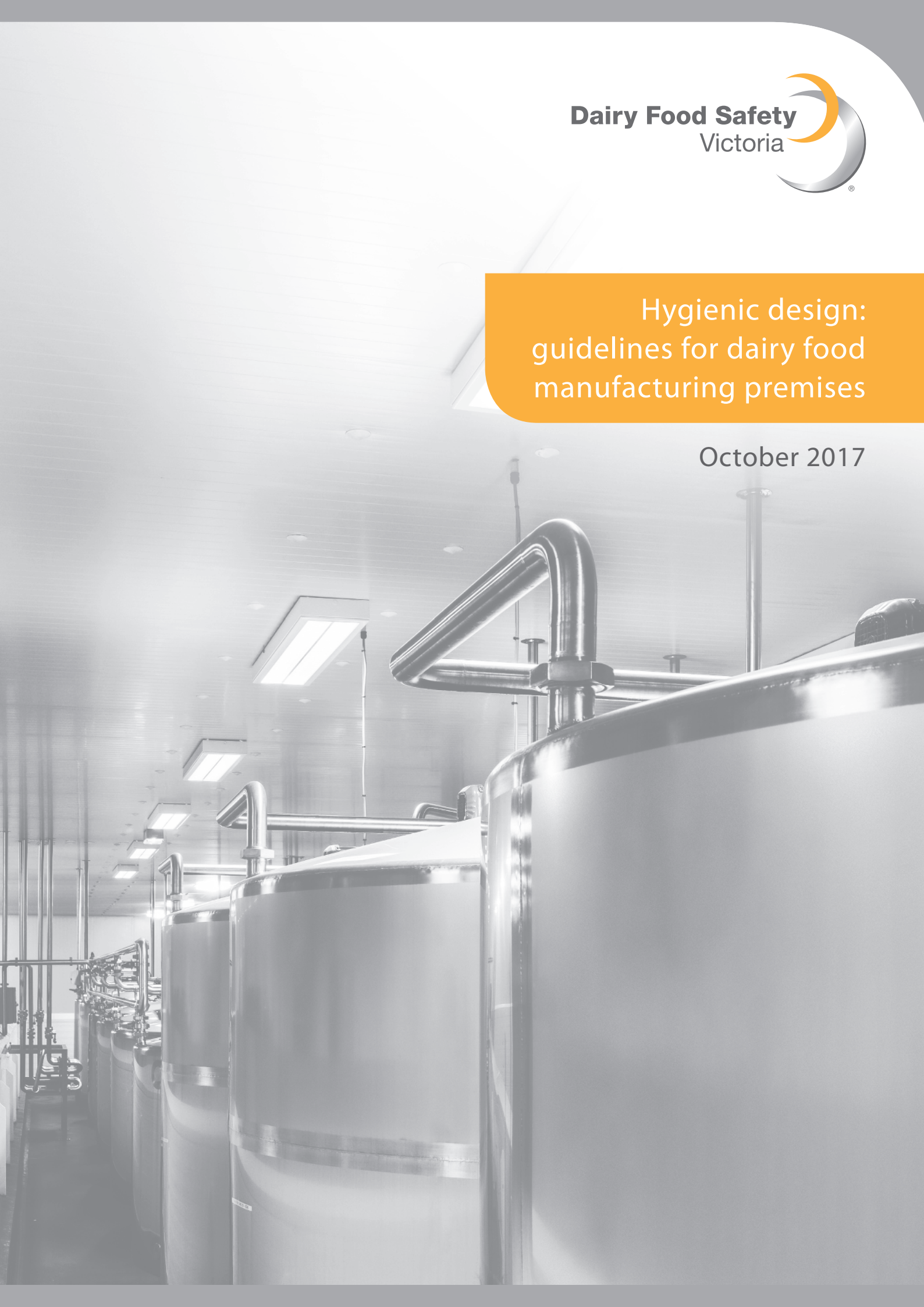
Dairy Food Safety Victoria

Hygienic design: guidelines for dairy food manufacturing premises

October 2017



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Introduction

The construction and layout of your manufacturing premises is critical in ensuring the safety of dairy foods.

Failure to adequately plan and construct a premises that meets hygienic requirements may result in persistent microbial environmental contamination that is difficult to remove or manage. Poorly designed premises are more susceptible to colonisation by foodborne pathogens such as *Listeria monocytogenes* and *Salmonella* spp.

As part of the licence approval process, Dairy Food Safety Victoria will conduct a site inspection to ensure your premises and equipment:

- are fit for purpose
- are in a good state of repair
- are able to be cleaned and sanitised effectively
- comply with legislation.

This document outlines practical hygienic design considerations for both premises and equipment to assist potential and existing dairy manufacturers plan and develop premises both fit for purpose and compliant with regulatory licensing requirements.

This guideline will help businesses achieve compliance with Standard 3.2.3 – Food Premises and Equipment of the Australia New Zealand Food Standards Code, and support the production of safe and suitable food.

Australia New Zealand Food Standards Code – Standard 3.2.3

The objective of this standard is to ensure that the construction and layout of premises, fixtures, fittings, and equipment minimises opportunities for food contamination, and all can be easily cleaned and sanitised.

This hygienic design guideline follows the format of Standard 3.2.3, focusing specifically on the sections relevant to dairy manufacturing businesses. It outlines DFSV's expectations regarding the design and construction of premises and equipment, and the provision of services to minimise opportunities for food contamination and comply with regulations.

