

## **CHAPTER 1**

**GOOD MANUFACTURING PRACTICES  
FOR  
THE CANNING OF TUNA**

**SECTION I**  
**RECEIPT, EXAMINATION, HANDLING**  
**AND STORAGE OF RAW FISH**

The quality of the raw fish is one of the most important factors in determining the quality of the finished product. If the raw product is of inferior quality, it is not possible for the canned product to be of high quality. Each step in processing has the potential to lower the quality; none can raise it.

***GMP 1.1 Each delivered shipment of raw or frozen tuna shall be inspected to determine its condition and quality. The condition of the fish shall be noted on receipt. The name of the supplier, the temperature and appearance of the fish and the number of rejects (smashed, sours, decomposed) shall be recorded on a suitable report.***

***GMP 1.2 Each lot of raw fish shall be graded. A lot shall be rejected if it fails to meet guidelines for acceptable quality. Rejected lots and individual rejected fish shall be removed from the area; they shall not be further processed for human food.***



Grading frozen whole tuna



*Frozen tuna*



*Frozen Tonggol*



***REASON***

Since the quality of the final product depends upon the quality of the raw material, each delivered shipment of raw or frozen tuna shall be inspected and graded to determine its condition so that no tainted, decomposed, or unwholesome tuna are utilized, and to ascertain if all fish have been handled in a clean and sanitary manner.

It is essential that records of the quality of the fish in each shipment be maintained in order to identify lots which may not meet specifications.

Records of the quality and condition of the shipment, containing the following information, are made and kept for a period not less than 3 years after the shipment has been processed:

- a) species,
- b) date of receipt of shipment,
- c) name of supplier,
- d) name of delivery vessel or transport company,
- e) the average temperature of the fish,
- f) the grade of each fish inspected as per the Raw or Frozen Whole Tuna Grade Standard, including the reason or reasons for such grade, and
- g) the lots of final products identified by can codes which were produced from the particular lot of raw material.

NOTE: Culling of reject fish from a lot may be permitted in processing areas at the discretion of an Inspector, provided the rejected lots and individual rejected fish are physically segregated and there is no possibility that they can be combined with tuna of acceptable quality that is being thawed, butchered, or otherwise prepared for processing.

Grade standards for whole or butchered tuna intended for processing are given in Table 1, and a sampling plan is given in Chapter 2.

Table 1

**GRADE STANDARD  
WHOLE OR BUTCHERED TUNA INTENDED FOR PROCESSING**

Grades are assigned to each sample unit examined using the combination of factors given below. The assigned grade cannot be higher than the lowest grade for any of the grading factors. Table 3 describes a sampling plan. The grade(s) assigned to the lot are determined by the percentage of each grade of the sample units in the lot. A lot of fish shall be rejected if the number of reject fish exceeds the acceptance number in Table 3. A reject lot may be culled and is subject to re-inspection.

<i>Grade Factors</i>	<i>Grade 'A' or '1'</i>	<i>Grade 'B' or '2'</i>	<i>Grade 'C' or '3'</i>	<i>Reject</i>
ODOUR Belly cavity and cut through flesh at nape	Fresh characteristic odours.	No odour.	Slightly stale odour or uncharacteristic odours not associated with taint or decomposition.	Any detectable odour associated with taint or decomposition such as ammonia, bilge, sour.
BELLY CAVITY Internal organs and belly wall	Smooth, bright, no evidence of burn; organs bright, firm, characteristic colour.	Slight burn, slightly rough peritoneum; organs slightly soft with loss of lustre, red discolouration evident.	Breakdown of belly wall, no holes to skin, excessively rough peritoneum; organs bleached and soft; 10% of belly wall affected by protruding bones; cracks if bent 90°.	Burns through to skin, greater than 10% of belly wall has protruding bones; organs show liquifaction, and/or grey or green colours evident.
PHYSICAL DAMAGE Edible portion of fish	No evidence of mutilation or damage.	Slight mutilation or deformation; no evidence of splitting.	Slight splitting; less than 10% of fish slightly smashed or broken to expose muscle.	Greater than 10% of the fish is split, smashed or mutilated to expose muscle.
TEXTURE	Firm and elastic.	Slightly soft.	Soft.	Excessively soft and mushy.
EYES	Clear, bright, protruding.	Sunken, cloudy-white or reddish.	Sunken, dull white or red. Center of eye liquified.	Not assigned.
SKIN	Characteristic lustre and colour, clear and bright.	Dull colour.	Absence of characteristic colour and lustre; breaks in skin.	Gross discolouration of skin, skin decomposed, broken with decomposed muscle visible.
GILLS	Characteristic odour and blood red appearance.	No odour; pale red to brown red colour.	Uncharacteristic odours not associated with taint or decomposition; dark brown to yellow brown colour.	<i>Grade 'D' or '4'</i>  Detectable odours associated with taint and decomposition; white-yellow colour and slimy appearance.

***GMP 1.3 On receipt, fish shall be tested for mercury, histamine and other chemical parameters related to safety and quality***

***REASON***

Histamine is formed through the action of naturally occurring spoilage bacteria on the histidine in tuna. Histamine, when ingested in sufficient quantities, may give rise to “scombroid poisoning”. Heavy metals such as mercury, if present in amounts exceeding permissible levels, can pose a severe health threat. These tests are necessary to ensure the health and safety of the consumer.

Official methods and some methods developed and modified by Thailand are given in Chapter 5.

***GMP 1.4 Fish which are in transit to the cold storage area shall be protected from the elements by appropriate covers on the shipping containers, and must be moved to cold storage as quickly as possible in order to keep surface thawing to a minimum.***

***REASON***

This is necessary to prevent premature thawing between unloading and delivery to the plant, which could result in quality deterioration of the fish.



*Raw material  
in  
cold storage*



*Collection of samples for raw material quality evaluation*



*Determination for histamine using Fluorometer*



*Determination for mercury using mercury analyser*



***GMP 1.5 Fish in storage shall be properly stored in sanitary containers and identified within the storage area according to the date it entered storage.***



*Storage of fish in stainless steel bins*

***REASON***

This will ensure that tuna storage containers do not become a source of contamination and that stored tuna is processed as soon as possible, so that freer burn, rancidity development and, in general, quality deterioration is minimized.

***GMP 1.6 Rooms in which frozen fish are stored shall be maintained at a temperature of  $-18^{\circ}\text{C}$  or colder, providing that the storage time of the fish is no longer than 3 months.***

***REASON***

Temperature fluctuations will adversely affect the quality of frozen fish. Automatic temperature recorders are highly recommended.



## SECTION II

### THAWING

***GMP 2.1 Fish to be used immediately for canning shall be thawed in a uniform manner in safe, sanitary water which complies with the requirements of a competent authority. Recycling of water is not permitted. The temperature of the thaw water may be increased as appropriate, but if this is done, a tempering process should be carried out before introduction of the water to the thawing tank.***

Note: Recycling is defined as using water for the thawing of more than one load of fish in the same thaw tank.

Tempering is a controlled warming process for frozen fish where the temperature is raised to approximately  $-7^{\circ}\text{C}$

#### ***REASON***

These practices are necessary to ensure that the plant water supply will not be a source of contamination to the product and that the thawing process does not adversely affect the quality of the fish.

*Thawing of fish*



*Thawed fish*



***GMP 2.2 Thaw tanks shall be of non-corrodible material, other than wood, and shall have smooth surfaces free from cracks and crevices.***

***REASON***

This will help ensure that the thaw tanks do not become a source of contamination.

