Sanitary Design: Optimal, and in Real Life

Melissa Ortner
mortner@heinzen.com
Sanitary Design Guidance

- AMI Sanitary Design Checklist
- GMA Sanitary Design Checklist
- CFS Sanitary Design Checklist
- IFPA Sanitary Equipment Design Buying Guide and Checklist
- Channelized Solutions OEM Design Guide
Importance of Sanitary Design

- Environmentally Friendly for *Listeria* growth
- Niche Points
- Shortage of Time
  - Production days are getting longer
  - Sanitation and maintenance times are shorter
- Labor Availability
We know where it hides... Or do we?

- **Laminations**
  - Bolt Connections, Sandwich Joints

- **Surface Finishes**
  - Poor welds
  - Corrosion (rusting, pitting)
  - Exposed aggregate flooring

- **Control Panels**
  - Condensation, Buttons, Unmaintained gaskets

- **Hollow Areas**
  - Tubing
  - Product Containers (Bins/Totes)
  - Product Utensils (Shovels, Paddles)
  - Whether purposely penetrated or not

- **Floors and Drains**

- **Air Blowers, Cooling Evap Coils**
Zone Definitions

Zone 4
Remote: doorways, walls, drains (non-processing)

Zone 3
Around the production flow, still subject to environmental and sanitation concerns for a RTE (ready to eat) food processing facility.

Zone 2
Non-Food Contact: table legs, floors, drains, aprons

Zone 1
Product Contact Surfaces
Incidental Product Contact Surfaces:
Drip • Drain • Drawn • Diffuse
How does the PLANT ENVIRONMENT allow *Listeria* to move?

- Water
  - Condensation & Over-Spray
- Floors & Drains
  - Floor Pitch for Water Drainage
  - Overflow of Drains
- Air Units, Cooling Evap Coils
- Flow Patterns
  - Water
  - Trash
  - Product (Raw/WIP/Finished)
  - Allergens
Defined Hygienic Zoning Approach

- RAW: Incoming product storage area, pallets, wood, cardboard.
- RTE: Ready to Eat, zone where the product is undergoing microbial reduction.
- HH: High Hygienic, product is in its cleanest state, just prior to packaging.
- LR: Low Risk, Finished Product, Offices, Locker rooms.
Floor Systems:
What’s the risk of a compromised Floor System?

Sloped Floors:
- Typically 1/8” to 1/4” per foot (Specify Non-Pooling)
- 3/16” per foot in HH areas
- High forklift traffic areas need extra strength

Floor Coatings:
- Take time into consideration
- Polyester, Epoxy, or Urethane-based
- Urethane Floors, Set in 12 hours @ 36 degrees in wet env.

Retrofitting Existing Facilities
- Preparation is 90% of the work
- Urethanes cure fast in the cold

If our floor is peeling, should we keep peeling it?
Floor Drain Systems

- Short vs. Long Trench Drains
- Stainless Steel allows concrete to “key” to prevent delamination

Options:
- 12” X 12” Drain Box
- 8” X 48” Area Drains for High Flow
- Route drainage from the wash system towards the drain?
Walls, Ceilings & How to Handle Laminations & Penetrations

- Ceiling Height – 25’-30’
- Raised Curb System with Sloped Ledge, Epoxy-Coated or SS Base
- Wall & Roof Systems – Urethane Insulated Metal panel
- Pre-Qualified Sub-Contractors
  - Sanitary Wall Connections
How does EQUIPMENT allow *Listeria* to move?

- **Laminations**
  - Bolt Connections, Sandwich Joints
- **Surface Finishes**
  - Poor welds
  - Exposed aggregate flooring
  - Corrosion (rusting, pitting)
- **Penetrated Hollow Areas (Whether purposely penetrated or not)**
  - Tubing
  - Product Containers (Bins/Totes)
  - Product Containers (Shovels/Paddles)
- **Equipment Anchoring**
- **Control Panels**
  - Condensation, Buttons, Unmaintained Gaskets
How does SANITATION allow *Listeria to move*?

