

WHITEPAPER

CABLES AND CONNECTORS
FOR THE FOOD AND
BEVERAGE INDUSTRY

Cables and connectors for the food industry



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Wherever food is affected, hygiene is at the top of the agenda. Production facilities should therefore be designed according to the principles of hygienic design. Cables, connectors and housing bushings play an important role. Minimising downtime, ensuring quality, protecting employees – while these are priorities in all industrial sectors, they are particularly important in food production. In the food and beverage industry, once the processing of perishable foodstuffs ceases, it leads to profit losses as well as high costs as a result of waste disposal and the need to restart production.

Quality is another important factor for the industry – if the quality is insufficient, consumers become dissatisfied and it could also put their health at risk. It is therefore important that the production facilities are regularly cleaned to remove dirt and germs. This is often done using steam jets and either acidic or alkaline cleaning agents, aggressive cleaning agents in a dry process or the most recent innovation: dry ice. In each case, the facilities are exposed to highly strenuous conditions, the details of which can vary greatly. Therefore, all components need to be designed in such a way that, even under such diversified degrees of stress, they remain permanently sealed and functional, while being made from shapes and materials which do not provide a breeding ground for germs.

Three hygiene zones

The first prerequisite is that the right components are selected for the Hygienic Design Zone, Splash Zone and Non-Product Zone when constructing the facilities, and that these components are used correctly. Industrial working groups such as "Safe Food Factory" in the Benelux states are compiling recommendations for this. Broadly speaking, the closer a component comes to foodstuffs, the higher the requirements.

Robust against cleaning agents and foodstuffs

The strictest hygiene requirements are placed on the Hygienic Design Zone and the Splash Zone – these areas need to be thoroughly cleaned at regular intervals. The components in the machines and facilities in these zones are subject to product-specific hygiene regulations. Depending on the food to be processed and the materials and design of the facility, various cleaning options can be used to avoid food contamination and keep the facility in good condition for as long as possible. Aggressive cleaning agents, such as corrosive acids and alkalines in various concentrations, are used in several working steps according to how dirty the facility is. They can be used in a dry process by applying them and wiping them off or as a low- or high-pressure cleaning solution. Visual residues are removed manually or in a pre-rinsing process, organic matter is removed using an alkaline cleaning agent, inorganic residues using acid-based agents and micro-organisms are destroyed using disinfectants with a rinse between each step. Dry-ice blasting is a trend, and it acts as an alternative for users who do not want to use a cleaning agent. Dry-ice particles at temperatures of -78°C are applied to extremely dirty components, e.g. boilers or the insides of ovens, at a pressure of two to six bar. The dirt freezes and becomes brittle so that it can be quickly and safely removed.

In practice, the machines and facilities are cleaned several times a day (depending on the foodstuffs being produced), which has a major impact on efficiency. Cleaning also incurs high costs as it requires the use of either your own staff or cleaning and hygiene service providers. At the component level, hygienic design decreases the time needed to clean machine and facility components. If components are easier to clean, this will also have a positive effect on the concentration of the cleaning agent and



In the food and beverage industry, cables and cabling components are subjected to particularly strenuous conditions. If unsuitable components are used, then screw joints could corrode and the cable insulation could swell, as can be seen in the image. The components would lose some of their functionality and it could result in hazardous situations.

disinfectant for each facility. This reduces cost and saves the environment. Lower concentrations of cleaning agents and disinfectants also have a positive impact on the durability of the materials, which reduces the risk of downtime.

The fact is that whether you are cleaning using high pressure, aggressive chemicals or dry ice, only a few materials can withstand this treatment over an extended period of time. The top choice is stainless steel, which is used almost exclusively, particularly in the Hygienic Design Zone. Tubes and cables were also once laid in stainless steel pipes, but this is an expensive method, so equipment manufacturers and their customers prefer an open installation of cables and conduits wherever possible. These installations also need to be able to withstand the cleaning procedures, otherwise there is a risk that a cable could lose its insulation.

