



Te Pou Oranga Kai O Aotearoa

Operational Guideline:
Design and Construction of Dairy Premises
and Equipment

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New Zealand Food Safety Authority
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Acknowledgments

NZFSA wishes to acknowledge the contribution from the dairy industry in the review/development of this code into guideline format.

Table of Contents

1.0	Introduction	4
2.0	New or Significantly Altered Dairy Premises and/or Plant	10
3.0	Layout of the Site.....	16
4.0	Layout for Buildings	17
5.0	Design and Construction of Buildings.....	23
6.0	Building Services	31
7.0	General Requirements for Manufacturing Equipment	41
8.0	Layout of Manufacturing Equipment.....	45
9.0	Process engineering	47
10.0	Requirements for Specific Types of Equipment	53

1.0 Introduction

1.1 Background to the Development of this Guideline

Criteria relating to the design and construction of Dairy Premises and plant were originally published by MAF within the documents DDM1A, DDM1B, DDM1C. The ownership of these documents was then transferred to MQM and the documents were renamed as MQD1A, MQD1B, MQD1C.

These precursor documents were then reviewed by an industry working group and published by the New Zealand Dairy Board (NZDB) as NZCP6 (Design and Layout of Manufacturing Premises) This review was funded by the NZDB, and copyright was vested with the NZDB.

NZCP6 was approved by MAF as a Code of Practice for the NZ Dairy Industry. It was, and is, widely regarded within the NZ industry as a benchmark for the design and construction of Dairy Plants and Premises.

In 2005, Fonterra transferred copyright of NZCP6 to NZFSA. This transfer has enabled NZFSA to review the document and to develop the NZFSA Guideline for the Design and Construction of Dairy Premises and Equipment.

1.2 What is the purpose of this guideline?

All operations involving dairy material processing intended for export must be conducted in accordance with the requirements of an approved Risk Management Programme. The approval of the RMP will include consideration of the issues covered in this Guideline (e.g. buildings, equipment, building services and amenities).

This guideline does not cover laboratories, farm dairies or stores. [Location will be advised as become available].

This purpose of this guideline is to provide information to dairy stakeholders concerning the production of safe product with regard to the following areas:

- Technical guidance material, regarding the design, construction and approval of dairy premises, by which the RMP can be deemed to be compliant in the areas of premises and equipment
- NZFSA prior evaluation process of sections of the RMP relating to premises and plant design and construction. Note that this prior approval process is a non mandatory process developed to assist the dairy industry. It is recommended that the prior evaluation process is followed in order to minimise the risk of potentially costly conditions being imposed at time of RMP assessment.

This guideline should be read in conjunction with relevant market requirements e.g. ICR's/OMARS.

It is intended that this guideline be applied to new or significantly altered premises or plants.

1.3 What is included in this guideline?

This guideline sets out standards and guidelines for the design and construction of premises and equipment used for the manufacture and processing of dairy products and transport of bulk milk and liquid milk products.

This guideline is relevant to the requirements of the Animal Products Act 1999. Whilst this document is prepared for the dairy industry, it may provide assistance to other food manufacturers.

Food premises will also need to comply with other regulatory requirements (e.g. OSH) and specific processing requirements and the requirements of local authorities, especially the Resource Management Act 1991 and the Building Act 1992.

This guideline provides technical information for the hygienic design and construction of dairy manufacturing premises and equipment. It also satisfies NZFSA requirements for RMP approval.

1.4 What are the desired outcomes?

It is expected that after reading this guideline dairy processors will have gained technical information regarding the requirements for hygienic design and construction of premises and equipment. Conformance with the technical material in this guideline will facilitate RMP approval in the areas of premises and plant design and construction.

1.5 Glossary of terms

These definitions must be read in conjunction with the interpretations in the Animal Products Act 1999 and the Animal Products (Dairy) Regulations 2005.

NZFSA definitions of terms can be found in the “Glossary of Terms,” available on the Dairy & Plants website (www.nzfsa.govt.nz/Dairy/).

Dairy Material means animal material that is -

- milk extracted from a milking animal
- any material derived or processed from milk extracted from a milking animal, up until delivery of the material at the place of sale for consumption or for end use for purposes other than consumption, or its export; and
- includes dairy product that, having been purchased or imported, is further processed.

Equipment means all apparatus, containers, conveyances, machinery, piping, pumps, utensils, vehicles, and other things used in the transport, reception, testing, grading, manufacture, or storage of milk.

“Fit for intended purpose” – The phrase “fit for intended purpose”, used in relation to animal product that has been processed in accordance with Parts 2 to 4, means that, by reason of animal material or product having had the relevant risk factors managed in accordance with Parts 2 and 3, and meeting any relevant animal product standards and associated specifications set under Part 4, the product is suitable for the purpose for which the product is specifically stated or could reasonably be presumed to be intended having regard to its nature, packaging and identification.

Manufacture (Dairy Processing) All processing activities in relation to dairy material, including milking, transport, processing, addition of other material, manufacture, packaging, and storage.

Must expresses a requirement of the Animal Products Act 1999.

Recognised agency In relation to any function or activity, means a person or body recognised under section 103 for the purpose of performing that function or activity

Shall expresses a mandatory requirement, sourced from NZFSA requirements and which is reiterated in this guideline.

Should expresses a recommended provision which when followed may improve the design.

Significant amendments to risk management programme –

(1) The operator of a registered risk management programme must amend that programme, and apply for registration of the amendment, where any change, event, or other matter means that the programme -

(a) is no longer appropriate, or will no longer be appropriate, to the animal material or product, processes, or premises or place covered by the programme; or

(b) otherwise impacts, or will impact, on the fitness for intended purpose of the animal product concerned or the content of the risk management programme as required under section 17 (1).

For further information

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1.6 References

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2.0 New or Significantly Altered Dairy Premises and/or Plant

2.1 Introduction

The suitability of the premises and equipment shall be determined as part of the risk management programme (RMP) assessment. However potential dairy processors may choose to apply for prior assessment of the premises and equipment. The prior assessment process for new premises or significant alterations is not mandatory but does provide the applicant with more timely information regarding premises and equipment suitability.

2.2 Assessment of the Design and Construction of Dairy Premises and Plant Components of an RMP

2.2.1 Registration Process for RMP including premises under an RMP

The process for prior assessment of new premises is outlined below:

1. **RMP Operator** develops the RMP or significant amendment to the RMP that covers the premises concerned, and captures the premises specific requirements.
2. **RMP Operator** applies to NZFSA for unique location identifier, if new location.
3. **NZFSA** assign unique location identifier.
4. **RMP Operator** validates the RMP or RMP amendment.
5. **RMP Operator** submits the RMP or amendment to a dairy RMP evaluator recognised for the appropriate product groups within the scope of the RMP.
6. **Recognized dairy RMP evaluator–**
 - a. ensures that a recognised premises evaluator assesses the design and construction aspects.
 - b. ensures that a recognised heat treatment evaluator assesses dairy heat treatments covered by the RMP or amendment.
 - c. provides an evaluation report and, if satisfactory, an endorsement to the RMP Operator
7. **RMP operator** submits the evaluator endorsed RMP, the evaluator endorsed RMP outline, or the evaluator endorsed RMP amendment to NZFSA for registration, along with the appropriate application form, evaluation report and endorsement.

8. **NZFSA** registers the RMP with or without conditions (NZFSA to develop internal guidance on which conditions are applied when).
9. **NZFSA Approvals & Registrations Group** notify CIG upon registration of the RMP or amendment.

2.2.2 Information that may be required by the Recognised Agency (RA) from the RMP Operator

The RA should be notified before **construction work commences** on new or significantly altered premises which could impact on food safety. The notification should provide an overview of the project. This initial notification should contain the following information where appropriate:

- the likely timetable for the work
- the proposed main contractor
- a summary of the proposed construction activities. As the project proceeds and further information details becomes available, relevant details are provided to the RA. These details may include:

General

- the legal description of the site
- description of where the site is located
- the zoning of the premises and the surrounding properties
- neighbouring industries with the potential to create food safety hazards
- the intended methods of effluent disposal
- the intended methods of waste air discharge.

Site location plan

The site location plan should show the proposed site in relation to the following:

- boundaries
- North
- nearby roads
- effluent disposal areas
- dimensions or scale;

and where applicable:

- nearby rivers, streams, swamps and other waterways
- nearby railway lines
- existing buildings on nearby sites and their use.

Site plan

The site plan should show the following to scale:

- North
- site boundaries
- the location on the site of all existing and proposed buildings
- service tunnels, where installed
- clear labels showing the use planned for each part of the building
- the location on the site of any special areas, other than existing and proposed buildings, e.g. water treatment
- all road and access ways, tanker washing areas and proposed tanker movements on site
- the location of any railway lines
- the storm water collection system
- the location of silos
- on-site effluent drains and effluent treatment facilities
- the prevailing wind direction.

Building layout plans

Building layout plans should show accurately the facilities as they will exist when the premises is in operation. The items that should be shown where appropriate are:

- the location of walls, columns, airlocks, stairs, windows, doorways and other openings, such as ventilation inlets and outlets, conveyor openings, removable panels, etc.
- floor drainage, indicating the direction of fall and gradient, and the location of drains and drain openings
- if open channel drains are used, their fall, direction of flow and dimensions
- details of drain inlets, traps and grills
- the intended use of each area of the factory (e.g. hygiene zoning and wet and dry zoning)
- storage facilities for product and product ingredients
- amenities, indicating lockers, toilet facilities, urinals, hand basins, showers, hand washing and hand drying facilities
- dimensions according to regulatory requirements and minimum standards.