- **Water**
  - In-Line cleaning of neighboring equipment
  - High Pressure Water (NO!)
  - Hoses
- **Footware & Outwear**
  - Captive & Controlled
- **Air**
  - Blow-down for Change-Over
- **Vehicles**
  - Forklifts & Lift-trucks
- **Utensils**
  - Storage of FC & NFC utensils
  - Moving Foamers & Buckets (Verify Concentration!)
Proactive *Listeria* Prevention Starts at the Source

“Tell me and I forget, teach me and I may remember, involve me and I learn”

-Benjamin Franklin
Sanitary Operational Performance

- Assurance of Safety in normal operations (processing, sanitation and maintenance)
- Equipment will not contribute to unsanitary conditions nor promote harborage and growth of bacteria if properly designed and maintained

Food Contact Materials are approved for zone use and are:
- Non-Reactive
- Non-Corrosive
- Non-Contaminating
- Non-Absorbent
- Cleanable

Zone 1 Disassembly is conducted tool-less for sanitation and maintenance

Removable Covers/Components have a designated place for cleaning and sanitation

Equipment Markings can be easily wiped clean

A ‘How-to-Clean’ Guide has been developed by the manufacturer
Fabricated Weldments

- It is important to ensure the main support structure is cleanable as desired. The main components in weldments are sheet metal, welds, surface finishes, and corners/bends.

- Designed to properly drain
- No Paint/Coating
- Zone 1 = 2B Mill-rolled finish, non-grained
- Thread-less legs and footings
- Joints and welds are smooth
- 18” off the floor for Zone 1 surfaces
- No Skip Welds or Laminations
- No Piano Hinges

Examples of bad welds, field repairs by unqualified welder
Component Fasteners

- Fasteners are what temporarily (or permanently) hold pieces together. These are nuts, bolts, acorn nuts etc. and should not be installed in locations that can contribute to harborage and contamination.

Zone 1 is free of bolts, nuts, or other fasteners

Horizontal surfaces are free of recessed fasteners

Loctite, Anti-Seize and other lubricants meet approval standards (Food Grade) depending on installation zone
Drive Components

- Drive components are responsible for making the equipment move. From motors to gear boxes, there is the potential for hard to reach areas and pinch points with a fine-line between safety and access for sanitation.

- Motors, gearboxes, and bearings are located away from the product zone, mounted on stand-offs.

- Motors, drives, control boxes, and other sensitive pieces of equipment are IP69K. Appropriate drainage is in place to account for condensation.

- All faceplates on gauges/sensors/sight glasses are made of shatterproof material.

- Carry/idler/return rollers are solid or slides rather than hollow rollers.

- Pulleys are machined stainless steel.

- Sprockets are held to the shaft in a manner that allows for proper cleaning either in or out of place.
Motor Controls & Electrical

- With electrical, comes cords which need to provide power to equipment. There’s no app for that yet!
- These wires and cords should be routed and installed in a sanitary manner, not contributing to potential contamination.

- Slope-top enclosures which are NEMA 4X are stand-off mounted with cable penetrations from the bottom of the panel.
- Wire and cording is routed and mounted using sanitary stand-off wire routing looms or clips.
- Sensors and their connectors are IP69K, mounted out of Zone 1.
# Ingress Protection (IP) Ratings Guide

**Example:**

(Ingress Protection) IP24

<table>
<thead>
<tr>
<th>Solids</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Symbol" /> 32.5 mm</td>
<td><img src="image" alt="Symbol" /> Protection against vertically falling droplets.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /> 2.5 mm</td>
<td><img src="image" alt="Symbol" /> Protection against spraying water up to an angle of 60°.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /> 1 mm</td>
<td><img src="image" alt="Symbol" /> Protection against splashes of water from all directions.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td><img src="image" alt="Symbol" /> Limited ingress of dust. Will not interfere with equipment.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td><img src="image" alt="Symbol" /> Protection against high pressure jets of water.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td><img src="image" alt="Symbol" /> No ingress of dust permitted.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td><img src="image" alt="Symbol" /> Protection level not formally tested.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td><img src="image" alt="Symbol" /> Protection against immersion in water between 15cm - 1m deep for 30 minutes.</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td><img src="image" alt="Symbol" /> Protection from close-range, powerful, high temperature water jets.</td>
</tr>
</tbody>
</table>

A digit of '0' for either solids or liquids indicates no protection.

