



SANITARY DESIGN

made simple

FOR THE REST OF US

FOOD
NORTHWEST



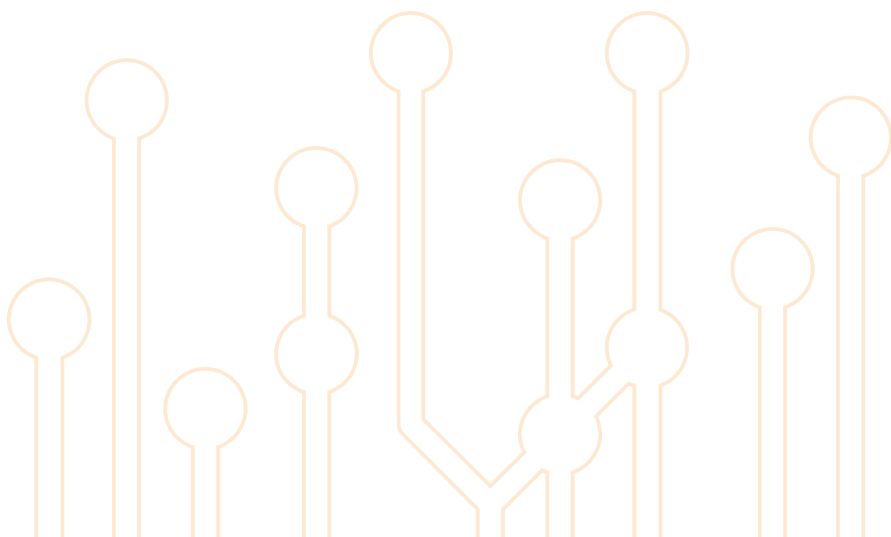
Sanitary Design Task Force

John Damon, OFD Foods, Chair
Kevin Browning, J.R. Simplot Co.
Dan Freeman, OFD Foods
Sam Grubb, Kerr Concentrates
Ron Hall, Ecolab
Justin Lai, FPS Corporation
Debbie Radie, Boardman Foods
Melissa Sales, OFD Foods
George Sargent, Pacific Seafoods
Rick Stokes, Ecolab
Jamie Wiggins, Food Northwest
Connie Kirby, CLK, LLC

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What is Sanitary Design and Why Do I Care?

Sanitary design in food processing plants refers to when equipment and the facility are constructed so they are easy to clean, meaning that the likelihood of producing a safe food product is at its best. Unfortunately, equipment and facilities aren't always designed that way. Many facilities and their equipment were designed before our current understanding of sanitary design became more widely known. That's when **hygienic restoration** is needed to make changes that allow for better cleaning, sanitizing and inspection. This guide will help everyone involved with getting and keeping the plant clean to be on the same page about some basic sanitary design ideas.

Every food processing plant should have written procedures for cleaning and sanitizing the equipment and facility. This makes sure everyone knows what to do and how to do it, in addition to meeting the requirements of Food & Drug Administration (FDA), United States Department of Agriculture (USDA), your local food processing regulators, and your customers.

That's because sanitation is one of the most important lines of defense for keeping food safe to eat.

How does the plan get written?

First, it takes everyone involved – sanitation, maintenance, production, Quality Assurance (QA) – putting their heads together, using their experience, historical knowledge, and sanitation records (including microbiological data), to create a plan.



At the same time, whenever a piece of equipment is relied on to prevent cross-contamination of the final product with pathogens and/or allergens, you must prove that your sanitation plan actually does get that equipment free of them. This is called **validation** of your plan.

How to validate your sanitation plan:

- 1 Break down and clean the equipment according to the plan.
- 2 Call QA to inspect and swab in all the 'hot' spots where pathogens or allergens might hide.
- 3 Do this several times to see if your plan works every time.

Once you are satisfied that your plan is a good one, QA will want to test regularly after sanitation and before start-up to make sure cleaning and sanitizing procedures are effective. This is when you'll see them looking over the equipment for signs of residue (Figure 1). They'll also need to take swabs, which the laboratory will analyze for pathogens or allergens, because these are not visible to the eye.

This is called **verification** of cleaning and sanitizing procedures. **It needs to be done according to the frequency outlined in your Food Safety Plan.**

Some reasons why they wouldn't be cleaned and sanitized are:

- New personnel might need more training and experience to do the job right.
- Wear, damage, or modifications have made the ability to clean the equipment challenging.



Figure 1

QA inspector doing visual pre-operative inspection for residue and swabbing for pathogens.

Sometimes, after production has run for a while, pathogens that were hiding can break free and contaminate the food. QA will also want to take swabs for testing during these times too (Figure 2). This will give additional important information about how well the equipment was cleaned and sanitized to begin with.



Figure 2

Production swabs being taken to detect pathogens that have broken free from niches during processing.

How do Sanitation and Sanitary Design Go Together?

When equipment and facilities are designed with sanitation in mind, the sanitation crew can do their job better, with less effort, and in less time. This means there is less opportunity for contamination of food with pathogens or allergens.

That's where this guide comes in.

We aren't trying to cover the whole subject of how to engineer sanitary design. There are lots of standards that help do that.

This guide is meant to help sanitation and food plant workers who are working with equipment and in facilities every day to understand the most important sanitary design problems and solutions. Those are the people who know the equipment and the plant the best. They can often come up with some of the best solutions to problems in existing plants, or provide some of the best advice when buying new equipment or building new facilities.

Is it Designed with Sanitation in Mind?

Here's some questions to ask yourself to help you look at equipment and facilities in a new sanitary design way.

1 Would you lick it?

Is it really clean? Even after the best cleaning, if the answer to the question is still no, there is a good chance that the equipment isn't designed effectively to properly clean it.



2 Could it ooze out?

If, over time, product could ooze, flow, fall or "juice" out due to agitation, vibration, or gravity, then there is opportunity for improvement on that equipment. Product and/or moisture accumulation can lead to cross contamination and unsafe product.



3 Where would I hide to survive?

To answer this question, you must think like a bacterium. If I am microscopic, where can I go on this equipment to not be destroyed by cleaning and sanitation and still have access to water and food?



Overview of Sanitary Design for Key Sanitary Design Stakeholders

The purpose of this section is to provide a quick reference for food workers, sanitation workers, maintenance staff, and any other interested persons, to assess some of the most important attributes of sanitary design of food processing equipment. This guide provides a visual reference to quickly identify some of the most commonly discovered sanitary design flaws that have been associated with food production equipment.

The objective is to help these people:

- Spot improvements that will have the most impact on improving sanitation in existing Zone 1 and 2 equipment and facilities, or;
- Talk to suppliers about expectations or good sanitary design, when evaluating for purchase, new equipment for Zones 1 and 2 that will be easily and effectively cleaned.

This guide is not meant to be comprehensive or in-depth treatment of sanitary design. Extensive sanitary design checklists and in-depth training are available separately (See page 43 for resources).

Use the checklist on the next page to ensure all key sanitary design areas are addressed.

Use the Principle chapters that follow for a visual reference and more detail around each of the key sanitary design principles.



