

Wisconsin Department of Agriculture,
Trade and Consumer Protection
Division of Food Safety

GUIDELINES FOR
THE DESIGN AND CONSTRUCTION
OF DAIRY PROCESSING EQUIPMENT

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A. Purpose

The purpose of these Guidelines is to provide design and construction criteria that will result in equipment that:

1. Inhibits undesired microbiological growth in product.
2. Can be efficiently cleaned and sanitized.
3. Is constructed of materials which will not contaminate the product or deteriorate in their use environment.
4. Isolates the product from contact with contaminants.
5. Is free of areas, inside and outside, where product or contaminants may be trapped.

B. Definitions

1. Product

Shall mean any dairy product.

2. Product Contact Surface

Shall mean any surface that is exposed to product or from which liquids or other contaminants may drain, drop, be drawn or be mechanically blown into the product or a container. It also includes any surface that touches a product contact surface of a container.

3. Splash Contact Surface

Any surface, other than a product contact surface, which is subject to routine splash (wet or dry), or other potential contamination during normal use.

4. Non-Product Contact Surface

Shall mean all other exposed surfaces.

C. Materials

General Considerations: Materials used in equipment construction should be able to withstand normal wear and the corrosive action of product, cleaning compounds, and other such elements present in the use environment. Materials used should not impart undesirable odors, colors, or tastes to the product or contribute to its contamination. Materials shall be compatible with the specific type of product being processed.

1. Stainless Steel

Product contact surfaces shall be stainless steel of the AISI 300 series, or metal which under conditions of intended use is at least as corrosion-resistant as stainless steel of the foregoing types and is nontoxic and nonabsorbent.

2. Aluminum

Aluminum is satisfactory for certain product applications. Aluminum may be used for liquid or high moisture content product contact surfaces only when a specific functional requirement exists and the parts are not subjected to strong caustic cleaning solutions or to the corrosive action of dissimilar metals.

3. Engineering Plating (Electrical)

The minimum thickness of engineering plating should not be less than 0.0002 in. (0.005 mm) for all product contact surfaces when used on stainless steel. When these surfaces

are other than stainless steel, the thickness of engineering plating should not be less than 0.002 in. (0.05 mm).

4. Engineering Plating (Electroless)

The minimum thickness of an engineering plating of electroless nickel alloy, should be 0.002 in. (0.05 mm).

5. Plastic or Composite Material

Plastic or composite materials used in the construction of equipment shall be cleanable and nontoxic. Plastic materials and bonded plastic coatings having product contact surfaces should be of such composition as to retain their surface and conformational characteristics when exposed to the conditions encountered in the environment of intended use.

Plastic materials should comply with the applicable provisions of the "3-A Sanitary Standards for Multiple- Use Plastic Materials Used as Product Contact Surface for Dairy Equipment".

Plastic material and bonded plastic coatings shall comply with the applicable Food and Drug Administrative Regulations (CFR Title 21 Part 177).

6. Rubber Materials

Rubber and rubber-like materials used in the construction of equipment shall be cleanable and non-toxic.

Rubber, rubber-like materials, and bonded rubber coatings having product contact surfaces should be of such a composition as to retain their surface and conformation characteristics" when exposed to the conditions encountered in the environment of intended use.

Rubber and rubber-like materials when used should comply with the applicable provisions of the "3-A Sanitary Standards for Multiple-Use Rubber and Rubber-Like Materials Used as Product Contact Surface in Dairy Equipment".

Rubber and rubber-like material shall comply with the applicable Food and Drug Administrative Regulations (CFR Title 21 Part 177).

7. Adhesive

The final bond and residual adhesive on bonded rubber and rubber-like materials and bonded plastic materials shall be nontoxic. Adhesives shall comply with the applicable Food and Drug Administrative Regulations (CFR Title 21 Part 175).

8. Gasket and Seal Material

Gaskets and seal material shall be nontoxic and nonabsorbent. They shall be installed in a manner which results in a true fit to prevent protrusion in the product zone or creation of recesses or ledges between the gasketed joints. Gasket material shall

comply with the applicable Food and Drug Administrative Regulations (CFR Title 21 Part 177).

9. Glass and Glass-like Materials

Glass or plastic used for sight and/or light ports and similar type uses should be clear, heat resistant and shatter resistant. They should be resistant to scratching and chipping when exposed to the conditions encountered in the environment of intended use.

10. Silver Solder

Solder, when used, should be silver solder. It shall be corrosion-resistant, free of cadmium, lead and antimony and shall not impart any toxic substance to the product.

11. Protective coatings

Protective coatings should be inert, nonporous, nontoxic, nonabsorbent, insoluble, and resistant to scratching, scoring, and distorting or otherwise failing to retain their surface and conformational characteristics when exposed to the conditions encountered in the environment of intended use.

12. Other Materials

specialty materials including carbon, tungsten carbide, cast metallic coatings and property-enhancing surface impregnations, and/or ceramic materials may be used for specific applications, such as pump and fill valve seals. These materials should be inert, nonporous, nontoxic, nonabsorbent, insoluble, and resistant to scratching, scoring, and distorting or otherwise failing to retain their surface and conformational characteristics when exposed to the conditions encountered in the environment of intended use.

Copper, bronze, brass, monel, and other copper alloys shall not be used for product or splash contact surfaces.

D. Fabrication Guidelines – General

These guidelines utilize principles set forth in 3-A Standards. Equipment for which a specific 3-A Standard exists must comply with that standard. Information on 3-A Standards is included as Appendix A.

