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## EAST AFRICAN STANDARD

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Application of thermal process control to low-acid fish canning factories

EAST AFRICAN COMMUNITY

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## Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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## Introduction

In the preparation of this East African Standard, the following sources were consulted extensively:

SANS 10066:2007, *Application of thermal process control to low-acid fish canning factories*

CAC/RCP 52:2003(Rev. 4:2008), *Code of practice for fish and fishery products*

IS 4303-1:1975, *Code of hygienic conditions for fish industry — Part 1: Pre-processing stage*

IS 4303-2:1975, *Code of hygienic conditions for fish industry — Part 2: Canning stage*

Codex Alimentarius website: [http://www.codexalimentarius.net/mrls/vetdrugs/jsp/vetd\\_q-e.jsp](http://www.codexalimentarius.net/mrls/vetdrugs/jsp/vetd_q-e.jsp)

USDA Foreign Agricultural Service website: <http://www.mrlatabase.com>

USDA Agricultural Marketing Service website: <http://www.ams.usda.gov/AMSV1.0/Standards>

European Union: [http://ec.europa.eu/enterprise/sectors/pharmaceuticals/veterinary-use/maximum-residue-limits/index\\_en.htm](http://ec.europa.eu/enterprise/sectors/pharmaceuticals/veterinary-use/maximum-residue-limits/index_en.htm)

Assistance derived from these sources is hereby acknowledged.

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## Application of thermal process control to low-acid fish canning factories

### 1 Scope

This standard describes procedures in the canning of low-acid canned fish, which, when strictly followed, ensure microbiological stability in the final product. It covers the exhausting of cans, temperature of packing medium, seaming, can washing, retorting, cooling of processed cans, storage and inspection.

### 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.

CAC/GL 21, *Principles for the establishment and application of microbiological criteria for foods*

CAC/RCP 1, *Recommended international code of practice — General principles of food hygiene*

CAC/GL 30, *Principles and guidelines for the conduct of microbiological risk assessment*

CAC/GL 31, *Guidelines for the sensory evaluation of fish and shellfish in laboratories*

CD/K/572:2010, *Fish and fisheries products — Methods of sampling*

CAC/RCP 52[CD/K/521:2010], *Code of practice for fish and fishery products*

EAS 35, *Edible salt — Specification*

EAS 12, *Drinking (potable water) — Specification*

EAS 38, *Labelling of prepackaged foods — Specification*

EAS 41, *Fruits, vegetables and derived products — Sampling and methods of test*

EAS 103, *Schedule for permitted food additives*

EAS 123, *Distilled water — Specification*

ISO 4831, *Microbiology of food and animal feeding stuffs — Horizontal method for the detection and enumeration of coliforms — Most probable number technique*

ISO 4832, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of coliforms — Colony-count technique*

ISO 4833, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of microorganisms — Colony-count technique at 30 degrees C*

ISO 6579, *Microbiology of food and animal feeding stuffs — Horizontal method for the detection of Salmonella spp.*

ISO 6887-1, *Microbiology of food and animal feeding stuffs — Preparation of test samples, initial suspension and decimal dilutions for microbiological examination — Part 1: General rules for the preparation of the initial suspension and decimal dilutions*

ISO 6887-3, *Microbiology of food and animal feeding stuffs — Preparation of test samples, initial suspension and decimal dilutions for microbiological examination — Part 3: Specific rules for the preparation of fish and fishery products*

ISO 6888-1, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of coagulase-positive staphylococci (Staphylococcus aureus and other species) — Part 1: Technique using Baird-Parker agar medium*

ISO 6888-2, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of coagulase-positive staphylococci (Staphylococcus aureus and other species) — Part 2: Technique using rabbit plasma fibrinogen agar medium*

ISO 6888-3, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of coagulase-positive staphylococci (Staphylococcus aureus and other species) — Part 3: Detection and MPN technique for low numbers*

ISO 7251, *Microbiology of food and animal feeding stuffs — Horizontal method for the detection and enumeration of presumptive Escherichia coli — Most probable number technique*

ISO 7937, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of Clostridium perfringens — Colony-count technique*

ISO 13720, *Meat and meat products — Enumeration of Pseudomonas spp.*

ISO 17239, *Fruits, vegetables and derived products — Determination of arsenic content — Method using hydride generation atomic absorption spectrometry*

ISO 6634, *Fruits, vegetables and derived products — Determination of arsenic content — Silver diethyldithiocarbamate spectrophotometric method*

ISO 21567, *Microbiology of food and animal feeding stuffs — Horizontal method for the detection of Shigella spp.*

ISO/TS 21872-1, *Microbiology of food and animal feeding stuffs — Horizontal method for the detection of potentially enteropathogenic Vibrio spp. — Part 1: Detection of Vibrio parahaemolyticus and Vibrio cholerae*

ISO/TS 21872-2, *Microbiology of food and animal feeding stuffs — Horizontal method for the detection of potentially enteropathogenic Vibrio spp. — Part 2: Detection of species other than Vibrio parahaemolyticus and Vibrio cholerae*

ISO 11290-1, *Microbiology of food and animal feeding stuffs — Horizontal method for the detection and enumeration of Listeria monocytogenes — Part 1: Detection method*

ISO 11290-2, *Microbiology of food and animal feeding stuffs — Horizontal method for the detection and enumeration of Listeria monocytogenes — Part 2: Enumeration method*

### 3 Definitions

For the purpose of this standard the following definitions shall apply:

#### 3.1 acceptable

acceptable to the authority administering this standard, or to the parties concluding the purchase contract, as relevant

#### 3.2 acid food

food that has a natural pH value of 4.6 or below

**3.3****appropriate technician**

process control operator (see 3.18) or retort operator (see 3.21), as relevant

**3.4****canned fish**

commercially sterile fish in hermetically sealed containers

**3.5****coming-up time****CUT**

time, including venting time, which elapses between the introduction of the heating medium into the closed retort and the time when the temperature in the retort reaches the required sterilization temperature

**3.6****commercial sterility**

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

**3.7****corrective actions**

actions to be taken when results of monitoring at the critical control point indicates a loss of control or trend towards loss of control

**3.8****headspace**

volume in a container not occupied by the fish

**3.9****hermetically sealed containers**

containers which are sealed to protect the contents against the entry of micro-organisms during and after heat processing

**3.10****initial temperature****IT**

temperature of the contents of the coldest container to be processed at the time the sterilizing cycle begins, as specified in the scheduled process

**3.11****inspector**

inspecting officer who

- a) is appointed by the party concerned in the application of this standard other than the manufacturer, and
- b) subject to agreement between the manufacturer and the other party concerned, has access to the factory at all times when production is in progress, and for whom certain facilities are provided for determining compliance with the provisions of this standard