Key Sanitary Design Checklist

Principle #1: *Accessible for Inspection, Maintenance, Cleaning, and Sanitation*

- ☐ All surfaces are accessible for mechanical cleaning and treatment to prevent biofilms formation.
- ☐ All surfaces are easy to see.
- ☐ Equipment is easy to disassemble for cleaning and inspection without the use of tools.
- ☐ Pay special attention to:
 - ☐ Exposed wiring near food contact surfaces;
 - ☐ Product hoppers and gates;
 - ☐ Conveyor belts and surrounding areas including catch pans, belt scrapers, and rotators that direct product along the line;
 - ☐ Access doors;
 - ☐ Chain guards;
 - ☐ Piping.

Principle #2: *No Niches*

Free of:

- ☐ Pits;
- ☐ Cracks;
- ☐ Corrosion;
- ☐ Recesses;
- ☐ Open seams;
- ☐ Protruding ledges;
- ☐ Inside threads;
- ☐ Bolts;
- ☐ Rivets;
- ☐ Bunched wires;
- ☐ Dead ends.

Principle #3: *No Collection Points*

- ☐ All surfaces should be designed to be self-draining and prevent pooling.
- ☐ Horizontal members on equipment should be rounded or angled to prevent buildup of liquid or product.
- ☐ Surfaces are made of non-absorbent material.
- ☐ Surfaces are made of material that won't warp over time and create collection points.
- ☐ Moisture does not drip, drain, or draw into product areas.
- ☐ Conveyor belts are tense enough to prevent collection or pooling.
- ☐ Dead spaces where product or liquid can collect of time are eliminated.

Principle #4: *Eliminate or Minimize Hollow Areas*

- ☐ Hollow areas are hermetically sealed wherever possible.
- ☐ In Zone 1, eliminate:
 - ☐ Tubes;
 - ☐ Drilled or taped holes;
 - ☐ Partially welded seams;
 - ☐ Bolts;
 - ☐ Studs;
 - ☐ Mounting plates;
 - ☐ Junction boxes;
 - ☐ Brackets;
 - ☐ Plates;
 - ☐ End caps;
 - ☐ Sleeves;
 - ☐ Hinges.





Principle #1: *Accessible for Inspection, Maintenance, Cleaning, and Sanitation*

Areas of equipment where product is going to be present should be **easy to see** and **need no tools for disassembly**. This facilitates maintenance, cleaning and sanitation and makes it so the equipment can be inspected before running product over it.

Some of the key problem areas we'll cover include:

- Exposed wiring near food contact surfaces
- Product hoppers and gates
- Conveyor belts and surrounding areas including catch pans, belt scrapers, and rotators that direct product along the line
- Access doors
- Chain guards
- Piping

Exposed Wiring Near Food Contact Surfaces

Poor Design

Figure 3 shows a neatly bundled collection of wires. The problem is that it is next to a belt where product is exposed. Food and debris can collect on and between the wires, but the wires cannot be easily disassembled for cleaning. This creates a great place for pathogens to build permanent homes, or niches, and contaminate the product that goes by during production.



Figure 3

Food debris collects between the bundled wires and they can't be disassembled for cleaning.

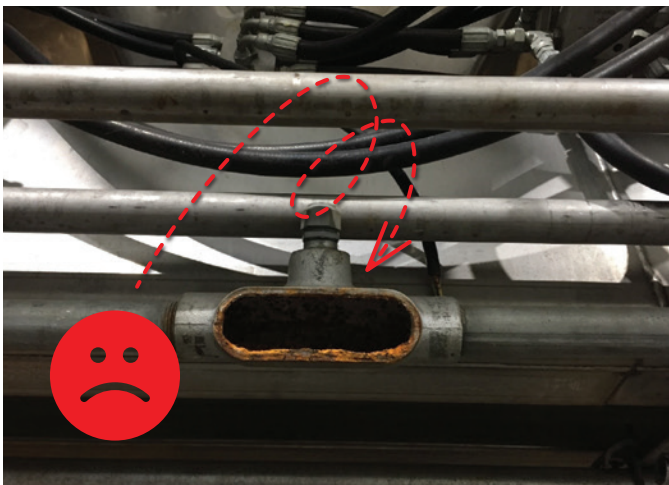


Figure 4

Metal conduit with signs of water having gotten inside, creating potential harborage point for pathogens.

Poor Design

Conduit for wires can present problems, especially at joints and access points. Figure 4 shows where water has obviously entered into the metal conduit joint and rusted. The interior of this joint and conduit cannot be accessed for cleaning and inspection. This creates a potential harborage point for pathogens.

Poor Design

The cables in Figure 5 are banded together with plastic zip ties. They have collected food debris and cannot be cleaned and inspected while bundled. The ties could be cut and replaced after cleaning and inspection but this time-consuming job is unlikely during regular sanitation shifts.

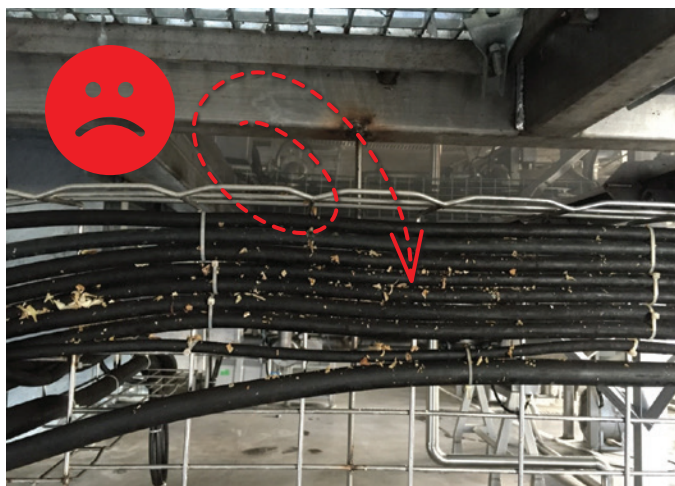


Figure 5

Cables banded together such that they cannot be cleaned - note food debris.



A worried Sanitary Design Man sees several opportunities for hygienic restoration here. Can you help him point out what else is wrong with this picture?

Better Design

Wires can be “hung” along equipment framework by D-rings, as in Figure 6, that allow for easy access or contained in a wire chase that allows ease of cleaning (where multiple wires/cables are involved – each individual wire must be able to be separated from the others).

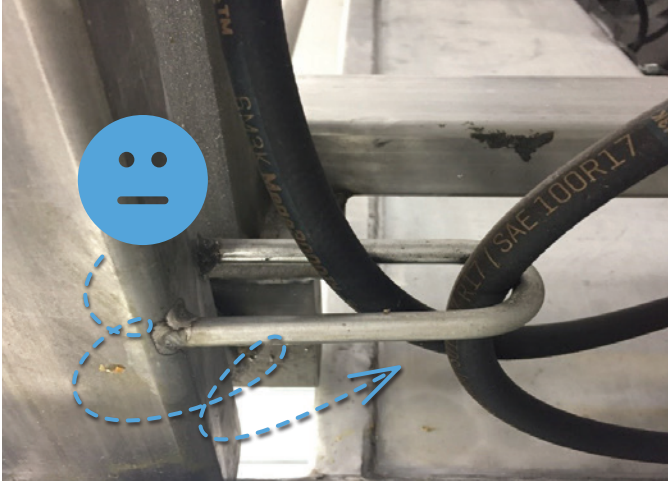


Figure 6

D-ring allows cables to not be banded together so they can be moved, separated, and cleaned, but contains poor welds.