Courtesy of heatingpoint.com
Belting

- There are many versions and preferences for belting. Think of the intended use accompanied with maintenance and sanitation required frequencies.

  - Solid and endless belting material is preferred, no cloth-backed belting or lacing is present.

  - Modular belting is used in non-food contact areas or in areas where solid belting will not allow.

  - Quick-Release mechanisms and belt-lifters are provided for cleaning. (One lifter per 6 ft. is recommended)
Process Piping

- How does the water get circulated to and in the equipment and processing facility? Just as important as the wash system itself, process piping can present specific challenges in cleaning and accessibility.

- The piping system is free of dead legs greater than two pipe diameters and can be cleaned via CIP or COP means.

- All process piping is purge-welded and smooth on the interior and exterior.

- A clear, 12” section (minimum) of piping has been installed in order to ensure visual cleanliness is maintained.

- All sections of piping can be disassembled without tools into discrete sections that allow line-of-sight sanitation/inspection.

- Piping has minimal use of threaded connections/adaptors or slip connectors with external hose clamps.
Air & Pneumatics

- Air and pneumatics can help reduce the presence of hydraulics in some situations. It is important to ensure a clean air supply in addition to properly maintaining the use of air in any processing facility.

Compressed air directly applied to product or product contact surfaces is to be filtered to a minimum of 0.3 microns.

- **Listeria**: 0.5-2 µm
- **Salmonella**: 0.5-5 µm
- **E. coli**: 0.2-05 µm
- **Mold**: 3-40 µm
- **Yeast**: 4-12 µm
Time to turn back time...

When Sanitary Design is not so sanitary
What have we learned?

- Older Equipment and Infrastructure present challenges
  - Difficulty in Cleaning and Maintenance

- New = costs Money
  - We do not have the $ to replace our equipment tomorrow
  - We need to make due with what we have

- Old = costs Time & Money
  - How do we make this better to save both time (more time for operations) and money (spent in sanitation and maintenance time)
Common Equipment Struggles

Fabricated Weldments
Drive Components
Belting
Motor Controls & Electrical
Fabricated Weldments

- Welding
- Tube Construction
- Cracking & Scratches
- Paint
Welding

Do not just immediately grind or reweld! The repair will depend on the location of the weld. Evaluate the area to ensure structural integrity is maintained so that cracking will not occur. Be sure the metal is cleaned and prepped prior to any repair.

Options for Repair:
1. TIG-wash the weld.
   1. **Pros**: Quick and easy if there is a good welder in house.
   2. **Cons**: Could negatively impact the quality or structure of the weld.

2. Cut out the heat-affected zone and replace with a continuous weld or move the weld location.
   1. **Pros**: A smoother weld will be easier to clean and maintain.
   2. **Cons**: Surface may warp, causing uneven surfaces that could lead to water/product pooling.
Tube Construction

Short Term Question: What’s the quick fix? If any?
Long Term Question: Is the structure worth further modifications?

Options for Repair:
1. Inspect for penetrations, drain at base (if possible) and plug weld.
   1. **Pros**: Relatively cheap and easy and can be completed in house with a qualified welder. (Be ready for what you might find!)
   2. **Cons**: Moisture can remain in the tubes and will need inspection to ensure tubes are not penetrated in the future. (PM Program & Training)

2. Cut & remove, replace with open frame.
   1. **Pros**: Easy to clean with little maintenance.
   2. **Cons**: Expensive. Will require engineering to ensure proper support structure.
Cracking & Scratches

Ask yourself: Why is this equipment cracking? Does it have a lift-kit? Typically seen on the insides of hoppers, especially after bin dumpers as rock, nails, and other items may damage the surface at dumping. These types of objects can have a high iron content which contaminates the surface of the Stainless Steel, impregnating the surface with these impurities.