***GMP 2.3 Hard frozen fish shall be sufficiently thawed to facilitate butchering. A properly thawed fish shall have a maximum internal temperature of 5°C at the butchering table.***

***REASON***

Adherence to this section is critical to prevent rapid deterioration of the quality of the product; once the temperature of the fish exceeds 5°C, the rate of bacteriological and enzymatic spoilage begins to accelerate. If the fish are not thawed sufficiently, proper butchering may be difficult to perform and/or correct precooking temperatures at the backbone of the fish may not be attained.

## SECTION III

### BUTCHERING, RACKING AND STAGING

***GMP 3.1 The time between thawing and the end of butchering must not exceed 2 hours for fish under 5 kg in weight, or 4 hours for fish 5 kg or greater in weight.***

Note: Thawing is defined as ending when the thaw water is drained from the thawing tanks. Butchering ends when the fish are placed on the cooking racks.

#### ***REASON***

In order to maintain the quality of the fish, the time between thawing and the end of butchering should be kept to a minimum and proportional to the sizes of fish under consideration. For fish weighing less than 5 kg, that time must not exceed 2 hours. For fish weighing 5 kg or more that time must not exceed 4 hours.

***GMP 3.2 Fish shall be rinsed with safe, sanitary water before butchering.***

#### ***REASON***

In order to remove all extraneous and unwanted material from the fish, they shall be rinsed thoroughly using a sanitary water system.

***GMP 3.3 Thawed or fresh fish shall be properly butchered, the belly cavities thereof thoroughly washed with safe, sanitary water, and the fish inspected for defects by well-trained and qualified personnel. All fish of questionable quality shall be examined, using sensory evaluation techniques and, where fish of unacceptable quality are found, all fish of the lot(s) involved shall be examined.***



*Butchering of fish*



*Recording temperature and quality of raw material*

*Segregation of rejected raw material*



***Any fish which are decomposed or rancid, fail to meet the tuna species requirements, or are too mutilated to process shall be segregated from acceptable tuna and disposed of for other than human food.***

#### **REASON**

Proper butchering and washing is necessary to prevent bacteriological and enzymatic decomposition of the flesh. The gut of the fish harbours huge populations of spoilage organisms as well as autolytic enzymes and, therefore, it is critical that internal organs and viscera be removed quickly and completely and the belly cavity thoroughly washed with safe, sanitary water to protect sound flesh from contamination and subsequent decomposition. The external surfaces of fish also contain populations of microorganisms, and during butchering these surfaces may become further contaminated. Washing significantly reduces this bacterial load.

***GMP 3.4 The butchered, washed and inspected fish shall be placed in an orderly manner, belly-down, in suitable non-corrodible metal racks of sanitary design, for movement into the pre-cooker.***

***Reasonable consistency in size shall be maintained amongst the fish in any given rack.***

***The racks shall be kept in a clean and sanitary condition.***

#### **REASON**

It is necessary to ensure that the fish are pre-cooked at a uniform rate and that the cooking racks do not become a source of contamination to the product. The importance of placing the fish belly down on the cooking racks cannot be overemphasized. This arrangement allows the fish juices, oils, and rancid fat to drain off the fish during the cooking process. If the fish were belly up, these juices would collect in the belly cavities of the fish thereby penetrating and tainting the edible portions of their flesh. Unless the pre-cooking racks are properly sanitized, a build-up of proteinaceous material, juices, oils, fats, and other grime will occur and possibly contaminate and taint the edible portions of the fish flesh.

***GMP 3.5 The time during which fish are kept at the staging step must not exceed two hours for fish less than 5 kg in weight, or four hours for fish 5 kg or more in weight. If the ambient temperature exceeds 22°C, the maximum permitted staging time should be reduced accordingly.***

NOTE: Staging is defined as starting when the fish are placed on the cooking racks and ends when the racks have been placed in the cooker and the steam has been turned on.

***REASON***

In order to reduce the extent of bacterial spoilage, the staging time between butchering and pre-cooking should be kept to a minimum. The racks shall be kept in clean and sanitary condition.



*Staging of gutted fish (5 kg. or less) should not exceed 2 hours*



<p style="text-align: center;"><b>SECTION IV</b></p> <p style="text-align: center;"><b>PRECOOKING</b></p>
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***GMP 4.1 The precooking units, cooking racks, pre-cookers, etc. shall be of sanitary design and be kept clean at all times. All precooking surfaces and materials coming into contact with the fish shall be clean and sanitary. No copper alloys or brass shall be used in any surface which comes into contact with the fish.***

***REASON***

This is necessary to ensure that equipment and utensils do not become a source of bacteriological or other contamination of the product, and to prevent the greening and other discoloration of the fish flesh caused by contact with copper alloys or brass.

***GMP 4.2 Cooking times and temperatures shall be adequate to remove excess fish oils and body fluids and to make the loins easy to separate from the backbone.***

***REASON***

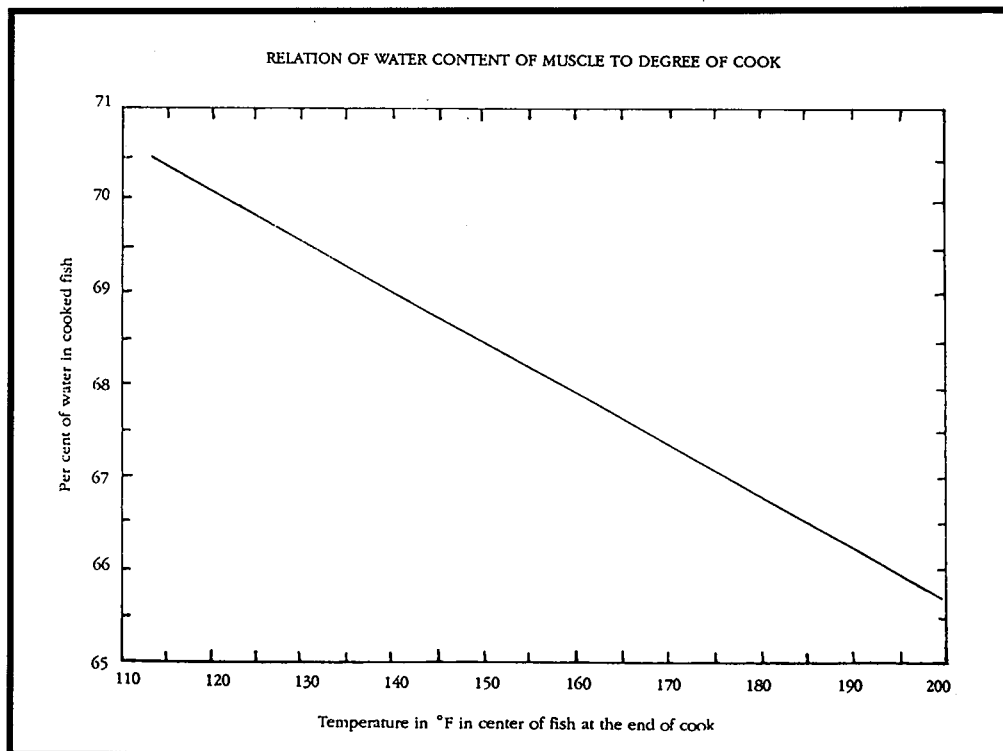
The following excerpt from *Fish as Food*, Vol. IV, Academic Press Inc., 1965, p. 226 is instructive. "As the cooking proceeds, water, and water-soluble proteinaceous material such as gelatin, nitrogen-containing extractives, and other substances are leached out of the fish and accumulate in the condensed steam which flows from the cooker continuously during the cooking operation. This condensate also contains a certain amount of oil. The steam which, during the cooking, escapes through the steam vents contains certain volatile substances that are characteristic of raw fish odour (amines). Under the influence of heat, the protein in the tuna muscle will coagulate and shrink away from the bony structure, thereby making easier the subsequent cleaning and separation of the dorsal and ventral loins which are used for canning. The precooking of tuna is,

therefore, a very important step in the over-all canning operation, as this step, perhaps more than any other, influences not only yield but quality.

