



Guidance for the Control of *Listeria monocytogenes* in Ready-to-eat Foods Part 2: Good Operating Practices

13 February 2017

Title

Guidance Document: Guidance for the Control of *Listeria monocytogenes* in Ready-to-eat Foods Part 2: Good Operating Practices

About this document

The Ministry for Primary Industries (MPI) has developed a series of documents “Guidance for the control of *Listeria monocytogenes* in ready-to-eat foods” that address different areas of *L. monocytogenes* management in a food manufacturing or processing environment.

These guidelines are intended to assist food operators to develop, implement and review control measures for *Listeria monocytogenes* in the context of a Risk Management Programme (RMP) or Food Control Plan (FCP).

The guidelines are intended to support but do not replace any specific requirements for *L. monocytogenes* and/or other pathogen management as described in New Zealand legislation, such as the Animal Products Act 1999, for dairy and seafood, or under the Food Act 2014.

Related Requirements

The documents in the series “Guidance for the control of *Listeria monocytogenes* in ready-to-eat foods” are:

- (1) Part 1: *Listeria* Management and Glossary; and
- (2) Part 2: Good Operating Practices (GOPs); and
- (3) Part 3: Monitoring Activities; and
- (4) Part 4: Corrective Actions.

Document history

Previous Version Date	Current Version Date	Section Changed	Change(s) Description
December 2012	January 2013		Update text.
January 2013	July 2016		Updated document
July 2016	February 2017		Updated section 2

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1 Purpose

This document is Part 2 in the series of guides “Guidance for the control of *Listeria monocytogenes* in ready-to-eat foods” that have been developed by the Ministry for Primary Industries (MPI).

This document should be used in conjunction with the other documents in the series to provide an overall strategy for managing *Listeria* when manufacturing, processing or preparing ready-to-eat (RTE) foods.

2 Scope

2.1 What is covered by this Part

Part 2 provides information (guidance, and where appropriate legal requirements) related to the Good Operating Practice (GOP) with specific focus on minimising the contamination of foods with *L. monocytogenes* during production if implemented effectively.

After reading this Part, you should have a better understanding of how to develop and implement elements of GOP that provide specific control measures to minimise *Listeria* contamination of RTE foods.

All *Listeria* species can be found in the same niches in a processing environment. Finding any *Listeria* identifies the need to implement or increase control measures. Therefore in this document the term ‘*Listeria*’ is used to include all *Listeria* spp. except where the actions relate specifically to the major pathogenic species *Listeria monocytogenes*, in particular where it is found in a RTE food or on a product contact surface.

2.2 How does this Part relate to the other parts of the guidance for the control of *Listeria monocytogenes* in ready-to-eat foods

Part 1 provides a glossary of terms and information on the characteristics of *Listeria monocytogenes*, the sources, the consequences of food contamination and how it may enter the processing environment. It also provides information on a *Listeria* Management Programme (LMP).

Part 2 provides information on specific Good Operating Practices (GOP) that should assist in either preventing contamination of food with *L. monocytogenes* or managing the pathogen if present.

Part 3 provides information on monitoring activities for verification of the control of *Listeria monocytogenes* through microbiological testing.

Part 4 identifies how to act response to the detection of *Listeria* in the processing environment, ingredients, raw materials or product.

3 Introduction

3.1 Good Operating Practices

All food businesses are expected to implement Good Operating Practice (GOP), also known as:

- Good Hygienic Practice (GHP);
- Good Manufacturing Practice (GMP); and
- Good Agricultural Practice (GAP).

In some cases, legislation requires that GOP is documented.

The GOP procedures are generally facility-wide programmes covering such aspects as personal hygiene, staff training, cleaning and sanitation, allergen management as well as process control. Whilst they tend to deal more with food hygiene rather than food safety, having GOP in place may be enough to:

- control relevant food safety hazards such as *L. monocytogenes*; and
- assist the food operator in providing safe and suitable food.

GOP is a fundamental component of any risk-based programme for a food business, such as a Food Control Plan (FCP) or a Risk Management Programme (RMP).

Individual guidance documents are available for the GOP procedures that a food operator may need at: <http://foodsafety.govt.nz/industry/general/gop/>

General and specific references are provided in **15 References**.

GOP is the foundation for the establishment of *Listeria* control measures.

In the first Part of this series of documents (Part 1: *Listeria* Management), the key factors to reduce the potential for RTE food to be the cause of consumers developing listeriosis were identified as:

- removing or reducing *Listeria* present in or on the food i.e. process control;
- minimising the likelihood that the food becomes contaminated during processing, especially after a listericidal process has been applied; and
- limiting the potential for growth to occur in the RTE food post-processing until consumed.

To develop effective GOP, it is important to understand:

- how *Listeria* enters the processing environment;
- factors for *Listeria* control measures; and
- the particular characteristics that make this bacterium a problem for the production of RTE food industry.

Listeria is widespread in the environment; has the ability to form biofilms and is able grow at low (refrigeration) temperatures. These characteristics mean that processing environments are easily and frequently contaminated. Once *Listeria* is present it may be difficult to remove. As a result there should be a major focus on:

- limiting the introduction of *Listeria* into the processing environment;
- locating and removing *Listeria* that does get in; and
- preventing its transfer to the food.

3.2 Where to focus GOP

Food operators should review the GOP that is already in place to ensure that it will provide the necessary *Listeria* control. It is important to understand how particular processes affect the safety and suitability of the food.

This means thinking about the:

- ingredients, raw materials and other inputs;
- food product and process;
- equipment;
- people;
- premises;
- surrounding environment; and
- checks to show that GOP is working.

Examples of poor good operating practices:

- staff taking waste from a high care hygiene area to an external disposal point and walking back without boot change or washing will contaminate the high care area;
- maintenance contractors whose previous job was working with drains, farms, etc. where there is likely to be *Listeria* present may contaminate the processing areas if there is not appropriate hygiene and protective clothing routines applied;
- a meat slicer used to slice a processed meat for consumer packs can become a source of contamination if it is subject to a frequent and thorough deep and clean. Food and waste residues may be build up and become a source of nutrition for *Listeria* that can contaminate the food;
- damaged floor surfaces, conveyor belts etc. that allow *Listeria* to become established and may intermittently lead to contamination of a food or food contact surface; or
- raw materials and ingredients stored together with ready-to-eat foods may allow cross-contamination.

3.3 How to apply to guidance to the food business

Part 2 is intended to highlight the factors that might lead to the *Listeria* contamination of the processing environment, particularly the high care area, and RTE foods and to provide guidance to produce safe and suitable RTE foods.

- (5) Read through this document to identify which procedures and activities should be included in GOP.
- (6) Consider the food safety systems and practices already in place. Use the guidance to determine if current practices are sufficient and amend them as necessary.
- (7) If there are gaps in existing GOP, identify how further good practices that are missing, can be introduced. Use the guidance to develop the procedures that are necessary to complete GOP. Not all food businesses need to document their GOP practices. However, if GOP is part of a food operator's FSP, FCP or RMP then it will need to be documented before the food operator can register the plan or programme.
- (8) Let staff know of any changes and how they need to do things.
- (9) Monitor staff and other people to ensure they are following GOP procedures. Take appropriate corrective action if necessary.
- (10) Keep appropriate records to support GOP.

(11) Verify that the GOP continues to be effective for the food business and change them if necessary.

4 People

What: It is important that everyone who is involved with the food business understands how they can contribute to the control of *Listeria*.

Why: Failure to follow GOP and other procedures could potentially result in producing a food that is contaminated with *Listeria*. This could result in foodborne illness (listeriosis) at a cost to the consumer and to the business (product recall, corrective actions and a loss of reputation and income).

How: Putting in place GOP for people to prevent the *Listeria* contamination of the processing environment, particularly the high care area, and RTE foods will help to provide a safe and suitable food.

4.1 Access controls

What: Access for employees, contactors, visitors, office workers and other people to the processing environment should be controlled and monitored. The unnecessary access of people avoided.

Why: Employees or other people visiting processing areas may inadvertently bring *Listeria* into the processing environment.

How: The risk of entry of *Listeria* on people can be minimised by:

- restricting access to high care area;
- preventing people moving between raw processing areas and finished product processing areas, such as through the use of a double barrier entry system. Where this cannot be avoided, a hygiene regime e.g. red line should be carried out prior to access to the high care area;
- ensuring that all people that entering the processing areas comply with the required procedures for hand washing and other hygiene requirements, such as protective clothing;
- ensuring staff are adequately trained;
- ensuring that personal items are not brought into the processing area;
- observing people to ensure that they follow the food operation controls and access requirements. Where possible staff should work solely in either the standard hygiene areas or the high care areas and not move between areas, e.g. where there is physical separation of raw and RTE areas;
- ensuring that any visitor tours of the premises should start in the high care areas and follow the process in reverse order visiting standard hygiene areas last. It is strongly recommended that visitors are not allowed into the high care area. Records of visitors should be maintained; and
- ensuring that all people who come onto the site do not contaminate the processing area. For example:
 - truck drivers and office staff should not walk through the processing area to access other parts of the business; and
 - maintenance engineers can be a particularly high risk as they may have come directly from another job and often carry tools (which can be contaminated with

movement from site to site). For further information refer to **5.4 Pest management**.

4.2 Personal hygiene

What: All people entering a process area should follow the required hygiene regime. This includes processing staff, maintenance personnel, contractors, visitors and office workers.

Why: *Listeria* can be carried on clothing, tools, boots, etc. and foods brought into the process area.

How: Procedures should be established and implemented for access to the high care area. These should consider:

- the required hygiene routines for entry including:
 - initial hand washing;
 - clothing and footwear exchange before entry; and
 - a further hand wash before entry, etc. in a boot room or ante-room; and
- restrictions on what may be brought into process areas.

4.2.1 Footwear

What: Use dedicated footwear and a double barrier entry system to enter the process area.

Why: The most effective method available for controlling the transmission of pathogens on footwear is to use dedicated footwear combined with a 'double barrier entry system'.

How:

A double barrier entry system is where the external footwear is left on the outside of the first barrier. Hands are washed and protective clothing donned, then the internal dedicated footwear are changed into on the other side of the second barrier.

The hygiene barriers should be physical rather than a line drawn on the floor. The use of a physical hygiene barrier is a reminder to use dedicated footwear to help to prevent people from inadvertently contaminating the high care area.

The hygiene barrier:

- can be a low physical bench that staff can sit on and swing their legs from the low care side to the high care side where dedicated footwear are stored;
- should be located immediately by the pedestrian door into the high care area (i.e. you should pass through it to go into the high care area); and
- should be kept clean and sanitised regularly.

The control measure will only be effective if it is:

- used correctly (e.g. a hygiene barrier will only work if boots are changed every time); and
- actively managed (e.g. if dedicated footwear is to be used in a process area then it could be of a different colour).

Other practices for the use of footwear are not recommended as these can still introduce contamination from the external environment, are less efficient and are hard to actively manage.

Avoid:

- disinfecting footwear i.e. boot-dips. In practice these must be carefully controlled to ensure sufficient contact time, the disinfectant replaced regularly in the boot-dip, and as a result are less effective than other measures; and
- covering up the footwear with a clean layer i.e. boot/shoe covers. In practice boot or shoe covers are prone to coming off or tearing and this may be more difficult to manage than the other measures.

This is because the likelihood of *Listeria* being brought into a process area on the soles of boots or other footwear is very high if no preventative measures are taken or the measures in place are ignored.

4.2.2 Protective clothing

What: Dedicated protective clothing (overalls, boots/shoes, etc.) should be used by all staff processing food. The clothing should be different and clearly identifiable for staff working in the standard and high care areas.

Why: To minimise the likelihood of introduction and cross-contamination of *Listeria* from the external environment and standard care area.

How: Dedicated and clearly identifiable clothing (overalls, jackets, etc.) should be worn by all staff. The clothing (and hair nets) should be identifiable (e.g. colour coded) and stored separately from street clothing and protective clothing worn in other food processing areas.

Routine hygiene regimes should be observed before changing clothes and entering the processing areas. It is preferred that a double entry barrier system is used.

Overalls etc. are worn (possibly over the top of street clothing). Avoid wearing uncovered street clothing and footwear.

When gloves are used:

- people should wash and sanitise their hands before putting on gloves;
- reusable gloves used for a number of different purposes should be washed and sanitised (e.g. alcohol gel) frequently and at least after a non-product contact surface is touched;
- single use gloves should be replaced after touching a non-food contact surface e.g. floor or machine buttons; and
- use of gloves should be carefully monitored to ensure gloves are cleaned or replaced before they become a source of contamination.

When separation between raw and RTE products occurs by time, food operators should process different products at different types of the day. Often it is possible to slice and package RTE products in the morning then process the raw ingredients in the afternoon. Using this approach can mean that the same overalls and footwear can be worn all day. Where raw and RTE foods are handled intermittently during the day consideration should be given to an appropriate hygiene regime and whether there should be a change of clothing, protective aprons, etc.

4.2.3 What happens at breaks?

At breaks, 'smoko' and meals, staff should exit the processing area by the double entry barrier system, remove the protective clothing and stored separately from street wear. Hair nets, protective plastic aprons, plastic shoe covers should be discarded and replaced upon entry.

4.3 Training and competency

The adequate training of staff involved with the processing of RTE foods is critical. It helps to develop a food safety culture and reinforces the food safety and hygiene messages. The elements that should be included in a training programme and core competencies are covered in **Part 1, 4.4.2 Training and competency**.

