White Paper: Cleaning is a Must!

Cleaning is an absolute must if foodstuffs are to be produced hygienically. The highest priority here is afforded to avoiding the spread of germs and eliminating foreign particles. Proper cleaning reduces the downtime of your plant and systems, while protecting the consumer and your brand.

This white paper has information on:

- Regulatory requirements on cleaning
- Electrical protection classes
- Cleaning methods and processes
- Ease of cleaning and corrosion resistance of system components
- Correct selection of components such as cylinder seals and tubes

Statutory regulations on cleaning

Machinery Directive 2006/42/EC, Section 2.1: "Machinery intended for use with foodstuffs or with cosmetics or pharmaceutical products must be designed and constructed in such a way as to avoid any risk of infection, sickness or contagion." All surfaces that come in contact with foodstuffs must be easy to clean and disinfect. The operating instructions for foodstuff machinery must specify the recommended cleaning and disinfection agents as well as the corresponding methods (for all areas).

The hygienic design of machines and components is also described by EN 1672-2, ISO 14159 and Doc 8 & Doc 13 of the EHEDG. These stipulate essential design elements which can be taken into consideration in the design of components and systems.

In essence, a perfect production process needs to be guaranteed that does not pose a risk for either the food or ultimately the consumer. Significant risks are caused by:

- Decay caused by micro-organisms
- Residues, e.g. of lubricants, cleaning and disinfection agents
- Foreign matter

To ensure a machine's design is hygienic, the consequences of all risks must be taken into account. The risks must be eliminated or minimised as far as possible.
The aim: an optimally hygienic condition with minimal time and detergent required.

The Food Processing and Packaging Machinery Association and the Process Plant and Equipment Association within the German Engineering Federation VDMA estimate that in the foodstuffs industry 20 to 30% of all production time is given over to cleaning.

Selecting components that are suitable for cleaning reduces the number of unforeseeable breakdowns and thus increases the availability of the system.

Electrical protection classes

IP (International Protection):
Housings of electrical components must protect personnel, on the one hand, and prevent harmful influences from the outside, on the other. The IP protection class is specified by two code digits:

- Digit 1:
  Protection against ingress of particles
- Digit 2:
  Protection against ingress of water

In the food and beverages industry, most electrical components used have the protection class IP 65, IP 66, IP 67, IP 68 and IP 69k.

In the evaluation according to the US standard, **NEMA (National Electrical Manufacturers Association)** Standards Publications 250-1997, a classification by operating environment, i.e. hazardous and non-hazardous, is performed. In addition to DIN EN 60529 and DIN 40050, tests such as corrosion tests, tensile tests on seals and icing tests are required.

Cleaning methods and processes

The cleaning method is determined by operational structures, but also by special applications, products and processes. The effect of cleaning is based on the primary influencing factors: temperature, time, mechanics/force and concentration.

Temperature	Time
Mechanics/force	Concentration

Primary influencing factors in cleaning

Dry cleaning, e.g. with brushes or suction devices, serves to generally remove any loose or easy to remove dirt. Depending on the type of contamination, this is frequently followed by wet cleaning using **high-pressure cleaning** or **low-pressure foam methods**.

In order to clean special system parts outside and inside in accordance with the hygiene regulations, additional **special methods** must be used:

- Flow-through
- Spraying
- Filling
- Scraping

These cleaning methods can be used for different **cleaning processes**:

- Manual cleaning
- **CIP** (Cleaning In Place)
  An automatic process ensures complete cleaning/disinfection. The system parts and components need not be disassembled. This takes place in accordance with a defined sequence of steps that has been stipulated by the manufacturer.

CIP is frequently also called cleaning in process. According to the definition in the EHEDG, however, it is actually cleaning in place – i.e. the cleaning takes place with the parts and components in their installed position as opposed to during the actual process.

- **COP** (Cleaning Out of Place)
  System parts and/or components are disassembled for cleaning. This can take place manually or automatically, e.g. using a washing machine.

- **SIP** (Sterilization In Place)
  An automatic process sterilizes the stipulated areas completely. The system parts and components need not be disassembled. This takes place in accordance with a defined sequence of steps that has been stipulated by the manufacturer.