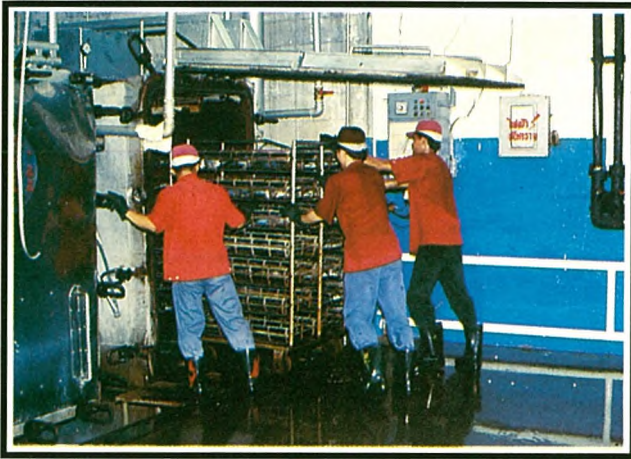
"It is known, however, that in order to obtain a good cook, the temperature of the tuna, as measured along the upper part of the spinal column, in the thickest part of the fish, must be brought up to approximately 140-150°F. Further cooking beyond this point is not only unnecessary but actually reduces both yield and flavor of the tuna meat.

"In as much as the temperature attained in the centre of the tuna is directly related to the time of pre-cook, the moisture content cooking time relationship may be expressed by a graph of similar slope.

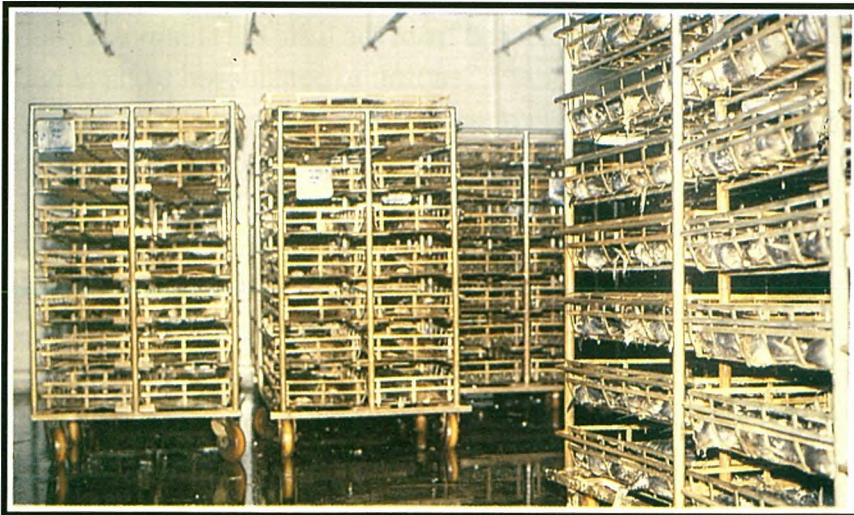
"To obtain a good cook, it is also important that the tuna be graded for uniform size, within very narrow limits. This sometimes proves difficult when the size distribution in a load of tuna is wide. Another important point to observe in connection with pre-cooking of tuna is that all the tuna must have the same temperature when entering the cooker. Tuna which has not been fully thawed will need much more heat before a temperature rise takes place in the tuna than will a fully thawed fish."



*Tuna canning and Preservation of Raw Material*



*Cooling of fish should be under temperature and time control*



*After end of pre-cooking, fish should be cleaned within 6 hours*

*Cooking of fish, a stage of the art*





<p style="text-align: center;"><b>SECTION V</b></p> <p style="text-align: center;"><b>COOLING THE PRE-COOKED FISH</b></p>
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***GMP 5.1 The precooked fish shall be cooled for a period sufficient to allow the loins to be handled. The allowable time period between pre-cooking and cleaning shall not exceed 6 hours.***

NOTE: This time is measured from the time the steam is turned off to when the cleaning ends. Cleaning is considered to have ended when all the loins or flaked product from the pre-cooked lot is placed in trays or on a conveyor for delivery to the packing area.

***REASON***

The cooling and cleaning of pre-cooked fish should be achieved as quickly as possible. In no case should this exceed 6 hours. Reference to this process is made in *Fish As Food*, Volume IV, page 228. "The cooling is carried out in cooling rooms provided with good air circulation and screened for protection against infestation. During the cooling period, the tuna undergo some very important changes. The weight of the cooked tuna is further reduced through evaporation from the hot fish. A general drying up of the surface area of the fish often takes place. The skin on the tuna, which during cooking has loosened from the muscle tissue and which at that point may be peeled off, will, as a result of the drying during cooling, dehydrate and become leathery and reattach itself to the cooked tuna muscle. Some of the oil contained in the tuna, which during cooking has accumulated on the surface of the cooked tuna, may become oxidized."

<p style="text-align: center;"><b>SECTION VI</b></p> <p style="text-align: center;"><b>CLEANING</b></p>
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***GMP 6.1 Fish cleaning shall be done in a sanitary area. All tables, pans, cleaning surfaces, etc. shall be of non-porous materials which are non-corrodible and easily cleaned and sanitized. No wooden surfaces are permitted. All surface joints shall be smooth and watertight.***

***REASON***

To maintain sanitary conditions at all times, all fish cleaning shall be done in an area and on surfaces easily cleaned and sanitized.

***GMP 6.2 Workers shall have clean outer clothing and effective hair restraints to protect fish from foreign contamination. Employees who handle fish with their bare hands shall not wear fingernail polish.***

***REASON***

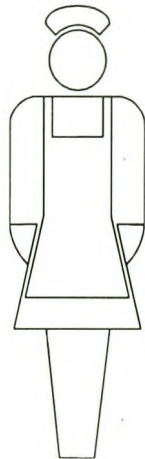
In order to prevent contamination of fish products, every person in food handling areas should maintain a high degree of personal cleanliness and should at all times wear suitable protective clothing including head covering and footwear, all of which should be cleanable unless designed to be disposed of, and should be maintained in a clean condition. Aprons and similar items should not be laid on the floor for washing. Personnel should not wear any insecure jewellery when engaged in food handling, and jewellery that cannot be adequately disinfected should be removed from the hands. Employees who handle fish with their bare hands shall not wear fingernail polish, because it may flake off and contaminate the product.