Requirements for export

If you intend to export dairy food, your business must also meet the requirements detailed in the Export Control (Milk and Milk Products) Orders 2005 and be registered with the Department of Agriculture and Water Resources. There may also be additional importing country requirements.

Design and construction

Design and construction

The decisions made at this stage of development can be critical for a business, as any changes needed to rectify poor choices following construction can be both disruptive and expensive.

Site location is important. A food manufacturing premises should operate in an environment free from offensive odours, dust and other potential contamination sources, with consideration being given to potential impacts from any surrounding businesses, residents or the environment.

All buildings and their immediate surrounds must be able to be kept in a clean and orderly condition.

Regulatory building requirements such as the *National Construction Code of Australia 2016* must be met. The national construction code provides the minimum necessary requirements for safety, health, amenity and sustainability in the design and construction of new buildings (and new building work in existing buildings) throughout Australia.

The construction should ensure that food safety and hygiene standards can be maintained. Construction materials should be durable under the conditions they will encounter during use, and should not pose a risk of contaminating food with microorganisms, chemicals, foreign matter and off-flavours. Importantly, they must be able to be effectively cleaned and, if required, sanitised.

It is important to involve key stakeholders in the early stages of planning and design to consider and discuss different perspectives and requirements for hygiene outcomes. This may involve industry experts, consultants, customers, certification bodies, as well key inputs from within your business.

Plans should be submitted to Dairy Food Safety Victoria to support the granting of a dairy manufacturer licence.

General requirements

The design and construction of food premises must be appropriate for the activities for which the premises are used.

Std 3.2.3 Div 2 Clause 3

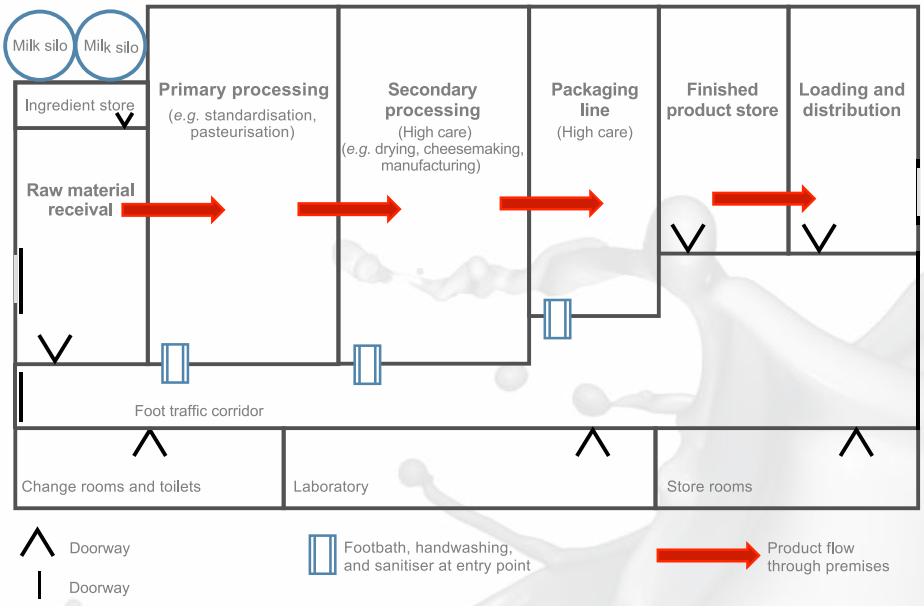
Dairy processing operations (activities) generally occur in recognisably discrete manufacturing areas. The processing of products should follow a one-way flow, from product receipt through the various processing operations to final storage and dispatch (Figure 1).

Selection of the appropriate construction standards, materials, building finish, and services will generally be determined by:

- the degree to which *product or packaging* will be exposed
- the degree to which *the production environment* will be exposed to chemicals, moisture, temperature or product *e.g.* spillage or processing by-products.

For example, in a wet manufacturing area such as in cheesemaking, where product is exposed, a high standard is warranted for the building finishes and services, including drainage and ventilation. By contrast, a lower-level standard for flooring may be adequate in a dry packaged goods storage area.

Figure 1: Example of plant layout with a one-way flow



Design and construction

Adequate space

The design and construction must provide adequate space for the activities to be conducted on the food premises, and for the fixtures, fittings and equipment used for those activities.

Std 3.2.3 Div 2 Clause 3

To meet the requirements of this clause, consideration should be given in the planning stage to factors such as:

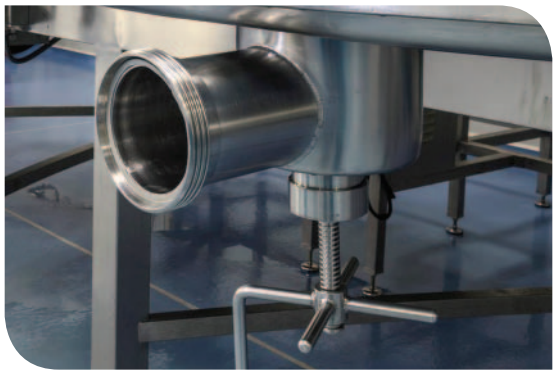
- delivery of incoming goods and services
- transfer of equipment, ingredients and finished goods between areas
- segregated/secure storage *e.g.* for allergens and chemicals
- staff changing facilities and toilets
- a safe and ergonomic working environment for operators
- safe access for equipment maintenance
- ability to access equipment for dismantling, cleaning and sanitising
- space for potential operation expansion and access for future upgrades
- storage and dispatch of outgoing products
- site security.