- **SOP** (Sterilization Out of Place)
  System parts and/or components are disassembled for sterilization. This can take place manually or automatically.

Ease of cleaning and corrosion resistance of system components

Many potential sources of contamination in food production such as bacteria, chemical influences or corrosion particles can be eliminated with just a few design tweaks. To ensure that cleaning is safe, the materials used must not react with the cleaning agents or the disinfectants. The machine parts must be resistant to corrosion and be mechanically and chemically stable.

Incorrect choice of materials – typical damage profiles

Tips to avoid damage:

- High surface quality through a mean peak-to-valley height Ra between 0.4 and 0.8 µm
- Open connection elements and threads must be closed off with suitable covers and seals.
- Inside corners and internal radii are very difficult to clean. The prescribed minimum radius is 3 mm.

Easy-to-clean design: DSBF drive

Correct selection of components such as cylinder seals and tubes

Drives must also work in aggressive environments. In order to guarantee their operation and a long service life, special requirements are placed on the component materials. This applies to the materials used for the drive unit and those used for interface components, such as connections and seals.

Only **seals and lubricants approved for use with foodstuffs** are to be used for operation in contact with foodstuffs. Depending on the requirements, different FDA-compliant sealing types can be selected, such as

- standard seal or
- dry-running seal.

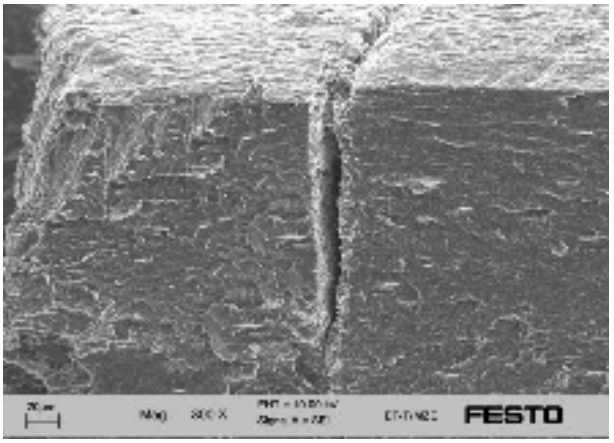
Reliable function – the dry-running seal from Festo (e.g. CRDSNU drive)

Dry-running seals ensure the reliable function of the components (e.g. of the drive), even if the lubricant is washed out through intensive cleaning.

Important aspects of **tubing selection**:

Tubing is at risk from various environmental influences. The most frequent causes for tubing defects lie in the direct working environment of applications. Only a small portion are caused by mechanical load such as fracture or friction. Approx. 90% of the defects on pneumatic tubing is caused by chemical, microbiological or physical influences:

- **Chemical influences**
  Through chemical reactions, acids and bases split the molecular structure of the plastic compounds in the tubing. The integrity of the tubing is compromised by cracking.



SEM micrograph of cracking in plastic

  The influence or inclusion of polar organic substances, solvents or hydrocarbons in the tubing material leads to the development of internal stresses and the simultaneous reduction of intermolecular bonding forces in the tube.

- **Microbiological influences**
  Micro organisms such as fungi and bacteria damage the tubing, generally indirectly, through their metabolites. In certain rare cases, the components of the tubing can even serve as a source of food for these organisms.

- **Physical influences**
  An impermissible pressure/temperature ratio can lead to plastic deformation of the tube material. In addition, intensive UV, X-ray or gamma radiation can lead to the break-up of the macromolecules in the tube material.

Sources:

- Machinery Directive 2006/42/EC, Section 2.1
- The Food Processing and Packaging Machinery Association and the Process Plant and Equipment Association within the German Engineering Federation VDMA - Frankfurt, 5 January 2012.
- EHEDG: Doc 8 and 13
- EHEDH: Yearbook 2013/2014
- Festo: Product report for the food and beverage industry
- Festo: White Paper 'Hygienic automation technology in food production'
- Festo: White Paper 'Food quality through high quality compressed air'
- Festo: Sizing software for tube selection

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