4.4 Maintenance staff and contractors

What: It is important that the activities of the company engineer or contracted tradesmen do not contaminate the processing area. Appropriate actions must be taken prior to recommencing processing.

Why: Maintenance staff and their equipment may introduce *Listeria* or disturb harbourage sites.

How: Construction, renovation, maintenance or emergency repairs should be agreed and approval given for access to the high care area.

Develop and implement a policy for maintenance staff and contractors.

Ensure that all maintenance staff and other contractors follow appropriate hygiene routines if they need to enter the high care area. Maintenance staff and other contractors may have come from a previous job where there may be high levels of *Listeria* present, e.g. working with drains, farms, external environment, etc.

Maintenance staff should be briefed and/or trained to do their job whilst minimising contamination of the equipment and facilities. In particular they should be trained in:

- appropriate personal hygiene including the use of clean protective clothing and a change of footwear;
- waste removal and adequate clean-up upon completion of the work;
- the use of dedicated tools for the high care area or at least a sanitation step to minimise cross-contamination;
- normal and acceptable behaviours; and
- access restrictions.

5 Buildings and design

5.1 Building location

- What:** Identify possible sources of *Listeria* contamination. Consider other activities or businesses that occur in the area surrounding the proposed site of the food operation.
- Why:** *Listeria* is widespread in the environment and may enter the premises if identified sources are not controlled, e.g. wildlife, agricultural areas, etc.
- How:** Dust, drainage, waste food and other activities and conditions may attract pests and birds in the surrounding area. These can be a source of contamination.

Other ways to minimise introducing contamination from the outside include:

- tar sealed or concrete roadways or car parks;
- not placing landscaped areas, e.g. shrubs, trees, grass close to the building; and
- minimising the storage of disused equipment outside the building.

5.2 Building layout and design

- What:** Buildings need to be designed and laid out in a way to promote the safe and hygienic processing of RTE foods.
- Why:** The design of premises will help to minimise potential sources of *Listeria* and opportunities for cross-contamination.

5.2.1 Building layout

- How:** When modifying existing buildings or designing new purpose-built buildings it is important to consider the process and access routes to allow the movement of people, incoming materials and product flows. For example, consider:

Access

- the location of doors and windows. Are there any unnecessary doors or windows that could be blocked up or sealed to prevent uncontrolled access? Consider how the position of the entrance ways affects air currents, as draughts may carry *Listeria* bacteria from the external environment or from the raw processing area;
- keep external contamination out;
- where possible try to ensure that there are no doors (except for fire exit purposes) and windows that open to the outside;
- have a simple way for people to enter the processing area. Avoid people needing to enter the high care area via the low-care area or vice versa; and
- there should be no access to the high care areas other than by going through an area that provides facilities for completing the required hygiene routine. Any doors leading into the high care area that don't lead people through an appropriate hygiene routine should be blocked off if possible. Emergency exits should not be blocked off.

Separation

- the use of a 'red line' between the areas that handle raw materials and ingredients and those that handle RTE food products is a visual reminder of the dangers of *Listeria* contamination. This may be achieved through physical separation e.g.:
 - a wall (floor to ceiling high);
 - distance, e.g. processing occurs in the same room but is separated by the use of a low wall;
 - curtain; and
 - barrier or a red line.

Alternatively separation may occur by time, e.g.:

- processing of different products;
 - stages are scheduled to occur at different times;
- the location of protective equipment including clothing, changing areas and hygienic routines should occur in a dedicated area away from where food is processed, e.g. in an ante-room;
 - store packaging in an ante-room to prevent contamination and access ways to bring in these to high care area without introducing a further source of contamination; and
 - store raw materials and ingredients, partially processed product and intermediaries and the final product separately to prevent cross-contamination. Ideally these should be stored in separate storage facilities.

Preventing contamination

- the space between and around pieces of equipment to allow effective cleaning and sanitation; and
- minimise exposed pipe work and other overhead structures, e.g. stairs, decks and walkways, so that these do not occur directly above open processing or packing equipment. Consider whether covering these with a false ceiling is a suitable option provided that this does not become a source of contamination.

Process flow

- equipment and the process should be physically positioned to enable product to flow in one direction from the start of the process to the end;
- the process should occur in a logical sequence and should not cross-over or backtrack as this may introduce a source of *Listeria* contamination. For example, avoid raw ingredients passing over the top of or close-by product following a *Listeria* control step or processing raw ingredients between RTE-product on the same surface; and
- where the shape of buildings and rooms allows, the processes before a CCP (listericidal step) should be separated from those afterwards, e.g. a validated cook step.

5.2.2 Building design

How: Buildings should be designed so that:

- the internal surfaces (floors, walls and ceilings) are impervious, and made of non-absorbent materials that prevent water uptake; and

- the surfaces should be free from depressions, pits, cracks and crevices and other niches where *Listeria* may hide and grow. For example, in poly-board, within a hollow door or in pre-formed coving with a hollow cavity.

Food incidents involving *Listeria* and other pathogens have been traced to cracked floors or within walls where *Listeria* has been unable to be removed. *Listeria* may be transferred from these sites:

- by boots or wheels;
- renovations or construction; or
- through the water used for cleaning due to splashing and drips.

If poly-board is being used avoid drilling holes into this as water and bacteria may be able to travel through the screw or bolt and enter the space behind.

Design and construction elements that are important for the control of *Listeria* include:

- floors should be easily cleaned, smooth and not prone to damage from equipment;
- ensure that processing (and storage) areas for RTE foods are as dry as possible;
- ensure adequate drainage from air-conditioning and condensing units) and that there are no leaks from pipe work. Pipe condensate (and other waste waters) directly to the drains;
- prevent water accumulation by using sloping floors to drain water to spot drains instead of using open drains across the floor which may be a source of contamination due to splash. The United States Food and Drug Administration (US FDA) recommends that the floor should slope by 2.1 cm for every 1 m;
- use coved floor/wall joints (that are solid behind the coving) in any wet processing areas to allow effective cleaning and prevent contaminants building up behind the wall that could then seep out and contaminate the area;
- doors, door jams and frames should be sealed and there should be no crevices between these and the adjoining wall. Doors into and within the high care area should be self-closing, except where there is a conflict with the emergency exit requirements;
- avoid doors that are difficult to clean, e.g. slide over doors, concertina doors, folding doors and other multi-section doors;
- ensure that all surfaces within the building can be accessed for cleaning. Any nooks and crannies have the potential to become harbourage sites for *Listeria*;
- place air vents so that humid air can be exhausted outside. Do not place air vents directly above process lines as this increases the risk of condensation dripping back onto exposed product;
- use filtered air in the high care area and where possible operate under positive pressure; and
- ensure that where there is no fully enclosed high care area the air flow should be designed to flow from the area where the RTE product is exposed towards the standard hygiene area.

5.3 Design, operation and use of drains

What: Water pooling in processing areas should be avoided and if present, removed as soon as possible.

Why: Water and moisture in the processing areas can assist with the growth and movement of *Listeria* and the indirect contamination of the RTE food.

- How:
- Map the drain flow within the building and use this to try to ensure that separate drainage systems are in place for high and standard hygiene areas;
 - all water and waste liquids in processing areas should be ducted directly into a drain;
 - direct the condensation from air conditioning/cooling/freezing units directly to drains;
 - drains should be sealed, especially if they move through areas where water is not used, and located away from the processing line where possible;
 - drain traps and access to drains should be located outside the high care area and should be regularly cleaned and sanitised;
 - the drains from the standard hygiene area (e.g. raw ingredients) and high care area process lines should be separate where possible;
 - there should be no interconnecting pipe-work to prevent cross-contamination. Where this is not possible, the food operator should ensure that backflow preventative mechanisms are used and that there is positive air pressure in the high care area to prevent aerosol formation in the drains;
 - drains and traps should be made of materials that are compatible with the temperature and corrosive nature of the material being removed, e.g. stainless steel in the high care area or polypropylene, PVC, CPVC, PVDF. The use of corrosion-resistant materials will avoid deterioration which would otherwise enhance the formation of harbourage sites and make materials harder to clean;
 - floor drains in the process area should have basket strainers to collect solid waste which should be emptied, cleaned and sanitised at each full clean down. Refer to **14 cleaning and sanitation**; and
 - drains should be flushed with sanitiser at the end of a major clean down.

5.4 Pest management

What: Pest management controls should be in place.

Why: *Listeria* are unable to enter a processing area unless they are carried by something else, e.g. pests such as insects, rodents, birds, etc.

How: Review the pest management controls in place and any requirements or guidelines.

Check:

- bait stations position and efficiency;
- any pest management contract in place;
- the structural integrity of the building to ensure that there are limited opportunities for pests to enter; and
- that electrical fly killers and zappers are not positioned directly over the processing line or preparation tables.

5.5 Building maintenance

Refer to **7 Repairs and maintenance**.

6 Equipment

6.1 Equipment design

What: The equipment should be designed to provide easy access for cleaning and sanitation, and to minimise the formation of harbourage sites for *Listeria*.

Why: Good hygienic design and construction of processing equipment will help to reduce the risk of *Listeria* contamination in the finished product by minimising niches and harbourage sites that allow *Listeria* to grow and survive. These sites may be indirect product contact surfaces and provide a source of contamination to the product.

How: Design, purchase and install equipment to minimise the presence of cracks, crevices, nooks and crannies, chips, rough welds, joints between different surfaces and materials or hollow tubes and supports.

Where possible, equipment should be designed so that all surfaces can be readily accessible for cleaning and sanitising and inspection.

When designing, purchasing or installing equipment it is important to consider the following key design features for equipment:

- interior surfaces in contact with food should be self-emptying/draining to avoid the formation of dead space that may trap food and bacteria. For example, open seams, gaps, corroded areas, recesses, protruding ledges, inside threads, bolt rivets and crevices;
- exterior surfaces not in contact with food should be arranged to prevent the collection of soils and microorganisms;
- contour surfaces to allow for drainage of liquid;
- construct from non-porous, non-absorbent materials;
- welds should be continuous, fully penetrating, ground and polished where appropriate;
- use moveable equipment if possible, to allow easy access for cleaning and sanitation;
- easy to disassemble by hand or with simple tools;
- simple, fewer moving parts;
- pipe waste liquids direct to drain;
- shield aerosol generating equipment, e.g. pumps, air/water sprays, etc.;
- keep product contact surfaces or any surfaces that could come in contact with product contact surfaces off the floor. Conveyor belts should not touch the floor and should be located far enough off the ground to prevent any impact from splash;
- personnel hygiene equipment should be non-hand operated where possible to prevent cross-contamination, e.g. wash basins, foot baths;
- cover wheels and other moving parts, e.g. motors, with easily cleaned cover guards;
- electrical cords should enter machines from the roof;
- minimise dropped product which could build up and be source of contamination;
- look for equipment manufacturers who consider pathogen management and cleaning and sanitation when designing equipment;
- be aware if modifying equipment or installing modified/second-hand equipment that unexpected design error may be introduced. When purchasing or installing equipment in high care areas, thoroughly investigate all aspects of sanitary design;
- any sensitive electronic systems should be able to be cleaned and sanitised. Electrical equipment systems should be designed and maintained to prevent entry and accumulation of product, water and waste, etc. For example, electrical control panels,

chain guards, gear enclosures, junction boxes, push buttons, valve handles, switches, touch screens.

- conveyor belts should use rollers that are solid or completely open to facilitate cleaning;
- conveyor belts should be made of non-absorbent material that is hygienic and easy to clean. Do not use fabric or nylon;
- eliminate hollow areas of equipment, e.g. frames. Angle sections can be used for legs and frames and are easily cleanable; and
- cooling units should have dehumidifying capability.

6.2 Equipment operation

What: Equipment should be designed to facilitate operation and minimise the formation of sources of contamination.

Why: Equipment that is hygienically designed, correctly installed and operated and used for the intended purpose should reduce the number of harbourage sites and minimise the potential for the introduction of *Listeria*.

How: When operating equipment it is important to consider the following key design features for equipment:

- don't place cooling units, refrigerators, insect control devices or anything that could be a source of contamination above exposed product;
- all equipment should be cleaned and sanitised thoroughly before being taken into the high care area and again before operation. Where possible equipment should be installed hygienically and not during processing;
- consider potential contamination from second hand/rented equipment prior to installation;
- equipment should be dedicated for either the processing of raw or RTE foods;
- consider covering exposed product and process lines with hygienic packaging if there are lengthy delays in processing;
- use food grade lubricants with preservative properties;
- empty, clean and sanitise any drip pans at least daily;
- replace worn seals or gaskets as they provide niches or harbourage sites that are hard to clean and sanitise and allow *Listeria* to survive and grow. Even if fixed seals etc. are new, check that they remain firmly in place and are not allowing contaminants to build up behind or around them;
- prevent insulation on equipment from becoming damp or wet;
- make sure equipment is positioned to be able to be cleaned and sanitised easily (e.g. elevated);
- periodic deep cleans should be conducted where the covers are removed from machines, motor fan cowls and any other item that cannot be cleaned easily and regularly;
- sensitive equipment such as electrical control boxes can be internally cleaned (after they have been electrically isolated) using ethanol or propanol infused wipes and allowing time for evaporation before covers are replaced. An engineer is usually required to strip down and rebuild equipment;
- locate food processing equipment away from sources of contamination, e.g. drain flows, evaporators, air flows from raw material intake;

- where appropriate, equipment should be fitted with devices which monitor and record its performance by measuring factors, e.g. time, temperature, flow rate, pH and weight;
- only authorised people should be permitted to alter the environmental temperature, air extraction and intake and humidity settings;
- use filtered and dry compressed air; and
- sanitise equipment before use as part of the pre-operation checks.