*Loin cleaning operation in which time and sanitation should be controlled*



*Personnel hygiene is vital*



*Workmanship is considered important to many markets*





**GMP 6.3** *No person who is known to be suffering from any communicable disease, is a known “carrier” of any disease or has an infected wound or open lesion on any part of the body shall be permitted to handle the fish.*

### **REASON**

Any person suffering from a communicable disease or who has an infected wound or open lesion or is a disease carrier has the potential to infect the food product with bacteria capable of causing food poisoning. The following guidelines are given in FAO/WHO Codex Alimentarius *Recommended International Code of Practice for Low-acid and Acidified Low Acid Canned Foods*:

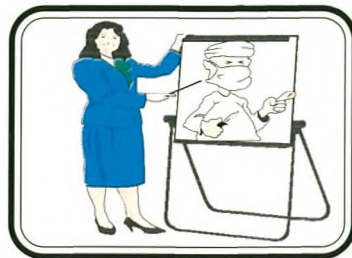
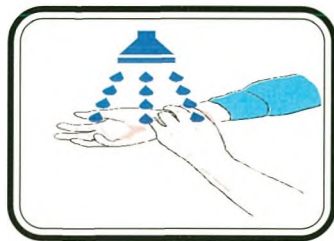
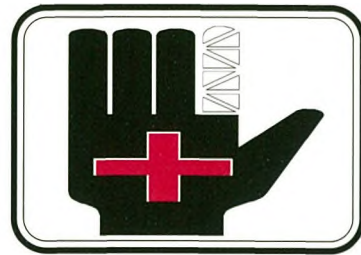
**Hygiene Training:** Managers of establishments should arrange for adequate and continuing training of every food handler in hygienic handling of food and in personal hygiene so that they understand the precautions necessary to prevent contamination of food. Instruction should include relevant parts of this code.

**Medical Examination:** Persons who come in 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.

**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 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.

**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 waterproof covering which is firmly secured, and which is conspicuous in colour. Adequate first-aid facilities should be provided for this purpose.

**Washing of Hands:** Every person engaged in a food handling area, while on duty, should wash his hands after each absence from duty with a suitable hand cleaning preparation under running warm, potable water. Hands should always be washed before commencing work, immediately after using the toilet, after handling contaminated material and whenever else necessary. Notices requiring hand-washing should be prominently displayed. There should be adequate supervision to ensure compliance with this requirement.



***GMP 6.4 Off-colour loins (discoloured flesh, either green, orange or red), off-odour fish and fish exhibiting “honeycomb” material detected during cleaning or during loin inspection shall be removed from the tuna pack.***

***REASON***

This is a critical processing step. Off-colour, off-odour and honeycombed flesh are indicative of quality deterioration and such flesh must be removed, since its inclusion in the final pack would render the final product unacceptable.



*Defective loin meat*

***GMP 6.5 Care shall be taken to ensure that cleaned edible product is not contaminated with offal.***

***REASON***

Offal is defined as non-edible parts of the tuna, including viscera, scales, eyes, gills, skin, bones, blood meat and other material not characteristic of the pack, and any rancid or decomposed flesh which would render the product unacceptable.



***GMP 6.6 There shall be a complete washdown and cleaning of processing surfaces and the cleaning tables shall be sanitized at the end of each work shift. Containers used to transport finished material shall be washed after each use. The table shall be rinsed down at least once during a 4-hour period.***

***REASON***

Unless there is a complete washdown and sanitizing of processing surfaces, cleaning tables, and containers used to transport the cleaned flesh, there will be an accumulation of pieces of fish and an increase in bacterial growth, thereby contaminating the product coming in contact with these surfaces.

*Table should be washed down every 4 hours, and trays washed at every use*



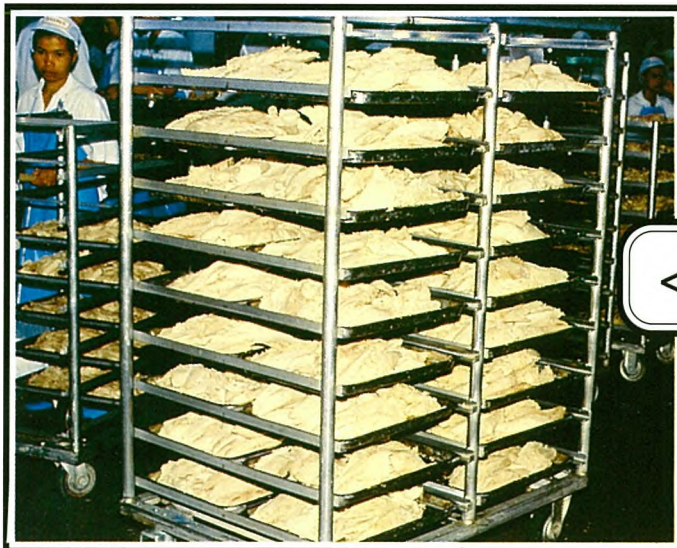
***GMP 6.7 Cleaned fish loins and flesh shall be stored for as short a period as possible, and not for more than one hour before the material is packed in a can.***

NOTE: The storage of cleaned fish shall be deemed to start from the time cleaned product is placed on conveyors or in trays until the product is packed in a can.

***REASON***

In order to prevent the growth of spoilage bacteria, cleaned loins, chunks and flakes shall be stored for as short a period as possible, and definitely not more than one hour before being packed.

*Cleaned loins should be packed within 1 hour*



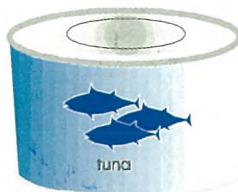
**SECTION VII**  
**PACKING**

**GMP 7.1 INGREDIENTS**

**GMP 7.1.1** *Ingredients other than tuna shall be of food grade quality. Dry or fresh ingredients shall be inspected upon receipt for cleanliness and other attributes as appropriate.*

**REASON**

Ingredients are part of the final product and, as such, must be of food grade quality.



**GMP 7.1.2** *The water supply for “spring water” tuna packs shall meet the requirements of the competent authority having jurisdiction.*



## ***GMP 7.2 EMPTY CANS AND LIDS***

***GMP 7.2.1 All lots of cans and lids brought into the cannery shall be inspected according to pre-determined standards and procedures. Cans shall be inspected for proper type of inside enamel, outside coating, defects and integrity of the side seam and bottom double seams, and general cleanliness. Cans shall be cleaned thoroughly prior to filling. Records shall be kept on the can lots and compiled in such a manner that can lots can be related to finished product can codes.***

### ***REASON***

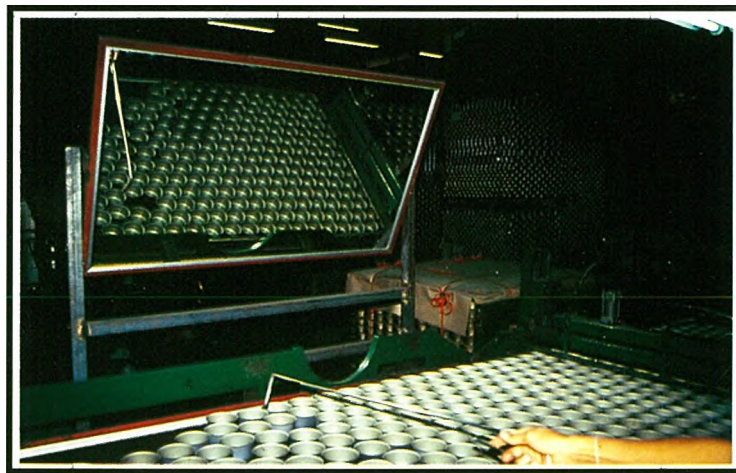
Empty cans and lids must meet specifications and the cans must be cleaned before any final product is put into them.