Best Design

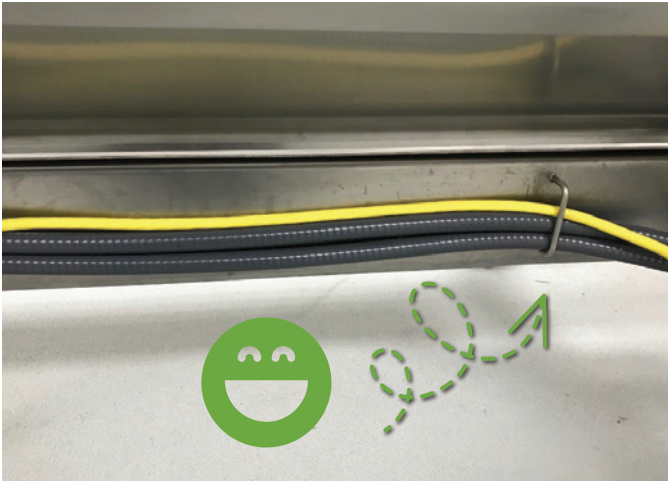


Figure 7

D-ring holds cables, allows for cleaning, and contains smooth welds.

Product Hoppers

Poor Design

Hoppers and gates offer challenges in sanitary design. Inaccessible surfaces, like the interior of the flange joints in Figure 8, are not easily disassembled without tools, as the bolts in this example. There are several catch points for soil that cannot be disassembled and are not accessible for cleaning or inspection.

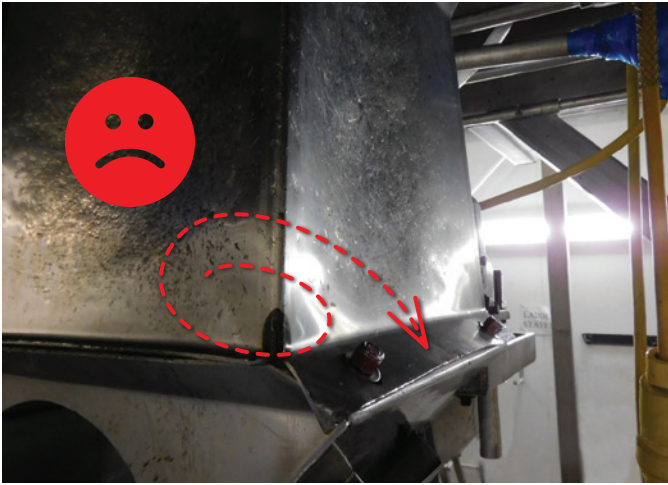


Figure 8

Hopper sections that cannot be cleaned without taking apart.

Poor Design

In Fig. 9, the equipment is designed with a flexible hose laying over the hopper with exposed product. Due to the indentations that give the hose its flexibility, it is difficult to clean and will be a potential harborage point for pathogens.

Poor Design

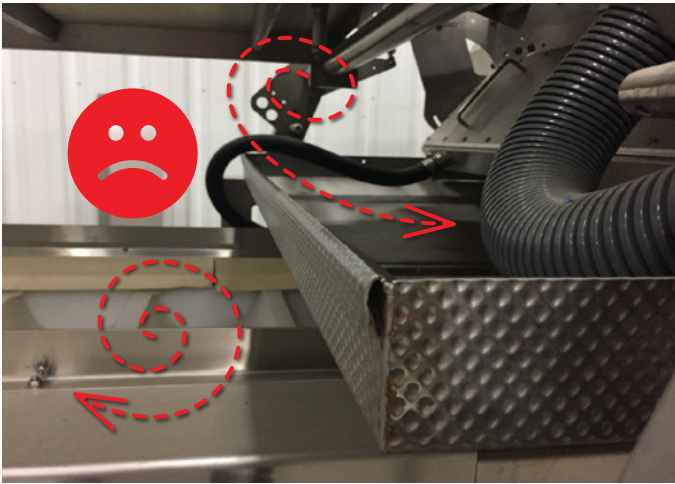


Figure 9

New sorter with hose made of difficult to clean material, located over a product hopper.



A worried Sanitary Design Man sees several opportunities for hygienic restoration here. Can you help him point out what else is wrong with this picture?

Better Design

Figure 10 shows a better hopper design because there are spacers to allow cleaning between them. However, the spacers are not easily removed for cleaning and can become a harborage point themselves.

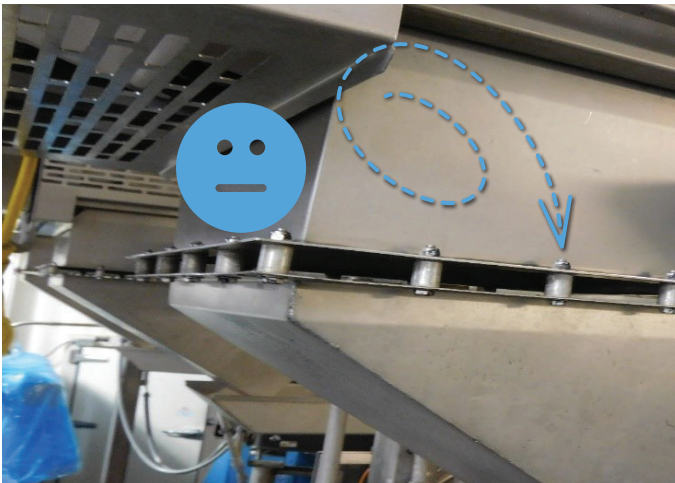


Figure 10

Better access for cleaning and inspections, however, spacers are bolted and not easily disassembled.

In hoppers of good design, sections that are not welded should be designed for easy disassembly without tools or redesigned for accessibility, as in Figures 11, 12 and 13.

Best Design



Figure 11

Open-easy access for inspection and cleaning.



Figure 12

Pinned instead of bolted for easy disassembly and cleaning.

Best Design

The shaker hopper in Figure 13 can be fully disassembled without tools for cleaning and inspection.



Figure 13

Shaker hopper is easily disassembled and accessible for cleaning.

Conveyor Belts and Surrounding Equipment

Poor Design

The belt in Figure 14 is joined by metal rods that are difficult to disassemble making it impossible to access for cleaning and inspection. The thousands of small holes that thread the rods are harborage points for pathogens and will contaminate the product that moves over it.