6.3 Equipment maintenance

Refer to [7 Repairs and maintenance](#).

7 Repairs and maintenance

7.1 General construction, repairs and maintenance

What: Conduct regular preventative maintenance and repairs of the process equipment and buildings.

Why: Preventative maintenance of floors and other surfaces, including those on equipment to minimise cracks and exposed rough areas will reduce the number of harbourage sites for *Listeria*.

Regular repairs and maintenance should minimise any emergency repairs during processing when RTE food is exposed. RTE food exposed during maintenance may be at-risk from *Listeria* contamination. Maintenance may disturb harbourage sites.

How: Before commencing repairs and maintenance, consider:

- the type and extent of the work, e.g. could it cause airborne contamination or splashes, could it affect items or equipment near where the work is taking place;
- exposure of ingredients, products, packaging, or equipment to contamination, and controls for protecting them e.g. removing them from the affected area;
- type of product and processing area affected;
- movement and access of maintenance staff and contractors;
- maintenance equipment, tools and materials to be used, i.e. could they be a source of contamination;
- it can be very difficult to maintain hygienic conditions during construction, repairs and maintenance activities. Where possible these activities should be carried out only when processing is not occurring; and
- particular attention should be given to ensure that cleaning and sanitation after construction or maintenance has been carried out. These activities may inadvertently dislodge *Listeria* from niches inside equipment or the building infrastructure.

7.2 Tools

What: Tools used for repairs and maintenance in the high care areas should be dedicated for that purpose.

Why: Tools may be a source of *Listeria*, other harmful micro-organisms and physical hazards.

How:

- where tools, used in construction and maintenance (including scaffolding), tool bags and boxes are not dedicated for use in the high care areas. These should be cleaned and sanitised before being brought into the processing room; and
- tool bags and boxes used by maintenance staff and contractors should be made of a material that can be easily cleaned, i.e. not fabric.

7.3 Routine maintenance

7.3.1 Overview

What: Routinely inspect and systematically review the buildings, infrastructure and equipment to identify sites that require preventative maintenance and repair.

Why: This reduces the possibility of contaminating exposed product, equipment, surfaces, personnel, packaging etc.

Repairs can be expensive if not dealt with proactively. Conducting regular preventative maintenance may lessen any expensive association with a food incident or foodborne outbreak associated with the operation. A well maintained operation should also provide customers with the confidence that the food operator is managing food hygiene and safety.

How: Routine maintenance of the high care area should take place when processing has finished for the day. The food operator should consider how frequently maintenance checks need to occur e.g. daily, weekly and periodically.

Suggested frequencies for the routine maintenance inspection and systematic review of buildings and equipment include:

- daily maintenance checks including equipment that is used as part of a *Listeria* control step (i.e. forms part of a CCP) and other key equipment, e.g. conveyor belt rollers, slicer, vacuum packaging machine, etc.;
- weekly maintenance checks including building maintenance, e.g. flaking paint, light covers, gaskets, conveyor belts, rust or condensate on overhead pipe-work; and
- periodic maintenance checks including roofs and gutters, pumps and motors.

Determine the impact that the maintenance or repair will have on the safety of the product:

- repair or maintain immediately if it has a direct or immediate impact on product safety, e.g. resulting in a CCP failure;
- repair or maintain at the earliest opportunity (i.e. at the end of a processing period) if the problem has a direct effect on product safety; and
- repair problems that do not affect the safety of the RTE food or maintain as the opportunity arises.

Contractors and maintenance personnel should be briefed and managed to prevent the contamination of the processing area. Refer to **4 People**.

If routine maintenance cannot occur at the end of the day, it should take place at a normal work break. All products and packaging should be removed or covered and the specific area/equipment isolated when maintenance or repairs are conducted in the high care area.

After repairs and maintenance, clean and sanitise the area and run through the pre-operation check before processing resumes.

Taking additional microbiological samples of the product and environment in the high care area should be considered after cleaning and sanitation as this may identify if *Listeria* harbourage sites and niches have been disturbed and remain a source of contamination.

Repetitive problems or breakdowns may indicate that the maintenance frequency needs to be increased or that equipment and the facilities may need replacing.

7.3.2 Building maintenance

What: The walls, floors and ceilings should be subject to periodic maintenance checks and scheduled repairs.

Why: *Listeria* may survive in niches and other areas that are not able to be effectively cleaned and sanitised. For example behind flaking paint or rust on walls or equipment, behind damaged fibreboard or in cracked or chipped floors.

- How:
- design and implement an effective preventative maintenance programme which includes a schedule and frequencies for the maintenance and repair of the building and facilities;
 - cracks or breaks in the floor, coving and in the wall lining require sealing as a priority of plant maintenance, particularly in high risk areas;
 - inspect the completed maintenance work, and where necessary, take additional microbiological samples for analysis before processing recommences; and
 - undertake extensive cleaning and sanitation before the routine pre-operation checks and enhanced environmental testing if significant or major maintenance and repairs have occurred.

7.3.3 Equipment maintenance

What: An effective preventative maintenance programme should be implemented.

Why: Equipment failures during processing increase the risk of *Listeria* contamination as a result of both the failure and any repair work that may be required.

How: Schedule routine inspections and systematically look at all the equipment to identify items for repair, replacement and maintenance of the equipment.

Equipment maintenance checks should include:

- the equipment's overall condition and integrity, i.e. is it working properly and/or as intended;
- harbourage sites, e.g. loose/flaking paint, rust, worn parts, worn or frayed hoses, gaskets or belts, porous welds, contaminants behind joints and seals, damage to product contact surfaces, etc.; and
- any loose, damaged or broken parts, nuts and bolts (especially on equipment that is subject to vibration).

Repetitive equipment problems or breakdowns may indicate that the maintenance frequency should be reviewed and adjusted accordingly, or that the equipment needs to be replaced. Areas of equipment to check include:

- conveyor belts, seals, wheels, pneumatic equipment and rollers. For example, worn or frayed conveyors and belts should be replaced because they are impossible to clean effectively as are rollers if water and food scraps get inside them;
- equipment such as sealing machines (especially those that pull a vacuum during operations) and utensils;
- attachments to walls/floors and other equipment, e.g. metal-to-metal or plastic-to-plastic sandwiches;
- wear strips on metal conveyors;
- fabric equipment covers, e.g. electrical boxes;
- rubber foot mats;
- hoses, taps, etc. to eliminate leaks;
- maintain air filters as per the manufacturers' instructions. Place dirty external air filters and other pieces of potentially contaminated equipment in a sealed bag when moving through the high care area;
- seals and gaskets should be replaced on a routine basis and not just when worn; and
- ventilation systems should be maintained and the filters replaced frequently in high care areas as these may be a source of contamination. The dirty filters should be changed when processing is not occurring.

7.3.4 Returning equipment to use

What: Have a procedure to ensure that equipment is brought back into use safely.

Why: Equipment that has not been used for a period or following repairs and maintenance or re-commissioning may be a source of *Listeria* contamination.

How: The procedure should include steps to ensure that:

- equipment (including that which has been stored or repaired outside processing areas) is cleaned and sanitised before being returned to a processing area; and
- equipment should be cleaned and sanitised before use, or before processing recommences, e.g. pre-operational hygiene check. Refer to **10 Process control**.

7.3.5 Construction, renovations and emergency maintenance

What: The emergency repair and maintenance of equipment and machinery should not have any adverse effect on the safety of the RTE food.

Construction and renovation should not occur in the high care area unless the area can be completely isolated from areas where food processing continues.

Why: Product which is exposed at the time of construction, renovation or an equipment breakdown may be at-risk from contamination as repairs and building work may introduce or disturb existing *Listeria* harbourage sites. For example, contamination may spread on dust produced or through the disturbance of existing *Listeria* niches, e.g. replacing floor drains, walls or cooling units.

How:

- determine the urgency of the emergency repairs and maintenance by assessing the potential risk;
- determine the impact of the breakdown and equipment defect on product safety;
- when conducting emergency repairs and maintenance, all exposed product should be removed wherever possible from the high care area before maintenance occurs. If not, cover and isolate any product and/or intermediary products. Record the batch number(s) of RTE product affected;
- thoroughly clean and sanitise the equipment and high care area and conduct any pre-operation checks before processing resumes;

Floors and drains should always be considered to be contaminated with *Listeria*. Any product that falls onto the floor is therefore considered to be contaminated and should be disposed of appropriately.

- product and environmental testing programmes should be temporarily modified after the completion of the work. Increase the number of samples, sample sites or frequency of sampling to verify that *L. monocytogenes* has not been disturbed or introduced and that control is being maintained; and
- for more information on how to conduct product and environmental testing programmes see **Part 3: Microbiological testing for verification of the control of *Listeria monocytogenes***.

7.4 Maintenance Staff

Refer to **4 People**.

8 Incoming materials

Incoming materials include all the ingredients and components of the food, packaging materials, water and air used during processing and manufacture.

8.1 Raw materials

- What:** When producing RTE foods, extra attention should be given to the quality, storage and handling of the raw materials used.
- Why:** Raw materials are a potential source of *L. monocytogenes* contamination even if they have been processed or the final product is subject to a listericidal step.
- How:** All raw materials entering the processing areas are a potential source of *Listeria* contamination. Raw materials include ingredients, food-grade packaging materials, additives, processing aids, gases, lubricants and other chemicals.

Develop a list of all the ingredients used and those likely to be contaminated with *Listeria* will be known. Consider what kind of control that should be put in place for each ingredient/raw material.

In order to check that any raw materials delivered meet specifications and comply with any legislative requirements, suppliers should provide the food operator with:

A description of the raw material

- source and any processing information of the raw materials/inputs, e.g. what controls or practices were incorporated at the primary production level. For example:
 - GAP for horticultural produce;
 - GOP / risk based management programmes; or
 - any specific controls for the management of *Listeria*.

Packaging and labelling requirements

- microbiological, chemical, physical and sensory criteria, and what analysis of the raw material(s) has been conducted by the supplier and whether it meets specifications;
- agreed tolerances if applicable on any of the above;
- distribution, delivery and storage conditions;
- recall and traceability requirements. Refer to **9 Identification and traceability**; and
- notification procedures between supplier and customer.

On receipt of the raw materials, the food operator should:

- inspect the raw materials to ensure that they are in an appropriate condition (meet the raw material specification) and accompanied by appropriate documentation;
- check the information provided by the supplier including any food operator specifications and test results;
- store raw materials/inputs as per the manufacturer's instruction to prevent contamination or deterioration. Refrigerated raw materials and inputs that support growth of *Listeria* should be at 2-6°C unless frozen;
- store raw materials/inputs separately from finished, processed products; and

- store and prepare raw unwashed and unpeeled fruit and vegetables separately as these may be a source of *Listeria*.

A food operator should conduct regular supplier audits.

- validation of food safety requirements for raw materials inputs can be a useful exercise;
- inputs and ingredients that could be a source of *Listeria* and whose safety cannot be confirmed by other means. For example, through supplier guarantees or test results, may be tested for general microbiology and *Listeria*, and the results subjected to trend analysis;
- microbiological testing may be considered for raw material and inputs from a new supplier or if there are any concerns about the origin or safety of the input;
- consider whether the material will receive a listericidal step. This is particularly important if the incoming material will be added to or in contact with the RTE food, e.g. a fruit sauce added to ice-cream or packaging materials; and
- any sampling plan should include a minimum of 5 samples (n=5). When using a new supplier or before a history is established of the safety of the material, batches should be sampled at a higher frequency. Once the history is established the frequency can be reduced.

8.2 Packaging materials

What: Packaging materials used for the RTE-product should be kept clean, dry and stored under hygienic conditions.

Processes should be in place to ensure that the exterior wrappers, packaging or containers surrounding raw materials and inputs do not enter the high care area.

Why: Packaging materials often come into direct contact with the finished product and may be a source of contamination.

How:

- packaging materials should be stored off the floor and kept clean and dry;
- the storage area should be kept dry and clean and there should be minimal human and vehicle traffic, i.e. it shouldn't be used as a walkway/thoroughfare;
- depending on the size and scale of the food operation, it may be good practice to have a dedicated storage area, sanitation of packaging materials and controlled access;
- bins, pails and other containers used in food processing should be kept off the floor in storage and during processing;
- packaging materials should be removed from their external carton, etc. before entering the high care area; and
- microbiological testing of the packaging materials, e.g. inner and outer packaging and pallet wrapping, should also be considered if packaging is suspected of being a source of the contamination.

8.3 Water and air

8.3.1 Water

What: Water used for the processing of food should be fit for purpose. Water is used for a many different purposes within the food processing environment.

Why: Water and any residual moisture is an ideal medium for transferring contamination throughout processing areas.

The control of water is important because bacteria cannot grow without water.

How:

- minimise the amount water used during processing;
- consider the source of the water used for processing of each particular RTE food and whether it is appropriate;
- do not use recirculated water where it may come into contact with the final product unless it has been treated, and this has been validated to produce water of an equivalent potable standard. Treatments may include filtration and chlorination, ozone, UV treatment, etc. that have a bactericidal effect; and
- internal pipes in processing equipment used for transferring water may have hidden surfaces or areas that could provide *L. monocytogenes* to form a biofilm. Bacteria cells from this biofilm may occasionally contaminate the product via water as they shed from the biofilm

Refer to specific industry guidance for further information on the use, type and quality of water.

