codex alimentarius commission

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

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Agenda Item 5b) **CX/FFP 05/27/6-Add.1**

JOINT FAO/WHO FOOD STANDARDS PROGRAMME
CODEX COMMITTEE ON FISH AND FISHERY PRODUCTS

Twenty-seventh Session
Cape Town, South Africa
28 February – 4 March 2005

PROPOSED DRAFT CODE OF PRACTICE FOR FISH AND FISHERY PRODUCTS (OTHER SECTIONS) REVISED SECTION ON SHRIMPS AND PRAWNS (Prepared by the United Kingdom)

PART 1: SECTION WITH MARKED CHANGES

SECTION 14 – PROCESSING OF SHRIMPS AND PRAWNS

Scope: Shrimp frozen for further processing may be whole, head-off or beheaded or raw headless, peeled, peeled and de-veined or cooked on board harvest or processing vessels or at on shore processing plants.

In the context of recognising controls at individual processing steps, this section provides examples of potential hazards and defects and describes technological guidelines, which can be used to develop control measures and corrective action. At a particular step only the hazards and defects, which are likely to be introduced or controlled at that step, are listed. It should be recognised that in preparing a HACCP and/or DAP plan it is essential to consult Section 5 which provides guidance for the application of the principles of HACCP and DAP analysis. However, within the scope of this Code of Practice it is not possible to give details of critical limits, monitoring, record keeping and verification for each of the steps since these are specific to particular hazards and defects.

14.1 FROZEN SHRIMPS AND PRAWNS – GENERAL

- the term shrimp is the internationally recognised generic name for Panaeus, Pandalus and Palaemonidae and other related species in the family Peneidae.
- shrimps for frozen product originate from a wide variety of sources as varied as deep cold seas to shallow tropical inshore waters and rivers through to aquaculture in tropical and semi tropical regions.
- the methods of catching, or harvesting and processing are as equally varied. Species in northern regions may be caught by modern freezer vessels, cooked, individually quick frozen and packed on board in their final marketing form. More often however, they will be raw IQF on board for further processing at onshore plants, or even landed chilled on ice. Shrimps of these species are invariably pre-cooked at onshore plants through in-line integrated process lines, followed by mechanical peeling, cooking, freezing, glazing and packing. On the other hand, Panaeus species, or warm water shrimps are usually hand peeled before cooking and freezing. More common marketing formats for these shrimps however, are in raw presentations such as head-off shell-on peeled and devined, or as butterfly shrimps, where the head and shell, except for the tail swimmers, are removed and the body is split ventrally and longitudinally to yield an attractive presentation.
- warm water shrimps may also be subject to further added value processes such as marinading and batter and crumb coatings.

- since some raw shrimp products, as well as cooked ones, may be consumed without further processing safety considerations are paramount.
- the processes described above are captured on two flow charts, but it must be appreciated that because of the diverse nature of production methods individual HACCP/DAP plans must be devised for each product.
- Other than the previous description of on-board cooking, there is no reference to processing of shrimps at sea or in farms. It is assumed that product will be correctly handled and processed in line with the relevant sections in the code of practice and that where appropriate some element of pre-preparation, such as de-heading, will have taken place prior to receipt at processing plants.
- Fresh shrimps from estuaries, and shallow coastal waters should be processed as soon as possible after receipt, particularly from artisinal sources with limited facilities.