**3.12****jam up**

jamming of a can or cans in the seamer in such a manner that the setting of the seaming rolls or the base plate might be affected

**3.13****logbooks**

books, documents or sheets situated at various points (as detailed hereinafter) and in which specified data are entered, which are adequately protected from damage and are available for inspection at all

times

**3.14**

**low acid food**

food other than alcoholic beverages, with an equilibrated pH value greater than 4,6 and a water activity (see 3.28) greater than 0.85

**3.15**

**packing medium**

liquid or semi-liquid, including brine or vegetable oil or sauce, which is added to cans of fish either before or after exhausting

**3.16**

**process control**

procedure in the canning and packaging of fish that, when strictly followed, ensures commercial sterility of the final product

**3.17**

**process control officer**

**PC officer**

factory employee, with suitable thermal process training or demonstrable expertise, and approved by the parties concerned in the application of this standard, who is responsible for the efficient execution of the process control procedure, and who is on duty at all times when production is in progress

**3.18**

**process control operator**

**PC operator**

trained and experienced employee of the factory who operates under the supervision of the PC officer and who is responsible to him<sup>1</sup> for certain duties specified in this standard

NOTE The PC operator should have at least passed a recognized course relevant to his task.

**3.19**

**processing authority**

**PA**

**process specialist**

person or organization who has expert knowledge of thermal process requirements for low-acid foods packed in hermetically sealed containers

**3.20**

**retort**

**autoclave**

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

**3.21**

**retort operator**

employee of the factory who is suitably trained and experienced in the handling of retorts and retort processes and who operates under the supervision of the PC officer

NOTE The retort operator should have passed a recognized retort operator course.

**3.22**

**sterilization temperature**

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

**3.23**

**thermal process**

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

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<sup>1</sup> Wherever the words "he" or "him" are used in this standard, the words "she" and "her" are implied.

**3.24****vacuum**

negative air pressure created inside a container by removal of air

**3.25****venting**

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

**3.26****venting time**

time taken to thoroughly remove the air from steam retorts

**3.27****vents**

large pipes, located opposite the steam entry on steam retorts, used to expel the air from the retort before beginning the thermal process

**3.28****water activity** **$a_w$** 

measure of the free moisture in a product that is the quotient of the water vapour pressure of the substance divided by the vapour pressure of pure water at the same temperature

**4 Control procedures****4.1 Exhausting of cans****4.1.1 General**

There are various ways to remove air from the can, including

- a) steam flushing of the headspace of containers,
- b) so-called vacuum seaming or sealing, or
- c) hot filling or steam exhausting (or both).

The PC operator is responsible for ensuring proper air removal that results in a satisfactory negative pressure inside the sealed container (a minimum negative pressure of 17 kPa at ambient temperature at sea level is considered to be satisfactory). Additional checks are necessary for the exhausting of cans in an exhaust box system.

**4.1.2 Duties of the PC operator with exhaust box air removal**

The PC operator shall be present when the exhausting operation commences and shall personally satisfy himself that the exhaust box is operating satisfactorily (i.e. fully vented and operating correctly), and that the can's exit temperature is sufficient to have allowed effective air removal. He shall also be responsible for ensuring, in the event of a prolonged breakdown of the exhaust box, packing medium filler, seaming machine or any other operative machine, that

- a) no cans are left standing before the exhaust box for more than 1 h,
- b) no cans are left standing in the exhaust box for more than 1 h, and
- c) no cans that are left standing between the exhaust box and the seamer for more than 30 min undergo further processing, and that the contents are either discarded, or re-exhausted.

**NOTE** This precaution is deemed necessary because of the possible impact on the can vacuum achieved or on the initial temperature (IT). Caution should be exercised with the re-exhausting of cans that have stood for longer than 1 h due to the risk

of pre-process spoilage.

### 4.1.3 Duties of the PC officer

The PC officer shall ensure that the duties specified in 4.1.2 are satisfactorily carried out.

## 4.2 Temperature of packing medium

### 4.2.1 General

When the packing medium is poured into the can hot, the entire contents shall be sufficient to achieve the IT and vacuum as stipulated in the scheduled process.

### 4.2.2 Duties of the PC operator

The PC operator shall determine the temperature of the packing medium at intervals not exceeding 1 h. If the temperature is below that specified in the scheduled process, he shall take immediate steps to restore compliance with 4.2.1. He shall also be responsible for entering the following data in a logbook kept specifically for this purpose:

- a) the times at which the temperature was checked;
- b) the actual temperatures so determined; and
- c) the corrective step that might have been taken.

### 4.2.3 Duties of the PC officer

The PC officer shall determine the temperature of the packing medium at intervals not exceeding 2 h. He shall inspect the logbook at least once daily and sign or initial it at the end of each day's production run or at the end of his shift, as relevant.

## 4.3 Seaming

### 4.3.1 Seamers

#### 4.3.1.1 Identification

Every seamer shall be clearly and indelibly marked.

#### 4.3.1.2 Coding

Every seamer shall be provided with a coding device that will indelibly mark or emboss symbols or numbers on the cans from which the following information can be obtained by referring to a code chart:

- a) the number of the seamer;
- b) the type of product;
- c) the batch or subcode, shift, time, day, month and the year on which the canning operation was conducted; and
- d) the establishment number (code) of the factory.

Alternatively, subject to agreement between the parties concerned in the application of this standard, another type of marking device may be used, provided that it marks the required information indelibly on the cans.

#### 4.3.1.3 Counting devices

Every seamer should be equipped with an effective, automatically-operated device for counting the number of cans seamed.

### 4.3.2 Duties of the PC operator

**4.3.2.1** The factory shall document procedures for the correct setting of seamers in accordance with the seamer and can manufacturer's industry-approved specifications. The PC operator shall check documented procedures at least at the start of each operation and after each break or reset of equipment.

**4.3.2.2** In order to ensure the correct operation of seamers, the PC operator shall examine one can from each second operation seaming head at intervals not exceeding 1 h, and also after every jam up and at the end of each day's production run.

After the seamer has warmed up (if using steam, seamers warm within 1 min, but if no steam is used, the seamers need 3 min to warm with cans running through), the operator shall take, for examination, cans that are either filled with hot water or are from the normal production line. The operator shall examine the marking or embossing (or both) of the code to check that it is legible, that the correct symbols are being used and that the end is not being damaged by the dies, using approved methods. In the event of damage to coating or metal, the operator shall inform the PC officer immediately.

**4.3.2.3** The PC operator shall also make adjustments to the seamer that are necessary to ensure satisfactory coding. If the seamer is a vacuum seamer or if steam flow is used to form the vacuum, the cans for examination shall be filled with cold water, and the PC operator shall determine the vacuum in addition to examining the embossing of the code. If the vacuum reading is lower than 40 kPa immediately after closing, the PC operator shall cause the seamer to be adjusted until a vacuum of 40 kPa or better is obtained.