8.3.2 Air

What: Air quality, pressure and flow should be controlled to minimise cross-contamination.

Why: Air has not been identified as a direct source of *Listeria* contamination in food however *Listeria* can survive in aerosols that can be moved by air currents.

Air that comes into direct contact with food contact air should be fit for purpose, e.g. filtered.

How:

- the high care area should use filtered air under positive pressure. Where there is no fully enclosed high care area, the air flow should be designed to flow from the area where product is exposed towards the lower risk areas;
- avoid drafts from entrances that may move air from the lower risk areas to the high care area;
- pipe droplets and aerosols from condensation and waste liquids directly away to the drains. These prevents an aerosol formation that could be moved by air currents and contaminate food and/or food contact surfaces.; and
- equipment should be maintained to prevent the introduction of *Listeria*.

9 Identification and traceability

What: All materials and products should be:

- appropriately identified at receipt, during processing, storage and sale; and
- traceable forward to immediate customers and backwards to suppliers..

Why: Raw materials and ingredients may be a source of *Listeria* contamination. A traceability system can help to quickly identify contaminated product in the event of failure of process controls or a suspected *Listeria* contamination event.

How: Identify who is responsible for putting in place an identification and traceability system:

Receipt and Storage

- refer to **8 Incoming materials**;
- ensure that the food operator can identify all materials received, through the use of delivery dockets/invoices, product labels, date marking, and lot marking / batch numbers (as appropriate); and
- ensure traceability of raw materials and ingredients after they enter the premises. Use bar-coding, labels, tags, markers, colour coding, e.g. colour coded bins.

Process

- ensure that traceability is maintained during processing, e.g. labels, tags, markers are transferred during various stages of processing; and
- when ingredients or other materials are added or used, keep the records of the batch (batch number or date of processing) to which these are added.

Dispatch

- ensure forward traceability to be able to quickly identify product to support any product recalls;
- maintain appropriate inventory control and dispatch records; and
- ensure that the necessary information is included on the food label, or in accompanying documentation, in order to identify the food. Refer to the Australia New Zealand Food Standards Code for the mandatory Food Identification Requirements (<http://www.foodstandards.govt.nz/code/Pages/default.aspx>).

Monitoring and records

- put in place checks to inspect incoming materials, storage areas, process control, labelling (refer to **8 Incoming Materials**);
- conduct mock recalls to check that the traceability system is working properly. Refer to Part 3: Microbiological testing for verification of the control of *L. monocytogenes* and to the MPI website and search using the terms "Conducting a food recall" for further information;
- if a problem is identified then handle affected product appropriately. This could be either reprocessed using a validated process and/or subject to disposition (Part 3: 7.10 Documentation, records, and reporting (<http://www.foodsafety.govt.nz/elibrary/industry/microbiological-testing.pdf>) and **Part 2: 10.5.2 Handling of rework (reprocessed products)**);

- use information gained from the problem to ensure that it doesn't happen again. For example, develop better procedures, improve checking systems, improve the storage area, provide better staff training, look at customer specifications provided to suppliers, etc.; and
- put in place a system to document that appropriate checks are taking place.

10 Process control

What: Process control refers to the on-line process and checks that are designed to:

- consistently produce food that is safe and suitable for its intended use;
- comply with regulatory standards; and
- ensure that the process is working as intended.

Why: It is important to control all aspects of the process. For example:

- quality and weight of raw ingredients;
- source of ingredients;
- time and temperature parameters;
- the source of water;
- measure any additives;
- ingredients or preservatives
- equipment calibrated;
- pressure; and
- chill times, etc.

How: Note: the level of detail required in the food operator's procedures will vary depending on:

- how complicated the process is;
- variability of the inputs;
- how much information is available that can be referred to (e.g. FCP, RMP, instructions from equipment suppliers, or in customer product specifications, etc.);
- whether the product will support the growth of *L. monocytogenes*;
- if there is a validated listericidal process, e.g. a cook step; and
- whether there is an opportunity for the food to be recontaminated.

10.1 How well does the food operator know the process and controls?

All process steps designed to specifically control pathogens to a certain level including *Listeria* should be identified and validated to ensure that the treatments are effective and the performance criteria achieved. HACCP applications are an important tool in achieving this¹.

Note: processes that provide the desired quality product may not always give the required degree of *Listeria* control. **Food safety should be the driver of the process control parameters.**

What: To control the food production or manufacturing process so that the food operator produces consistently safe and suitable food.

Why: It is important to ensure that the same process is applied each time, i.e. reduces variability between batches, so that any *Listeria* controls are consistently and robustly applied.

¹ Refer to MPI guidance: <http://www.foodsafety.govt.nz/industry/general/haccp/documents.htm>

- How:
- identify who is responsible for establishing process control procedures and for following these during processing, including completion of on-line checks, e.g. pH, time/temperatures, etc;
 - identify who is responsible for setting up machinery and equipment, and is authorised to change any critical settings as required, e.g. flow rate, temperatures, etc; and
 - control inputs and the process

For each food, or group of foods made using the same process and equipment write down:

- how the food operator ensures that the correct inputs are used (refer to **10.3 Control of inputs**), the quantities and any specifications. Refer to **8 Incoming materials** for checks that may be conducted;
- how the food operator ensures that the same process is applied each time (refer to **10.4 Control of the process**). For example, develop a flow diagram and task instructions; and
- checks that will be conducted to ensure the integrity of the inputs, the quantities used, the date marking and to record any batch identification information.

Process flow diagram and task instructions

Write down:

- the process steps in the order in which they are performed (i.e. from the first process step through to release of the product from food operator control, and including any rework as may be required). Refer to **10.5 Control of the product**;
- the steps where inputs enter the process;
- where outputs leave the process (including end-products, waste products or inputs into other processes);
- instructions necessary to make the product correctly (what, when, where, how and who by);
- any parameters that must be met at each process step (e.g. pH, moisture content, time and temperature requirements). Refer to **Part 1** and to **Part 2, Appendix 1** for further information on the intrinsic and extrinsic factors that can be used to control the growth of *L. monocytogenes* in food; and
- where cleaning and sanitising activities integrate into the process flow (refer to **14 Cleaning and sanitation**).

Equipment set up

Write down:

- how the food operator ensures that equipment is set up the right way, every time, e.g. initial set up of critical settings, and also, how the food operator checks that the equipment is working well;
- conduct pre-start up checks including:
 - checks that any equipment required for critical measurements has been calibrated;
 - checks that equipment is clean; and
 - where necessary sanitised prior to use; checks that the equipment settings are correct).

Refer to **10.2 Equipment set up**; and

- ensure that only authorised and competent persons may change critical settings (and only if required).

End product

Write down:

- how the food operator ensures that the final food is safe and suitable for the intended use. This may be by visual inspection, quality and operator checks, laboratory testing etc. Refer to **10.5 Control of the product**.

10.2 Equipment set up

10.2.1 Pre-operational hygiene check

What: The pre-operational (pre-op) hygiene check or the pre-start-up check is the inspection and check of equipment and settings prior to the start of processing.

Why: The equipment may be a source of contamination if it has not been cleaned and sanitised thoroughly and correctly.

How:

- the pre-op checks of facilities and equipment should be conducted by a responsible employee who has the authority to delay the start of processing until any problems identified have been rectified. This check should ensure that operations only begin after cleaning and sanitation requirements have been met;
- the pre-op check is a systematic check of all the equipment and surfaces and should include any problems that have been identified as problems or failures on previous occasions;
- a comprehensive check-sheet should be developed, e.g. with the assistance of a consultant, to ensure that all equipment and surfaces are covered;
- staff responsible for cleaning, sanitising and the pre-op hygiene checks should be trained and periodically attend refresher training;
- observations made during pre-op hygiene inspection and corrective actions for any deficiencies identified should be documented in an appropriate check sheet or record form and should be included in further assessments;
- repetitive failures of the cleaning and sanitation programme should be investigated and the causes corrected;
- where problems are identified during the pre-operation hygiene check, the area or equipment should be cleaned and sanitised again as appropriate, e.g. spot clean, and then checked again before processing commences; and
- when spot cleaning, it is important to consider the risk to other equipment and surfaces from the use of water or from the dismantling of equipment. For example, use a cloth soaked with sanitiser or isolate the area using sheets to avoid contaminating the surrounding area.

10.2.2 Calibration of equipment

What: Equipment used for critical measurements should be calibrated, e.g. thermometers, temperature recorders, pH meters, flow meters, heat sensors, pressure sensors, scales.

Why: Non-calibrated equipment may not be functioning correctly.

If this forms part of a *Listeria* control step then it may result in failure of that step and the survival and/or growth of *Listeria*. If the settings for temperature and times have been altered then this may

result in CCP failure. Similarly if the pH meter or measuring scales are not regularly calibrated, this may result in appropriate microbiological hurdles not being achieved.

- How:
- establish a list of critical items requiring calibration;
 - ensure all critical items are uniquely identified;
 - establish procedures for calibrating each item, including proposed corrective actions for when items go out of calibration;
 - establish a calibration schedule with the most critical items being calibrated more frequently;
 - ensure responsibility for carrying out calibration is clearly defined; and
 - ensure that all personnel involved in calibration activities are adequately trained to carry out these out.

10.3 Control of inputs

What: Monitoring (including visual checks) and as necessary, testing should be carried out to ensure the quality and safety of the inputs before they are used in the processing of RTE foods.

Why: The inputs and raw materials including ingredients, water, air and packaging, etc. may all be a source of *Listeria*.

- How:
- visually check for signs of deterioration, damage to packaging and/or seals.
 - check the quantities required;
 - check and ensure that the ingredients and other incoming materials are within the best-before and use-by dates;
 - record the batch numbers used of the ingredients and packaging; and
 - develop a supplier agreement to ensure that the ingredients and raw materials meet particular specifications for quality. This might be accompanied by evidence of microbiological testing or other supporting systems.

10.4 Control of the process

What: Process or product parameters should be met during processing.

Why: If the processing parameters, e.g. time and temperature for cooking are not achieved then any *Listeria* present may not be eliminated and may be able to grow to levels that could cause listeriosis.

If the microbiological hurdles or product parameters, e.g. aqueous salt concentration, water activity, pH, nitrite, phenol, lactic acid, or gas concentration and mix in any sealed packaging, are not achieved then this may permit any *Listeria* bacteria to survive and grow in the RTE food.

- How:
- the settings and calibration status on the equipment should be checked during pre-operational hygiene checks e.g. ovens and measuring equipment;
 - the amounts of ingredients added should be checked to ensure the correct amounts are used each time and concentration is achieved in the end product;
 - the time/temperature, pH, time to achieve the required pH drop, etc. should be monitored during processing and throughout storage. (Note: The processes and parameters that should be recorded are likely to be specific to the RTE food and the process); and

- the processes and parameters should be recorded.

10.5 Control of the product

10.5.1 End product

What: Visually check the RTE food (end product).

Why: A visual check of the product and review of the process controls will provide an early indication as to whether there have been any problems that may have resulted in a listericidal process failure or contamination event. The results from microbiological testing of the RTE food will usually take a number of days to return from the laboratory.

How:

- visually inspect the RTE food. Check that the integrity of the seals on the packaging where appropriate;
- check the processing parameters, e.g. time and temperature, and records for each batch to ensure that nothing untoward occurred; and
- consider process control test results to ensure that the specified limits or parameters have been achieved. The specified limits/parameters may be established in legislation (e.g. [Food Standards Code, Standard 1.6.1](#)), food operator's own limits or customer limits.

10.5.2 Handling of rework (reprocessed products)

What: Food operators should develop a plan for handling of product to be reworked or reprocessed, including food that falls on the floor.

Why: Product that has either been returned to the processor or has failed in-house checks should be treated as high-risk material and a source of *Listeria*. For example, during storage *Listeria* may grow and could contaminate any unpackaged food that it comes into contact with either in store or during a processing run.

How:

- the reprocessing of product should be conducted using a validated listericidal process;
- food that falls onto the floor during processing, catering, retail sale should be considered as waste and should not be reprocessed as rework;
- re-grade – consider whether the RTE food could be provided as a raw ingredient for a food receiving a listericidal step, e.g. cooking;
- if *Listeria* is present in a food that does not support growth, consider whether it is possible to enumerate the levels of *Listeria* present. Refer to **Part 3: Microbiological testing for verification of the control of *Listeria monocytogenes***;
- dispose; and
- consider whether the product is safe for consumption by the general population.

10.5.3 Process and final product checks

What: Check that the process has achieved the intended outcomes.

Why: Using the incorrect ingredient or quantity, or the incorrect processing temperature may result in an unsafe product that may result in the *Listeria* contamination.

How: Write up completed checks that may include:

- checks that process parameters have been met, e.g. pH, time and temperature;
- visual inspections of equipment assembly and settings, and product at particular points in the process;
- visual inspections of the final product. Try not to directly touch the product as this may introduce microbial contamination;
- product tests using rapid tests, e.g. *Listeria*, pH, water activity;
- laboratory tests against specified parameters/limits as appropriate;
- how any problems were corrected that were identified by monitoring, or that the food operator otherwise became aware of;
- defining the extent of the problem (i.e. what has happened, when and why it happened, how it happened and whether any product has been affected);
- restoring control (i.e. the action needed immediately to stop more product becoming affected and to fix problem);
- handling affected product, e.g. preventing any unsafe product from being used. Refer to **Part 3 for guidance on Complaints, Non-conforming Product, Corrective Action and Recall**; and
- preventing re-occurrence. For example:
 - using information gained from the problem to identify better ways to do things;
 - develop better procedures;
 - improve checking systems provide better staff training;
 - repair/replace faulty equipment; and
 - amend ingredient specifications.

