

Hygienic Drainage:
A holistic guide to better performance in Food & Drink Manufacturing





HYGIENIC DRAINAGE: A HOLISTIC GUIDE TO BETTER PERFORMANCE IN FOOD & DRINK MANUFACTURING

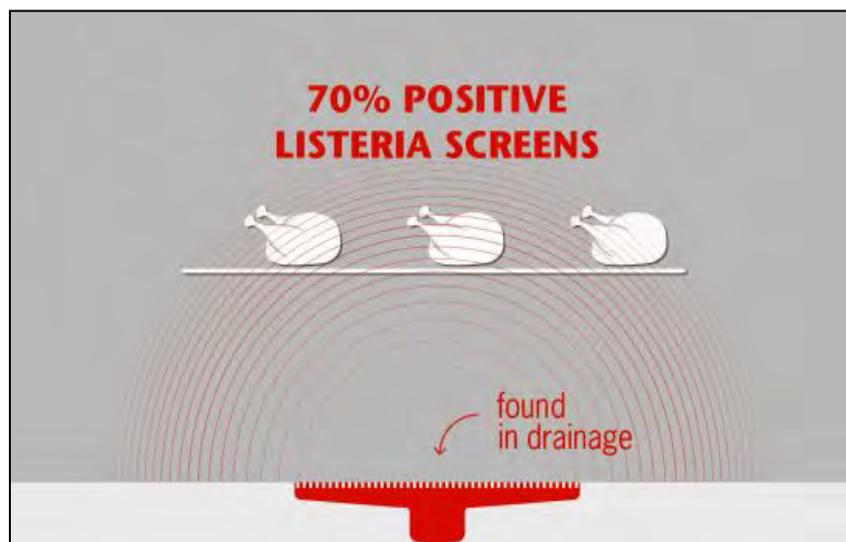
Contents	Pg
1. Introduction	2
2. Drainage Design: Essential Specification Criteria	4
3. Cleaning protocols and drainage cleanability	9
4. Flooring and floor/drainage compatibility	14
5. Adopting an evidence, research led approach	17
6. Reference documents for further information	18

1. INTRODUCTION: WHY DRAINAGE MATTERS

To achieve high levels of hygiene and ensure product safety in a food and drink manufacturing environment, it is critical to adopt best practice across all areas of manufacturing. Recent research and best practice guidance from various academic bodies means that the food industry increasingly recognises the need to pay attention to the infrastructure of a food/drink processing facility and specifically to the drainage.

Listeria & Drainage

Earlier this year, the world's largest listeria outbreak - which so far has killed 180 people - was traced back to a food factory. It is worth noting that in food and drink factories, 70% of positive listeria screens are found in drainage and floor environment.



More locally, a small UK food manufacturer was recently fined more than £275,000 for a 'drainage failure'. The court heard that "poor drainage meant waste water from raw meat areas flowed back into the cooked meat production room" contaminating production.

Furthermore research published in 'Applied and Environmental Biology' states:

"Floor drains in food processing facilities are a particularly important niche for the persistence of listeriae and can be a point of contamination in the processing plant environment and possibly in food products. Drainage is a critical component affecting the hygienic performance of food production. Effective drainage helps mitigate hazards from the external environment and is central to the safe and hygienic operation internally." 'Applied and Environmental Biology, Volume 72'



A Holistic Approach

Drainage has an important role to play when it comes to food hygiene and ultimately public safety. Drainage cannot, however, be considered in isolation. It is, as the European Hygienic Engineering and Design Group (EHEDG) states, essential that drainage, cleaning processes and flooring are considered holistically as they all directly impact upon the performance of each other. In addition, drainage, cleaning and flooring are all prerequisites of an effective HACCP system and are part of the Pre-Requisite Programme

Applying Best Practice

Ultimately if you want the right outcome you need to do the right things. This short technical paper has been written to help food and drinks manufacturers to consider and adopt a best practice approach to drainage and its specification.

This paper:

- Gives expert advice on drainage specification, key pointers regarding cleaning and essential information regarding flooring specification all of which are based on the principles of HACCP and the best practice recommendations of the European Hygienic Engineering & Design Group (EHEDG)
- Explains the five key design features to look for when specifying hygienic drainage for your facility
- Gives information about the findings of the latest research into the impact of product design on cleanability
- Reveals the first research-led specification guidelines for floor/drainage integration
- Includes a list of additional sources for impartial advice and information



2. DRAINAGE DESIGN: ESSENTIAL SPECIFICATION CRITERIA

A properly specified drainage system will positively impact upon hygienic performance, food/drink safety, employee health and safety, and operational costs, and it is vital to consider drainage at the initial stages of a factory build or refurbishment. If drainage is only treated as an afterthought, food and drink producers run the risk of having to rectify the drainage at a later stage in the build. This is not a quick, cheap or easy process, and involves the removal of production equipment and floors, and considerable disruption to the manufacturing process. Inevitably this can impact significantly on plant capacity.