**4.3.2.4** The PC operator shall examine the seams of all cans taken for examination, first externally, and then internally by stripping and dismantling the seams. He shall immediately report to the PC officer all double seams with a tightness rating (iron out) of less than 70 %. All other deviations from specifications pertaining to a particular container and laid down in a specification manual of the container manufacturer shall be reported.

**4.3.2.5** The PC operator shall measure, calculate and record, as relevant, the following data on forms of a type as given in the accepted double-seaming manual of the industry:

- a) vacuum reading, where relevant (for example, vacuum fillers);
- b) description of the seam condition;
- c) plate thickness of end and body;
- d) seam length;
- e) seam thickness;
- f) body hook length;
- g) cover hook length;
- h) percentage overlap;
- i) actual overlap;
- j) percentage body-hook butting (critical);
- k) free space;
- l) chuck wall impression;
- m) tightness rating, as a percentage; and

n) countersink depth.

NOTE For specimen report forms see annex A.

**4.3.2.6** All measurements in 4.3.2.5(a) to (n) (inclusive) shall comply with the minimum accepted can manufacturers' industry approved double-seaming standards.

In case of non-compliance, the PC operator shall adjust the seamer(s) immediately to achieve a satisfactory seam. He shall also ensure that an immediate report is made to the PC officer concerning the faulty seams.

**4.3.2.7** The PC operator shall ensure that the number of measurements (see 4.3.2.5) at equal distances on the periphery of the seam are not less than:

- a) three for round cans;
- b) four for oval cans; and
- c) eight for rectangular cans (each corner shall be included, and positions shall be measured in accordance with the can manufacturer's manual).

**4.3.2.8** The PC operator shall ensure that, after examination, each tested can is clearly marked with the time at which it was withdrawn from the line, the number of the relevant seamer and in the case of multi-head seamers, the number of the head. Alternatively, a series of pegs can be set up on a board at a convenient spot, with the cans hung on the pegs, and each peg marked with the time and the seamer number. The PC operator shall also ensure that all tested cans are kept available for 24 h for further inspection purposes.

**4.3.2.9** The PC operator shall enter the following data into a seamer logbook (kept specifically for this purpose for each seamer):

- a) the times of running the seamer;
- b) the product;

### **4.4.3 Duties of the PC officer**

**4.4.3.1** The PC officer shall verify the records of the temperature of the water or detergent solution at intervals not exceeding 2 h. He shall inspect the logbook at least once daily and sign or initial the entries at the end of each day's production run or at the end of his shift, as relevant. If temperatures are automatically recorded on a chart, the PC officer shall ensure that the chart is attached to the relative entries in the logbook. He shall also check that the recording device is properly calibrated.

**4.4.3.2** The PC officer shall ensure that at least one can in every retort basket, or a trolley route card, is furnished with a process temperature-sensitive sticker, which will change colour to indicate that a particular basket or trolley has undergone the necessary process. This is required in a scenario where there is the slightest chance that trolleys can be passed through or around the retort process without being processed.

NOTE The temperature-measuring devices should be calibrated or verified for accuracy as required for retorting equipment.

## **4.5 Retorting**

### **4.5.1 Retorts**

#### **4.5.1.1 Retort types**

Various retorting (autoclaving) systems are used, and each has its own specific requirements. The quantity of a specific type and size of retort required for specific processes, the required heating

medium specifications and the best practices for retort link-up, are discussed in various scientific publications and manuals (see bibliography).

This standard reflects the requirements for a few types of retorts mostly used in Southern African fish canning factories, but does not exclude the acceptance of other types of retort, subject to agreement struck between the parties concerned.

Operators are reminded that the operation of high pressure vessels is legislated and regulated in terms of the relevant national legislation (see foreword) and therefore all retorts shall be furnished with equipment (for example, safety valves) and tested in accordance with these requirements.

NOTE For new operations it is recommended that guidance is sought from processing and regulatory authorities, as required.

#### 4.5.1.2 General

Where a batch retort process using steam as the direct heating medium is employed, the requirements detailed in 4.5.1.3 to 4.5.1.12 (inclusive) shall be followed but, subject to agreement between the parties concerned, other systems may be used. All retorts and retort baskets shall bear a distinctive number that is clearly and indelibly inscribed to enable traceability of production linked to a specific retort or basket as required by the control system.

Before acceptance by the parties concerned of the time and temperature process for a specific product undergoing commercial sterilization in a specific container, a proper validation of the process (including a proper heating study in accordance with the retorting system and link-up used) shall be conducted by a thermal process specialist or an independent thermal PA, and detailed records shall be kept. The records shall reflect all information that is required to enable verification of all standards and data necessary to establish whether a particular process conforms to the minimum required lethal dose ( $F_0$  value) which is calculated on the heating cycle only.

The following information shall *inter alia* be available:

- a) a record of the retort specifications (or of each retort if retorts with differing specifications are used) including main steam-supply pressure and, where relevant, water pressure of main lines;
- b) studies comparing different retorts to find the area(s) reflecting the worst heating scenarios (including coldest spots in retorts);
- c) studies to confirm the optimum venting cycle;
- d) specifications of retort baskets used and studies to ensure that the retort basket (trolley) reflecting the worst heat transfer data was used to reflect the process calculation;
- e) studies to establish worst-case scenario heat transfer to the product in cans due to variation in ingoing mass (overfilling and under filling), varying sauce consistency and overfilling with solid food material;
- f) establish the permissible standards and tolerances pertaining to the following:
  - 1) can specifications (type, shape and size),
  - 2) product description and manner in which packed,
  - 3) drained mass tolerances,
  - 4) sauce consistency and tolerances,
  - 5) position of temperature-measuring probes in containers during the study, and
  - 6) manner in which cans are packed in retort baskets, and specifications for divider plates (if any);

- g) shortest cooling cycle scenario for the product;
- h) minimum initial temperatures for the standard measured process (for the contents of the coolest can in the batch);
- i) certification for the accuracy of measuring instruments used by the PA, traceable, to at least, relevant national standards;
- j) the processing standards and instructions for the particular product, can size and retorting system; and
- k) processing tables reflecting different processing times for some
  - 1) different processing temperatures, and
  - 2) slightly different ingoing can temperatures.

#### **4.5.1.3 Instruments required for pressure processing in steam retorts**

##### **4.5.1.3.1 Recording thermometer**

The temperature charts shall be graduated in divisions of 1 °C and be readily readable to 0.5 °C within the range of ± 5 °C of the processing temperature (see 4.5.2.1) to be used.