Equipment layout plans

Equipment layout plans should show accurately:

- the location and name of all but minor items of plant and equipment
- all product lines, including conveying lines, roller conveyors, belt conveyors, etc.

CIP system drawings

A schematic drawing of the proposed cleaning-in-place (CIP) system should be provided. It should show all items of plant intended to be cleaned-in-place, all processing lines and all CIP lines. On this drawing, all major items of plant should be named and the dimensions given.

A description of each cleaning circuit, including cleaning flow rates, and describing the sequence of items in that circuit, should be included.

Cross-section drawings

Cross-section drawings should show the following details when they are not obvious from other drawings:

- the interior finish system for floors, walls and ceilings (or a finishes schedule)
- covings
- window ledges, trusses, platforms and supports where they occur within the processing rooms
- heights of ceilings
- the position of principal items of plant, equipment and overhead gear
- the construction materials, method of fixing and method of jointing of doors, window frames, walls, ceilings and floors
- dimensions.

Elevation drawings

Where appropriate, exterior elevations should be included to show clearly the location and size of doors, windows and other openings, canopies, etc.

Drainage plan

The drainage plan should show clearly the effluent drainage system, the sanitary sewerage system and the storm water system. The plan of the drainage system should include all details within the site boundaries. The drainage plan should also show rodding points. Where appropriate, site levels or contours should also be shown. Proposed materials should be shown.

Ventilation plan

The ventilation plan should show the location of and access to inlets, filters, fans, ducting, distribution points, exhausts and inspection points. If these details are clearly shown on other plans, a separate ventilation system plan need not be supplied.

Lighting services plans

Unless the details are shown on other plans, a lighting services plan should be supplied. The plan should show the location and type of lights to be installed (or a lighting schedule).

General

Give:

- the name of the company applying for approval
- the date
- the location of the proposed factory site
- the products intended to be produced and the expected peak throughput or capacity
- a concise description of the proposed method of operation
- the approximate increase in water demand, effluent load, ventilation load, refrigeration load.

Materials schedule

This section may have been included in the specifications. If so, it need not be repeated.

Identify the construction materials and finish of the:

- floors
- inside walls
- ceilings
- jointings used on ceilings and inside walls
- window frames
- doors
- drains inside processing areas and under processing floors.

Ventilation

Supply the type of air filter being used, or the appropriate specification.

For each processing room supply either:

- evidence that ventilation meets the requirements of this code for minimum overpressure and minimum airchanges, or
- provide:
 - the air flow rate
 - an estimate of heat release, including steam and moisture release, and
 - differential pressures

Equipment

Give:

- a detailed written description of the equipment, outlining its intended end use (including the products for which the equipment is designed)
- details of the intended capacity of the equipment
- full details of the composition of all product contact surfaces within the equipment together with any relevant finish standards
- a concise description of the proposed method of operation and cleaning.

Amenities

State whether the amenities comply with the relevant regulatory requirements.

2.2.3 Recognised agency (RA) undertakes assessment of proposal and construction process. During the planning and Construction process, the RA will provide timely written reports at intervals agreed with the Dairy Operator.

2.2.4 Where significant alterations are planned to an existing RMP, progress will be reported

by the RMP Operator as part of regular reporting to the RA.

- 2.2.5 At completion of the premises and /or plant construction the RA provides an evaluation report.
- 2.2.6 The application for new or significantly altered RMP approval is submitted together with the RA evaluation reports (which includes evaluation of premises and Plant design and / or construction).

3.0 Layout of the Site

3.1 Requirements for the Site

Product factories shall be located in areas free from objectionable odours, smoke, dust and other contaminants which might be produced from neighbouring industries, or any other hazards which could affect the safety of the dairy products.

It is advised that consideration should be given to such natural factors e.g. flooding and the previous use of site e.g. soil pollutants.

3.2 Requirements for Site Layout

The layout of buildings and facilities on the site should minimize any hazard to product safety.

Factors which should be taken into consideration when considering site layout include:

- tanker access routes and wash areas
- access routes for vehicles involved with waste removal
- effluent storage, treatment and disposal areas
- other vehicle access
- fuel storage and handling facilities
- ventilation and process air intakes and exhausts
- staff access and amenities
- prevailing winds.

3.3 Roads

Roads, traffic areas and access ways on the product factory site should be formed, graded, sealed and sloped so that they drain surface water. They should be kerbed where necessary to control traffic and drainage. Sufficient drainage should be provided to convey water away from the premises and roadways. Section 4.9 contains additional requirements for tanker unloading, loading and washing areas.

4.0 Layout for Buildings

4.1 General

The layout and construction of buildings must support good manufacturing practice. E.g. Areas in which dairy produce is manufactured shall be designed:

- a) to provide separation by partition, location or other effective means between operations that may cause cross – contamination.
- b) protect product from risk of contamination
- c) and protect deterioration of product by exposure.

[NZFSA is shortly to publish a document “Pathogen Management Plan Guideline” which will contain further information regarding Hygiene Zones.]

4.2 Hygiene Area Zoning

4.2.1 **Critical Hygiene Areas** are those areas in a product factory where environmental control is necessary to prevent contamination of heat treated product after the heat treatment step. There should be no raw milk in Critical Hygiene Areas. Processing equipment should be placed in or open into a Critical Hygiene Area where any of the following are **routinely exposed** to the environment:

- pasteurised or heat treated milk and milk products which will not receive a further pasteurising heat treatment,
- product ingredients that are incorporated into the process stream after the designated pasteurising heat treatment step,
- product contact surfaces of packaging materials,
- product contact surfaces in equipment that follow the pasteurising heat treatment step in the process flow.

In some circumstances there may be justification for locating processes which are inherently safe due to design and operating characteristics, in a Standard Hygiene Area (e.g. UHT or similarly totally enclosed processing). However, this would be regarded as an exception and would need to be discussed with the appropriate RA and NZFSA before construction.

4.2.2 **Standard Hygiene Areas** are those areas in a product factory in which environmental control is necessary to prevent contamination of milk and milk products prior to a microbiocidal critical control point such as pasteurisation. Processing equipment should be placed in a Standard Hygiene Area only where any of the following are **routinely exposed** to the environment:

- milk and milk products prior to a microbiocidal critical control point such as pasteurisation,
- product ingredients which are incorporated into the process stream before the pasteurising heat treatment step,
- product contact surfaces of equipment before the pasteurising heat treatment step of the process.

Depending on individual circumstances and related food safety risks, the following activities may need to be located in Standard Hygiene Areas:

- Process equipment cleaning,
- air filter washing, drying and sanitising
- laundry of process hygiene overalls and other process protective clothing.

4.3 Isolation of Critical Hygiene Areas and Standard Hygiene Areas

It is recognised that some existing facilities may not be in full agreement with this guideline, in such cases additional procedures to control food safety risks should be put in place, and will be assessed on a case by case basis by the verifier. However it is recommended new/significantly altered premises should adopt this guideline.

4.3.1 Critical Hygiene Areas should be isolated from all other parts of the factory including Standard Hygiene Areas. There should be hygiene control measures for entry of personnel, equipment, materials and ingredients. Access by personnel to Critical Hygiene Areas should only be via a personnel changing facility. Routine access by plant, equipment, ingredients, chemicals, etc., to Critical Hygiene Areas should be via an airlock. Alternatives to maintain isolation may be approved on a case by case basis where satisfactory control is demonstrated.

4.3.2 The boundary limits of Critical Hygiene Areas and Standard Hygiene Areas Signs should be clearly identified for staff and visitors, by signage or other means.

4.3.3 Access into, and within Standard Hygiene Areas should be controlled in the following areas to prevent contamination:

- the area outside (including roofs, roof spaces, service rooms, basements, and the external environment),
- amenities
- product and consumable goods stores,
- areas of potential contamination from odours (e.g. ammonia compressors), foreign matter, or micro-organisms.

Doors in high risk areas should be the “the kick open” type –i.e. no handles where possible.

Locker areas, toilets, showers and handbasins should only be on the non-critical hygiene side of the personnel changing facility and additionally toilets should be in a

separate room from the personnel changing facilities. Such facilities should be located within the same building.

Routine access by personnel, plant and equipment to Standard Hygiene Areas should be via a self-closing door. Routine access/egress of bags, drums, cans, or cartons should be via a doorway, airlock or hatchway.

- 4.3.4 Ventilation air in Critical Hygiene and Standard Hygiene Areas
Refer Section 6.4
- 4.3.5 There should not be movement of forklifts or pallets from the standard hygiene area to the critical hygiene area unless there are approved documented hygiene control procedures in place.
- 4.3.6 Critical Hygiene Areas and Standard Hygiene Areas should operate under positive air pressure relative to the outside, and Critical Hygiene Areas should operate at higher air pressure than adjoining Standard Hygiene Areas, so that air movement is from the most sensitive product areas outwards.
- 4.3.7 Doors designated as removable wall panels or emergency exit doors need not be air locked or self-closing but should be managed to ensure they are not used for routine access, e.g. alarmed and/or monitored.

4.4 Personnel Changing Facilities

- 4.4.1 All personnel access to a Critical Hygiene Area should be via a personnel changing facility or a suitable alternative
- 4.4.2 The personnel changing facility should have provision for:
 - exchanging or covering footwear,
 - exchanging or covering clothing,
 - covering hair,
 - handwashing and hand sanitising.
- 4.4.3 The personnel changing facility should be designed so that, when used correctly, it will minimise the transfer of contamination into a Critical Hygiene Area.
- 4.4.4 Ventilation should be provided to prevent stale or offensive odours developing, and the air should flow from that area to an area of lesser hygiene status.