To give a drastic example, if unsuitable components are used, the screw joints could corrode and the cable insulation could swell (see image above). The components would lose some of their functionality and it could result in hazardous situations. Another cause of wear is often the food being processed. As such, the focus should be shifted away from the resistance to cleaning agents and disinfectants themselves. Bio-oils, fats, fruit acids, lactic acids, etc. can have a significant impact

on the components' long-term functionality. To give an example, in a bakery, outgassing from the dough had caused a PVC sheath on a standard cable to swell and become brittle. This could have caused a short circuit or electric shocks, and the staff were in acute danger. The plastic also could have fallen into the dough. The cables needed to be replaced, which led to lengthy downtime. This could have been avoided if ÖLFLEX® ROBUST cables had been used.

Choosing suitable components and their proper use can have direct impacts on the safety of staff and the final product quality. We have gained a wealth of experience in our international laboratories over the past few years. Around 100 different cleaning agents and more than 700 other substances, such as oils, fats and emulsions, have already been tested on our product materials. Customer-specific tests are the most important here. From experience, we know that differing results can often be expected due to changing requirements, e.g. the concentration of the substances or varying temperatures. If the results are transferable, we can use them as an excellent basis for product recommendations. Customer-specific tests are also beneficial in other respects. In addition to cables, marking systems – such as the FLEXIMARK® LCK wrapping labels – also underlie resistance tests. The benefits of this include a minimal clearance volume and a high resistance to substances with an acid and alkaline base.

Loops along the cables trap dirt and are tough to clean, so they should be avoided in food production.



Best practice: loose cabling

The Safe Food Factory working group is tasked with discussing how such hazards can be prevented. One important aspect is the type of installation: cables are often bundled more tightly together than they ought to be. Loose cabling with a bit of space would be better for easy cleaning. However, technical inspectors normally put great emphasis on the use of fixed installations – a happy medium needs to be found. The members of the working group also recommend not using overly long cables. Cables are often installed with a reserve. Although this is convenient, it is dangerous from an electrical perspective (in terms of bundling). The cables also form loops that catch dirt and are tough to clean. Generally speaking, cables should be kept as far away as possible from the areas requiring thorough cleaning. The use of hybrid cables – in which several cables are combined into one – is also beneficial as there are fewer gaps where impurities can later settle. There are contradictory requirements in the USA: on the one hand, companies who want to export to the USA face the NFPA requirements for maximum fire protection. On the other hand, the FDA is critical of cables with reduced flame-propagation since some fire-retardant additives are prone to outgassing and can therefore contaminate raw materials. As such, the overriding requirement needs to be determined on an individual basis.

The application is the crucial factor

It is not always possible to keep cables out of the Hygienic Design Zone, for example those found in temperature or capacitive level sensors in a fermenter. These cables need special protection, if not in stainless steel pipes, then in protective conduits. This also makes them easier to clean. Nevertheless, there is a further complication when it comes to major temperature fluctuations: condensation may form and collect in the protective conduit, which is not hygienic in the long term. In this case, a highly resistant cable in an open installation connected to a suitable cable gland is the better choice. However, there is not a universal "best solution" – each individual case needs to be considered. LAPP's application engineers can help you to find the best solution. For users, it is important to bear in mind how individual components interact. We therefore recommend choosing a supplier who can offer competent advice on all connection technology with an extensive product portfolio of cables, connectors and accessories that comply with hygienic design requirements. Hygienic design is increasingly in demand. It has brought about major progress in terms of quality, safety and efficiency in the food and beverage industry. According to this principle, facilities should be constructed in such a way that germs cannot take hold in the first place. The facilities should also be very robust and easier and quicker to clean.

At first glance, components in hygienic design, and specially designed accessories, are often seen as a way to increase prices – which is why they have not been universally implemented in practice. The focus soon shifts to the higher expenditure in comparison to standard products rather than the long-term benefits. But it is worth noting that the higher the components' quality and level of suitability, the lower the running costs will be because these components are more durable and easier to clean. By contrast, unsuitable components could cause enormous damage. A breeding ground for germs caused by a crack in a component that is not compliant with hygienic design could mean expensive unplanned maintenance or even downtime for the facility operator. Contaminated food would need to be thrown out or, in a worst-case scenario, recalled. In addition to the direct costs, this could lead to long-term damage for the brand.