Cleanability

The design and construction must permit the food premises to be effectively cleaned and, if necessary, sanitised.

Std 3.2.3 Div 2 Clause 3

The design, layout, and type of food contact materials in your premises can directly impact the success of cleaning and sanitation operations. Across dairy manufacturing a wide range of products are made using distinctly different processing operations. These may generate a variety of soils that need to be removed from the manufacturing environment.



As cleaning regimes vary widely, it is important that both food contact surfaces and the processing environment are able to withstand the corrosive nature of many cleaning chemicals.

Documentation of the cleaning and sanitising program, including what is covered and how it is done, will form part of your company's food safety program.

Australian Standard AS 4709-2001 *Guide to Cleaning and Sanitizing of Plant and Equipment in the Food Industry* provides additional information and guidance on this subject.

Contaminants

The design and construction must, to the extent that is practicable, exclude dirt, dust, fumes, smoke and other contaminants.

Std 3.2.3 Div 2 Clause 3

The exclusion of these contaminants, which may include microorganisms or foreign matter, from the food processing environment is often addressed by control measures such as:

- effectively sealed buildings
- covers to protect exposed product from overhead risks
- air lock entry into production areas
- internal positive pressure filtered air
- clothing change areas
- footwear exchange areas *e.g.* 'step-over benches' or footwear sanitising systems
- handwashing/sanitising stations
- 'high-care' personnel washing/changing areas
- high velocity air shower devices for personnel clothing.

Pests

Design and construction, to the extent that is practicable, must not permit the entry and harbourage of pests.

Std 3.2.3 Div 2 Clause 3

Food processing buildings need to be effectively sealed to prevent pest entry. The type of pests found on a site may vary according to location. For example, sites in rural locations may need to control additional or different pests to those common to urban areas. Pest control requirements may need to be adapted to seasonal conditions, or other environmental conditions such as nearby construction zones.

In addition to the control measures listed under Contaminants, the following strategies can be used to limit access and breeding opportunities for pests:

- rapid roller doors or self-closing doors
- rubber seals or bristle strips on doors
- plastic strip curtains
- fly screens
- bird deterrents.

It may be useful to seek guidance from a professional pest control company.

Water supply

Food premises must have an adequate supply of potable water.

Std 3.2.3 Div 2 Clause 4

Potable water (water that is fit for human consumption) must be available at a volume, pressure and temperature sufficient to cover the demands of the operations during peak loads.

Where water is not sourced from a treated town (reticulated) supply, and is instead sourced from rivers, bores or rainwater tanks, it will need to be effectively treated and stored, and tested to ensure it is potable. Treatment systems utilising chlorination, UV light, and ozonation are available options, however all need to be monitored and maintained to be effective.

Design and construction

Hot water will need to be generated for cleaning, handwashing, processing heat treatments and possibly sanitising. Where steam is used and comes in direct contact with product, only boiler water additives suitable for food applications may be used, and must be of culinary standard. Plant design incorporating steam traps, strainers and condensate traps will also help to prevent possible product contamination with physical and chemical contaminants from steam.

If a food business demonstrates that the use of non-potable water for a purpose will not adversely affect the safety of the food handled by the business, then non-potable water may be used for that purpose.

Std 3.2.3 Div 2 Clause 4

There are some circumstances where non-potable water may be used outside of manufacturing rooms, such as in boilers, condensers, non-product passes in heat exchangers, outside cleaning and fire-fighting. Piping and outlets used in these situations will need to be clearly distinguishable from the potable water system. The use of non-potable water will need approval from Dairy Food Safety Victoria, with evidence provided to support where and how it will be used and managed.

Sewage and waste water disposal

Food premises must have a sewage and waste water disposal system that will effectively dispose of all sewage and waste water and is constructed and located so that there is no likelihood of the sewage and waste water polluting the water supply or contaminating food.

Std 3.2.3 Div 2 Clause 5

There must be an effective system in place for the disposal of liquid wastes from the site. This must be constructed and located so there is no likelihood of contaminating food or polluting the water supply and takes into account peak loads.

Dairy processing may involve large volumes of effluent such as whey and detergents, which may require further treatment before they can be discharged to the sewage system. Seek advice from the local water authority or the Environment Protection Authority Victoria (EPA) on food and oil interceptor requirements. Note that food and oil interceptors should be installed outside of production areas. Minimising objectionable odours generated from effluent may also need to be considered.

Storage of garbage and recyclable matter

Food premises must have facilities capable of containing the volume and type of wastes, keep them enclosed to prevent pest and animal access, and be easily and effectively cleaned.

Std 3.2.3 Div 2 Clause 6

Food premises must ensure adequate handling and storage of waste so it does not pose a risk to product, attract pests, or create a nuisance.

- Internal waste bins must be of sufficient capacity and be sited appropriately.
- External holding of waste and recyclable material must be of sufficient capacity and collected on a regular basis.
- Internal and external bins must be clearly differentiated, and not used interchangeably.
- External waste bins should have close-fitting lids and be regularly cleaned.
- Obsolete equipment should be stored so as to not provide a harbourage for pests.

Ventilation

Premises must have sufficient natural or mechanical ventilation to effectively remove fumes, smoke, steam and vapours.

