry of Agriculture and Animal Resources (MINAGRI)

National Industrial Research and Development Agency (NIRDA)

Rwanda Agriculture and Animal Resources Development Board (RAB)

Rwanda Agriculture and Livestock Inspection and Certification Services (RALIS)

Rwanda Fisheries Sector

Simba Supermarket

University of Rwanda-College of Agriculture, Animal Science and Veterinary Medicine (UR - CAVM)

Rwanda Standards Board (RSB) – Secretariat

Handling, processing and distribution of fish — Code of practice — Part 2: Processing of canned fish

1 Scope

This Draft Rwanda Standard provides guidelines and recommendations for processing of canned fish intended for human consumption.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

RS 184, *Food safety system based on Hazard Analysis and Critical Control Points (HACCP) — Requirements for any organization in the food chain*

RS CAC/RCP 54, *Code of Practice on good animal feeding*

CAC/RCP 23, *Code of Hygienic Practice for low and acidified low acid canned foods*

CAC/RCP 68, *Code of practice for the reduction of contamination of food with polycyclic aromatic hydrocarbons (PAH) from smoking and direct drying processes*

CODEX STAN 166, *Standard for quick frozen fish sticks (fish fingers), fish portions and fish Fillets — Breaded or in Batter*

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

3.1

biotoxins

poisonous substances naturally present in fish and fishery products or accumulated by the animals feeding on toxin-producing algae or in water containing toxins produced by such organisms

3.2

chilling

process of cooling fish and shellfish to a temperature approaching that of melting ice

3.3

clean water

water from any source where harmful microbiological contamination, substances and/or toxic plankton are not present in such quantities that may affect the safety of fish, shellfish and their products intended for human consumption

3.4

Cleaning

removal of soil, food residues, dirt, grease or other objectionable matter

3.5

contaminant

any biological or chemical agent, foreign matter or other substances not intentionally added to food that may compromise food safety or suitability

3.6

contamination

introduction or occurrence of a contaminant in fish, shellfish and their products CAC/RCP 52-2003

3.7

control measure

any action and activity that can be used to prevent or eliminate a food safety hazard or reduce it to an acceptable level. For the purposes of this standard, a control measure is also applied to a defect

3.8

corrective action

any action to be taken when the results of monitoring at the CCP indicate a loss of control. For the purposes of this standard, this also applies to a DAP

3.9

critical control point (CCP)

step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level

3.10

critical limit
a criterion that separates acceptability from unacceptability. For the purposes of this standard, this also applies to a DAP

3.11

decision tree

sequence of questions applied to each process step with an identified hazard to identify which process steps are CCPs. For the purposes of this standard, this also applies to a DAP

3.12

decomposition

deterioration of fish, shellfish and their products including texture breakdown and causing a persistent and distinct objectionable odour or flavour

3.13

defect

condition found in a product that fails to meet essential quality, composition and/or labelling provisions of the appropriate Codex product standards

3.14

defect action point (DAP)

step at which control can be applied and a quality (non-safety) defect can be prevented, eliminated or reduced to an acceptable level, or a fraud risk eliminated

3.15

disinfection

reduction by means of chemical agents and/or physical methods in the number of micro-organisms in the environment to a level that does not compromise food safety or suitability

3.16

dressed

that portion of fish remaining after heading and gutting

3.17

facility

any premises where fish and fishery products are prepared, processed, chilled, frozen, packaged or stored. For the purposes of this standard, premises also include vessels

3.18

fish

any of the cold-blooded (ectothermic) aquatic vertebrates. Amphibians and aquatic reptiles are not included

3.19

hazard

biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect

3.20

hazard analysis

process of collecting and evaluating information on hazards and conditions leading to their presence in order to decide which are significant for food safety and, therefore, should be addressed in the HACCP plan

3.21

Hazard Analysis and Critical Control Point (HACCP)

system that identifies, evaluates and controls hazards that are significant for food safety

3.22

microbiological contamination

presence, introduction, reintroduction, growth and/or survival of pathogens of public health concern

3.23

monitor

act of conducting a planned sequence of observations or measurements of control parameters to assess whether a CCP is under control. For the purposes of this standard, this also applies to a DAP

3.24

potable water

freshwater fit for human consumption. Standards of potability should not be lower than those contained in the latest edition of the International Standards for Drinking-water issued by the World Health Organization

3.25

prerequisite programme

programme that is required prior to the application of the HACCP system to ensure that a fish and shellfish processing facility is operating according to the Codex Principles of Food Hygiene, the appropriate Code of Practice and appropriate food safety legislation

3.26

raw materials

fresh and frozen fish, shellfish and/or their parts that may be utilized to produce fish and shellfish products intended for human consumption

3.27

refrigerated water

clean water cooled by a suitable refrigeration system

3.28

shelf-life

period during which the product maintains its microbiological and chemical safety and sensory qualities at a specific storage temperature. It is based on identified hazards for the product, heat or other preservation treatments, packaging method and other hurdles or inhibiting factors that may be used

3.29

step

point, procedure, operation or stage in the food chain including raw materials from primary production to final consumption

3.30

validation

obtaining evidence that the elements of the HACCP plan are effective

3.31

verification

application of methods, procedures, tests and other evaluations, in addition to monitoring to determine compliance with the HACCP plan. For the purposes of this standard, this also applies to a DAP

3.32

whole fish (or round fish)

fish as captured, ungutted

any substance applied or administered to any food-producing animal, such as meat- or milk-producing animals, poultry, fish or bees, whether used for therapeutic, prophylactic or diagnostic purposes or for modification of physiological functions or behaviour

3.33

withdrawal time

period of time necessary between the last administration of a veterinary drug to fish, or exposure of these animals to a veterinary drug, and harvesting of them to ensure that the concentration of the veterinary drug in their edible flesh intended for human consumption complies with the maximum permitted residue limits

3.34

candling

passing fillets of fish over a translucent table illuminated from below to detect parasites and other defects

3.35

dehydration

3.36

glazing

application of a protective layer of ice formed at the surface of a frozen product by spraying it with, or dipping it into, clean or potable water with approved additives, as appropriate

3.37

minced fish

comminuted flesh produced by separation from skin and bones

3.38

modified atmosphere packaging (MAP)

packaging in which the atmosphere surrounding the fish is different from the normal composition of air

3.39

pre-frying

frying of breaded and battered fishery products in an oil bath in a way so that the core remains frozen

3.40

sawing

cutting (by hand or fully mechanized) of regular shapes of fish blocks into pieces suitable for later coating

3.41

barrel

cylindrical container made of wood or plastic or other suitable food contact material with a lid for watertight closure