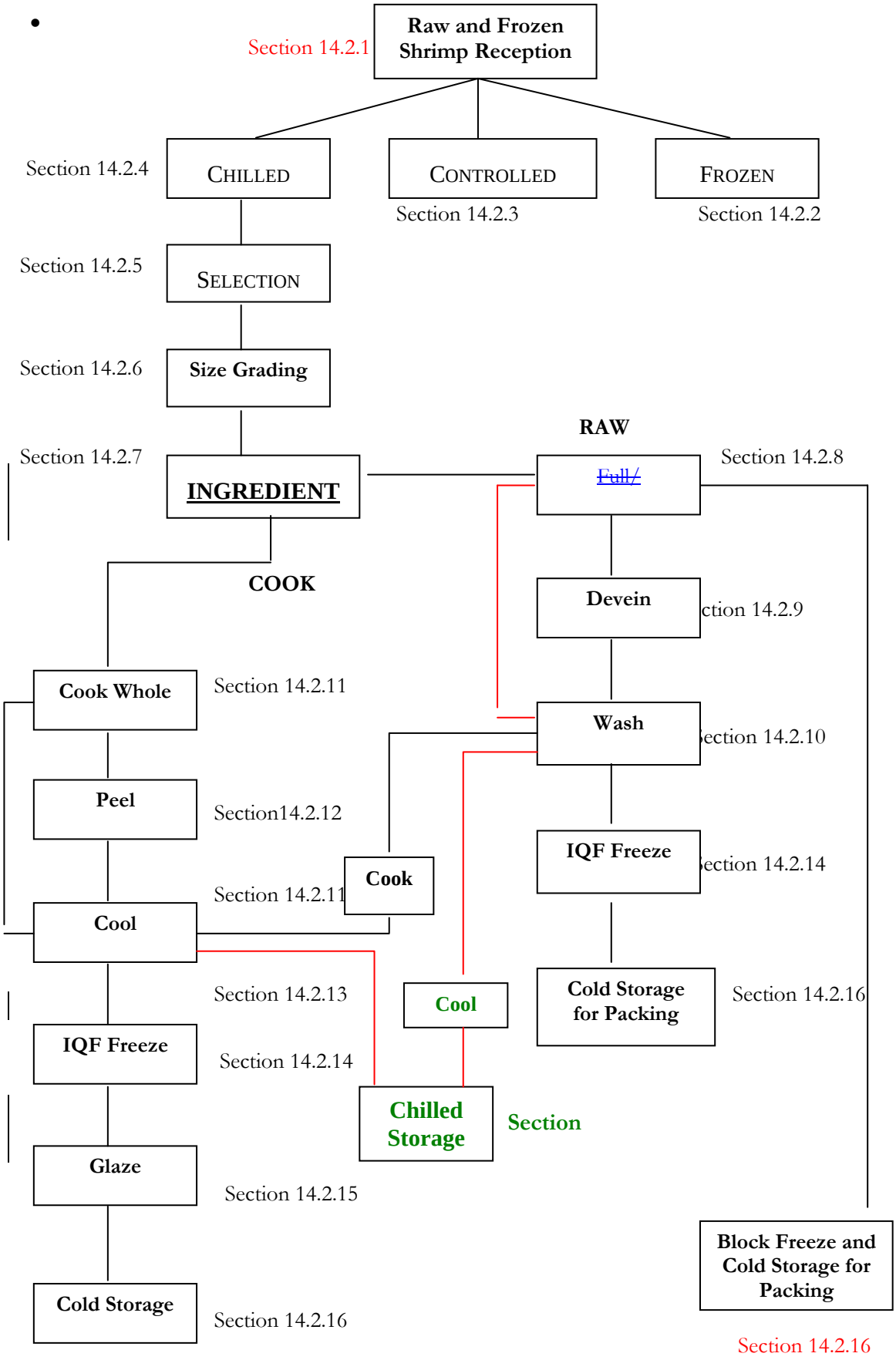


Figure 14.2 Process flow diagram for preparation of frozen shrimps via typical routes for cooked, whole, cooked and peeled and raw prepared and semi prepared products.

SHRIMP PREPARATION [PROCESSING STEPS 14.2.1 TO 14.2.16]

14.2.1 Raw Fresh and Frozen Shrimp Reception (Process Steps)

Potential Hazards: *phyto toxins (e.g. PSP)*
pathogens/Microbiological contamination
antioxidants
sulphites
pesticides
veterinary drugs (aquaculture products)

Potential Defects: *variable batch quality*
mixed species
taints
blackspot
softening from head enzymes

Technical Guidance:

- inspection protocols should be devised to cover identified quality , HACCP and DAP plan parameters together with appropriate training for inspectors to undertake these tasks.
- shrimps should be inspected upon receipt to ensure traceability and that they are well iced or deep frozen.
- the origin and previous known history will dictate the level of checking that may be necessary for, for example, phyto toxins in sea caught shrimps for potential antibiotics presence in aquaculture shrimps, particularly if there is no supplier assurance certification. In addition, other chemical indicators for heavy metals, pesticides and indicators of decomposition such as TVBN's may be applied.
- microbiological checks should be undertaken.
- shrimps should be stored in suitable facilities and allocated use-by times for processing to ensure quality parameters are met in end products.
- incoming lots of shrimp should be monitored for sulphite at harvesting.
- a sensoric evaluation should be performed on incoming lots to ensure that the product is of acceptable quality and not decomposed.

14.2.2 Frozen Storage

Potential Hazards: *unlikely*
Potential Defects: *protein denaturation, dehydration*
Technical Guidance:

- protective packaging should be undamaged, otherwise repacking to exclude possibilities of contamination and dehydration.
- cold storage temperatures to be suitable for storage with minimum fluctuation.
- product to be processed within the best before time on the packaging, or before as dictated at reception.
- the cold storage facility should have a temperature monitoring device preferably a continuous recording unit to properly monitor and record ambient temperature.

14.2.3 Controlled Thawing

Potential Hazards: *microbiological deterioration/contamination*
contamination from wrapping
Potential Defects: *quality deterioration*
Technical Guidance:

- thawing processes may be undertaken from block frozen or IQF shrimps depending on the raw material source. The outer and inner packaging should be removed prior to defrosting to prevent contamination and extra care should be taken on block frozen prawns where inner wax or polyethylene packaging may be entrapped with blocks.
- thawing tanks should be purpose designed and allow for 'counter current' water defrosting where necessary to maintain lowest temperatures possible. However water re-use is discouraged.

- thawing water and ice should either be fresh or sea water of potable quality with a water temperature no higher than 20°C (68°F) by use of additional ice.
- thawing should be achieved as quickly as possible to maintain quality.
- it is desirable for the exit conveyor, leading from the defrost tanks, to be equipped with a series of low velocity sprays to wash the shrimps with chilled clean water.
- immediately after thawing, the shrimps should be re-iced or held in chill to avoid temperature abuse before further processing.

14.2.4 Chilled Storage

Potential Hazards: *unlikely*
Potential Defects: *quality deterioration*
Technical Guidance:

- chilled storage, preferably under ice in chill rooms at less than 4°C after reception.

14.2.5 Selection

Potential Hazards: *unlikely*
Potential Defects: *quality deterioration*
Technical Guidance:

- shrimps may be selected for different quality grades according to specification requirements. This should be undertaken with minimum of delay followed by re-icing of the shrimps.
- the chilled storage facility should have a temperature monitoring device (preferably a continuous recording unit) to properly monitor and record ambient temperatures.

14.2.6 Size Grading

Potential Hazards: *microbiological growth*
Potential Defects: *quality deterioration*
decomposition
Technical Guidance:

- size grading of shrimps is typically undertaken through mechanical graders of various degrees of sophistication. There is a possibility of shrimps becoming trapped in the bars of the graders so that regular inspection is required to prevent 'carry over' of old prawns and bacteriological contamination.
- shrimp should be re-iced and stored in chill prior to further processing.
- the grading process should be carried out promptly to prevent unnecessary microbiological growth and product decomposition.

14.2.7 Addition of Ingredients and Use of Additives

Potential Hazards: *chemical and microbiological contamination*
sulphites
Potential Defects: *quality deterioration*
ingredient quality
exceeding legislation standards
Technical Guidance:

- according to specification and legislation, certain treatments may be applied to shrimps to improve organoleptic quality, preserve yield or preserve them for further processing.
- examples would including sodium metabisulphite to reduce shell blackening, sodium benzoate to extend shelf-life between processes and sodium polyphosphates to maintain succulence through processing and prevent black spot after peeling, whilst common salt would be added as brine for flavour.
- these ingredients can be added at various stages, for instance common salt and sodium polyphosphates at defrost stages or chilled brine as a flume conveyor between cooking and freezing, or as glaze.
- at whatever stage ingredients are added, it is essential to monitor the process and product to ensure that any legislative standards are not exceeded, quality parameters are met and that where dip baths are used, the contents are changed on a regular basis according to drawn up plans.
- chill conditions to be maintained throughout.
- sulphites used to prevent blackspot autolysis should be used in accordance with manufacturer's instructions and Good Manufacturing Practices.