4.5 Air Locks

- 4.5.1 Airlocks should be provided for routine access into and out of a Critical Hygiene Area for all items of plant, equipment, ingredients, chemicals, etc. Some packaging materials may also be transferred into a Critical Hygiene Area via an airlock. Airlocks should have provision for cleaning and sanitising all items expected to pass through the airlock.

For entry and exit of large pieces of equipment, refer to Section 5.9.
For the entry of packaging material refer to Section 5.6.1

- 4.5.2 Airlocks should be designated as Standard Hygiene Areas.
- 4.5.3 The doors at each end of an airlock should be fitted with an interlocking device to prevent both doors being open simultaneously. The interlocking device should be capable of being over-ridden upon activation of the fire alarm.
- 4.5.4 Air locks that are only intended for equipment and materials transfer should not be used for personnel for direct entry into Critical Hygiene Area. Airlocks may also be required between internal processing areas to control air flow patterns.
- 4.5.5 All airlock doors should be well-fitted and self-closing to minimise the ingress of pests and contamination.

4.6 Staff Amenities

Staff amenities include cafeterias, locker areas, showers and toilets.

- 4.6.1 Staff amenities should not be located in a Critical Hygiene Area. Access between staff amenities and a Critical Hygiene Area should be via a personnel changing facility. A café bar may be provided in a Critical Hygiene Area for the preparation and consumption of refreshments. Raw food should not be taken into a Critical Hygiene Area.
- 4.6.2 Lockers provided must ensure that protective clothing is adequately protected from dust and other contaminants. (including boots/freezer jackets/aprons etc). There should be adequate facility for workers boots/aprons etc

Staff amenities should be located so that staff required to work in the Critical Hygiene Area are not required to cross contaminated areas, such as tanker access routes, before entry to the personnel changing facility. Locker areas, toilets and showers should be located outside both standard and critical hygiene areas. In addition toilets should be in separate rooms from the personnel changing facility, accessed from the non hygiene side of the changing facility, and where possible within the same building.

- 4.6.3 Handwashing facilities should be provided in each toilet complex. Taps should be electronic eye-, knee- or foot-operated, to minimise the transfer of contamination.

Hand drying facilities should be provided within easy reach of each hand basin. Single use paper towels or electronic eye-operated hot air driers should be used. Where disposable paper towels are used, a suitable receptacle for used towels should be provided.

4.7 Separate Room Requirements

Separate rooms should be provided for areas where processing difficulties or contamination are possible.

Note that wet areas should be in separate rooms from dry areas.

Energy and services plant and workshops should be in separate rooms from, and should not open directly into, Critical Hygiene Areas, Standard Hygiene Areas, or storage areas involving dairy products or dairy product ingredients, except where these areas have been designated Critical Hygiene Areas or Standard Hygiene Areas, and are maintained and environmentally controlled to the level specified by that classification.

4.8 Milk Reception and Treatment Areas

Milk reception and treatment areas should be situated so as not to be thoroughfares between Critical Hygiene Areas and amenities.

Raw milk processing equipment should be designed to minimise contamination (e.g. fully enclosed or covered at all times) of the controlled environment in which it is located.

In milk reception and treatment areas, the pasteurised product should be fully enclosed, so that contamination by aerosols, etc., is not possible.

4.9 Tanker Unloading, Loading and Washing Areas

4.9.1 Tanker area location

Areas used for washing the outside of tankers should be segregated from processing areas, staff access ways and amenities (refer to Section 3.3) and / or controlled so as to prevent contamination.

4.9.2 Tanker pad

Tanker loading, unloading and washing areas should be paved with an appropriate material such as concrete. Bitumen should not normally be used.

4.9.3 Tanker area drainage

Tanker loading, unloading and washing areas should be designed to prevent ponding and prevent back-up in the drainage system. Drainage from these areas should be collected and disposed of through the factory's effluent disposal system.

4.9.4 Tanker area canopies

Tanker bay canopies are not obligatory, but where provided they should be made birdproof to prevent roosting and nesting.

4.9.5 Tanker fittings

There should be adequate provision for storage of pipes and fittings used in the tanker areas. Racks should be provided for all hoses so that these are not lying on the tanker bay floor. Where possible all hoses/pipes to be capped off when not in use.

Hoses should be clearly identified (preferably colour coded) to distinguish product lines from CIP lines.

5.0 Design and Construction of Buildings

5.1 Floors

Consideration should be given to ensure that the floor materials have appropriate properties for the area (i.e. water, chemical, mechanical and chemical resistance properties)

- 5.1.1 Floors and floor jointing compounds should be installed in accordance with manufacturers recommendations and in accordance with section 5.4.

Unprotected concrete finishes are generally unsatisfactory for floors in manufacturing and processing areas, and their use should be restricted to areas where porosity and low chemical resistance would not cause problems.

Floors should be designed and laid to minimise the possibility of cracking.

Metal floors should be constructed and installed so that they are impervious to water and crevice-free.

The junction of floors with walls, nibs and plinths should be coved. Preformed coving that has a hollow cavity behind it when installed should not be used in Critical Hygiene Areas or Standard Hygiene Areas.

- 5.1.2 Floors in wet processing areas should be installed and maintained so that there are no low or depressed areas that are undrained and so would allow pools of water to accumulate. Floors in dry processing areas, including overhead decking and walkways, should be adequately graded and should be provided with drainage that can be mechanically sealed (refer Section 6.7).

Water from predominantly wet areas (e.g. casein make rooms) should not contaminate dry areas. This can be prevented by, for example, having wet areas at a lower level than adjoining dry areas or nib walls at doors.

5.2 Walls

- 5.2.1 Wall finishes in Critical Hygiene and Standard Hygiene Areas should comply with Section 5.4 and installed so that walls are impervious to moisture and dust.

Unprotected concrete and plaster finishes are generally unsatisfactory for walls in Critical Hygiene or Standard Hygiene Areas and should only be used where their porosity and low chemical resistance would not cause problems.

Unprotected concrete blocks are not suitable as a surface finish in Critical Hygiene or Standard Hygiene Areas. If concrete blocks are used, they should be finished to ensure

the elimination of small pits and pin-holes. Cement bagging, cement render or plastering should be used where the applied surface finish is not capable of filling the pin holes. Courses between concrete blocks should be finished flush or to a radius of not less than 12 mm. The back side of concrete block walls should be sealed to prevent moisture migration causing damage to the applied inner surface.

5.2.2 All joints (including floor and ceiling junctions) should be sealed with a suitable compound, or otherwise made impervious to moisture and dust. All interior walls should be readily cleanable.

5.2.3 Because Expanded polystyrene (EPS walls), or similar, are susceptible to mechanical, chemical and heat damage, special conditions apply when using this material:

- In wet areas the bottom of panels should either be placed on a nib wall or coated with a protective specialist finish. The nib wall or specialist coating should be at least 400 mm high.
- In wet processing areas panels should be finished with a coating resistant to chemical attack.
- Areas of panel subject to regular chemical, salt, whey, steam or hot-water spillage should be protected from damage by a suitable inert buffer plate or stainless outer skin in affected areas.
- Where the ends or sides of panels are not fully covered by the skin of an adjoining panel or by a structural member the exposed portion of the interior of the panel should be capped and effectively sealed to make it insect, vermin, water and dust proof.
- All panel jointers, base channels, cornices and coves should be sealed with suitable sealants to provide a crevice-free finish.

5.2.4 Walls should be designed to minimise condensation, e.g. with insulation or by controlled environment.

5.2.5 Where rooms are built within manufacturing rooms in such a position that an inaccessible cavity is formed (a) between the top of the room and the ceiling above, or (b) between the walls of the room and the existing wall construction, such cavities shall be made pest- and dust-proof.)

5.3 Ceilings

5.3.1 Ceilings in Critical Hygiene and Standard Hygiene Areas should comply with Section 5.4 and be installed so they are impervious to moisture and dust. Joints on both the upper and lower surfaces of the ceiling lining material should be sealed with suitable sealing compounds to provide a crevice-free finish.

Ceilings should be designed and constructed to minimise the growth of mould, accumulation of dirt and condensation.

Appropriate methods of minimising mould growth and the accumulation of dirt and condensation include proper movement of ventilation air and sloping ceilings with ventilation at the highest points.

5.3.2 Special additional conditions apply when panel ceilings are used:

- In wet processing areas and areas where panels are subject to regular chemical, salt or steam exposure, they should be finished with a coating or material that is resistant to chemical attack
- Where the ends, sides or penetrations through panels are not fully covered by the skin of an adjoining panel or by a structural member, the exposed portion of the interior of the panel should be capped or flashed and effectively sealed to make it insect, vermin, water and dust proof.

5.3.3 Where there is a space between the ceiling and roof, it should be accessible from outside the hygiene areas so that the roof can be checked for leaks and properly maintained.

Ceilings in wet processing areas should be designed to control condensation (e.g. insulation, controlled environment).

5.3.4 Surfaces of ceilings and ceiling spaces should be able to be easily cleaned and in such a way that food safety is not compromised.

5.4 Interior Finishes

5.4.1 Introduction

The use of appropriate interior finishes for the walls, floors, and ceilings in the Critical Hygiene, Standard Hygiene and storage areas of dairy factories can help prevent contamination of the product.

Design detail should minimise any potential hygiene hazards such as ledges or interfaces between incompatible materials.