3.42

black membrane

parietal peritoneum, the pigmented lining of the abdominal cavity

3.43

brine

solution of salt in water

3.44

brine injection

process for injecting brine directly into the fish flesh

3.45**brining**

process of placing fish in brine for a period of sufficient length for the fish tissue to absorb a specific quantity of salt

3.46**dry-salting**

process of mixing fish with suitable food-grade salt and stacking the fish in such a manner that the resulting brine drains away

3.47**dun**

discoloration and a development of the mould *Sporendonema epizoum*, which affects the fish surface and makes it look peppered. The fish flesh is unaffected

3.48**fatty fish**

Fish in which the main reserves of fat are in the body tissue and the fat content is more than 2 %

3.49**gibbing**

process of removing the gills, long gut and stomach from fatty fish, such as herring, by inserting a knife or using hands at the gills; the milt or roe and some of the pyloric caeca are left in the fish

3.50**lean fish (white fish)**

fish in which the main reserves of fat are in the liver and less than 2 percent fat in the body tissue

3.51**maturing**

process from salting until the fish is salt-matured

3.52**nobbing**

removing the head and gut from fatty fish, such as herring, in one operation by partially severing the head and pulling the head away together with the attached gut; the roe or milt is left in

3.53**pickle**

brine that may contain vinegar and spices

3.54**pickling**

process whereby primary fatty fish is mixed with suitable salt (which may contain vinegar and spices) and stored in watertight containers under the resultant pickle that forms by solution of salt in the water extracted from the fish tissue. Pickle may be added to the container. Pickled products will always remain in a brine solution

3.55**pink**

discoloration caused by red halophilic bacteria that damages the fish flesh

3.56**salt**

crystalline product consisting predominantly of sodium chloride. It is obtained from the sea, from underground rock salt deposits or from vacuum processed and refined brine

3.57**canned food**

commercially sterile food in hermetically sealed containers

3.58

commercial sterility of thermally processed food

condition achieved by application of heat, sufficient, alone or in combination with other appropriate treatments, to render the food free from micro-organisms capable of growing in the food under normal non-refrigerated conditions at which the food is likely to be held during distribution and storage

3.59

hermetically sealed containers

containers that are sealed to protect the content against the entry of micro-organisms during and after heat treatment

3.60

retort

pressure vessel designed for thermal processing of food packed in hermetically sealed containers

3.61

scheduled process (or sterilization schedule)

thermal process chosen by the processor for a given product and container size to achieve at least commercial sterility

3.62

sterilization temperature

temperature maintained throughout the thermal process as specified in the scheduled process

3.63

sterilization time

time between the moment sterilization temperature is achieved and the moment cooling starts

3.64

thermal process

heat treatment to achieve commercial sterility and is quantified in terms of time and temperature

3.65

venting

thorough removal of the air from steam retorts by steam prior to a scheduled process

3.66

retail

operation that stores, prepares, packages, serves or otherwise provides fish and their products directly to the consumer for preparation by the consumer for human consumption. This may be free-standing seafood markets, seafood sections in grocery or department stores, packaged, chilled or frozen and/or full service

3.67

packaged

packaged in advance and displayed chilled or frozen for direct consumer pick-up

3.68

full-service display

display of chilled fish and their products to be weighed and wrapped by establishment personnel at the request of the consumer

4 Prerequisite programmes

4.1 Facility design and construction

4.1.1 The facility should include a product flow-through pattern that is designed to prevent potential sources of contamination, minimize process delays (which could result in further reduction in essential quality), and prevent cross-contamination of finished product from raw materials. Fish and other aquatic invertebrates are

highly perishable foods and should be handled carefully and chilled without undue delay. Therefore, the facility should be designed to facilitate rapid processing and subsequent storage.

4.1.1.1 For ease of cleaning and disinfection, the design and construction of a facility should take into consideration the following shall apply:

- a) the surfaces of walls, partitions and floors should be made of impervious, non-toxic materials;
- b) all surfaces with which fish and their products might come into contact should be of corrosion-resistant, impervious material that is light-coloured, smooth and easily cleanable;
- c) walls and partitions should have a smooth surface up to a height appropriate to the operation;
- d) floors should be constructed to allow adequate drainage;
- e) ceilings and overhead fixtures should be constructed and finished to minimize the buildup of dirt and condensation, and the shedding of particles;
- f) windows should be constructed to minimize the build-up of dirt and, where necessary, be fitted with removable and cleanable insect-proof screens. Where necessary, windows should be fixed;
- g) doors should have smooth, non-absorbent surfaces; and
- h) joints between floors and walls should be constructed for ease of cleaning (round joints).

4.1.1.2 To minimize contamination, the following should apply:

- a) facility layout should be designed to minimize cross-contamination and may be accomplished by physical or time separation;
- b) all surfaces in handling areas should be non-toxic, smooth, impervious and in sound condition in order to minimize the build-up of fish slime, blood, scales and guts and to reduce the risk of physical contamination;
- c) working surfaces that come into direct contact with fish and their products should be in sound condition, durable and easy to maintain. They should be made of smooth, non-absorbent and non-toxic materials, and inert to fish and their products, detergents and disinfectants under normal operating conditions;
- d) adequate facilities should be provided for the handling and washing of products and should have an adequate supply of cold potable water for that purpose;
- e) suitable and adequate facilities should be provided for storage and/or production office;
- f) ceiling lights should be covered or otherwise suitably protected to prevent contamination by glass or other materials;
- g) ventilation should be sufficient to remove excess steam, smoke and objectionable odours, and cross-contamination through aerosols should be avoided;
- h) adequate facilities should be provided for washing and disinfecting equipment, where appropriate;
- i) non-potable water lines should be clearly identified and separated from potable water to avoid contamination;
- j) all plumbing and waste lines should be capable of coping with peak demands;
- k) accumulation of solid, semi-solid or liquid wastes should be minimized to prevent contamination;
- l) where appropriate, containers for offal and waste material should be clearly identified, suitably constructed with a fitted lid and made of impervious material;
- m) separate and adequate facilities should be provided in order to prevent contamination by:
 - 1) poisonous or harmful substances;
 - 2) dry storage of materials, packaging, etc.;
 - 3) offal and waste materials.
- n) adequate hand washing and toilet facilities, isolated from handling area, should be available;
- o) prevent the entry of birds, insects or other pests and animals; and
- p) water supply lines should be fitted with back-flow devices, where appropriate.