- a) All charts shall have a temperature scale of not less than 1.0 mmrC and a time scale of not less than 20 mm/h over the range of ±5 °C of the processing temperature.
- b) Each recorder shall bear a distinctive number, clearly and indelibly inscribed, and shall have a logbook for use by the PC officer or inspector (or both) for indicating dates of checking and corrections made. Each recorder shall be kept locked, and the key shall be available to the PC officer only.
- c) The bulb of the recording thermometer shall be left bare and shall be installed in a position where steam can freely circulate, and there shall be a calibration pocket alongside the bulb. This pocket shall be 125 mm in length and approximately 13 mm in diameter and shall be kept nearly filled with high boiling point oil such as cylinder head oil, and it shall be available for use by the PC officer or appropriate technician for verifying accuracy or for calibrating the recording thermometer.
- d) The recorders shall be installed in such a way that their proper operation is not affected by steam or vibration.
- e) Each chart shall be numbered according to the recorder to which it is fitted.
- f) No adjustments whatsoever shall be made to the mechanism of the recording thermometer by any member of the factory staff, except the PC officer who may adjust the temperature-setting arm.
- g) Each recording thermometer shall be accurately calibrated at intervals not exceeding one year and verified for accuracy as part of the daily processing controls.

The servicing and repairing of recording thermometers shall be effected only by the manufacturer's technician or by an expert agreed upon by the parties concerned. An up-to-date instrument record for every critical measuring instrument shall be kept.

##### **4.5.1.3.2 Mercury-in-glass thermometer (MIG thermometer)**

The MIG thermometer is the reference instrument for all temperature readings, including venting temperatures, CUT temperatures and processing temperatures.

The thermometer shall be clearly and indelibly numbered and be easily readable to 0.5 °C. The divisions shall not exceed 10 °C for each 30 mm of graduated scale.

The thermometer shall be installed in a position where steam can readily circulate around it and preferably in the same well as the bulb of the recording thermometer (see 4.5.1.3.1 (c) and 4.5.1.4). The thermometer shall be accurately calibrated by a laboratory that has been accredited by the national accreditation body (see foreword), at installation and thereafter at intervals not exceeding one year.

#### 4.5.1.3.3 Pressure gauge

The pressure gauge shall be graduated in divisions representing pressures of not more than 10 kPa per division and shall have a range of not less than 200 kPa. The diameter of the dial shall be at least 100 mm. The operating mechanism shall be independent of the case.

The gauge shall be connected to the retort by means of a gauge siphon or gooseneck.

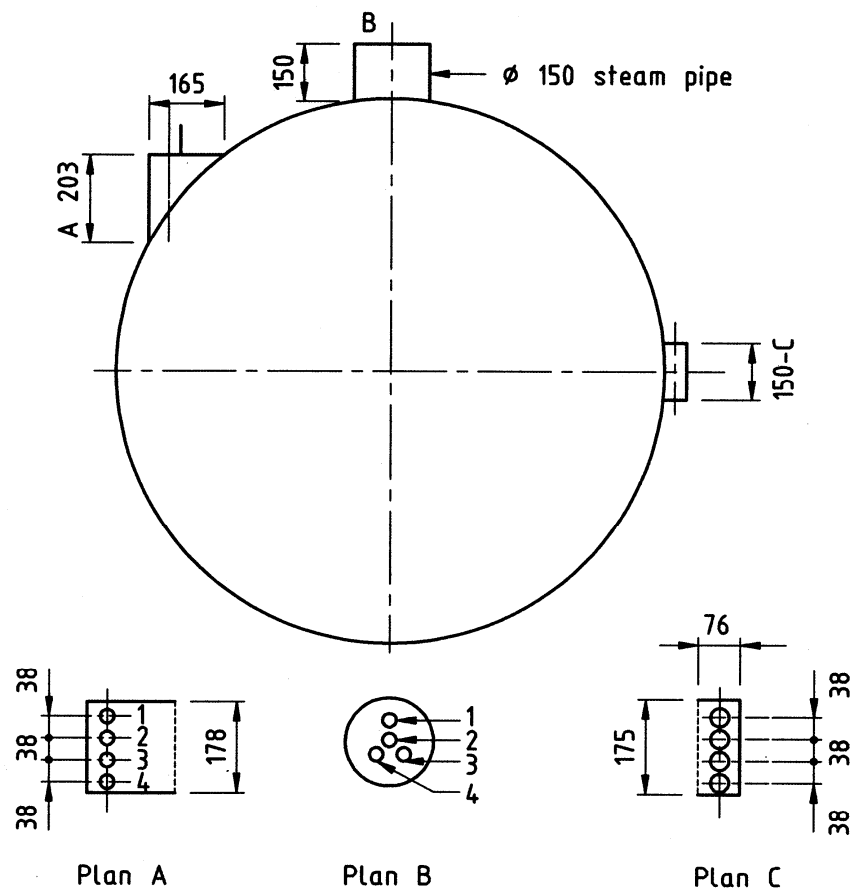
#### 4.5.1.4 The arrangement of instruments on steam retorts

The MIG thermometer shall be installed in such a manner that it can be easily read, without the operator having to go to extraordinary measures to take the reading.

Two thermometers (the recording thermometer and the MIG thermometer) shall be installed in a well that also contains the pocket for use when calibrating, and a 6 mm bleeder vent. An instrument (other than a pressure gauge) that is not installed in such a well shall have a 3 mm bleeder vent next to it. Three acceptable alternative arrangements are shown in Figure 1, however, subject to agreement between the parties concerned, other systems may be used.

NOTE Instruments may also be located in the end of the retort or in any other position that ensures good steam circulation.

Dimensions in millimeters

**Key**

- 1 MIG thermometer
- 2 6 mm bleeder (Petcock)
- 3 Sealed pocket filled with mercury
- 4 Bulb of recording thermometer

Figure 1 — Suggested disposition of thermometer wells and instruments

#### 4.5.1.5 Steam distribution in steam retorts

The distribution of steam in the retort shall be such as to ensure the rapid and even rise of the temperature of the contents to the desired temperature. The following arrangements are recommended, but, subject to agreement between the parties concerned, other systems may be used:

- a) In retorts of length less than 6 m, the steam may enter the retort either at the ends or at the centre of the retort.
- b) In retorts of length 6 m and longer, the steam shall enter the steam spreader pipe near the centre of the retort.
- c) In retorts of length longer than 12 m there shall be branching of the main steam inlet such that two inlets are provided at a distance twice as far apart from one another as from each end of

the retort. The main inlet pipe shall be of diameter of at least 60 mm, and each of the branching spreaders shall not be less than two-thirds the size of the main inlet pipe.