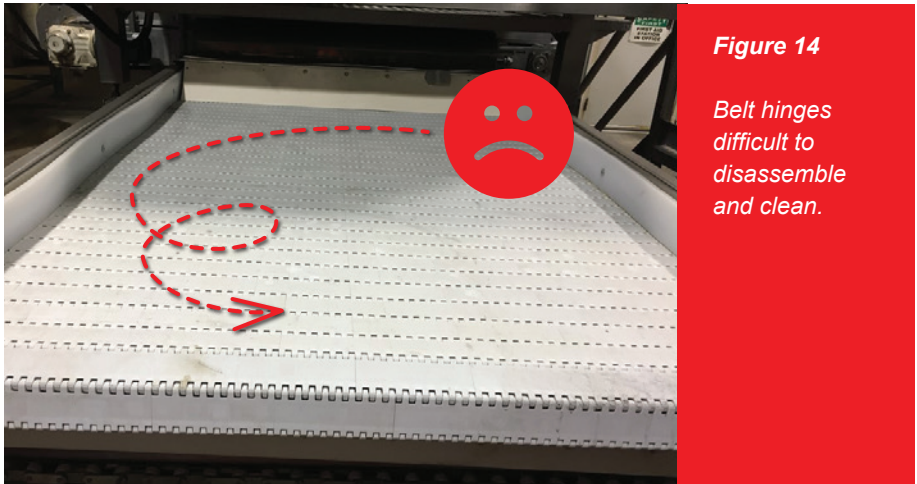


Figure 14

Belt hinges difficult to disassemble and clean.



A worried Sanitary Design Man sees several opportunities for hygienic restoration here. Can you help him point out what else is wrong with Figure 14?

Better Design

Scrapers and side rails on conveyor belts should be removable or designed so that they may be rotated away from the conveyor or head/tail roll for cleaning as in Figure 17. They should be installed underneath the conveyor where possible. Scrapers should be designed of one solid material with a minimum of penetrations (scraper should not have screws or bolts exposed to the food contact side of the scraper). If made of multiple materials the scraper should be easily disassembled for cleaning and sanitation.

The mechanism for the shaker conveyor in Figure 15 is mounted to the bottom flange of the belt and not exposed to the Food Contact Surface (FCS). In addition, the belt surface itself is solid, so no disassembly is required to clean and inspect this belt.

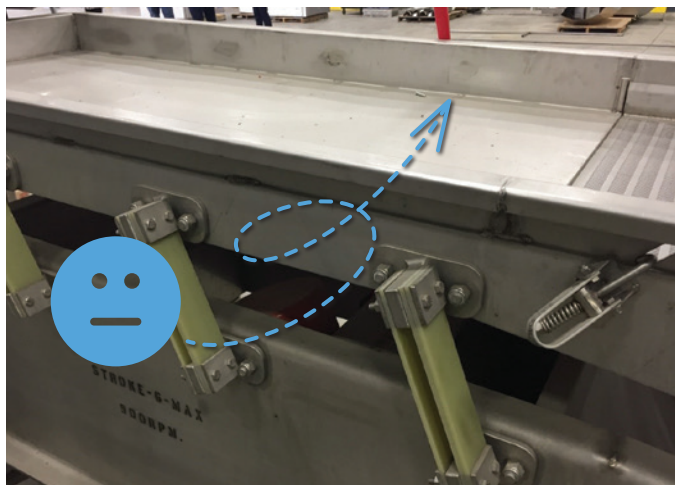


Figure 15

Note that this shaker conveyor does not have penetrations (bolts have been removed) on stainless steel food contact surfaces.

Best Design

The conveyor belt in Fig. 16 rides on solid stainless-steel supports. To clean, the tension rods on the support system are loosened and the belt is accessible for cleaning and inspection before reassembly. Also, notice that the belt is composed of one solid piece of material, leaving no places for niches, as in Fig.14.



Figure 16

Conveyer rides on stainless supports - note removable stainless scraper.

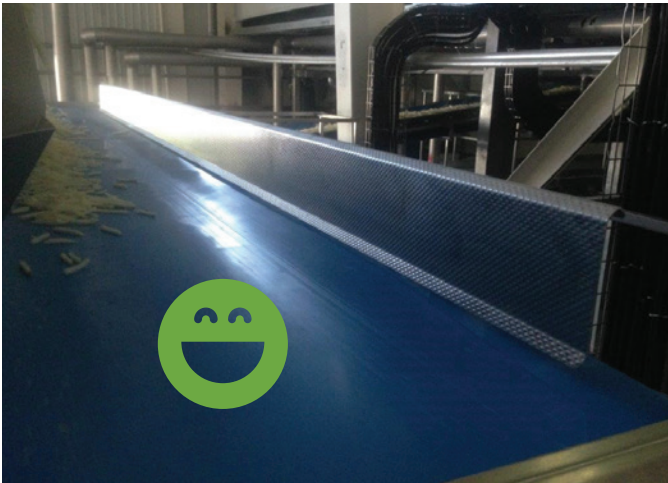


Figure 17

Side guide made of stainless steel (no UHMW) that swings away.



Principle #2: *No Niches*

Equipment in Zones 1 and 2 should be free of pits, cracks, corrosion, recesses, open seams, gaps, lap seams, protruding ledges, inside threads, bolts, rivets, bunched wires, and dead ends. Any of these can create protected areas where bacteria can hide and live. Once established, no routine amount of scrubbing or chemicals will eliminate their colonies. The only solution is correcting the defect and taking extraordinary measures to kill the bacteria lodged there.

Niches and Harbor Points

Figure 18a shows high hygiene risk finishes for edges on the left that can potentially trap pathogens and create niches that will contaminate product. By contrast, acceptable edge finishes on the right in Figure 18b can be more easily cleaned.

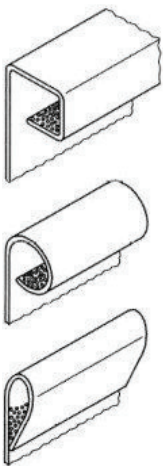


Figure 18a

Hygiene risk for edge finishes.

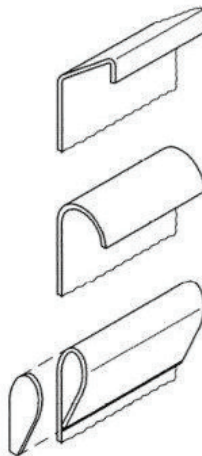


Figure 18b

Acceptable risk alternatives for edge finishes.

Poor Design

Figure 19 has recessed bolts, lapped seams, square corners, etc. Product is accumulating in this area and there are many opportunities for niches to form and become a product contamination problem.

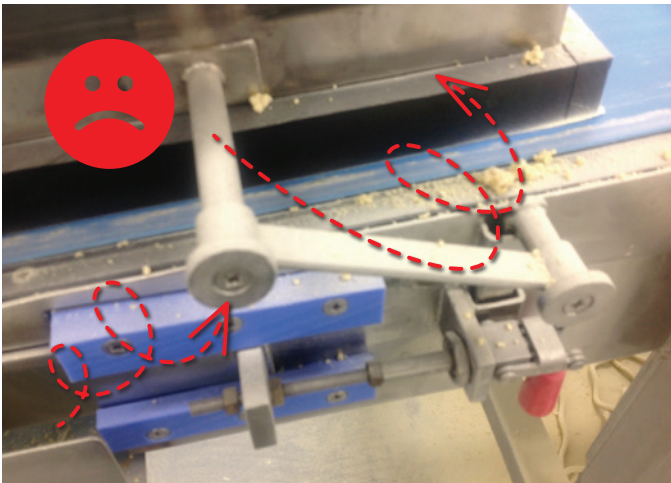


Figure 19

Belt assembly showing recessed bolts, other potential niche areas.