4.1.1.3 Adequate lighting should be provided to all work surfaces.

4.2 Design and construction of equipment and utensils

For fish canneries, additional requirements to the guidelines described in clause 4 are necessary because of the specific technology involved. Some of them are listed below, but reference should also be made to CAC/RCP 23 for further information. This should therefore apply:

- a) design, working and maintenance of baskets and handling and loading devices aimed at retorting should be appropriate for the kinds of containers and materials used. These devices should prevent any excessive mishandling of the containers;
- b) an adequate number of efficient sealing machines should be available to avoid undue delay in processing;
- c) retorts should have a suitable supply of energy, vapour, water and/or air so as to maintain in them sufficient pressure during the heat treatment of sterilization; their dimensions should be adapted to the production to avoid undue delays;
- d) every retort should be equipped with an indicating thermometer, a pressure gauge and a time and temperature recorder;
- e) an accurate, clearly visible clock should be installed in the retorting room;
- f) canneries using steam retorts should consider installing automatic steam-controller valves; and
- g) instruments used to control and to monitor, in particular, the thermal process should be kept in good condition and should be regularly verified or calibrated. Calibration of instruments used to measure temperature should be made in comparison with a reference thermometer. This thermometer should be regularly calibrated. Records concerning the calibration of instruments should be established and kept.

4.3 Hygiene control programme

4.3.1 General

4.3.1.1 The potential effects of harvesting and handling of products, on-board vessel handling or in-plant production activities on the safety and suitability of fish and their products should be considered at all times. In particular, this includes all points where contamination may exist and taking specific measures to ensure production of a safe and wholesome product. The type of control and supervision needed will depend on the size of the operation and the nature of its activities.

4.3.1.2 Schedules should be implemented to:

- a) prevent the build-up of waste and debris;
- b) protect the fish and their products from contamination;
- c) dispose of any rejected material in a hygienic manner;
- d) monitor personal hygiene and health standards;
- e) monitor the pest control programme;
- f) monitor cleaning and disinfecting programmes; and
- g) monitor the quality and safety of water and ice supplies.

4.3.1.3 The hygiene control programme should take into consideration the requirements specified in 4.4.2 – 4.4.6.

4.3.2 A permanent cleaning and disinfection schedule

4.3.2.1 A permanent cleaning and disinfection schedule should be drawn up to ensure that all parts of the vessel, processing facility and equipment therein are cleaned appropriately and regularly. The schedule should be reassessed whenever changes occur to the vessel, processing facility and/or equipment. Part of this schedule should include a “clean as you go” policy.

4.3.2.2 A typical cleaning and disinfecting process may involve as many as seven separate steps:

- a) **Precleaning:** Preparation of area and equipment for cleaning. Involves steps such as removal of all fish, shellfish and their products from area, protection of sensitive components and packaging materials from water, removal by hand or squeegee of fish scraps, etc.
- b) **Pre-rinse:** A rinsing with water to remove remaining large pieces of loose soil.
- c) **Cleaning:** The removal of soil, food residues, dirt, grease or other objectionable matter.
- d) **Rinse A:** rinsing with potable water or clean water, as appropriate, to remove all soil and detergent residues.
- e) **Disinfection:** Application of chemicals, approved by the official agency having jurisdiction, and/or heat to destroy most micro-organisms on surface.
- f) **Post-rinse:** As appropriate, a final rinse with potable water or clean water to remove all disinfectant residues.
- g) **Storage:** Cleaned and disinfected equipment, container and utensils should be stored in a fashion that would prevent their contamination.
- h) **Check of the efficiency of the cleaning:** The efficiency of the cleaning should be controlled as appropriate.

4.3.2.3 Handlers or cleaning personnel, as appropriate, should be well trained in the use of special cleaning tools and chemicals, and in methods of dismantling equipment for cleaning and they should be knowledgeable in terms of the significance of contamination and the hazards involved.

4.3.3 Designation of personnel for cleaning

In each processing plant or vessel, a trained individual should be designated to be responsible for the sanitation of the processing facility or vessel and the equipment therein.

4.3.4 Maintenance of premises, equipment and utensils

For maintenance of premises, equipment and utensils, the following shall apply:

- a) buildings, materials, utensils and all equipment in the establishment, including drainage systems should be maintained in a good state and order;
- b) equipment, utensils and other physical facilities of the plant or vessel should be kept clean and in good repair; and
- c) procedures for the maintenance, repair, adjustment and calibration, as appropriate, of apparatus should be established. For each item of equipment, these procedures should specify the methods used, the persons in charge of their application, and their frequency.

4.3.5 Pest control systems

For pest control systems, the following should apply:

- a) good hygienic practices should be employed to avoid creating an environment conducive to pests;
- b) pest control programmes could include preventing access, eliminating harbourage and infestations, and establishing monitoring detection and eradication systems; and
- c) physical, chemical and biological agents should be properly applied by appropriately qualified personnel.

4.3.6 Supply of water, ice and steam

4.3.6.1 Water

When an establishment has its own supply of fresh water or seawater or other water sources, and chlorine is used for the treatment of water that may come in direct contact with fish and fishery products, the residual content of chlorine should not exceed that of potable water. The use of higher concentrations of chlorine in water treatment, in the primary production-to-consumption food chain is subject to approval by the competent authority, where appropriate.

NOTE Attention has to be paid to the possible formation of potentially toxic compounds such as chloramines when adding chlorine to the water.

4.3.6.2 Ice

For ice, the following should apply:

- a) ice should be produced using potable water or clean water; and

- b) ice should be protected from contamination.

4.3.6.3 Steam

For steam, the following should apply:

- a) for operations that require steam, an adequate supply at sufficient pressure should be maintained and
- b) steam used in direct contact with fish or food contact surfaces should not constitute a threat to the safety or suitability of the food.

4.3.7 Waste management

For waste management, the following should apply:

- a) offal and other waste materials should be removed from the premises of a processing facility or vessel on a regular basis;
- b) facilities for the containment of offal and waste material should be properly maintained; and
- c) vessel waste discharge should not contaminate vessel water intake systems or incoming product.

4.4 Personal hygiene and health

Personal hygiene and facilities should be such to ensure that an appropriate degree of personal hygiene can be maintained in order to avoid contamination.

4.4.1 Facilities and equipment

Facilities and equipment should include:

- a) adequate means of hygienically washing and drying hands; and
- b) adequate toilet and changing facilities for personnel should be suitably located and designated.