The sizes of the steam spreader pipe and sizes and number of holes shall comply with the following requirements:

1) Steam spreader pipes:

The diameter of the steam inlet and steam spreader pipe may vary from 25 mm to 63 mm (it shall be 60 mm and larger for retorts in excess of 12 m in length). If vents are of a size and are placed as specified in 4.5.1.6.4.1, the total of the cross-sectional areas of the vents shall be at least one vent cross-sectional area larger than the cross-sectional area of the steam inlet.

2) Sizes and number of holes:

The diameter of holes may vary from 4 mm to 12 mm. The number of holes shall be such that the sum total of their cross-sectional area is at least 1.5 times but not more than twice the cross-sectional area of the steam inlet pipe. Holes shall be placed in the top section of the pipe at an angle between 45° and 135° at equal distances on the steam spreader pipe in such a way that they can be inspected for blockages or corrosion damage.

3) Diameter of steam leader pipes to retorts

The steam demand rises extensively if two or more retorts are brought up to processing temperature simultaneously. Table 1 gives directives for the range of pipe diameters in this regard.

**Table 1 — Diameter of steam leader pipes**

1	2
Number of retorts vented simultaneously	Range of diameters of steam leader pipe mm
1	50 to 62.5
2	78 to 88
3	89 to 100
4	101 to 125

#### 4.5.1.6 Vents and venting of steam retorts

##### 4.5.1.6.1 General

Vents are large, valve-controlled ports in retorts used for purging or eliminating air from the retorts during the coming-up time (CUT) and before the start of process timing. Vent lines and valves shall be one pipe size larger than the steam inlet, and where such lines discharge to a common manifold, the manifold shall be so sized that its cross-sectional area is at least equal to the total of the areas of all the lines venting simultaneously.

The valves or cocks used shall be of such size as to ensure an opening at least equivalent to the full pipe bore.

The vents shall be left fully open for a sufficient time to remove all air.

Sometimes a bottom condensate drain is opened to remove condensate build up. Unless the venting schedule specifies otherwise, the drain valve shall be left cracked when the water is removed, so it does not interfere with the venting adequacy.

The venting schedule shall be validated as in 4.5.1.2 and during operation measured with accurate timing and temperature devices.

It is recommended that one of the systems in 4.5.1.6.3 or 4.5.1.6.4 be adopted but, subject to agreement between the parties concerned, other arrangements may be used.

### 4.5.1.6.2 Adequacy of the venting process

The venting of all retorts shall be adequate to ensure the complete removal of air in the stipulated CUT, and uniform steam distribution throughout the retorts when the process temperature (see 4.5.2.1) has been attained.

Temperature distribution tests shall be done to verify the adequacy of the venting process. The results of these tests shall specify the following parameters:

- container type and size;
- minimum initial product temperature;
- retort design;
- number of baskets;
- basket design;
- can configuration;
- venting time; and
- temperature.

### 4.5.1.6.3 Venting horizontal retorts through multiple vents discharging directly to the atmosphere

#### 4.5.1.6.3.1 Vents

One 25 mm diameter vent for every 1,5 m of retort length, or one 20 mm diameter vent for every 1 m of retort length (see figure 2(a)).

There shall be one of these vents within 760 mm of each end of the retort shell. For ease of operation all the valves shall be coupled to a single rod running the length of the retort (see figure 2(b)). This enables all valves to be opened or closed simultaneously by movement of the rod.

#### 4.5.1.6.3.2 Operation

The vent valves shall be wide open when steam is admitted to the retort and shall remain open for at least 5 min. If, at the end of this period the MIG thermometer registers at least 107°C, the valves may be closed. If, however, this temperature has not been attained at the end of 5 min, the valves shall remain open until this temperature has been attained or until a period of at least 7 min has elapsed and the temperature registered has reached at least 104 °C.

NOTE The PA might request longer venting times following on tests or verifications performed by them.

### 4.5.1.6.4 Venting through multiple vents discharging through a manifold to the atmosphere

#### 4.5.1.6.4.1 Vents

One 25 mm diameter vent for every 1.5 m of retort length, or one 20 mm diameter vent for every 1 m of retort length (see figure 2c)).

There shall be one of these vents within 760 mm of each end of the retort shell. The manifold shall be of 65 mm pipe size for retorts of length less than 4.5 m, and of 75 mm pipe size for retorts over 4.5 m in length.

#### 4.5.1.6.4.2 Operation

As in 4.5.1.6.3.2, but with periods of at least 6 min and 8 min for temperatures of 107°C and 104 °C respectively.

4.5.1.6.5 Venting through a single 25 mm top vent (vertical retorts only)

4.5.1.6.5.1 Vents

One 25 mm diameter vent in the top of the retort and discharging directly to the atmosphere.

4.5.1.6.5.2 Operation

As in 4.5.1.6.3.2, but with periods of at least 5 min and 7 min for temperatures of 107 °C and 104 °C respectively.

NOTE The PA might request longer venting times following on tests or verifications performed by them.

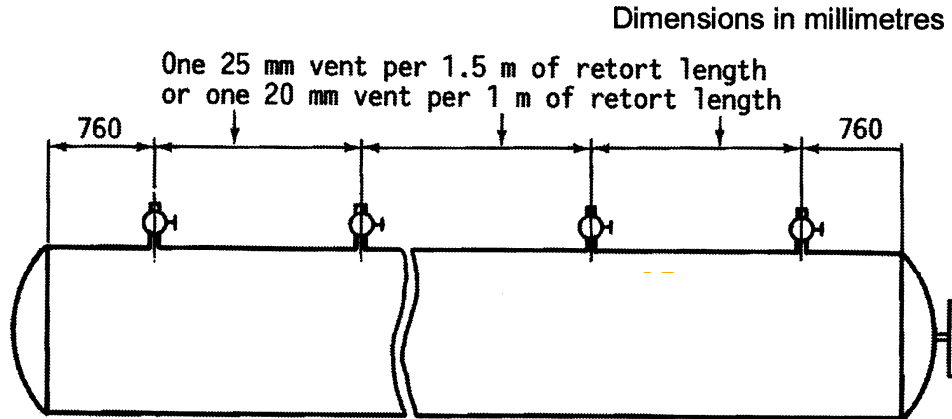


Figure 2(a)

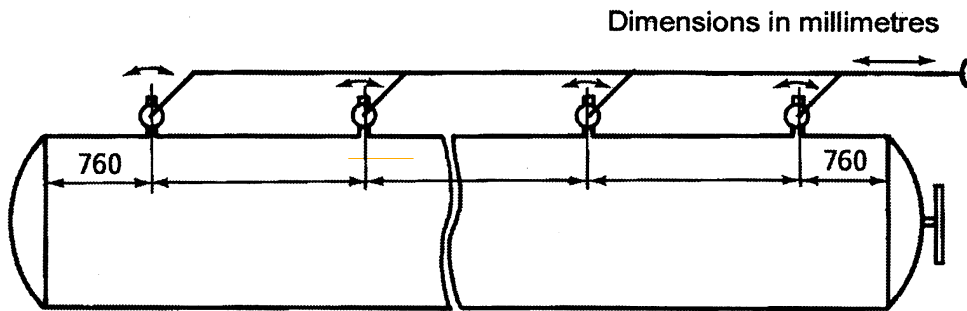


Figure 2(b)