Interior finishes should be selected so as to be suitable for the area and duty to which they apply and be applied/ installed in accordance with manufacturers instructions.

5.4.2 Cleanability

The material should be:

- adequately cleaned by normal procedures for that area of the dairy factory without damage to the surface
- free from cracks and crevices.

5.4.3 Resistance to water and water vapour

Finishes materials are to resist water and water vapour.

5.4.4 **Resistance to chemicals**

The material and its finish should be resistant to chemicals used in the area concerned.

Where highly concentrated chemicals are used in normal production areas, it may be necessary to provide drip trays under valves and flanges to prevent damage to normal finish materials.

5.4.5 **Toxicity**

Materials should not release toxic substances in their completed or installed forms.

5.4.6 **Durability**

The material should be sufficiently durable for the area in which it is used, e.g.

- resistant to chipping, flaking, delamination and shrinkage
- able to withstand long periods of exposure to heat and water
- resistant to abrasion
- able to withstand machinery vibration.

5.4.7 **Resistance to thermal shock and thermal fluctuations**

Consideration should be given to the thermal properties of materials to ensure they are suitable for the conditions in which they are to be used.

5.4.8 **Recommended properties**

Interior finish materials should also have the following properties:

Ease of repair

- The material should be easily repaired, any damage should not be likely to spread, and the damaged areas should be usable soon after repairs are completed.

Staining and bleaching

- Wall materials should not stain or bleach when splashed with milk or milk products, acids or alkaline solutions, or the other chemicals normally found in dairy factories.

Traction

- Floors should be non-slip whether wet or dry.

5.4.9 **Glass**

Glass, where used as an interior surface finish in windows, doors and mirrors, should be fit for purpose.

Glass should not be used where there is a risk of product contamination. Where there is no practical alternative to the use of glass e.g. pH probes, there should be adequate controls in place to ensure that contamination has not occurred.

The interior surface of glass should be flat and smooth, so that it can be easily cleaned.

5.5 Penetrations

- 5.5.1 Where product lines, service lines, ducting and trunking pass through walls, ceilings or floors, they should be flashed and sealed (using appropriate materials) to eliminate crevices on both the interior and exterior surfaces.
- 5.5.2 Where any pipe, wire or duct passes through any ceiling, floor or wall, the gap, whilst allowing for possible pipe expansion, should be sealed to prevent water seepage, harbourage of pests and the entry of insects and vermin from either side. Electrical ducting should be sealed to prevent the access of insects and rodents.
- 5.5.3 Flashings and seals around penetrations should not compromise the fire rating of the wall, ceiling or floor containing the penetration.

5.6 Wall openings

- 5.6.1 Openings from critical hygiene areas through which drums, cartons, cans, bags etc. are handled in rapid succession, that make the use of an airlock impractical, should be protected by properly constructed flaps, strips or air curtains. These openings should be the minimum size necessary to allow passage of the containers, and should be sealed when not in use to prevent building air pressure loss and the entry of vermin and insects. This will normally require that conveyors have a removable section at the door.

5.7 Windows

- 5.7.1 Windows in Critical Hygiene and Standard Hygiene Areas should not be able to be opened and easily cleanable.
- 5.7.2 Opening windows may be used in non-dairy material/product processing or storage areas. Insect screens should be fitted to opening windows and should be fixed so that insects cannot get past them and enter the factory.

Insect screens should be mounted either on the outside of the window or flush with the window seating to prevent dead insects and other foreign matter collecting on the window ledge.

- 5.7.3 Where double glazing is used, the cavity between the panels should be sealed to

prevent the entry of dust and insects and condensation forming.

- 5.7.4 In Critical Hygiene and Standard Hygiene Areas, windows should be as flush as practicable to the inside wall. Window ledges should be minimised and should be able to be inspected and cleaned.

Window frames should be sealed and there should be no crevices between them and the adjoining wall structure.

Window framing joints and corners should be sealed and crevice-free.

5.8 Doors and Doorways

- 5.8.1 Doors, door jambs and frames in Critical Hygiene and Standard Hygiene Areas should be made of suitable materials for the environment.

Doors, door jambs and frames should be sealed and there should be no crevices between them and the adjoining wall and if, applicable, the floor. Doors in Critical Hygiene and Standard Hygiene Areas should be self-closing and, except where there is conflict with emergency exit requirements, should close with the internal pressure rather than against that pressure.

- 5.8.2 Roller doors, sectional slide-over doors, concertina doors, folding doors and other multi-section doors that are difficult to clean should be avoided if possible in Critical Hygiene Areas and Standard Hygiene Areas.

- 5.8.3 Emergency exit doors which are kept closed except during an emergency need not be airlocked. An emergency exit door should be able to be opened from the inside only. A system to verify the integrity of exit points and identify unauthorised use, should be incorporated into the design of the door unit, e.g. an alarm activated by the opening of the door.

5.9 Removable Wall Panels

To allow for the entry and exit of large pieces of equipment from Critical Hygiene or Standard Hygiene Areas, removable wall panels may be provided as part of the main wall construction.

These panels should be a sealed unit and should be sealed tightly to the adjacent walls, floor and, if applicable, to the ceiling. They should be fixed shut to prevent unauthorised use.

The interior surface of removable wall panels should meet the requirements for interior wall finishes (refer Section 5.2).

5.10 Stairs, Decks and Walkways

- 5.10.1 Stairs, decks and walkways should not be above open processing or packing equipment.

All stairs, decks, walkways and associated handrails sited where they could cause a hazard to product in Critical Hygiene or Standard Hygiene Areas should be constructed of impervious material and have up-stands. Up-stands should be not less than 150 mm high. All seams in metal stairs and walkways should be continuously welded (or stitch welded with the application of sealant) and tubular handrails should have fully sealed ends.

Where the process is fully enclosed and there is no danger of product being contaminated, open grid type decks and walkways may be used.

- 5.10.2 All stairs, decks and walkways should be constructed to prevent the ponding of water and should be sloped to drain points.
- 5.10.3 Stairs in Critical Hygiene and Standard Hygiene Areas should have closed treads and risers, except that the bottom riser should be designed to allow for easy floor cleaning.

5.11 Ledges and Other Protrusions

- 5.11.1 In Critical Hygiene and Standard Hygiene Areas, ledges should be avoided or if required should be as narrow as possible as they may collect soil and become a source of contamination.
- 5.11.2 Overhead trusses and beams should be fully enclosed and crevice-free. Footings and ledges at the base of walls should be easily cleanable. Interfaces between exposed decks and beams should be fully sealed to eliminate crevices, either by continuously welding them or by using suitable flexible sealants.
- 5.11.3 Ventilation ducts in Critical Hygiene and Standard Hygiene Areas may be installed lower than the ceiling. This ducting should either be faced continuously to the ceiling so that there are no ledges or suspended at a height which allows ready access for regular inspection and cleaning (see Section 6.2).
- 5.11.4 Electrical wiring and dry service piping may be routed through ceiling spaces or service tunnels to keep it external to hygiene areas. Routing of product, steam, water, and other liquid service piping through ceiling spaces and other cavities should be avoided to minimise undetected leaks and related hygiene problems. Process piping and storm water drains should not be placed in inaccessible wall or ceiling cavities. Where electrical wiring enters Critical Hygiene or Standard Hygiene Areas, it should be sealed at the hygiene interface.
- 5.11.5 Whichever system is utilised the outcome should be cleanable (e.g. cable tray or ladder rack) or contained (e.g. conduit). Wiring in exposed ladder racks should be accessible and readily cleanable. Where wiring, service piping or process piping has to be mounted on internal walls or ceilings, it should be sufficiently clear of the wall or ceiling to allow cleaning between the surfaces. All switch and pipeline mountings and fixings should be positively sealed to the walls or ceilings and should be free of crevices.
- 5.11.6 Where ledges are unavoidable in Critical Hygiene and Standard Hygiene Areas, they

should, where practicable, be sloped to facilitate ease of cleaning.

- 5.11.7 Roofs of internal rooms, the tops of indoor silos and other large pieces of equipment should be capable of being readily cleaned and inspected. Where possible the walls of rooms should be extended to the ceiling of the main room so that there is no internal roofing.

5.12 Roofs

- 5.12.1 Roofs should be designed and built to prevent the entry of liquid, dust, insects, rodents and birds.
- 5.12.2 All drainage from roofs should be piped to a storm water system. Gutters and downpipes should be designed and constructed so that rainwater cannot contaminate the interior of the factory. Gutters should be easy to clean.

Where internal downpipes are unavoidable, they should be capable of overflowing without leaking into the building. Internal gutters should have a suitable overflow system discharging to the outside. Internal gutters and downpipes should have at least twice the capacity of well-designed external gutters.

- 5.12.3 Access to roofs should be from outside the building.
- 5.12.4 Roof penetrations should be minimised wherever practical.

6.0 Building Services

6.1 Ventilation Systems

- 6.1.1 There should be a well designed ventilation or air conditioning system for each processing area to minimise condensation on walls and the ceiling throughout the range of operating conditions. The ventilation system should provide satisfactory working conditions. Mould growth is inhibited by relative humidities below 80%; the ventilation system should be designed to keep the relative humidity below this level during normal processing conditions.

It is recommended that where there is a risk of mould growth that the ventilation system continue to operate to during periods of plant shutdown.

- 6.1.2 Equipment which releases a large amount of heat or moisture may be isolated in a dedicated room or the equipment may be covered and vented.