4.4.2 Personnel hygiene

For personal hygiene, the following should apply:

- a) no person who is known to be suffering from, or who is a carrier of, any communicable disease or has an infected wound or open lesion should be engaged in preparation, handling or transportation;
- b) where necessary, adequate and appropriate protective clothing, head coverings and footwear should be worn;
- c) all persons working in a facility should maintain a high degree of personal cleanliness and should take all necessary precautions to prevent contamination;
- d) hand washing should be carried out by all personnel working in a processing area:
 - 1) at the start of fish or shellfish handling activities and upon re-entering a processing area and
 - 2) immediately after using the toilet.
- e) the following should not be permitted in handling and processing areas:
 - 1) smoking;
 - 2) spitting;
 - 3) chewing or eating;
 - 4) sneezing or coughing over unprotected food; and
 - 5) the adornment of personal effects, such as jewellery, watches or pins, or other items that, if dislodged, might pose a threat to the safety and suitability of the products.

4.5 Transportation

Vehicles should be designed and constructed:

- a) such that walls, floors and ceilings, where appropriate, are made of a suitable corrosion-resistant material with smooth, non-absorbent surfaces. Floors should be adequately drained;
- b) where appropriate with chilling equipment to maintain chilled fish during transportation to a temperature as close as possible to 0 °C or, for frozen fish and their products, to maintain a temperature of –18 °C or colder (except for brine frozen fish intended for canning which may be transported at –9 °C or colder);
- c) so that live fish are transported at temperatures tolerable for the species;
- d) to provide the fish with protection against contamination, exposure to extreme temperatures and the drying effects of the sun or wind; and
- e) to permit the free flow of chilled air around the load when fitted with mechanical refrigeration means.

4.6 Product tracing and recall procedures

A system for recall of product is a necessary component of a prerequisite programme because no process is fail-safe. Product tracing, which includes lot identification, is essential to an effective recall procedure.

- a) managers should ensure effective procedures are in place to effect the complete product tracing and rapid recall of any lot of fishery product from the market;
- b) appropriate records of processing, production and distribution should be kept and retained for a period that exceeds the shelf-life of the product;
- c) each container of fish and their products intended for the final consumer or for further processing should be clearly marked to ensure the identification of the producer and of the lot;
- d) where there is a health hazard, products produced under similar conditions, and likely to present a similar hazard to public health, may be withdrawn. The need for public warnings should be considered; and
- e) recalled products should be held under supervision until they are destroyed, used for purposes other than human consumption, or reprocessed in a manner to ensure their safety.

4.7 Training

4.7.1 Fish hygiene training is of fundamental importance. All personnel should be aware of their role and responsibility in protecting fish from contamination and deterioration. Handlers should have the necessary knowledge and skill to enable them to handle fish hygienically. Those who handle strong cleaning chemicals or other potentially hazardous chemicals should be instructed in safe handling techniques.

4.7.2 Each fish facility should ensure that individuals have received adequate and appropriate training in the design and proper application of an HACCP system and process control. Training of personnel in the use of HACCP is fundamental to the successful implementation and delivery of the programme in fish processing establishments. The practical application of such systems will be enhanced when the individual responsible for HACCP has successfully completed a course. Managers should also arrange for adequate and periodic training of relevant employees in the facility so that they understand the principles involved in HACCP.

4.8 General considerations for the handling of fresh fish

4.8.1 General

Unless they can be reduced to an acceptable level by normal sorting and/or processing, no fish, shall be accepted if they are known to contain parasites, undesirable micro-organisms, pesticides, veterinary drugs or toxic, decomposed or extraneous substances known to be harmful to human health. When fish determined as unfit for human consumption are found, they shall be removed and stored separately from the catch and either reworked or disposed of in a proper manner. All fish deemed fit for human consumption shall be handled properly with particular attention being paid to time and temperature control.

4.8.2 Time and temperature control

4.8.2.1 Temperature is the single most important factor affecting the rate of fish deterioration and multiplication of micro-organisms. For species prone to scombrototoxin production, time and temperature control may be the most effective method for ensuring food safety. Therefore, it is essential that fresh fish, fillets and their products that are to be chilled should be held at a temperature as close as possible to 0 °C.

4.8.2.1.1 To minimize deterioration, it is important that:

- a) chilling should commence as soon as possible; and
- b) fresh fish and other aquatic invertebrates should be kept chilled, processed and distributed with care and minimum delay.

4.8.2.1.2 Where temperature control is concerned:

- a) sufficient and adequate icing or chilled or refrigerated water systems where appropriate, should be employed to ensure that fish and other aquatic invertebrates are kept chilled at a temperature as close as possible to 0 °C;
- b) fish and other aquatic invertebrates should be stored in shallow layers and surrounded by finely divided melting ice;
- c) live fishes are to be transported at temperatures tolerable for species;
- d) chilled or refrigerated water systems and/or cold storage systems should be designed and maintained to provide adequate cooling and/or freezing capacities during peak loads;
- e) fish should not be stored in refrigerated water systems to a density that impairs its working efficiency; and
- f) monitoring and controlling the time and temperature and homogeneity of chilling should be performed regularly.

5 Processing of canned fish

5.1 In the context of recognizing controls at individual processing steps, this clause provides examples of potential hazards and defects and describes technological guidelines that can be used to develop control measures and corrective action. At a particular step, only the hazards and defects that are likely to be introduced or controlled at that step are listed. It should be recognized that in preparing an HACCP and/or DAP plan it is essential to consult clause 6, which provides guidance for the application of the principles of HACCP and DAP analysis. However, within the scope of this standard, it is not possible to give details of critical limits, monitoring, record-keeping and verification for each of the steps as these are specific to particular hazards and defects.

5.2 This clause concerns the processing of heat processed sterilized canned fish products that have been packed in hermetically sealed containers and are intended for human consumption. Aseptic filling is not covered by this standard.

5.3 As stressed by this standard, the application of appropriate elements of the prerequisite programme (clause 4) and HACCP principles (clause 6) at these steps will provide the processor with reasonable assurance that the essential quality, composition and labelling provisions of the appropriate standard will be maintained and food safety issues controlled.

5.1 General – addition to prerequisite programme

5.1.1 Clause 4 gives the minimum requirements for good hygienic practices for a processing facility prior to the application of hazard and defect analyses.

