

# WISCONSIN DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

## GUIDELINES FOR FOOD PROCESSING EQUIPMENT DESIGN AND CONSTRUCTION

### A. Purpose

The guidelines for equipment construction outlined in this document may not apply in its entirety to all food products. **Products which may not require the full use of these guidelines include pickles, sauerkraut, powdered sugar, oils, and other non-potentially hazardous type food products.**

It is intended that these Guidelines provide design criteria that will result in equipment that:

1. Exposes quickly for cleaning and inspection with tools normally used by operating or cleaning personnel. However, disassembly should not be assumed necessary for proper cleaning of all components and equipment.
2. Can be efficiently cleaned and sanitized in all product contact and non-product contact areas of the equipment skin and control enclosures; processing surfaces, mechanisms, drives, frames and feet.
3. Avoids materials, which deteriorate in their use environment or contaminate the product.
4. Isolates the product from contact with contaminants.
5. Contains no areas, inside and outside, where the product or contaminants may be trapped.
6. Contains no areas that may harbor vermin or lead to infestation.
7. Inhibits undesired microbiological growth in product.
8. Prevents nuisance spillage of product.
9. Prevents unnecessary air movements and the formation of aerosols.

### B. Definitions

1. **Product shall mean any food product.**
2. **Product Contact Surface:**

Shall mean any surface that is exposed to product or from which liquids may drain, drop, be drawn or mechanically blown into the product or a container; any surface that touches a product contact surface of a container; any surface from which particles may be dislodged to drop, except the part of the equipment handling raw agriculture products (fruits & vegetables) that comes

in contact with the product from point of receipt and continuing to the end of initial wet cleaning operation.

**3. Splash Contact Surface:**

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

**4. Non-Product Contact Surfaces:**

Shall mean any surface, other than a product contact surface, and splash contact surfaces, specifically including surfaces that are shielded, covered, or guarded (as in the case of mechanisms, drives, frames, etc.).

**C. Materials**

**1. General Considerations:**

The materials used in equipment construction should be able to withstand normal wear and the corrosive action of foods, cleaning compounds, and other such elements as may be found in the use environment. The materials used shall not impart an undesirable odor, color, or taste to the food, contribute to contamination, or allow penetration by vermin. The material shall be compatible with the specific type of food being processed.

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

**2. Non-Product Contact Surface**

Non-product contact surfaces should either be cleanable and of corrosion-resistant materials, or rendered corrosion-resistant with a nontoxic material which resists cracking, chipping, and de-lamination.

**3. Splash Contact Surface**

Splash 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.

**4. Product Contact Surface**

Product contact surface materials shall be smooth, cleanable, corrosion-resistant, and nontoxic. The surfaces shall be durable and nonabsorbent under use conditions. In addition, they shall not impart undesirable odors, colors, or tastes, or contribute to the adulteration of food.

**Specific Equipment Construction Materials:**

• **Aluminum:**

Aluminum is satisfactory for certain produce 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.

- **Special Use 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.
- **Cast Iron:**
  - (1) Cast iron may not be used for utensils or food contact surfaces of equipment except as follows:
  - (2) Cast iron may be used as a surface for cooking.
  - (3) Cast iron may be used in utensils for serving food if the utensils are used only as part of an uninterrupted process from cooking through service.
- **Lead in Ceramic, China, and Crystal Utensils:**  
Ceramic, china, crystal utensils, and decorative utensils such as hand painted ceramic or china that are used in contact with food shall be lead-free, (Defined as .05% or less).
- **Copper, Brass, Bronze:**
  - (1) Copper and copper alloys such as brass & bronze may not be used in contact with a food that has a pH below 6 such as vinegar, fruit juice, or wine or for a fitting or tubing installed between a backflow prevention device and a carbonator except in the following instances:
  - (2) Copper and copper alloys may be used in contact with beer brewing ingredients that have a pH below 6 in the pre-fermentation and fermentation steps of a beer brewing operation such as a brewpub or microbrewery.
- **Galvanized Metal:**  
Galvanized metal may not be used for utensils or food contact surfaces of equipment that are used in contact with acidic food.
- **Sponges:**  
Sponges may not be used in contact with cleaned and sanitized or in-use food contact surface.
- **Lead in Pewter Alloys:**  
Pewter alloys containing lead in excess of 0.05% may not be used as a food contact surface.
- **Lead in Solder and Flux:**  
Solder and flux containing lead in excess of 0.2% may not be used as a food contact surface.
- **Wood:**
  - (1) Wood and wood wicker may not be used as a food contact surface except as follows:.
  - (2) Hard maple or an equivalently hard, close grained wood may be used for:
    - (a) Cutting boards; cutting blocks; bakers' tables; and utensils such as rolling pins, doughnut dowels, peel boards, proof boards and salad bowls; **and**

