SRI LANKA STANDARD 873 PART 1 : 2015

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CODE OF HYGIENIC PRACTICE FOR CANNED FOODS

PART 1 - LOW ACID CANNED FOODS

(First Revision)

SRI LANKA STANDARDS INSTITUTION

Sri Lanka Standard
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SLS 873 Part 1 : 2015

Gr. 17

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Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This standard does not purport to include all the necessary provisions of a contract.

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TABLE OF CONTENTS

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FOREWORD

This standard was approved by the Sectoral Committee on Food Products and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 2015-10-08.

The principles of canning are to destroy all enzymes and those microorganisms capable of activity in the food and to prevent further contamination of the food with fresh enzymes and microorganisms. Hermetically sealed containers are used to prevent recontamination by those enzymes and microorganisms to retain the sterility of the food.

The primary public health concern with low-acid and acidified low-acid canned foods is the formation of the toxin produced by the heat resistant microorganism *Clostridium botulinum*. This toxin is the most deadly neuro-paralytic toxin known. Thermal processing schedules should be adopted to ensure that this organism and its spores are completely destroyed. It is essential that these scheduled processes for low acid and acidified low acid foods should be established by qualified, experienced persons who have detailed knowledge of the requirements for these types of products packed in hermetically sealed containers and who have adequate facilities for undertaking this work.

In general consumers do not have the available knowledge or means of determining the hygienic quality of the food they purchase. For this, they rely on the hygienic standards/ codes of various industries that prepare and handle foods. Unless the factory producing the food is governed by a strict hygienic code, the quality of food produced cannot be considered as safe.

This Code was first published in 1989 and is being revised with a view to updating it with the latest publication of Codex Standard – Code of Hygienic Practice for low and acidified low acid canned foods CAC/RCP 23 (2011). This revision identifies the necessary requirements that have to be fulfilled in order to ensure the low acid and acidified low acid canned foods are safe and suitable for human consumption and provides guidance containing conditions specifically linked to those products.

In order to accommodate different types of canned foods within the scope of one standard, this Code is published in two parts.
Part 1- Low acid canned foods
Part 2- Acidified low acid canned foods

This Code is subject to the restrictions imposed under the Food Act No. 26 of 1980 and the regulations framed there under, wherever applicable.

In revising this Code, the assistance derived from the publications of the Codex Alimentarius Commission (CAC) is gratefully acknowledged.

1 SCOPE

1.1 This Part applies to the canning and heat processing of low acid foods, packaged in hermetically sealed containers.

1.2 This Part does not apply to acidified low acid foods and foods in hermetically sealed containers which require refrigeration.

2 REFERENCES

SLS 143 Code of practice for general principles of food hygiene
SLS 614 Potable water

3 DEFINITIONS

For the purposes of this Code, the following definitions should apply:

3.1 acid food: A food that has a natural pH of 4.6 or below.

3.2 acidified low acid food: A food which has been treated so as to attain an equilibrium pH of 4.6 or lower after heat processing.

3.3 aseptic processing and packaging: Filling of a commercially sterile product into sterilized containers followed by hermetical sealing with a sterilized closure in an atmosphere free from microorganisms.

3.4 bleeders (Bleeds)**:** Small orifices through which steam and other gases escape from the retort throughout the entire heat process.

3.5 canned food: Commercially sterile food in hermetically sealed containers.

3.6 cleaning: The removal of food residues, dirt, grease or other objectionable material.

3.7 code lot: All products produced during a period of time identified by a specific container code mark.

3.8 coming-up-time: The 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 temperatures.

3.9 commercial sterility of thermally processed food: The condition achieved by application of heat, sufficient, alone or in combination with other appropriate treatments, to render the food free from microorganisms capable of growing in the food at normal non-refrigerated conditions at which the food is likely to be held during distribution and storage.

3.10 commercial sterility of equipment and containers used for aseptic processing and packaging of food: The condition achieved and maintained by application of heat, or other appropriate treatment, which renders such equipment and containers free from microorganisms capable of growing in the food at temperatures at which the food is likely to be held during distribution and storage.

3.11 disinfection: The reduction, without adversely affecting the food, by means of hygienically satisfactory chemical agents and/ or physical methods, of the number of microorganisms to a level that will not lead to harmful contamination of food.

3.12 equilibrium pH: The pH of the macerated heat processed food product.

3.13 flame sterilizer: An apparatus in which hermetically sealed containers of foods are agitated at atmospheric pressure, by either continuous, discontinuous or reciprocating movement, over gas flames to achieve commercial sterility of foods.

3.14 heating curve: A graphical representation of the rate of temperature change in the food throughout the heat process; this is usually plotted on semi-log graph paper so that the temperature on an inverted log scale is plotted against time on a linear scale.

3.14.1 ***broken heating curve*****:** A heating curve which shows a distinct change in the rate of heat transfer such that the curve may be represented by two or more distinct straight lines.

3.14.2 ***simple heating curve*****:** A heating curve which approximates a straight line.

3.15 headspace: The volume in a container not occupied by the food.

3.16 holding time: See sterilization time (3.26).

3.17 incubation tests : Tests in which the heat processed product is kept at a specific temperature for a specified period of time in order to determine if outgrowth of microorganisms occurs under these conditions.

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

3.19 low acid food: Any food, other than alcoholic beverages, where any component has a pH value greater than 4.6 and a water activity greater than 0.85.

3.20 potable water: Water conforms to the **SLS 614.**

3.21 product container: A container designed to be filled with food and hermetically sealed.

3.21.1 ***hermetically sealed containers*****:** Containers which are sealed to protect the contents against the entry of microorganisms during and after heat processing.

3.21.2 ***rigid container*****:** The shape or contours of the filled and sealed container are neither affected by the enclosed product nor deformed by an external mechanical pressure of up to 0.7 kg/cm^2 (10 psig), (i.e., normal firm finger pressure).

3.21.3 ***semi-rigid container*****:** The shape or contours of the filled, sealed container are not affected by the enclosed product under normal atmospheric temperature and pressure but can be deformed by an external mechanical pressure of less than 0.7 kg/ cm^2 (10 psig), (i.e., normal firm finger pressure).

3.21.4 ***flexible container*****:** The shape or contours of the filled, sealed container are affected by the enclosed product.

3.22 retort: A pressure vessel designed for thermal processing of food packed in hermetically sealed containers.

3.23 scheduled process: The thermal process chosen by the processor for a given product and container size to achieve at least commercial sterility.

3.24 seals of a semi-rigid container and lid or flexible container: Parts which are fused together in order to close the container.

3.25 sterilization temperature: The temperature maintained throughout the thermal process as specified in the scheduled process.

3.26 sterilization time: The time between the moment sterilization temperature is achieved and the moment cooling started.

3.27 thermal process: The heat treatment to achieve commercial sterility and is quantified in terms of time and temperature.

3.28 venting: Thorough removal of the air from steam retorts by steam prior to a scheduled process.

3.29 water activity (a_W): The ratio of the water vapour pressure of the product to the vapour pressure of pure water at the same temperature.

4 HYGIENE REQUIREMENTS IN PRODUCTION/ HARVESTING AREA

4.1 Environmental hygiene and areas from which raw materials are derived

4.1.1 *Unsuitable growing or harvesting areas*

Food should not be grown or harvested where the presence of potentially harmful substances would lead to an unacceptable level of such substances in the food.

4.1.2 *Protection from contamination by wastes*

4.1.2.1 Raw food materials should be protected from contamination by human, animal, domestic, industrial and agricultural wastes which may be present at levels likely to be a hazard to health. Adequate precautions should be taken to ensure that these wastes are not used and are not disposed of in a manner which may constitute a health hazard through the food.

4.1.2.2 Arrangements for the disposal of domestic and industrial wastes in areas from which raw materials are derived should be acceptable to the official agency having jurisdiction.

4.1.3 *Irrigation control*

Food should not be grown or produced in areas where the water used for irrigation might constitute a health hazard to the consumer through the food.

4.1.4 *Pest and disease control*

Control measures involving treatment with chemical, physical or biological agents should only be undertaken by or under direct supervision of personnel who have a thorough understanding of the potential hazards to health, particularly those which may arise from residues in the food. Such measures should only be carried out in accordance with the recommendations of the official agency having jurisdiction.

4.2 Harvesting and production

4.2.1 *Techniques*

Methods and procedures associated with harvesting and production should be hygienic and such as not to constitute a potential health hazard or result in contamination of the product.

4.2.2 *Equipment and containers*

Equipment and containers used for harvesting and production should be so constructed and maintained as not to constitute a hazard to health. Containers which are re-used should be of such material and construction as will permit easy and thorough cleaning. They should be cleaned and maintained clean and, where necessary, disinfected. Containers previously used for toxic materials should not subsequently be used for holding foods or food ingredients.

4.2.3 *Removal of obviously unfit raw materials*

Raw materials which are obviously unfit for human consumption should be segregated during harvesting and production. Those which cannot be made fit by further processing should be disposed of in such a place and in such a manner as to avoid contamination of the food and/or water supplies or other food materials.

4.2.4 *Protection against contamination and damage*

Suitable precautions should be taken to protect the raw materials from being contaminated by pests or by chemical, physical or microbiological contaminants or other objectionable substances. Precautions should be taken to avoid damage.

4.3 Storage at the place of production/ harvesting

Raw materials should be stored under conditions which provide protection against contamination and minimize damage and deterioration.

4.4 Transportation

4.4.1 *Conveyances*

Conveyances for transporting the harvested crop or raw materials from the production area or place of harvest or storage should be adequate for the purpose intended and should be of such material and construction as will permit easy and thorough cleaning. They should be cleaned and maintained clean, and where necessary disinfected and disinfested.

4.4.2 *Handling procedures*

All handling procedures should be such as will prevent raw materials from being contaminated. Care should be taken to prevent spoilage, to protect against contamination and to minimize damage. Special equipment - such as refrigeration equipment – should be used if the nature of the product or distances involved so indicate. If ice is used in contact with the product it should be of the quality required in 5.4.1.2 of this Code.

5 ESTABLISHMENT: DESIGN AND FACILITIES

5.1 Location

Establishments should be located in areas which are free from objectionable odours, smoke, dust or other contaminants and are not subject to flooding.

5.2 Roadways and areas used by wheeled traffic

Such roadways and areas serving the establishment which are within its boundaries or in its immediate vicinity should have a hard paved surface suitable for wheeled traffic. There should be adequate drainage and provision should be made to allow for cleaning.

5.3 Buildings and facilities

5.3.1 Buildings and facilities should be of sound construction and maintained in good repair.

5.3.2 Adequate working space should be provided to allow for satisfactory performance of all operations.

5.3.3 The design should be such as to permit easy and adequate cleaning and to facilitate proper supervision of food hygiene.

5.3.4 The buildings and facilities should be designed to prevent the entrance and harbouring of pests and the entry of environmental contaminants such as smoke, dust, etc.

5.3.5 Buildings and facilities should be designed to provide separation, by partition, location or other effective means, between those operations which may cause cross-contamination.

5.3.6 Buildings and facilities should be designed to facilitate hygienic operations by means of a regulated flow in the process from the arrival of the raw material at the premises to the finished product, and should provide for appropriate temperature conditions for the process and the product.