When specifying drainage, there are four key areas to consider: Is your drainage fit for purpose; is it hygienically designed; is it designed by knowledgeable industry experts, and is it designed to be cleanable?

1. Is your drainage fit for purpose?

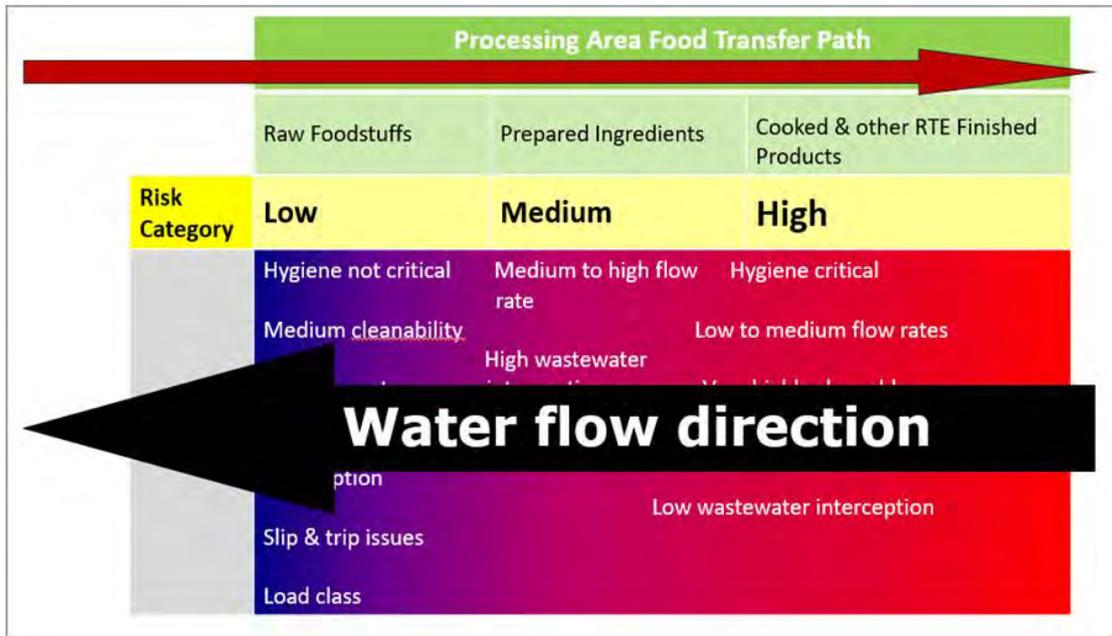
There are six key areas to consider to ensure your drainage system is fit for purpose.

KEY CONSIDERATIONS CHECKLIST	
1. Area of application	<ul style="list-style-type: none">• Hygiene requirement / risk level• Factory and equipment layout• Fluid type to be drained
2. Grating requirements	<ul style="list-style-type: none">• Slip resistance• Loading issues
3. Adequacy and hydraulic capacity	
4. Installation and cleaning	<ul style="list-style-type: none">• Floor/drainage connection• Thermal shock loads• Chemical attack
5. Maintenance requirements	
6. Future proofing	

Key questions to ask include...

- Is the drainage required in a low, medium or high risk area? (refer to the illustration below)

FOOD/DRINK PROCESSING: RISK CATEGORIES



- Is line or point drainage more appropriate?
- What falls are required in the floor?
- Does the drainage system layout work in the context of the equipment being used? (see poor example of equipment/drainage layout in image below)



- What hydraulic capacity is required?
- Does your application require 304 or 316 grade steel drainage?
- Is your choice of drainage and flooring future-proofed?

2. Is your drainage hygienically designed?

Drainage systems should be designed in accordance with the best practice design principles of EHEDG and should apply the standards reserved for food contact surfaces EN1672 and EN ISO 14159. ACO's hygienically design drainage systems comply with both. So what design criteria should you look for?

EHEDG: The principles of hygienic design

i. Channels should have completely drainable sumps and a minimal slope of 1% longitudinal and cross all areas

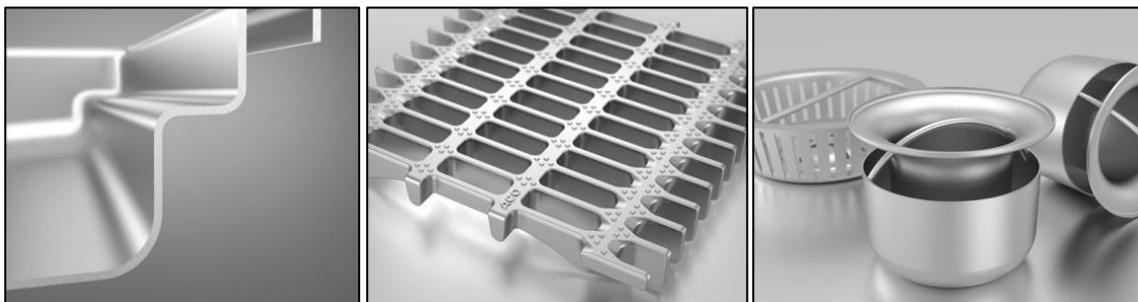
If your drainage isn't fully drainable then its hygienic performance will be compromised. To optimise hygienic performance, drainage channels should have completely drainable dry sumps with engineered positive slopes to prevent the build-up of stagnant water, odours, microbial growth and potential chemical hazards.

