Hygienic Equipment Design Principles

For manufacturers, the best defense is a hygienic offense

How to select the right level of equipment protection for your processing application

Thanks to greater domestic and global regulatory vigilance, as well as advancing mechanisms for identifying, tracking and tracing pathogens and contaminants, the manufacturing industry has a better handle than ever before on product safety. Even so, the need for vigilance remains. In 2018, the U.S. Centers for Disease Control and Prevention (CDC) investigated more than 20 multistate foodborne[1] disease outbreaks – more than any previously recorded year – and more than 200 food recalls. This after 2017 saw the highest number of food recalls, at 456[2], in five years in the United States.

The U.S. food industry alone loses an estimated $55 billion[3] annually due to food-borne pathogens, with individual companies losing millions of dollars[4] in the event of a recall due to business interruptions, product disposals, lost sales and legal expenses. That's just the business costs. An estimated 3,000 Americans die each year from food-borne illnesses, and another 48 million get sick, according to the CDC.

As food-borne pathogens continue their assault on consumer health and significantly challenge food production facilities[5], Food & Beverage manufacturers need to be prudent in deploying advanced sanitary solutions to safeguard their processing plants and keep them from becoming bacterial breeding grounds. Among the important pieces of equipment in any processing plant are the electrical enclosures relied on to protect the housed equipment and provide safety for those in the vicinity.

Meeting hygienic standards

Traditionally designed enclosures have the potential of failure when exposed to the rigors of routine sanitary washdown cleaning procedures used in today's processing plants. In an attempt to circumvent these potential failures, maintenance personnel often end up taking extra manual steps, such as bagging enclosures or caulking doors and seals, to keep moisture from entering or pooling on the enclosure, damaging equipment and breeding bacteria.

Rather than rely on these manual hacks that fatten lean processes and delay production, Food & Beverage manufacturers can take advantage of new and advanced hygienic electrical enclosure solutions. These specially engineered enclosures are built to withstand the high-temperature, high-pressure sprays of sanitary washdown procedures, especially for clean-in-place and harsh applications. Hygienic equipment design principles encompass:

- **Surfaces** – Most standards require a surface finish with a roughness average (Ra) of 0.8 µm (32 µ in) or less.
- **Materials** – Must be compatible with the application. This includes the food being produced, as well as, cleaning chemicals and processes.
- **Construction** – Food equipment must be constructed to have self-draining surfaces, with no undercuts or crevices in which soil can accumulate.
- **Installation** – The equipment should allow for complete access during cleaning. If mounted directly to a wall, it must be sealed or offset from the wall to minimize the collection of soil.
- **Maintenance** – Designed to withstand the rigors of high-pressure and -temperature cleaning operation.

In addition, hygienic enclosure solutions comply with harmonized global standards that indicate how well they will prevent liquid ingress, resist corrosion, and withstand temperature and pressure ranges. Standards include:

- **IP69** – These ratings indicate the level of protection of an enclosure against ingress of liquids (IPX9) and dust (IP6X). During the testing procedures, enclosures are subjected to the high temperatures (80 C) and high-pressure sprays (approx. 1200 psi) associated with – but more rigorous than – routine sanitary washdown cleaning procedures. IP69 (IEC) for electrical equipment and IP69K (DIN) represent the highest level of protection.
- **3-A Sanitary Standards** – These standards indicate hygienic equipment design, i.e. equipment designed to prevent bacterial ingress, survival, growth and reproduction on both product and nonproduct contact surfaces. Today this standard is widely relied on for a range of food and beverage processing solutions. Currently, only one electrical enclosure on market today bears this certification.
- **NSF** – Originally formed in 1944 as an independent third-party to standardize U.S. sanitation and food safety requirements, NSF now is an international certification body that tests and certifies products to verify they meet public health and safety standards. Enclosures are constructed to NSF 169 Special Purpose Food Equipment and Devices.
- **Type 4X** – Type 4X certification indicates protection for personnel against access to hazardous parts as well as a superior level of protection for equipment inside an enclosure against ingress of water or solid foreign objects like dust, which can damage critical equipment inside the enclosure and cause bacterial growth. In addition, Type 4X indicates a superior level of corrosion resistance.