A worried Sanitary Design Man sees several opportunities for hygienic restoration here. Can you help him point out what else is wrong with Figure 19?

Best Design

The gate assembly in Figure 20 was originally bolted as one piece onto the hopper wall. It was redesigned to be removable by use of wing nuts. The flexible gate is easily disassembled by slipping the pins from their slots.

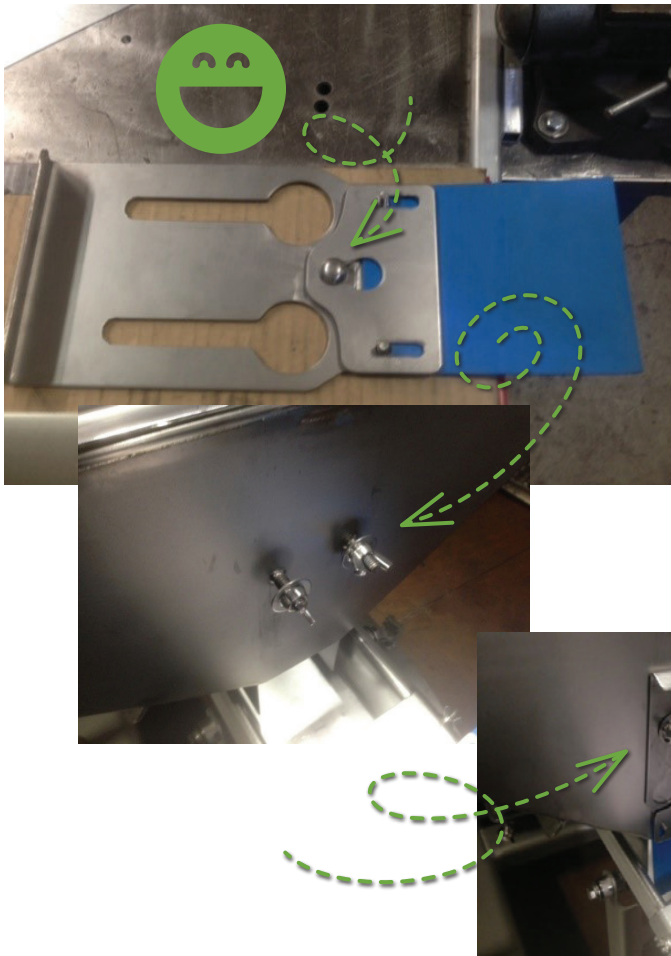


Figure 20

Product gate with fasteners removed, designed to be easily cleanable.

Poor Design

The hopper in Figure 21 has stickers applied to the outside to communicate important information about use of the equipment. However, stickers peel over time and potentially introduce foreign material into the product, as well as provide places where niches can harbor harmful bacteria.

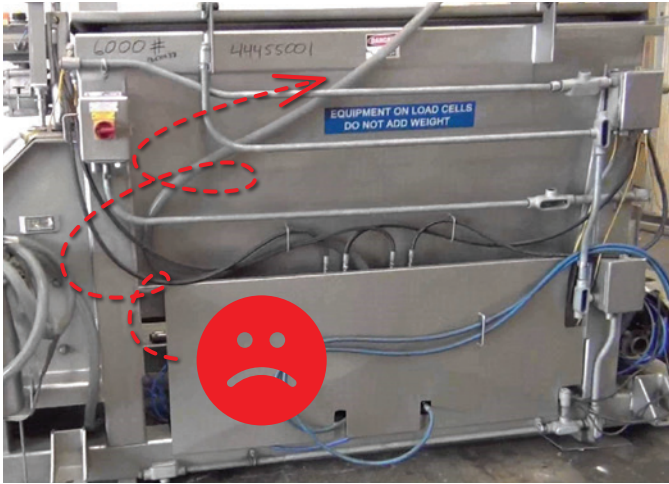


Figure 21

Stickers create uncleanable niches on equipment surfaces.



A worried Sanitary Design Man sees several opportunities for hygienic restoration here. Can you help him point out what else is wrong with this picture?

Better Design

The signage in Figure 22 eliminates the need for stickers and can be cleaned underneath because of the spacing. However, the paint on the sign can chip over time and create foreign material problems as well as niches where the rough edge of the paint is exposed. In addition, the sign is riveted to the equipment and cannot be disassembled for cleaning. Another option would be laser etching. However, laser etching must be done with care to minimize any niches in the grooves of the etching.



Figure 22

Offset sign eliminates the need for stickers, but chipping paint and attachment site can cause niches.

Best Design

The best option to signage, would be to not use any on food processing equipment. When stickers are necessary, they should be easily removable and placed away from food contact surfaces.

Poor Design

The mixer in Figure 23 has flat cross-members on the legs and flat flanges for anchoring. Both of these can accumulate product and liquid and form harborage sites for bacteria.



Figure 23

Flat horizontal surfaces on cross-members and feet create niche points.

Better Design

The cross-members in Figure 24 are angled so that material can slide off and not accumulate there. The smooth weld prevents niches from forming on a rough surface. The legs are not bolted to the floor and can be moved for cleaning.



Figure 24

Angled cross-member on legs and smooth weld prevent accumulation of product, niche formation.

Best Design

The top of the cabinet in Figure 25 is sloped to prevent buildup of product and liquid from collecting on the surface.



Figure 25

The top of this cabinet is sloped to prevent accumulation of product and liquid.

Hinges

Poor Design

Hinges and door clamps can create harborage points if they are not designed for easy disassembly. The piano hinge on Figure 26 is a good example. Each one of the pin loops allows entry of water and cannot easily be accessed for cleaning.



Figure 26

The piano hinge on this control box cannot be cleaned.

Better Design

Clamps can be used instead of hinges that run the length of the equipment, which reduces the number of niche points and allows for easier cleaning.



Figure 27

The external door clamps cannot be disassembled for cleaning.

Better Design



Figure 28

Hinges shielded to help prevent water entry, and is offset from floor and wall. However, hinges can still be niche points.

Best Design



Figure 29

¼ turn latch is more cleanable and creates less harborage space.



Principle #3: *No Collection Points*

All surfaces of equipment should be designed to prevent pooling of water and be self-draining. Think about where water accumulates, pools or condenses alone or with product. Never use absorbent materials on equipment.

Moisture should never drip, drain, or draw into product areas. Conveyor belts should be tense enough to prevent pooling. Eliminate dead spaces where water and/or product can accumulate over the course of the shift.

Drip Pans

Poor Design

The drip pan in Figure 30 is designed to catch fluids from the connections or motor above it. However, it is more likely to be an opportunity for water and/or product to accumulate and create a product contamination hazard.