(b) Wooden paddles used in confectionery operations for pressure scraping kettles when manually preparing confections at a temperature of 230F or above.

(3) Whole, uncut, raw fruits and vegetables, and nuts in the shell may be kept in the wood shipping containers in which they were received, until the fruits, vegetables, or nuts are used.

(4) If the nature of the food requires removal of rinds, peels, husks, or shells before consumption, the whole, uncut, raw food may be kept in:

(a) Untreated wood containers; **or**

(b) Treated wood containers if the containers are treated with a preservative that meets the requirements specified in 21 CFR 178.3800 Preservatives for wood.

- **Nonstick Coatings:**

Multiuse kitchenware such as frying pans, griddles, sauce pans, cookie sheets, and waffle bakers that have a perfluorocarbon resin coating shall be used with non-scoring or non-scratching utensils and cleaning aids.

5. **Single Service and Single Use ;**

Materials that are used to make single service and single use articles:

(1) **May not:**

(a) Allow the migration of deleterious substances, **or**

(b) Impart colors, odors, or tastes to food **and**

(2) Shall be:

(a) Safe, **and**

(b) Clean

6. **Engineer 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)

7. **Engineering Plating (Electroless)**

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

8. **Plastic or Composite Material**

Plastic or composite materials used in the construction of equipment shall be cleanable, corrosion-resistant, and nontoxic.

Plastic materials 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.

Bonded plastic materials having product contact surfaces that are a bonded coating or a covering 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 and in cleaning and bactericidal treatment. Plastic bonded coatings shall comply with CFR's section 177.

9. **Rubber Materials**

Rubber and rubber-like materials 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.

Bonded rubber and rubber-like materials having product contact surfaces that are a bonded coating or a covering 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 and in cleaning and bactericidal treatment.

Rubber and rubber-like material shall comply with CFR section 177.

#### **10. Adhesive**

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

#### **11. Gasket and Seal Material**

Gasket and seal materials should not break down under use conditions. They should be nonabsorbent and unaffected by the foods or the environment with which they are in normal contact. Material used shall be impervious to penetration and harborage of microorganisms, and suitable for the cleaning and sanitizing methods used for the equipment of which they are a part.

Gaskets shall be nontoxic, nonabsorbent, and shall not affect or be affected by the product, ingredients, or cleaning and sanitizing compounds, and 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.

#### **12. Inspection Windows, Sight Glasses, and Light Ports**

Materials used for inspection windows, sight glasses, and light ports shall be shatter-resistant and resistant to scratches, chips, or nicks under normal conditions of use, cleaning, and sanitizing.

#### **13. Silver Solder**

Solder, when used, should be silver solder and shall be corrosion-resistant, free of cadmium, lead and antimony, nonabsorbent, and shall not impart any toxic substance to the product when exposed to the conditions encountered in the environment of intended use and in cleaning and bactericidal treatment.

#### **14. Protective Coating**

Protective coatings shall prevent corrosion of the base material, shall not affect or be affected by the substances in contact with it, shall be nontoxic, nonabsorbent, shall not impart an odor or taste to the product, and shall be bonded to the underlying surface so as to be resistant to chipping and peeling. It shall have a durable, smooth surface without breaks exposing the base material, shall resist abrasion in ordinary use, and shall maintain its surface characteristics under prolonged influence of the environment such as the product, and cleaning and sanitizing agents.