5.3.7 In food handling areas **:**

- **Floors,** where appropriate, should be of water-proof, non-absorbent, washable, non-slip materials, without crevices, and should be easy to clean and disinfect. Where appropriate, floors should slope sufficiently for liquids to drain to trapped outlets.
- **Walls**, where appropriate, should be of water-proof, non-absorbent, washable materials, sealed and free of insects, and should be light coloured. Up to a height appropriate for the operation they should be smooth and without crevices, and should be easy to clean and disinfect. Where appropriate, angles between walls, between walls and floors and between walls and ceilings should be sealed and coved to facilitate cleaning.
- **Ceilings**, should be so designed, constructed and finished as to prevent the accumulation of dirt and minimize condensation, mould development and flaking, and should be easy to clean.
- **Windows** and other openings should be so constructed as to avoid accumulation of dirt and those which open should be fitted with insect proof screens. Screens should be easily movable for cleaning and kept in good repair. Internal window sills, if present, should be sloped to prevent use as shelves.
- **Doors** should have smooth, non-absorbent surfaces and, where appropriate, be self-closing and close fitting.
- **Stairs, lift cages and auxiliary structures such as platforms, ladders, chutes,** should be so situated and constructed as not to cause contamination to food. Chutes should be constructed with inspection and cleaning hatches.

5.3.8 In food handling areas all overhead structures and fittings should be installed in such a manner as to avoid contamination directly or indirectly of food and raw materials by condensation and drip, and should not hamper cleaning operations. They should be insulated where appropriate and be so designed and finished as to prevent the accumulation of dirt and to minimize condensation, mould development and flaking. They should be easy to clean.

5.3.9 Living quarters, toilets and areas where animals are kept should be completely separated from and should not open directly on to food handling areas.

5.3.10 Where appropriate, establishments should be so designed that access can be controlled.

5.3.11 The use of materials which cannot be adequately cleaned and disinfected, such as wood, should be avoided unless its use would clearly not be a source of contamination.

5.4 Sanitary facilities

5.4.1 *Water supply*

5.4.1.1 An ample supply of water, conforming to the **SLS 614**, under adequate pressure and of suitable temperature should be available with adequate facilities for its storage, where necessary, and distribution, and with adequate protection against contamination.

5.4.1.2 **Ice** should be made from water, conforming to the **SLS 614**, and should be manufactured, handled and stored so as to protect it from contamination.

5.4.1.3 **Steam** used in direct contact with food or food contact surfaces should contain no substances which may be hazardous to health or may contaminate the food.

5.4.1.4 **Non-potable water** used for steam production, refrigeration, fire control and other similar purposes not connected with food should be carried in completely separate lines, identifiable preferably by colour, and with no cross-connection with or back-siphonage into the system carrying potable water.

5.4.2 *Effluent and waste disposal*

Establishments should have an efficient effluent and waste disposal system which should at all times be maintained in good order and repair. All effluent lines (including sewer systems) should be large enough to carry peak loads and should be so constructed as to avoid contamination of potable water supplies.

5.4.3 *Changing facilities and toilets*

Adequate, suitable and conveniently located changing facilities and toilets should be provided in all establishments. Toilets should be so designed as to ensure hygienic removal of waste matter. These areas should be well lit, ventilated and should not open directly on to food handling areas. Hand washing facilities with warm/ hot and/ or cold water, a suitable hand-cleaning preparation, and with suitable hygienic means of drying hands, should be provided adjacent to toilets and in such a position that the employee must pass them when returning to the processing area. Where hot and cold water are available mixing taps should be provided. Where paper towels are used, a sufficient number of dispensers and receptacles should be provided near to each washing facility. Taps of a non-hand operable type are desirable. Notices should be posted directing personnel to wash their hands after using the toilet.

5.4.4 *Hand washing facilities in processing areas*

Adequate and conveniently located facilities for hand washing and drying should be provided wherever the process demands. Where appropriate, facilities for hand disinfection should also be provided. Warm/ hot and/ or cold water and a suitable hand-cleaning preparation should be provided. Where hot and cold water are available, mixing taps should be provided. There should be suitable hygienic means of drying hands. Where paper towels are used, a sufficient number of dispensers and receptacles should be provided adjacent to each washing facility. Taps of a non-hand operable type are desirable. The facilities should be furnished with properly trapped waste pipes leading to drains.

5.4.5 *Disinfection facilities*

Where appropriate, adequate facilities for cleaning and disinfection of working implements and equipment should be provided. These facilities should be constructed of corrosion-resistant materials, capable of being easily cleaned, and should be fitted with suitable means of supplying hot and/ or cold water in sufficient quantities.

5.4.6 *Lighting*

Adequate natural or artificial lighting should be provided throughout the establishment. Where appropriate, the lighting should not alter colours and the intensity should not be less than:

540 lux (50 foot candles) at all inspection points
220 lux (20 foot candles) in work rooms
110 lux (10 foot candles) in other areas

Light bulbs and fixtures suspended over food materials in any stage of production should be of a safety type and protected to prevent contamination of food in case of breakage.

5.4.7 *Ventilation*

Adequate ventilation should be provided to prevent excessive heat, steam condensation and dust and to remove contaminated air. The direction of that air flow should never be from a dirty area to a clean area. Ventilation openings should be provided with a screen or other protecting enclosure of non-corrodible material. Screens should be easily removable for cleaning.

5.4.8 *Facilities for storage of waste and inedible material*

Facilities should be provided for the storage of waste and inedible material prior to removal from the establishment. These facilities should be designed to prevent access to waste or inedible material by pests and to avoid contamination of food, potable water, equipment, buildings or roadways on the premises.

5.5 Equipment and utensils

5.5.1 *Materials*

All equipment and utensils used in food handling areas and which may contact food should be made of material which does not transmit toxic substances, odour or taste, is non-absorbent, resistant to corrosion and capable of withstanding repeated cleaning and disinfection. Surfaces should be smooth and free from pits and crevices. The use of wood and other materials which cannot be adequately cleaned and disinfected should be avoided except when their use would clearly not be a source of contamination. The use of different materials in such a way that contact corrosion can occur should be avoided.

5.5.2 *Sanitary design, construction and installation*

5.5.2.1 **All equipment and utensils** should be so designed and constructed as to prevent hygienic hazards and permit easy and thorough cleaning and disinfection and, where practicable, be visible for inspection. Stationary equipment should be installed in such a manner as to permit easy access and thorough cleaning. Canneries should have suitable conveyor systems to transport empty product containers to the filling stations. Their design, structure and installation should ensure that such containers do not become contaminated or unacceptable because of damage.

5.5.2.2 **Containers for inedible material and waste** should be leak-proof, constructed of metal or other suitable impervious material which should be easy to clean or disposable and able to be closed securely.

5.5.2.3 **All refrigerated spaces** should be equipped with temperature measurement or recording devices.

5.5.2.4 **Retorts** must be designed, installed, operated and maintained in accordance with the safety standards for pressure vessels of the agency having jurisdiction. Over-pressure facilities required (e.g. for flexible containers) may mean that the safe working pressure rating of the retort may have to be considerably increased.

5.5.3 *Equipment identification*

Equipment and utensils used for inedible materials or waste should be so identified and should not be used for edible products.

5.6 Steam supply

Steam supply to the thermal processing system should be adequate to the extent needed to ensure that sufficient steam pressure is maintained during thermal processing, regardless of other demands for steam by the plant.

6 ESTABLISHMENT: HYGIENE REQUIREMENTS

6.1 Maintenance

The buildings, equipment, utensils and all other physical facilities of the establishment, including drains, should be maintained in good repair and in an orderly condition. As far as practicable, rooms should be kept free from steam, vapour and surplus water.

6.2 Cleaning and disinfection

6.2.1 Cleaning and disinfection should meet the requirements of this Code. For further information on cleaning and disinfection procedures refer the **SLS 143**.

6.2.2 To prevent contamination of food, all equipment and utensils should be cleaned as frequently as necessary and disinfected whenever circumstances demand.

6.2.3 Adequate precautions should be taken to prevent food from being contaminated during cleaning or disinfection of rooms, equipment or utensils by water and detergents or by disinfectants and their solutions. Detergents and disinfectants should be suitable for the purpose intended and should be acceptable to the official agency having jurisdiction. Any residues of these agents on a surface which may come into contact with food should be removed by thorough rinsing with water, conforming to **SLS 614**, before the area or equipment is again used for handling of food.

6.2.4 Either immediately after cessation of work for the day or at such other times as may be appropriate, floors, including drains, auxiliary structures and walls of food handling areas should be thoroughly cleaned.

6.2.5 Changing facilities and toilets should be kept clean at all times.

6.2.6 Roadways and yards in the immediate vicinity of and serving the premises should be kept clean.

6.3 Hygiene control programme

A permanent cleaning and disinfection schedule should be drawn up for each establishment to ensure that all areas are appropriately cleaned and that critical areas, equipment and material are designated for special attention. A single individual who should preferably be a permanent member of the staff of the establishment and whose duties should be independent of production, should be appointed to be responsible for the cleanliness of the establishment. He should have a thorough understanding of the significance of contamination and the hazards involved. All cleaning personnel should be well-trained in cleaning techniques.

6.4 By-products

By-products should be stored in such a manner as to avoid contamination of food. They should be removed from the working areas as often as necessary and at least daily.

6.5 Storage and disposal of waste

Waste material should be handled in such a manner as to avoid contamination of food or potable water. Care should be taken to prevent access to waste by pests. Waste should be removed from the food handling and other working areas as often as necessary and at least daily. Immediately after disposal of the waste, receptacles used for storage and any equipment which has come into contact with the waste should be cleaned and disinfected. The waste storage area should also be cleaned and disinfected.

6.6 Exclusion of domestic animals

Animals that are uncontrolled or that could be a hazard to health should be excluded from establishments.

6.7 Pest control

6.7.1 There should be an effective and continuous programme for the control of pests. Establishments and surrounding areas should be regularly examined for evidence of infestation.

6.7.2 When pests gain entrance to the establishment, eradication measures should be instituted. Control measures involving treatment with chemical, physical or biological agents should only be undertaken by or under direct supervision of personnel who have a thorough understanding of the potential hazards to health resulting from the use of these agents, including those hazards which may arise from residues retained in the product. Such measures should only be carried out in accordance with the recommendations of the official agency having jurisdiction.

6.7.3 Pesticides should only be used if other precautionary measures cannot be used effectively. Before pesticides are applied, care should be taken to safeguard all food, equipment and utensils from contamination. After application, contaminated equipment and utensils should be thoroughly cleaned to remove residues prior to being used again.

6.8 Storage of hazardous substances

6.8.1 Pesticides or other substances which may represent a hazard to health should be suitably labelled with a warning about their toxicity and use. They should be stored in locked rooms or cabinets used only for that purpose and dispensed and handled only by authorized and properly trained personnel or by persons under strict supervision of trained personnel. Extreme care should be taken to avoid contaminating food.

6.8.2 Except when necessary for hygienic or processing purposes, no substance which could contaminate food should be used or stored in food handling areas.

6.9 Personal effects and clothing

Personal effects and clothing should not be deposited in food handling areas.

7 PERSONAL HYGIENE AND HEALTH REQUIREMENTS

7.1 Hygiene training

Managers of establishments should arrange for adequate and continuing training of all food handlers in hygienic handling of food and in personal hygiene so that they understand the precautions necessary to prevent contamination of food. Instruction should include relevant parts of this Code.