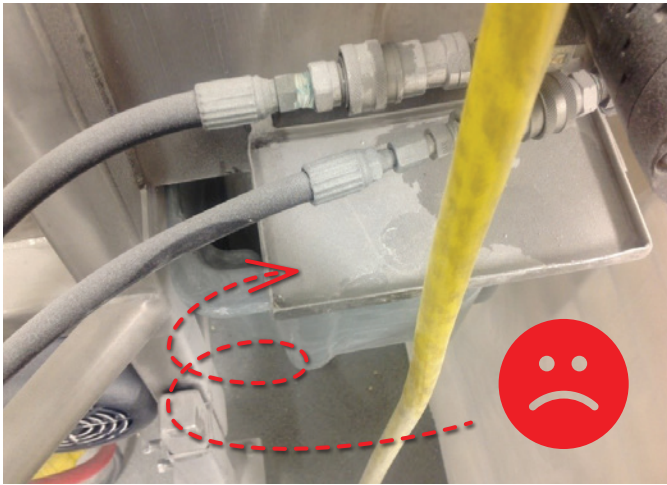


Figure 30

*Drip pan
collects water
and/or product.*

Poor Design

There is a lip along the bottom of the hopper in Figure 31. It's unclear why it is there, maybe to give strength to a long stretch of stainless steel. Perhaps it was designed to catch condensation, although the acute angle of the lip limits the amount of condensation before it overflows and there is no drainage point. If the outside of the hopper is clean, then the condensate collecting there will most likely also be clean. However, if food collects there as well, the opportunity for pathogens to collect and grow is a potential.

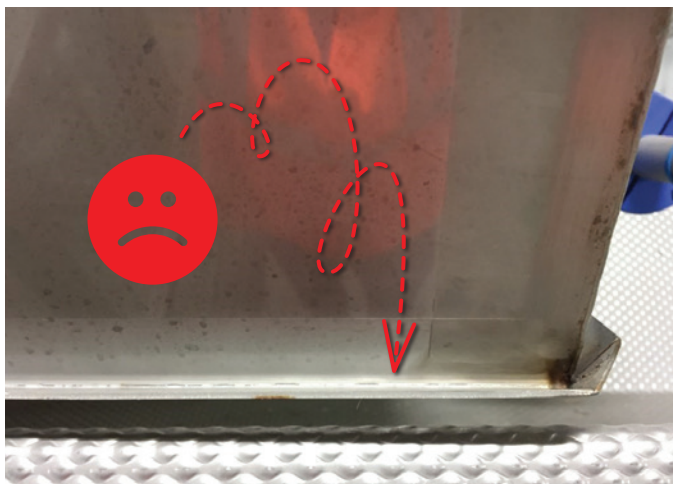


Figure 31

Condensate on the outside of a hopper will be caught by this lip. If food debris gets into this area, it can result in microbial harborage.

Better Design

Drip pans should be designed to catch fluids, but direct it away from product and prevent accumulation. Flat surfaces and lips should be avoided.



Figure 32

Drip pan removed from under motor housing to prevent water accumulation. However, without the drip pan there is no direction of drippings, which can lead to contamination.

Best Design

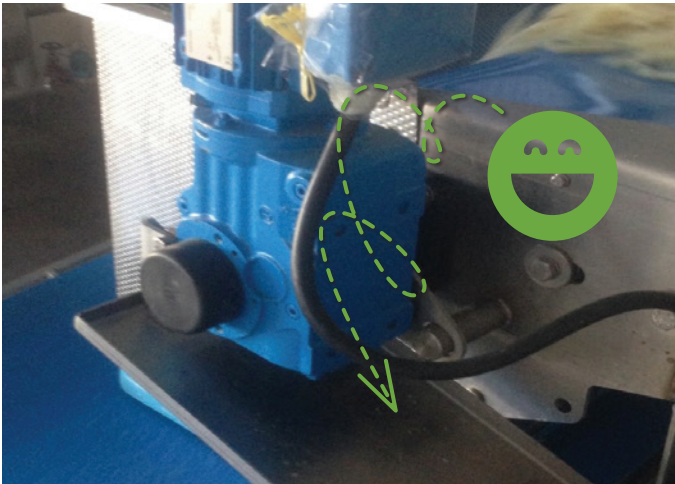


Figure 33

Catch pan is inclined so there is no accumulation. Moisture is directed away from the product.

Drains

The trench drains in Figure 34 have plastic inserts, pits and cracks, and gaps. They provide multiple locations for moisture accumulation and are nearly impossible to clean adequately.

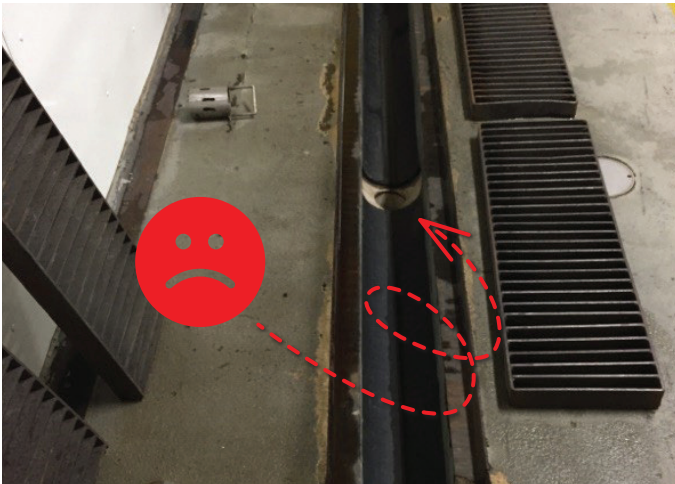


Figure 34

Trench drains with many opportunities for moisture accumulation.



A worried Sanitary Design Man sees several opportunities for hygienic restoration here. Can you help him point out what else is wrong with this picture?

Better Design

Trench drains in Figure 35 are redesigned with a stainless steel lining that is smooth and cleanable and reduces the potential for water accumulation.



Figure 35

Trench drains with stainless steel lining reduces water accumulation, makes for easier cleaning.

Best Design

An even better design is to convert to stainless steel circular drains like that in Figure 36. Sloping of floors toward the drain guides waste water away to prevent pooling on the floor. These drains are smooth, cleanable surfaces.

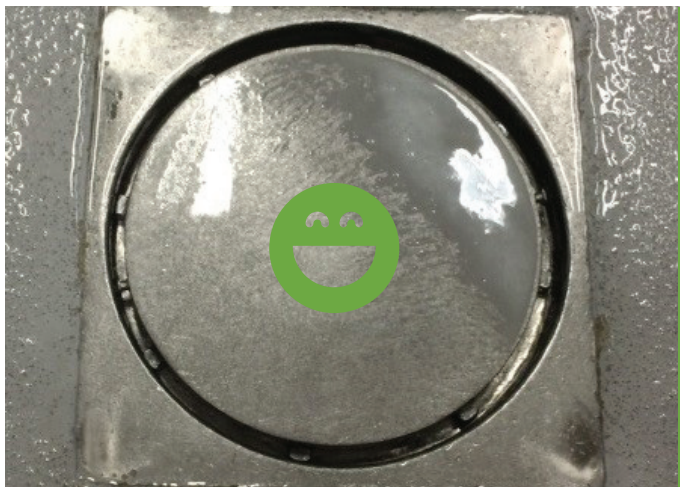


Figure 36

Stainless steel circular drain is better alternative to trench drains.

Dead Spots or Product Collection Points

The drain table in Figure 37 shows signs of rust where water collection has occurred. This standing water can recontaminate the equipment that is stored here.