*Every lot of empty cans should be inspected*



*Inspection of can ends*



*Inspection of empty cans before use*

*Inspection of loin  
before packing*





### **GMP 7.3 FILLING**

***GMP 7.3.1 Prior to can filling, cleaned fish loins and flesh shall be visually inspected for defects including off-colours, skin, bones, blood meat, foreign matter, etc. and all defective material removed.***

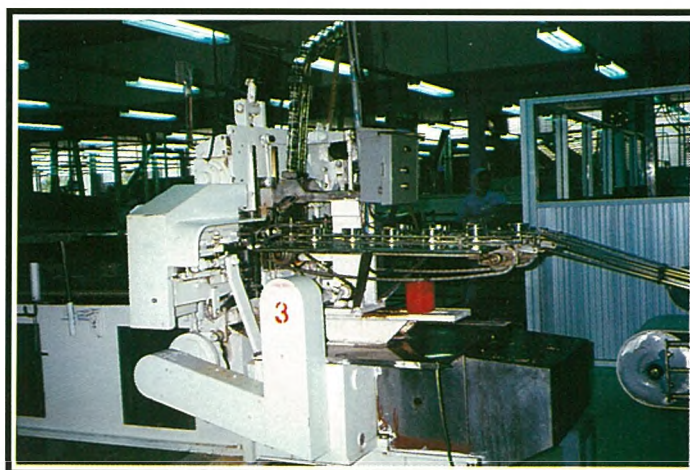
#### **REASON**

Can filling is the last point where visual inspection can take place and at which defective material can be removed from the product.

***GMP 7.3.2. Filling shall be done by hand or by machine to ensure that cans are filled to the proper level. In preparation for filling, loins shall be cut neatly and uniformly to ensure proper piece size for the intended style of pack. Cans which are improperly filled shall be removed from the processing line and corrected or rejected as required. Balance scales or other suitable weighing devices shall be available at the filling area to ensure that minimum fish fill weight and net weight requirements are met.***

#### **REASON**

It is essential that can filling operations, mechanical or manual, ensure that the filling requirements specified in the scheduled process for the particular type of tuna pack being produced are met. Improper can filling, overfilling and underfilling can adversely affect the safety and shelf life of a product. Improper filling or overfilling can result in product being deposited on the flanges where it interferes with the double-seam formation during the seaming operation and leads to a high proportion of cans being produced with seam defects or with inadequate vacuum due to insufficient head space.



*Packing machine*

***GMP 7.3.3 The recipe for the particular product involved shall be adhered to fully, to insure that sufficient liquid (oil, water, broth), salt and/or other ingredients are added, to bring can contents up to total fill specifications and net weight requirements.***

***REASON***

It is essential that can contents meet the recipe specifications and net weight requirements so that the intended label correctly describes the product, and that the product will be properly processed.

***GMP 7.4 CANSEAMING***

***GMP 7.4.1. Cans shall be washed after seaming to remove any extraneous materials from the surfaces.***

***REASON:***

Extraneous material adhering to the surfaces of cans is a real source of contamination to the can contents if any leakage into the can occurs in subsequent stages of processing, handling, storage and distribution.

***GMP 7.4.2. The can seams shall be inspected for smoothness and tightness and, if any defects such as scuffed ends, rough edges, lipped metal or other evidence of defective seams are found, the seamer shall be stopped immediately for corrective action. The top double seam and can code shall be inspected every 30 minutes during the operation of each seamer. A daily record of inspections shall be maintained for each line.***

***REASON***

Hermetically sealed containers must protect their thermally processed contents from recontamination with microorganisms. Thus, can integrity is critical for the safety and shelf stability of canned foods. An example of a daily record for seam inspection is given in Chapter 2, table 10.





*Seaming machine*



*Inspection of can ends*

*Visual inspection of seam*



***GMP 7.4.3 At least once every 4 hours of seamer operations, after a jam, or after a lengthy shut down, one can from each seaming head of each machine shall be removed for top double seam tear down examination. Can vacuums shall be monitored to ensure proper vacuum drawing procedure sufficient to maintain can ends concave at 35°C. The cans shall be opened and the seams disassembled, measured and inspected to ensure that they meet the recommendations of the can and seamer manufacturers. If defective seams are found, the seamer shall be stopped and all production of finished goods that has passed through the seamer since the last approved can seam inspection shall be isolated and held for further testing. The nature of the defective seams shall be determined, corrections shall be made and the seams shall be retested and found acceptable, before this machine will be returned to regular production. Seam measurements shall be recorded.***

#### ***REASON***

Since the hermetically sealed containers must protect their thermally processed contents from recontamination with microorganisms, can integrity is critical for the safety and shelf stability of canned foods. Producers should be capable of producing lots with can defect levels of 0.01% defective or less. It should be noted that, even under GMP the average number of serious defects may reach up to 0.01% defectives (10 per 100,000) for 3-piece cans and up to 0.004% defectives (4 per 100,000) for 2-piece cans or welded side seam cans. Under GMP, the canning industry must be capable of producing canned products which do not exceed 0.04% defectives (40 per 100,000 cans).

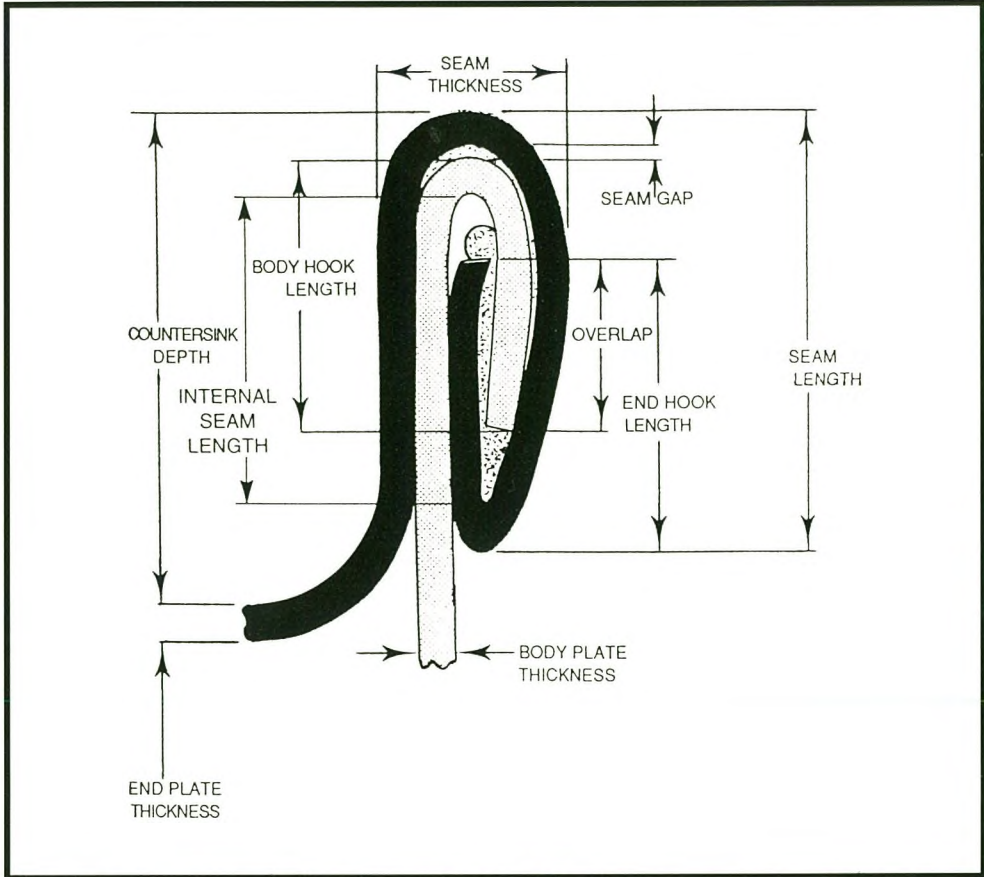
The recommended procedures involved for double seam tear down are given in Appendix I (Recommended International code of Practice Low-Acid and Acidified Low-Acid Canned Foods).