6.2 Design of Ventilation Systems

- 6.2.1 Filters should be serviced from the dirty side of the air filter bank to prevent contamination.
Fans should sit in and draw air directly from a fan room, with the air supply to the room being via filters.

- 6.2.2 Reference should be made to the following in the design of ventilation systems:

- ASHRAE Handbook—HVAC Applications – 2003
- AS 1668.2-2002 : The use of ventilation and airconditioning in buildings - Ventilation design for indoor air contaminant control
- AS 4254-2002 : Ductwork for air-handling systems in buildings
- HVAC Duct Construction (SMACNA), Sheet Metal and Air Conditioning Contractors' National Association (USA)

- 6.2.3 Ducts should be fabricated according to good manufacturing practice and the ventilation system installed to meet AS 1668. In particular:

- Air filters should be readily accessible.
- Ducting should be waterproof, fitted with drains with valves at its low points and be designed and installed to prevent pooling.

- Ducting should be able to be readily cleaned and inspected on the inside. Inspection points should be provided and diffuser grills should be removable for cleaning.
- Ducting should be sealed to prevent air leakage.
- Where ducting is insulated, the insulation will be installed in such a way that it cannot enter the air stream.

6.2.4 Where air conditioning units are used or air is otherwise heated or cooled, fins on radiator and evaporator banks should be accessible for inspection, cleaning and sanitising. Condensate collection trays should be accessible for inspection, cleaning and sanitising. Fins and trays should be fabricated from materials that can be cleaned and sanitised. Product contact air should be filtered after the radiators.

6.3 Air Inlets

6.3.1 Air inlets should be located in clean areas. Where an inlet draws air from outside, it should be at least 1.5 m, and preferably 3.0 m or more, above the ground to minimise fouling of the filters. Where air is drawn from inside the building, the intake should be at least 1.0 m above the floor. Where air is drawn from above the roof, the air intakes should be mounted 1.0 m above the roof surface. Air inlets should be located well clear of exhaust outlets so that cross contamination is prevented.

6.3.2 All air inlets to the factory should be protected against the weather. All air filters and roughing filters should be spaced sufficiently far back from the weather louvres to prevent rain and drizzle reaching them; a minimum of 1.00 m is recommended.

6.3.3 Screens should be fitted to the outside of inlet louvres to stop birds nesting and insect entry. Insect screens should be able to be easily cleaned and fitted to the inside of the louvres. Where lighting is installed in the area of the louvres and filters it should be designed to minimise night attraction of insects to the air inlet area.

6.3.4 The frames for holding filter panels should be designed so that no air by-passes the filters. Access doors for filter maintenance should be on the upstream side of the final filter and should not open into Critical Hygiene Areas. Where air supply fans are located downstream from the final filters, filtered air should be ducted directly to the fans.

6.4 Air Filtration

6.4.1 Filters can be classified according to their efficiency as described in Table 7.4.1. This classification is based on European Standard EN 779; which uses the G and F prefixes, and European Standard EN 1822 which uses the H and U prefixes listed in Table 7.4.1. This classification system is similar to the previously used DIN 24-185 standard which used the EU 1 to EU 9, and EU10 to EU 17 equivalent classes.

Table 7.4.1: EN779 and EN 1822 Air Filter Classification System

Filter Group	EN 779 Filter Class	Average arrestance of synthetic test dust (gravimetric measurement) (A%) ASHRAE 52.1 (or EN 779)	Average dust spot efficiency (opacity measured) (E%), atmospheric dust. ASHRAE 52.1 (or EN 779)
Primary filters to collect coarse dust.	G1 G2 G3 G4	A ≤ 65 65 ≤ A < 80 80 ≤ A < 90 90 ≤ A	
Secondary filters to collect and retain atmospheric dust particles	F5 F6 F7 F8 F9		40 ≤ E < 60 60 ≤ E < 80 80 ≤ E < 90 90 ≤ E < 95 95 ≤ E
	EN 1822 Filter Class		EN 1822 MPPS % efficiency
HEPA filters (High Efficiency Particulate Air), for specific small particulate control	H10 H11 H12 H13 H14		85.0% 95.0% 99.5% 99.95% 99.995%
			EN 1822 MPPS% efficiency
ULPA filters (Ultra Low Penetration Air),	U15 U16 U17		99.9995% 99.99995% 99.999995%

Filters should be designed and installed following manufacturers specifications and be capable of producing air for safe food production.

- 6.4.2 Where there is potential for air to present a food safety risk ventilation air to Critical Hygiene Areas should be filtered through air filters of at least Class F5 Where food is manufactured which is intended for consumption by sensitive populations (eg. infant

formula or pharmaceutical) consideration should be given to the adoption of an appropriately higher standard.

All ventilation air to Standard Hygiene Areas should be filtered through air filters that comply with Class G3.

Where filters of higher standard than G3 are used then filter banks should be fitted with pre-filters to meet at least Class G3.

All stages of filtration should be fitted with a pressure differential measuring device.

The air velocity at the filter media face should not exceed the maximum value specified by the manufacturer.

6.4.3 Final filter media designed to be disposable should not be washed.

Fibres in final filter media should be securely held in place (e.g. by binding agents or backing material) to prevent fibres being shed.

6.4.4 Where washable filters are used, safe removal, transport and washing procedures should be in place. In all cases the filter design and material must be fit for purpose.

6.5 Ventilation Air Distribution and Extraction

6.5.1 Ventilation air should be circulated in a way that there are no dead spots. Adjustable air distributors are recommended.

6.5.2 Ventilation ducting should be fitted so that it does not form ledges.

6.5.3 Inlets and exhausts should not be placed in positions which would allow condensation or debris to fall and contaminate product e.g., above open vats.

Exhaust outlets should be designed and built to prevent the entry of water, insects, vermin and birds. They should be sealed and free from crevices on both the internal and external surfaces.

Exhaust outlets should be installed along the apex of the ceiling to make the maximum use of natural convection. It may be necessary for additional extraction units to be placed above sources of heat or moisture in the room. The design should take into account the prevailing wind conditions.

6.5.4 Critical Hygiene and Standard Hygiene Areas should always operate at a minimum positive air pressure of 40 Pa (4 mm water gauge). A design pressure of 60 Pa (6 mm water gauge) is generally considered adequate to achieve this. The Critical Hygiene Areas should operate at a higher pressure than the adjacent areas of the factory so that air flow is outward from the Critical Hygiene Area. The factory should be maintained under positive pressure outside processing times. Ventilation systems should be balanced and periodically checked to ensure that design pressures are achieved.

6.5.5 Precautions should be taken to eliminate excessive dust in any room where a dusty or

powdered product is handled. Well designed local extraction hoods should be used as necessary.

6.6 Water

Dairy processing water meets the NZFSA requirements for dairy processing water – Dairy Processing Specification and approved criteria.

Non dairy processing water is any water that does not meet the definition of dairy processing water.

Dairy processing water shall be used for:

- all water coming into contact with any food or product contact surface and all water used as an ingredient
- cleaning all rooms where food is processed or packed
- all eating rooms and handwashing facilities
- all hoses in processing and packing areas
- defrosting refrigeration coils in air chillers
- water seals in product pumps
- all fire fighting sprinkler systems where there is a risk of the water contaminating product during processing.

Non dairy processing water, of an adequate standard for the purpose, may be used for:

- toilets and urinals (flushing only)
- factory exterior washing
- condensers
- fire hydrants
- washing down external sumps and drains.
- fire fighting systems, including sprinklers, where the hygiene areas and product contact surfaces are completely cleaned and sanitised after any system activation and prior to any further processing.

Non dairy processing water shall not be used in such a way that it constitutes a food safety risk to the product. Such uses are described in dairy processing approved criteria.

6.6.2 Identification of water lines

Regulation 17 of the Water Supplies Protection Regulations 1961 requires that companies colour-code, or otherwise suitably identify, their dairy processing and non-dairy processing water lines. This colour coding is not required where the water comes exclusively from a public water supply. The requirements of the Water Supplies Protection Regulations 1961 shall be observed.

Lines should be identified at all junctions, valves, outlets, both sides of wall penetrations

and at any other place where identification is necessary.

The identifying code should meet NZS 5807: *Industrial Identification by Colour, Wording or Other Coding*

6.6.3 Contamination of dairy processing water

Care should be taken to ensure that there incompatible fittings between the dairy processing and non-dairy processing systems.

Dairy processing water could become contaminated within the distribution system, e.g. by non-dairy processing water supplies, back siphoning, dead ends in the lines of the distributing system and pollution in the storage tanks.

Cross-connections between dairy processing and non-dairy processing supplies shall not be permitted, unless there are adequate controls to prevent any possible contamination of dairy processing water. Unused or dead-ended lines in the reticulation system shall be closed off to isolate them from the reticulation system. All dairy processing water storage tanks shall be effectively covered and protected to exclude light and prevent contamination. Backflow prevention should be provided where any potential of siphoning or backflow exists.

6.6.4 “Re-use” Water

Care should be taken in the use of “re use” water (e.g. UF/ RO permeate, evaporator condensate or cow water) to ensure that the food safety of the dairy product/ material is not compromised.

6.6.5 Handwashing facilities in processing areas

Handwashing facilities, including detergent and sanitisers, should be provided as near as practical to the entrances to Critical Hygiene Areas and Standard Hygiene Areas.

Signs should be posted next to each hand basin instructing staff to keep their hands clean.

Hand basins should be made of suitable material e.g. stainless steel and of hygienic design and have an adequate supply of warm dairy processing water. Taps should be foot-, knee- or electronically-operated. Hand-operated taps are not suitable. Drainage from hand basins should be piped to drain.