No germs allowed

The SKINTOP® HYGIENIC cable gland is one of the products that meets the particularly stringent hygienic design requirements. It follows the general design principles of DIN EN 1672-2 for the food industry and is certified according to the latest EHEDG testing.

It does not provide any surfaces for contaminants to attack. All seals are fixed tightly to the cable and connection point with no gaps. Instead of an O-ring, it has a radial moulded seal above the connection thread, a sealing ring below the domed cap nut and a specially formed conduit sealing ring on the cable. It has smooth surfaces and no edges, meaning that remaining food cannot settle there and can easily be washed off. Furthermore, the cable gland – just like the SILVYN® FG (NM) cable conduit and the ÖLFLEX® ROBUST cable – meet the ECOLAB® requirements relating to resistance to cleaning agents and disinfectants.

Designers of facilities and components do not always need to reinvent the wheel, but when making decisions it is important that they bear the precise operating conditions in mind. Specialised products are not always necessary. Existing mechanical engineering and plant manufacturing products can by all means be used for many applications in the food industry, for example the classic ÖLFLEX® ROBUST, a series of cables that can withstand both machine oils in industrial manufacturing and cleaning agents in food production.

This also applies to a wide selection of accessories and other cables with sheath materials designed by LAPP and made from PVC, TPE and PUR, some of them have also received a ECOLAB® certification. Good and comprehensive advice from experts who know the industry is invaluable here.

Signal colour blue protects against losses

If you do not want to use expensive, rigid stainless steel pipes to lay cables in the product or Splash Zone, you may be interested in the SILVYN® FG NM protective conduit with the matching SILVYN® HYGIENIC conduit gland. The flexible and dimensionally stable soft PVC protective conduit with an inner spiral and the gland are both suitable for coming into contact with food – and thus for use in the Hygienic Design Zone – and are easy to clean. The conduit has no grooves in which residue can settle, unlike conduits used in mechanical engineering. It is blue – if a piece of plastic somehow fell into the food, it would be easier to detect in this way because there are no natural raw ingredients with such an intense blue colour. This is also the case for the cable ties and fastening openings, which are especially designed for the food industry. They are also blue and contain an admixture of metal. This means that a missing cable tie, for instance, can be retrieved very easily using a metal detector or an X-ray unit.