General Considerations: Equipment should be designed and constructed to be easily cleanable and should not contribute to the contamination of the product.

Equipment should be designed and constructed so that the product can be processed in a sanitary manner.

Equipment shall be free of areas, inside and out, where product or contaminants can be trapped and stagnate.

1. Product Contact Surface

Product contact surface materials shall be smooth, cleanable, corrosion-resistant, and nontoxic. The surfaces should not crack, and should be nonabsorbent under use

conditions. In addition, they should not impart undesirable odors, colors, or tastes, or contribute to the adulteration of the product.

Dissimilar materials shall not be used where electrolytic corrosion may take place during use or during exposure to cleaning or sanitizing materials.

All product contact surfaces shall be self-draining except for normal clingage. Where for functional or safety reasons self-draining is not possible, the equipment shall be drainable by other means.

All product contact surfaces shall be easily accessible for cleaning, either when in an assembled position or when disassembled. Removable parts shall be readily demountable.

All product contact surfaces shall be easily accessible for inspection by means of inspection points which can be easily and safely reached from the floor, a platform, or other permanent work area.

Product contact surfaces shall not be painted.

Surface Finish -All product contact surfaces shall have a smooth uniform surface free of pits, folds, cracks and crevices. Within the product zone, surface roughness height shall be no greater than 32 micro inches Ra. (0.8 micrometer)

Finishes that meet this requirement are:

- a. A #4 ground and polished finish on stainless steel sheets free of pits, cracks and crevices and other imperfections.
- b. A 2B mill finish on stainless steel sheets if the finish is free of defects, such as pits, folds or cracks.
- c. A finish obtained by 150 grit silicon carbide properly applied to stainless steel.

Glass beading or sand blasting is not an acceptable alternative to required grinding and polishing of welded junctures to provide a #4 finish.

Glass beading or sand blasting of product contact surfaces may be approved provided the treatment serves a specific functional purpose, the surface has been previously prepared to the equivalent of the #4 finish, and the glass or sand grit does not exceed the coarseness of 150 grit silicon carbide.

2. Splash Contact Surfaces and Non-Product Contact Surfaces

Splash contact and non-product contact surfaces shall be smooth, easily cleanable, and of corrosion-resistant materials, or be rendered corrosion-resistant with a nontoxic material which resists cracking, chipping, and delamination.

3. Permanent Joints

All permanent joints in metallic product contact surfaces should be continuously welded. Silver soldering or brazing is also acceptable. Welded and silver soldered or brazed areas of product contact surfaces should be at least as smooth as #4 ground and polished finish on stainless steel sheets. All joints and seams in the product zone shall be sealed and sanitary, and shall be free of recesses, crevices, and dead ends.

Exposed threads, bolt and rivet heads, nuts and screws, shall be eliminated from food contact surfaces.

Drilled and tapped holes, keyways, sockets or other recesses shall be eliminated. All permanent joints in the splash zone shall be sealed by continuous welding wherever possible.

4. Internal Corners and Angles

Internal corners and angles in product contact areas may be welded or formed and should have at least a #4 finish.

5. Radii

Internal corners and angles formed by the intersection of surfaces at 135 degrees or less should have a minimum continuous radius of a 1/4 in. (6.4 mm), except when smaller radii are required for essential functional reasons, as in small parts and sealing ring grooves.

O-Ring Radii

O-Ring Cross Section			Minimum Groove Radius	
Inch		mm	Inch	mm
Nominal	Actual	Actual		
1/16	.070	1.80	.016-1/64	.406
3/32	.103	2.65	.031-1/32	.787
1/8	.139	3.55	.031-1/32	.787
3/16	.210	5.30	.062-1/16	1.575
1/4	.275	7.00	.094-3/32	2.388

Where the radii are less than 1/32 inch (1 mm), the product contact surfaces are to be readily accessible for inspection and cleaning. Radii in holes for retaining pins shall not be less than 5/64 inch (2 mm).

The minimum radii for fillets of welds in product contact surfaces should not be less than 1/4 in. (6 mm) except that the minimum radii for such welds may be 1/8 in. (3mm) when the thickness of one or both parts joined is less than 3/16 in. (5mm) .Minimum radii for fillets of welds where head(s) and the side wall(s) of tanks join shall not be less than 3/4 in. (19mm).

6. External Corners and Angles

External corners and angles in product contact areas may be welded or formed and should have at least a #4 finish. Radii are not required but are recommended for safety reasons.

7. Non-Permanent Joints

Non-permanent joints which are intended for dismantling and manual cleaning are to be constructed so they are easy to disassemble.

Exposed threads, bolt and rivet heads, nuts and screws shall be eliminated from product contact surfaces. Drilled and tapped holes, keyways, sockets, or other recesses shall also be eliminated.

Gasketed joints shall be installed in a manner which results in a true fit with a substantially flush interior surface to prevent creating recesses or ledges between the gasketed parts. Where a flange design requires less than a full face gasket the flanges shall be spaced apart at least 1/2 in. (12 mm) to facilitate cleaning.

Gasketed joints shall have a means of self-centering the gasket.

Gaskets having a product contact surface should be removable.

Wing, "T" or palm nut style fasteners are preferred over hex or dome nut construction for non-product fastening applications in order to facilitate dismantling for cleaning and/or inspection.

E. Fabrication Guidelines – Specific

These guidelines are designed to give fabricators and processors guidance on the proper construction of systems and their components.