7.2 Medical examination

Persons who come into contact with food in the course of their work should have a medical examination prior to their employment if the official agency having jurisdiction, acting on medical advice, considers that this is necessary, whether because of epidemiological considerations, the nature of the food prepared in a particular establishment or the medical history of the prospective food handler. Medical examination of a food handler should be carried out at other times when clinically or epidemiologically indicated.

7.3 Communicable diseases

The management should take care to ensure that no person, while known or suspected to be suffering from, or to be a carrier of a disease likely to be transmitted through food or while afflicted with infected wounds, skin infections, sores or with diarrhoea, is permitted to work in any food handling area in any capacity in which there is any likelihood of such a person directly or indirectly contaminating food with pathogenic microorganisms. Any person so affected should immediately report to the management that he is ill.

7.4 Injuries

Any person who has a cut or wound should not continue to handle food or food contact surfaces until the injury is completely protected by a water-proofing covering which is firmly secured, and which is conspicuous in colour. Adequate first-aid facilities should be provided for this purpose.

7.5 Washing of hands

Every person, while on duty in a food handling area should wash his hands frequently and thoroughly with a suitable hand cleaning preparation under running water in compliance with the 5.4.1.1 of this Code. Hands should always be washed before commencing work, immediately after using the toilet, after handling contaminated material and whenever else necessary. After handling any material which might be capable of transmitting disease, hands should be washed and disinfected immediately. Notices requiring hand-washing should be displayed. There should be adequate supervision to ensure compliance with this requirement.

7.6 Personal cleanliness

Every person, while on duty in a food handling area should maintain a high degree of personal cleanliness, and should at all times while so engaged wear suitable protective clothing including head covering and footwear, all of which articles should be cleanable unless designed to be disposed of and should be maintained in a clean condition consistent with the nature of the work in which the person is engaged. Aprons and similar items should not be washed on the floor. When food is manipulated by hand, any jewellery that cannot be adequately disinfected should be removed from the hands. Personnel should not wear any insecure jewellery when engaged in food handling.

7.7 Personal behaviour

Any behaviour which could result in contamination of food, such as eating, use of tobacco, chewing (e.g., gum, sticks, betel nuts, etc.) or unhygienic practices such as spitting, should be prohibited in food handling areas.

7.8 Gloves

Gloves, if used in the handling of food products, should be maintained in a sound, clean and sanitary condition. The wearing of gloves does not exempt the operator from having thoroughly washed hands.

7.9 Visitors

Precautions should be taken to prevent visitors to food handling areas from contaminating food. These may include the use of protective clothing. Visitors should observe the provisions recommended in 6.9, 7.3, 7.4 and 7.7 of this Code.

7.10 Supervision

Responsibility for ensuring compliance by all personnel with all requirements of 7.1 to 7.9 inclusive should be specifically allocated to competent supervisory personnel.

8 ESTABLISHMENT: HYGIENIC PROCESSING REQUIREMENTS

8.1 Raw material requirements

8.1.1 Raw material or ingredient should not be accepted by the establishment if known to contain parasites, microorganisms or toxic, decomposed or extraneous substances which will not be reduced to acceptable levels by normal plant procedures of sorting and/or preparation of processing.

8.1.2 Raw materials or ingredients should be inspected and sorted prior to being moved into the processing line and where necessary laboratory tests should be made. Only clean sound raw materials or ingredients should be used in further processing.

8.1.3 Raw materials and ingredients stored on the premises of the establishment should be maintained under conditions that will prevent spoilage, protect against contamination and minimize damage. Stocks of raw materials and ingredients should be properly rotated.

8.1.4 Blanching by heat, when required in the preparation of food for canning, should be followed by either rapidly cooling the food or subsequent processing without delay. Thermophilic growth and contamination in blanchers should be minimized by good design, the use of adequate operating temperatures and by routine cleaning.

8.1.5 All steps in the production process, including filling, closing, heat processing and cooling should be performed as rapidly as possible and under conditions which will prevent contamination, and deterioration, and minimize the growth of microorganisms in the food.

8.2 Prevention of cross-contamination

8.2.1 Effective measures should be taken to prevent contamination of food material by direct or indirect contact with material at an earlier stage of the process.

8.2.2 Persons handling raw materials or semi-processed products capable of contaminating the end-product should not come into contact with any end-product unless and until they discard all protective clothing worn by them during the handling of raw materials or semi-processed products which have come into direct contact with or have been soiled by raw materials or semi-processed products and they have changed into clean protective clothing.

8.2.3 If there is a likelihood of contamination, hands should be washed thoroughly between handling products at different stages of processing.

8.2.4 All equipment which has been in contact with raw materials or contaminated material should be thoroughly cleaned and disinfected prior to being used for contact with end-products.

8.3 Use of water

8.3.1 Only potable water, conforming to the **SLS 614**, should be used in food handling.

8.3.2 With the acceptance of the official agency having jurisdiction non-potable water may be used for steam production, refrigeration, fire control and other similar purposes not connected with food.

8.4 Packaging

8.4.1 *Storage and characteristics of containers*

All packaging material should be stored in a clean and sanitary manner. The material should be appropriate for the product to be packed and for the expected conditions of

storage and should not transmit to the product objectionable substances beyond the limits acceptable to the official agency having jurisdiction. The packaging material should be sound and should provide appropriate protection from contamination. The product containers should be sufficiently durable to withstand the mechanical, chemical and thermal stresses encountered during normal distribution. An overwrap may be necessary for flexible and semi-rigid containers. With laminates particular attention should be paid to ensure that the combination of processing requirements and product characteristics does not cause delamination as this may result in loss of integrity. The sealant material chosen must be compatible with the product as well as the container and closure systems. The closures for glass containers are particularly susceptible to mechanical damage which may result in a temporary or permanent loss of hermetic seal. The closures of sealed jars should therefore be contained within the glass body diameter to avoid closure to closure contact of the sealed jars.

8.4.2 *Inspection of empty product containers*

8.4.2.1 Appropriate sampling and inspection schemes should be used by both container manufacturer and canner to ensure that containers and closures are in compliance with jointly agreed specifications and any requirements of the agency having jurisdiction that may apply. As a minimum these should include those inspections and measurements given in 8.4.8 of this Code. Empty containers are particularly subject to damage by fault operation of depalletizers and by badly designed or controlled conveyors to filling and seaming machines.

8.4.2.2 Dirty containers should not be filled. Immediately prior to filling, rigid containers should be cleaned mechanically in an inverted position by suitable air or water jet appliances. Glass containers may also be cleaned by suction (vacuum). Containers intended for use on aseptic filling lines should not be cleaned with water unless they are thoroughly dried prior to sterilization. Inspection is particularly important in the case of glass containers which might possibly contain fragments of glass and glass defects which are difficult to see.

8.4.2.3 Faulty containers should not be filled. Faulty rigid containers and covers include those that have punctures or severe dents, defective side or bottom seams, deformed body flanges or cover curls, abnormal levels of scratches or flaws in the plating or enamel (lacquer) and covers with defective sealing compound or gaskets. Care should be taken to avoid damage to empty containers, closures and container materials which can result from faulty handling prior to closure. If these are filled, material will be wasted and there is always a danger of damaged containers jamming a filling or sealing machine and necessitating a shutdown. Faulty containers may leak during or after thermal processing and storage.

8.4.2.4 The canner should ensure that the container and closure specifications are such that the container is capable of withstanding the processing and subsequent handling strains to which the containers are normally subjected. Since such specifications may vary depending upon the canning operation and subsequent handling, they should be established in consultation with the container or closure manufacturer.

8.4.3 *Proper use of product containers*

Product containers must never be used within the cannery for any purpose other than packaging food. They should never be used as ash trays, small waste containers, receptacles for small machine parts or for other purposes. This should be avoided because there is a considerable risk that such containers may accidentally find their way back onto the production line and result in the packaging of food in the same container with very objectionable or possible dangerous material.

8.4.4 *Protection of empty product containers during plant cleaning*

Empty containers should be removed from the packaging room and from the conveyors which lead to the filling machines before production lines are washed down. If not practicable the containers may be shielded or located so they will not become contaminated or obstruct clean-up operations.

8.4.5 *Filling of product containers*

8.4.5.1 During filling of containers, contamination of seal or seam areas with product should be avoided and seam or seal areas should be kept as clean and dry as necessary to obtain a satisfactory closure. Overfilling can lead to contamination of seam or seals and adversely affect container integrity.

8.4.5.2 The filling of containers, either mechanically or by hand, should be controlled so as to meet the filling and headspace requirements as specified in the scheduled process. It is important to achieve a constancy of filling, not only for economic reasons, but also because both the heat penetration and the container integrity may be affected by excessive fill variation. In rotationally processed containers the headspace should be accurately controlled and sufficient to ensure consistent and adequate agitation of the contents. When flexible packaging is used, variations in product particle size, fill-weight and/or headspace may lead to variations in the filled pouch dimensions (thickness) which may adversely affect the heat penetration.

8.4.5.3 Air content of filled flexible and semi-rigid containers should be kept within specified limits to prevent excessive stressing of the seals during thermal processing.

8.4.6 *Exhausting of containers*

The exhausting of containers for the removal of air should be controlled so as to meet the conditions for which the scheduled process was designed.

8.4.7 *Closing operations*

8.4.7.1 Particular attention should be given to the operation, maintenance, routine checking and adjustment of closing equipment. Sealing and closing machines should be fitted and adjusted for each type of container and cover used. Seams and other closures should be tight and secure and meet the requirements of the container manufacturer, the canner and those of the agency having jurisdiction. The equipment manufacturer’s or supplier’s instructions should be followed meticulously.

8.4.7.2 For heat sealing, seal jaws should be plane-parallel to each other with one or both jaws being heated. The temperature of the jaws should be maintained at the specified temperature over the whole seal area. Pressure build-up on the jaws should be fast enough and final pressure high enough to allow product to be squeezed away from the seals before bonding commences. Flexible pouches are normally sealed in the vertical position. The requirements for the control and operation of sealing equipment are similar to those for semi-rigid containers. The seal area should be free from product contamination.

8.4.8 *Inspection of closures*

8.4.8.1.1 Inspection for external defects

During production runs, regular observations should be made for external container defects. At intervals of sufficient frequency to ensure proper closure, the operator, closure supervisor, or other person competent to inspect container closures should visually examine either the top seam of a can randomly selected from each seaming head, or the closure of any other type of container being used, and should make a record of the observations. Additional visual closure inspections should be made immediately following a jam in a closure machine, after adjustment of closure machines, or after starting up of machines following a prolonged shutdown. Side seams should be visually examined for defects or product leakage.
All pertinent observations should be recorded. Where irregularities are found, corrective action should be taken and recorded.

8.4.8.1.1 Inspection of glass container closures

Glass containers consist of two pieces, i.e., a glass container and lid (closure) usually metal, which can be twisted or pried off according to the closure design. Appropriate detailed inspections and tests should be conducted by competent personnel at intervals of sufficient frequency to ensure consistently reliable hermetic sealing. Many different designs of closures exist for glass jars, so that it is impossible to give definitive recommendations for such closures. The recommendations of the manufacturer should be carefully followed. Records of such tests and corrective actions should be maintained.