5.1.1.1 For fish canneries, additional requirements to the guidelines described in clause 4 are necessary because of the specific technology involved. Some of them are listed below, but reference should also be made to CAC/RCP 23 for further information. This should therefore apply:

- a) design, working and maintenance of baskets and handling and loading devices aimed at retorting should be appropriate for the kinds of containers and materials used. These devices should prevent any excessive mishandling of the containers;
- b) an adequate number of efficient sealing machines should be available to avoid undue delay in processing;
- c) retorts should have a suitable supply of energy, vapour, water and/or air so as to maintain in them sufficient pressure during the heat treatment of sterilization; their dimensions should be adapted to the production: to avoid undue delays;
- d) every retort should be equipped with an indicating thermometer, a pressure gauge and a time and temperature recorder;

- e) an accurate, clearly visible clock should be installed in the retorting room;
- f) canneries using steam retorts should consider installing automatic steam-controller valves; and
- g) instruments used to control and to monitor, in particular, the thermal process should be kept in good condition and should be regularly verified or calibrated. Calibration of instruments used to measure temperature should be made in comparison with a reference thermometer. This thermometer should be regularly calibrated. Records concerning the calibration of instruments should be established and kept.

5.2 Processing operations

Processors can also refer to CAC/RCP 23 in order to obtain detailed advice on canning operations.

5.2.1 Reception of fish

5.2.1.1 Potential hazards

Chemical; and biochemical contamination (DSP, PSP, scombrototoxin, heavy metals, etc.)

5.2.1.2 Potential defects

- a) species substitution;
- b) decomposition; and
- c) parasites.

5.2.1.3 Technical guidance

- a) containers, covers and packaging materials should be suitable for the type of product, the conditions provided for storage, the filling, sealing and packaging equipment and the transportation conditions;
- b) the containers in which fish products are canned should be made from suitable material and constructed so that they can be easily closed and sealed to prevent the entry of any contaminating substance;
- c) containers and covers for canned fish and shellfish should meet the following requirements;
 - 1) they should protect the contents from contamination by micro-organisms or any other substance;
 - 2) their inner surfaces should not react with the contents in any way that would adversely affect the product or the containers;
 - 3) their outer surfaces should be resistant to corrosion under any likely conditions of storage; and

they should be sufficiently durable to withstand the mechanical and thermal stresses encountered during the canning process and to resist physical damage during distribution.

5.2.2 Reception of containers, covers and packaging materials

5.2.2.1 Potential hazards

Microbiological contamination.

5.2.2.2 Potential defects

Tainting of the product.

5.2.2.3 Technical guidance

Refer to clause 5.2.1.3.

5.2.3 Reception of other ingredients

5.2.3.1 Potential hazards

- a) microbiological contamination;
- b) chemical and physical contamination.

5.2.3.2 Potential defects

Misdescription.

5.2.3.2 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) only ingredients, packaging material and labels complying with the specifications of the processors should be accepted into the processing facility;
- b) labels that are to be used in direct contact with the fish should be made of a non-absorbent material and the ink or dye used on that label should be approved by the official agency having jurisdiction; and
- c) ingredients and packaging material not approved by the official agency having jurisdiction should be investigated and rejected at reception.

5.2.4 Storage – packaging, labels and ingredients

5.2.4.1 Potential hazards

- a) microbiological contamination;
- b) chemical and physical contamination.

Potential defects

loss of quality characteristics of packaging materials or ingredients.

5.2.5 Storage of fish

5.2.5.1 Chilled storage

5.2.5.1.1 Potential hazards

- a) microbiological contamination;
- b) biotoxins;
- c) scombrototoxin.

5.2.5.1.2 Potential defects

- a) decomposition;
- b) physical damage.

5.2.5.1.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) fish should be moved to the chilled storage facility without undue delay;
- b) the facility should be capable of maintaining the temperature of the fish between 0 °C and +4 °C;
- c) the chill room should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended;
- d) stock rotation plans should ensure proper utilization of the fish;
- e) the fish should be stored in shallow layers and surrounded by sufficient finely divided ice or with a mixture of ice and water before processing;
- f) fish should be stored such that damage from overstacking or overfilling of boxes will be prevented;
- g) where appropriate, replenish ice supply on the fish or alter temperature of the room.

5.2.5.2 Frozen storage

5.2.5.2.1 Potential hazards

- a) microbiological contamination;
- b) toxins;
- c) viable parasites.

5.2.5.2.2 Potential defects

- a) dehydration;

- b) Rancidity;
- c) loss of nutritional quality.

5.2.5.2.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) the facility should be capable of maintaining the temperature of the fish at or colder than $-18\text{ }^{\circ}\text{C}$, and with minimal temperature fluctuations;
- b) the store should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended;
- c) a systematic stock rotation plan should be developed and maintained;
- d) product should be glazed and/or wrapped to protect it from dehydration;
- e) fish should be rejected if known to contain defects that subsequently cannot be reduced or eliminated to an acceptable level by re-working. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the DAP plan modified where necessary; and
- f) for killing parasites harmful to human health, the freezing temperature and monitoring of duration of freezing should be combined with good inventory control to ensure sufficient cold treatment.

5.2.5.3 Storage of containers and packaging

5.2.5.3.1 Potential hazards

Unlikely.

5.2.5.3.2 Potential defects

Foreign matter.

5.2.5.3.3 Technical guidance

- a) all materials for containers or packages should be stored in satisfactorily clean and hygienic conditions;
- b) during storage, empty containers and covers should be protected from dirt, moisture and temperature fluctuations in order to avoid condensation on containers and, in the case of tin cans, the development of corrosion; and
- c) during loading, stowing, transportation and unloading of empty containers, any shock should be avoided. Containers should not be stepped on. These precautions become more imperative when containers are put in bags or on pallets. Shocks can deform the containers (can body or flange) – this may compromise tightness (shocks on the seam, deformed flange) or be prejudicial to appearance.

5.2.6 Storage of other ingredients

5.2.6.1 Potential hazards

- a) microbiological contamination;
- b) chemical and physical contamination.

5.2.6.1.2 Potential defects

Loss of quality characteristics of packaging materials or ingredients.

5.2.6.1.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) ingredients and packaging should be stored appropriately in terms of temperature and humidity;
- b) a systematic stock rotation plan should be developed and maintained to avoid out-of-date materials;
- c) ingredients and packaging should be properly protected and segregated to prevent cross-contamination and
- d) defective ingredients and packaging should not be used.

5.2.7 Unwrapping, unpacking

5.2.7.1 Potential hazards

Unlikely.

5.2.7.2 Potential defects

Foreign matter.

5.2.7.3 Technical guidance

During unwrapping and unpacking operations, precautions should be taken in order to limit product contamination and foreign matter introduction into the product. To avoid microbial proliferation, waiting periods before further processing should be minimized.

5.2.8 Thawing

5.2.8.1 Controlled thawing

5.2.8.1.1 Potential hazards

- a) microbiological contamination;
- b) biotoxins;
- c) scombrototoxin.

5.2.8.1.2 Potential defects

Decomposition.