Table 2

VISUAL SEAM EXAMINATION		
EXTERNAL SEAM APPEARANCE		
Inspection Items	Frequency	Sample Size
Check for any externally visible defects or irregularities, for example, cut over, cut seam, vee, droops, false seams, spinner, etc.	1) At the closing machines as frequently as feasible. Minimum - every 30 minutes during operation. Also set up, after adjustments, jam-ups and change overs.	A minimum of cans each seaming head.
	2) Once a day. Cans from each line.	
TEAR DOWN EXAMINATION		
EXTERNAL SEAM MEASUREMENTS		
First Operation		
Inspection Items	Frequency	Sample Size
1. Thickness 2. Width	At set up and at least after every 40 hours of operation.	A minimum of 1 can from seaming head.
Second Operation		
1. Thickness 2. Width 3. Countersink	At set up. After adjustments, jam-up and change overs. Minimum: every 4 hours	A minimum of 1 can from each seaming.
VISUAL INTERNAL SEAM INSPECTION AFTER TEAR DOWN		
Inspection Items	Frequency	Sample Size
1. Tightness 2. Jumped Seam 3. Internal Droop (Juncture Rating) 4. Pressure Ridge 5. Pucker or Pleat	At set up.	A minimum of 1 can from each seaming head.



## COMPONENTS OF DOUBLE SEAM



GRAPHIC "Dimensional Terminology of the Double Seam"



Seam tear down

## TECHNICAL NOTE: CAN JAM-UPS

**Jam-ups**, i.e. points where the flow of cans is obstructed, can occur at several points in the line.

**Depalletizer and Conveyors:** All the affected cans and those in the immediate vicinity must be removed.

**Filling Machine:** Most jam-ups occur where the cans are ejected from the turret, when the flange of the can becomes jammed in the upper portion of the pocket instead of being released.

**Weighing Machine:** The area most susceptible to jam-ups on mechanical weighing machines is the underweight eject mechanism where the cans take a sudden change of direction.

**Clincher:** Devices used to separate the ends of cans and emboss the can code cause jam-ups. Generally, jam-ups occur when the clincher screw-worm is timed improperly, the coder is improperly adjusted, a separator knife is worn or a defective lid is encountered.

**Closing Machine:** Jam-ups may be caused by defective cans or can ends or improper clinching.

**Can Washer:** Jam-ups may occasionally occur at the can washer for a variety of reasons.

**The following procedure must be followed to clear jam-ups:**

1. Remove all sound and damaged cans and fish within the proximity of the jam-up.
2. If all metal can be accounted for,
  - a) It is safe to start the line and re-commence normal operation.
  - b) Inspect the fish and give it to the patching table for separate inspection before use as patching material.
  - c) Wash the empty, undamaged cans and carefully inspect prior to their re-use.
3. If all metal cannot be accounted for,
  - a) Thoroughly wash-out the equipment, paying particular attention to the trouble spots identified above.
  - b) Check the machine for metal fragments; use a waterproof flashlight and mirrored surface steel probe if necessary.
  - c) Start canning again and remove the first six cans; remove the fish and, after inspection, give it to the patching table for inspection and use as patching material.
  - d) Wash out the cans and carefully inspect prior to re-use.
  - e) Resume normal operations.
4. In any event, determine and eliminate the cause of the jam-up.
5. If the jam-up occurred in the seamer, carry out seam tear-downs on the first cans seamed to ensure that the seams are within all established tolerances.
6. Maintain a record of the number and location of every jam-up and the corrective action taken.



**GMP 7.5 CAN CODING**

***GMP 7.5.1 All cans shall be legibly embossed, at the time of can closing, with a can code indicating the establishment and day, month and year of processing.***

**REASON**

Products must be identified by establishment and packing date to facilitate the segregation of lots because of real or potential problems with safety or quality, or to initiate a complete and rapid recall of any lot. It is also standard practice to code batch/retort load and/or shift period/sub-period. In addition, a procedure to permit the complete and rapid recall of any lot of finished food products from the market should be established by the producing company.

**SECTION VIII**  
**RETORTING**

***GMP 8.1 The equipment and procedures used, the process time and temperature and the records maintained shall be approved by the competent authority***

***REASON***

This is necessary to ensure adequate commercial sterilization of canned tuna, and adequate record keeping in case of process deviation or product recalls.

NOTE : In order to comply to minimum standards for processing Low Acid Canned Food :

- 1) The tuna cannery needs to be equipped with:
  - a) retorts properly installed and controls including
    - i) mercury-in-glass thermometers,
    - ii) pressure guages,
    - iii) steam spreaders,
    - iv) venting valves,
    - v) bleeders, and
    - vi) automatic temperature recorders, and
  - b) a steam supply at a sufficient pressure and quantity to ensure uninterrupted sterilization of all products in all retorts. The steam header pressure must maintain a minimum pressure of 90 p.s.i. during maximum utilization, and
  - c) an accurate wall clock positioned in such a manner that it is clearly visible from the retort operator's station, and

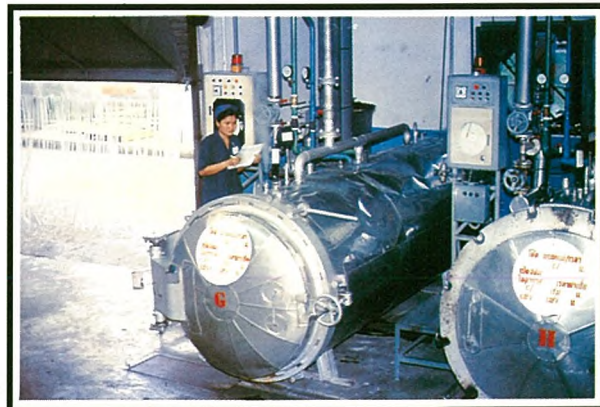
- 2) The tuna cannery is operated in accordance with recognized National and International procedures such as those described in:
  - *Canadian Code of practice for Low-Acid and Acidified Low-Acid Canned Foods,*
  - *The Canadian Food Processing Association: Canned Foods Thermal Processing and Container Evaluation,*
  - *Codex Alimentarius Commission: Recommended International Code of Hygienic Practice for Low-Acid and Acidified Low-Acid Canned Foods,*
  - *Codex Alimentarius Commission: Recommended International Code of Practice for Canned Fish,*
  - *National Canners Association: Processes for Low-Acid Canned Foods in Metal Containers Bulletin 26-L, and*
- 3) All retort operators have successfully completed a recognized Retort Operators Course, and have a Certificate/Diploma therefrom, and
- 4) Time and temperature submissions including information listed below, for each product, can size and style of pack have been submitted to verification by the competent authority and
  - a) Scheduled processes shall be established by qualified persons having expert knowledge of thermal processing requirements for low-acid foods in hermetically sealed containers and having adequate facilities for making such determinations. The type, range, and combination of variations encountered in commercial production shall be adequately considered in establishing the scheduled process. Critical factors that may affect the scheduled process, e.g. minimum headspace, consistency, maximum fill-in weights, ingredients, process times, temperatures, etc., shall be specified in the scheduled process, and
  - b) Acceptable scientific methods of establishing heat sterilization processes shall include, when necessary, but shall not be limited to, microbial thermal death time data,