14.2.8 Peeling

Potential Hazards: *microbiological cross contamination*

Potential Defects: *quality deterioration*
shell fragments
foreign bodies

Technical Guidance:

- this process applies mainly to warm water prawns and could be as simple as inspecting and preparing whole large prawns for freezing and down-grading blemished prawns for full peeling.
- other peeling stages could include full peeling or partial peeling leaving tail swimmers intact.
- whatever the process, it is necessary to ensure that the peeling tables are kept clear of contaminated shrimps and shell fragments with water jets and the shrimps are rinsed to ensure no carry over of shell fragments.

14.2.9 Deveining

Potential Hazards: *microbiological cross contamination*
metal contamination
foreign body contamination
Potential Defects: *objectionable matter*
quality deterioration

Technical Guidance:

- the vein is the gut which may appear as a dark line in the upper dorsal region of prawn flesh. In large warm water prawns, this may be unsightly, gritty and a source of bacterial contamination.
- removal of the vein is by razor longitudinally cutting along the dorsal region of the shrimp with a razor slide and removal of the vein by pulling. This may be partially achieved with head-off shell-on shrimps as well.
- this operation is considered to be a mechanical though labour intensive process so that:
- cleaning and maintenance schedules should be in place and cover the need for clearing before, after and during processing by trained operatives.
- further, it is essential to ensure that damaged and contaminated shrimps are removed from the line and that no debris build up is allowed.

14.2.10 Washing

Potential Hazards: *microbiological contamination*
Potential Defects: *quality deterioration*
contamination

Technical Guidance:

- washing of peeled and deveined shrimps is essential to ensure that shell and vein fragments are removed.
- shrimps should be drained and chilled without delay prior to further processing.

14.2.11Cooking Processes

Potential Hazards: *undercooking, microbiological cross contamination*
Potential Quality Defects: *under/over cooking*
Technical Guidance:

- the cooking procedure, in particular time and temperature, should be fully defined according to the specification requirements of the final product, for example whether it is to be consumed without further processing and the nature and origin of the raw shrimp and uniformity of size grading.
- the cooking schedule should be reviewed before each batch and where continuous cookers are in use, constant logging of process parameters should be available.
- only potable water should be used for cooking, whether in water or via steam injection.
- cooking temperatures should be monitored by selecting samples and recording the process in shrimps of the largest size used.
- maintenance and cleaning schedules should be available for cookers and all operations should only be undertaken by fully trained staff.
- adequate separation of cooked shrimps exiting the cooking cycle utilising different equipment is essential to ensure no cross contamination.

14.2.12 Mechanical Peeling Cooked Prawns

Potential Hazards: *cross contamination*

Potential Defects: *presence of shell*

Technical Guidance:

- this is essentially a process for Pandalus species of cold water prawns and is a highly mechanised process in-line with cooking, cooling and freezing processes.
- cleaning and maintenance schedules should be available, implemented by fully trained staff to ensure efficient and safe processing are essential.

14.2.13 Cooling

Potential Hazards: *microbiological contamination*

Potential Defects: *unlikely*

Technical Guidance:

- raw or cooked shrimps, should be cooled as quickly as possible to bring the temperature of the product to a temperature range limiting bacteria proliferation or toxin production
- cooling schedules should enable the time-temperature requirements to be met and maintenance and cleaning schedules should be in place and complied with by fully trained operatives.
- only cold/iced potable water should be used for cooling and should not be used for further batches, although for continuous operations a top-up procedure and maximum run-length will be defined.
- raw/cooked separation is essential.
- after cooling and draining, the shrimps should be frozen or chill-stored as soon as possible, avoiding any environmental contamination.

14.2.14 Freezing Processes

Potential Hazards: *mcrobiological*

Potential Defects: *slow freezing – textural quality and clumping of shrimps*

Technical Guidance:

- the freezing operation will vary tremendously according to the type of product. At its simplest, raw whole or head-off shrimps may be block or plate frozen in purpose-designed cartons into which potable water is poured to form a solid block with protective ice.
- cooked and peeled Pandalus cold water prawns, at the other extreme, tend to be frozen through fluidised bed systems, whilst many of the warm water shrimp products are IQF frozen either on trays in blast freezers or in continuous belt freezers.
- whichever the freezing process, it is necessary to ensure that the freezing conditions specified are met and that for IQF products, there is no clumping, i.e. pieces frozen together. Putting product into a blast freezer before it is at operating temperature may result in glazed, slow frozen product and contamination.
- freezers are complex machines requiring cleaning and maintenance schedules operated by fully trained staff.