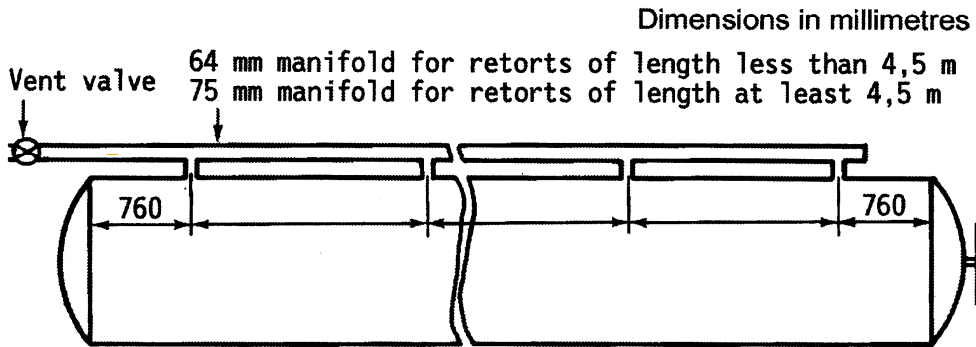


Figure 2(c)

Figure 2 — Venting of retorts

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## 4.5.1.7 Bleeders

Horizontal retorts shall be equipped with 6 mm bleeders (along the top of the retorts) spaced not more than 2.5 m apart, and there shall be one within approximately 300 mm of each end of the retort. Vertical retorts shall have one 6 mm bleeder at the end opposite to that where steam is admitted. Bleeders shall be kept wide open throughout the entire process.

## 4.5.1.8 Automatic controllers

Automatic controllers shall be used on the steam inlet pipes. It is recommended that the type that enables smooth temperature control be used to limit fluctuation in the operating temperature. A steam by-pass (of a size not smaller than that of the line governed by the controller) shall be provided. Automatic controllers shall be calibrated and verified in accordance with the MIG thermometer standards and at least once annually by the national accreditation body (see foreword).

## 4.5.1.9 Drainage of retorts

The pipe(s) draining the retort shall be large enough to permit the rapid removal of water after cooling, and its (their) size shall be at least equivalent to that of the water inlet.

## 4.5.1.10 Diameter of cooling water pipes

The diameter of the pipe supplying cooling water to a retort shall be such that the retort is completely filled with water in not more than 5 min.

## 4.5.1.11 Valves on steam supply lines and venting lines

All valves shall be gate type valves that can open to at least the same cross-sectional area as that of the pipe to which they are linked.

## 4.5.1.12 Steam condensate traps and bleeders

Steam condensate traps and bleeders shall be fitted on the bottom of the retort, the steam supply leader and vent manifolds, as applicable. The PC operator shall ensure that the traps and bleeders are open at all times to drain off condensate.

NOTE A cracked water drain valve in the bottom of the retort may replace traps or bleeders in the bottom of the retort.

## 4.5.2 Operation of retorts

### 4.5.2.1 Processing times and temperatures

The processing times and temperatures shall be established and validated by the PA. The retort operator, the PC officer and the PC operator shall have controlled copies of the scheduled processes for all the can sizes and products produced. These tables shall be controlled and issued by the PC officer. He shall ensure that only the relevant processing tables are available at each location that requires them, while outdated versions shall be destroyed.

In the event that the processing time or temperature for a load is less than the requirements laid down and tabled for the particular product and can size, the documented and recorded process details shall be submitted to the PA for the calculation of  $F_0$  values attained in the particular process. An  $F_0$  value in excess of 3 is the minimum requirement for fish safety purposes.

NOTE Processing times and temperatures are sometimes increased for other reasons such as to control the hardness of fish bones that could be too hard.

Where an  $F_0$  value of 3 has not been attained, the batch shall be isolated and destroyed under supervision and suitable records such as a destruction certificate shall be kept. Each and every deviation from scheduled processes, including recipe and raw material changes, shall be validated by the PA.

#### 4.5.1.8 Automatic controllers

Automatic controllers shall be used on the steam inlet pipes. It is recommended that the type that enables smooth temperature control be used to limit fluctuation in the operating temperature. A steam by-pass (of a size not smaller than that of the line governed by the controller) shall be provided. Automatic controllers shall be calibrated and verified in accordance with the MIG thermometer standards and at least once annually by the national accreditation body (see foreword).

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### 4.5.2.2 Duties of the retort operator and the PC operator

#### 4.5.2.2.1 Daily process report

NOTE In addition to hard copy reports, electronic records may be kept.

The retort operator shall keep a log sheet (of a type similar to the Specimen Report Form No.1, see Annex A) covering each day's processing activities. This report shall include the following:

- a) number of the retort batch;
- b) temperature chart number (if different from retort number);
- c) retort number;

- d) identification number of each basket in the batch;
- e) product processed;
- f) can size;
- g) code of basket contents or of retort batch, if homogeneous;
- h) approximate number of cans of each code;
- i) time at which steam was turned on;
- j) time and temperature at which vents were closed;
- k) time at which processing was started;
- l) time at which processing was stopped;
- m) duration of processing;
- n) processing temperature;
- o) record of checks and all deviations; and
- p) product IT.

#### 4.5.2.2.2 Checking of thermometers and pressure gauges

The retort operator shall check, once daily, the agreement between the recording thermometer and the MIG thermometer on each retort and a verified standard MIG thermometer. If the standard MIG thermometer is used, it shall be inserted in the calibration pocket (see 4.5.1.3.2), and the mouth of the pocket shall be packed with thermal insulating material. The retort operator shall leave the standard thermometer in position in the pocket for at least 5 min at the processing temperature (see 4.5.2.1) before taking the readings of all three thermometers and recording them permanently on the relevant temperature chart. An accurate and verified digital thermometer with a platinum probe may also be used.

The retort operator shall also check the accuracy of the pressure gauge by reference to a temperature versus pressure graph such as that in figure 3. Records of the readings shall be kept.

NOTE The graph shown in figure 3 only reflects the pressure/temperature correlations at sea level. An appropriate graph for other heights above sea level can be obtained from the PA.