*Retort area*



*Retort equipment*



*Retort monitoring*



*Clock*



*Heat sensitive indicator is used to ensure that cans passed heat processing, and will not mix with un-retorted lot*

*Retort Operator*



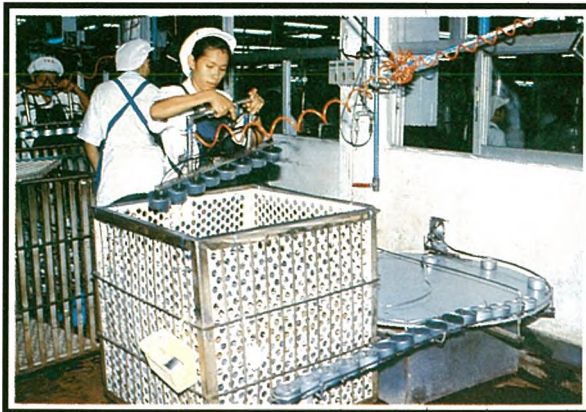
process calculations based on product heat penetration data, and data from inoculated packs. Calculations shall be performed according to procedures recognized by the competent authority. If incubation tests are necessary for process confirmation, they shall include containers from test trials and a number of containers from each of four or more actual commercial production runs during the period of instituting the process, and

- c) Complete records covering all aspects of the establishment of the process and associated incubation tests shall be prepared and shall be permanently retained by the organization making the determination and shall be subject to inspection, and
- 5) Accurate retort records, available for inspection, shall be maintained at all times, and shall include the following information and be kept for a period of not less than 5 years,
- a. Product, including packing medium,
  - b. Date of processing,
  - c. Name of retort operator,
  - d. Retort number,
  - e. Product processed,
  - f. Can size and type
  - g. Code and approximate number of cans,
  - h. Initial temperature,
  - i. Venting schedule, time steam on, time and temperature vent closed,
  - j. Clock time at start of cook, i.e. when processing (sterilization) temperature is reached.
  - k. Temperatures from mercury thermometer and recording thermometer and pressure gauge readings at start of cook,
  - l. Clock time at end of cook,
  - m. Length of time of cook,
  - n. Cooling method and time cooling started and ended and can temperature at end of cooling, and
  - o. Residual chlorine level in cooling water (**GMP 9.3**)

***GMP 8.2 The time between seaming the first can of the lot to retorting shall not exceed 2 hours. However, any delay beyond one hour must be treated as a process deviation and the time of cook adjusted to compensate for the increase in microbial load.***

### ***REASON***

Spoilage of canned fish in sealed containers can occur quickly at cannery temperatures, particularly in temperate and warmer weather conditions. Even very slight spoilage becomes quite noticeable because any odorous gases produced will be retained in the container and will consequently result in souring, off-flavour and loss of vacuum. Also, it is necessary to limit and control the conditions which permit the growth of staphylococci and the production of toxins, which are not destroyed by the heat normally applied during heat processing.



*First can of first basket is taken for temperature measurement*

*Loading of cans*



## SECTION IX

### CAN COOLING

***GMP 9.1 After finishing a full retort cycle, the canned tuna products shall be water-cooled. The temperature of the cans after cooling shall be between 45° - 50°C.***

#### ***REASON***

If canned fish is not substantially cooled after heat processing, it will continue to cook, and its texture and flavour may be impaired. This condition is known as stackburn. Furthermore, problems with struvite will often be avoided if canned fish is cooled rapidly. Struvite, which is magnesium ammonium phosphate, forms from the natural constituents of some fish products during the heat process; it crystallizes out of solution and lodges in the flesh as the product cools. If cooling is slow, the crystals of struvite are large and consumers may mistake them for glass. If cooling is rapid the crystals formed will be very small and the problem of adverse consumer reaction may be avoided. In addition, if cans are kept at elevated temperatures for too long a period, thermophilic microorganisms not destroyed by the retorting process may grow and cause spoilage.

Water cooling should not reduce the temperature of the container below the point at which its surfaces will be dried quickly by the residual heat in each container. Each can must retain sufficient heat to quickly evaporate any water droplets left on the can after retorting. Failure to do this may cause external corrosion of the can.





45° - 50° C

Can temperature measurement



Restricted area



Don't touch can in basket; only authorized personnel are allowed into restricted areas

***GMP 9.2 The cooled cans shall be dried in a clean area free from sources which could dirty the cans with water spots, oil, stains, dirt, dust, etc. Cans must not be touched by hands until they are dry and cooled. Cans shall not be rewashed after retorting.***

***REASON***

Entry to the cooling area must be restricted to those working in the area. This will ensure that people, clothing, aprons, gloves or any other foreign objects do not come into contact with the cans as they are cooling. The cooling area must be clean and free of sources of dust and dirt and there must be no possibility of condensed water, dust and dirt or other debris falling onto the cooling cans.

People must not touch the cooling cans until they are dry and cool. Hand contact, particularly without proper gloves/glove dips, increases the possibility of contamination, particularly since the cans have a vacuum and may draw in minute amounts of air or moisture which could result in post-process contamination.

Protection of the canned food must extend to the post-cooling container handling systems. Studies have indicated that excessive bacterial contamination may develop on wet and soiled post-cooling can handling equipment, even though the cooling water is chlorinated or is naturally of good sanitary quality. Bacterial contamination may be transferred, in varying degrees, to the seam areas of the cans, and may lead to contamination of the product.

Cans should be handled gently. If the cans are roughly handled after processing, the seams may be damaged and the can bodies dented. Dents may fracture the lacquer coating in the can. Leaks caused by dents or by damaged seams can result in the contamination of the product. Cans are also very susceptible to vacuum loss due to rough handling and this may also lead to contamination of the product.

***GMP 9.3 All water used for cooling shall be safe and sanitary. Water shall be chlorinated, and a residual chlorine level of at least two parts per million in the cooling water discharged at completion of cooling shall be maintained at all times. Residual chlorine shall be measured at least twice per packing shift and the results recorded on the retort records. Chlorine shall be added to the water at least twenty minutes prior to use of the water for cooling purposes.***

**REASON**

Cooling water may be sucked into the can when the seam is hot, and there is a correlation between the microbial population levels in water used to cool cans after processing and the rates of spoilage which occur in these cans. Increased contamination of cooling water invariably causes a proportional increase in product spoilage in the cans, and may cause a health hazard.

Water of good sanitary quality must be used and chlorination employed to keep the chance of contamination at a minimum. A measurable free chlorine residual of at least 2 ppm is required at the discharge end of the cooler.

In order to ensure adequate contact time, sufficient chlorine to produce a 2 ppm residual must be added at least 20 minutes prior to use of the cooling water. Care must be taken to ensure the levels of chlorine are not so high as to damage the exterior finish of the cans.