### **D. General Fabrication Principles**

General Considerations: Equipment should be designed and constructed to be cleanable. The design and construction of equipment shall not contribute to or promote the contamination of the product with lubricant, metal fragments, glass, contaminated water, or other contaminants. Steam, condensate, process air, and water should be included in this consideration.

Equipment should be designed and constructed so that ingredients or product can be added, processed, finished, dispensed or removed in a sanitary manner.

Equipment should be easily disassembled for cleaning or inspection when needed. Equipment shall be free of areas, inside and out where product or contaminants can be trapped or stagnate.

## 1. Surface Finish

All product contact surfaces shall have a smooth uniform surface free of pits, crevices and scale. Within the product zone, surface roughness height shall be no greater than 32 micro inches Ra. 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 milk finish on stainless steel sheets if the finish is free of defects, such as pits, chips or flakes.
- c. A finish obtained by 150 grit silicon carbide properly applied to stainless steel.

Glass beading or sand blasting of product contact surfaces is acceptable 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. (Glass beading or sand blasting are not an acceptable alternative to required grinding and polishing of welded junctures to #4 finish smoothness). Non-product contact surfaces shall have a smooth finish, be free of pockets and crevices and be readily cleanable.

## 2. Permanent Joints and Seams

All permanent joints in metallic product contact surfaces shall be continuously welded. If it is impractical to weld, you might consider assembling and continuously brazing them (joining by various brazing processes sometimes termed silver-soldering) in a continuous manner that will be rigid and without pockets or crevices. Welded and silver soldered or brazed areas of product contact surfaces should be at least as smooth. All joints and seams in the food zone shall be sealed and sanitary, and shall be free of recesses, gaps, crevices, protruding ledges, inside shoulders, and dead ends. All joints and seams in the splash zone shall be sealed. Horizontal joints shall be made by overlapping sheets of suitable material so as to eliminate soil-catching horizontal ledges. Permanently joined surfaces with a total included internal angle less than 135° shall have a radius of not less than 1/4 inch mm.

## 3. Non-Permanent Joints

Non-permanent junctures which are intended for dismantling and manual cleaning are to be constructed so they are easy to disassemble without the use of special tools.

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.

Gasketed joints shall be installed in a manner which results in a true fit with a substantially flush interior surface. Exposed edges of gaskets shall be readily cleanable and shall be installed in a manner that results in a true fit to prevent

creating recesses or ledges between the gasketed parts. Where 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.

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

#### **4. Drainage**

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.

#### **5. Accessible**

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

#### **6. Fittings/Connections**

Fittings shall be of a sanitary design with a means of self-centering the gasket. Pumps, piping, valves and fittings used to dispense or convey frying fats, batter, glaze, icings, jellies and fillings shall be of sanitary, take-apart type at least equal to 3A Standards, and shall be accessible for inspection and cleaning.

#### **7. Tubing & Valves**

The tubing & valves shall be of stainless steel or other approved material.

#### **8. Flexible Connectors/Hose**

Flexible connectors/hose shall be equipped with sanitary fittings.

#### **9. Instrumentation and Related Items**

Sensing elements to be immersed in the food contact areas shall be made from corrosion resistant, nontoxic materials designed to prevent food contamination, be easily cleanable, and capable of withstanding temperatures, pressures and other abuses encountered in operation and cleaning methods. Where protecting wells are provided, weep holes shall be provided and shall drain to the outside of the product zone. 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.

#### **10. Gaskets (also see Radii)**

Gaskets shall be non-toxic, non-absorbent, non-exuding and self-lubricating, and shall not affect or be affected by the product, ingredients, or cleaning and sanitizing compounds, and 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.

Gaskets having a product contact surface should be removable or bonded.

Bonded rubber and rubber-like materials and bonded plastic materials having product contact surfaces should be processed to form a bond that is continuous and mechanically sound when exposed to use conditions.

Grooves in gaskets should be no deeper than their width and the minimum radius on any internal angle should not be less than a 1/8 in. (3 mm) unless the gaskets are readily removable and reversible for cleaning.

