



Hygienic Design Best Practices for Food & Dairy Processing

A TECHNICAL BRIEF FOR SAFE, CLEANABLE, AND RELIABLE PROCESS SYSTEMS

PREPARED BY KODIAK PROCESS & INSTALLATION

Executive Summary

In food and dairy processing, hygienic design is essential to protect product safety, maintain regulatory compliance, and ensure consistent operational performance.

Improperly designed systems can harbor bacteria, trap product residue, and compromise cleaning effectiveness - increasing the risk of contamination, spoilage, and recalls. This technical brief outlines hygienic design best practices specific to food and dairy environments and provides guidance for engineering and maintaining cleanable, compliant process systems.

Hygienic Design in Food & Dairy Facilities

Hygienic design ensures that equipment and piping systems can be effectively cleaned and sanitized while preventing microbial growth and cross-contamination.

Key standards and regulations include:

- 3-A Sanitary Standards
- FDA Food Safety Modernization Act (FSMA)
- Current Good Manufacturing Practices (cGMP)
- EHEDG Guidelines (where applicable)

Why It Matters in Food & Dairy

Food and dairy products are highly susceptible to contamination from pathogens such as *Listeria, Salmonella, and E. coli*. Poor hygienic design can result in:

- Residual milk solids and sugars feeding bacterial growth
- Incomplete CIP coverage leading to inconsistent sanitation
- Moisture accumulation enabling biofilm formation
- Regulatory non-compliance and audit failures
- Costly recalls and production losses



Proper hygienic design supports:

- Food safety and brand protection
- Consistent cleaning and sanitation
- Reduced downtime and rework
- Faster inspections and audits

Hygienic Design Best Practices

Material Selection

- Use 304L or 316L stainless steel for all product-contact surfaces.
- Avoid carbon steel, painted surfaces, and porous materials in product zones.
- Ensure gasket and seal materials are FDA-compliant and chemical compatible.

Surface Finish

- Maintain ≤ 32 Ra surface roughness on product-contact surfaces.
- Avoid scratches, pits, or weld oxidation.
- Consider electropolishing for high-risk zones.

Drainability & Flow

- Design piping to be self-draining wherever possible.
- Avoid flat runs and low points that trap liquids.
- Slope lines (typically 1/8" per foot) toward drain points.

Eliminate Dead Legs

- Dead legs should not exceed 1.5 times the pipe diameter.
- Avoid capped tees, unused branches, and stagnant pockets.

Weld Quality

- Use full-penetration, smooth, crevice-free welds.
- Perform internal grinding and polishing where required.
- Document weld procedures and inspections.

Clean-In-Place (CIP) Compatibility

- Ensure spray coverage reaches all product-contact surfaces.



- Validate flow velocity and turbulence.
- Avoid shadowed zones behind valves and fittings.

Common Hygienic Design Failures in Dairy Plants

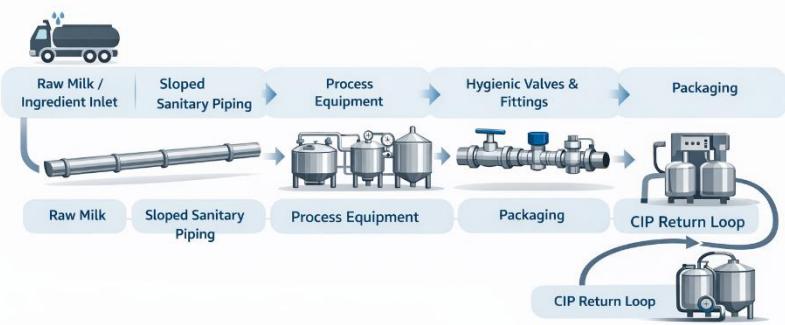
- Flat piping runs that retain milk residue
- Improperly sloped pasteurizer connections
- Dead-ended branches after line changes
- Rough welds harboring bacteria
- Incompatible elastomers degrading under caustic cleaning

Hygienic Design Checklist

Use this checklist during design reviews or audits:

- All product-contact materials are stainless steel or FDA-compliant
- Surface finish meets hygienic requirements ($\leq 32 \text{ Ra}$)
- Piping is sloped for full drainability
- No dead legs exceed $1.5 \times$ pipe diameter
- Welds are smooth, inspectable, and documented
- CIP spray coverage is validated
- All gaskets and seals are chemically compatible
- System is accessible for inspection and maintenance
- Design aligns with 3-A and FSMA requirements

Hygienic Flow Diagram (Conceptual)



Design Notes:

- No horizontal dead zones
- All components accessible
- CIP flow reaches all product-contact areas



Conclusion

Hygienic design is critical for safe, compliant, and efficient food and dairy processing. It must be addressed at the system level - from engineering and fabrication to installation and operation.

Facilities that invest in proper hygienic design reduce contamination risk, improve cleaning effectiveness, and protect both their product and their brand.

About Kodiak Process & Installation

Kodiak Process & Installation designs, fabricates, and installs sanitary process systems for food and dairy manufacturers. Our team focuses on building cleanable, compliant, and reliable infrastructure that supports safe food production and efficient operations.

For more information, please visit: www.kodiakprocess.com or send us an email at: info@kodiakprocess.com.