Monitoring and records

- record any checks made. These are useful records to show future auditors, customers and other people that the food operator is taking responsibility for the production of safe food;
- assess the records and introduce any additional records needed for the monitoring and corrective actions specified in procedures; and
- when monitoring, the following options may be available:
 - record every check; or
 - indicate that checks have regularly been carried out, e.g. throughout a week. Only record the results of a specific check where something went wrong. In these instances, always make a record of what was done to put things right (the corrective action).

11 Minimising cross-contamination

What: Control measures during the food operation that reduce the potential for contamination to occur.

Why: Foods that enter the factory free of *Listeria* can become contaminated in the processing environment.

It is critical to prevent the recontamination of an exposed RTE food after a listericidal process, or final microbiological hurdle before the packing, i.e. in the period when the unpackaged food can be contaminated.

How: To avoid microbiological cross-contamination during processing, the following should be considered:

- the movement of employees, food and equipment between raw processing, storage and finished product areas should be controlled and processing scheduled to avoid build-up of intermediary products;
- the process flow in the premises should avoid crossing back and forth between different surfaces and areas;
- avoid having raw/unprocessed food operations in the finished product area or vice versa as this creates greater opportunity for cross-contamination. Similar operations should be grouped together and incompatible activities segregated; and
- dedicated utensils and equipment etc. should be used in either the raw or the finished product areas.

Have one member of the team act as the 'rousty.' This is the only person who is allowed to touch non-product contact surfaces, e.g. floors, drains and other areas in the high care area which are not in contact with unpackaged RTE food.

Their duties are likely to include:

- moving pallets or other non-product contact items;
 - picking up waste (food or packaging);
 - keeping the area clean and tidy;
 - spraying sanitiser on the floor in high traffic areas and around drains; and
 - any other non-product contact activities required.
- use separate protective clothing for high care areas; and
 - clothing should also be laundered separately. Clothing may be:
 - laundered in the same machine but mixed loads should not be permitted; and
 - the temperatures and/or chemicals used should provide a defined sanitising step.If the washing machine does not have a separate unloading door then the door and the surrounding area should be sanitised (an alcohol impregnated wipe is adequate) before unloading into segregated or cleaned and sanitised trolleys. The loading door and surrounds of the dryer should be sanitised in a similar way before loading the clothing used in the high care area.

11.1.1 Access controls – people and equipment

What: Access for personnel and equipment moving between raw/unprocessed food (standard hygiene) and finished food products (high care area) should be controlled.

Why: Personnel and equipment may introduce *L. monocytogenes* cross-contamination.

How Identify pathogen transfer pathways (particularly from the standard hygiene and high care areas).

Pathogen transfer pathways include:

- people
- equipment
- tools
- vehicles
- pallets
- crates
- bins
- raw materials, ingredients and intermediary products
- packaging

11.1.2 Process flow – separation of activities

Establishing the process flow or separation of activities is a way of grouping common activities together such as activities that:

- involve the handling of unprocessed raw ingredients; and
- that focus on the exposed RTE food prior to final packaging.

There are three ways by which separation of activities can be achieved:

- physical separation, (best choice/highly recommended);
- separation by distance; and
- separation by time.

11.1.3 Physical separation

What: Premises and facilities need to be designed in new builds, and wherever possible in existing facilities, to allow the physical separation during the processing and storage of raw ingredients through to finished RTE food. Food operators should use dedicated personnel and separate equipment for raw ingredients and finished RTE product.

Physical separation is highly recommended.

Why If not adequately separated, the finished RTE food may be contaminated with *Listeria* from raw products or ingredients as well as from equipment or staff that handle these.

How: It is good practice to have:

- linear process flow, with no backtracking;
- separate locker rooms, and separate break and lunch rooms for standard hygiene (raw) and high care (post listericidal process) staff;
- separate equipment, storage, staff, waste collection including drains, protective clothing for each area;
- hygiene facilities available on entry to the high care such as:
 - red line areas;
 - ante-room (locker room) with boot and clothing exchanges;
 - at least hand and boot washing facilities; and
 - the inclusion of barriers that prevent entry without the completion of hygiene routines;

- positive air pressure in the rooms or areas where RTE food is being handled prior to packaging. Maintaining the high care areas at a higher air pressure than other food areas will help to prevent contaminated air entering the high care area;
- pressure measuring and recording devices should be used to monitor the air pressure;
- pre-determine the response and corrective actions in the event of a failure;
- include an entry barrier system that helps to ensure the completion of hygiene routines prior. A double-entry barrier system is preferred; and
- Figure 2 provides an example of physical separation.

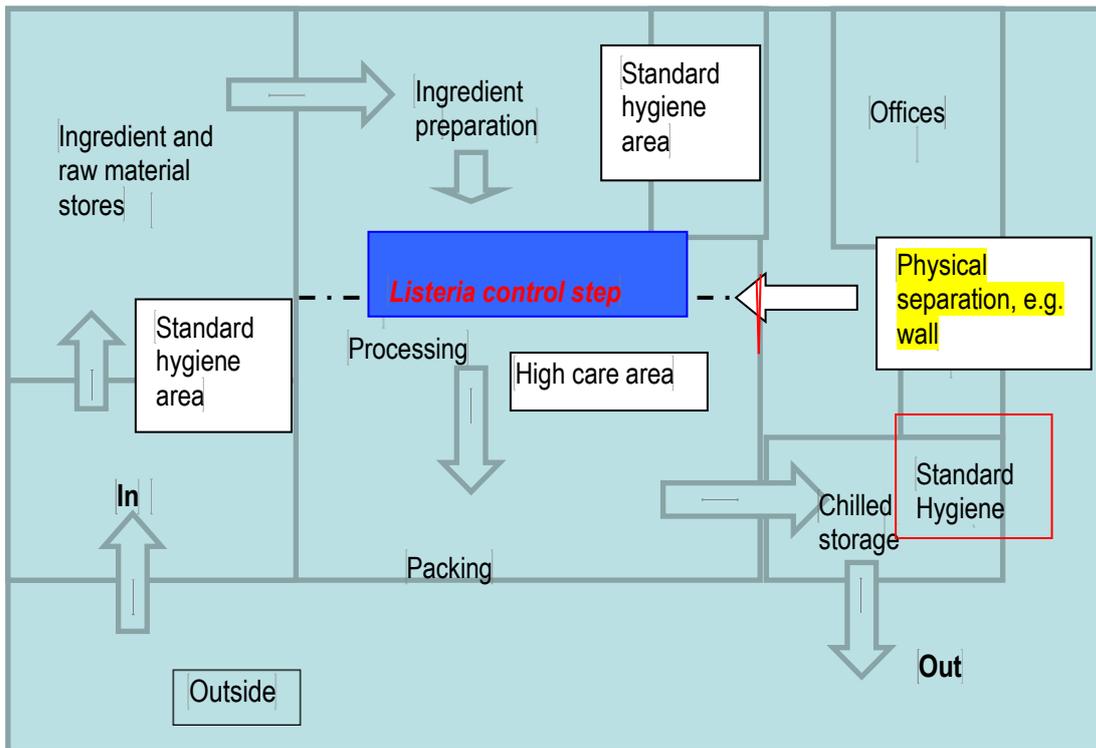


Figure 2: An example of physical separation

11.1.4 Separation by distance

What: Separate processing operations by distance when they occur in the same room and space permits, to allow the separation of raw ingredients through to finished RTE product areas.

Why: The finished RTE food may be contaminated with *Listeria* from raw products or ingredients as well as equipment or personnel that handle these during any stage of processing exposed food.

How:

- linear process flow is ideal, with the process designed to avoid backtracking and movement between the standard hygiene and high-care areas;
- clearly delineate the high-care area from the standard hygiene areas by defining a red line area, e.g.:
 - physical barriers such as a fence or bar;
 - passive barriers such as a red line on the floor; or
 - different coloured floor tiles.

A physical barrier presents a greater challenge and prevents people, equipment and materials moving from the high care area to the standard hygiene area;

- use dedicated staff and equipment for operations in the standard hygiene or high-care areas to prevent cross-contamination;
- use separate storage areas, waste collection, protective clothing and operations for each area;
- where possible there should be two entry doors to the processing room, one for each of the standard hygiene and high-care areas. The doors should be clearly labelled and/or colour coded;
- where there is only one access door into the processing room, this should ideally open onto a 'safe' zone from where access to the standard hygiene and high-care areas can be made;
- avoid the use of 'high-care corridors' through the standard hygiene area
- have separate locker rooms and/or anterooms for staff that process the raw or RTE food.
- ensure there are separate hygiene facilities available on entry to the high-care and standard hygiene areas, such as an ante-room with boot and clothing exchanges and at least hand and boot washing facilities; and
- include an entry barrier system that helps to ensure the completion of hygiene routines prior;
- see Figure 3 for an example of separation by distance.

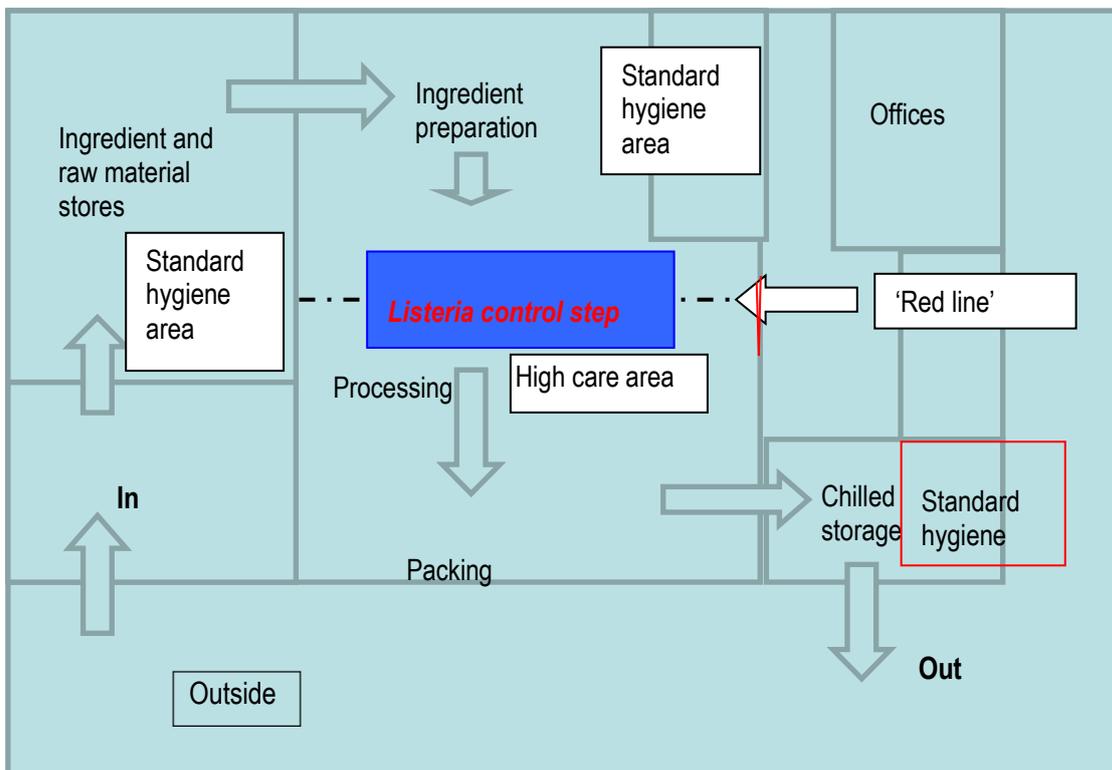


Figure 3: An example of separation by distance

11.1.5 Separation by time

What: Separate processing operations by time when they occur in the same room and space is limited.

Where possible use dedicated personnel and separate equipment for different tasks or schedule similar tasks for similar times.

Why: The finished RTE food may be contaminated with *Listeria* from raw products or ingredients as well as equipment or personnel that handle these during any stage of processing.

How:

- schedule tasks with the same processing stage to occur at the same time. Perform tasks with the RTE food, e.g. slicing and packing, before those with raw product and ingredients, e.g. mixing, cooking or smoking, etc.;

Some food operators manage to schedule tasks by cleaning and sanitising the processing room between handling or processing discrete products.

- where a number of different products are produced in the same room, try to schedule the tasks so that the RTE foods are handled together and where possible raw ingredients;
- clean and sanitise the work surfaces in between processing products. Ensure that the sanitiser is left on the surfaces for the length of time required by the manufacturer;
- ensure there are hygiene facilities available on entry, such as hand and boot washing facilities, boot and clothing exchanges and that there are barriers that prevent entry without completing hygiene routines;
- Figure 4 provides an example of how an operator may organise separation by time;
- some operators conduct further processing of RTE products on a dedicated day. Slicing, packing, etc. is all conducted on a single day and before any raw ingredients are handled.