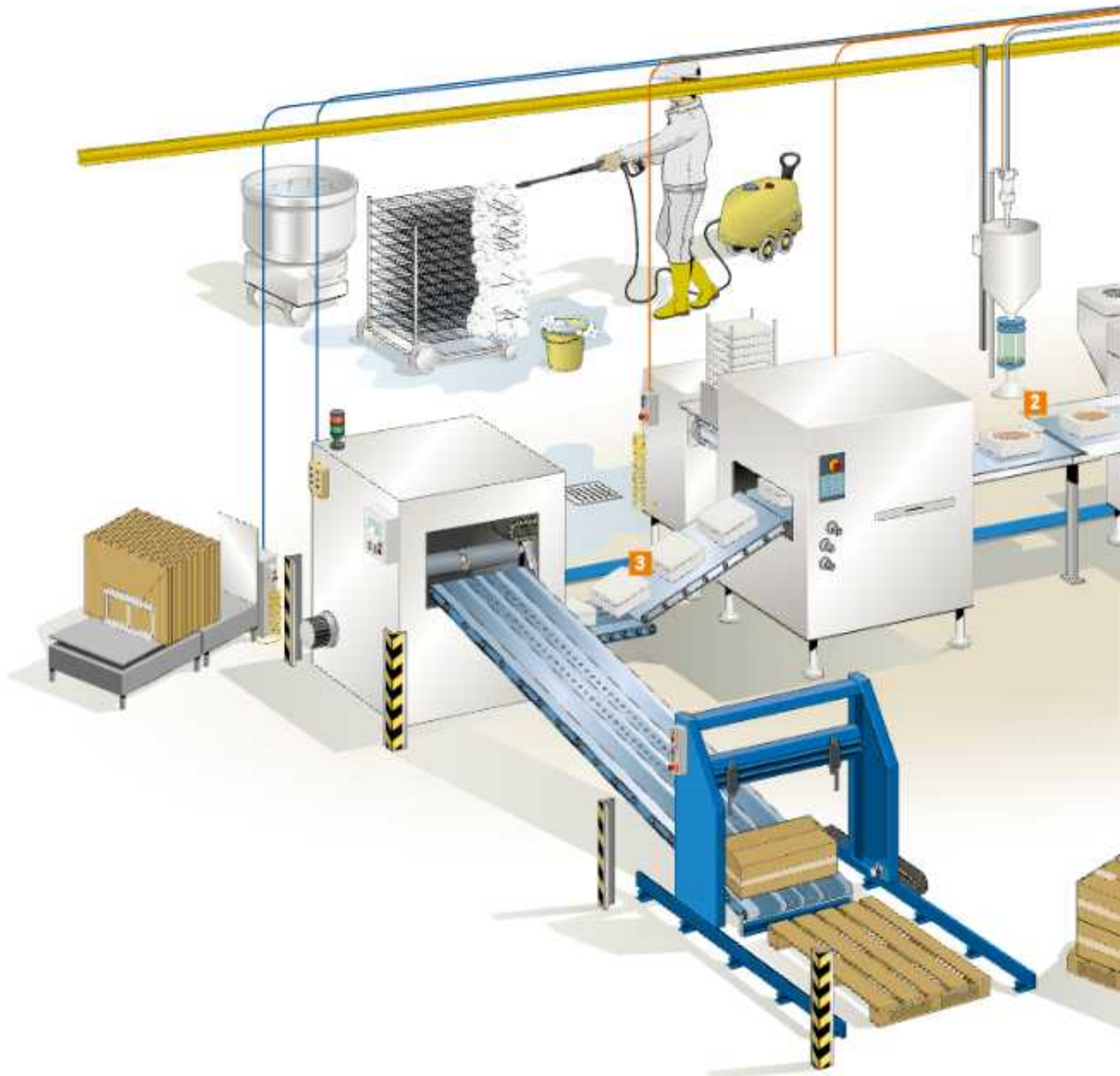
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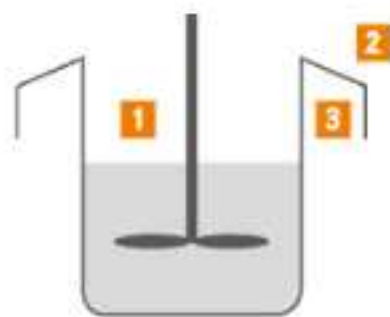
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Definition of Food & Beverage zones



The 3 zones in Food & Beverage production and machineries

- 1 Hygienic Design Zone**
Food is in direct contact with equipment and electrical components
- 2 Splash Zone**
Drips or splashes of food could not return to the food manufacturing process, causing contamination
- 3 Non-Product Zone**
No contact with food

Definition of Food & Beverage zones



1 Hygienic Design Zone (product zone)

Practical example

- Zone that comes into direct contact with food (permanently or through contact with the components in the machines). Contact with cables is avoided as far as possible here. According to the principle of hygienic design, these cables should usually be laid in stainless steel pipes or protective conduits in potential contact areas.
- The components in the machines and facilities are subject to product-specific hygiene regulations. Depending on the food to be processed and the materials and design of the facility, various cleaning options can be used to avoid food contamination and keep the facility in good condition for as long as possible. These options include dry cleaning using brushes, various stages of low- or high-pressure wet cleaning or the use of dry-ice blasting equipment.

Requirements/recommendations set out in the standards

- Hygienic design standards are observed (e.g. EHEDG, DIN EN ISO 14159, DIN EN 1672-2, NSF)
- Approved or food-safe substances are mainly observed (e.g. in keeping with the FDA's recommendations or DIN EN ISO)

Our approach to the solution

- Hygienic designs minimise the risk of microbiological, chemical and physical contamination, so the use of design approaches on all machine components has significant benefits. Simple cable glands, e.g. in hygiene control cabinets, often form a potential breeding ground for germs which can be avoided through the use of specialised cable glands.