8.4.8.1.2 Inspection and tear-down of double seams

In addition to regular observations for external container defects by visual inspections, tear-down inspections should be performed by a competent individual and the results recorded at intervals of sufficient frequency at each seaming station to ensure maintenance of seam integrity. In the case of reformed cans, both double seams should be observed and inspected. When abnormalities are found, the corrective actions taken should be recorded. Both the measurements and their trends are important in the assessment of seam quality for control purposes.

Either of the two following systems should be used to evaluate can seams:

(i) Micrometer measurement

The following measurements should be made to the nearest 0.1 mm (0.004 in) using a suitable micrometer. The dimension of each measurement is indicated in Figure 1.

Prior to tearing down the double seam, measure and record the following:

a) countersink depth (A)
b) double seam width (length or height) (W)
c) double seam thickness (S)

The following measurements and evaluations should be made on the torn down seam:

a) body hook length (BH)
b) cover hook length (CH)
c) end plate thickness (Te)
d) body plate thickness (Tb)
e) overlap (O)
f) tightness rating
g) juncture rating
h) pressure ridge (chuck impression)

The overlap can be calculated by either of the following two equations:

i) Overlap = 0 = (CH+BH+Te) – W

ii)

$$Per\ \ cent\ \ Overlap\ \ = \%\ = \frac{(BH\ + CH\ + Te\ - W\ )}{\{\ W\ - (2Te\ + Tb\ )\ \}} \times 100$$

For evaluation of the tightness, juncture (internal droop) and pressure ridge the references given above should be consulted. For round cans the above measurements should be made at a minimum of three points approximately 120° apart around the double seam, (excluding the point of juncture with the side seam).

The free space and body hook butting are also measurements useful in the evaluation of double seam quality. These may be calculated by the following formulae :

Free Space = S – (2Tb + 3Te)

$$Per\ \ cent\ \ Body\ \ Hook\ \ Butting\ \ = \frac{(BH\ - 1.1Tb\ )}{\{\ W\ - 1.1\ (2Te\ + Tb\ )\ \}} \times 100$$

or

= b/c x 100 (Figure 2)

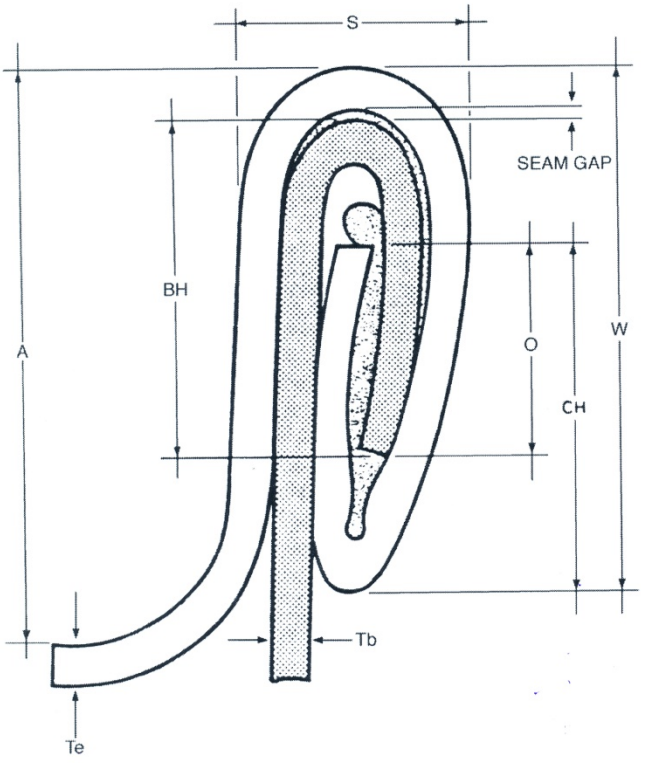

FIGURE 1

DOUBLE SEAM DIMENSIONAL TERMINOLOGY

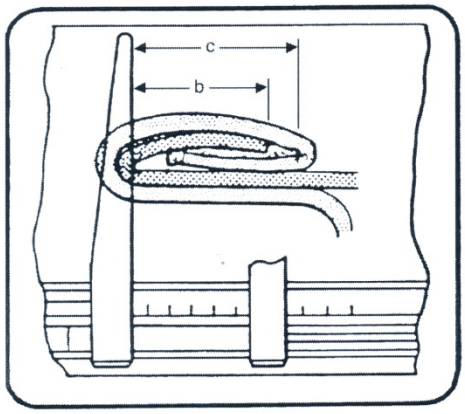

FIGURE 2

(ii) Optical measurements: overlap, body and coverhook lengths are directly visible in a cross-section of the double seam. Dimensions which cannot be optically measured should be measured by the micrometer (See 8.4.8.1.2). Wrinkling and other visual attributes can only be observed by stripping of the coverhook. The segments of the double seam to be examined should, for example, be taken at two or more places on the same double seam of round cans.
The instructions of the container supplier and seaming machine manufacturer should be accurately followed in the assessment of the results by either system or any additional tests. The agency having jurisdiction may have additional requirements which must be met.
Non-round cans require special consideration. Container manufacturer's specifications should be consulted and followed to ensure that the appropriate measurements and observations are made at the critical locations.

8.4.8.1.3 Inspection of heat seals

Appropriate visual inspections and tests should be conducted daily by competent, trained and experienced personnel at intervals of sufficient frequency to ensure consistent reliable hermetic sealing. Records of such tests and corrective action required should be maintained.

The strength of a heat seal may be reduced at the elevated temperatures used in retorts, hence it is important that such seals uniformly have the required strength prior to retorting. Small leaks or seal imperfections which may lead to loss of integrity can be aggravated by the physical strains induced by retorting and can permit microbial contamination after heat processing. Inspection should include some physical testing of the uniformity of strength of heat seals. There are several ways of checking seal integrity, for example, burst-pressure testing, seal thickness measurements. Appropriate methods should be obtained from the manufacturers of these containers or materials.

8.4.8.1.4 Closure defects

If a seam or closure defect is found upon routine inspection, which would result in a loss of hermetic integrity, all products produced between the discovery of the fault and the last satisfactory check should be identified and assessed.

8.4.9 *Handling of containers after closure*

8.4.9.1 At all times containers should be handled in a manner that protects container and closures from damage which may cause defects and subsequent microbial contamination. Design, operation and maintenance or container handling methods should be appropriate for the types of containers used. Poorly designed or incorrectly operated container conveying and loading systems are known to cause damage. For example, cans which are scramble packed may suffer damage, even when water cushioned, when the level of the cans in a crate or the crateless retort reduces the effectiveness of the cushion. Additionally, damage which may adversely affect integrity may be caused by poor alignment of the can feed mechanism, or by the presence of floaters.

Care should also be taken with semi and fully automatic crate loading systems as well as in-feed conveyor systems to continuous sterilizers. The accumulation of stationary containers on moving conveyors should be kept to a minimum, as this may also damage containers.

8.4.9.2 Semi-rigid and flexible containers may be prone to certain types of damage, (for example, snagging, tearing, cutting and flex cracking). Containers having sharp edges should be avoided as they may cause damage. Semi-rigid and flexible containers should be handled with special care (See also 8.7).

8.4.10 *Coding*

8.4.10.1 Each container should be marked with an identifying alphanumeric code which is permanent, legible and does not adversely affect the container integrity. Where the container does not permit the code to be embossed or inked, the label should be legibly perforated or otherwise marked, and securely affixed to the product container.

8.4.10.2 The code mark should identify the establishment where the product was packed, the product, the year and the day of the year and preferably the period of the day when the product was packed.

The code mark permits the identification and isolation of code lots during production, distribution and sale. Canneries may find it useful to have a coding system from which the particular processing line and/or sealing machine can be identified. Such a system, supported by adequate cannery records, can be very helpful in any investigation.

The identification of code lots on cases and trays is desirable.

8.4.11 *Washing*

8.4.11.1 Where necessary, filled and sealed containers should be thoroughly washed before sterilization to remove grease, dirt and product from the outside of the container.

8.4.11.2 Washing containers after sterilization should be avoided as it increases the risk of post-processing contamination and also it may be more difficult to remove food debris from the container external surface as it will adhere rather firmly after heating.

8.5 Thermal processing

8.5.1 *General considerations*

8.5.1.1 Prior to use, after installation of a thermal processing system or following any modification to or in the use of a system, temperature distribution studies should be carried out to determine the uniformity of temperature within the thermal processing system. Appropriate records should be maintained.

8.5.1.2 Scheduled processes for low-acid canned foods must be established only by competent persons having expert knowledge of thermal processing and having adequate

facilities for making such determinations. It is absolutely necessary to establish the required heat process with accepted scientific methods.

The heat process required to make low-acid canned foods commercially sterile depends on the microbial load, storage temperature, the presence of various preservatives, water activity, composition of the products and container size and type. Low-acid foods with pH values above 4.6 may be able to support the growth of many kinds of microorganisms including the heat resistant sporeforming pathogens such as *Clostridium botulinum.* It should be emphasized that the thermal processing of low-acid canned foods is a very critical operation, involving public health risks and appreciable losses of finished product if under-sterilization occurs.

8.5.2 *Establishing scheduled processes*

8.5.2.1 The procedure to establish the required heat treatment for a product can be divided into two steps. First the required heat process to achieve commercial sterility should be established on the basis of factors such as:

Microbial flora including *Clostridium botulinum* and spoilage microorganisms;
Container size and type;
pH of the product;
Product composition or formulation:
Levels and types of preservatives:
Water activity; and
Likely storage temperature of the product

Due to the nature of the packaging materials used, flexible, and to some extent semi-rigid, containers will change dimensions when exposed to applied physical stress. It is extremely important that the package dimensions, particularly the depth or thickness, should be as specified in the scheduled process.

8.5.2.2 The second step is to determine the scheduled process taking into account the sterilizing facilities available and the desired product quality by carrying out heat penetration tests. The heat penetration into the product must be determined under the most adverse conditions that are likely to be met in production. For this purpose the temperature in the slowest heating point in the container contents should be monitored during a heat process. It is essential to carry out an adequate number of heat penetration tests to determine the variations which should be taken into account in the scheduled process. The scheduled process can be determined from the time temperature graph obtained.

8.5.2.3 Because of the nature of the packaging materials used in flexible and semi-rigid containers, the container alone cannot generally be used to fix the heat sensing element at the “cold point” in the container contents, which is vital to the proper interpretation of the results. Therefore, other means may be required to ensure that the temperature sensing device is maintained at the pre-determined point in the container contents without altering the heat penetration characteristics. During such testing the container dimensions, specially the thickness, should be controlled.

8.5.2.4 If the heat penetration tests have been made using laboratory stimulators, the results should be verified in the production retort under conditions of commercial operation because there may be unexpected deviations in product heating and cooling characteristics.

8.5.2.5 If accurate heat penetration data cannot be obtained, alternative methods acceptable to the agency having jurisdiction should be used.

8.5.2.6 For products showing a simple heating curve only, where size of the container, sterilization temperature, initial temperature or process time are changed from an existing scheduled process the original heat penetration tests can be used to calculate the scheduled process for the new conditions. The results should be verified by further heat penetration tests when the size of the container is substantially changed.

8.5.2.7 With products showing a broken heating curve, changes in the scheduled processes should be determined using further heat penetration tests or other methods acceptable to the agency having jurisdiction.