Gasket grooves or gasket retaining grooves in product contact surfaces for removable gaskets should not exceed 1/4 in. (6 mm) in depth or be less than a 1/4 in. (6 mm) wide except those for standard O-rings smaller than a 1/4 in. (6 mm).

#### **11. Radii (also see Gaskets)**

All internal angles of 135 degrees or less on product contact surfaces should have radii of not less than a 1/4 in. (6 mm).

The radii in gasket grooves or gasket retaining grooves, except for those for standard 1/4 in. (6 mm) and smaller O-Rings, should not be less than a 1/8 in. (3 mm).

The radii in groove for standard 1/4 in. (6 mm) O-Rings should not be less than a 3/32 in. (2 mm) and for standard 1/8 in. (3 mm) O-Rings not less than a 1/32 in. (1 mm).

The minimum radii for fillets of welds in product contact surfaces should not be less than 1/4 in. (6 mm) except; fillets of welds where one or both of the pieces being joined are 3/16 of an inch thick or less, in which case the radius shall be not less than 1/8 in. where necessary for functional reasons, such as intricately machined parts. Where the radii are less than 1/32 in. the product contact surfaces are to be readily accessible for inspection and cleaning. Radii in holes for retaining pin shall not be less than 5/64 in.

#### **12. Internal Corners and Angles**

Internal corners and angles in product contact areas should: 1) be welded; 2) have an equal or better surface finish than those being joined, and 3) be formed with sufficient radii to eliminate sharp edges which may interfere with drainage. 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. When for functional reasons the radius must be less, the product contact surfaces should be accessible for cleaning and inspection.

#### **13. External Corners and Angles of Food Contact Surfaces**

All external corners and angles in the food zone shall be sealed, shall have an equal or better surface finish than surfaces being joined, and shall be formed with sufficient radii to eliminate sharp edge(s) which might be an accident hazard, or which may interfere with proper drainage.

#### **14. Pumps**

Pumps shall be of a sanitary design meeting product contact surface requirement. Pumps, piping, valves and fittings used to dispense or convey frying fats, batter, glaze, icings, jellies and fillings shall be of sanitary, take-apart type at least equal to 3A Standards, and shall be accessible for inspection and cleaning.

#### **15. Tanks and Hoppers**

Tanks and hoppers shall be made of materials which do not deteriorate due to their use or environment, or allow degradation or contamination of the product. Tanks and hoppers should be cleaned in place; if CIP methods cannot be utilized, the equipment shall be readily cleanable. That portion of the metal used to join the inside tank lining to the outer wall shall be integral with or welded to the inside lining and shall be sloped or so arranged that all drainage will be away from the product zone.

Tank bridges shall be pitched to the outside of the tank for complete drainage and shall have a raised rim of at least 10 mm (3/8 inch) where edges meet covers. Bridges shall be installed so that the underside is readily accessible from outside the tank.

The exterior of processing tanks shall be of corrosion resistant material.

If the lip or edge of a tank, cover or bridge is rolled, the arc of roll shall not exceed 180° and the returned edge shall be at least 20 mm (3/4 inch) from the adjacent surfaces.

When drive mechanism is supported on a bridge across the top of the tank, the support members shall be made of corrosion-resistant material, and if made of channel, Channel shall be pitched from center to outside for drainage. All other supports attached to the bridge shall be of corrosion-resistant material, or shall be provided with a protective coating. The bridge shall be provided with a minimum radius of 6 mm (1/4 inch) at its joining to the top side of the kettle.

## **16. Covers and Doors**

When covers or doors are provided to prevent contamination from reaching the food 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 1/2 in. (12 mm) and shall be provided with a cover which overlaps the flange. Covers shall be designed with sufficient clearance to avoid contact with foods that they cover. 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 food zone when the covers are closed or opened unless other comparable means of egress are provided, a manhole shall be provided at the drainage end or side of the tank. The dimensions of the manhole opening shall be not less than 380 mm (15 inches) vertical and 500 mm (20 inches) horizontal, or 460 mm (18 inches) in diameter. The cover shall be of the inside-outside swing-type and shall be readily removable.