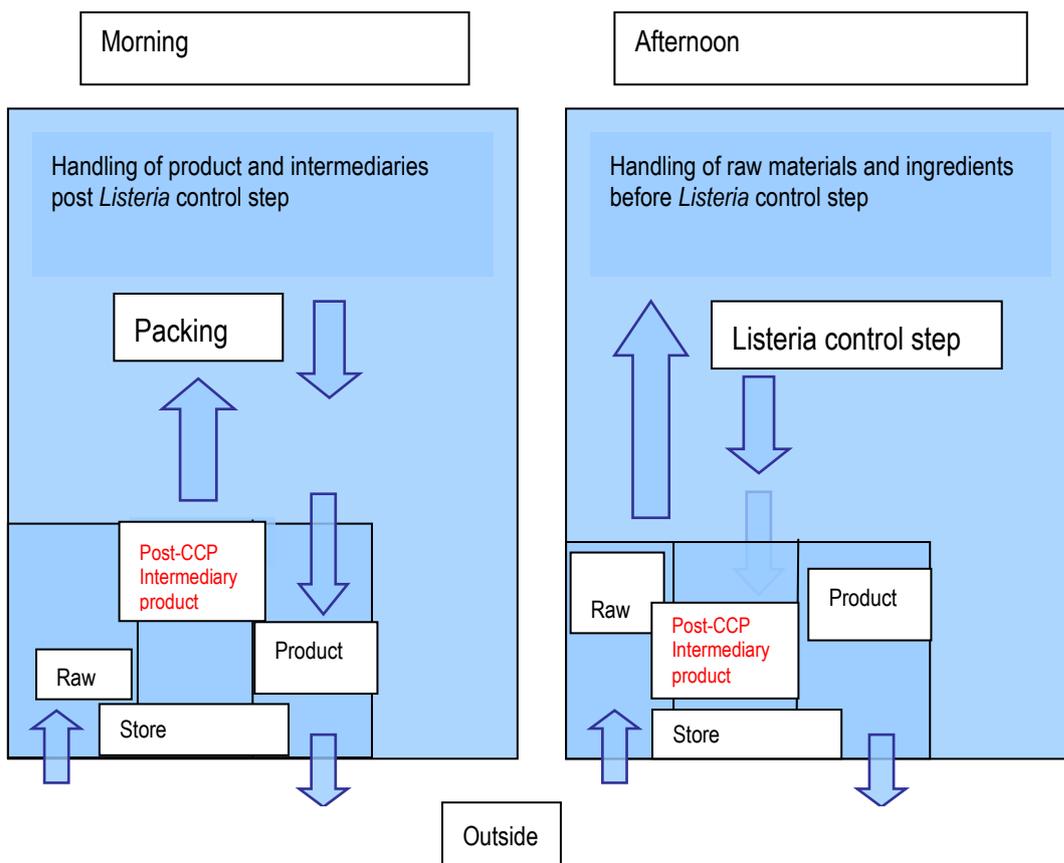


Figure 4: An example of separation by time

11.2 Hygiene areas and zones

The terms zone and hygiene area may often be used inter-changeably as they define areas based on the likelihood that a food product may be contaminated with *L. monocytogenes*. Further details on the use of zones can be found in Part 1: *Listeria Management* and Glossary, and the application of zones for testing can be found in Part 3: Microbiological testing for verification of the control of *L. monocytogenes*.

12 Labelling and product information

What: The labels should comply with the requirements of the Food Standards Code:

- dates should be either 'best before' or 'use by'; and
- where appropriate, product labels should include information on storage, safe handling practices and/or advice on the time frames in which product should be eaten.

Why: Food businesses should put in place control measures to ensure that *L. monocytogenes* is not present in the food at the end of the production and processing.

As required in the Food Standards Code, information should be provided to the consumer/retailer/food service food operator to ensure that the food is handled, stored and used appropriately so that the consumers do not become ill.

How: Issues to consider include:

- determining the shelf-life with respect to microbiological safety of the RTE food as well in terms of quality and spoilage;
- instructions for storage and consumption;
- reheating or storage instructions; and
- whether a non-RTE food could be misinterpreted as being RTE, if so provide clear and unambiguous statements that the product should be cooked before consumption.

Consumer education and information should be directed at:

- at-risk groups (vulnerable consumers) and their carers'; and
- caterers, food retail, consumers, to provide instructions on how best to store and present the RTE food for consumption.

The shelf-life of a product should be determined based on the parameters of the particular product, the process, opportunity for contamination and the storage conditions.

It is not good practice to use the shelf-life from a similar product available at retail as the characteristics and hence the shelf-life may be very different from the product. For example, the ingredients may come from a different source with different specifications, the processes used may differ, different packaging materials, etc.

Further information on how to determine the shelf-life of a food is available from:

<http://www.foodsafety.govt.nz/elibrary/industry/determine-shelf-life-of-food/>

13 Storage and transport

What: Products should be stored and transported appropriately e.g. chilled or frozen as soon as possible after processing.

It is important to maintain the separation of raw from RTE foods during storage and transportation.

Why: Raw ingredients or foods may be a source of contamination.

Listeria can grow under refrigeration temperatures but it is still important to maintain the cool chain to minimise the growth of any bacteria present.

How:

- use data loggers to monitor transport temperatures;
- it is necessary to establish the time/ temperature combination used for refrigerated storage, < 6°C (preferred temperature 2-4°C);
- the temperature of refrigeration units should be monitored and corrective actions determined in case of failure;
- Figure 5 shows the different growth rates for *Listeria* held at different temperatures (2°C, 4°C, 6°C and 10°C) over 240 hours (10 days);
- the temperatures of freezers used for storage should be monitored and controlled continuously; and
- vehicles used to transport RTE product(s) should be inspected to ensure that there is appropriate segregation between raw and RTE products during transport.

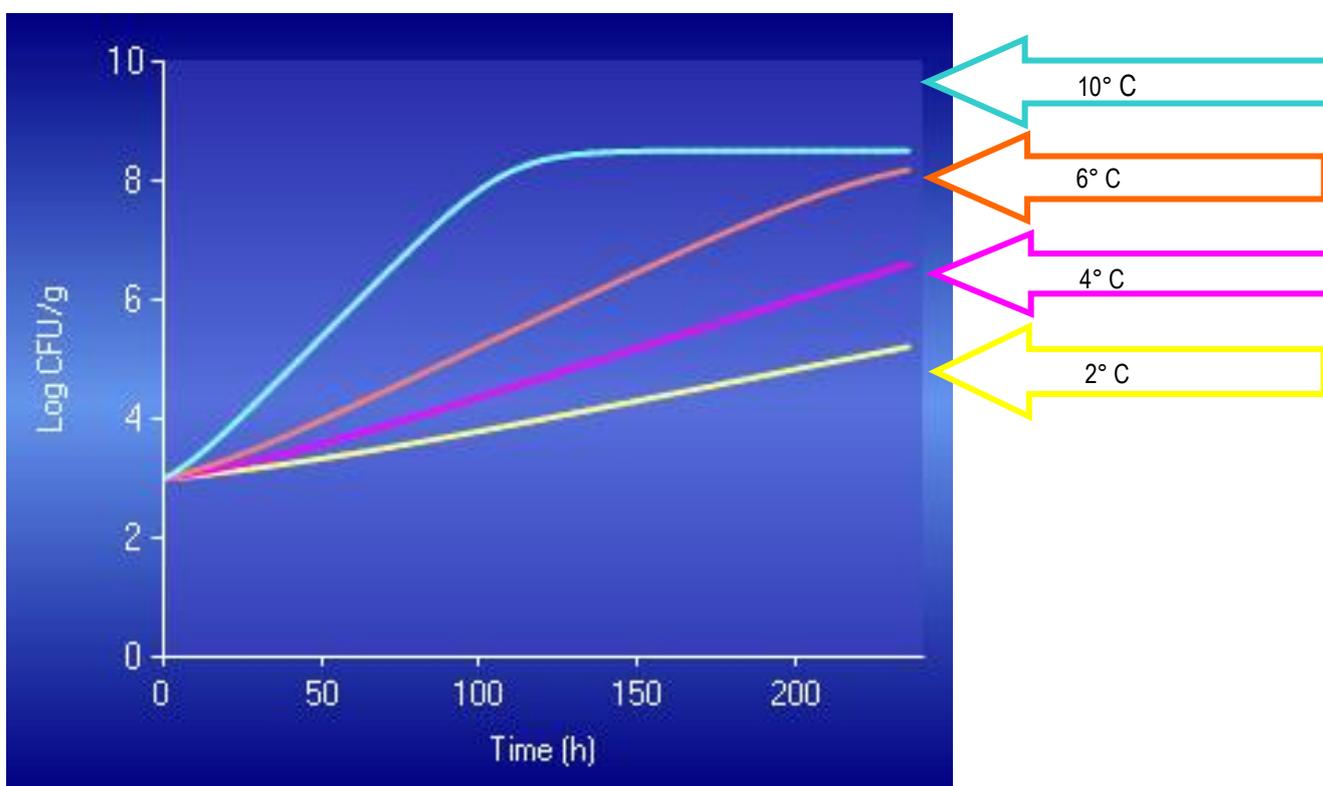


Figure 5: Predicted growth of *L. monocytogenes* 2°, 4°, 6° and 10°C over 240 hours (10 days). *L. monocytogenes* growth rate predicted using ComBase (http://modelling.combase.cc/ComBase_Predictor.aspx)

14 Cleaning and sanitation

14.1 Introduction to cleaning and sanitation

What: This cleaning and sanitation section is intended for use by RTE food operators in the following circumstances:

- where there is physical separation:
 - in the high-care area, immediately after a validated *Listeria* control step and where product is exposed before packaging; or
 - in the high care area, for RTE foods that are not subject to a further control step where these are exposed before packaging;
- where separation occurs by distance; and
- where separation occurs by time.

Why: More stringent controls, including the effective implementation of cleaning and sanitation procedures, are required in these areas to prevent or minimise post-process contamination of RTE foods.

Controls should be targeted to prevent *Listeria* contamination of food, product contact surfaces and the processing environment in the high care area.

How: Cleaning and sanitation processes should cover:

- all product contact and non-product contact surfaces, utensils, equipment, fixtures and fittings:
 - after raw foods and/or ingredients have been handled or processed;
 - between processing of raw and RTE foods; and
 - as determined by the assessment of cleaning procedures and frequency;
- check, as part of the pre-op process checks, when slicing and packing RTE foods
 - the slicer,
 - work tables
 - other product contact surfaces.

Spray with a non-rinse sanitiser before starting slicing at the start of each day and at regular intervals during the day (e.g. before breaks);
- use cleaning detergents and sanitisers that have good activity against *Listeria* for cleaning and sanitising (check with chemical supplier); and
- initially clean surfaces to remove physical debris before the application of sanitisers, in order to be more effective against microbial pathogens.

14.2 General cleaning and sanitation

What: Effective cleaning and sanitising is one of the key risk mitigation tools to manage *Listeria*.

Why: Bacteria have specific requirements for growth and survival, such as water, temperature and nutrition. Inadequate or inefficient cleaning and sanitation can provide bacteria with these requirements. For further information refer to **Part 1** and **Part 2, Appendix 2**.

When *Listeria* is able to grow in a niche or as a biofilm, normal cleaning and sanitation is less effective at removing them. Any *Listeria* present may build up on product contact surfaces and contamination may spread to food either directly or indirectly.

- How:
- cleaning and sanitation should ensure that all areas within the premises, including buildings, facilities and equipment, are maintained in a hygienic and sanitary condition by implementing an effective cleaning and sanitation programme;
 - document the cleaning and sanitation procedures;
 - ensure that cleaning staff have been trained in the application of these procedures and that a copy is always available; and
 - have a system to monitor the effectiveness of the cleaning and sanitation programme, i.e. how well the building and equipment has been cleaned and sanitised.

14.2.1 What method of cleaning should be used?

What: Minimise the amount of wet cleaning undertaken in the high care area and try to avoid the use of high pressure hoses.

Why: Cleaning should be carried out in a way that prevents the contamination of products, equipment and other product contact surfaces and materials (e.g. packaging materials); or previously cleaned areas, facilities or equipment.

When cleaning, it is important to pay close attention to surfaces, areas and equipment used to handle exposed product after a listericidal step, to prevent re-contamination.

- How:
- the cleaning programme should be designed and developed according to the nature of the product and the processing environment;
 - most high care processing areas will require a wet cleaning routine. Wet cleaning should include:
 - sweep or low pressure water to remove food waste;
 - detergent to loosen soiling. Detergent is often applied as foam. Some manual scrubbing is also likely to be needed to aid removal of adherent soiling from surfaces;
 - rinse with water to remove loosened soiling and detergent;
 - sanitiser may be applied as a spray or a foam;
 - dry cleaning should be more appropriate for areas where dry materials are handled and stored (e.g. dry store room, dry ingredient weighing or batching areas);
 - other areas may require a combination of both methods. For example, the packing areas should be kept dry during operations and should only be dry cleaned during processing, but will require wet cleaning at the end of the processing day; and
 - where dried products are produced, e.g. dried powders, water should not be used and areas will be likely to be cleaned using vacuum cleaners. Alternatively some food operators may have closed processing systems, e.g. pasteurising milk, where Cleaning in Place (CIP) will be used for product contact surfaces.

14.3 Setting up a cleaning and sanitation programme

14.3.1 Cleaning and sanitising chemicals used

- discuss the particular process and needs with the chemical supplier to help ensure that the correct cleaning and sanitation chemicals are used. Points to consider:

- how the chemicals will be applied;
 - what is being cleaned;
 - the hardness of the water;
 - the particular RTE foods processed (e.g. blood, fat, starch, cooked-on product). In a premises handling animal products, the cleaning detergents will typically contain alkali (to remove protein) and chlorine (to remove fat).
- avoid using a product described as a combined detergent/sanitiser. A stand-alone sanitiser should still follow this;
 - follow the instructions for the storage, preparation and application provided by the supplier of cleaning and sanitiser chemicals; and
 - consider rotating the sanitiser used in the cleaning process. This may help to prevent the bacteria developing resistance against its use. The chemical supplier should be able to offer further advice.