1. Instrumentation and Related Items

Sensing elements in product contact areas shall be made from corrosion resistant, nontoxic materials, be easily cleanable, and capable of withstanding the temperatures and pressures encountered in operation and cleaning.

Where protecting wells are provided, weep holes shall be provided and shall drain to the outside.

Mercury or other toxic materials shall not be used in product zones unless enclosed within a corrosion-resistant well or case which drains to the outside of the product zone.

2. Entry Points For Instruments, Shafts, Etc.

Points which allow piping, thermometers, sight glasses, rotary shafts, and other functional parts to extend into product zones should be sealed at the point of entry or an appropriately designed drip deflecting apron provided.

Openings in horizontal surfaces should have an upward flange of at least 3/8 in. (10 mm).

3. Mechanical Agitators

Agitator drives and shafts should be shielded and/or sealed to protect the product from condensate or lubricants.

On bulkheaded tanks where the agitator motor is located outside the production area, the agitator shaft should be equipped with a sanitary seal.

Agitators should be readily cleanable and easily sanitized.

4. Shaft Seals

Shaft seals shall be of sanitary design, durable, of suitable material for the application, and be readily demountable.

There shall be at least 4 inches (100 mm) space between the driving mechanism and the seals when these parts are normally removed during cleaning.

5. Bearings

Bearings having a product contact surface shall be of a non-lubricated type and be accessible for cleaning.

Lubricated bearings are not permitted in the product contact area.

Lubricated bearings shall be mounted to provide a minimum of 1 inch (25 mm) exterior open space on the shaft between the mechanical seal for the bearing and the nearest part of the sanitary seal at the opening to the product contact area. The 1 inch (25 mm) minimum open space shall be open to the atmosphere and be easily accessible for inspection.

6. Covers and Doors

When covers or doors are provided to prevent contamination from reaching the product zone, they shall be so designed as to provide a flange which overlaps the opening and shall be sloped to provide drainage from the cover surface. Any port opening through the horizontal covers shall be flanged upward to at least 3/8 in. (10 mm) and shall be provided with a cover which overlaps the flange. All covers should be readily removable as a unit or in sections. Sliding doors, when used, shall slide easily and freely and be readily removable.

Hinges or pivots shall be designed to be easily cleaned and of simple take-apart design and construction. Piano hinges are not permissible. Sliding or hinged covers, where used, shall be constructed in such a manner as to prevent seepage of liquids, condensate or other foreign materials into the product zone. Manhole openings shall not be less than 15 inches (27.5 cm) vertical and 20 inches (50 cm) horizontal, or 18

inches (45 cm) in diameter.

The cover for a manhole in an end or side wall may be either of the inside or outside swing type. If the cover swings inside, it shall also swing outside, away from the opening. Threads or ball joints employed to attach the manhole cover(s) shall not be located within the lining. The sleeve or collar of a manhole opening for an inside swing type manhole cover shall be pitched to drain away from the opening.

A top manhole opening shall be not less than 3/8 inch higher than the surrounding area and if the exterior flange is incorporated in it, it shall slope and drain away from the opening. A top manhole opening cover shall be of the outside swing type.

7. Shields and Diverting Aprons

Shields and diverting aprons should be designed and located to prevent contaminants from draining or dropping into the container or product, or onto product contact surfaces.

Shields, diverting aprons and guards should release or detach readily for efficient inspection and cleaning.

8. Body or Frame Panels

Where fixed panels are applied to equipment the method of fastening shall be such as to minimize projections. Welding is preferred. Areas enclosed shall be accessible for cleaning.

Removable panels should be are readily accessible and easily removable. They shall be of adequate size to serve the purpose intended. Methods of attachment should eliminate bolts and screws wherever possible.

Panel construction shall be such as to minimize the collection of soil particles, spillage, and other foreign matter, and preferably without channel sections at the bottom. If channel sections are used, they shall be inverted or shall be shallow and wide enough to be easily cleanable. Clean-out holes shall be provided.

Hollow sections of double panel doors shall be sealed by welding.

9. Tracks and Guides

All tracks and guides for doors, covers and access panels shall be built in such a manner as to be easily cleaned and to minimize the collection of product particles, condensation, spillage and foreign matter. The following are examples of design features that are in compliance with this requirement:

- a. Providing open-ended clean-outs at the ends of track or guide bottoms.
- b. Stopping tracks or guides 1 inch (25.4 mm) minimum short of framing at each end.
- c. Forming tracks or guides integral with interior bottoms of the enclosure and without square corners.

10. Fastening Methods

There shall be no exposed threads on product contact surfaces except where needed for safety or functional reasons. In those instances the threads shall conform to the dimensions of the coarse "Acme" thread or the "brass valve stem thread." Refer to JA Standards.

Bolts, rivet heads, nuts, screws, projecting screws, and studs should be eliminated from product contact surfaces. Drilled and tapped holes, keyholes, sockets, and other recesses should be eliminated.

Fastening components subject to loosening or breaking and falling into the product or into the equipment should be retained by safety chains, retaining bars, or other fail-safe fastening techniques. To facilitate proper cleaning, interior fastenings should minimize projections, ledges, and recesses.

11. Framing and Reinforcing

Framing and reinforcing members should be designed and constructed to eliminate areas where product can accumulate.

Framework should be readily accessible for cleaning and maintenance.

Framework should be constructed of corrosion-resistant material or material that is rendered corrosion-resistant, nonabsorbent, durable, and cleanable. If coated, the coating should adhere.

Tubular material is preferred for framing and reinforcing.