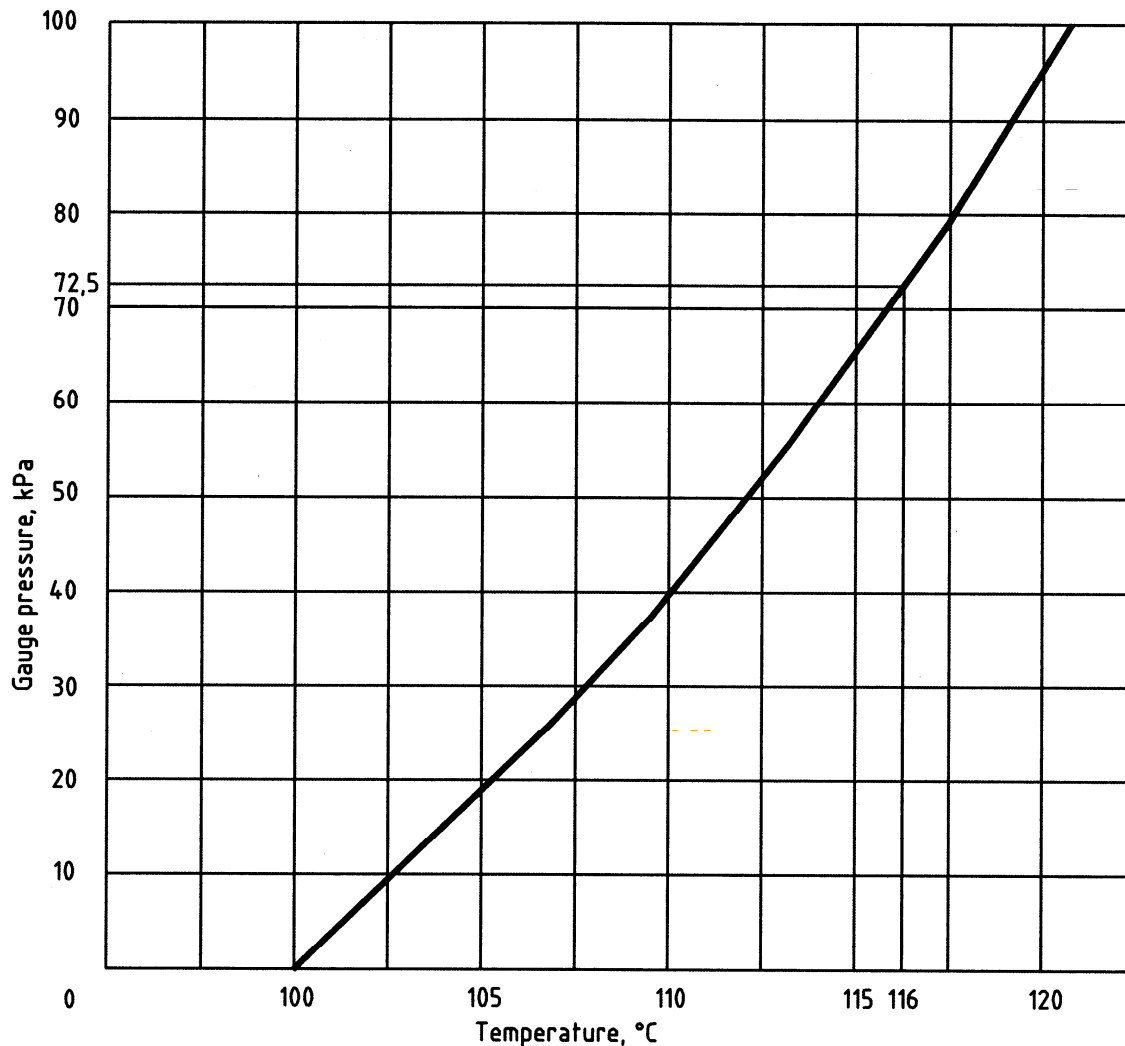


Figure 3 — Temperature versus pressure graph (at sea level)

#### 4.5.2.2.3 Temperature recorder charts

The PC operator shall complete processing records daily by filling in the following data against the relevant record on each temperature chart:

- the date and retort batch number (as taken from his log sheet);
- product processed;
- size of can processed;
- the agreement between the documented process and the thermograph readings as studied and recorded; and
- non-agreements as studied and corrective actions instituted.

#### 4.5.2.2.4 Checking and disposal of records

The retort operator shall check the total number of baskets of cans retorted with the total number of baskets filled at the seamers (as recorded in the seamer logbooks). He shall then pass all the previous day's temperature charts and log sheets to the PC officer. Records shall be held for the duration of the product's shelf life, and an additional six months would be advisable.

#### 4.5.2.2.5 Processing

The retort operator shall process the cans at the temperature and processing time as established and validated by the PC officer (see 4.5.2.1). In the event of any time and temperature deviation from the scheduled process, this shall be immediately reported to the PC officer.

The retort operator shall minimize delays between the arrival of baskets of cans and the commencement of retorting. The retort operator shall measure the centre temperature of a can selected from the first basket into the retort, immediately after closing the retort for the load. This shall be recorded as the initial temperature of the load.

The retort operator shall report to the PC officer any instance where recorder pens are not inking correctly or where he suspects that a recorder is not registering the correct temperature or time. Recorder time shall be verified for accuracy daily and shall correlate with accurate wall clocks that are also verified daily for correctness.

#### 4.5.2.2.6 Cooling

The retort operator shall also ensure that retort cooling is conducted expeditiously and in a manner that will impose the minimum of strain on the containers.

NOTE After the cooling cycle and upon unloading the retort, the retort operator should assess whether the cooling was done correctly by observing the condition of the containers.

#### 4.5.2.2.7 Training

The PC officer shall have available an official training certificate for each retort operator indicating that the retort operator was officially trained to operate the specific type of retort.

### 4.5.2.3 Duties of the PC officer

#### 4.5.2.3.1 General

The PC officer shall verify that the retort operator is conversant with the standard times and process temperatures employed for each product/can size combination in production at a given production period and that the operator sets the control instruments correctly.

#### 4.5.2.3.2 Isolation of cans from defective processing

For easy traceability purposes the PC officer shall arrange the unpacking of baskets of dry and cooled cans in such a manner that all affected cans in any defective process being detected, can be isolated from the main production.

#### 4.5.2.3.3 Daily duties

##### 4.5.2.3.3.1 The PC officer shall personally

- a) remove from the temperature recorders all charts used during the previous day's processing and replace them with charts correctly dated and bearing the number of the recorder, and
- b) hand the used charts to the PC operator so that he can add to them the data detailed in 4.5.2.2.3.

##### 4.5.2.3.3.2 When this data has been entered, the PC officer shall

- a) inspect the charts and the corresponding daily process report,
- b) carefully check the processing time and temperature of each retort load.
- c) confirm that all the processes comply with 4.5.2.1 before allowing the cans to be moved to the

store,

- d) verify and sign off the process reports, and
- e) confirm that all baskets filled at the seamers have been processed.