## **17. Mechanical Agitators**

Agitator drive shafts should be sealed. Internal agitator parts should be treated as product contact surfaces. Agitators, should be readily cleanable and easily sanitized, disassembled, and stored. In addition, agitator drives and shafts shall be shielded and/or sealed to protect the product from condensate or lubricants. In the case of top mounted agitators on bulk headed tanks where the agitator motor is located outside the production area, the agitator shaft shall be equipped with a sanitary weather tight seal.

## **18. Shaft Seals**

Seals for rotary shafts shall be of sanitary design, durable for the application, and be readily demountable.

There shall be at least 4 inches (102 mm) space between the driving mechanism and the seals when these parts are normally removed during cleaning. Shaft seals shall be self- or product-lubricated and ready cleanable.

## **19. Bearings**

Bearings having product contact shall be nonlubricated type and 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 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 minimum open space shall be open to the atmosphere and be easily accessible for inspection.

## **20. 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.

## **21. Fastening Methods**

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.

Exposed threads, bolts, rivet heads, nuts, screws, projecting screws, and studs shall be eliminated from product contact surfaces. Drilled and tapped holes, keyholes, sockets, and other recesses shall be eliminated.

## **22. Threads**

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."

## **23. Guards**

Guards required by a safety standard that will not permit accessibility for cleaning and inspection when in place shall be designed so that they can be removed without the use of tools. Guards should be designed to drain.

## **24. Shields, Diverting Aprons and Guards**

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

Shields, guards, and diverting aprons that protect either product contact or non-product contact surfaces should release and attach readily for efficient inspection and cleaning.

## **25. Clean in Place Systems (CIP)**

CIP equipment should be designed to preclude potential contamination of the system between pasteurized and nonpasteurized products. The equipment design should also provide for the safety of operating personnel due to the hazardous nature of the chemicals used and the high operating temperature. Tanks, valves, and piping used within the system should follow the principles suggested for product contact surfaces.

Where CIP systems are utilized, the equipment to be cleaned shall be designed to insure that all product contact surfaces are free of cracks, crevices, dead ends, and areas that would impede cleaning.

CIP spraying devices which have small holes and which are permanently installed within the product contact area shall be designed and installed to allow for inspection and removal of entrapped debris.

Spray distribution devices which are intended to remain inside the equipment during processing operations must be of sanitary design. Other devices, which must be removed after cleaning is completed, shall be designed and located to allow easy installation and removal.

CIP systems should be equipped with proper controls to insure consistent operation and sequencing of cleaning cycles. They should have appropriate recording devices to monitor and record temperature, time, and velocity of the cleaning cycle. Specifications for CIP instrumentation should include locating the temperature sensing probe after the last equipment washed and before the addition of heat to the cleaning solution, provided that this arrangement accurately provides the proper temperatures at the use point.

## **26. Controls Instruments**

Controls should be designed to prevent nuisance spillage of product and packaging materials due to overflows, faulty containers, lids or wrapping material dispensing, or faulty product ejection or transfer.

Control enclosures should be constructed and/or mounted to cause a natural drainage angle of a 1/8 in. per ft. (10 mm per m) away from enclosure seals from any liquid on the enclosures exterior. Furthermore, there should be a natural drainage angle of a 1/8 in. per ft. (10 mm per m) inside the enclosure toward an inside diameter drain piped to waste.

Control enclosures should be shielded from or located away from falling or dripping product, product laden cleaning solutions, or excessive cleaning and sanitizing liquid activity.

Operator panel electric, electronic and pneumatic penetrations should be directed for natural drainage away from the enclosure. Control boxes should be mounted on at least 1 in. (25 mm) stand-offs, or sealed to mounting surface.

## **27. Electrical 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.

All electrical enclosures shall be sealed to the mounting surface and any adjacent surface, or shall be spaced away at least 25 mm (1 inch) 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 460 mm (18 inches).

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

Conduit should be installed so that it does not form hard-to-clean areas or crevices against adjacent surfaces, including supports.