Hand-drying facilities should be provided within easy reach of each hand basin. Paper towels, roller towels or hot air driers may be used. Hot air driers should not be located close to powder handling, storage or packing areas as there is a danger of explosions caused by high dust loadings in the air. Where disposable paper towels are used, a suitable receptacle for used towels should be provided.

6.6.6 Reticulation of dairy processing water for cleaning

Dairy processing water should be reticulated throughout the plant in quantities sufficient for all operating needs and under enough pressure for effective cleaning. A sufficient

number of hoses should be provided to facilitate effective cleaning. There should be no dead legs in the reticulation piping system.

6.6.7 Fire fighting systems

Water distribution systems for automatic sprinklers are subject to condensation and rust; therefore should be designed and constructed (e.g. stainless steel) to minimise food safety impact in food processing areas.

6.6.8 Lagging

Cold water pipes shall be lagged wherever condensation from them could enter the product.

All pipes operating below 10 °C should be insulated and covered with a suitable material or designed to prevent dripping condensation and therefore potential product contamination. Refer Section 7.2.

6.7 Drainage

Drainage channels and outlets should be directed or designed so as not to compromise the integrity of the hygiene zones or product safety. eg. flow to be directed from critical areas to less critical areas.

6.7.1 Drainage should be provided to remove liquid waste quickly from processing areas. It should be sized to prevent wastes backing up into the building. All floors in wet processing areas should have trapped drains. Point drains are preferred in Critical Hygiene Areas rather than open channel drains, and they should be spaced appropriate to the activity.

A floor slope of 1 in 60 is suitable on monolithic type floors, but a gradient of 1 in 50 is preferred with tiles.

Liquid waste should be piped directly to underfloor drainage systems instead of spilling on to the floor. Drainage from hand basins must not spill on to floors. Discharges from self-desludging separators should be piped to a closed drain.

Open channel drains, where used in Critical Hygiene or Standard Hygiene Areas, should have a fall of at least 1 in 60 and be covered to allow ready cleaning. These drains should be deep enough along their length to prevent overflow and wide enough to allow for cleaning.

6.7.2 All drains should be designed (by a water-filled gully trap or another effective means) to prevent odours entering the processing areas. The drainage system should be designed to ensure that water seals are not evacuated by downstream pressure differentials.

Water-filled traps used in normally dry areas should be sealed between periodic cleaning. Threaded drain caps, or similar odour and pest preventers, should be used to seal these outlets.

The drainage system should have rodding points outside the Critical Hygiene or Standard Hygiene Areas so that blocked drains can be cleaned without contamination occurring.

6.7.3 All drainage from roofs shall be piped to a storm water or process effluent system.

6.7.4 Drain inlets and open channel drain discharge points through factory walls should be screened and water-sealed to prevent the entry of rodents and insects. Where water traps can dry out, drain caps should be used.

Screens on drains should have apertures of not more than 12 mm across, to prevent the entry of rodents.

6.8 Effluent and Liquid Waste Disposal

6.8.1 Factories should have an efficient effluent and liquid waste disposal system which should always be maintained in good order and repair. All effluent lines (including sewer systems) should be large enough to carry peak loads and should be constructed to avoid contamination of dairy processing water supplies. Where drained by gravity, effluent lines should not be less than 150 mm in diameter.

6.8.2 Effluent ponds shall be located at least 10 m away from any product factory and shall be sited so that they do not create a nuisance or problem at the factory, e.g. from odours or pests.

6.9 Sewerage

6.9.1 Toilet rooms should be ventilated and all opening windows or vents should be adequately screened against insects. Toilet vents should be sited far enough away from ventilation intakes that there is no possibility of cross-contamination.

Adequate handwashing facilities should be provided in each toilet complex, and should comply with Section 6.6.5.

6.9.2 Toilets and urinals should either drain to an adequate septic tank system located at a safe distance from any Critical Hygiene or Standard Hygiene Area, or be discharged into the local sewerage system in a way that prevents any foul water entering the building as a result of blockages. Toilet and urinal drain piping should not pass through any Critical Hygiene Areas, nor should they be connected to any drainage system passing under a Critical Hygiene Area. Drains should be of material and construction that ensure no leakage of effluent.

6.10 Solid Wastes

Provision should be made for the transfer of waste from Critical Hygiene and Standard Hygiene Areas to a waste holding facility (e.g. covered rubbish bin) before its removal from site.

Waste containers should be designed to prevent access by pests and to avoid contamination of product, dairy processing water, equipment, buildings and roadways.

Processing area operators should be able to dispose of waste without leaving the processing environment.

Vehicles involved in waste removal should not cross pedestrian access ways leading into process plants.

6.11 Signs

6.11.1 The dairy operator should display in the factory suitably large and prominent notices or indicate by another means the need for good hygienic and housekeeping practices. The signs should be erected in clearly visible and logically sited places throughout the manufacturing premises.

6.11.2 These signs should generally have easily identifiable graphics included with the words, so that a limited knowledge of the English language will not be a handicap to interpreting them.

The notices should be made from a durable, impervious material. To aid visibility it is recommended that the minimum size for the graphic signs is 250 × 300 mm.

6.11.3 These signs should specify:

- the limits of the critical hygiene areas
- that hands must be washed
- that approved clothing must be worn

6.12 Lighting

6.12.1 Adequate lighting should be provided in all areas of the factory.

Recommended minimum light levels (during processing) at 900 mm above the floor, or at the inspection plane, are:

- external areas (e.g. silos and external valves) — 150 lux;
- storage areas (e.g. ingredient stores) — 150 lux;
- amenities (e.g. toilets, showers, locker areas and cafeterias) — 150 lux;
- tanker areas (e.g. unloading bays and wash areas) — 300 lux;
- milk treatment areas (e.g. raw milk reception, milk separation and pasteurisation) — 500 lux;
- product manufacturing areas — 500 lux;

- inspection areas (e.g. cheese trimming and wrapping rooms, powder bagging areas and butter boxing areas) — 1000 lux with natural light colour correction.

6.12.2 All light bulbs and fluorescent tubes should be protected to prevent broken glass causing a risk to food safety. Wherever possible plastic covers should be used.

Where protective fittings are made of glass it should be at least 5 mm thick. Similar precautions should also be taken in product storage areas.

6.12.3 Light fittings should be sealed so that they cannot collect dust or moisture from the processing area. Recessed light fittings should be flashed from within the ceiling space so that dust, moisture, and insects cannot gain access to the light fitting or through the crevice around it.

In Critical Hygiene and Standard Hygiene Areas, light fittings should be reasonably flush with the ceiling panel and accessible from the ceiling space. Where this is not feasible, they may be attached directly and parallel to the ceiling. Such installations should be sealed to eliminate cracks and crevices between the light fitting and ceiling.

If neither of these methods is possible, light fittings may be hung from ceilings. When suspended light fittings are used, the top of the fitting should be sloped to at least 45° so that any debris will fall to the floor, or be obvious when the processing area is cleaned.

6.12.4 Lighting systems should be designed and constructed according to good light design principles (see NZS 6703: *Code of Practice for Interior Lighting Design*). Good design minimises shadowing and glare, reflections off finished surfaces and equipment, and provides a light of suitable colour.

6.12.5 The maintenance of bulbs and tubes should be considered when siting lights.

7.0 General Requirements for Manufacturing Equipment

7.1 Design of Equipment for Product Processing

7.1.1 Prevention of contamination

Equipment should be designed to protect its contents as much as practicable from external contamination. Crevices and dead pockets should be minimised; if they are present, they should be readily cleanable.

7.1.2 Inspection points

There should be a sufficient number of inspection points located so that the hygienic status of the equipment can be readily monitored.

7.1.3 Internal radii

For internal angles of 135° or less, a radius of not less than 6 mm is recommended. When the radius is less than 6 mm, the product contact surface of the internal angle should be accessible for cleaning and inspection.

7.1.4 Springs

Springs should not be used as product contact surfaces.

7.1.5 Bolts, Nuts and Threads

Bolts, nuts and threads on product contact surfaces should be avoided. Where the use of these is unavoidable, they should be secured and readily accessible for cleaning and inspection. Nuts should be open-ended.

7.1.6 Seals, glands and bearings

Glands and bearings should not come into contact with product. Seals that come in contact with product should be removable for inspection, maintenance and, where appropriate, cleaning.

Mechanical rotary seals should be used rather than packed glands.

All lubricated bearings should be located outside the product zone. If adjacent to it, they should be constructed with a seal at the entrance to the shaft into the product zone.

Equipment having seals and bearings should be so designed and fabricated that lubricant cannot leak, drip, be forced into, or in any way contaminate the product zone. All lubricants that may come into contact with product must be recognised as meeting food grade criteria.

7.1.7 **Openings**

Openings on equipment, including those for hinged or removable covers, should have raised edges of at least 10 mm or be fitted with a permanently attached sanitary fitting. The purpose of the raised edge is to prevent extraneous material entering the product zone.

7.1.8 **Lids and doors**

Lids and doors on equipment should be:

- close-fitting, self-draining and sufficiently rigid to prevent buckling
- designed so that any liquid or dry material on the exterior will not enter the product or touch product contact surfaces.

Lids should have downward edges of at least 10 mm.

7.1.9 **Corrosion**

Equipment should be designed and manufactured to minimise conditions resulting in stress corrosion, crevice corrosion or any other factors which could cause hygiene or contamination problems.