Framing shall be constructed to provide a floor clearance of at least 6 inches (150 mm).

Structural members shall be arranged as not to form traps, recesses, or pockets. If made of hollow stock, frame members shall have the ends closed by welding. Any holes going into or passing through tubing must be into a solid sleeve that has been continuous welded to the tube to prevent contamination from entering the tube. (See Fig. 1)

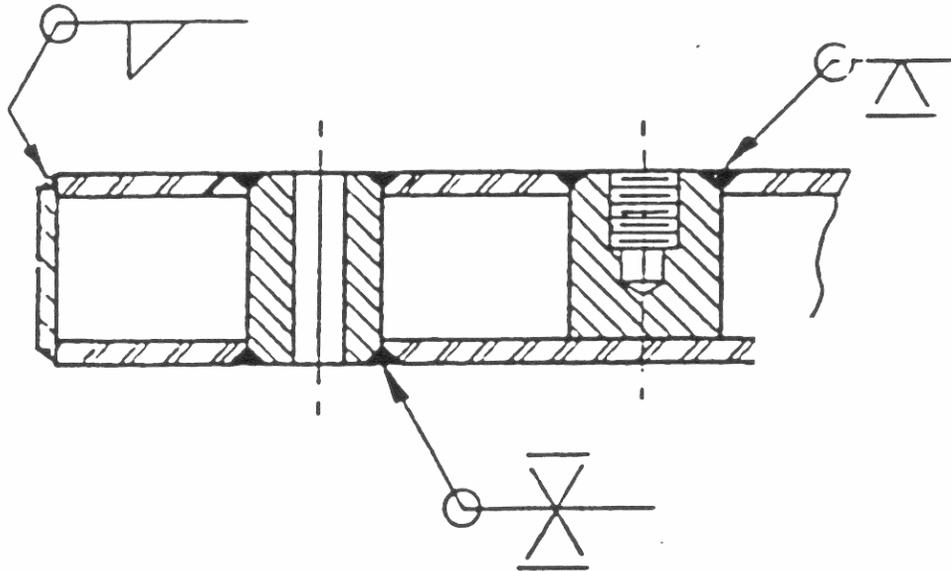


Fig. 1

Horizontal angle reinforcing should be used only when dictated by specific mechanical and/or structural requirements. Where angles are used horizontally, they should have one leg turned down, if possible, or be integrally formed with equipment sides (as for use with removable shelves or draw slides). Horizontal reinforcing angles should not be placed where product or soil can accumulate. Horizontal ledges should be kept to a minimum.

Stand-off construction should be used whenever continuous welding is not used to minimize part-to-part contact and provide suitable clearance for inspection, cleaning and air drying. Bolted construction should be utilized only when welding is not practical. Bolted construction should have a sealant applied between the mating surfaces. After tightening, excess sealant should be wiped off. Exposed threads must be capped with acorn nuts.

Eliminate the following where possible: lock washers, flat washers, socket head bolts, exposed threads, slot style bolts, counter bore holes and unused holes.

Joints and seams in the splash zone should be sealed by welding.

Set screws used to secure sprockets, pulleys, clamp blocks, etc., should be of the square head type when used in splash and product contact areas.

Clamp blocks should have a minimum .25 wide slot. (See Fig. 2)

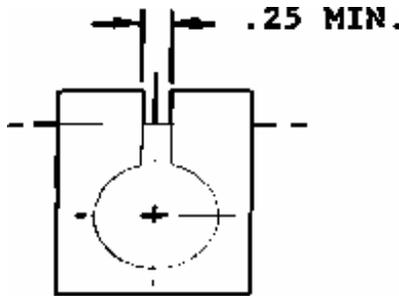


FIG. 2

Where lubrication is required, the design and construction shall be such that the lubricant cannot leak, drip or be forced into the product zone.

All housings, guards, casings, shrouds, and other enclosures which block access to machinery shall be easily removable or be provided with adequately sized, properly placed access openings for cleaning the enclosed areas. Guards should be designed to drain.

Nameplates, if present, shall be sealed to the surface. If fasteners are required, they should be round head drive screws.

12. Legs and Feet

Legs and feet shall be of sufficient rigidity to provide support with a minimum of cross-bracing and so fastened to the body of the equipment and so shaped at the floor contacts as to prevent the accumulation of soil.

Adjustable legs of the threaded type shall have no exposed threads.

Adjustable legs of the threaded or slip tube type shall have the bottom end of the leg extension sealed. The inside dimension of the leg shall be greater than the outside dimension of the leg extension. The leg extension shall, at minimum adjustment, extend at least 1 in. (25 mm) below the leg. The openings between the leg and the leg extension shall be no greater than 1/32 in. (1 mm).

Round, square, or rectangular shapes shall be used for legs. Angle or channel or similar open shapes shall not be used. The feet shall be round at point of contact with floor or be sealed to the floor or pads. Clearance of at least 6 inches (150 mm) shall be provided between the lowest part of the frame or equipment and the floor.

13. Casters

All surfaces should be corrosion-resistant or shall have a protective coating. Paint shall not be used.

Axle bolt ends should be flush, and shall not extend more than 2 1/2 exposed threads beyond the retaining nut.

Washers shall not be used between the horn and the axle retaining nut.

All removable joints shall be sealed.

All structural members shall have a minimum of horizontal flat surfaces.

Lubrication reservoirs shall be sealed and the seals shall be protected against rupture during lubrication by the use of relief fittings or other effective means. The seal should be located as close to an outer surface as possible.