8.5.2.8 The result of these heat process determinations together with established critical factors should be incorporated into the scheduled process. For conventionally sterilized canned products such a scheduled process should include as a minimum the following data:

- Products and filling specification, including any restrictions on ingredient changes;
- Container size (dimensions) and type;
- Container orientation and spacing in retort where appropriate;
- Ingoing weight of product(s) including liquor where appropriate;
- Headspace, where applicable;
- Minimum initial product temperature;
- Venting procedures and come-up procedures for certain retort systems, where applicable, should be determined on fully loaded retorts;
- Type and characteristics of heat processing system;
- Sterilization temperature;
- Sterilization time;
- Overpressure, where applicable; and
- Cooling method.

Any changes in the product specifications should be evaluated as to their effect on the adequacy of the process. If the scheduled process is found to be inadequate it must be re-established.

Product and filling specifications should contain at least the following where applicable: full recipe and preparation procedures, filling weights, headspace, drained weight, temperature of product at filling, consistency. Small deviations from the product and filling specifications which may seem negligible can cause serious deviations in the heat penetration properties of the product. For rotational sterilization, viscosity (rather than consistency) can be an important factor, and this should be specified.

8.5.2.9 Air content of filled flexible and semi-rigid containers should be kept to a minimum to prevent excessive stressing of the seals during thermal processing.

8.5.2.10 For aseptically processed packs a similar list should be made which also should include equipment and container sterilization requirements.

8.5.2.11 Complete records concerning all aspects of the establishment of the scheduled process, including any associated incubation tests, should be permanently retained and available.

8.5.3 *Heat processing room operations*

8.5.3.1 Scheduled processes and venting procedures to be used for products and container sizes being packed should be posted in a conspicuous place near the processing equipment. Such information should be readily available to the retort or processing system operator and to the agency having jurisdiction. It is essential that all heat processing equipment should be properly designed, correctly installed and carefully maintained. Only properly determined scheduled processes must be used.

8.5.3.2 Heat processing and associated processing operations should be performed and supervised only by properly trained personnel. It is extremely important that the heat processing is carried out by operators under the supervision of personnel who understand the principles of heat processing and who realize the need to follow instructions closely.

8.5.3.3 Heat processing should be commenced as soon as possible after closing to avoid microbial growth or changes in heat transfer characteristics of the products. If during breakdowns the production rate is low, the product should be processed in partly filled retorts. Where necessary, a separate scheduled process should be established for partly filled retorts.

8.5.3.4 In batch operations the sterilization status of the containers should be indicated. All retort baskets, trucks, cars or crates containing unretorted food product or at least one of the containers on the top of each basket, etc., should be plainly and conspicuously marked with a heat sensitive indicator, or by other effective means, which will visually indicate whether or not each such unit has been retorted. Heat sensitive indicators attached to baskets, trucks, cars or crates should be removed before they are refilled with containers.

8.5.3.5 The initial temperature of the contents of the coldest containers to be processed should be determined and recorded with sufficient frequency to ensure that the temperature of the product is not lower than the minimum initial temperature specified in the scheduled process.

8.5.3.6 An accurate, clearly visible clock or other suitable timing device should be installed in the heat processing room and times should be read from this instrument and not from wristwatches, etc. Where two or more clocks or other timing devices are used in a heat processing room they should be synchronized.

8.5.3.7 Generally temperature/ time recording devices are not satisfactory for measuring the sterilization or thermal process times.

8.5.4 *Critical factors in the application of the scheduled process*

In addition to the minimum product initial temperature, sterilization time and temperature together with overpressure, where applicable, as specified in the scheduled process, other critical factors specified should be measured, controlled and recorded at intervals of sufficient frequency to ensure that these factors remain within the limits specified in the scheduled process. Some examples of critical factors are:

(i) Maximum fill-in or drained weight.
(ii) Minimum headspace of product containers.
(iii) Product consistency or viscosity as determined by objective measurement on product taken before processing.
(iv) Product and/ or container type which may result in layering or stratification of the product, or in changes in the container dimensions hence requiring specific orientation and spacing of the containers in the retort.
(v) Solids percentage.
(vi) Minimum net weight.
(vii) Minimum closing vacuum (in vacuum packed products)

8.6 Equipment and procedures for heat processing systems

8.6.1 *Instruments and controls common to different heat processing systems*

8.6.1.1 Indicating thermometer

Each retort and/ or product sterilizer should be equipped with at least one indicating thermometer. The mercury-in-glass thermometer is recognized as the most reliable temperature indicating instrument at the present time. An alternative instrument having equal or better accuracy and reliability may be used subject to the approval of the official agency having jurisdiction. The mercury-in-glass thermometer should have divisions that are easily readable to 0.5 °C (1 °F) and whose scale contains not more than 4.0 °C per cm (17 °F per inch) of graduated scale. Thermometers should be tested for accuracy against a known accurate standard thermometer. This should be done in steam or water as appropriate and in a similar position of aspect to that which it is installed in the retort. Such tests should be performed just prior to installation, and at least once a year thereafter or more frequently as may be necessary to ensure their accuracy. A dated record of such tests should be kept. A thermometer that deviates more than 0.5 °C (1 °F) from the standard should be replaced. A daily inspection of mercury-in-glass thermometers should be made to detect and replace, if found, thermometers with divided mercury column or other defects.

8.6.1.2 Where other types of thermometer are used, routine tests should be made which ensure at least equivalent performance to that described for mercury-in-glass thermometers. Thermometers which do not meet these requirements should be replaced or repaired immediately.

8.6.1.3 Temperature/ time recording devices

Each retort and/ or product sterilizer should be equipped with at least one temperature/ time recording device. This recorder may be combined with the steam controller and may be a recording-controlling instrument. It is important that the correct chart is used for each device. Each chart should have a working scale of not more than 12 °C per cm (55 °F per in.) within a range of 10 °C (20 °F) of the sterilizing temperature. The recording accuracy should be equal to or better than ± 0.5 °C (1 °F) at the sterilizing temperature. The recorder should agree as closely as possible (preferably within 0.5 °C (1 °F) and should not be higher than the indicating thermometer at the sterilizing temperature. A means of preventing unauthorized changes in the adjustment should be provided. It is important that the chart should also be used to provide a permanent record of the sterilization temperature in relation to time. The chart timing device should be accurate and checked as often as necessary to maintain accuracy.

8.6.1.4. Pressure gauges

Each retort should be equipped with a pressure gauge. The gauge should be checked for accuracy at least once a year. The gauge should have a range from zero such that the safe working pressure of the retort is about two-thirds of the full scale and be graduated in divisions not greater than 0.14 kg/cm^2 (2 p.s.i.). The gauge dial should not be less than 102 mm (4.0 in.) in diameter. The instrument may be connected to the retort by means of a gauge cock and syphon.

8.6.1.5 Steam controller

Each retort should be equipped with a steam controller to maintain the retort temperature. This may be a recording-controlling instrument when combined with a recording thermometer.

8.6.1.6. Pressure relief valve

An adjustable pressure relief valve of a capacity sufficient to prevent undesired increase in retort pressure and approved by the agency having jurisdiction should be fitted.

8.6.1.7. Timing devices

These should be checked as often as necessary to ensure accuracy.

8.6.2 *Pressure processing in steam*

8.6.2.1 Batch (Still retorts)

8.6.2.1.1 Indicating thermometers and temperature/ time recording devices (see 8.6.1.1, 8.6.1.2 and 8.6.1.3)

Bulb sheaths of indicating thermometers and probes of temperature recording devices should be installed either within the retort shell or in external wells attached to the retort. External wells should be equipped with an adequate bleeder opening so located as to provide a constant flow of steam past the length of the thermometer bulb or probe. The bleeder for external wells should emit steam continuously during the entire heat processing period. Thermometers should be installed where they can be accurately and easily read.

8.6.2.1.2 Pressure gauges **(**see 8.6.1.4**)**

8.6.2.1.3 Steam controllers (see 8.6.1.5)

8.6.2.1.4 Pressure relief valve (see 8.6.1.6)

8.6.2.1.5 Steam inlet

The steam inlet to each retort should be large enough to provide sufficient steam for proper operation of the retort, and should enter at a suitable point to facilitate air removal during venting.

8.6.2.1.6. Crate supports

A bottom crate support should be employed in vertical still retorts so as not to substantially affect venting and steam distribution. Baffle plates should not be used in the bottom of retorts. Centering guides should be installed in vertical retorts to ensure adequate clearance between the retort crate and the retort wall.

8.6.2.1.7. Steam spreaders

Perforated steam spreaders, if used, should be checked regularly to ensure they are not blocked or otherwise inoperative. Horizontal still retorts should be equipped with perforated steam spreaders that extend for the full length of the retort. In vertical still retorts the perforated steam spreaders, if used, should be in the form of a cross or coil. The number of perforations in spreaders for both horizontal and vertical still retorts should be such that the total cross-sectional area of the perforations is equal to 1 1/2 to 2 times the cross-sectional area of the smallest part of the steam inlet line.

8.6.2.1.8. Bleeders and condensate removal

Bleeders should be of suitable size, (e.g., 3 mm (1/8 in.)), and location and should be fully open during the entire process, including the coming-up-time. In retorts having top steam inlet and bottom venting, a suitable device should be installed in the bottom of the retort to remove condensate and a bleeder fitted to indicate condensate removal. All bleeders should be arranged in such a way that the operator can observe that they are functioning properly. Bleeders are not part of the venting system.

8.6.2.1.9. Stacking equipment

Crates, trays, gondolas, dividers, etc., for holding product containers should be so constructed that steam can adequately be circulated around the containers during the venting, coming-up and sterilization times.

8.6.2.1.10. Vents

Vents should be located in that portion of the retort opposite the steam inlet and should be designed, installed and operated in such a way that air is removed from the retort before timing of the thermal process is started. Vents should be fully opened to permit rapid removal of air from retorts during the venting period. Vents should not be connected directly to a closed drain system without an atmospheric break in the line. Where a retort manifold connects several pipes from a single still retort, it should be controlled by a single suitable valve. The manifold should be of a size such that the cross-sectional area of the manifold is larger than the total cross-subsection area of all connecting vents. The discharge should not be directly connected to a closed drain without an atmospheric break in the line. A manifold header connecting vents or manifolds from several still retorts should lead to the atmosphere. The manifold header should not be controlled by a valve and should be of a size such that the cross-subsectional area is at least equal to the total cross-sectional area of all connecting retort manifold pipes from all retorts venting simultaneously. Other vent piping arrangements and operating procedures which differ from the above specifications may be used, provided that there is evidence that they accomplish adequate venting.

8.6.2.1.11 Air inlets

Retorts using air for pressure cooling should be equipped with an adequate tight closing valve and piping arrangement on the air line to prevent air leakage into the retort during processing.

8.6.2.1.12 Critical factors (see 8.5.4)

8.6.2.2 Batch agitating retorts

8.6.2.2.1 Indicating thermometers and temperature/ time recording devices (see 8.6.1.1, 8.6.1.2 and 8.6.1.3)

8.6.2.2.2 Pressure gauges (see 8.6.1.4)

8.6.2.2.3 Steam controller **(**see 8.6.1.5)

8.6.2.2.4 Pressure relief valve (see 8.6.1.6)

8.6.2.2.5 Steam inlet (see 8.6.2.1.5)

8.6.2.2.6. Steam spreaders (see 8.6.2.1.7)

8.6.2.2.7 Bleeders and condensate removal **(**see 8.6.2.1.8)

At the time the steam is turned on, the drain should be opened for a time sufficient to remove steam condensate from the retort and provision should be made for continuing drainage of condensate during the retort operation. The bleeders in the bottom of the shell serve as an indicator of continuous condensate removal. The retort operator should observe and periodically record how this bleeder is functioning.