A worried Sanitary Design Man sees several opportunities for hygienic restoration here. Can you help him point out what else is wrong with this picture?



Figure 37

Sanitation drain table has a dead spot which allows collection of product and moisture, and has led to corrosion. This could re-contaminate clean equipment.

Best Design



Figure 38

Sanitation table has stainless steel perforated insert, is in good condition and is easily removed for effective cleaning.



Principle #4: *Eliminate or Minimize Hollow Areas*

Hollow areas should be hermetically sealed, wherever possible, to prevent water and food entry. The internal spaces of hollow areas are not accessible for cleaning and inspection which provides a harborage point for pathogens. There should be no tubes, drilled or taped holes, or partially welded seams on any equipment in areas where product is exposed. Bolts, studs, mounting plates, brackets, junction boxes, plates, end caps, sleeves, and hinges.

Poor Design

Figure 39 illustrates a poorly designed packing table where telescoping legs were installed. The legs are hollow to accommodate the leg jack inside – a tube in tube construction. Where the jack exits the leg to allow for adjustment, water can enter the threaded holes. Neither the interior surface of the leg or the jack can be accessed for cleaning and inspection without dismantling each leg, a time-consuming task unlikely to get done in a sanitation shift.

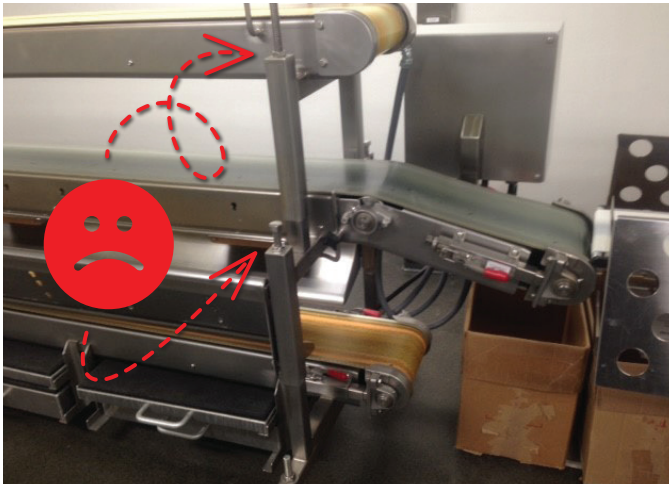


Figure 39

Telescoping legs create hollow cavities - tube in tube construction is difficult to clean and inspect.

Best Design

The telescoping legs in Figure 39 were replaced with sealed-tube legs welded to the packing table, as shown in Figure 40. There is no need for disassembly and they are easily cleanable.



Figure 40

Packing table with telescoping legs replaced by seal welded tube legs.

Poor Design

The product funnel in Figure 41 has numerous clamps, fasteners, and plastic pieces over product creating a potential foreign material contamination problem. In addition, the complicated disassembly of the funnel mechanism prohibits thorough and effective cleaning and inspection.



Figure 41

Numerous small parts over the product requires extensive disassembly.

Best Design

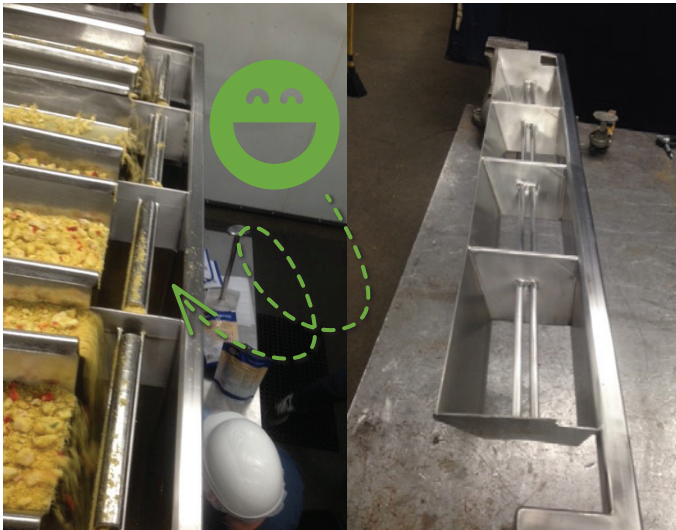


Figure 42

On the left, pins, plastic clamps, and fasteners have been removed from this product funnel. It is held in place with magnets only. On the right, it is lifted off the frame and removed for easy cleaning.

Poor Design

The product pole in Figure 43 is uncleanable due to the hollow interior surface.



Figure 43

Hollow tubes of such narrow diameter are not cleanable on their interior surface.



A worried Sanitary Design Man sees several opportunities for hygienic restoration here. Can you help him point out what else is wrong with this picture?

Improved Design



Figure 44

Hollow tubes have been capped with continuous weld. Sealed tube is easily cleanable.

Augers

Poor Design

Figure 45 shows the auger filler as supplied by the equipment manufacturer. The open product hopper is difficult to separate from the frame for cleaning because of the fasteners around the rim.

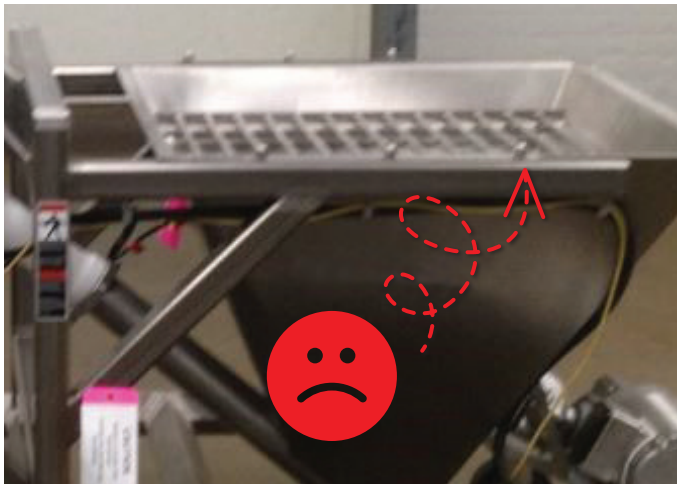


Figure 45

Hopper cover is not easily disassembled for cleaning and inspection.



A worried Sanitary Design Man sees several opportunities for hygienic restoration here. Can you help him point out what else is wrong with this picture?

Best Design

Figure 46 is the same type of hopper, but the fasteners have been removed. Clamps and gravity are relied upon to hold equipment in place.

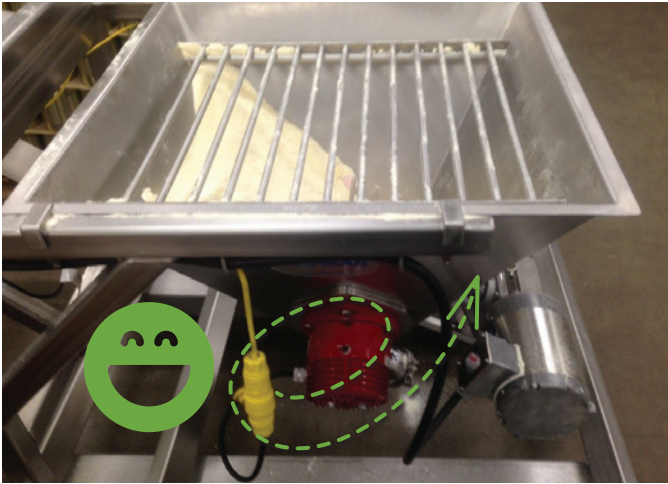


Figure 46

Hopper cover fasteners removed, replaced with clamps that set in place.