A clearance of not less than 3/16 inch (5 mm) shall be provided between the horn assembly and the maximum width of the vertical surfaces of the wheel of all casters having wheel diameters of 4 inches (100 mm) or less. A clearance of not less than 3/8 inch (10 mm) shall be provided between these same surfaces of casters with wheels larger than 4 inches (100 mm).

A clearance of not less than 1/4 inch (6 mm) shall be provided between the horn assembly and the rolling surface of wheels 4 inches (100 mm) and smaller. A clearance of 1/2 inch (12 mm) shall be provided between these same surfaces on casters with wheels larger than 4 inches (100 mm).

The plate mounting shall be constructed to have a flat top surface. The angle between the top surface and the edge of the plate shall be 90° or less.

Mounting holes and other devices provided for installation shall be so designed as to prevent the formation of pockets, patterns or areas difficult to clean.

The horn assembly or fork shall be constructed so that the surface facing the wheel shall have no concave surface except that part joining the horn plate.

Kingpin assemblies, which have the nuts or rivets at the bottom shall have suitable caps covering the ends.

Axles shall be so constructed that cotter pins or castellated nuts are not used.

Caster wheels should be constructed so as to have no concave surfaces facing the horn assembly except that part which joins the hub. The included angles between all vertical and horizontal surfaces shall have a radius of not less than 1/4 inch (6 mm). Caster wheels shall have solid webs.

Brakes and locking devices when attached to caster assemblies or wheels shall be easily cleaned.

14. Electric Motors and Accessory Equipment

Motors and accessory equipment shall have a minimum of 2 inches (50 mm) clearance between the lowest part of the assembly of the motor or accessory equipment and the mounting surface. This clearance may be provided by spacers which shall be no larger in area than the feet of the motor or accessory equipment. Spacers shall be sealed.

Face-flange or base-mounted motors or accessory equipment with machined surfaces are permitted if sealed.

Mounting feet shall be designed and constructed so that all joints of the support to the frame shall have an included angle of more than 90° and have a minimum internal radius of 1/4 inch (6 mm) .Creation of the radii does not preclude the use of nontoxic, permanently bonded, filler material.

There should be no indentations and like concave surfaces in end bells and center housing castings. Bolt heads and nuts shall not be recessed.

Cooling fans of totally enclosed fan-cooled motors shall be removable.

Covers for cooling fans of totally enclosed fan-cooled motors shall be securely fastened and removable.

The conduit box shall be mounted on the housing so that all connecting surfaces shall have a minimum radius of 1/4 inch (6 mm) .The conduit box shall be sealed or integral with the frame.

In the absence of a conduit box, leads may be brought out of the housing as a connecting cable, provided the cable is sealed to the housing. The point of entry of the cable through the housing shall be no larger in diameter than is required for proper sealing.

Connecting cable shall be supported at least 6 inches (150 mm) off the floor, if attached to framework they must be attached on at least 1 inch (25 mm) standoffs.

15. Processing and Electrical Control Systems

Electrical systems should meet all applicable requirements and codes. Conduits should be sealed, cleanable, and constructed of noncorrosive material. Electrical boxes in splash-contact areas should be treated as a splash-contact, surface.

The electrical system, including wiring, should be located and designed to prevent seepage or spillage of cleaning solutions, product, and water splash into electrical equipment.

Control enclosures should be constructed and/or mounted to provide an exterior drainage angle of a 1/8 in. per ft. (10 mm per m) away from enclosure seals. There

should be a drainage angle of a 1/8 in. per ft. (10 mm per m) inside the enclosure toward a drain.

All electrical enclosures shall be sealed to the mounting surface or shall be spaced away at least 1 inch (25 mm) or at a distance equal to one-fifth of the shortest dimension of the electrical enclosure parallel to the surface, whichever is greater, but not necessarily more than 18 inches (460 mm).

Leads penetrating electrical and pneumatic control panels should be directed away from the enclosure for natural drainage.

Conduit should be installed so that it does not form hard-to-clean areas or crevices against adjacent surfaces, including supports. Flexible conduit should have a smooth external surface. Conduit should be installed at least 1 in. (25 mm) from any surface.

Recessed push button switches shall be installed with boots. "Touch pad" panels should be used in splash zones.

16. Louvers and openings

Louvers or openings located in the splash zone shall be of drip deflecting design. Louvers shall be large enough, or so spaced, to allow for ease of cleaning between louvers and shall be free of sharp edges and burrs.

17. Venting Ducts and Hoods

Ducts and hoods shall be designed, constructed and located so that condensate, grease, carbon or other extraneous substances cannot drip or fall into the product zone.

Ducts and hoods shall be designed and constructed so the entire interior is accessible. Internal protrusions such as screws, bolt heads, nuts, rivets and similar projections shall be eliminated.

Ducts shall be designed, constructed and assembled so that the joints are sealed or the sections removable.

Ducts which are not removable, but adjacent to a fixed surface, shall either be sealed thereto, or the duct shall be spaced away from the fixed surfaces a distance equal to one-fifth (1/5) of the width of the duct, except that such distance shall not be less than 2 inches (50 mm).

18. Coil Springs

Coil spring having product contact surface should have at least a 3/32 inch (2 mm) openings between coils, including the ends when the spring is in the free position.

19. Conveyors

This applies to the design and construction of all types of product conveyors, and any directly related equipment for the handling of packaged products.