14.2.15 Glazing

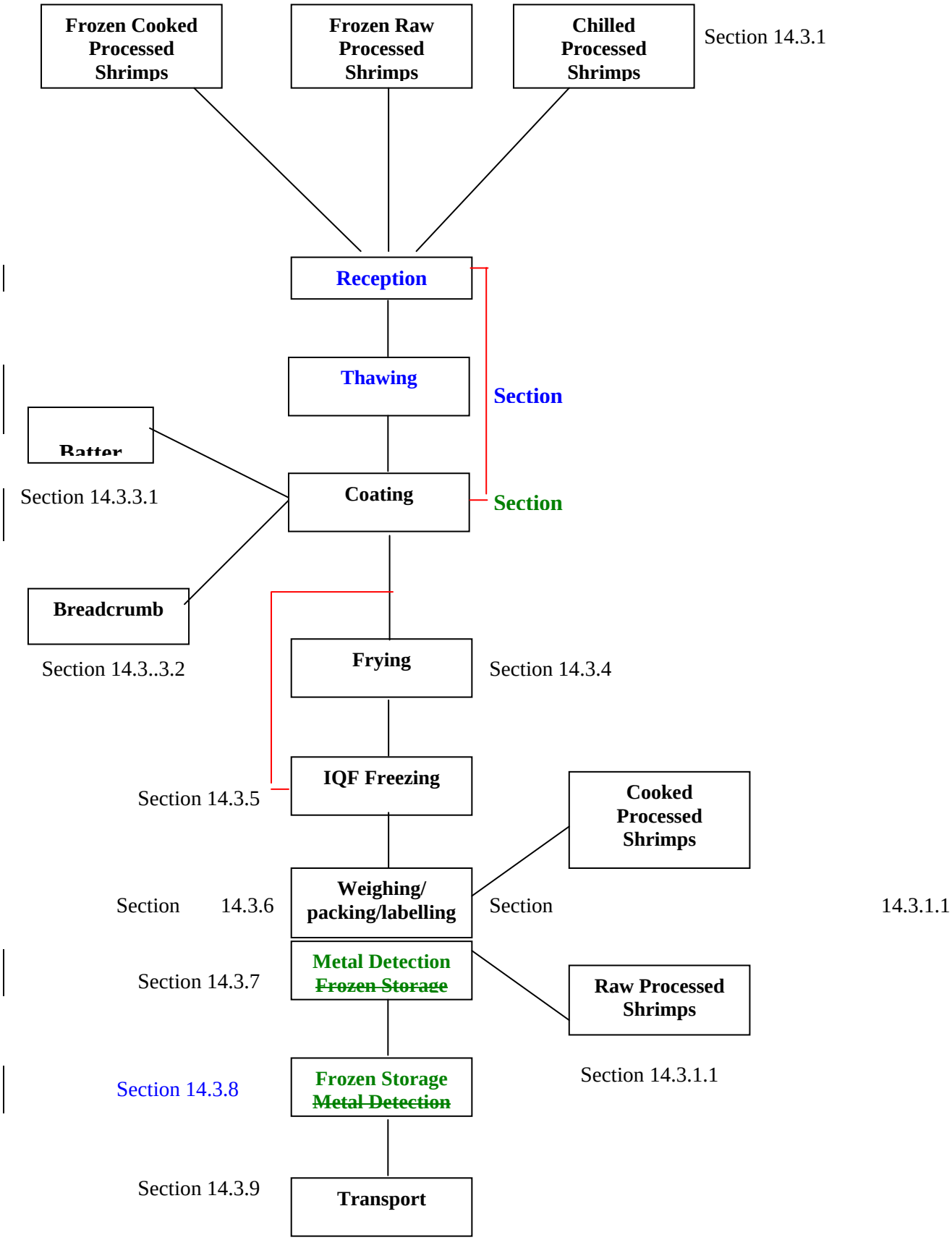
Potential Hazards: *microbiological cross-contamination*
Potential Defects: *inadequate glaze, too much glaze, spot welding, incorrect labelling.* *Technical Guidance:*

- glazing is applied to frozen shrimps to protect against dehydration and maintain quality during storage and distribution.
- ice block frozen shrimps is the simplest form of glazing, followed by dipping and draining frozen shrimps in chilled potable water. A more sophisticated process is to pass frozen size graded shrimps under coldwater sprays on vibratory belts such that the shrimps pass at a steady rate to receive an even and calculable glaze cover.
- ideally, glazed shrimps should receive a secondary re-freezing prior to packing, but if not, they should be packaged as quickly as possible and moved to cold storage. If this is not achieved, the shrimps may freeze together and ‘spot weld’ or clump as the glaze hardens.
- there are Codex methods for the determination of glaze.

14.2.16 Cold Storage

Potential Hazards: *unlikely*
Potential Defects: *dehydration, protein denaturation*
Technical Guidance: *see 14.2.2*

14.3 Process flow diagram for further added-value shrimp product preparation and for packing, weighing and labelling of all products.



14.3.1 Further Processing and Packing including reception

Potential Hazards: *microbiological and toxin production*
Potential Defects: *contamination by extraneous material*
poor quality coatings

Technical Guidance:

- where further processing is undertaken independently of primary processing, the reception steps in 14.2.1 may be necessary.

14.3.2 Thawing

Potential Hazards: *microbiological*
Potential Defects: *quality deterioration*
contamination by extraneous materials

Technical Guidance:

- where thawing may be necessary, for example, block frozen raw material, the process should be under temperature controlled conditions.
- if thawing in water, it should be potable.

14.3.3 Coated Product Production

Potential Hazards: *oil fire risks*
microbiological toxins
Potential Defects: *Incorrect coating pick ups and labelling issues*
burnt crumb coating
poor texture

Technical Guidance:

- the essential process flow for further processed added value coated products involves the use of cooked frozen shrimps, raw frozen shrimps or either of these taken chilled immediately from the process lines.
- where chill shrimp materials are used, the issues of quality and continued protein deterioration need to be taken into account.
- where frozen shrimp materials are used, steps should be taken to keep them frozen to preserve quality and texture. Note also that frozen shrimp material should not be glazed otherwise coatings will 'blow-off' on frying or cooking.

14.3.3.1 Batter

- batter ingredients powders should be checked against buying specification and ideally sieved before use to remove any packaging and extraneous materials.
- water should be potable and chilled
- batter mixing should be to preset recipes and viscosity checked to ensure correct for batter pick up required on product.
- note that bacterial toxin formation is a possibility in batter mixes so that usage times and temperatures should be set and cleaning schedules of equipment defined and maintained.
- tempura style batters may be used, in which case additional crumb coatings will probably not be applied. However, frying temperatures and times will be critical to ensure correct texture.
- where batter is for adherence of a crumb coating, formulation and viscosity will be different to tempura styles.

14.3.3.2 Breadcrumb

- breadcrumb formulation and grist, or particle size will need to be checked against buying specification and stored according to supplier instructions to avoid staling.
- outer protective packaging from crumb containers should be removed prior to use to prevent potential contamination.

14.3.4 Frying

- whilst frying is necessary for tempura batter coatings, it may not always be used for crumb coating operations, although it does ensure adhesion.
- fryers should be operated by trained staff. Oil changed on a regular basis to avoid oxidative rancidity.
- oil temperatures should be controlled to avoid burning crumb or fire risks.

14.3.5 IQF

- freezing conditions are typical of those described in 14.2.14

14.3.6 Weighing, Packing and Labelling of All Products

Potential Hazards: *unlikely*
Potential Defects: *incorrect labelling*
quality deterioration
Technical Guidance:

- all wrappings for products and packaging including glues and inks should have been specified to be food grade, odourless with no risk of substances likely to be harmful to health being transferred to the packed food.
- all food products should be weighed in packaging with scales appropriately tared to ensure correct weight.
- where products are glazed, coated or otherwise prepared, checks should be carried out to ensure the correct compositional standards to comply with legislation and packaging declarations.
- ingredients lists on packaging should declare presence of ingredients in the food product in descending order by weight, including any additives used and still present in the food.
- all wrapping and packaging should be carried out in a manner to ensure that the frozen products remain frozen and that temperature rises are minimal before transfer back to cold storage.