Std 3.2.3 Div 2 Clause 7

For most dairy manufacturing premises, this will be a system that:

- minimises condensation on walls and ceilings
- does not contaminate product with extraneous matter or allergens
- maintains a hygienic and comfortable working environment.

There are regulatory building requirements that may need to be complied with, which can be complex and may require expertise to interpret. Areas that need to be considered include:

- weather and pest-proofing of air inlets and outlets
- direction of prevailing winds
- effective sealing of all openings, and the use of air locks
- whether incoming air requires filtration
- selection of a purified, recycled air flow, or a once-through system
- minimum distance of separation between air inlets and outlets

- the types, effectiveness and maintenance of air filters
- the appropriate number of air changes per hour
- design, fabrication and routing of the ducting used in air transfer
- air flow over exposed product
- location of exhaust fans in 'high-load' areas of production
- minimisation of wet floors, open drains and, where practicable, isolation of open processes that emit large amounts of heat or moisture into the air.

Unfiltered air and negative air pressure in processing areas where product is exposed can cause microbiological product contamination. Exhaust fans used to remove air, such as in areas of high humidity, may create a negative air pressure within the facility. In this situation, whenever an outside door or window is opened, the incoming air may contain moisture, dust, chemicals, bacteria, mould, insects, off odours and other debris that may contaminate the food and food contact surfaces.

Positive air pressure is often used to prevent the ingress of airborne contaminants into processing areas, particularly critical high-care or product packing areas. In these instances attention needs to be paid to the:

- volume (proportion) of supply air exceeding the exhaust air capacity under operational conditions *e.g.* >20%
- internal pressure to be maintained *e.g.* >50 pascals.

Heating, ventilation and air conditioning (HVAC) design require input from a competent HVAC engineer to meet the needs of the facility and the process.

Humidity, temperature control and air flow are critical issues in cheese maturation rooms. Specialist systems and expertise may be required to achieve the optimal balance of these factors.

Lighting

Natural or artificial light provided must be sufficient for the activities conducted by the business.

Std 3.2.3 Div 2 Clause 8

The amount of light needed for food processing operations depends on the functions being performed. In general, the more critical an operation the greater the required light intensity to support efficient and safe operations. At least 540 lux is required in processing areas where employees work with utensils or equipment and safety is a factor.

Higher intensities may be required in areas where product or packaging is being inspected. Less intense light is needed in receiving areas, walk in refrigerators, storage areas, change rooms, and toilets. Importantly, lighting should be adequate to conduct operations in a safe and efficient manner.

The amount of light that should be available in a workplace environment is outlined in Australian *Standard AS 1680.1-2006 Interior and workplace lighting: Part 1 General principles and recommendations*.

The type of lights and their location and installation are also important. To minimise the possibility of overhead product contamination, light fittings must be enclosed, or shatterproof lamps used. Low-energy LED lights are an alternative suitable for many applications. All internal lights should be recessed flush with the ceiling or wall wherever possible.

Manufacturers may need to obtain technical expertise in calculating lighting requirements and to comply with building regulation energy efficiency provisions.

Floors, walls and ceilings

Floors, walls and ceilings

Floors

Floors must be designed and constructed in a way that is appropriate for the activities conducted on the food premises.

Std 3.2.3 Div 3 Clause 10

The selection of flooring materials is a critical factor in the design of dairy manufacturing premises. Floors need to withstand the rigours and stresses of manufacturing operations, and minimise the likelihood of environmental contamination of product.

Floors must be:

- suited to the operating environment *e.g.* robust material and with long term durability
- able to be effectively cleaned
- unable to absorb grease, food particles or water
- laid so that they drain effectively and there is no ponding of water
- to the extent practicable, unable to provide harbourage for pests and microorganisms.

Further information on flooring is provided in Appendix 1.

Australian Standard AS 4674-2004: *Design, construction and fit-out of food premises* also provides information on the suitability of floor finishes.

Internal drainage

The importance of an appropriate internal drainage system should not be underestimated. Once in place it cannot be easily altered. Drains can become contaminated, as almost anything present in the environment will find its way into a drain.

They should:

- flow from a higher hygiene area to a lower hygiene area *i.e.* from packaged product to raw milk receival
- be of a smooth and impermeable construction, have sufficient capacity and fall, and be easily cleaned and maintained
- be made of suitable materials, considering the corrosive nature of dairy effluent *e.g.* hot whey or cleaning chemicals
- have channels and outlets positioned to minimise the flow of waste water across the floor, preferably parallel and near (but no closer than 12 cm) to the wall
- with underground grid-type drainage systems, have a drain located in the centre of each 'square' (usually by dividing the floor into a series of six metre squares)
- have collection points away from packaging areas, and not be inaccessible due to equipment located over them
- have a fitted straining device that can be easily removed for cleaning, in conjunction with a water seal.

Where minimal waste liquid volumes are generated, an above-floor drainage system may be a suitable option.

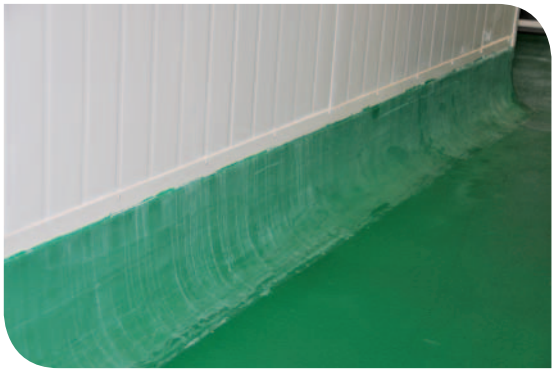
Floors, walls and ceilings

Walls and ceilings

Walls and ceilings must be designed and constructed in a way appropriate for the activities conducted on the premises.