8.6.2.2.8 Stacking equipment (see 8.6.2.1.9)

8.6.2.2.9 Vents **(**see 8.6.2.1.10)

8.6.2.2.10 Air inlets (see 8.6.2.1.11)

8.6.2.2.11 Retort or reel speed timing

The rotational speed of the retort or reel is critical and should be specified in the scheduled process. The speed should be adjusted and recorded when the retort is started, and at intervals of sufficient frequency to ensure that the retort speed is maintained as specified in the scheduled process. If a change of speed inadvertently occurs such should be recorded together with corrective action taken. Additionally, a recording tachometer may be used to provide a continuous record of the speed. The speed should be checked against a stop watch at least once per shift. A means of preventing unauthorized speed changes on retorts should be provided.

8.6.2.2.12 Critical factors (see 8.5.4)

8.6.2.3 Continuous agitating retorts

8.6.2.3.1 Indicating thermometers and temperature/time recording devices (see 8.6.1.1, 8.6.1.2 and 8.6.1.3)

8.6.2.3.2 Pressure gauges (see 8.6.1.4)

8.6.2.3.3 Steam controllers **(**see 8.6.1.5)

8.6.2.3.4 Pressure relief valve (see 8.6.1.6)

8.6.2.3.5 Steam inlet (see 8.6.2.1.5)

8.6.2.3.6 Steam spreaders (see 8.6.2.1.7)

8.6.2.3.7 Bleeders and condensate removal **(**see 8.6.2.2.7)

8.6.2.3.8 Vents **(**see 8.6.2.1.10)

8.6.2.3.9 Retort and reel speed timing (see 8.6.2.2.11)

8.6.2.3.10 Critical factors (see 8.5.4)

8.6.2.4 Hydrostatic retorts

8.6.2.4.1 Indicating thermometers (see 8.6.1.1)

Thermometers should be located in the steam dome near the steam-water interface and preferably also at the top of the dome. Where the scheduled process specifies maintenance of particular temperatures of water in the hydrostatic water legs, at least one indicating thermometer should be located in each hydrostatic water leg so that it can accurately measure water temperature and be easily read.

8.6.2.4.2 Temperature/ time recording device (see 8.6.1.3)

The temperature recorder probe should be installed either within the steam dome or in a well attached to the dome. Additional temperature recorder probes should be installed in the hydrostatic water legs if the scheduled process specifies maintenance of particular temperatures in these hydrostatic water legs.

8.6.2.4.3 Pressure gauges **(**see 8.6.1.4**)**

8.6.2.4.4 Steam controllers (see 8.6.1.5)

8.6.2.4.5 Steam inlet (see 8.6.2.1.5)

8.6.2.4.6 Bleeders

Bleeders should be of suitable size, {e.g., 3 mm (1/8 in.)} and location and should be fully open during the entire process, including the come-up-time and should be suitably located in the steam chamber or chambers to remove air which may enter with the steam.

8.6.2.4.7 Venting

Before the start of processing operations, the retort steam chamber or chambers should be vented to ensure removal of air.

8.6.2.4.8 Conveyor speed

The speed of the container conveyor should be specified in the scheduled process and should be determined with an accurate stop watch, and recorded at the start of processing and at intervals of sufficient frequency to ensure that the conveyor speed is maintained as specified. An automatic device should be used to stop the conveyor and provide warning when the temperature drops below that specified in the scheduled process. A means of preventing unauthorized speed changes should be provided. Additionally a recording device may be used to provide a continuous record of the speed.

8.6.2.4.9 Critical factors **(**see 8.5.4**)**

8.6.3 *Pressure processing in water*

8.6.3.1 Batch (Still retorts)

8.6.3.1.1 Indicating thermometer (see 8.6.1.1)

Bulbs of indicating thermometers should be located in such a position that they are beneath the surface of the water throughout the process. On horizontal retorts this should be in the side at the centre, and the thermometer bulbs should be inserted directly into the retort shell. In both vertical and horizontal retorts, the thermometer bulbs should extend directly into the water for a minimum of at least 5 cm (2 in.).

8.6.3.1.2 Temperature/ time recording device (see 8.6.1.3)

When the retort is equipped with a temperature recording device, the recording thermometer bulb should be at a location adjacent to the indicating thermometer or at a location which adequately represents the lowest temperature in the retort. In any case, care should be taken that the steam does not strike the controller bulb directly.

8.6.3.1.3 Pressure gauge (see 8.6.1.4)

8.6.3.1.4 Pressure relief valve (see 8.6.1.6)

8.6.3.1.5 Pressure control valve

In addition to the pressure relief valve an adjustable pressure control valve of a capacity sufficient to prevent undesired increases in retort pressure, even when the water valve is wide open, should be installed in the overflow line. This valve also controls the maximum water level in the retort. The valve should be suitably screened to prevent blockage by floating containers or debris.

8.6.3.1.6 Pressure recorder

A pressure recorder device is needed and may be combined with a pressure controller.

8.6.3.1.7 Steam controller (see 8.6.1.5)

8.6.3.1.8 Steam inlet

The steam inlet should be large enough to provide sufficient steam for proper operation of the retort.

8.6.3.1.9 Steam distribution (see 8.6.2.1.7)

Steam should be distributed from the bottom of the retort in a manner to provide uniform heat distribution throughout the retort.

8.6.3.1.10 Crate supports (see 8.6.2.1.6)

8.6.3.1.11 Stacking equipment

Crates, trays, gondolas, etc. and divider plates when used for holding product containers, should be so constructed that the heating water can adequately circulate around the containers during the coming-up and sterilization times. Special equipment will be required to ensure that the thickness of filled flexible containers will not exceed that specified in the scheduled process and that they will not become displaced and overlap one another during the thermal process.

8.6.3.1.12 Drain valve

A screened, non-clogging, water-tight valve should be used.

8.6.3.1.13 Water level

There should be a means of determining the water level in the retort during operation (e.g., by using a water gauge glass or petcock(s)). Water should adequately cover the top layer of containers during the entire coming-up, sterilizing and cooling periods. This water level should be at least 15 cm (6 in.) over the top layer of product containers in the retort.

8.6.3.1.14 Air supply and controls

In both horizontal and vertical still retorts for pressure processing in water, a means should be provided for introducing compressed air at the proper pressure and rate. The retort pressure should be controlled by an automatic pressure control unit. A non-return valve should be provided in the air supply line to prevent water from entering the system. Air or water circulation should be maintained continuously during the coming-up-time, processing and cooling periods. Air is usually introduced with steam to prevent “steam hammer”. If air is used to promote circulation it should be introduced into the steam line at a point between the retort and the steam control valve at the bottom of the retort.

8.6.3.1.15 Cooling water entry

In retorts processing glass jars the cooling water should be introduced in a manner which avoids direct impingement on the jars, in order to prevent breakage by thermal shock.

8.6.3.1.16 Retort headspace

The air pressure in the headspace of the retort should be controlled throughout the process.

8.6.3.1.17 Water circulation

All water circulation systems, whether by pumps or air, used for heat distribution should be installed in such a manner that an even temperature distribution throughout the retort is maintained. Checks for correct operation should be made during each processing cycle, for example, alarm systems to indicate malfunction of water circulation.

8.6.3.1.18 Critical factors in the application of the scheduled process (see 8.5.4)

8.6.3.2 Batch agitating retorts

8.6.3.2.1 Indicating thermometer (see 8.6.3.1.1)

8.6.3.2.2 Temperature/ time recording device (see 8.6.1.3)

The recording thermometer probe should be located adjacent to the bulb of the indicating thermometer.

8.6.3.2.3 Pressure gauges (see 8.6.1.4)

8.6.3.2.4 Pressure relief valve (see 8.6.1.6)

8.6.3.2.5 Pressure control valve (see 8.6.3.1.5)

8.6.3.2.6 Pressure recorder (see 8.6.3.1.6)

8.6.3.2.7 Steam controller (see 8.6.1.5)

8.6.3.2.8 Steam inlet (see 8.6.2.1.5)

8.6.3.2.9 Steam spreader (see 8.6.2.1.7)

8.6.3.2.10 Drain valve (see 8.6.3.1.12)

8.6.3.2.11 Water level indicator **(**see 8.6.3.1.13)

8.6.3.2.12 Air supply and controls (see 8.6.3.1.14)

8.6.3.2.13 Cooling water entry (see 8.6.3.1.15)

8.6.3.2.14 Water circulation (see 8.6.3.1.17)

8.6.3.2.15 Retort speed timing (see 8.6.2.2.11)

8.6.3.2.16 Critical factors in the application of the scheduled process (see 8.5.4)

8.6.4 *Pressure processing in steam-air mixtures*

Both the temperature distribution and the rates of heat transfer are critically important in the operation of steam-air retorts. There should be a means of circulating the steam-air mixtures to prevent formation of low temperature pockets. The circulating system used should provide acceptable heat distribution as established by adequate tests. The operation of the processing system should be the same as that required by the scheduled process. A recording pressure controller should control the air inlet and the steam-air mixture outlet. Because of the variety of existing designs, reference should be made to the equipment manufacturer and to the agency having jurisdiction for details of installation, operation and control. Some items of equipment may be common to those already in this Code and those standards given may be relevant.

8.6.5 *Aseptic processing and packaging systems*

8.6.5.1 Product sterilization equipment and operation

8.6.5.1.1 Temperature indicating device (see 8.6.1.1)

The device should be installed in the product holding section outlet in such a way that it does not interfere with product flow.

8.6.5.1.2 Temperature recording device (see 8.6.1.3)

The temperature sensor should be located in the sterilized product at the holding section outlet in such a way that it does not interfere with the product flow.

8.6.5.1.3 Temperature recorder – controller

An accurate temperature recorder-controller should be located in the product sterilizer at the final heater outlet in such a way as not to interfere with product flow. It should be capable of ensuring that the desired product sterilization temperature is maintained.

8.6.5.1.4 Product-to-product regenerators

Where a product-to-product regenerator is used to heat the cold unsterilized product entering the sterilizer by means of a heat exchange system, it should be designed, operated and controlled so that the pressure of the sterilized product in the regenerator is greater than the pressure of any unsterilized product.
This ensures that any leakage in the regenerator will be from the sterilized product into the unsterilized product.

8.6.5.1.5 Differential pressure recorder-controller

Where a product-to-product regenerator is used, there should be an accurate differential pressure recorder-controller installed on the regenerator. The scale divisions should be easily readable and should not exceed 0.14 kg per cm^2 (2 lbs per square in.) on a working scale of not more than 1.4 kg/cm^2 /cm (20 lbs per square inch per inch). The controller should be tested for accuracy against a known accurate standard pressure indicator, upon installation and at least once every three months of operation thereafter or more frequently as may be necessary to ensure its accuracy. One pressure sensor should be installed at the sterilized product regenerator outlet, and the other pressure sensor should be installed at the unsterilized product regenerator inlet.

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8.6.5.1.6 Metering pump

A metering pump should be located upstream from the holding section and should be operated consistently to maintain the required rate of product flow. A means of preventing unauthorized speed changes should be provided. The product flow rate, which is the critical factor controlling the sterilization holding time, should be checked with sufficient frequency to ensure that it is as specified in the scheduled process.