14.3.7 Metal Detection

Potential Hazard: *residual metal contamination*
Potential Defect:
Technical Guidance:

- products should be metal detected in final pack through machines set to the highest sensitivity possible.
- larger packs will be detected at a lower sensitivity than smaller packs so that consideration should be given to testing product prior to packing. However, unless potential re-contamination prior to packing can be eliminated, it is probably still better to check in-pack.

14.3.8 Storage of End Product

Potential Hazard: *none likely*
Potential Defects: *texture and flavour deviations due to fluctuations in temperature, deep freezer burn, cold store flavour, cardboard flavour*

***Technical* Guidance:**

- all end products should be stored at frozen temperature in a clean, sound and hygienic environment.
- severe fluctuations of storage temperature (greater than 3^{o}C) has to be avoided.
- too long storage time (depending on fat content of species used and type of coating) should be avoided.
- the facility should be capable of maintaining the temperature of the fish at or colder than minus 18^{o}C with minimal temperature fluctuations.
- the storage area should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended.
- a systematic stock rotation plan should be developed and maintained.
- products should be properly protected from dehydration, dirt and other forms of contamination.
- all end products should be stored in the freezer to allow proper air circulation.

14.3.9 Transport of End Product

Potential Hazard: *none likely*
Potential Defects: *quality deterioration*
Technical Guidance:

- during all transportation steps deep-frozen conditions should be maintained minus 18^{o}C (maximum fluctuation +/-3^{o}C) until final destination of product is reached.
- cleanliness and suitability of the transport vehicle to carry frozen food products should be examined.
- use of temperature recording devices with the shipment is recommended.

PART 2: REVISED SECTION

SECTION 14 – PROCESSING OF SHRIMPS AND PRAWNS

Scope: Shrimp frozen for further processing may be whole, head-off or beheaded or raw headless, peeled, peeled and de-veined or cooked on board harvest or processing vessels or at on shore processing plants.

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- the processes described above are captured on two flow charts, but it must be appreciated that because of the diverse nature of production methods individual HACCP/DAP plans must be devised for each product.
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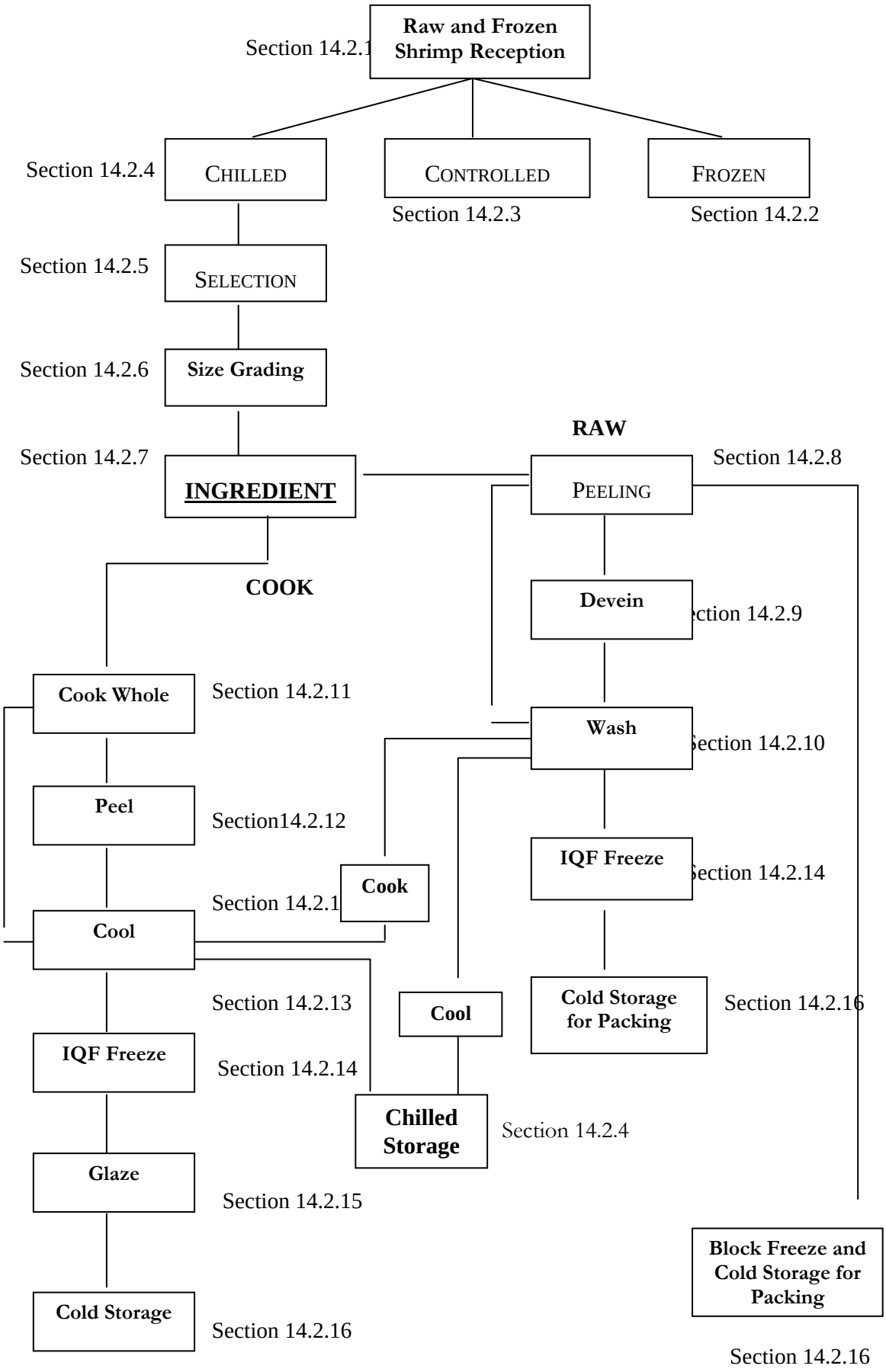