Std 3.2.3 Div 3 Clause 11

Materials used in both the construction and finish may vary depending on the risks of food or environment contamination within the different areas of the factory *e.g.* wet versus dry processing or exposed versus packaged product.



Factors to consider for food processing areas include:

- construction of solid materials (including sandwich panelling) to prevent vermin access
- use of approved non-toxic materials
- the likelihood of surfaces being subjected to heat, condensation, product splashing
- cleaning methods *e.g.* wet or dry, hot or cold water, water pressure, and chemicals used
- the need to withstand possible impact from equipment such as trolleys
- any regulatory building code requirements, such as minimum floor to ceiling height
- ease of maintenance and replacement
- a ceiling slope *e.g.* 1:20 to assist air movement in mechanical ventilation
- the fire rating of sandwich panels.

Solid dwarf walls should be used to support sheet walls, such as pre-formed panels *e.g.* sandwich panels. Coved dwarf walls provide an excellent defence against environmental contamination, and should be at least 15 cm high. The junction between the dwarf wall and the wall panelling should be sealed so that moisture and product cannot penetrate the joint or panel.

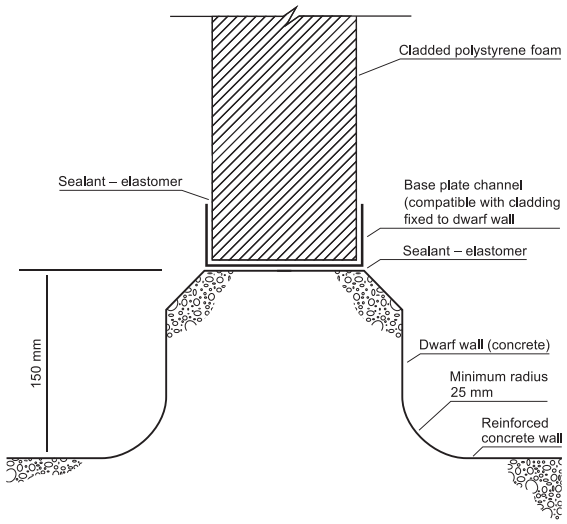


Figure 2. Typical dwarf wall design to support sheet walls in dairy processing areas

Coving

Few areas of the processing floor are as prone to bacterial contamination as the junction between the floor with walls, nibs or plinths. This 90 degree angle makes effective cleaning extremely difficult, and can become a haven for bacteria such as Listeria in wet areas.

Coving, usually in conjunction with dwarf walls, presents a protective and easily cleanable surface of this floor/wall intersection. However, relying on materials such as aluminium strip coving attached and sealed with silicone can lead to environmental contamination problems once moisture gains access into the hollow cavity.

A minimum radius of 25 mm is advisable, although for other particular materials or locations, other radii may be acceptable, such as in freezers.

Seals

Walls and ceilings must be sealed to prevent entry of dirt, dust and pests.

Std 3.2.3 Div 3 Clause 11

Air lock access, with self-closing doors, is recommended into any food production area. Doors need to be of rigid construction, impervious to moisture, and effective in minimising external contaminants.

When made of wood, a full width kick-plate should be fitted to resist damage. Where practicable, door jambs should have vertical corners protected *e.g.* from trolleys, crates etc, and frames finished flush with the wall. Internal doors should be used to separate manufacturing and non-manufacturing sections, and may be constructed of heavy plastic, rubber or other suitable materials. Emergency exit one-way doors must be effectively sealed.

Windows must be non-opening in any room where product is manufactured, packed or stored in an exposed condition, and located where the chance of any impact with the glass is unlikely. The glass used in windows may need to comply with a minimum thickness under building code requirements.

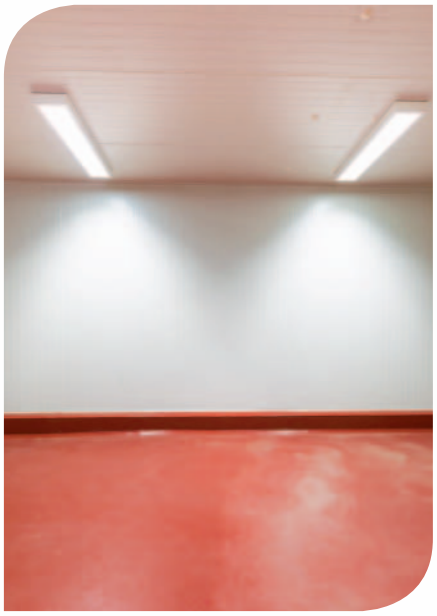
Openable windows used in other areas must be close-fitting with insect screens fitted.

Any wall openings, such as for pipelines or services, should be effectively flashed flush with the wall.

Cleanability

Walls and ceilings must be unable to absorb grease, food particles or water, be easily and effectively cleaned and not provide harbourage for pests.

Std 3.2.3 Div 3 Clause 11



The surface and finish needs to be smooth and impervious, effectively sealed, and be able to withstand the rigours of cleaning over time. This would include resistance to corrosion and flaking. The finish should be light coloured to help visually assess cleanliness.

To facilitate cleaning and discourage pest harbourage, the attachment of pipes, cables and shelves to walls should be minimised.