Flexible conduit, if any, should have a smooth external surface. Conduit should be installed at least 1 in. from any surface.

## **28. Compressed Air Supplies**

Compressed air that is introduced into ingredients or directed toward product contact surfaces shall be of adequate quality to prevent product contamination. It is recommended that the air quality meets the applicable provisions of the 3-A Accepted Practices for Supplying Air Under Pressure in Contact with Milk, Milk Products and Product Contact Surfaces, Number 604-03.

Compressed air pipelines should be sloped at .12 in. (2 mm) per foot to allow contained liquids to freely drain toward a drain point area, 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 piping between the final filter and point of use should be of sanitary type. Check valves should also be sanitary.

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

Mechanical fans and blowers that supply air to equipment should be cleanable, and noncorrosive. Air intakes should be located at least 20 in. (50.8 cm) above the work floor. Intakes should be filtered with 0.2 micro HEPA filter.

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.

Air or other gases mechanically introduced into the product or product zone shall be filtered or washed to remove particles 5 microns or larger, and shall not contain oil, water and other liquids, unless such materials are specifically required as an operational procedure. Air used for combustion purposes or heat transfer shall be filtered to remove particles of 50 microns or larger.

## 29. Reinforcing and Framing

Frames and drives are located in nonproduct contact areas. However, product contact surfaces may potentially be contaminated by product build-up on machine frames and drives since product build-up can eventually penetrate seams and drip into frame areas. To preclude potential contamination, these areas should be readily cleanable.

Poor designed frame leads to the development of microbiological niches in the mechanical areas and framework of the equipment. Exterior and mechanical areas should be readily accessible for cleaning and maintenance. Construction materials should be corrosion-resistant and readily cleanable.

Nonproduct contact surfaces should be of corrosion resistant material or material that is rendered corrosion-resistant. If coated, the coating should adhere. Nonproduct contact surfaces should be relatively nonabsorbent, durable, and cleanable. Parts removable for cleaning having both product contact and nonproduct contact surfaces should not be painted.

Framing and reinforcing members should be located to eliminate harborage or infestation of vermin. Tubular material, preferred for framing and reinforcing members, should be sealed by welding.

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

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. Exposed threads, projecting screws, and studs should be utilized only when welding is not practical. When used, exposed fasteners should be easily cleanable and located to eliminate the possibility of loose pieces entering the product zone. Any bolted construction should be free draining, exposed threads must be capped with acorn nuts.

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

Hollow construction, as in the case of tubular frames, shall be sealed by continuous welding or other effective means. Penetrations, if any, should occur through tube or pipe sleeves that are continuously welded or brazed to the penetrated material.

Joints and seams in the splash zone should be sealed by welding. On horizontal joints, to eliminate soil catching, horizontal ledges could be made by overlapping. Fixed panel attachment methods should minimize projections. Continuously welded attachment is preferred.

### **30. Access Openings**

All housings, casings, shrouds, and other enclosures which block access into the interior of machinery shall be provided with adequately sized, properly placed access openings for cleaning the inaccessible areas.

### **31: Louvers and Openings**

Louvers or openings located in the splash zone shall be of drip deflecting design or be so located as not to be subject to splash, splatter, spillage, or overhead drippage, or they shall be so designed and constructed as to be readily accessible and the space behind them shall be easily cleanable. Louvers shall be designed to eliminate contamination from spillage and/or upward splash. Screening on openings, if provided, shall be 16 mesh or the equivalent, and in a removable sash to facilitate cleaning. 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.

### **32. Fixed Panels**

Where fixed panels are applied to the outside or inside, or set into angle or other reinforced body or frames, the method of fastening shall be such as to minimize projections. Welding is preferred. Areas enclosed shall be accessible for cleaning.

### **33. Removable Panels**

Panels should be provided which are readily accessible and easily removable. They shall be of adequate size to serve the purpose intended, but otherwise confined in size and so constructed that they may be removed and transported by no more than one workman without use of cranes, chainfalls or other lifting devices. Methods of attachment should eliminate bolts and screws wherever possible.

### **34. Single Panel**

Single 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.