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SHRIMP PREPARATION [PROCESSING STEPS 14.2.1 TO 14.2.16]

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Potential Defects: *variable batch quality*
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- the origin and previous known history will dictate the level of checking that may be necessary for, for example, phyto toxins in sea caught shrimps for potential antibiotics presence in aquaculture shrimps, particularly if there is no supplier assurance certification. In addition, other chemical indicators for heavy metals, pesticides and indicators of decomposition such as TVBN's may be applied.
- microbiological checks should be undertaken.
- shrimps should be stored in suitable facilities and allocated use-by times for processing to ensure quality parameters are met in end products.
- incoming lots of shrimp should be monitored for sulphite at harvesting.
- a sensoric evaluation should be performed on incoming lots to ensure that the product is of acceptable quality and not decomposed.

14.2.2 Frozen Storage

Potential Hazards: *unlikely*
Potential Defects: *protein denaturation, dehydration*
Technical Guidance:

- protective packaging should be undamaged, otherwise repacking to exclude possibilities of contamination and dehydration.
- cold storage temperatures to be suitable for storage with minimum fluctuation.
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- the cold storage facility should have a temperature monitoring device preferably a continuous recording unit to properly monitor and record ambient temperature.

14.2.3 Controlled Thawing

Potential Hazards: *- microbiological deterioration/contamination*
- contamination from wrapping

Potential Defects: *quality deterioration*

Technical Guidance:

- thawing processes may be undertaken from block frozen or IQF shrimps depending on the raw material source. The outer and inner packaging should be removed prior to defrosting to prevent contamination and extra care should be taken on block frozen prawns where inner wax or polyethylene packaging may be entrapped with blocks.
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- immediately after thawing, the shrimps should be re-iced or held in chill to avoid temperature abuse before further processing.

14.2.4 Chilled Storage

Potential Hazards: *unlikely*
Potential Defects: *quality deterioration*
Technical Guidance:

- chilled storage, preferably under ice in chill rooms at less than 4^{o}C after reception.

14.2.5 Selection

Potential Hazards: *unlikely*
Potential Defects: *quality deterioration*
Technical Guidance:

- shrimps may be selected for different quality grades according to specification requirements. This should be undertaken with minimum of delay followed by re-icing of the shrimps.
- the chilled storage facility should have a temperature monitoring device (preferably a continuous recording unit) to properly monitor and record ambient temperatures.

14.2.6 Size Grading

Potential Hazards: *microbiological growth*
Potential Defects: *quality deterioration*
decomposition
Technical Guidance:

- size grading of shrimps is typically undertaken through mechanical graders of various degrees of sophistication. There is a possibility of shrimps becoming trapped in the bars of the graders so that regular inspection is required to prevent 'carry over' of old prawns and bacteriological contamination.
- shrimp should be re-iced and stored in chill prior to further processing.
- the grading process should be carried out promptly to prevent unnecessary microbiological growth and product decomposition.

14.2.7 Addition of Ingredients and Use of Additives

Potential Hazards: *chemical and microbiological contamination*
sulphites
Potential Defects: *quality deterioration*
ingredient quality
exceeding legislation standards
Technical Guidance:

- according to specification and legislation, certain treatments may be applied to shrimps to improve organoleptic quality, preserve yield or preserve them for further processing.
- examples would including sodium metabisulphite to reduce shell blackening, sodium benzoate to extend shelf-life between processes and sodium polyphosphates to maintain succulence through processing and prevent black spot after peeling, whilst common salt would be added as brine for flavour.
- these ingredients can be added at various stages, for instance common salt and sodium polyphosphates at defrost stages or chilled brine as a flume conveyor between cooking and freezing, or as glaze.
- at whatever stage ingredients are added, it is essential to monitor the process and product to ensure that any legislative standards are not exceeded, quality parameters are met and that where dip baths are used, the contents are changed on a regular basis according to drawn up plans.
- chill conditions to be maintained throughout.
- sulphites used to prevent blackspot autolysis should be used in accordance with manufacturer's instructions and Good Manufacturing Practices.

14.2.8 Peeling

Potential Hazards: *microbiological cross contamination*
Potential Defects: *quality deterioration*
shell fragments
foreign bodies
Technical Guidance:

- this process applies mainly to warm water prawns and could be as simple as inspecting and preparing whole large prawns for freezing and down-grading blemished prawns for full peeling.
- other peeling stages could include full peeling or partial peeling leaving tail swimmers intact.
- whatever the process, it is necessary to ensure that the peeling tables are kept clear of contaminated shrimps and shell fragments with water jets and the shrimps are rinsed to ensure no carry over of shell fragments.

14.2.9 Deveining

Potential Hazards: *microbiological cross contamination*
metal contamination
foreign body contamination
Potential Defects: *objectionable matter*
quality deterioration
Technical Guidance:

- the vein is the gut which may appear as a dark line in the upper dorsal region of prawn flesh. In large warm water prawns, this may be unsightly, gritty and a source of bacterial contamination.
- removal of the vein is by razor longitudinally cutting along the dorsal region of the shrimp with a razor slide and removal of the vein by pulling. This may be partially achieved with head-off shell-on shrimps as well.
- this operation is considered to be a mechanical though labour intensive process so that:
- cleaning and maintenance schedules should be in place and cover the need for clearing before, after and during processing by trained operatives.
- further, it is essential to ensure that damaged and contaminated shrimps are removed from the line and that no debris build up is allowed.

14.2.10 Washing

Potential Hazards: *microbiological contamination*
Potential Defects: *quality deterioration*
contamination
Technical Guidance:

- washing of peeled and deveined shrimps is essential to ensure that shell and vein fragments are removed.
- shrimps should be drained and chilled without delay prior to further processing.