7.1.10 **Vibrating equipment**

Where fans and other items of vibrating equipment are connected to stainless steel ducting, a flexible coupling made of material with properties in accordance with Section 7.2 should be used.

7.1.11 **Cleanability**

All equipment and piping should be able to be cleaned either manually or in-place. Equipment designed to be manually cleaned should be able to be readily disassembled and reassembled.

7.1.12 **Drainage**

All equipment that can be wet cleaned should be self-draining and graded to drain points, so that no pools of liquid are left after cleaning. A slope of 1:15 will generally provide adequate drainage.

7.1.13 **Glass**

Glass should not be used in processing environments. Where its use is unavoidable the glass should be suitable for its application and be installed and/or controlled so as to

prevent contamination of the product in the event of breakage (e.g. pH probes).

7.1.14 **Screens, strainers and filters**

All screening and straining devices should be readily accessible for cleaning and inspection.

Suitable strainers should be installed on the suction side of the tanker discharge pumps.

Strainers should be installed in cleaning-in-place (CIP) circuits to prevent the blockage of spray devices.

Duplex filters are recommended if the filter is expected to require regular cleaning.

7.1.15 **Spray balls**

Spray devices should be easily accessible, readily removable or easily dismantled for periodic inspection and cleaning. They should be fitted so that they cannot fall into product.

7.2 **Materials**

7.2.1 **Product contact surfaces**

Metals should be corrosion-resistant, non-toxic, non-contaminating and cleanable under the conditions of intended use.

Non-metal materials should be non-toxic, non-contaminating, cleanable and durable under the conditions of use and where relevant should be certified as food grade.

Where specific functional properties are necessary, e.g. bearing surfaces and seals, carbon or ceramic type materials may be used. These materials should be inert, non-porous, non-toxic, non-absorbent, non-tainting, insoluble, and resistant to scratching and distortion by the environment of intended use.

Natural or synthetic fibres may be used for screening surfaces and flexible connectors. These materials should be non-toxic, food grade where appropriate, easily cleanable and manufactured to prevent loss of fibres.

7.2.2 **Non-product contact surfaces**

All non-product contact surfaces should be made of corrosion-resistant material, or material that is rendered corrosion-resistant.

Surface coatings in the vicinity of open product should be selected to prevent chipping or flaking.

7.3 Fabrication

7.3.1 Surface finish

All product contact surfaces should be finished to an Ra value of no more than 1 µm. All product contact surfaces should be free from imperfections such as pits, folds and crevices.

7.3.2 Welds

The product contact surface of welded joints should be ground and polished to an Ra value of no more than 1 µm, and be free from pits, cracks and slag and gas inclusions, except that internal grinding and polishing is not required on product pipelines.

Take-offs from stainless steel pipes should be formed or pulled holes to obtain the correct weld finish.

It is advised that welders employed for these activities should be qualified to NZ4703 standard.

7.3.3 Plating

The minimum thickness of chromium plating should be 0.005 mm for all product contact surfaces when that plating is on to stainless steel. For other metals the minimum thickness of plating should be 0.05 mm.

7.3.4 Rubber and plastic materials

Where rubber and rubber-like or plastic materials forming product contact surfaces are bonded to base metal, the bond should remain continuous and mechanically sound under the intended conditions of use.

7.3.5 Painted surfaces

Product contact surfaces should not be painted.

If non-product contact surfaces are painted, the finish should be resistant to cleaning systems and products in their intended areas of use (also refer Section 7.2).

7.3.6 Gaskets

Gaskets should be made of materials specified in Section 8.2 and installed in a manner resulting in a true fit, to prevent protrusion into the product zone or the creation of recesses or ledges at the joint.

Gaskets should be removable or bonded to one surface so that the bond is continuous and mechanically sound.

8.0 Layout of Manufacturing Equipment

8.1 Equipment Spacing

There should be an adequate gap (recommended minimum of 75mm) to allow access for cleaning and inspection between the equipment and walls.

There should be an adequate spacing between pieces of processing equipment to allow access for cleaning and inspection.

Equipment which releases a great deal of heat or moisture (e.g. vacreators) should be spaced sufficiently from walls or ceilings to prevent damage to buildings.

An adequate gap should be provided between a wall and the equipment or piping running parallel to it to allow easy cleaning and inspection.

8.2 Equipment Mounting

The point of attachment of equipment mounted on a wall should be sealed to the wall with a suitable sealant.

Vibrating equipment should be vibration-isolated, especially on metal decks.

Where equipment is supported on legs, these should provide minimal risk for material entrapment. This can be achieved by sealing the legs to the floor or where this is not practical using leg ends with minimal floor contact.

8.3 Clearance for Cleaning

There should be sufficient clearance between the base of the equipment and the floor to allow the floor beneath to be cleaned.

As a guide:

Width	Minimum clearance
Up to 0.5 m	150 mm
0.5 to 2.0 m	200 mm
Over 2.0 m	250 mm

8.4 Explosion Ducts

8.4.1 Where processing equipment is fitted with explosion ducts which connect to the outside of the building, the explosion duct should conform to the following:

- Ready access should be provided into the ducting to allow regular cleaning and inspection of the explosion door seal. An inspection port and interior lighting are recommended.
- The access to the ducting should have a locking system to ensure close-out during operation of the processing equipment.
- The ducting should be designed for wet cleaning.
- The floor of the ducting should be free draining, i.e. built to prevent deformation and subsequent ponding, and sloped to a drainage point with effluent piped to the effluent drainage system.
- The duct should be weatherproof.

8.5 Access to Silos

8.5.1 Vents and overflow lines for silos holding pasteurised milk and its derivatives, and sanitary pipelines associated with the silos, should open to Critical Hygiene Areas. If it is not practical to vent to Critical Hygiene Area, filtered vents that are to an equivalent standard should be used.

Where manholes are required to be opened for cleaning they should open into critical hygiene areas.

8.5.2 Manholes, vents and overflow lines for silos holding raw milk and unpasteurised milk derivatives should not terminate in a Critical Hygiene Area. Where vents end outside a processing area they should be fitted with suitable insect mesh.

8.5.3 Where additional protection is required to guard against accidental creation of a vacuum within a silo, vacuum release vents may be fitted which vent to an atmosphere of the same air quality as the process. Pressure release vents should be self resealing. Where the rupture type are used the membranes should have activation detection, and should be replaced in the event of rupture. All pressure/vacuum vents should form a fully sealed, cleanable-in-place surface on the inside of the silo. Vents and membranes should be designed and located to allow ready inspection and servicing.

9.0 Process engineering

9.1 Product Contact Steam

9.1.1 General

An adequate supply of steam, or another heating medium, should be provided to ensure satisfactory processing and cleaning.

Product contact steam is steam intended to come in direct contact with product or steam used to directly heat water which will come in contact with product. This steam should be free from harmful or odorous substances and extraneous material.

Steam used in direct contact with food or food contact surfaces should not constitute a threat to the safety and suitability of food.

9.1.2 Steam piping system

Product contact steam should be filtered to remove particles larger than 5 microns in diameter. The filter and the steam line downstream from the filter should, as far as practicable, be made of stainless steel to avoid recontamination with extraneous material.

A means of sampling the product contact steam or condensate downstream from the filter should be provided.

A check valve or other device should be fitted in the steam line to prevent product and cleaning chemicals gaining access to all parts of the steam piping and fittings.

9.1.3 Boiler water

- Only Approved Food Grade, non-toxic and non-tainting boiler water additives should be used in product contact steam.
- Boiler water treatment feed systems shall be to food grade standards.

9.2 Product Contact Air

9.2.1 Product contact air includes cooling air, drying air, conveying air, mixing and stirring air, conditioning air and compressed air that may come in contact with product or product contact surfaces. This air should be free from harmful or odorous substances and extraneous material.

9.2.2 Product contact air should be filtered. The location of filters and design of ducts should comply with Section 6.2 except that air to be compressed should be filtered upstream from the compressing equipment.

Filters should be located and installed so as to be easily accessible for examination and replacement. The filters should be protected from weather, water, product spillage and physical damage.

All filters should be sealed in their holders and installed according to the manufacturer's requirements to prevent access of unfiltered air.

The minimum filter efficiencies should comply with Section 6.4, except that compressed air filters may be alternatively specified as removing a minimum of 99.9% of particles 10 µm in size. Compressed air should be further filtered to comply with Table 9.2.1.

9.2.3 Air intakes for product contact air should be sited to comply with Section 6.3.

9.2.4 Compressed air lines should have oil and water removal devices to remove entrained oil and water.

The compressed air should meet the requirements of *3A Accepted Practices for Supplying Air under Pressure in Contact with Milk, Milk Products and Product Contact Surfaces*, No. 604-03 and the following standards:

Table 9.2.1: Compressed air quality

Solid contaminants		Water	Oil (hydrocarbons)
Maximum particle size (µm)	Maximum concentration (mg/m ³)	Dewpoint of compressed air (°C maximum)	Maximum content (mg/m ³)
1.0	1.0	+2	0.01

9.3 Dairy processing Water

Refer to Section 6.6.

9.4 Refrigeration

9.4.1 General

Sufficient refrigeration capacity should be available to chill raw and microbiodically treated (e.g. heat treated) materials/product and maintain them at a temperature low enough to ensure that there is no adverse effect on the hygienic quality of the product.

9.4.2 Refrigeration equipment

Equipment for re-cooling and compressing refrigerants should be located outside processing or packing areas. The cooling air from the refrigeration plant, that might contain ammonia, should not discharge into processing or packing rooms.