Conveyor belts having shall be endless. Belts which have absorbent core material shall have the edges sealed. The sealant shall comply with Food and Drug Administration regulations, CFR Title 21 Part 173. If wicking of liquids does not occur, sealing the edges of the belt is not required. Open belting and plastic link conveyors should be provided with an integral mechanical cleaning device that is located so all exposed surfaces of the belting and sprockets are automatically cleaned. Cleaning solution catch pans or trays shall be designed to be self draining and be assessable for cleaning and inspection.

Wire or rod type belts shall have a minimum of 3/8 inch (10mm) space between the rods and shall be easily removable or provided with facilities for in-place cleaning.

The spaces between slats on slat conveyors shall be wide enough to facilitate cleaning and shall not be less than one-half of the depth of the slats, with a minimum of 1/2 inch (12mm) between slats.

Conveying surfaces shall be supported by the minimum amount of carrying surface or bed necessary. Rods, slats, rollers or like supports shall be used where practical.

The area between the top and bottom belt and the side frame areas shall have at least a #4 finish and be of sanitary construction on all conveyors used for direct product contact. All welds shall be continuous, and ground and polished to a #4 finish. The minimum radii shall be 1/4 inch.

Rollers, pulleys, and sprockets shall be free of end recesses, cracks, and crevices. Plastic rollers and pulleys shall be of single piece construction.

The joints between rollers, pulleys, and sprockets and the shafts on which they are mounted shall be welded, or provided with sufficient clearance for cleaning. The head and tail sections, including take-up devices and brackets shall be considered food contact surfaces and shall be easily cleanable. Brackets shall be mounted with at least 1/2" clearance between the brackets and the conveyor frame. Take-up devices shall be free of "V" type threads or have the exposed threads encapsulated in a sealed tube. ACME type threads are permitted.

The belt tension device shall be easily released on conveyors not designed for CIP.

Scrapers, brushes, or other attachments used to prevent accumulation of deposits on belt surfaces or pulleys shall be removable. Attachments shall be of sanitary construction.

Drip or catch pans shall be provided under all scrapers, brushes, or other continuous cleaning attachments and shall be readily removable or readily accessible and shall not rest on the floor.

Easily removable guards shall be provided to keep the product from contacting conveyor drive chains and other lubricated surfaces.

Conveyors which run partially submerged in brine systems are required to meet the direct product contact construction requirements in all areas. The conveyors shall be designed so they can be easily removed from the brine for cleaning as needed. Such conveyors shall not be cleaned while in the brine tank or flume unless the tank or flume has been drained.

Bearings having a product contact surface shall be of the non-lubricated type. Lubricated bearings, including the permanent sealed type, shall be located outside the product zone with at least 1 inch clearance between the bearing and any product contact surface. Standard bearing units such as pillow blocks, flange blocks, etc. shall be of corrosion resistant material. Pillow blocks shall be free of recesses. Pillow blocks shall be mounted on at least 1 inch (25mm) spacers.

Drive mechanisms should be mounted below or at side of the product zone and off the floor. Drive mechanisms above the product zone shall have drip pans which are readily removable or readily accessible for cleaning.

Non-product contact surfaces shall have a finish that can be readily cleaned and shall be relatively free of cracks and crevices. See Reinforcing and Framing (section 11).

All surfaces and areas where product or foreign material accumulate shall be readily accessible.

20. Brine Systems Salt Storage

Bulk storage vessels must be nontoxic and resistant to corrosion, be good repair, and be weather tight. If in bags they must be held in a dry product ingredient environment.

Brine Makeup Tanks

If the makeup tank is separate from the brine system the construction must be equivalent to the salt storage vessel only.

If the makeup tank is an integral part of the brine system and brine is recirculated back into this tank then the finish shall be visibly smooth and free of cracks, pits and crevices.

All brine makeup tanks must be easily accessible for cleaning.

Brine Tanks

The finish shall be visibly smooth and free of cracks, pits and crevices. Uncovered concrete or exposed grouting is not acceptable.

Radii for internal angles shall be at least 1 inch.

Stainless steel tanks should be made from 316 L Series or equivalent stainless steel. A 2B mill finish is satisfactory. All welds shall be continuous and be free from cracks, pits and crevices.

All tanks shall be located at least 24 inches from the wall and other equipment.

The distance from the bottom of the tanks to the floor should be as follows:

Tank Width	Minimum Clearance
3- 6 Feet	20 Inches
6- 8 Feet	22 Inches
8 Feet and Up	24 Inches

Piggyback tanks shall be separated by the following minimum distance. This also applies to the distance between the top tank and the ceiling (including joists and beams).

Tank Width	Minimum Clearance
3- 6 Feet	18 Inches
Over 6 Feet	24 Inches

Piggyback tanks shall be provided with sanitary means for personnel access to the upper tanks.

Spray Distribution Systems

Plastic or rigid PVC piping suitable for potable water systems may be used for the transport of brine. Brine piping shall be rigidly supported and self draining.

Access points shall be provided and their location noted on the plans.

Valves for use on brine distribution piping shall be non-toxic and non-corrosive.

Threaded fittings may be used for brine spray nozzles.

Pumps shall be sanitary in design but need not have a polished finish.

Conveyors and Related Equipment

Conveyors located totally in the brine or partially submerged in brine shall be designed and installed in a manner so they can be easily removed for cleaning.

Conveyors located outside of the brine shall be designed to be easily cleaned. Refer to conveyor guidelines for construction.

Screens Used For Fat and Foreign Material Removal

Drum type screen systems and their housing shall be constructed with sanitary design principles in mind. A polished finish is desirable but not mandatory.