Poor Design

The auger drive mechanism in Figure 47 was difficult to clean and the grease might be able to get into the product. The processor redesigned the drive to separate the bearings from the product, making it much easier to clean and removing potential for grease to contaminate the product.

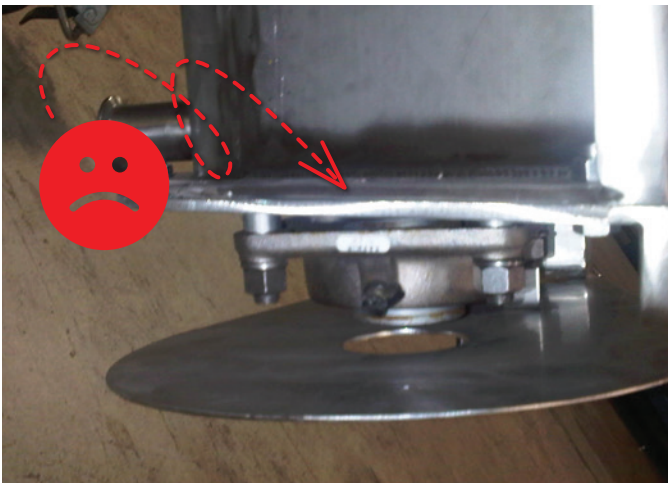


Figure 47

Difficult to clean and leakage can occur in the product.

Better Design

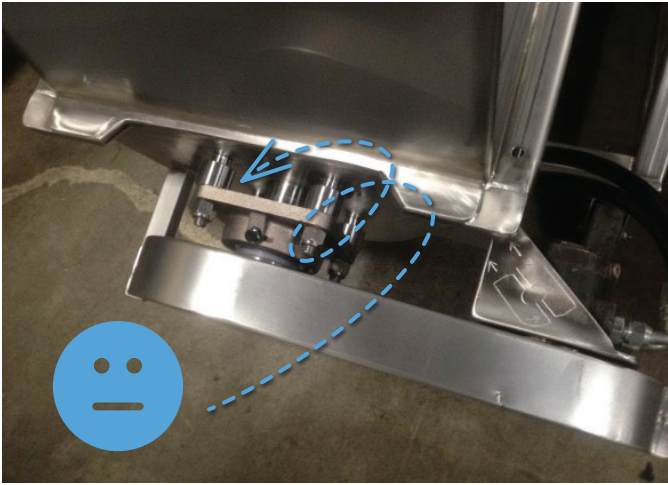


Figure 48

Bearing separated from product-more cleanable.

Holes

Holes drilled into equipment should be avoided when possible. Holes create hollow areas that can be difficult to clean and possibly create harborages. If holes can't be avoided then they should have smooth internal surfaces free from threads and rough welds, as seen below in Figure 49.

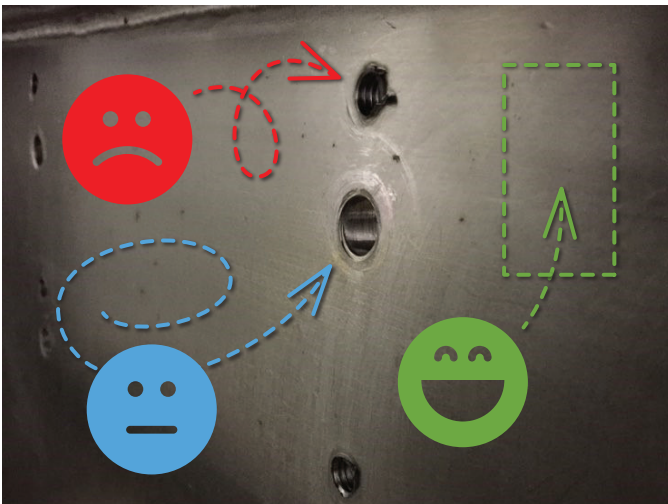


Figure 49

Poor design of a hole that contains threads -improved design with hole that is smooth inside. Best design contains no holes and avoids potential harbor spots.

glossary of terms

FCS: Food Contact Surface - a site on equipment where food product makes direct contact with the equipment.

Food Safety Plan (FSP): A document, required by the Food Safety and Modernization Act, which contains all identified food safety hazards and the preventative activities in place to control them. It contains all documents that outline the safety practices for food during manufacturing, processing, packing and holding.

Harborage: a site on food processing equipment that is difficult to access for cleaning and can support bacterial survival and growth.

Hygienic Restoration: the process of redesigning and improving existing equipment to better protect against the harborage and growth of bacteria in the food processing facility.

Niche: a pit, recess, crack, gap or other site on equipment where bacteria can hide and survive.

Sanitary Design: the design, manufacture and installation of facilities and equipment to reduce the risks of bacterial contamination of food.

Validation: the process of confirming that a cleaning and sanitation plan works by collecting and analyzing swabs for harmful (pathogenic) bacteria.

Verification: the process of confirming that a cleaning and sanitation plan is being done consistently and effectively.

Zone 1: any area considered to be a food contact surface (FCS), it is the most sensitive hygienic zone and should have the most controls in place to protect the area from the presence of bacteria.

Zone 2: a slightly less sensitive hygienic zone, it is not a product contact surface, but may be near or close to one. These areas are near enough to Zone 1 areas, and could possibly introduce bacteria to a food contact surface.

where to go to learn more

This guide is intended to be a quick introduction to basic sanitary design principles. If you are interested in learning more about sanitary design and hygienic restoration, review the websites and publications below.

Sanitary Design Checklists Used Throughout the Industry:

North American Meat Institute

<https://www.meatinstitute.org>

Commercial Food Sanitation

<http://www.commercialfoodsantiation.com/documents/>

Food Plant Engineering (Facility design)

<https://www.foodplantengineering.com/knowledge/food-plant-design-white-papers/food-facility-sanitary-design-principles.html>

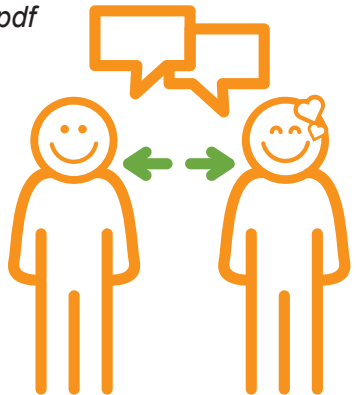
Websites and Other Resources:

Northwest Food Processors Association Listeria Checklist

<https://www.nwfpa.org/listeria-checklist>

Process Validation and Verification

<https://nifa.usda.gov/sites/default/files/resource/Overview%20of%20FDA%20Regulations%20and%20Process%20Validation%20Considerations.pdf>
(starting on page 27).



Let Us Know How We Did!

Contact us with feedback on how we can improve this guide at sanitarydesign@nwfpa.org