Ledges or sills, particularly in powder processing operations, should be sloped at 45 degrees to minimise dust accumulation.

Above-ceiling areas will need to be accessible, preferably from outside the production area, to enable pest control.

Fixtures, fittings and equipment

Fixtures, fittings and equipment

General requirements

Fixtures, fittings and equipment must be designed, constructed, located and installed so that there is no likelihood they will cause food contamination, be fit for their intended use, and be easily and effectively cleaned.

Std 3.2.3 Div 4 Clause 12

A business must ensure that all sources of potential contamination are identified and controlled.

Examples of this include:

- dead ends in pipework that prevent adequate cleaning
- hollow box sections *e.g.* equipment frames that can trap residues and contaminants
- hollow rollers used in conveyors
- falling components *e.g.* loose bolts/nuts over a filling machine
- dripping/spraying liquid product or lubricants
- uncovered food product
- soil or product build-ups
- inaccessible inspection hatches
- cross-contamination of processed product from raw product or allergens.

'Clean' is defined as a state that can be assessed physically by sight, touch and smell. There are, however, more objective methods available to do this, such as protein, ATP or microbial swabs that are commonly used to verify cleanliness. Suitable cleaning and sanitising procedures must be in place for all items of equipment. Documentation of the cleaning and sanitising program, including what is covered and how it is done, will form part of every company's food safety program.

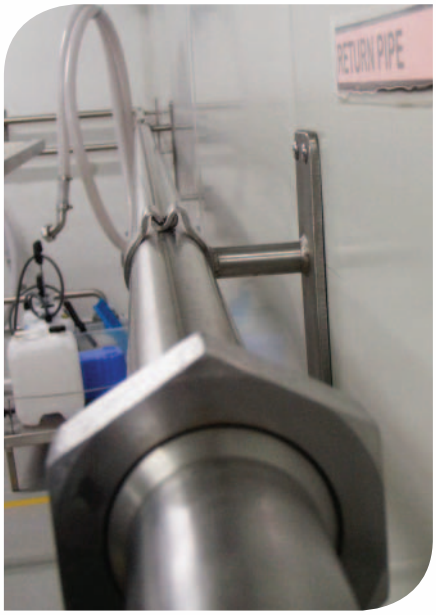
Cleanability

Fixtures, fittings and equipment must allow for adjacent floors, walls, ceilings and other surfaces to be easily and effectively cleaned.

Std 3.2.3 Div 4 Clause 12

A gap of at least 75 mm between equipment and walls is recommended for safe cleaning and inspection. Similarly, adequate spacing needs to be provided between items of processing equipment.

Sufficient clearance between the base of equipment items and the floor should be allowed for cleaning.



Contaminants

Where there is a likelihood they would cause food contamination, ensure food contact surfaces are made of material that will not contaminate food, are unable to absorb grease, food particles and water, and be effectively cleaned and sanitised.

Std 3.2.3 Div 4 Clause 12

To meet this requirement, all food contact surfaces should be:

- non-absorbent
- smooth (free of pits, cracks, and crevices)
- non-toxic and unaffected by food products or ingredients
- constructed of materials classified as 'food grade'
- capable of withstanding repeated cleaning.

Fixtures, fittings and equipment

Stainless steel is universally used as a food contact surface in the dairy industry. Stainless steel is a class of corrosion resistant alloy steels containing at least 10.5% chromium. Resistance to attack is due to the naturally occurring chromium-rich oxide film formed on the surface of the steel.

There are various grades and surface finishes of stainless steel to suit the conditions the steel must withstand. Stainless steel used in food containers, pipework, and food contact equipment is predominantly 304 or 316 type austenitic stainless steels. The key difference between these two metals is that 316 contains molybdenum – an alloy which enhances corrosion resistance, especially in more saline or chloride-exposed environments.

Selection of the appropriate grade of stainless steel will depend on the application, such as exposure to low pH products and the types of cleaning and sanitising agents used. The stainless steel surface should be finished to an Ra value (surface roughness measure) of <1.0 µm. All welds should also have a smooth finish. Smooth surfaces promote efficient and effective cleaning and reduce the rate of corrosion.

Plastics and rubber compounds can be used for a wide range of purposes *e.g.* seals and gaskets, but must be made of suitable food grade materials, and be cleanable and durable under the conditions of use.

Wood is generally not acceptable as a food contact surface as it can be difficult to clean and disinfect and may shed splinters. An exception, however, is made for the storage and maturation of cheese, as long as the timber is close grained, not chemically treated, and the surface is well maintained.

Effective cleaning can be performed by either dry, manual, or cleaning-in-place (CIP) methods, or a combination of these. CIP installations can vary widely from basic to complex automated systems. More details on cleaning and CIP systems can be found in the Dairy Food Safety Victoria Technical information notes: *Developing a cleaning and sanitising program* and *Cleaning in place (CIP) systems*.

Hand washing facilities

Designated and appropriate hand washing facilities must be available and accessible for food handlers.

Std 3.2.3 Div 4 Clause 14

Food premises must have hand washing facilities:

- that can be easily accessed by food handlers
- immediately adjacent to toilets
- with a supply of warm running potable water.

Ideally, stations for hand washing, drying and sanitising should be provided adjacent to all entry points into manufacturing areas, as well as adjacent to toilets. The use of hands-free taps is recommended to reduce microbial cross-contamination.

These facilities should be clearly designated to indicate use for handwashing only.