5.2.8.1.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) the thawing method should be clearly defined and should address the time and temperature of thawing, temperature measuring instrument used and placement of device for measurement. The thawing schedule (time and temperature parameters) should be carefully monitored. Selection of the thawing method should take into account in particular the thickness and uniformity of size of the products to be thawed;
- b) thawing time and temperature and fish temperature critical limits should be selected so as to control the development of micro-organisms and histamine (where high-risk species are concerned) or persistent and distinctive objectionable odours or flavours indicative of decomposition or rancidity;
- c) where water is used as the thawing medium, it should be of potable quality;
- d) where recycling of water is used, care should be taken to avoid the build-up of micro-organisms;
- e) where water is used, circulation should be sufficient to produce even thawing;
- f) during thawing, according to the method used, products should not be exposed to excessively high temperatures;
- g) particular attention should be paid to controlling condensation and drip from the fish. Effective drainage should be ensured;
- h) after thawing, fish should be immediately processed or refrigerated and kept at the adequate temperature (temperature of melting ice); and
- i) the thawing schedule should be reviewed as appropriate and amended where necessary.

5.2.8.2 Fish preparation

5.2.8.2.1 Washing and gutting

5.2.8.2.1.1 Potential hazards

- a) microbiological contamination;
- b) biochemical development (histamine).

5.2.8.2.1.2 Potential defects

- a) objectionable matter (viscera, skin, scales, etc. in certain products);
- b) off- flavours;
- c) presence of bones;
- d) parasites, etc.

5.2.8.2.1.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) gutting is considered complete when the intestinal tract and internal organs have been removed;
- b) an adequate supply of potable water should be available for washing of:
 - 1) whole fish, to remove foreign debris and reduce bacterial load prior to gutting;
 - 2) gutted fish, to remove blood and viscera from the belly cavity;
 - 3) surface of fish, to remove any loose scales;
 - 4) gutting equipment and utensils, to minimize build-up of slime, blood and offal.
- c) depending on the vessel or processing facility product flow pattern and where a prescribed critical limit for staging time and temperature regime has been established for the control of histamine or a defect, the gutted fish should be drained and well iced or appropriately chilled in clean containers and stored in specially designated and appropriate areas within the processing facility; and
- d) separate and adequate storage facilities should be provided for the fish roe, milt and livers, if these are saved for later utilization.

5.2.8.2.2 Filleting, skinning, trimming and candling**5.2.8.2.2.1 Potential hazards**

- a) viable parasites;
- b) microbiological contamination;
- c) biotoxins;
- d) scombrototoxin;
- e) presence of bones.

5.2.8.2.2.2 Potential defects

- a) parasites;
- b) presence of bones;
- c) objectionable matter (e.g. skin, scales);
- d) decomposition.

5.2.8.2.2.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) to minimize time delays, the design of the filleting line and candling line, where applicable, should be continuous and sequential to permit uniform flow without stoppages or slowdowns and removal of waste;
- b) an adequate supply of clean water or potable water should be available for washing of:
 - 1) fish prior to filleting or cutting, especially fish that have been scaled;

- 2) fillets after filleting, skinning or trimming to remove any signs of blood, scales or viscera;
 - 3) filleting equipment and utensils to minimize build up of slime and blood and offal;
 - 4) for fillets to be marketed and designated as boneless, fish handlers should employ appropriate inspection techniques and use the necessary tools to remove bones not meeting standards or commercial specifications.
- c) the candling of skinless fillets by skilled personnel, in a suitable location that optimizes the illuminating effect, is an effective technique in controlling parasites (in fresh fish) and should be employed when implicated fish species are being used;
 - d) the candling table should be frequently cleaned during operation in order to minimize the microbial activity of contact surfaces and the drying of fish residue caused by heat generated from the lamp;
 - e) where a prescribed critical limit for staging time and temperature regime has been established for the control of histamine or a defect, the fish fillets should be well iced or appropriately chilled in clean containers, protected from dehydration and stored in appropriate areas within the processing facility.

5.2.9 Precooking and other treatments

5.2.9.1 Potential hazards

- a) chemical contamination (polar components of oxidized oils); and
- b) microbiological or biochemical (scombrototoxin) contamination.

5.2.9.2 Potential defects

- a) water release in the final product (for products canned in oil); and
- b) abnormal flavours.

5.2.9.3 Technical guidance

5.2.9.3.1 General considerations

5.2.9.3.1.1 For the control of the above hazards and defects, the following guidance should all apply:

- a) methods used to precook fish for canning should be designed to bring about the desired effect with a minimum delay and a minimum amount of handling; the choice of method is usually strongly influenced by the nature of the treated material. For products canned in oil, precooking should be sufficient in order to avoid excessive release of water during heat processing;
- b) means should be found to reduce the amount of handling subsequent to precooking, wherever practical;
- c) if eviscerated fish are used, then the fish should be arranged in the belly-down position for precooking to allow for the drainage of fish oils and juices, which may accumulate and affect product quality during the heating process;
- d) care should be taken to prevent temperature abuse of scombrototoxic species before precooking.

5.2.9.3.1.2 For precooking schedule, the following shall apply:

- a) the precooking method, particularly in terms of time and temperature, should be clearly defined. The precooking schedule should be checked; and
- b) fish precooked together in batches should be very similar in size. It also follows that they should all be at the same temperature when they enter the cooker.

5.2.9.3.1.3 For control of quality of precooking oils and other fluids, the following should be considered:

- a) only good-quality vegetable oils complying with relevant standards should be used in precooking fish for canning;

- b) cooking oils should be changed frequently in order to avoid the formation of polar compounds. Water used for precooking should also be changed frequently in order to avoid contaminants; and
- c) care should be taken that the oil or the other fluids used, such as vapour or water, do not impart an undesirable flavour to the product.

5.2.9.3.1.4 For cooling, the following should apply:

- a) except for products that are packed when still hot, cooling of precooked fish should be done as quickly as possible to bring the product temperatures in a range limiting proliferation or toxin production, and under conditions where contamination of the product can be avoided; and
- b) where water is used to cool crustaceans for immediate shucking, it should be potable water or clean seawater. The same water should not be used for cooling more than one batch

5.2.9.3.1.5 For use of brine and other dips, the following should apply:

- a) where fish are dipped or soaked in brine or in solutions of other conditioning or flavouring agents or additives in preparation for canning, solution strength and time of immersion should both be carefully controlled to bring about the optimal effect;
- b) dip solutions should be replaced and dip tanks and other dipping apparatus should be thoroughly cleaned at frequent intervals; and
- c) care should be taken to ascertain whether or not the ingredients or additives used in dips would be permitted in canned fish by the related standards.