**4.5.2.3.3.3** In the event of non-compliance with 4.5.2.1, the PC officer shall

- a) ensure that the retort load in question is quarantined for screening, retention or incubation and microbiological examination before being released, and
- b) ensure that, if the affected cans cannot be isolated, the entire day's production of that product and can size shall be quarantined for corrective action.

**4.5.2.3.3.4** In the event of a recorder being reported to the PC officer as not functioning correctly, the PC officer shall

- a) immediately inform the authority administering this standard,
- b) take steps to isolate all cans affected by the fault, for corrective action.
- c) ensure that the faulty instrument is not used until it has been repaired,
- d) ensure that all cans processed while the instrument was out of order are quarantined while corrective action is implemented, and
- e) ensure that the retort charts are stored in chronological order and are available for inspection for at least three years.

## 4.6 Cooling of processed cans

### 4.6.1 General

The cooling of all processed cans shall be conducted in such a way as to avoid permanent distortion of the cans.

### 4.6.2 Water

The water used for cooling shall be so treated that it complies with the requirements of EAS 12. If the water is treated with chlorine, it shall be so chlorinated as to contain at least 2 mg/l but not more than 4 mg/l of available chlorine, during the period from 30 min before use until the end of cooling operations. After cooling operations, the residual chlorine concentration shall be at least 0.5 mg/l. Available chlorine content determination shall be carried out with standard colorimeters and chemical indicators available in the trade.

### 4.6.3 Duties of the PC officer

The PC officer shall ensure that a PC operator determines the available chlorine content of chlorinated water daily

- a) during the period from 1 h to 30 min before daily cooling operations commence, and
- b) at intervals of duration not exceeding 2 h during the entire cooling process.

If, during a test, the available chlorine content falls below 2 mg/l, the PC officer shall ensure that testing is undertaken at intervals not exceeding 30 min until he is satisfied that an available chlorine content of at least 2 mg/l is present at all times.

If cooling water is reused, it might become so contaminated that available chlorine will disappear

almost immediately. In such cases, the cooling water shall be replaced with fresh water. Water for reuse shall be filtered through sand filters that are backwashed frequently with clean water containing chlorine levels up to 8 mg/l, and the water shall be cooled before chlorination. The water shall be in contact with at least 2 mg/l chlorine for at least 20 min before reuse.

After each chlorine determination, the PC officer shall ensure that all deviation of available chlorine content from 2 mg/L is corrected, and that a daily report form, containing the data detailed in Specimen Report Form No.2 (see Annex A) is completed and made available for inspection.

## 4.7 Storage and inspection

### 4.7.1 General

Cooled, processed cans shall be left in a temporary storage place (until dry, in the retort baskets) until the PC officer has authorized their removal. The cooling of cans shall take place in a locked enclosed area with controlled access, and no cans shall be touched until they are dry and have cooled to below 35 °C. Upon receipt of a certificate of clearance from the PC officer, the cans shall be prepared for dispatch to the storage and labelling area.

Before labelling, the cans shall be inspected for contour defects, and damaged cans (including cans with obvious seam defects) shall be removed from the stock. Details of all cans removed shall be categorized and recorded, and made available for inspection.

### 4.7.2 Duties of the PC officer

The PC officer shall ensure that a daily record is kept of the following:

- a) product labelled;
- b) size of can;
- c) code;
- d) number of cans labelled;
- e) number of cans rejected because of blowing, flipping or leakage;
- f) number of cans rejected because of damage (nature or type of damage shall be recorded); and
- g) number of cans rejected because of obvious seam defects other than those which were rejected because of blowing, flipping or leakage (the seamer number and time shall be recorded).

The PC officer shall examine and sign the daily records and ensure that these records are kept available for inspection for a period equal to the product's shelf life plus six months. He shall also ensure that the provisions of 4.7.1 are complied with.

## 5 Corrective action required

### 5.1 General

In the event that any of the processes or procedures are found to deviate from specified tolerances, the PC officer shall ensure that documented and controlled corrective actions are implemented. The corrective action might be predetermined (for example, in accordance with the Hazard Analysis Critical Control Point (HACCP) plans) and shall be appropriate for the particular deviation, or, if such a plan is not available, the processor shall document that the following procedures shall be followed:

- a) the affected product segregated and quarantined;
- b) a review performed to determine the acceptability of the affected product for trading purposes

by an individual who has adequate training or experience to perform such a review (for example, the PA may assist);

- c) corrective action taken to ensure that no product enters commerce that is either injurious to health or is otherwise adulterated as a result of the deviation;
- d) corrective action taken to correct the cause of the deviation;
- e) a timely re-assessment performed by an individual or individuals that have the authority and necessary training to determine whether the process control procedures have to be modified to reduce the risk of recurrence of the deviation;
- f) the process control procedures modified where necessary; and
- g) corrective action procedures fully documented so that they can be verified and reviewed as necessary. These records shall be kept for the duration of the product's shelf life, and an additional six months would be advisable.

## **5.2 Records**

**5.2.1** All records that are essential to ensure efficient process control procedures shall be safely kept for at least three years. In addition to normal process control, the following records shall also be available:

- a) Records demonstrating the safety and suitability of all raw materials used for canning.
- b) Records demonstrating the safety, suitability and traceability of containers (cans and ends).
- c) Records reflecting control of hygiene and good manufacturing practice.
- d) Records reflecting the integrity of cans before labelling.

**NOTE** It is strongly recommended that a suitable and automatic can defect detection system be incorporated before can labelling so that the types of defects can be monitored, documented, and where necessary, investigated. Defect detection systems might, under certain conditions, demonstrate the necessity to perform a 100 % screen on particular batches to remove and destroy unsafe containers.

Each type of container defect found before or during the labelling operation shall be identified and recorded for corrective action.

**5.2.2** The PC officer shall study all the records so as to be able to make a decision on the safety and suitability of products for trading purposes. Products found to be unsuitable for trading shall be destroyed under controlled conditions, and records shall be maintained to demonstrate how the affected product was disposed of and the nature of the defects detected. In the event of uncertainty, a suitable specialist on processed fish shall be consulted for guidance.

**Annex A**  
(informative)

**Specimen report forms**

**A.1 Specimen Report Form No.1**

**Daily process report**

Factory..... Date.....

Retort batch number	Chart number	Retort number	Basket number	Product	Can size	Code	Approximate number of cans	Steam on	Temperature and time vent closed	Process start	Process end	Process time	Process temperature	Remarks

Retort operator: Name ..... Signature..... Date.....

Process control officer: Name..... Signature..... Date.....

**A.2 Specimen Report Form No. 2**

**Report on cooling water**

Factory..... Date.....

Time tested	Available chlorine (Operator)	Available chlorine (or other remarks) (Inspector)

Signature of process control officer:.....

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