The MPI Approved Maintenance Compounds (Non Dairy) Register provides information on approved maintenance compounds. The database is present on the MPI website www.mpi.govt.nz and searching using the terms “Approved Maintenance Compounds Register”.

14.3.2 What should be cleaned?

- What: Make an assessment of all equipment and surfaces in the premises to determine what needs to be cleaned and how.
- Why: Equipment in the high care area may be complex and have hidden surfaces which are difficult to clean and could provide harbourage sites for microbial growth.
- How: **Appendix 2** includes a summary of those areas and pieces of equipment that should be included in a cleaning and sanitation programme.

It is important to be able to take apart the equipment to target those hidden areas that may collect a build-up of waste and residues. These are ideal harbourage sites for *Listeria*.

14.3.3 Frequency of cleaning and sanitation

- What: The frequency that each surface should be cleaned and sanitised will depend on things such as:
- the process;
 - the product;
 - the ability of *Listeria* to grow on the product surfaces and product;
 - the operation temperature of the room; and
 - the down times and product range.
- Why: Some surfaces will require:
- in-process cleaning, e.g. between handling raw and RTE foods;
 - cleaning during work breaks (e.g. smokos and lunch);
 - cleaning between batches;
 - cleaning at the end of the shift; and
 - a major clean down at the end of the day.
- How:
- determine the frequency of cleaning of sanitation for all the different surfaces (equipment and infrastructure) that require cleaning and sanitising;

- any special instructions or operating procedure as to how these items should be cleaned. Whether they require dismantling, tackled in a specific order or the electrical systems protected should be recorded; and
- in **Appendix 2**, there is an example of a cleaning and sanitation programme. Within this Appendix:
 - Figure 6 provides a suggested format that can be used to develop a cleaning schedule;
 - Figure 7 provides an indication of suggested cleaning frequencies for different pieces of equipment; and
 - there is further guidance for the cleaning of the specific facilities and equipment within the high care area.

14.3.4 How to avoid cross-contamination

What: Avoid contaminating the high care area during cleaning and sanitation.

Why: Cleaning and sanitation may introduce *Listeria* bacteria from low care or external areas if control measures are not taken.

How:

- only use low to medium pressure water hoses. High pressure water hoses cause splashing, and can create aerosols which can carry contaminants and micro-organisms for considerable distances;
- any pooling of water should be swept into the drain as soon as possible;
- any cloths and scourers that have been used should be stored in sanitiser immediately after use and disposed of regularly, e.g. weekly;
- all brushes, scrapers and other tools should be cleaned, sanitised and hygienically stored. These too should be replaced regularly, e.g. monthly;
- condensation on the ceiling and overhead structures due to the use of hot water or steam during cleaning should be removed before the start of operation; and
- equipment made of metal, e.g. trolleys and racks, can be sanitised in the oven/smoke house after routine cleaning if the oven/smoke house is capable of producing listericidal conditions.

14.4 Cleaning equipment

14.4.1 Use of different cleaning equipment

What: Different sets of cleaning equipment should be dedicated for use in the high care area

- to clean the floors and drains;
- for product contact surfaces; and
- non-product contact surfaces.

Why: This prevents cross-contamination and the introduction of *Listeria* from other areas to any product, packaging or product contact surface.

How:

- the colour coding of cleaning equipment and supplies helps to differentiate those used in different areas, and those used to clean the floor and drains;
- clean and sanitise the cleaning equipment following use;
- cleaning and sanitising equipment used for the high and standard hygiene areas should be stored separately;
- re-usable cleaning equipment must be cleaned before storage in sanitiser; and

- the cleaning and sanitation equipment has been found to be the source of a *Listeria* incident in a RTE food operation. *L. monocytogenes* was detected in the inside of a hose that had been used to clean the high care area.

14.4.2 What should the cleaning equipment be made of?

What: The cleaning equipment should be made of material that can be easily cleaned and that is non-absorbent.

Why: Hoses and other cleaning equipment have been sources of *Listeria* contamination in past food incidents.

Porous and absorbent items (e.g. rags, wooden handled tools) are difficult to clean and they harbour bacteria.

How:

- cleaning equipment that is re-used (e.g. brushes, buckets) should be sanitised prior to reuse, and maintained in a good state of repair;
- the use of steel wool should be avoided. If used, the affected area should be thoroughly washed and checked for contamination of metal fibres;
- hoses should be stored on reels and racks when not in use (not left on the floor)
- reusable cleaning equipment may be stored in a container of sanitiser solution; and
- scourers and brushes will gradually gain a build-up of product residue that cannot be removed by cleaning or disinfected. These should be replaced regularly, e.g. weekly/monthly depending on the risk.

15 References

15.1.1 Specific references

- Approved Maintenance Compounds (Non-Dairy) Register: <http://www.foodsafety.govt.nz/registers-lists/maintenance-compounds/>
- Further Processing - Code of Practice:
<http://www.foodsafety.govt.nz/elibrary/industry/further-processing-code/>
- Dairy - Heat Treatment – Code of Practice:
<http://www.foodsafety.govt.nz/elibrary/industry/dairy-code-practice-heat-treatment/index.htm>
- Dairy – Operational Guideline – Heat Treatment:
http://www.foodsafety.govt.nz/elibrary/industry/Operational_Guideline-Provides_Product.pdf
- Pathogen Management Plan Guidance Material: Draft May 1, 2006:
http://www.foodsafety.govt.nz/elibrary/industry/Pathogen_Management-Sets_Requirements.pdf
- Dairy – Specialist Cheese – Code of Practice is available from the Specialist Cheesemakers Association:
<http://www.nzscsca.org.nz/> (External Website)
- Interim Code of Practice for Ice Cream:
<http://www.nzicecream.org.nz/members/documents/Ice-Cream-Guidelines-April2012.pdf>
- Guidance Material for the development of a Food Safety Programme (Food Act 1981) for Yoghurt Manufacture:
http://www.foodsafety.govt.nz/elibrary/industry/Guidance_Material-Purpose_Document.pdf
- RMP template: Dairy processors - Yoghurt domestic supply:
<http://www.foodsafety.govt.nz/elibrary/industry/template-dairy-processors-yoghurt/index.htm>
- RMP template: Dairy processors - Cheese domestic supply:
<http://www.foodsafety.govt.nz/elibrary/industry/template-dairy-processors-cheese/index.htm>
- Farm House Cheese Risk Management Programme Template:
<http://www.foodsafety.govt.nz/elibrary/industry/Farm-House-Cheese-Programme-Template%20-May-2014.pdf>
- Poultry Processing – Code of Practice:
<http://www.foodsafety.govt.nz/elibrary/industry/processing-code-practice-poultry/index.htm>
- Processed Meats – Code of Practice
<http://www.foodsafety.govt.nz/elibrary/industry/processed-meats-code-part-4/index.htm>
- Guidelines for the Production of Uncooked Comminuted Fermented Meat (UCFM) Products:
<http://www.foodsafety.govt.nz/elibrary/industry/guidelines-production-uncooked-guide/ucfm-guide-july-2009-final.pdf>
- Separation Requirements for Ready to Eat and Raw Meat Products for Food Safety Programme Approval is available from: http://www.foodsafety.govt.nz/elibrary/industry/Separation_Requirements-Statement_Policy.pdf
- Processing of Seafood Products - Code of Practice:
<http://www.foodsafety.govt.nz/elibrary/industry/code-practice-seafood/>

15.1.2 General references

- Australia New Zealand Food Standards Code, Standard 1.6.1 Microbiological Limits for Food:
<http://www.comlaw.gov.au/Series/F2008B00630>
- MPI Food Labelling Guide:
<http://www.foodsafety.govt.nz/elibrary/industry/nzfsa-food-labelling-guide/> and a version for printing from: <https://mpi.govt.nz/document-vault/3696>
- Food Control Plan (FCP):
<http://www.mpi.govt.nz/food-safety/food-act-2014/food-control-plans/>
- Food Safety Programmes (FSP) is available from: <http://www.foodsafety.govt.nz/industry/general/fsp>

- Risk Management Programmes (RMP):
- <http://www.foodsafety.govt.nz/industry/general/rmp>
- Hazard analysis and critical control point (HACCP):
<http://www.foodsafety.govt.nz/industry/general/haccp>

15.1.3 Other references

- Tompkin, R.B. (2002). Control of *Listeria monocytogenes* in the food processing environment. *J. Food Prot.* 65, 709-725.
- Ohlsson T and Bengtsson N. (2002). "The hurdle concept" Minimal Processing Technologies in the Food Industry, Woodhead Publishing, pp. 175–195. ISBN 9781855735477.
- Food Safety Authority of Ireland (FSAI). (2005). The Control and Management of *Listeria monocytogenes* Contamination of Food available from:
<https://www.fsai.ie/WorkArea/DownloadAsset.aspx?id=1234>

Appendix 1 – Using properties of the food to control *Listeria*

What: The growth of *L. monocytogenes* in foods are dependent on:

- intrinsic characteristics of the product (e.g. pH, water activity);
- extrinsic characteristics of the product (e.g. storage temperature, relative humidity); and
- processing techniques (e.g. cooking, non-thermal processing) used in its production.

Why: Part 1 provides further information on the intrinsic properties. Some of the growth and survival limits for *L. monocytogenes* are shown in Figure 8 adapted from The Food Safety Authority of Ireland the Control and Management of *Listeria monocytogenes* Contamination of Food (published July 2005).

Figure 8: Growth and Survival Limits for *L. monocytogenes*

Parameter	Minimum	Maximum ^d	Optimal	Can survive (but no growth) ^e
Temperature (°C)	-1.5 to +3	45	30 to 37	-18°C ^f
pH ^a	4.2 to 4.3	9.4 to 9.5	7.0	3.3 to 4.2
Water Activity (a_w) ^b	0.90 to 0.93	> 0.99	0.97	< 0.90
Salt (%) ^c	< 0.5	12 to 16	N/A	≥ 20

a Hydrochloric acid as acidulant (inhibition is dependent on type of acid present)

b Sodium chloride as the humectant

c Percent sodium chloride, water phase

d When growth rate is highest

e Survival period will vary depending on nature of food and other factors

f A temperature of 70°C/2min is required for a 10⁶ reduction in numbers of *L. monocytogenes* cells

N/A Not Applicable

The principal factors that influence the survival and growth of *L. monocytogenes* in food are temperature, pH and water activity (a_w). As with other bacteria, the tolerance of *L. monocytogenes* to particular environmental constraints (processing and/or storage conditions) is greatest when all other conditions are optimal for growth.

- How:
- there are a number of processing methods that can be used to treat food and control *L. monocytogenes*:
 - only thermal processing has an established role for the definitive elimination of this and other pathogens in foodstuffs; and
 - other methods have a (cumulative) role when used collectively but on their own do not provide an acceptable reduction and/or elimination of *L. monocytogenes* in foods;
 - (microbiological) hurdle technology is a method of achieving the control or elimination of a pathogen in a food by:
 - combining a number of measures that act synergistically; or
 - cumulatively but if used individually would not be adequate for pathogen control.

The foods will be safe and their shelf-life will be extended. Each individual control measure is considered a hurdle the pathogen has to overcome if it is to remain active in the food. A hurdle may be based on:

- temperature (e.g. cooking);
 - water activity (e.g. drying, adding salt/sugar);
 - acidity (e.g. pickling);
 - redox potential (e.g. fermentation);
 - preservatives (e.g. adding salt);
 - other measures; and
- Part 1 provides further examples of physical, physicochemical or microbial hurdles that can assist food preservation and/or food safety

Further processing

The food operator should ensure that raw materials and products are properly handled to avoid additional contamination which the process is not designed to eliminate.

Cooking

What: Cooking causes the destruction of certain spoilage and pathogenic bacteria.

Why: The number of micro-organisms destroyed will depend on the time and temperature regime applied.

How

- the food operator should ensure that raw materials and products are properly handled to avoid additional contamination which the process is not designed to eliminate;
- a cooking step is likely to be a CCP when raw materials are known to have pathogens reasonably likely to occur at unacceptable levels prior to cooking;
- where cooking is used to control pathogens in ready-to-eat (RTE) products, cooking processes are usually designed to achieve a 6 decimal reduction of *Listeria monocytogenes* (a 6D process) unless otherwise validated; and
- alternatively time and temperature parameters for cooking can be met by the process and measured within in the centre of the product. For example, the internal temperature reaches 75°C or 72°C for 2 minutes or an equivalent time/temperature combination to reach to the desired outcome.

Validation of the process

What: Validate any listericidal control steps such as in-pack pasteurisation, high pressure processing, cooking, fermentation, microbiological hurdles.

Why: Listericidal steps should be designed and validated to eliminate or reduce *L. monocytogenes* to acceptable levels in the final product, e.g. a 6D reduction.

How:

- validation should be conducted, reviewed and/supervised by a competent person to ensure that the validation protocol is robust;
- for guidance on the validation of processes, refer to:
 - Further Processing Code of Practice available at:
<http://www.foodsafety.govt.nz/elibrary/industry/further-processing-code/part-3.pdf>;
 - and
 - the RMP manual available at:
<http://www.foodsafety.govt.nz/elibrary/industry/manual-risk-management-programmes/>; and

- predictive models and challenge tests can be used to help validate the process, further information on these is provided in Part 1: *Listeria* management.