Only non-toxic freezing point depressants shall be used in systems where the chilling liquid is immediately adjacent to milk or product. Food grade Monopropylene glycol and glycerol are accepted non-toxic freezing point depressants. Condensate from refrigeration units should be piped to the drainage system.

9.5 Product and CIP Piping

9.5.1 General Requirements

The construction materials, fabrication and installation of all product and CIP piping should comply with this code.

9.5.2 Design

Cleaning solution velocity

The average velocity of the cleaning solution flow should be adequate for good cleaning e.g. no less than 1.5 m/s or a Reynolds number of greater than 200 000 should be generated during CIP.

Where pipes with diameters greater than 100 mm are used, special care should be taken to ensure that stabilised air pockets cannot occur during cleaning.

CIP systems should be designed so that the suction intake of the primary circulation pump is flooded at all times during the cleaning cycle, or an appropriate alternative type of pump should be used (e.g. liquid ring).

CIP systems should be designed so that ponding of CIP fluid in tanks and vessels is avoided.

Cleaning solution strength

Provision should be made so solution strength can easily be monitored.

Cleaning solution temperature

An indicating thermometer or a temperature recorder should be used to monitor the CIP solution temperature.

Where CIP sets are used, the sensing element of the thermometer should be located in the return solution line after the end of the circuit being cleaned.

The solution temperature should be automatically controlled by the use of a temperature controller.

Inspection points

There should be an adequate number of inspection points on all milk and product pipelines.

Inspection points in piping systems should be couplings in the product piping that can be easily undone for inspection of the adjacent pipe. As a minimum, they should be located at:

- the outlet of each cleaning circuit;
- where cleaning problems might be expected, e.g. where the pipe increases in diameter;
- at each high and at each low point of a piping network.

CIP-product segregation

The processing system and CIP system should be constructed and controlled to positively prevent the intermixing of the product and the CIP solution, e.g. by venting the gap between the CIP solution and the product with swing-bends, key pieces or valves.

Strainers

Strainers should be fitted into cleaning circuits. The mesh size of the strainer should be smaller than the hole size in the spray device. Strainers should be installed to enable easy inspection.

9.5.3 Fabrication

Welding

Welds in product and CIP pipelines should be smooth and free from pits, craters, ridges and embedded material. Welders should be qualified according to NZS 4703: 1985 or an equivalent standard. Any unsatisfactory welds should be removed and the joints properly rewelded.

Coverings for outside openings

Openings of sanitary pipelines to the exterior environment should be covered when not in use. A stainless steel cap or a swing bend which closes the pipe when not in use is satisfactory.

Self-draining requirement

All product and cleaning system pipelines should be sloped to drain points. The recommended slope is 1 in 100 and it should not be less than 1 in 200.

Pipe supports

Pipe supports should be designed to provide adequate support without pipe sagging or liquid retention in product and CIP pipework. Allowance for expansion and contraction should be made.

9.6 Fittings

9.6.1 Materials

Plug-type or butterfly valves may have plugs or butterflies covered with rubber, rubber-like or plastic materials which comply with Section 8.2. The material used should have a composition which retains its surface and conformation characteristics when exposed to the conditions of intended use, including cleaning and sanitising.

9.6.2 Fabrication

Where equipment or pipelines are to be cleaned in place, removable fittings may be used with or without gaskets and should be designed to form flush or nearly flush interior joints. Wherever possible “dead ends” should be avoided. Wherever not possible to avoid “dead ends” pipework should be designed so that any “dead end” distance is not greater than 1.5 times the pipe diameter.

9.7 Instruments

9.7.1 Pasteuriser temperature control systems

All pasteuriser temperature control systems shall comply with heat treatment requirements of NZFSA Dairy specifications and criteria.

9.7.2 CIP temperature controllers

If they are used, temperature controllers located on CIP sets should control to an accuracy of ± 2 °C, and be protected against damage at 100 °C.

9.7.3 CIP temperature recorders

If they are used, temperature recorders located on CIP sets should comply with the following:

- The scale range should be 20-85 °C.
- The accuracy should be better than ± 1 °C in the range 60-80 °C.
- They should be protected against damage at 100 °C.

9.7.4 Glass thermometers

Glass thermometers must not be placed into dairy material streams or installed so that they come into contact with product or cleaning solutions.

9.7.5 Temperature sensors

Temperature sensors, including their protective pockets, should be able to be removed from the equipment or pipeline they are installed on in order to test their accuracy.

9.7.6 Pressure measurement

Recording or indicating gauges should be of the sanitary diaphragm or pressure bulb type.

10.0 Requirements for Specific Types of Equipment

The construction materials, fabrication and installation of all equipment should comply with this code.

10.1 Storage Vessels and Vats

10.1.1 Fabrication

The base of the vent of a raw product storage vessel should be able to be fitted with a filter suitable to prevent the escape of aerosols.

A means should be provided to prevent siphonage in the vent line.

A temperature sensor should be provided on all milk and liquid milk product vessels to allow recording of temperatures during product storage and cleaning.

All silos and other liquid storage vessels should be able to be cleaned by mechanical recirculation of the cleaning fluid (A strainer should be fitted in the CIP lines to assist in the prevention of spray ball blockage).

All product contact surfaces should be self-draining.

The bottom pitch of tanks designed to be cleaned by recirculation of the cleaning fluid should be at least:

- 1:15 for vertical tanks
- 1:50 for horizontal tanks.

The number of inlet and outlet ports in silos should be reduced to a minimum. They should be placed near the bottom of the tank for ease of CIP. Where large diameter pipes are required at the outlet, special care should be taken to ensure the outlet pipe is properly designed and fabricated to ensure cleanability.

Vessels for the storage of skim or whole milk should be provided with sufficient agitation to prevent thermal layering. The difference in temperature between the coolest and hottest sectors of the contents within the vessel should not exceed 1 °C.

Hinged manhole doors should have the hinge attached to the outside of the silo. The edge of the opening around the manhole should not protrude into the silo so that it shields an area of the inside surface of the silo from CIP solutions.

10.1.2 Installation

Silos CIP systems should be installed such that the silo cannot be cleaned whilst containing product. Ways of achieving this include:

- key pieces in the CIP line which cannot be fitted unless the manhole is open
- sensing devices which detect silo level and are interlocked with the CIP system.

Silo plinths should be raised so that the silo gullet is sufficiently above floor level so as to achieve the self draining requirement.

10.2 Heat Exchangers and Pasteurisation Equipment

10.2.1 General requirements

Only non-toxic freezing point depressants should be used in systems where the chilling liquid is used adjacent to milk or milk products. Mono-propylene glycol and glycerol are acceptable non-toxic freezing point depressants.

In chilling systems where the chilling liquid temperature is lower than the freezing temperature of the product, means should be provided to automatically control the temperature and/or flow of the cooling medium to prevent the product freezing.

10.2.2 Fabrication of plate heat exchangers

Plate heat exchangers should comply with the requirements of the relevant sections of this guideline.

Preferably a leak escape groove, open to the atmosphere at both ends, should be provided to allow leakage past the gaskets to free drain, or differential pressure in favour of the product.

10.2.3 Tubular heat exchangers

In tubular heat exchangers, all permanent joints in metallic contact surfaces should be welded, except that tubes may be expanded and rolled into tube sheets or return fittings. The resulting joint should be completely rigid and without pockets or crevices.

In tubular heat exchangers, the tubes should be supported in a manner to prevent sagging. In designs involving two or more concentric tubes, where the exchanger will be cleaned in place, a means should be provided of keeping the tubes equally spaced, as long as this does not interfere with cleaning. All product contact surfaces should be accessible for manual cleaning, unless it has been demonstrated that this is not necessary.

10.2.4 Heat Treatment Equipment

All validated heat treatment equipment must comply with NZFSA Dairy requirements relating to heat treatment.

10.3 Milk and Milk Product Tankers

10.3.1 Fabrication

10.3.2 Baffles

Any baffles should be designed to allow access to all areas within the tank for inspection. Compartments may be provided within the tanks.

10.3.3 Manholes

Manholes should be provided to allow easy access to each compartment. The upper edge of the manhole surround should not be less than 10 mm higher than the surrounding area. Manhole cover gaskets should be easily removable. The hinge for the manhole cover should be on the outside of the tank.

10.3.4 Vents

A sanitary vent of sufficient free opening to prevent excess vacuum or internal pressure should be installed. The air vent should be designed so that its parts are readily accessible, easily removable and readily cleanable. The vent should be able to be fitted with a filter suitable to prevent the escape of aerosols for the control of exotic animal diseases.

10.3.5 Hoses

When not in use, the hose should be able to be secured to the tank in such a way that prevents the entry of foreign matter and prevents the hose from falling off the tanker. The hose should be fitted with a strainer with holes of a maximum of 10mm diameter or equivalent free area.

10.3.6 Cabinets

A cabinet should be provided for the storage of milk samples and for the protection of the milk sampling devices. It should be lined with a suitable material and should be readily cleanable. The cabinet should be large enough and located so that there is easy access to the sampling devices and the milk samples, and to assemble and disassemble removable parts. Facilities should be provided to hold the supplier records in good condition.

10.3.7 Sample containers

A container should be provided to hold supplier samples and should be insulated, made of approved materials and dust-proof. The container should provide cooling facilities to maintain the required sample temperatures.

10.3.8 Meters

If a milk volume measuring device is fitted it should be designed and installed in such a manner, so as to not compromise food safety

10.3.9 **Thermometers**

A temperature sensing device should be fitted to the inlet of the tank. When fitted it should comply with the requirements of Section 9.7.5.