A CIP system shall be incorporated into all enclosed screen systems.

Membrane Systems

For the purpose of defining construction requirements the membrane system shall be considered as a separate entity from the rest of the brine system. Typically these systems are washed via CIP once per day.

During the cleaning cycle the membrane system shall be separated from the other portions of the brine system by a complete physical separation or by at least two automatically controlled valves with a drainable opening to the atmosphere equal to the largest pipeline size and the valves should be position detectable.

Construction of the system shall conform with the "3-A Sanitary Standards For Cross flow Membrane Modules" and "3-A Accepted Practices For The Sanitary Construction Installation and Cleaning of Cross flow Membrane Processing Systems For Milk and Milk Products".

21. Mechanical Washers

All interior surfaces of the washer shall have a smooth finish, free of pockets, cracks and crevices, and be easily cleanable.

All interior angles and welds must meet the criteria for product contact surfaces and be properly radiused. See Sections 3, 4, & 5. This does not preclude the use of chain drives or chain link conveyor belts if deemed to be of a sanitary design by the Department.

All doors and covers shall be designed so that when closed, condensate, wash water, or rinse water shall drip within the confines of the tank or housing.

Curtains shall be removable, made of non-toxic and non- absorbent material, and be readily cleanable.

All water and solution tanks shall be designed to drain completely. Blowers and other air handling equipment which may collect water shall be designed to drain.

Vapors shall be exhausted to the outside by vent fans through a vent opening or duct work.

Fans shall be accessible.

Air ducts shall be provided with openings or removable sections to permit visual inspection and cleaning.

Materials used in air handling equipment and exhaust ducts shall be corrosion resistant.

A continuous type equipment washer should have a pre-rinse section, power wash section, and a post-rinse section. A sanitizing section shall also be provided unless other means of sanitizing are employed.

The power wash and rinse sections shall provide sufficient volume, pressure, exposure time, and coverage to thoroughly wash and rinse the equipment.

The lowest point of the fresh water inlets on solution tanks shall be located not less than 1 inch (25 mm) or twice the fresh water inlet pipe diameter, whichever is greater, above the maximum overflow level of the tank. The inlets shall be placed at a point remote from the overflow.

Pump inlets for wash and rinse tanks shall be protected by strainers. Strainers shall have openings smaller than the spray nozzle orifices. Strainers shall be readily removable for cleaning.

Pumps and motors shall be mounted in such a way as to provide easy access for cleaning and maintenance.

Spray pipes shall have removable end fittings.

Spray nozzles shall be constructed to minimize clogging and shall be accessible or removable.

Submerged heating coils bolted to solution tanks shall be the smooth welded or brazed type. Submerged fin coils shall not be used. There shall be a minimum distance of 1 1/2 inches (40mm) between outer coil surfaces and adjacent bottom or side tank walls.

All submerged heating coils bolted to solution tanks shall be removable or accessible. All permanently installed submerged heating coils continuously welded to the solution tanks shall be designed to be cleaned in place.

Insulation shall be enclosed and sealed. See section 8.

Batch-type washers shall be so designed as to allow free circulation of water to all surfaces of the equipment or utensils being washed.

22. Air Supplies

Air that is introduced into ingredients or directed toward product contact surfaces should meet the applicable provisions of the "3-A Accepted Practices for Supplying Air Under Pressure in Contact with Milk, Milk Products and Product Contact Surfaces".

Air lines should be sloped at 1/10 inch (2 mm) per foot toward a drain point, away from the product. Branch lines should originate from the topside of parent lines.

A disposal media filter should be located in the sanitary air pipeline upstream from and as close as possible to each point of application or ultimate use of the air. The efficiency of the final filter shall be 99% at 1 micron. The piping between the final filter and point of use should be sanitary.

A sanitary check valve shall be provided downstream from the filter media whenever there is a possibility of product entering the air line.

Filter units should be designed and located to be readily accessible. A differential pressure indicator that shows filter conditions should be installed on each filter unit.

Mechanical fans and blowers should be cleanable, and noncorrosive. Air intakes should be located at least 20 in. (50 cm) above the floor. The efficiency of intake filters shall be 98% at 1 micron.

Flexible air lines should be enclosed in sealed conduits and watertight junction boxes with bulk head fittings and a minimum length of flexible tube exposed.

CO₂ or other gases mechanically introduced into the product or product zone shall be filtered. The filter shall have an efficiency of 99% at 1 micron.

23. Culinary steam

If the equipment provides for direct injection of steam into the product, the steam must be produced in accordance with the "3-A Accepted Practices for a Method of Producing Steam of Culinary Quality," or by an acceptable reboiler method.

The steam piping connections to the product contact surfaces shall be made in such a way that product cannot enter the steam lines. The connections, check valves, etc., shall be sanitary and be easily removable for cleaning and inspection.

24. Vacuum Applied to Product

Vacuum equipment shall be equipped with a readily removable sanitary check valve to prevent the return of materials from the vacuum line. Vacuum lines between the check valve and trap shall be sanitary construction and be readily removable.

Vacuum lines from the equipment to the trap shall be of sanitary construction and installed with at least 1/8 in. (6 mm) slope per foot toward the trap.

Vacuum traps shall be easily cleaned and readily removable.

Vacuum relief valves shall be easily cleaned and readily removable.

F. EQUIPMENT INSTALLATION GUIDELINES

These guidelines are provided to enable the processor to derive the full benefits of sanitary design and construction.