Predictive Microbiological Modelling

Predictive microbiology is a description of the responses of microorganism's to particular environmental conditions such as temperature, pH and water activity. Predictive microbiology uses mathematical models (built with data from laboratory testing) and computer software to graphically describe these responses.

Predictive microbiological models do not replace laboratory analysis or the training and judgment of an experienced food microbiologist. Predictive microbiological models must be used with great caution and only used by trained, experienced personnel with an understanding of the limitations of use.

In all predictive microbiology a prediction must only be used as a guide to the response of microorganism(s) to a particular set of environmental conditions. Consultation with a competent body is strongly recommended before their use. Food businesses should never rely solely on any predictive microbiological model to determine the safety of foods and/or processing systems. Determining the growth, survival or inactivation of pathogens in food requires:

- the determination of the intrinsic and extrinsic properties of the product, taking into account the storage and processing conditions, the possibilities for contamination and the foreseen shelf-life; and
- consultation of available scientific literature and research data regarding the survival, growth and inactivation of microorganisms of concern.

Where necessary on the basis of these studies food operators should also conduct additional studies, which may include:

- laboratory based microbiological sampling and analysis;
- predictive microbiological modelling; and
- challenge tests to investigate the ability of microorganisms of concern to grow or survive in the food product under reasonably foreseeable conditions of distribution and storage.

General information

Laboratory based microbiological tests are typically used to make the critical decisions regarding food safety and product shelf-life. However, the growth, survival and inactivation of microorganisms in foods are reproducible responses.

Predictive microbiological models which quantitatively describe the combined effect of specific environmental conditions can be used to predict growth, survival or inactivation of microorganisms. In product development a predictive microbiological model may allow a food business to evaluate the safety and stability of new formulations and identify those which may give a desired shelf-life.

Predictive microbiological models are also useful when the shelf-life has been determined, but the product is then subject to a minor process or formulation change (either planned or unplanned through loss of process control). A predictive microbiological model can then be used to initially establish if the change might have any effect on the safety and shelf-life of the product.

Predictive microbiological models allow product developers to pinpoint the combinations of hurdles that may achieve a desired shelf life. These specific conditions can then be tested by experiment if necessary thus reducing the cost of challenge studies.

Development and limitations of models

Predictive microbiological models are normally developed assuming that microbial responses are consistent. Predictive models can provide a cost effective means to minimise microbiological testing in determining shelf-life. There may be occasions when the model's predictions may not be accurate, due to inconsistent microbial responses and variations in the growth media. Research has indicated that this is often why some predictive microbiological models fail to accurately predict the survival, growth or inactivation of pathogens in food products.

Predictive microbiological models must undergo validation before they are used to aid in food safety decisions. Validation involves comparing model predictions to experimental observations not used in model development.

Microbiological modelling programs

Initiatives to develop microbiological modelling programs have been ongoing in the United States, the United Kingdom, Denmark, France, Australia and other countries for a number of years. These programs have resulted in the development of a wide range of microbiological modelling software packages becoming available on the internet for download. Some of the more commonly used models are listed below:

- a) ComBase <http://www.combase.cc/>
- b) Pathogen Modeling Program <http://www.ars.usda.gov/Services/docs.htm?docid=6786>
- c) Growth Predictor & Perfringens Predictor <http://www.ifr.ac.uk/Safety/GrowthPredictor/>
- d) Food Safety and Spoilage Predictor Software, Danish Technical University <http://fssp.food.dtu.dk/>
- e) Sym'Previs (an integrated database and predictive software, in French)
<http://www.symprevious.net/>

Appendix 2 – Cleaning and sanitation

An example of a cleaning and sanitation programme

A typical cleaning and sanitation programme for food operators processing RTE foods, such as cooked meats, smoked fish, fresh-cut pre-packaged salads, sandwiches, cheeses, etc. may include a number of steps. An example of a suggested format for a cleaning schedule is included in Figure 9, and frequencies and how specific guidance for in Figure 10.

AN EXAMPLE OF A CLEANING AND SANITATION PROGRAMME

Dry clean

- remove food scraps; and
- use a brush or vacuum to physically remove soil, dirt or scraps from the area.

Dismantle equipment

- dismantle complicated equipment;
- all equipment and machines should be disassembled in accordance with manufacturer's instructions and the food operator's own investigations before thorough cleaning and sanitising of all parts and surfaces. Particular attention should be given to areas where food and water waste builds up and other areas that are hard to reach e.g. the shafts of slicers and mixers;
- the equipment may require more extensive dismantling on a scheduled basis, e.g. weekly, to ensure that all areas of concern have been addressed; and
- cleaned equipment parts should be placed on clean tables, trolleys or shelves for cleaning and drying. Do not put disassembled equipment on the floor for cleaning.

Pre-rinse

- rinse with cold water.

Apply the cleaning detergent

- the method of applying the cleaning detergents will depend upon the specific area/surface/equipment;
- apply a detergent via cleaning tool such as a cleaning cloth, scourers, brushes or via automated foaming system; and
- some pieces of equipment may also be put into soak before scrubbing.

Leave the detergent and scrub

- leave the cleaning detergent solution, foam or gel on all surfaces for the time specified by the manufacturer to allow the chemical reactions to take place; and
- scrub the surfaces using a brush or scourer (or other mechanical action) to loosen and remove dirt.

Rinse and inspect

- rinse the detergent solution off the surfaces with potable water.

Apply the sanitiser and leave for the required contact time

The surfaces should be free of food, soil, or scraps and chemical residues for the sanitiser (disinfectant) to work effectively.

The sanitiser should be effective against *L. monocytogenes* or *Listeria spp.* or any other micro-organism of concern. Methods of sanitising include:

- soak sanitiser, e.g. using hot water and the sanitising chemicals – for a specified time and temperature, usually for knives, gloves and small utensils. Soaking in cold sanitiser solution for longer periods is also widely used;
- spray sanitiser, e.g. chemicals – application of approved sanitisers (e.g. halogens, quaternary ammonium compounds) at the recommended concentration and leave it on all surfaces for the time recommended by the manufacturer;
- periodic deep cleans are advisable (refer to Figure 10). This involves removing covers from machines, motor fan cowls and any other item that cannot be cleaned easily and regularly;
- Sensitive equipment such as electrical control boxes can be internally cleaned (after they have been electrically isolated) using ethanol or propanol infused wipes. Allow time for evaporation before covers are replaced. An engineer is usually required to strip down and rebuild equipment;
- place heat resistant equipment into the oven/smokehouse and process. This is an effective way of sanitising the equipment if the oven/smokehouse has a validated listerocidal process option; and
- steam is not an effective sanitizer as it will not heat large, complex pieces of equipment to a high enough temperature for a sufficient period of time. If possible disassemble the equipment, place it in water at 85°C, allow the water temperature to recover to 85°C and then hold it at that temperature for a minimum of 30 minutes. This has been used effectively for large sub-assemblies such as the carriers for slicer blades for many years.

Rinse – if required

- rinse off the chemical sanitiser with potable water and drain (not needed if a non-rinse sanitiser is used).

Reassemble and leave equipment so that it's dry at the start-up

- ideally all equipment and food contact surfaces that have been wet cleaned should be dry before processing (e.g. slicing, packing) starts as it is known to reduce cross-contamination.

Pre-operational check

- the pre-operational (pre-op) checks of facilities and equipment should be conducted by a responsible employee who has the authority to delay the start of processing until any problems identified have been rectified. This check should ensure that operations only begin after cleaning and sanitation requirements have been met; and
- the food operator should investigate and correct the causes of repetitive failures of the cleaning and sanitation programme.

Figure 9: An example of a table showing how and when cleaning and sanitation should occur for different surfaces

	In-process cleaning	End-of-day cleaning	Pre-operational check
High-care area – product contact surfaces			
Equipment and surfaces	When?	When?	When?
	How?	How?	How?
	Any special instructions?	Any special instructions?	Any special instructions?
Non-product contact surfaces (high and standard hygiene areas)			
Equipment and surfaces	When?	When?	When?
	How?	How?	How?
	Any special instructions?	Any special instructions?	Any special instructions?

Figure 10: Examples of cleaning and sanitation frequencies

<p>Product contact surfaces, including processing and conveying equipment (e.g. tubs, trolleys, trays), should be cleaned:</p> <ul style="list-style-type: none"> • at least at the end of each working day; <ul style="list-style-type: none"> – whenever surfaces become unacceptable or come into contact with waste; and – whenever necessary to prevent cross-contamination between raw and RTE-products; and • any equipment or machinery which has been used but is temporarily idle should be cleaned prior to reuse if the delay is in excess of 4 hours. When equipment is located in a non-refrigerated processing area, more frequent cleaning should be considered as bacteria will grow faster at these temperatures. <ul style="list-style-type: none"> – Floors <ul style="list-style-type: none"> • floors in the high care area should be cleaned daily; • particular attention should be given to cleaning and sanitising cracks or damage to the floor or coving seals. Damage should also be repaired by the maintenance staff; • cracks are potential for reservoir for <i>L. monocytogenes</i>, and if food scraps are also ground into a crack, the bacteria can grow to dangerous numbers; • drains, covers and sieves in processing areas should be cleaned and sanitised daily. • during processing, waste water should be directly removed to the drains; • drains should be cleaned daily as part of the daily major clean down (including sanitising). Drains should also receive more intensive weekly clean using chemicals that are able to remove any build-up of residues and micro-organisms; and • visible contamination on walls and doors should be removed by using foam, and low pressure water. Avoid using high pressure hoses in the high care area. – Benches, tables and framing <ul style="list-style-type: none"> • all surfaces of benches, tables, racks and frame should be cleaned and sanitised daily;
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- particular attention should be given to the underside, the legs, wheels and rollers and other areas where dirt and food scraps can accumulate, e.g. attachments to the walls or floors;
- **conveyor belts** used for transferring exposed product should be cleaned and sanitised at the same frequency as product contact surfaces in any food area;
- conveyors are usually difficult to clean because of crevices which are part of the design. Particular attention should be given to the following areas:
 - underside of belts;
 - under drive motor covers;
 - supports for plastic and fibre belts;
 - hollow rollers;
 - points where dirt and food scraps can accumulate;
- the **ceiling, overhead pipes and other structures** in the high care areas should be inspected regularly and cleaned as appropriate to prevent contamination of food from condensation and other contaminants;
- daily procedures should include the removal of obvious contaminants;
- where any overhead structure is a constant source of contamination, it should be regarded as a product contact surface and cleaned according to the requirements of those surfaces;
- clean, sanitise and maintain heating, ventilation and air conditioning units on a scheduled basis;
- **waste** collected during the day should be removed from the area and disposed of appropriately;
- avoid moving uncovered waste bins through the high care area whilst product is exposed. Where possible waste should be covered and moved during breaks or prior to the major clean down;
- the containers should be clean, sanitised and dry before being returned to the high care area;
- when **footbaths** are used, they should be maintained properly with effective concentrations of sanitiser so that they do not become a source of contamination;
- an automated foam disinfectant spray may be used on the floor where people, carts, trolleys, etc. enter the high care area;
- products, packaging material and other materials that may be contaminated during wash down should be removed from the high care area and stored in appropriate locations, or they should be protected by covers, before wet cleaning is started;
- cleaning water and steam should be contained within the immediate area that is being wet cleaned; and
- floors should be cleaned by a low-pressure water hose or other effective means. Product contact surfaces should be allowed to dry before use.

Cleaning of specific facilities and equipment

High-care chillers and blast freezers

What: Chillers, refrigerators and blast freezers should be emptied, and cleaned and sanitised periodically.

Why: Chillers, refrigerators and blast freezers may be an in-direct source of *Listeria* contamination, as the cool environment will allow *Listeria* to survive.

How:

- work in progress chillers and refrigerators should be included in the cleaning and sanitation programme of the high care areas. The outside door handles and rails should be cleaned and sanitised during every major clean-down. It may be appropriate to clean and sanitise the shelving and handles inside chillers, refrigerators and blast freezers less frequently;

- the drip trays in the chillers also need to be cleaned and sanitised. If possible remove the drip trays or, if hinged, dropped down and thoroughly cleaned. The drains from the drip trays should be flushed with cleaning detergent, rinsed and sanitiser applied;
- the frequency of cleaning fans, evaporators and/or fumigating the room should be determined according to the nature of the food and results from microbiological testing; and
- in the absence of microbiological testing, the fans and evaporators should be cleaned at least once per month (or as suggested in specific industry codes of practice). Whenever any substantial maintenance work is carried out in the chiller, refrigerator or blast freezer or to its refrigeration equipment.

Air conditioning and refrigeration units

What: The cleaning coils, fans, drip trays, drainage pipes, and vents for every air conditioning unit should be cleaned regularly.

Why: Damp areas due to the addition of inadequately piped condensate allows any *Listeria* present to grow and persist there in the constantly wet environment

How:

- ensure all condensate is piped directly into drains;
- the frequency of cleaning should be linked with the process, type of RTE food, the hygiene area and the environment conditions. For standard hygiene areas, monthly cleaning may be sufficient but for high care areas cleaning may need to be done more frequently;
- filters of the cold air ducting system should be replaced regularly; and
- fogging with a sanitiser may be used as a last resort to help eliminate any entrenched *Listeria* problems.