The number and distribution of additional internal facilities will depend on the size of the operation, the type of food processing, and the expected number of staff.

Waste from sinks should be plumbed to a drain.

The transmission of bacteria is more likely to occur from wet skin, so effective hand drying after washing is essential. Options available include single use paper towels, cloth roll towels, warm air dryers or high speed jet air driers. Each of these drying methods have their particular pros and cons. The method selected should effectively dry hands and minimise the dispersal of organisms through aerosol production.

Storage facilities

Premises must have adequate storage facilities for items that are likely to be the source of contamination, including chemicals, clothing and personal belongings, and be located where there is no likelihood of contaminating food or food contact surfaces.

Std 3.2.3 Div 5 Clause 15

Allowance needs to be made for safe and separate storage areas for chemicals such as detergents, sanitisers, water treatment chemicals, ingredients containing allergens and pest control agents. Any cleaning equipment used will also need to be stored in a location and manner that will prevent cross-contamination of clean surfaces.

Other regulatory agencies will have regulations that may need to be complied with, for example WorkSafe Victoria for chemical storage and EPA Victoria for chemical containment (bunding) or effluent disposal.

Staff entering production areas will require facilities where they can change into protective clothing prior to entry, and to store clothing and personal belongings. Storage space for clean and soiled protective clothing may also be required.

Toilet facilities

Adequate toilets must be available for the use of food handlers.

Std 3.2.3 Div 5 Clause 16

Toilets should be designed, located and maintained so that they are easily accessible for employees to use when required. Further aspects to consider in meeting the term 'adequate toilets' would include:

- location to ensure separation from, and not opening directly into, any areas where food is manufactured, handled or stored *e.g.* a ventilated intervening space or vestibule with close fitting and self-closing solid doors
- adequate ventilation, with the exhaust into a suitable environment
- suitable for the anticipated number of employees
- provision of hand washing facilities as described above
- accessibility *e.g.* within working hours and within a reasonable distance from work/staff facilities areas.

Refer to current building regulations to help determine the building class type and to ensure compliance with *Part F2 - Sanitary and other facilities* in the *National Construction Code of Australia 2016*.

Summary

Planning and building a dairy manufacturing facility can be painstaking and complex. It requires a considerable input of time, effort and resources to produce a premise that will be both fit for purpose and comply with licensing requirements.

This guide will assist businesses to ensure that the construction and layout of the premises, fixtures, fittings and equipment will minimise the opportunities for food contamination, maintain food safety and hygiene standards and meet the requirements of Standard 3.2.3 of the Australia New Zealand Food Standards Code.

Appendix 1: Floors for dairy manufacturing facilities

The selection of an appropriate floor surface in a dairy manufacturing premises is influenced by a combination of requirements:

- maintaining a hygienic environment
- achieving longevity and durability
- ensuring traction and personnel safety.

The extent to which these requirements must be met will vary depending on the location within the dairy processing premises. For example, in warehouses and light industrial areas, steel trowelled case-hardened concrete floors are usually acceptable. While in high traffic areas and wet processing zones, floor surfaces must be impervious, non-absorbent, washable, and allow adequate surface drainage.

Therefore the selection of a floor surface requires consideration of whether it will be:

- prone to high mechanical stress *e.g.* from trolleys, forklifts or vibrating machinery
- subject to scraping, chipping and abrasion *e.g.* by pallets, boxes or dismantled equipment
- exposed to milk, whey, hot liquids or heat shock
- exposed to strong chemical solutions
- expected to have foot traffic *i.e.* will need to be slip resistant
- required to slope to a drain *i.e.* a slope of between 1:80 to 1:100 is usually considered satisfactory.

A further consideration is the supporting foundation, as it is critical to ensuring the longevity of the floor, regardless of whether solid tiles, overlays, or coatings are used. It is not only the thickness of concrete that is important. The nature of the surface *e.g.* porous or otherwise, may necessitate further treatment to optimise adhesion of the overlying floor surface material.

The floor finish employed within a dairy processing plant will depend on the operations being carried out in each area, the type of soiling expected, and how the floor will be cleaned. The addition of antimicrobials including nanoparticles such as silver ions to floor surface coatings and grouting are an option that may warrant consideration for controlling microbial growth.

For all floors it is vital to have a maintenance program to ensure immediate repair or patching of any surface damage. Prompt action can prevent water getting under the floor surface, as it may compromise the flooring and make effective repairs difficult.