### **35. Double Panel**

Double panel construction shall be fabricated in such a manner as to minimize the collection of food particles, spillage and foreign matter thereon. Hollow sections of double panel doors shall be sealed by welding.

### **36. 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 food particles, condensation, spillage and foreign matter. The following are examples of design features that are in compliance with this requirement:

- a) Providing open-end clean-out at ends of track or guide bottom;
- 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.

### **37. Shelving**

All shelving, fixed or removable, shall be constructed to be readily cleanable.

### **38. Removable Shelves**

Removable shelves shall be readily removable and sized to facilitate their handling. Where shelves are used as removable false bottoms, the flanged corners shall be sealed or sufficiently open to permit cleaning.

### **39. Fixed Shelving**

Fixed shelving shall have the back and ends (where against side panels) turned up a minimum of 1 in. (25 mm) and sealed throughout their length, or an open space of 1 in. (25 mm) provided between the shelf and back and/or side panels, or the resulting joint or seam sealed.

### **40. Shelf Brackets**

When removable and/or adjustable shelving is provided, the shelf support bracket or pilaster shall be readily removable or easily cleanable.

### **41. 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 dirt and the harborage of vermin. 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 outside dimension of the leg shall be greater than the inside dimension of the leg extension. The leg extension shall, at minimum adjustment, extend at least 1 in. (25 mm) below the leg. All openings to hollow sections between the legs and the leg extension shall be of drip-roof construction with no openings greater than 1/32 in. (1 mm). All other openings to hollow sections shall be sealed.

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

#### **Castors shall meet the requirements:**

- a. All surfaces should be corrosion-resistant or shall have a protective coating. Paint shall not be used.
- b. Axle bolt ends should be flush, and shall not extend more than 2 1/2 exposed threads beyond the retaining nut.
- c. Washers shall not be used between the horn and the axle retaining nut.

- d. All removable joints shall be sealed.
- e. All structural members shall have a minimum of horizontal flat surfaces.
- f. 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.
- g. A clearance of not less than 5 mm (3/16 inch) 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 100 mm (4 inches) or less. A clearance of not less than 10 mm (3/8 inch) shall be provided between these same surfaces of casters with wheels larger than 100 mm (4 inches).
- h. A clearance of not less than 6 mm (1/4 inch) shall be provided between the horn assembly and the rolling surface of wheels 100 mm (4 inches) and smaller. A clearance of 12 mm (1/2 inch) shall be provided between these same surfaces on casters with wheels larger than 100 mm (4 inches).
- i. 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, as indicated by the sketches included with this standard.
- j. 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.
- k. 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.
- l. Kingpin assemblies, which have the nuts or rivets at the bottom shall have suitable caps covering the ends.
- m. Axles shall be so constructed that cotter pins or castellated nuts are not used.
- n. 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 6 mm (1/4 inch). Caster wheels shall have solid webs.
- o. Brakes and locking devices when attached to caster assemblies or wheels shall be easily cleaned.

#### **42. Electric Motors**

Motors and accessory equipment shall have a minimum of 50 mm (2 inches) 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.

Indentations and like concave surfaces in end bells and center housing castings shall not be permitted. Bolt heads and nuts shall not be recessed.

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

Covers for cooling fans of totally enclosed fan-cooled motors and accessory equipment 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 6 mm (1/4 inch). 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.

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 6 mm (1/4 inch). Creation of the radii does not preclude the use of nontoxic, permanently bonded, filler material.

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.

#### 43. Vacuum Source Applied to the 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 traps shall be easily cleaned and readily removable. Vacuum relief valves shall be easily cleaned and readily removable.

#### 44. Venting Ducts and Hoods

Ducts, hoods and canopies shall be designed, constructed, located and protected so that drippings of condensate, grease, carbon or other extraneous substances cannot 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 not be permitted.

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

Ducts, wherein water may accumulate, shall be pitched to provide complete drainage, and arranged so that the water shall not leak or drip into the product zone. Stacks which carry off combustion gases are exempt from this requirement. ,

Rectangular 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 50 mm (2 inches).