All equipment shall be designed and installed to permit complete access to all areas for inspection and cleaning.

Equipment shall be installed with at least 2 feet of clearance on all sides and the top.

Sufficient clearance shall be provided for the use of access and inspection openings and to permit the convenient removal or full opening of covers, doors, and panels, as well as catch pans and drip pans.

Surfaces adjacent to the installed equipment shall be readily accessible or the equipment shall be sealed to the adjoining surfaces.

Where equipment passes through walls, ceilings, or floors, either sufficient clearance to permit cleaning shall be provided between the equipment and the finished opening or the equipment shall be sealed to the adjoining surface.

Fixed equipment resting on floors or pads shall be supported by sanitary legs or shall be sealed to the floors or pads.

Equipment shall be installed on hard, even-surfaced foundations or floors which are easily cleanable and nonabsorbent.

Structural bracing shall be fabricated from rounded or rectangular shaped stock which minimizes horizontal surfaces and recessed areas. Such bracing shall be sealed at points of attachment.

Overhead rails shall be installed so that all parts of trolleys and rails are readily accessible'. Overhead rails, trolleys, and hoists shall be designed or installed or shielded to preclude product contamination.

Openings for product chutes through a floor shall be installed with a curb which shall be a minimum of 6 inches (100 mm) above floor level. Such openings shall be provided with overlapping covers when not in use.

Pans used to collect spillage or drippage shall be readily accessible or readily removable, and shall be large enough to catch all spillage or drippage. Fixed pans shall have drains and be pitched to ensure complete drainage away from the product zone.

Exhaust stacks, ducts, and hoods shall be so designed, constructed and installed as to be accessible for inspection and cleaning. Stacks shall be installed with a minimum of horizontal sections.

Inlet or exhaust openings shall be provided with a suitable means to exclude foreign materials.

Water used for air scrubbing, air humidifying, and evaporative cooling shall be from a potable source.

The potable water system shall be installed to preclude the possibility of back flow.

All drains from equipment shall be installed with an air gap.

Liquid ingredient inlet pipes, valves, and fittings shall be of sanitary take-apart type and shall be pitched for self-draining.

Utility piping and supports shall be installed so that all exterior surfaces are readily accessible. Sufficient clearance shall be provided between pipe runs and adjacent surfaces so that both the pipe and the adjacent surfaces are readily accessible. Hanger rods shall have a minimum thread length. Where used, "continuous thread" rods shall be coated or sealed with a covering.

Equipment shall not be installed under sewage or drainage lines unless provided with proper shielding.

All fixed piping subject to condensation shall be insulated. Insulation, unless enclosed and sealed, shall be nonabsorbent.

Floor drains shall be trapped and shall be so located, and the floor so pitched as to effect complete drainage.

All light bulbs, lamps, and tubes shall be protected against falling, and shall be shatter-resistant, housed in shatter-resistant fixtures, or otherwise protected against breakage.

Electric cords and flexible air lines shall be pendant without touching the floor.

The electrical wiring system shall be constructed so that dust shall not enter. When located in a wet or washdown area, the electrical system shall be constructed so that liquid shall not enter.

All electrical enclosures shall be sealed to the mounting surface and any adjacent surface, or shall be spaced away at least 1 inch (24 mm) or a distance equal to one-fifth of the shortest dimension of the electrical enclosure parallel to the surface whichever is greater, but not necessarily more than 18 inches' (48 mm).

Conduits shall be installed so that hard-to-clean areas or crevices are not formed, or shall be spaced away from adjacent surfaces at least 1 inch (24 mm) to allow for cleaning. Flexible conduit and fittings shall be liquid-tight.

Fans, motors, and accessory equipment shall be mounted so as to be accessible.

Motors and accessory equipment should be mounted on the driven unit and off the floor.

A minimum of 2 inches (48 mm) clearance between the lowest part of the assembly of the motor or accessory equipment and the mounting surface shall be provided.

Face-flange or base-mounted motors or accessory equipment with machined surfaces are permitted if sealed.

G. EQUIPMENT REVIEW PROGRAM

This program is the basis for fair and uniform application of requirements for the sanitary design and construction of equipment. This program applies to new, used, modified and reconditioned equipment.

The Equipment Review Program focuses on correcting problems during the initial development of equipment instead of resolving problems which may result when improperly designed or constructed equipment is put into use. This preventive mode of action benefits both equipment manufacturers and food processors and ultimately consumers.

The acceptance of new, modified, or reconditioned equipment for use in Wisconsin dairy and food plants is a two-step process. First, DFS Food Safety Consultants evaluate the design and construction of equipment by reviewing assembly type drawings with correlated parts and material lists. Then, if necessary, a DFS Food and Dairy Specialist will review the equipment at the manufacturing facility.

Equipment manufacturers, distributors, or plant operators should submit the assembly type drawings to:

Mail to:
DATCP
Division of Food Safety
Equipment & Process Specialist
PO Box 8911
Madison WI 53708-8911

Ship to:
DATCP
Division of Food Safety
Equipment & Process Specialist
2811 Agriculture Drive
Madison WI 53718

Phone: 608-224-4700
Fax: 608-224-4710

The division will issue a letter of compliance to the equipment manufacturer for all equipment reviewed and found in compliance with Wisconsin Dairy and Food Regulations

Information on the 3-A Sanitary Standards program:

3-A Sanitary Standards, Inc.
6888 Elm St Suite2D
McLean VA 22101-3829

Phone: 703-795-0295
Fax: 703-761-6284