Product portfolio/examples

- SKINTOP® HYGIENIC (SC)
- SILVYN® HYGIENIC/SILVYN® FG (NM)
- UNITRONIC® SENSOR HD M12
- Detectable cable ties (Detect/TY-RAP®)



2 Splash Zone

- Unlike in the product zone, drops or flecks of food can no longer get back into the food production process and cause contamination.
- The components in the machines and facilities are subject to product-specific hygiene regulations. Depending on the food to be processed and the materials and design of the facility, various cleaning options can be used to avoid food contamination and keep the facility in good condition for as long as possible. These include dry cleaning using brushes, various stages of low- or high-pressure wet cleaning or the use of dry-ice blasting equipment.



3 Non-Product Zone

- In contrast to the product zone and Splash Zone, there is no contact with food.
- The components in the machines and facilities are not subject to product-specific hygiene regulations here. Nevertheless, the service team must thoroughly clean all areas in each individual case. Foaming and rinsing individual components in the facilities, for instance, can be difficult in practice. Depending on the structure (e.g. modular) and size of the facilities, components can be partially cleaned as part of the facility or with the substances used in the product or Splash Zone.

- Approved or food-safe substances are also mainly observed (e.g. in keeping with the FDA's recommendations or DIN EN ISO)

- Components with chemical, thermal and mechanical resistance are observed on an individual basis. Adequate protection types for components in facilities are also observed.

- At the component level, hygienic designs decrease the time needed to clean machine and facility components. If components are easier to clean, this will also have a positive effect on the concentration of the cleaning agent and disinfectant for each facility. This reduces the cost and saves the environment. Lower concentrations of cleaning agents and disinfectants have a positive impact on the durability of materials, which reduces the risk of downtime. There seems to be a trend towards generally extending hygienic design concepts to all facility components and zones.

- Pockets of dirt are avoided through the use of proper cable installation types. Here it is worth not permanently binding cable bunches in order to make mechanical cleaning easier and to avoid the formation of loops. As a member of the Safe Food Factory body, our specialists are happy to offer one-to-one advice on how to install cables. Robust materials which can withstand substances typically used for cleaning and other production-related media (e.g. alkalines, acids, bio-oils, fats, hot water, cleaning agents and disinfectants) in the long-term are taken into account.

- ÖLFLEX® ROBUST series
- ETHERLINE® ROBUST series
- SKINTOP® HYGIENIC (SC)/SKINTOP® INOX (SC)
- EPIC® ULTRA series/EPIC® ULTRA COVER

- ÖLFLEX® CLASSIC 110 series
- ÖLFLEX® HEAT series
- SKINTOP® ST-M/SKINTOP® MULTI
- FLEXIMARK® LCK

Consortia, working groups and organisations

EHEDG

The European Hygienic Engineering & Design Group (EHEDG) is a consortium of machine and component manufacturers as well as experts from the food industry, research institutes and health authorities. The organisation was founded in 1989 with the intention of increasing awareness of hygiene when processing and packaging food. The EHEDG's main task is to play a part in hygienic design and construction in all areas of food production, and thus to guarantee the safe production of food. The EHEDG also supports European legislation and its call for hygienic handling, processing and packaging of food using hygienic machines in a hygienic environment (European Commission Machinery Directive 2006/42/EC, EN 1672-2 and EN ISO 14159 for hygiene requirements).

The EHEDG and the US organisation 3-A Sanitary Standards Inc. have a joint mission: to promote hygiene in food production and processing, and thus pursue the joint aim of improving food safety. The two organisations exchange drafts of guidelines and standards before they publish them so that both institutions can evaluate and comment on them prior to publication.

The EHEDG is also active in regions outside of Europe. Its members are spread across 55 countries, including Brazil, China, Japan and the Russian Federation.

Our SKINTOP® HYGIENIC cable gland has been tested and certified in keeping with the latest Guideline No. 2, Test No. 477/12/12.09.2014 – Type EL CLASS 1 AUX. In contrast to earlier test methods, the current guideline includes a practical test in addition to a pure design review.