14.2.11Cooking Processes

Potential Hazards: *undercooking, microbiological cross contamination*
Potential Quality Defects: *under/over cooking*
Technical Guidance:

- the cooking procedure, in particular time and temperature, should be fully defined according to the specification requirements of the final product, for example whether it is to be consumed without further processing and the nature and origin of the raw shrimp and uniformity of size grading.
- the cooking schedule should be reviewed before each batch and where continuous cookers are in use, constant logging of process parameters should be available.
- only potable water should be used for cooking, whether in water or via steam injection.
- cooking temperatures should be monitored by selecting samples and recording the process in shrimps of the largest size used.
- maintenance and cleaning schedules should be available for cookers and all operations should only be undertaken by fully trained staff.
- adequate separation of cooked shrimps exiting the cooking cycle utilising different equipment is essential to ensure no cross contamination.

14.2.12 Mechanical Peeling Cooked Prawns

Potential Hazards: *cross contamination*
Potential Defects: *presence of shell*
Technical Guidance:

- this is essentially a process for Pandalus species of cold water prawns and is a highly mechanised process in-line with cooking, cooling and freezing processes.

- cleaning and maintenance schedules should be available, implemented by fully trained staff to ensure efficient and safe processing are essential.

14.2.13 Cooling

Potential Hazards: *microbiological contamination*
Potential Defects: *unlikely*
Technical Guidance:

- raw or cooked shrimps, should be cooled as quickly as possible to bring the temperature of the product to a temperature range limiting bacteria proliferation or toxin production.
- cooling schedules should enable the time-temperature requirements to be met and maintenance and cleaning schedules should be in place and complied with by fully trained operatives.
- only cold/iced potable water should be used for cooling and should not be used for further batches, although for continuous operations a top-up procedure and maximum run-length will be defined.
- raw/cooked separation is essential.
- after cooling and draining, the shrimps should be frozen or chill-stored as soon as possible, avoiding any environmental contamination.

14.2.14 Freezing Processes

Potential Hazards: *mcrobiological*
Potential Defects: *slow freezing – textural quality and clumping of shrimps*
Technical Guidance:

- the freezing operation will vary tremendously according to the type of product. At its simplest, raw whole or head-off shrimps may be block or plate frozen in purpose-designed cartons into which potable water is poured to form a solid block with protective ice.
- cooked and peeled Pandalus cold water prawns, at the other extreme, tend to be frozen through fluidised bed systems, whilst many of the warm water shrimp products are IQF frozen either on trays in blast freezers or in continuous belt freezers.
- whichever the freezing process, it is necessary to ensure that the freezing conditions specified are met and that for IQF products, there is no clumping, i.e. pieces frozen together. Putting product into a blast freezer before it is at operating temperature may result in glazed, slow frozen product and contamination.
- freezers are complex machines requiring cleaning and maintenance schedules operated by fully trained staff.

14.2.15 Glazing

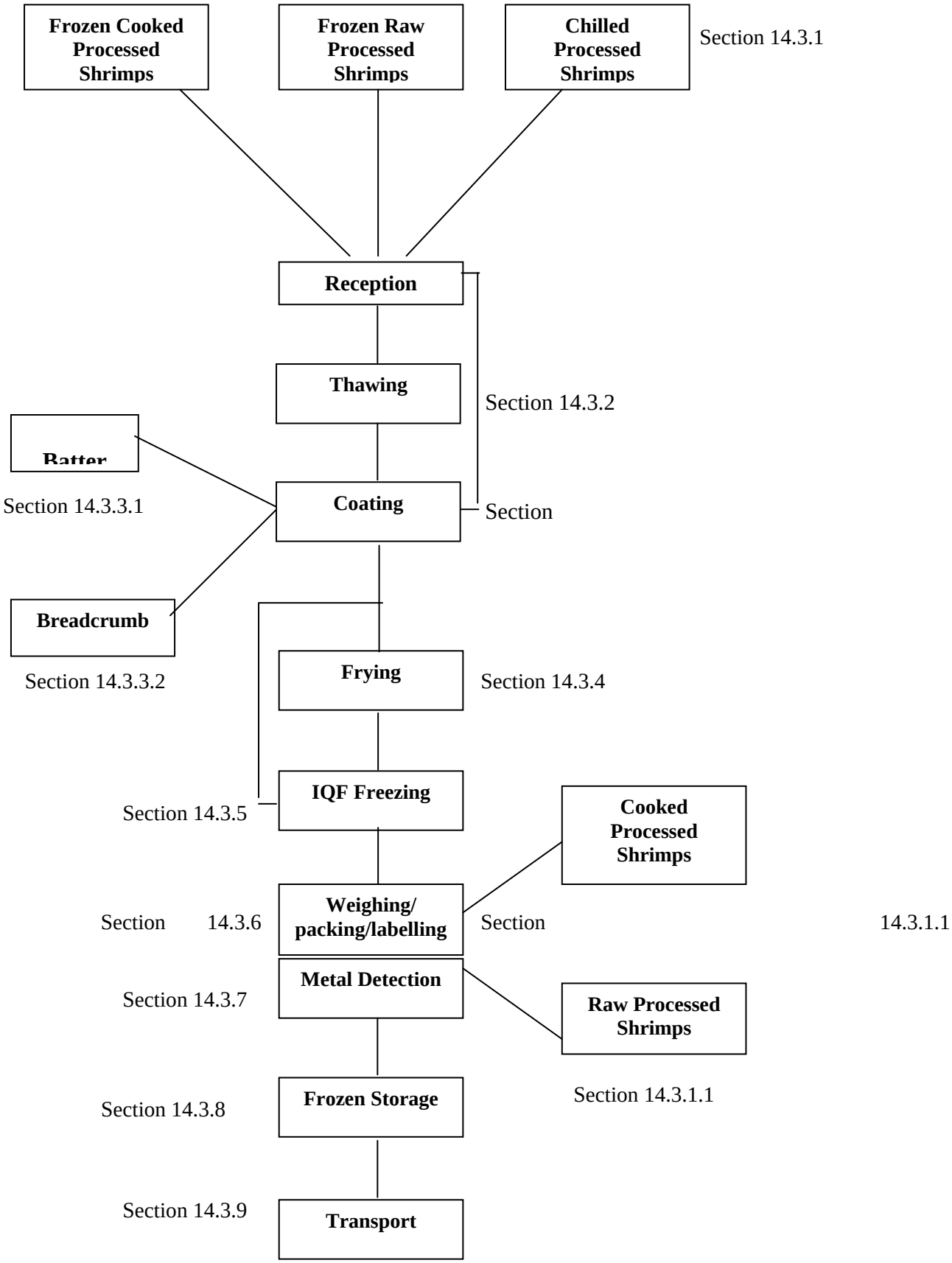
Potential Hazards: *microbiological cross-contamination*
Potential Defects: *inadequate glaze, too much glaze, spot welding, incorrect labelling.* *Technical Guidance:*