8.6.5.1.7 Product-holding section

The product sterilizer holding section should be designed to give continuous holding of the product, including particulates, for at least the minimum holding time specified in the scheduled process. It should be sloped upward at least 2.0 cm/m (0.25 in. per foot). The holding section should be designed so that no portion between the product inlet and the product outlet can be heated.

8.6.5.1.8 Startup

Prior to the start of aseptic processing operations, the product sterilizer should be brought to a condition of commercial sterility.

8.6.5.1.9 Temperature drop in product holding section

When product temperature in the holding section drops below the temperature specified in the scheduled process, the product in the holding section and any downstream portions affected should be diverted to recirculation or waste and the system returned to a condition of commercial sterility before flow is resumed to the filter.

8.6.5.1.10 Loss of proper pressures in the regenerator

Where a regenerator is used the product may lose sterility whenever the pressure of sterilized product in the regenerator is less than 0.07 kg/cm^2 (1 lb per square in.) greater than the pressure of unsterilized product. Product flow should be directed either to waste or recirculated until the cause of the improper pressure relationship has been corrected and the affected system(s) has been returned to a condition of commercial sterility.

8.6.5.2 Product container sterilization, filling and closing operations

8.6.5.2.1 Recording device

The systems for container and closure sterilization, as well as filling and closing should be instrumented to show that the scheduled conditions are achieved and maintained. During pre-sterilization as well as production, automatic recording devices should be used to record, where applicable, the sterilization media flow rates and/ or temperatures. Where a batch system is used for container sterilization, the sterilization conditions should be recorded.

8.6.5.2.2 Timing method(s)

A method(s) should be used either to give the retention time of containers, and closure if applicable, as specified in the scheduled process, or to control the sterilization cycle at the rate as specified in the scheduled process. A means of preventing unauthorized speed changes should be provided.

8.6.5.2.3 Startup

Prior to the start of filling, both the container and closure sterilizing system and the product filling and closing system should be brought to a condition of commercial sterility.

8.6.5.2.4 Loss of sterility

In the event of loss of sterility, the system(s) should be returned to a condition of commercial sterility before resuming operations.

8.6.6 *Flame sterilizers, equipment and procedures*

The container conveyor speed should be specified in the scheduled process. The container conveyor speed should be measured and recorded at the start of operations and at intervals of sufficient frequency to ensure that the conveyor speed is as specified in the scheduled process. Alternatively, a recording tachometer may be used to provide a continuous record of the speed. Speed should be checked against a stop watch at least once per shift. A means of preventing unauthorized speed changes on the conveyor should be provided. The surface temperature of at least one container from each conveyor channel should be measured and recorded at the end of the pre-heat section and at the end of the holding period at intervals of sufficient frequency to ensure that the temperatures specified in the scheduled process are maintained.

8.6.7 *Other systems*

Systems for the thermal processing of low-acid foods in hermetically sealed containers should conform to the applicable requirements of this Code and should ensure that the methods and control used for the manufacture, processing and/ or packaging of such foods are operated and administered in a manner adequate to achieve commercial sterility.

8.6.8 *Cooling*

To avoid thermophilic spoilage and/ or organoleptic deterioration of the product, the containers should be cooled as rapidly as possible to an internal temperature of 40 ^{o}C (104 ^{o}F). In practice, water cooling is usually used for this purpose. Further cooling is done in air to evaporate the adhering water film. This aids in preventing both microbiological contamination and corrosion. Air cooling alone may also be used for products in which thermophilic spoilage is not a problem, provided that the product and the containers are suitable for air cooling. Unless otherwise indicated, extra pressure should be applied during cooling to compensate for the internal pressure inside the container at the beginning of cooling to prevent the deformation or leakage of containers. This can be minimized by equating the outer pressure with the internal pressure.
When the integrity of the container is not adversely affected, water or air under atmospheric pressure may be used for cooling. Extra pressure is commonly achieved by introducing water or compressed air into the retort under pressure.

To reduce thermal shock to glass containers the temperature of the cooling medium in the retort should be reduced slowly during the initial cooling phase.
In all instances the container and closure manufacturers' instructions should be followed.

8.6.8.1 Cooling water quality

Cooling water should consistently be of low microbial content, for example, with an aerobic mesophile count of less than 100 c.f.u/ml. Records should be kept of cooling water treatment and of its microbiological quality. Although containers may normally be considered hermetically sealed, a small number of containers may allow intake of water during the cooling period mainly due to mechanical stress and pressure differential.

8.6.8.2 To ensure effective disinfection, chlorine or an alternative disinfectant should be thoroughly mixed with the water to a level which will minimize the risk of contamination of the can contents during cooling: for chlorination a 20 minute minimum contact time at suitable pH and temperature is normally considered adequate.
The adequacy of a suitable chlorination treatment may be established by:

a) the presence of a measurable residual free chlorine in the water at the end of the contact time; and
b) detectable amounts of residual free chlorine in the water after it has been used for cooling containers. (Residual free chlorine content of 0.5 ppm to 2 ppm is usually considered adequate. Chlorine levels in excess of this may accelerate corrosion of certain metallic containers.)
c) a low microbial content of the water at the point of use. The temperature and pH of the water should be measured and recorded for reference.

Once a suitable system has been established, the adequacy of treatment is indicated by measuring and recording the free residual chlorine according to b) above. In addition water temperature and pH should be measured and recorded since marked changes from the reference values previously established may adversely affect the disinfecting action of the added chlorine.

The amount of chlorine required for adequate disinfection will depend upon the chlorine demand of the water, its pH and temperature. Where water with a high level of organic impurity, (e.g., surface water) is used as a source of supply, it will usually be necessary to provide suitable treatment for separation of impurities, prior to disinfection by chlorine thereby reducing excessive chlorine demand. Recirculated cooling water may gradually increase in organic load and it may be necessary to reduce this by separation or other means. If the pH of cooling water is greater than 7.0 or its temperature is above 30 ^{0}C it may be necessary to increase the minimum contact time or concentration of chlorine to achieve adequate disinfection. Similar actions may be necessary with water disinfected by means other than addition of chlorine.

It is essential that cooling water storage tanks be constructed of impervious materials and protected by close-fitting covers thus preventing contamination of the water by seepage, entry of surface waters or other sources of contamination. These tanks should also be fitted with baffles or other means of ensuring thorough mixing of water and chlorine or

other disinfectant. They should be of sufficient capacity to ensure that the minimum residence time is achieved under maximum throughput conditions. Particular attention should be paid to positioning of inlet and outlet pipes to ensure all water follows a pre-determined flow pattern within the tank. Cooling tanks and systems should be drained, cleaned and refilled periodically to prevent excessive organic and microbial buildup. Records should be kept of such procedures.

Measurements of microbial content and chlorine or alternative disinfectant levels should be made with sufficient frequency to enable adequate control of cooling water quality. Records should be kept of cooling water treatment and of its microbiological quality.

8.7 Post process container handling

A small proportion of correctly made and closed cans may be subjected to temporary leaks (micro leakage) during the later stages of cooling and for as long as the cans and their seams remain externally wet. The risk of micro leakage may be increased if poor seam quality and inadequately designed container conveyor, handling, labelling and packaging equipment result in increased can abuse. When such leakage occurs, water on the can provides a source and a transport medium for microbial contamination from conveyor and equipment surfaces to areas on or near the can seams. To control leaker infection it is necessary to ensure that:

i) cans are dried as soon as possible after processing;
ii) conveying systems and equipment are designed to minimize abuse of the containers; and
iii) conveyor and equipment surfaces are effectively cleaned and disinfected

Glass jars may be similarly affected.

The post-process area should be effectively separated from raw food to avoid cross contamination. Precautions should also be taken to ensure personnel from the raw food areas do not have uncontrolled access to the post-process area.

Temporary leaks are not a problem with correctly formed heat seals on semi-rigid and flexible containers. However, leakage may occur through defective seals and perforations in the container bodies. Therefore the requirements for drying containers, minimizing abuse and ensuring effective cleaning and disinfection of conveyor systems are equally applicable to these types of containers.

8.7.1 *Retort crate unloading*

To minimize leaker infection especially by pathogenic microorganisms, processed containers should not be manually handled while still wet.

Before unloading retort crates, water should be drained from container surfaces. In many instances this can be accomplished by tilting the retort crates as far as possible and allowing sufficient time for the water to drain. The containers should remain in the crates until dry before manual unloading. Manual unloading of wet containers presents a risk of contamination from pathogenic microorganisms which may be transferred from the hands onto the container.

8.7.2 *Container drying precautions*

Where used, dryers should be shown not to cause damage to or contaminate containers and should be readily accessible for routine cleaning and disinfection. Not all driers meet these requirements. The drying unit should be employed in the line as soon as practicable after cooling.

Dryers do not remove all cooling water residues from container external surfaces but they reduce significantly the time containers are wet. This reduces the length of post-drier conveying equipment that becomes wet during production periods and which requires extra cleaning and disinfection measures.

The drying of batch processed containers may be accelerated by dipping the filled retort crates in a tank of a suitable surfactant solution. After immersion (15 sec) the crates should be tipped and allowed to drain.
It is essential that any dipping solution be kept at not less than 80 ^{0}C to avoid microbial growth and be changed at the end of each shift. Technically appropriate anti-corrosion agents may also be incorporated in dipping solutions.

8.7.3 *Container abuse*

Mechanical shock or abuse is mainly caused by either containers knocking into each other, (for example, on gravity runways), or by pressing against each other, for example, when the backup of containers on cable runways results in the development of excessive pressure and possible seam damage due to cable burn. Abuse may also be caused by containers hitting protruding sections on conveying systems. Such mechanical shocks may cause temporary or permanent leaks and result in infection if the containers are wet.

Careful attention to the design, layout, operation and maintenance of conveying systems is necessary if abuse is to be reduced to a minimum. One of the commonest design faults is unnecessary changes in the height of different sections of the conveying system. For lines speeds above 300 cpm (containers per minute), multi-lane conveying systems coupled with container accumulation tables are recommended. Sensors should be installed to allow the conveyor to be stopped if excessive buildup of containers occurs. Poor seam quality in combination with inadequately designed, adjusted or maintained unscrambling, labelling and packaging equipment increases the risk of microleakage. Special care should be taken to prevent abuse to glass containers and their closures, as well as to semi-rigid and flexible containers.

Abuse of semi-rigid and flexible containers may lead to perforation of the container or to flex cracking in the case of pouches. Therefore these types of containers should not be allowed to fall or slide from one section to another of the conveying system.

8.7.4 *Post Process cleaning and disinfection*

Any container conveyor or equipment surface that is wet during production periods will permit rapid growth of infecting microorganisms unless it is effectively cleaned at least once every 24 hours and, in addition, regularly disinfected during production periods.

The chlorine in the cooling water deposited on these surfaces from cooled cans is not an adequate disinfectant. Any cleaning and disinfection program that is instituted should be carefully evaluated before being adopted as a routine procedure. For example, properly treated surfaces should have a mesophilic aerobic bacterial level of less than 500 c.f.u. per 25/cm^2 (4/in^2). The assessment of the continuing effectiveness of post process cleaning and disinfection programs can only be made by bacteriological monitoring.