Options for Repair:
1. Determine why it’s cracking. A weld is a quick fix, need to address deep down issue.
   1. **Pros**: A drilled hole stops the crack in it’s tracks. Grind out the material for the weld to penetrate. Weld the crack to hold together.
   2. **Cons**: If the isolation is not fixed, welding will not hold it together.
2. Inspect to determine cause of scratches. Is it just on the surface? Treatment of the surface with an approved pickling paste or other passivation treatment followed by proper sanitation procedures.
   1. **Pros**: Quick and relatively easy
   2. **Cons**: If it happened once, it could happen again. Need monitoring to ensure it is addressed
Paint

Equipment is typically painted to reduce corrosion of non-stainless components. Although, sometimes SS has been painted. All paint requires maintenance and is not approved for FC surfaces. If equipment is very old, evaluate for potential use of lead-based paint and ensure proper removal or disposal.

Options for Repair:
1. Can be stripped and repainted.
   1. **Pros**: Easy to do with a limited amount of time.
   2. **Cons**: Will peel again, and depending on the location, corrosion will continue.

2. Can be stripped and powder coated - Contact Manufacturer for recommendations.
   1. **Pros**: Can be done within a couple of weeks depending on location and contractor availability.
   2. **Cons**: Could chip, and depending on the location, corrosion could continue.

3. Replace with IP69K Stainless Steel - Contact Manufacturer for recommendations.
   1. **Pros**: No need for recoating.
   2. **Cons**: Will be expensive and will take some time to get equipment built and installed.
Drive Components

- Hollow Rollers
- Belt & Chain Drives
- Hydraulics
Hollow Rollers

Rollers will expand and contract, not always showing the debris and water accumulation. End caps will wear and create openings for access to the hollow rollers. If they are not rolling, they are being penetrated.

Options for Repair:

1. Inspect, monitor and replace when penetrations/damage is seen.
   - **Pros**: Easy to replace with rotation schedules for some or all of the rollers at a PM. If one roller has failed, most are probably failing and replacing all might be beneficial.
   - **Cons**: Not all penetrations/damage may be visually caught and contamination could still occur.

2. Replace with solid rollers - Discuss with manufacturer.
   - **Pros**: Could be a direct replacement.
   - **Cons**: May not be a direct replacement and may require equipment modification.

3. Replace the conveyor for a more sanitary design.
   - **Pros**: A new conveyor could mean additional sanitary changes.
   - **Cons**: Expensive, although weigh out the cost of Sanitation & Maintenance time
Traditionally, chain driven drives are of mild steel construction with a cover to act as a pinch-point guard. Belts are usually constructed of rubber and require special cleaning chemicals.

**Options for Repair:**

1. Remove guarding and chain or belt for PEC. As they are removed, inspect for wear. There may be rubber fragments or small metal pieces on the guard indicating wear.
   
   **Pros:** Can be added into any maintenance and sanitation program with proper procedures and training.
   
   **Cons:** Will take time and resources each time this is taken apart and reassembled.

2. Potential shaft-driven modification - Discuss with manufacturer. Belt or chain drives, can possibly be converted to a motor and shaft-mounted gear box.
   
   **Pros:** If an easy modification, the old drive design could be eliminated
   
   **Cons:** Could be expensive and a new design may be required.
Hydraulics

Elimination of oil and surface area of hoses decreases sanitation needs. Heat associated with hydraulics raises the temperature in this area, creating a different concern for growth.

Options for Repair:

1. Purge system to replace with Food Grade Oil, if available. Ensure similarity in viscosity.
   - **Pros**: Relatively quick and easy and can be completed by in-house personnel.
   - **Cons**: Oil and hoses are still present in the processing environment. Heat is still produced within the hydraulic location. Standard detergents may not help remove oil spills, requiring a special degreaser.

2. Convert equipment to electric.
   - **Pros**: No concerns of oil in large amounts, hoses, or micro-climate associated with hydraulic oil.
   - **Cons**: Can be expensive and could require design change. Weigh out Sanitation & Maintenance time.
Belting

- Frayed/Damaged
- Cap Strip
- Lacing
Frayed/Damaged

With all belting issues, ensure proper tracking. If belting is going to be replaced, be sure to check the lacing as some may require special tooling for installation.

Options for Repair:

1. Cut the sides of the belt and melt, depending on the belt type. Check chemicals to ensure they are not the cause of belt degradation.
   1. **Pros**: Quick and easy to do in-house.
   2. **Cons**: This is only a temporary fix and the belt may not track properly.