3-A

3-A Sanitary Standards, Inc. is a US independent non-profit corporation dedicated to advancing hygienic equipment design for the food, beverage and pharmaceutical industries. 3-A has joined forces with the EHEDG to exchange drafts of guidelines and standards before they publish them so that both institutions can evaluate and comment on them prior to publication.

Observing hygienic design concepts outlined by the EHEDG or 3-A is thus a significant benefit to export-oriented companies. The more consistently design recommendations are incorporated into components in machines and facilities, the more efficient and durable a facility becomes.

ECOLAB®

ECOLAB® is a global leader in technologies and services relating to water, hygiene and energy. Around the world, companies operating in the fields of gastronomy, food processing, catering, healthcare, industry and the oil and gas market choose ECOLAB® products and services to keep their working environment clean and safe, to work more efficiently and to achieve sustainability targets. In order to clean and disinfect processing equipment for food and beverage technology, ECOLAB® offers a complete range of cleaning agents and EPA-registered cleaners as well as disinfectants for cleaning in place (CIP), cleaning out of place (COP), outer foam or manual cleaning.

A number of our products have already been tested and certified in line with the F&E/P3-E No. 40-1 test method (based on 9-2014 – REV 2 and REV 3) to ensure that they can withstand our customers' cleaning requirements.

Safe Food Factory

In the Benelux states, a working group called "Safe Food Factory" has been established in order to compile recommendations for selecting and installing facilities and components in the food and beverage industry. Safe Food Factory is an initiative set up by Dutch companies and the EHEDG. It sees itself as an international platform where industry, guidelines and practice come together.

A variety of industry representatives form a sub-group for a certain topic, where they work on special questions. For the topic of cabling, the participants included Lapp Benelux, Bosch Packaging Technology, Gouda Holland, the Niedax Group, Rittal, Anamet Europa, NIZO, food and beverage manufacturers FrieslandCampina and Heineken, as well as many cleaning service providers.

They discussed best practices, carried out practical tests and developed recommendations at more than ten meetings. Prior to being published, a commission of representatives from potential user companies such as BAT, Jacobs Douwe Egberts, Nestlé and Unilever tested the new guideline.

As a member of this working group, our experts are happy to advise you on the latest insights into the best cabling, installation type, choice of accessories, cleaning and chemical resistance from the LAPP product portfolio.

FDA

The Food and Drug Administration (FDA) is an agency within the US Department of Health and Human Services. As such, it is in charge of protecting public health by assuring the safety, effectiveness, quality and security of human and veterinary drugs, vaccines and other biological products and medical devices.

The FDA is also responsible for the safety and security of most of the USA's food supply, all cosmetics, dietary supplements and products that give off radiation. The FDA's Code of Federal Regulations Title 21 Part 177 Subpart C (Substances for Use Only as Components of Articles Intended for Repeated Use) defines the requirements placed on and the list of materials approved for use.

Solely approved materials which are allowed to come into direct contact with food are used in SKINTOP® HYGIENIC (SC), SILVYN® FG (NM) and UNITRONIC® SENSOR HD M12 S/A assemblies.

NSF

The NSF develops public health standards and certifications that help protect consumer products, the global food and water supply and the environment. Founded in 1944 as the National Sanitation Foundation, it changed its name to NSF International in 1990 as it expanded its services beyond sanitation and into global markets. NSF 51 is a set of regulations for plastic, materials and components used in food production equipment.

The SILVYN® FG (NM) protective conduit is made of approved materials that are allowed to come into direct contact with food.

DIN EN ISO 14169

This standard defines the hygiene requirements for machine design. Title: "Safety of machinery – Hygiene requirements for the design of machinery"

SKINTOP® INOX (SC) was developed based on this standard, particularly in terms of its design and material. It offers good value for money and is suitable for use in the Splash Zone and Non-Product Zone. SKINTOP® HYGIENIC is designed in compliance with the regulations defined for cable glands and has been tested and certified by the EHEDG. It is perfect for use in the product and Splash Zone.

DIN EN 1672-2

This standard defines the basic guidelines for product design and hygiene requirements for food machines. Title: "Food processing machinery – Basic concepts – Part 2: Hygiene requirements"

SKINTOP® INOX (SC) and SKINTOP® HYGIENIC were developed based on the guidelines defined in the standard. SKINTOP® HYGIENIC has been tested and certified by the EHEDG.