Conveying systems and equipment should be critically examined with the view to replacing unsuitable materials. Porous materials should not be used and surfaces which become porous, heavily corroded or damaged should be repaired or replaced.

All personnel should be made fully aware of the importance of personal hygiene and good habits in relation to the avoidance of post process container recontamination through handling of containers.
Post-cooling areas of continuous cookers, including hydrostatic cookers, may constitute continuing sources of high bacterial concentrations unless stringent measures are taken to clean and disinfect them regularly to avoid microbial buildup.

8.7.5 Containers should be overwrapped if such is required to protect container integrity. If they are overwrapped containers should be dry.

8.8 Evaluation of deviation in heat processing

8.8.1 Whenever the in-process monitoring records, processor check or other means disclose that a low-acid food or container system has received a thermal or sterilization treatment less than that stipulated in the scheduled process, the processor should:

a) identify, isolate and then reprocess to commercial sterility that part of the code lot or lots involved. Complete reprocessing records should be retained;
or

b) isolate and retain that part of the code lot or lots involved to permit further detailed evaluation of the heat processing records. Such evaluation should be made by competent processing experts in accordance with procedures recognized as being adequate to detect any hazard to public health. If this evaluation of the processing records demonstrates that the product has not been given a safe thermal treatment, the product isolated and retained shall be either fully reprocessed to render it commercially sterile or suitably disposed of under adequate and proper supervision to assure the protection of the public health. A record should be made of the evaluation procedures used, the results obtained and the actions taken on the product involved.

8.8.2 In the case of continuous agitating retorts emergency scheduled processes may be established to permit compensation for temperature deviations, not to exceed 5^oC (10^o F). Such scheduled processes should be established in accordance with 8.5.1 and 8.5.2 of this Code.

9 QUALITY ASSURANCE

It is important that scheduled processes be properly established, correctly applied, sufficiently supervised and documented to provide positive assurance that the requirements have been met. These assurances apply also to the seaming and sealing operations. For practical and statistical reasons, an end-product analysis by itself is not sufficient to monitor the adequacy of the scheduled process.

9.1 Processing and production records

Permanent and legible dated records of time, temperature, code mark and other pertinent details should be kept concerning each load. Such records are essential as a check on processing operations and will be invaluable if some question arises as to whether a particular lot had received adequate heat processing. These records should be made by the retort or processing system operator or other designated person, on a form which should include: product name and style, the code lot number, the retort or processing system and recorder chart identification, the container size and type, the approximate number of containers per code lot interval, the minimum initial temperature, the scheduled and actual processing time and temperature, the indicator and recorder thermometer reading, and other appropriate processing data. Closing vacuum (in vacuum-packed products), fill-in weights, filled flexible pouch thickness, and/ or other critical factors specified in the scheduled process should also be recorded. Records of water quality and plant hygiene should be kept. When deviations occur in the application of the scheduled process refer sub Clause 8.8 of this Code. In addition, the following records should be maintained.

9.1.1 *Processing in steam*

9.1.1.1 Batch still retorts

Time steam on, venting time and temperature, time sterilization temperature reached, time steam off.

9.1.1.2 Batch agitating retorts

As for still retorts (see 9.1.1.1) with additions of functioning of condensate bleeder as well as retort and/ or reel speed. Where specified in the scheduled process it is important to also record containers headspace and critical factors such as in-going product consistency and/ or viscosity, maximum drained weight, minimum net weight and solid percentage (see 8.5.4).

9.1.1.3 Continuous agitating retorts (see 9.1.1.2)

9.1.1.4 Hydrostatic retorts

The temperature in the steam chamber at just above the steam-water interface, at the top of the dome, if applicable, speed of the container conveyor, and, where the scheduled

process specifies, measurements of particular temperatures and water levels in the hydrostatic water legs.
In addition, for agitating hydrostatic retorts, rotative chain speed, and other critical factors such as the headspace and in-going product consistency.

9.1.2 *Processing in water*

9.1.2.1 Batch still retorts

Time steam on, coming-up time, time sterilization starts, sterilization temperature, water level, water circulation and pressure maintained, time steam off.

9.1.2.2 Batch agitating retorts

As for still retorts (see 9.1.2.1) with the addition of retort and reel speed. Where specified in the scheduled process it is important to record container headspace and critical factors such as in-going product consistency, maximum drained weight, minimum net weight and solids percentage (see 8.5.4).

9.1.3 *Processing in steam/air mixtures*

9.1.3.1 Batch still retorts

Time steam on, coming-up-time, time sterilization starts, maintenance of circulation of steam/ air mixture, pressure, sterilization temperature, time steam off.

9.1.4 *Aseptic processing and packaging*

Detailed automatic and manual record requirements depend on the type of aseptic processing and packaging system, but they must provide complete and accurate documentation of the pre-sterilization and running conditions actually used.

9.1.4.1 Product container sterilization conditions

Sterilization media flow rate and/ or temperature, where applicable, retention time in the sterilizing equipment of containers and closures. Where a batch system is used for container and/ or closure sterilization, sterilization cycle times and temperatures.

9.1.4.2 Product line conditions

Pre-sterilization of the product line “stand-by” and/ or “change-to-product”, as well as running conditions. Running condition records should include product temperature at the final heater outlet, product temperature at holding section outlet, differential pressures if a product-to-product regenerator is used, and the product flow rate.

9.1.4.3 Filling and closing conditions (see 9.1.4.1)

9.1.5 *Flame sterilizers*

Container conveyor speed, can surface temperature at the end of the process holding period, nature of container.

9.2 Record review and maintenance

9.2.1 *Process records*

Recorder charts should be identified by date, code lot and other data as necessary, so they can be correlated with the written record of lot processed. Each entry of the record should be made by the retort or processing system operator, or other designated person, at the time the specific retort or processing system condition or operation occurs, and the retort or processing system operator or such designated person should sign or initial each record form. Prior to shipment or release for distribution, but not later than one working day after the actual process, a representative of plant management who is competent should review and ensure that all processing and production records are complete and that all products received the scheduled process. The records, including the recorder thermometer chart, should be signed or initialled by the person conducting the review.

9.2.2 *Container closure records*

Written records of all container closure examinations should specify the code lot, the date and time of container closure inspections, the measurements obtained, and all corrective actions taken. Records should be signed or initialled by the container closure inspector and should be reviewed by a representative of plant management, who is competent, with sufficient frequency to ensure that the records are completed and that the operation has been properly controlled.

9.2.3 *Water quality records*

Records should be kept of tests showing that effective treatment was maintained or that the microbiological quality was suitable.

9.2.4 *Distribution of product*

Records should be maintained identifying initial distribution of the finished product to facilitate, if necessary, the segregation of specific food lots that may have been contaminated or otherwise unfit for their intended use.

9.2.5 *Retention of records*

The records specified in 8.6.1.1, 9.1 and 9.2, should be retained for not less than three years. They should be held in a manner which will permit ready reference.

10 STORAGE AND TRANSPORT OF FINISHED PRODUCT

Conditions of storage and transport should be such that the integrity of the product container and the safety and quality of the product are not adversely affected. Attention is drawn to common forms of damage such as that caused by improper use of fork lift trucks.

10.1 Warm containers should not be stacked so as to form incubatory conditions for the growth of themophilic organisms.

10.2 If containers are kept at high humidities particularly for a long time especially in the presence of mineral salts or substances which are even very weakly alkaline or acidic they are likely to corrode.

10.3 Labels or label adhesives which are hrygroscopic and therefore liable to promote rusting of tinplate should be avoided as should pastes and adhesives that contain acids or mineral salts.
Cases and cartons should be thoroughly dry. If they are made of wood it should be well seasoned. They should be of the proper size so that the containers fit snugly and are not subjected to damage from movement within the case. They should be strong enough to withstand normal transport.
Metal containers should be kept dry during storage and transportation to prevent their corrosion.

10.4 The mechanical properties of outer cartons, etc. are adversely affected by moisture and the protection of the containers against transport damage may become insufficient.

10.5 The storage conditions, including temperature, should be such as to prevent deterioration or contamination of the product. Rapid temperature changes during storage should be avoided as this may cause the condensation of moist air on the containers and thus lead to container corrosion.

11 LABORATORY CONTROL PROCEDURES

11.1 It is desirable that each establishment should have access to laboratory control of the processes used as well as the products packed. The amount and type of such control will vary with the food product as well as the needs of management. Such control should reject all food that is unfit for human consumption.

11.2 Where appropriate, representative samples of the production should be taken to assess the safety and quality of the product.

11.3 Laboratory procedures used should preferably follow recognized or standard methods in order that the results may be readily interpreted.

11.4 Laboratories checking for pathogenic microorganisms should be well separated from food processing areas.

12 END-PRODUCT SPECIFICATIONS

Microbiological, chemical, physical or extraneous material specifications may be required depending on the nature of the food. Such specifications should include sampling procedures, analytical methodology and limits for acceptance.

12.1 To the extent possible in good manufacturing practice the products should be free from objectionable matter.

12.2 The products should be commercially sterile, and not contain any substances originating from microorganisms in amounts which may represent a hazard to health.

12.3 The products should be free from chemical pollutants in amounts which may represent a hazard to health.

12.4 The products should comply with the requirements specified in relevant national standards on pesticide residues and food additives.

SLS CERTIFICATION MARK

The Sri Lanka Standards Institution is the owner of the registered certification mark shown below. Beneath the mark, the number of the Sri Lanka Standard relevant to the product is indicated. This mark may be used only by those who have obtained permits under the SLS certification marks scheme. The presence of this mark on or in relation to a product conveys the assurance that they have been produced to comply with the requirements of the relevant Sri Lanka Standard under a well designed system of quality control inspection and testing operated by the manufacturer and supervised by the SLSI *which includes surveillance inspection of the factory, testing of both factory and market samples.*

Further particulars of the terms and conditions of the permit may be obtained from the Sri *Lanka Standards Institution, 17, Victoria Place, Elvitigala Mawatha, Colombo 08.*

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SRI LANKA STANDARDS INSTITUTION

The Sri Lanka Standards Institution (SLSI) is the National Standards Organization of Sri Lanka established under the Sri Lanka Standards Institution Act No. 6 of 1984 which repealed and replaced the Bureau of Ceylon Standards Act No. 38 of 1964. The Institution functions under the Ministry of Industry & Commerce.

The Principal objects of the Institution as set out in the Act are to prepare standards and promote their adoption, to provide facilities for examination and testing of products, to operate a Certification Marks Scheme, to certify the quality of products meant for local consumption or exports and to promote Standardization and quality control by educational, consultancy and research and research activity.

The Institution is financed by Government grants, and by the income from the sale of its publications and other services offered for Industry and Business Sector. Financial and Administrative control is vested in a Council appointed in accordance with the provisions of the Act.

The development and formulation of National Standards is carried out by Technical Experts and representatives of other interest groups, assisted by the permanent officers of the Institution. These Technical Committees are appointed under the purview of the Sectoral Committees which in return are appointed by the Council. The Sectoral Committees give the final Technical approval for the Draft National Standards prior to the approval by the Council of the SLSI.

All members of the Technical and Sectoral Committees render their services in an honorary capacity. In this process the Institution Endeavours to ensure adequate representation of all view points.

In the International field the Institution represents Sri Lanka in the International Organization for Standardization (ISO), and participates in such fields of Standardization as are of special interest to Sri Lanka.

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