***GMP 9.4 Retorted and unretorted cans shall not be mixed together.*****REASON**

It is essential that a system for product traffic control in the retort room be established to prevent unretorted product bypassing the retort process and being mixed with retorted product. In addition, each retort basket, truck, car, or crate used to hold containers in a retort, or one or more containers therein, should, prior to each use, be plainly and conspicuously marked with a heat-sensitive indicator, or by other effective means to indicate visually those units that have been retorted. A visual check can then be performed to determine whether or not, as a result of retorting, the appropriate change has occurred in the heat sensitive indicator for all retort baskets, trucks, cars, or crates. Records that these checks have been made should be kept.

<p style="text-align: center;"><b>SECTION X</b></p> <p style="text-align: center;"><b>LABELLING</b></p>
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*GMP 10.1 Prior to labelling, the filled and sealed cans shall be examined to remove defective, swollen, rusty, dirty and damaged cans. Filled and labelled cans shall be examined as they leave the labelling area prior to being placed in cartons for shipment, and any defective, or damaged cans removed.*

**REASON**

Every cannery produces some cans with defects. Except for problems which become evident during storage, the final stage of processing at which defective cans can be identified and removed is during labelling and casing. The processor must ensure that all cans are inspected for abnormalities. Some methods of finding defective cans employ single or double dud testing and checkweighing, as well as hand culling. The latter is sometimes the only method of finding some defects such as scrap in die, metal plate flaw or false seams.

All can handling equipment from the labelling area through to the warehouse must be operated in such a manner that container damage is avoided. Dents on can bodies or damage to container ends may result in closure defects and leaker spoilage. Rough handling or improperly adjusted or maintained runways or conveyors may result in punctures, seam defects, or leaking containers. Careful handling of containers must continue through palletizing, casing, and storage or warehousing; in these areas, container damage and leaker spoilage may result from improper equipment operation, careless fork lift operation or improper stacking procedures.



## SECTION XI

### CASING

***GMP 11.1 Clean and sound materials shall be utilized. Codes on cans must be the same as case codes with respect to the plant and day, month and year of processing. Cartons/cases legibly marked with code.***

#### ***REASON***

It is essential that cartons and cases of products be identified by establishment and packing date and other information such as process batch, to facilitate the segregation of lots with potential or real safety or quality defects, or to facilitate recall procedures.



*Casing*

**SECTION XII**  
**PRODUCT STORAGE**

*GMP 12.1 The properly cased goods shall be kept in a clean, dry storage area to ensure that they are protected from excess heat, cold, water, dust, dirt, debris or any other foreign matter. The storage area shall also be kept insect- and rodent-free to prevent product contamination. Filled cartons are not to be stacked so high that container damage results.*

**REASON**

This section is necessary since proper warehousing of the finished product can greatly influence its safety and shelflife.



*Product storage in warehouse*



*Products after labelling and casing*

<p style="text-align: center;"><b>SECTION XIII</b></p> <p style="text-align: center;"><b>QUALITY CONTROL</b></p>
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***GMP 13.1 The quality control (QC) program for each canned tuna manufacturing establishment shall be developed by the manufacturer and approved by the competent authority.***

***GMP 13.2 Staff responsible for QC shall be specifically designated and appropriately trained, with periodic upgrading to ensure that they remain abreast of current knowledge. Retort supervisors shall be trained to meet the standards required by the competent authority. QC staff shall identify and appropriately monitor in accordance with established procedures, the critical control points in the manufacturing process.***

***GMP 13.3 QC records must be maintained in an appropriate manner and be available for examination by management and appropriate government regulatory authorities.***

***REASON***

The quality and safety of seafood products can be affected by a range of different factors. The most important of these include:

- a) the characteristics expected of the products themselves,
- b) the characteristics of the materials used to make them including ingredients, packaging and additives,
- c) the conditions in which processing takes place, including the construction, equipping, maintenance, operation and sanitation of buildings, facilities and equipment,
- d) the qualifications, reporting relationships and performance of personnel who perform work,

- e) the activities they perform, including work methods and equipment operating procedures, and
- f) steps taken to preserve quality and ensure safety during post-production storage and distribution, including conditions of storage, inventory management, shipping procedures and product recall.

A comprehensive quality management program includes consideration of all of the following elements for each of the factors listed above:

1. Specifying and defining the requirements set by the buyer, company, GMP and regulations,
2. Designation of responsibilities for meeting requirements,
3. Communication of the requirements to people expected to meet them,
4. Definition of systems for measuring compliance with the requirements,
5. Establishment of guidelines and procedures for dealing with situations in which non-compliance is indicated by the measurement system,
6. Implementation of the system for measuring compliance and of the guidelines and procedures for dealing with non-compliance, and
7. Verification through documentation, follow-up, audit and external evidence that specifications have been met and/or that appropriate procedures have been followed.

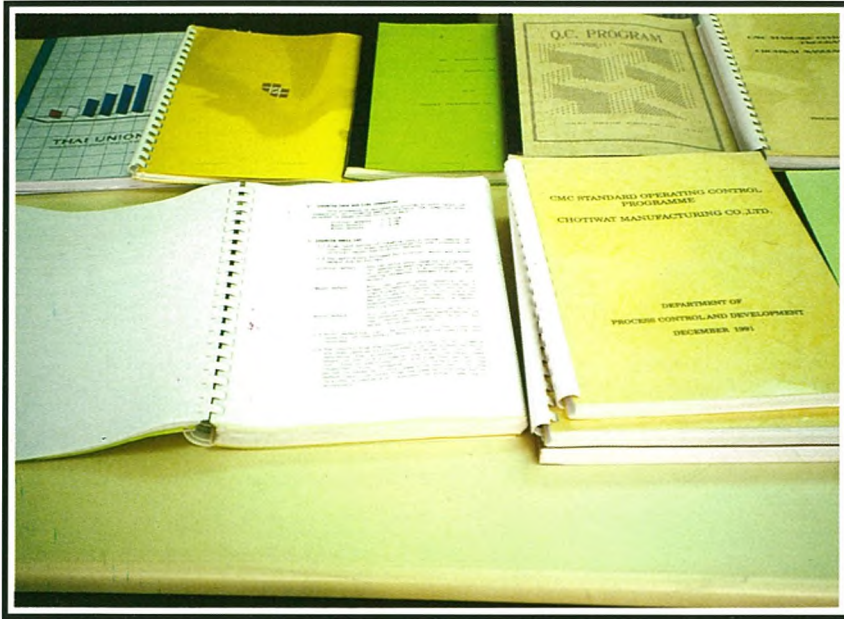
Of the above elements, the first five have customarily been referred to collectively as “*quality assurance*”, the sixth as “*quality inspection and process control*”, the seventh as “*quality verification*”; and the total as “*quality control*”.





*Sensory evaluation of end product*

Quality Control, or perhaps more appropriately “*quality management*”, involves planning, organizing and controlling operations to ensure that products consistently meet requirements set for them, whatever those requirements may be. In this context, quality management is not separate from but is an integral part of every management function. With respect to product quality and safety, it emphasizes prevention, rather than detection of problems and it should involve every person whose decisions and activities can affect the consistent meeting of requirements. It also involves the channelling of raw materials into products for which they are most appropriate, considering the manufacturer's own needs to obtain optimum value from the raw material, process them efficiently, and satisfy the customers who will buy the products as well as any minimum requirements for product quality and safety set by regulatory authorities.



*Quality manuals*

*Quality record verification*