2. Replace.
   1. **Pros**: If belting is in stock, replace.
   2. **Cons**: Might not be the right belt for that particular application. Is the belting continually having issues? Contact the manufacturer to ensure compatibility.

3. Replace with a new design - Check with the manufacturer to determine availability and compatibility.
   1. **Pros**: Could be better fitting application with more sanitary features.
   2. **Cons**: Could be expensive and will take some time to get belting in, tested, and installed.
Cap Strip

Cap strip was used in the slider bed of many older conveyors. When addressing cap strip, it is beneficial to remove the belt first, making easier access to the interior.

Options for Repair:
1. Remove the plastic bolt and UHMW on a periodic basis for cleaning.
   1. **Pros**: Cleaning can be completed in house.
   2. **Cons**: May be time consuming and plastic bolts may need to be replaced due to stripping.
2. Replace slider bed, check with the manufacturer for options.
   1. **Pros**: Could be a direct sanitary replacement.
   2. **Cons**: May require equipment modification, cost may vary.
3. Replace the equipment.
   1. **Pros**: Additional Sanitary Design aspects may be included on this design vs. the old.
   2. **Cons**: Could be expensive. Weigh out the time to clean and maintain; a new piece of equipment may not be as expensive as you think when all consumable and labor costs are spelled out.
Lacing

**Clipper:**
- Easiest to apply
- Least expensive

**Alligator (Gator):**
- Appears Cleaner
- Less to get caught
- More surface area

**Thermo-Lace:**
- Appears to be the cleanest of lacings
- Factory installed

**Vulcanized/Endless:**
- No lacing!
- Requires SD features to be built into the conveyor
Motor Controls & Electrical

- Fan-Cooled Motors
- Wiring
- To Cover or Not To Cover?
Fan-Cooled Motors

These fans are commonly seen in motors greater than 1hp. In legacy equipment, fan-cooled motors were more common than the non-ventilated motors we see today. Some of the larger motors, even today, are not available without these visible fans so a PEC will still be necessary.

**Options for Repair:**

1. Remove fan guard at PEC intervals following appropriate LOTO procedures.
   - **Pros**: Can be completed by in-house maintenance and sanitation.
   - **Cons**: Will require maintenance and sanitation communication.

2. Consult with manufacturer for availability of non-ventilated motors.
   - **Pros**: Concern eliminated with replacement.
   - **Cons**: Possible fit-up issue as they are typically a bit longer than FC motors. May be unable to locate a NV motors and will have to be special ordered, then installed.

It’s a mini-micro climate! Motors can run from 33°F to 140°F in fresh-cut environment.
Wiring

There are many methods to route electrical, but what is the most sanitary and maintenance friendly?

**Options for Repair:**

1. Zip-Ties
   1. **Pros**: Very quick and easy to route electrical.
   2. **Cons**: Cords are still bunched together with uncleanable areas.

2. Wire Looms
   1. **Pros**: Can be made for one wire or bunches. They allow the wires to be taken out of place for cleaning when desired.
   2. **Cons**: Need to be welded on and placement needs to be determined prior to affixing to equipment.

3. Completely sealed
   1. **Pros**: Easy wipe down for sanitation.
   2. **Cons**: Maintenance challenge and if penetrated can cause additional issues.
To Cover or Not To Cover?

Why do we cover control panels, sensors, motors?

Options for Repair:
1. If not wash-down rated, be sure to have a back-up cleaning procedure such as a wipe down or removal.
   1. **Pros**: Easy to do with a limited amount of time.
   2. **Cons**: Although easy to do, finding time can be a challenge. Remember, we need to cover, uncover, and clean.

2. Pressurize the Panel
   1. **Pros**: Can be done within a couple of weeks depending on location and contractor availability.
   2. **Cons**: Could be on the expensive side and addition into a maintenance program to ensure they are properly services.

3. Replace with Stainless Steel NEMA 4X - Contact Manufacturer for recommendations.
   1. **Pros**: No need for covering.
   2. **Cons**: Will be expensive and will take some time to get equipment built and installed. Include in Maintenance plan, nothing is a 1 and done.
What have we learned?

- Sanitary Design is a give and take
- Procedures need to speak to our risk
- There’s always a way to make sanitary design a little bit better, before we need to replace.