Appendix 1: Floors for dairy manufacturing facilities

Floor finish	Features	Considerations	Dairy processing	Wet areas	Chillers Freezers	Dry stores
Ceramic tiles*	• Highly durable and excellent for high traffic loads • Relatively expensive and require long duration for installation • Grout that is permeable makes cleaning and sanitising difficult	Epoxy grout finished flush with tiles Grout lines need to be maintained so they don't harbour microbes, dirt, and grease Impact resistance	✓	✓	✓	✓
Quarry tiles	• Machine-made clay or earthenware paving is usually unglazed, highly durable and excellent for high traffic loads • Relatively expensive and require long duration for installation • Grout that is permeable makes cleaning and sanitising difficult	Epoxy grout finished flush with tiles Grout lines need to be maintained – can harbour microbes, dirt, and grease Sealed with a water-based penetrating sealer Impact resistance	✓	✓	✓	✓
Steel trowelled case hardened concrete	• Smooth finishing treatment results in reduced surface absorbency • Not suitable for wet applications unless properly sealed *e.g.* heavy duty polymer screed	Unsuitable for use in wet areas – porous nature results in absorption of spillages Pressure washing can damage the surface				✓
Stainless steel – slip resistant	• Often used on stairs, raised platforms and decks, and for the construction of drains/drain covers • Durable and good for high traffic loads	Requires welded joints Slip resistance is a challenge for metal surfaces, especially in wet areas	✓	✓	✓	✓
Epoxy resin	• High solids epoxies provide good protection against acids and alkalis – but not against lactic acid • Good adhesion • Fast drying • Withstands abrasive cleaning • Compatible with textured, anti-slip additives • Don't handle cold or thermal shock conditions • Bonds well to prepared concrete	Must be durable and thick enough to create a protective barrier and prevent contaminants permeating to the concrete substrate Epoxy floors are harder, more durable and have a much higher compression strength than polyurethanes	✓	✓	✓	✓
Polyurethanes	• Long service life • Good resistance to thermal cycling • Excellent chemical resistance especially to lactic acid • Low odour, seamless, and easy to clean • Fast drying but not recommended for sloped floors • UV stable • Doesn't bond as well to concrete	Must be durable and thick enough to create a protective barrier and prevent contaminants permeating to the concrete substrate Polyurethane is softer and more elastic than epoxy resin, making it more resistant to scratching The elasticity makes it suitable for freezers where storage temperatures may reach -30°C	✓	✓	✓	✓
Poly vinyl sheet	• Long lasting, durable, hygienic, easy to clean and often recyclable • Lightweight • Economical	Requires heat welded joints Easily damaged by impact Not suited to heavy traffic Can be slippery when wet	✓		✓	✓
Laminated thermosetting plastic sheeting	• Cures when heated into durable and heat resistant materials • Long lasting, hygienic, easy to clean • Lightweight • Economical	Requires heat welded joints Easily damaged by impact Not suited to heavy traffic Can be slippery when wet	✓		✓	✓

* Australian Standard (AS 4674-2004 Construction and fit out of food premises) requires that ceramic floor tiles be epoxy grouted. Further guidance is provided in AS 3958.1—2007 Ceramic tiles, Part 1: Guide to the installation of ceramic tiles. Grout width of 2-12mm is considered acceptable for tiles. When selecting a grout, consideration must be made to resistance to continuous or sporadic exposure to chemicals in the processing plant, plus curing time at the installation temperature, and the ability of the grout to function at the envisaged operating temperature.

Glossary

Above-ground drain: a system suitable for some manufacturing sites where low levels of waste water are generated, thereby eliminating the need for floor disruption. The process utilises an internal above-floor collection sump, with waste pumped to an external treatment system before disposal to trade waste.

Aerosol: airborne suspension of extremely fine liquid droplets, which may carry microorganisms and can be widely dispersed.

Air lock: a small room, usually at the entry into processing areas, consisting of two airtight doors in series which do not open simultaneously.

Bunding: a constructed retaining wall around an area where potentially polluting substances are handled, processed or stored, to contain unintended leakage of material until remedial action can be taken.

Cleaning-in-place: mechanical cleaning, partly or fully automated, requiring little or no disassembly of the processing equipment.

Coving: an uninterrupted concave surface between the floor and wall, or other vertical surfaces.

Culinary standard steam: steam passed through a fine stainless steel filter element, removing 95% of all particles larger than two microns.

Dwarf wall: a low sub-wall, usually not less than 15cm in height, used to support sheet walls such as cladded polystyrene foam.

Fixtures and fittings: All non-structural items, distinct from the plant and machinery, that are permanently installed in a building, and normally form part of a food manufacturing business.

Flashing: thin pieces of impervious material installed as a barrier over or around a joint or opening to prevent the passage of water, contaminants or pests into a building.

High-care areas: sensitive areas of a manufacturing facility designed to a standard where higher levels of precaution, such as practices relating to personnel, ingredients, equipment, packaging and environment, are taken to prevent contamination.

High-load areas: for ventilation applications, production areas where high levels of steam, vapour, smoke or fumes are generated.

Kick plate: a metal plate fastened to the bottom of a door to resist damage.

Nib wall: a short section of a wall that juts out from a building's framework.

Plinth: a slab-like block beneath the base of a column or similar supporting structure.

Potable water: water that is fit for human consumption.

Sanitisation: the application of heat, chemicals, or a combination of these or other processes, to a surface to reduce the number of microorganisms.

Soil: Material that contaminates food processing equipment and contact surfaces including fat, protein, scale, burned on food residues

Step-over bench: a physical barrier defining where entry into a manufacturing area requires a change into protective clothing.

Recommended reading

Australia New Zealand Food Standards Code: Standard 3.2.3. Food Premises and Equipment. Division 2 – Design and construction of food premises.
https://www.legislation.gov.au/Details/F2012C00774

Australian Stainless Steel Development Association.
https://www.assda.asn.au

Australian Standard AS 4709-2001, Guide to Cleaning and Sanitizing of Plant and Equipment in the Food Industry

Australian Standard AS 4674-2004, Design, construction and fit-out of food premises

Australian Standard AS 1680.1-2006, Interior and workplace lighting: Part 1 General principles and recommendations.

Australian Building Codes Board 2016, National Construction Code Volume 1, ABCB, Canberra.
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http://www.foodstandards.gov.au/publications/Pages/safefoodaustralia3rd16.aspx

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