IPX9 Water Testing Requirements

Large enclosures (≥ 250 mm)

- Enclosure is mounted on wall or its intended use
- Enclosure is sprayed from all practical directions covering the entire exposed surface area
- The spray is perpendicular to the surface
- Distance between nozzle and enclosure is 175 ± 25 mm
- Temperature and pressure of spray for both tests (176F ± 9F and 1160 – 1450 PSI)
- Test duration is 1 min/m^2 of the surface area, with 3 min minimum duration

Small enclosures (< 250 mm)

- Enclosure is mounted on test device (i.e. rotating table)
- Turntable speed is 5 r/min ± 1 r/min
- Spray positions are at 0°, 30°, 60° and 90°
- Distance between nozzle and enclosure is 125 ± 25 mm
- Temperature and pressure of spray for both tests (176F ± 9F and 1160 – 1450 PSI)
- Test duration is 30 s per position

Passing Criteria

The technical committee specifies the amount of water that may be allowed to enter the enclosure. If any water has entered, it shall not:

- be sufficient to interfere with the correct operation of the equipment or impair safety;
- deposit on insulation parts where it could lead to tracking along the creepage distances;
- reach live parts or windings not designed to operate when wet; and
- accumulate near the cable end or enter the cable if any.

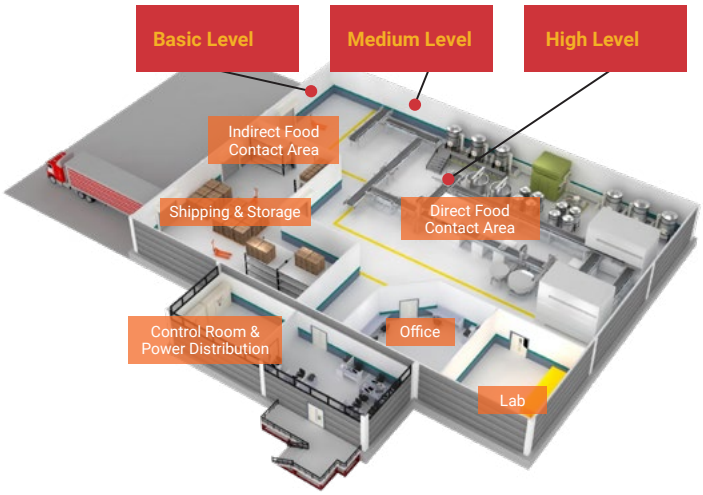
Selecting the right level of protection

Enclosures must be specially engineered for the harsh conditions associated with Food & Beverage applications. In general, an electrical enclosure suitable for washdown environments should:

1. Meet industry standards for preventing liquid ingress and resisting corrosion.
2. Provide a door seal that can be easily maintained and replaced, if necessary.
3. Be robustly capable of surviving the high temperatures and pressures associated with cleaning operations.
4. Reliably maintain functionality after repeated cleaning cycles.

Beyond these basic requirements, it is important to match the right level of protection to the processing application rigor required:

- **Basic Level** – For applications with no food contact that experience minor washdown or chemical contact, sloped top enclosures that meet IP66 and Type 4X are suitable.
- **Medium Level** – For food processing applications where enclosures will come into mild contact with water spray and chemicals, sloped top enclosures that meet IP66, Type 4X and NSF are suitable.
- **High Level** – In harsh applications where hygienic design is required due to clean-in-place, cleaning chemical rich contact and/or large temperature swings, sloped top enclosures that meet IP69K (DIN), IP69 (IEC), Type 4X, and NSF, and hold a 3-A System Component Qualification Certificate are appropriate. In addition, solutions that include a replaceable FDA food-grade silicone gasket help provide even more protection against water ingress, chemical attack and the harborage of bacteria.



Equipment for ultimate protection

By applying the right level of electrical enclosure solution protection to the washdown application need, Food & Beverage manufacturers will minimize their risks of bacterial growth and other contaminants, resist corrosion to equipment, promote longer lifecycles for controls and drives, and ultimately speed and simplify routine maintenance for sanitary washdown procedures.

With people's lives and millions of dollars at risk, the Food & Beverage manufacturers that adhere to international best practices and leverage hygienic equipment designs will be best equipped to thrive.

U.S. Food Safety Modernization Act

Sanitary washdown measures became increasingly stringent and in wider use after a series of food-borne illnesses in the early 2000s prompted the U.S. government to enact the first major piece of food safety legislation since 1938. The Food Safety Modernization Act, passed in 2011, gives the U.S. Food and Drug Administration increased authority to regulate the way foods are grown, harvested and processed.

In addition, U.S. Food & Beverage manufacturers, along with global peers, should follow the Good Manufacturing Practice (GMP) guidelines as a best practice.

Sources:
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About nVent HOFFMAN

nVent HOFFMAN provides a uniquely comprehensive enclosure portfolio to protect critical electrical equipment during washdown cleaning procedures. These solutions – including the industry's highest-rated total sanitary solution, HyShed – are specially engineered to meet the simplest to most challenging Food & Beverage application needs.

To learn more about HOFFMAN's complete portfolio of sanitary washdown solutions, visit: **hoffman.nvent.com**.