- glazing is applied to frozen shrimps to protect against dehydration and maintain quality during storage and distribution.
- ice block frozen shrimps is the simplest form of glazing, followed by dipping and draining frozen shrimps in chilled potable water. A more sophisticated process is to pass frozen size graded shrimps under coldwater sprays on vibratory belts such that the shrimps pass at a steady rate to receive an even and calculable glaze cover.
- ideally, glazed shrimps should receive a secondary re-freezing prior to packing, but if not, they should be packaged as quickly as possible and moved to cold storage. If this is not achieved, the shrimps may freeze together and 'spot weld' or clump as the glaze hardens.
- there are Codex methods for the determination of glaze.

14.2.16 Cold Storage

Potential Hazards: *unlikely*
Potential Defects: *dehydration, protein denaturation*
Technical Guidance: *see* *14.2.2*

14.3 Process flow diagram for further added-value shrimp product preparation and for packing, weighing and labelling of all products.



14.3.1 Further Processing and Packing including reception

Potential Hazards: *microbiological and toxin production*
Potential Defects: *contamination by extraneous material*
poor quality coatings

Technical Guidance:

- where further processing is undertaken independently of primary processing, the reception steps in 14.2.1 may be necessary.

14.3.2 Thawing

Potential Hazards: *microbiological*
Potential Defects: *quality deterioration*
contamination by extraneous materials

Technical Guidance:

- where thawing may be necessary, for example, block frozen raw material, the process should be under temperature controlled conditions.
- if thawing in water, it should be potable.

14.3.3 Coated Product Production

Potential Hazards: *oil fire risks*
microbiological toxins
Potential Defects: *Incorrect coating pick ups and labelling issues*
burnt crumb coating
poor texture

Technical Guidance:

- the essential process flow for further processed added value coated products involves the use of cooked frozen shrimps, raw frozen shrimps or either of these taken chilled immediately from the process lines.
- where chill shrimp materials are used, the issues of quality and continued protein deterioration need to be taken into account.
- where frozen shrimp materials are used, steps should be taken to keep them frozen to preserve quality and texture. Note also that frozen shrimp material should not be glazed otherwise coatings will 'blow-off' on frying or cooking.

14.3.3.1 Batter

- batter ingredients powders should be checked against buying specification and ideally sieved before use to remove any packaging and extraneous materials.
- water should be potable and chilled.
- batter mixing should be to preset recipes and viscosity checked to ensure correct for batter pick up required on product.
- note that bacterial toxin formation is a possibility in batter mixes so that usage times and temperatures should be set and cleaning schedules of equipment defined and maintained.
- tempura style batters may be used, in which case additional crumb coatings will probably not be applied. However, frying temperatures and times will be critical to ensure correct texture.
- where batter is for adherence of a crumb coating, formulation and viscosity will be different to tempura styles.

14.3.3.2 Breadcrumb

- breadcrumb formulation and grist, or particle size will need to be checked against buying specification and stored according to supplier instructions to avoid staling.
- outer protective packaging from crumb containers should be removed prior to use to prevent potential contamination.

14.3.4 Frying

- whilst frying is necessary for tempura batter coatings, it may not always be used for crumb coating operations, although it does ensure adhesion.
- fryers should be operated by trained staff. Oil changed on a regular basis to avoid oxidative rancidity.
- oil temperatures should be controlled to avoid burning crumb or fire risks.

14.3.5 IQF

- freezing conditions are typical of those described in 14.2.14

14.3.6 Weighing, Packing and Labelling of All Products

Potential Hazards: *unlikely*
Potential Defects: *incorrect labelling*
quality deterioration

Technical Guidance:

- all wrappings for products and packaging including glues and inks should have been specified to be food grade, odourless with no risk of substances likely to be harmful to health being transferred to the packed food.
- all food products should be weighed in packaging with scales appropriately tared to ensure correct weight.
- where products are glazed, coated or otherwise prepared, checks should be carried out to ensure the correct compositional standards to comply with legislation and packaging declarations.
- ingredients lists on packaging should declare presence of ingredients in the food product in descending order by weight, including any additives used and still present in the food.
- all wrapping and packaging should be carried out in a manner to ensure that the frozen products remain frozen and that temperature rises are minimal before transfer back to cold storage.

14.3.7 Metal Detection

Potential Hazard: *residual metal contamination*
Potential Defect:
Technical Guidance:

- products should be metal detected in final pack through machines set to the highest sensitivity possible.
- larger packs will be detected at a lower sensitivity than smaller packs so that consideration should be given to testing product prior to packing. However, unless potential re-contamination prior to packing can be eliminated, it is probably still better to check in-pack.

14.3.8 Storage of End Product

Potential Hazard: *none likely*
Potential Defects: *texture and flavour deviations due to fluctuations in temperature, deep freezer burn, cold store flavour, cardboard flavour*

Technical Guidance:

- all end products should be stored at frozen temperature in a clean, sound and hygienic environment.
- severe fluctuations of storage temperature (greater than $3^{o}C$) has to be avoided.
- too long storage time (depending on fat content of species used and type of coating) should be avoided.
- the facility should be capable of maintaining the temperature of the fish at or colder than minus $18^{o}C$ with minimal temperature fluctuations.
- the storage area should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended.
- a systematic stock rotation plan should be developed and maintained.
- products should be properly protected from dehydration, dirt and other forms of contamination.
- all end products should be stored in the freezer to allow proper air circulation.

14.3.9 Transport of End Product

Potential Hazard: *none likely*
Potential Defects: *quality deterioration*
Technical Guidance:

- during all transportation steps deep-frozen conditions should be maintained minus $18^{o}C$ (maximum fluctuation $+/-3^{o}C$) until final destination of product is reached.
- cleanliness and suitability of the transport vehicle to carry frozen food products should be examined.
- use of temperature recording devices with the shipment is recommended.