5.2.10 Packing in containers (filling, sealing and coding)

5.2.10.1 Filling

5.2.10.1.1 Potential hazards

Microbiological contamination (waiting period or, after heat processing owing to incorrect filling or defective containers)

5.2.10.1.2 Potential defects

incorrect weight; and

foreign matter.

5.2.10.1.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) a representative number of containers and covers should be inspected immediately before delivery to the filling machines or packing tables to ensure that they are clean, undamaged and without visible flaws;
- b) if necessary, empty containers should be cleaned. It is also a wise precaution to have all containers turned upside down to make certain that they do not contain any foreign material before they are used;
- c) care should also be taken to remove defective containers, because they can jam a filling or sealing machine, or cause trouble during heat processing (inadequate sterilization, leaks);
- d) empty containers should not be left on the packing tables or in conveyor systems during cleanup of premises to avoid contamination or splashes;
- e) where appropriate, to prevent microbial proliferation, containers should be filled with hot fish a (for example, > 63 °C for fish soups) or should be filled quickly (the shortest possible waiting period) after the end of the pre-treatments;
- f) if the fish shall be held for a long time before packing into containers, they should be chilled;
- g) containers of canned fish should be filled as directed in the scheduled process;
- h) mechanical or manual filling of containers should be checked in order to comply with the filling rate and the headspace specified in the adopted sterilization schedule. A regular filling is important not only for economic reasons, but also because heat penetration and container integrity can be affected by excessive filling changes;

- i) the necessary amount of headspace will depend partly on the nature of the contents. The filling should also take into account the heat processing method. Headspace should be allowed as specified by the container manufacturer;
- j) furthermore, containers should be filled such that the end product meets the regulatory provisions or the accepted standards concerning weight of contents;
- k) where canned fish are packed by hand, there should be a steady supply of fish, and, eventually, other ingredients. Build-up of fish, as well as filled containers at the packing table, should be avoided;
- l) the operation, maintenance, regular inspection, calibration and adjustment of filling machines should receive particular care. The instructions provided by the machine manufacturer should be carefully followed;
- m) the quality and the amount of other ingredients such as oil, sauce, vinegar, etc. should be carefully controlled to bring about the optimal desired effect;
- n) if fish has been brine-frozen or stored in refrigerated brine, the amount of salt absorbed should be taken into consideration when salt is added to the product for flavouring;
- o) filled containers should be inspected:
 - 1) to ensure that they have been properly filled and will meet accepted standards for weight of contents; and
 - 2) to verify product quality and workmanship just before they are closed.
- p) manual filled products such as small pelagic fish should be carefully checked by the operators to verify that container flanges or closure surface have no product residues, which could impede the formation of a hermetic seal. For automatic-filled products, a sampling plan should be implemented.

5.2.10.2 Sealing

Sealing the container and covers is one of the most essential processes in canning.

5.2.10.2.1 Potential hazards

Subsequent contamination owing to a bad seam.

5.2.10.2.2 Potential defects

Unlikely.

5.2.10.2.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) the operation, maintenance, regular inspection and adjustment of sealing machines should receive particular care. The sealing machines should be adapted and adjusted for each type of container and each closing method used. Whatever the type of sealing equipment, the instructions provided by the manufacturer or equipment supplier should be followed meticulously;
- b) seams and other closures should be well formed with dimensions within the accepted tolerances for the particular container;
- c) qualified personnel should conduct this operation;
- d) if a vacuum is used during packing, it should be sufficient to prevent the containers from bulging under any condition (high temperature or low atmospheric pressure) likely to be encountered during the distribution of the product. This is useful for deep containers or glass containers. It is difficult and hardly necessary to create a vacuum in shallow containers that have relatively large flexible covers;
- e) an excessive vacuum may cause the container to panel, particularly if the headspace is large, and may also cause contaminants to be sucked into the container if there is a slight imperfection in the seam;
- f) to find the best methods for creating a vacuum, competent technologists should be consulted;
- g) regular inspections should be made during production to detect potential external defects on containers. In order to guarantee a closure in accordance with specifications, at sufficiently close intervals, the operator, the supervisor of the closure or any other competent person should examine the seams or the closure

system for the other types of containers that are used. Inspections should consider, for example, vacuum measurements and seam teardown. A sampling plan should be used for the checks;

- h) in particular, at each start of the production line and at each change in container dimensions, after a jamming, a new adjustment or a restarting after a prolonged stop of the sealing machine, a check should be carried out; and
- i) all appropriate observations should be recorded.

5.2.10.3 Coding

5.2.10.3.1 Potential hazards

Subsequent contamination owing to damaged containers.

5.2.10.3.2 Potential defects

Loss of traceability owing to an incorrect coding.

5.2.10.3.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) each container of canned fish and shellfish should bear indelible code markings from which all-important details concerning its manufacture (type of product, cannery where the canned fish or shellfish was produced, production date, etc.) can be determined;
- b) coding equipment shall be carefully adjusted so that the containers are not damaged and the code; and
- c) coding may sometimes be carried out after the cooling step.

5.2.10.4 Handling of containers after closure – staging before heat processing

5.2.10.4.1 Potential hazards

Microbiological contamination (waiting period or owing to damaged containers).

5.2.10.4.2 Potential defects

Unlikely.

5.2.10.4.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) after closure, containers should always be handled carefully in such a way as to prevent any damage capable of causing defects and microbiological recontamination;
- b) if necessary, filled and sealed metal containers should be thoroughly washed before heat processing to remove grease, dirt and fish stains on their outside walls;
- c) to avoid microbial proliferation, the waiting period should be as short as possible;
- d) if the filled and sealed containers shall be held for a long time before heat processing, the product should be held at temperature conditions that minimize microbial growth; and
- e) every cannery should develop a system that will prevent non-heat-processed canned fish from being accidentally taken past the retorts into the storage area.

5.2.10.5 Thermal processing

Heat processing is one of the most essential operations in canning. Cannery can refer to CAC/RCP 23 in order to obtain detailed advice on heat processing. In this clause, only some essential elements are pointed out.

5.2.10.5.1 Potential hazards

Survival of spores of *C. botulinum*

5.2.10.5.2 Potential defects

Survival of micro-organisms responsible for decomposition.