Round ducts shall be spaced from fixed surfaces so the duct and adjacent surfaces shall be readily accessible.

Reservoirs or hoppers shall be provided with covers of the overlapping type, and if they are in two or more parts, they shall be designed with drip protectors. Hinged covers shall pivot outboard.

Pumps, piping, valves and fittings used to dispense or convey frying fats, batter, glaze, icings, jellies and fillings shall be of sanitary, take-apart type at least equal to 3A Standards, and shall be accessible for inspection and cleaning.

#### 45. Water:

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

## **EQUIPMENT INSTALLATION GUIDELINES**

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

Sufficient clearance shall mean designed and installed to permit complete access to all areas for inspection and cleaning.

All joints created during installation shall be sealed.

Equipment shall be installed with at least 2 feet clearance around.

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, sufficient clearance shall be provided between the equipment and the wall, ceiling or floor, and the opening shall be finished to permit cleaning or the equipment shall be sealed to the adjoining surface.

Accessory equipment shall be so installed as to permit removal of parts for cleaning.

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, rectangular or equivalent shaped stock, which minimizes horizontal surfaces and recessed areas. Such bracing shall be sealed at points of attachment. Hanger rods shall have a minimum thread length. Where used, "continuous thread" rods shall be coated or sealed with a covering.

Overhead hanger rails shall be installed so that all parts of trolleys and rails are readily accessible.

Insulation surfaces, unless enclosed and sealed, shall be nonabsorbent and readily accessible.

Product chutes at floor level shall be so installed that the rim is minimum of 100 mm (4 inches) above floor level. Such chutes shall be provided with overlapping cover. Pans used to collect spillage or drip shall be readily accessible or readily removable, and shall be large enough to catch all spillage or drip.

Fixed pans used to collect liquid spillage or drip shall be readily accessible, and shall have drains and be pitched to ensure complete drainage away from the product zone.

Exhaust stacks, ducts, hoods and canopies 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.

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, unless designed for in-place cleaning, 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.

Equipment shall not be installed under sewage or drainage lines unless provision has been made to prevent leakage thereon.

All fixed piping carrying products that would cause condensation shall be insulated.

Gaskets shall be flush with the inside edges to avoid ledges and crevices.

Fixed washing equipment and equipment requiring wet cleaning should be installed in an area with a floor drain.

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 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 20 mm (3/4 inch) 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 460 mm (18 inches).

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 20 mm (3/4 inch) to allow for cleaning. Flexible conduit and fittings shall be liquid-tight.

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

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

A minimum of 50 mm (2 inches) 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 are permitted. Flush-mounted machined surfaces shall be permitted on accessory equipment, if sealed.

## **EQUIPMENT REVIEW PROGRAM**

This program is the basis for fair and uniform application of requirements for the materials of construction and sanitary design of equipment. This condition 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 equipment manufacturers, food processors, WDA inspectors, and American consumers.

## **EXCLUDED EQUIPMENT**

Equipment which is presently in place and in use need not be reviewed provided the equipment is in a good state of repair and it can be operated and maintained in a manner acceptable to the department. Plants may transfer this equipment from one plant to another providing both establishments are under the same ownership. The assigned Food & Dairy Specialist will determine if the transferred equipment is in a good state of repair and is installed, operated, and maintained in an acceptable manner.

## **PROCEDURES FOR OBTAINING ACCEPTANCE**

The acceptance of new, modified, or reconditioned equipment for use in Wisconsin dairy and food plants is a two-step process. First, a WDA Food & Dairy Specialist evaluates the design and construction of equipment by reviewing assembly type drawings with correlated parts and material lists. Then, whenever possible, a WDA Food & Dairy Specialist will review the equipment first hand at the manufacturing facility or any other accessible location.

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

**WDATCP**  
**PO Box 8911**  
**Madison , WI 53708-8911**

**The plan will get forwarded to the applicable Food & Dairy Specialist for review.**

The Wisconsin DATCP issues a letter of compliance to the equipment manufacturer and processor for all equipment reviewed and found in compliance with Wis. food regulation.