EC 2002/72

"Commission Directive 2002/72/EC of 6 August 2002 relating to plastic materials and articles intended to come into contact with foodstuffs" concerns plastic materials and items which come into contact with food.

The SKINTOP® INOX (SC), SKINTOP® HYGIENIC (SC) and SILVYN® HYGIENIC glands comply with this directive.

DIN EN ISO 14644-1

This standard defines cleanrooms, associated areas and corresponding classifications. In food production and packaging, more and more cleanrooms are being used to avoid contamination through particles and to make food last for as long as possible. The cleanroom is an alternative to packaging in a controlled atmosphere in which various gases can be used. Unlike the pharmaceutical sector or semiconductor market, a compact specialised system module is used more frequently than a cleanroom for the entire manufacturing process in the food and beverage industry for financial reasons. Title: "Cleanrooms and associated controlled environments – Part 1: Classification of air cleanliness by particle concentration"

A number of products in the ÖLFLEX® and UNITRONIC® family have been tested and certified by the Fraunhofer Institute for Manufacturing Engineering and Automation IPA and observe the requirements for cleanroom classifications in the food industry. Our experts are happy to advise you based on your individual needs.

Examples of product portfolios

Food & Beverage technology

	Cables – Control, Signal	Data Transmission
<p>1 Hygienic Design Zone</p>	<p>Contact with cables and connectors is avoided as far as possible in this special zone. According to the principle of hygienic design, these cables should be laid, wherever possible, in stainless steel pipes or protective conduits in potential permanent contact areas.</p> <p>Examples of use include capped cables in stirring units and mixers or as an interface to optical capacitive level sensors.</p> <p>Our specialists are happy to advise you on your specific applications.</p>	
<p>2 Splash Zone</p>	 <p>ÖLFLEX® ROBUST 200</p>  <p>ÖLFLEX® CLASSIC 400 CP, 440</p>	 <p>ETHERLINE® ROBUST</p>  <p>UNITRONIC® BUS PB</p>  <p>ETHERLINE® PN Cat.5e Y</p>
<p>3 Non-Product Zone</p>	 <p>ÖLFLEX® SERVO FD 796 CP</p>  <p>ÖLFLEX® HEAT 180 EWKF</p>  <p>ÖLFLEX® CLASSIC 110, 110 CH</p>	 <p>ETHERLINE® P Cat.5e, 6, 7</p>  <p>UNITRONIC® PUR CP</p>

Connectors	Cable Glands	Conduits	Marking + Acc.
	 SKINTOP® HYGIENIC  SKINTOP® HYGIENIC SC	 SILVYN® HYGIENIC  SILVYN® FG  SILVYN® FG NM	 Detectable cable ties DETECT TY-RAP®
 EPIC® ULTRA  EPIC® ULTRA Protective Cover	 SKINTOP® INOX  SKINTOP® INOX SC  SKINDICHT® CN-M  SKINDICHT® SM CrNi M	 SILVYN® ELT	 FLEXIMARK® Wrapping labels LCK  FLEXIMARK® Stainless steel FCC
 EPIC® H-B  EPIC® MC module  EPIC® LS1 D6  EPIC® LS1 A3	 SKINDICHT® SHV-M-VITON®  SKINTOP® MS-M BRUSH  SKINDICHT® SM-M  SKINTOP® ST-M  SKINTOP® MS-M  SKINTOP® COLD	 SKINTOP® CUBE  SILVYN® SPLIT  SILVYN® RILL PA 6  SILVYN® SSUE	 FLEXIMARK® Cablelabel PUR  Basic Tie cable tie



ÖLFLEX®
Power and control cables



UNITRONIC®
Data communication systems



ETHERLINE®
Data communication systems
for ETHERNET technology



HITRONIC®
Optical transmission systems



EPIC®
Industrial connectors



SKINTOP®
Cable glands



SILVYN®
Protective cable conduit systems
and cable carrier systems



FLEXIMARK®
Marking systems

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