5.2.10.5.3 Technical guidance

5.2.10.5.3.1 Sterilization schedule

For sterilization schedule, the following should apply:

- a) to determine the sterilization schedule, first, the heat process required to obtain the commercial sterility should be established, taking into account some factors (microbial flora, dimensions and nature of the container, product formulation, etc.). A sterilization schedule is established for a certain product in a container of a given size;
- b) proper heat generation and temperature distribution should be ensured. Standard heat processing procedures and experimentally established sterilization schedules should be checked and validated by an expert to confirm that the values are appropriate for each product and retort; and
- c) before any changes in operations (initial temperature of filling, product composition, size of containers, fullness of the retort, etc.) are made, competent technologists should be consulted as to the need for re-evaluation of the process.

5.2.10.5.3.2 Heat processing operations

For heat processing operation, the following should apply:

- a) only qualified and properly trained personnel should operate retorts. Therefore, it is necessary that retort operators control the processing operations and ensure the sterilization schedule is closely followed, including meticulous care in timing, monitoring temperatures and pressures, and in maintaining records;
- b) it is essential to comply with the initial temperature described in the schedule process to avoid under-processing. If the filled containers have been held at refrigerated temperatures because of an excessively long waiting period before heat processing, the sterilization schedule should take into account these temperatures;
- c) in order that the heat processing is effective and process temperature is controlled, air shall be evacuated from the retort through a venting procedure that is deemed efficient by a competent technologist. Container size and type, retort installation and loading equipment and procedures should be considered;
- d) the timing of the heat processing should not commence until the specified heat processing temperature has been reached, and the conditions to maintain uniform temperature throughout the retort achieved, in particular, until the minimum safe venting time has elapsed;
- e) for other types of retorts (water, steam/air, flame, etc.), refer to CAC/RCP 23;
- f) if canned fish in different size containers are processed together in the same retort load, care shall be taken to ensure that the process schedule used is sufficient to provide commercial sterility for all container sizes processed;
- g) when processing fish in glass containers, care shall be taken to ensure that the initial temperature of the water in the retort is slightly lower than that of the product being loaded. The air pressure should be applied before the water temperature is raised.

5.2.10.5.3.3 Monitoring of heat processing operations

For monitoring of heat processing operation, the following guidance should apply:

- a) during the application of heat processing, it is important to ensure that the sterilization process and factors such as container filling, minimal internal depression at closing, retort loading and initial product temperature are in accordance with the sterilization schedule;
- b) retort temperatures should always be determined from the indicating thermometer, never from the temperature recorder;
- c) permanent records of the time, temperature and other pertinent details should be kept concerning each retort load;
- d) the thermometers should be tested regularly to ensure that they are accurate. Calibration records should be maintained; the recording thermometer readings should never exceed the indicating thermometer reading;

- e) inspections should be made periodically to ensure that retorts are equipped and operated in a manner that will provide thorough and efficient heat processing, and that each retort is properly equipped, filled and used, so that the whole load is brought up to processing temperature quickly and can be maintained at that temperature throughout the whole of the processing period; and
- f) the inspections should be made under the guidance of a competent technologist.

5.2.10.6 Cooling

5.2.10.6.1 Potential hazards

Recontamination owing to a bad seam and contaminated water.

5.2.10.6.2 Potential defects

- a) formation of struvite crystals;
- b) buckled containers;
- c) scorch.

5.2.10.6.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) after heat processing, canned fish should, wherever practical, be water cooled under pressure to prevent deformations, which could result in a loss of tightness. Where water is recycled, potable water should always be chlorinated (or other appropriate treatments used) for this purpose. The residual chlorine level in cooling water and the contact time during cooling should be checked in order to minimize the risk of post-processing contamination. The efficiency of the treatment other than chlorination should be monitored and verified;
- b) in order to avoid organoleptic defects in the canned fish, such as scorch or overcooking, the internal temperature of containers should be lowered as quickly as possible;
- c) for glass containers, the temperature of the coolant in the retort should be, at the beginning, lowered slowly in order to reduce the risks of breaking owing to thermal shock;
- d) where canned fish products are not cooled in water after heat processing, they should be stacked in such a way that they will cool rapidly in air;
- e) heat-processed canned fish should not be touched by hand or articles of clothing unnecessarily before they are cooled and thoroughly dry. They should never be handled roughly or in such a way that their surfaces, and in particular their seams, are exposed to contamination;
- f) rapid cooling of canned fish and shellfish avoids the formation of struvite crystals; and
- g) every cannery should develop a system to prevent unprocessed containers being mixed with processed containers.

5.2.11 Monitoring after heat processing and cooling

For monitoring after heat processing and cooling, the following should apply:

- a) canned fish should be inspected for faults and for quality assessment soon after they are produced and before labelling;
- b) representative samples from each code lot should be examined to ensure that the containers do not exhibit external defects and the product meets the standards for weight of contents, vacuum, workmanship and wholesomeness. Texture, colour, odour, flavour and condition of the packing medium should be assessed;
- c) if desired, stability tests could be made in order to verify, in particular, the heat processing;
- d) this examination should be made as soon as practical after the canned fish have been produced, so that if there are any faults owing to failings on the part of cannery workers or canning equipment, these failings can be corrected without delay. Segregating and properly disposing of all defective units or lots that are unfit for human consumption should be ensured.

5.2.12 Labelling, casing and storage of finished products (Processing Steps 5 and 13)

Refer to clause 5.2.11.3.

5.2.12.1 5.2.11.1 Potential hazards

Subsequent recontamination owing to container damage or exposure to extreme conditions.

5.2.12.2 Potential defects

Incorrect labelling.

5.2.12.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) the materials used for labelling and casing canned fish and shellfish should not be conducive to corrosion of the container. Cases should have an adequate size in order that the containers fit them and are not damaged by any movement inside. Cases and boxes should be the correct size and strong enough to protect the canned fish during distribution;
- b) code marks appearing on containers of canned fish and shellfish should also be shown on the cases in which they are packed;
- c) storage of canned fish should be done in such a way as not to damage the containers. In particular, pallets of finished products should not be stacked excessively high and the forklift trucks used for the storage should be used in a proper manner; and
- d) canned fish should be so stored that they will be kept dry and not exposed to extremes of temperature.

5.2.13 Transportation of finished products

5.2.13.1 Potential hazards

Subsequent recontamination owing to container damage or exposure to extreme conditions.

5.2.13.2 Potential defects

Unlikely.

5.2.13.3 Technical guidance

For the control of the above hazards and defects, the following guidance should apply:

- a) transportation of canned fish should be done in such a way as not to damage the containers. In particular, the forklift trucks used during the loading and unloading should be used in a proper manner;
- b) cases and boxes should be completely dry. In fact, moisture has effects on the mechanical characteristics of boxes and the protection of containers against damage during transportation may not be sufficient; and
- c) metal containers should be kept dry during transportation in order to avoid corrosion and/or rust.

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