ii. Eliminate lap joints and welded butt joints

Lap joints can't be welded hygienically. When you weld a lap joint you create a void which will harbour bacteria.

iii. Ensure all corners are rounded

Sharp corners are harder to clean, particularly if they're situated at a right angle or bend in the drainage. It's harder to get into a corner and to make contact with its entire surface, which means there's a very real risk that the corner won't get cleaned effectively. To ensure every part of the drainage surface is easily accessible and to meet best practice guidelines, drainage should feature rounded corners with minimum radii of 3mm.



iv. Weld on flat areas, not corners

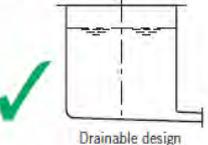
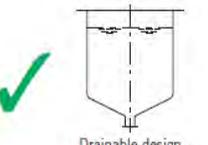
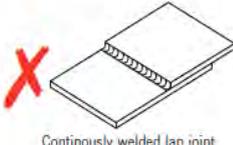
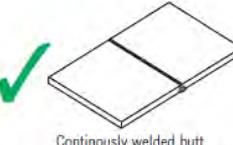
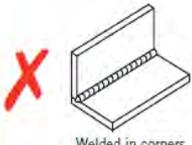
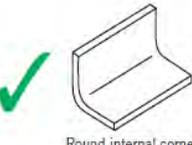
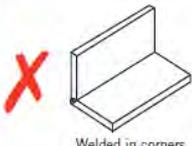
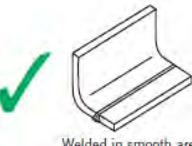
If the drainage you specify is welded on a flat area, the manufacturer can ensure the weld is smooth and smooth contours eliminate crevices that can harbour bacteria. It's a simple step but one that can make all the difference.

v. Ensure steel drainage is fully pickle passivated

Pickle passivation, is a process which is used to fully restore the all-important oxide layer that naturally occurs on stainless steel but is destroyed on welded joints. Without this layer, stainless steel ceases to be corrosion resistant and that can affect a product's lifespan as well as creating hygiene risks.

According to **EHEDG Doc 18**, it is essential that drainage is fully pickle passivated and as a result, pickle passivation is a key part of any reputable drainage providers manufacturing process. Processors which use localised pickling or pickle paste do not meet the requirements of EHEDG and run the risk of failing to meet longer term durability needs.

EN1672 and EN ISO 14159: Best Practice

AVOID	RECOMMEND
<p>Hygiene risk according to BS EN 1672 and BS EN ISO 14159</p>  <p>Not drainable design</p>	<p>Acceptable according to BS EN 1672 and BS EN ISO 14159</p>  <p>Drainable design</p>
 <p>Not drainable design</p>	 <p>Drainable design</p>
 <p>Continuously welded lap joint</p>	 <p>Continuously welded butt</p>
 <p>Welded in corners</p>	 <p>Round internal corner</p>
 <p>Welded in corners</p>	 <p>Welded in smooth area</p>



3. Is your drainage designed to be cleanable?

Drainage needs to be designed to be fully cleaned, to make the cleaning an easy process (and so encourages a culture of cleaning) and to work practically with the cleaning protocol of your manufacturing facility.

Please refer to the next section of this paper for more guidance.

4. Is your drainage designed by knowledgeable industry experts?

It is important to check that the people designing and manufacturing your drainage are fully conversant with the requirements of the food and drinks industry, and understand the principles of hygienic engineering and design with regard to drainage.



3. CLEANING PROTOCOLS & DRAINAGE

Cleaning practices have an important impact on hygiene, employee safety and operational cost. Your cleaning protocol also needs to be carefully considered to ensure compatibility with your facility's drainage.

There are three key factors to consider when it comes to cleaning and drainage: How robust is your cleaning protocol; are your cleaning products and equipment hygienically designed, and is your drainage designed to make cleaning a quick, easy and effective process.

1. How robust is your cleaning protocol?

At the most basic level and as part of your HACCP process, your protocol should state:

- What needs to be cleaned
- How frequently it will be cleaned
- How cleaning will physically be conducted (with what chemicals and what equipment)
- How you will measure cleanliness (e.g. by taking swabs from the drainage and conducting drainage performance audits)

When looking at how cleaning, flooring and drainage interact, you need to consider wider questions including:

- What cleaning chemicals will I need to use?
- Are these chemicals compatible with the drainage specified?
- Are these chemicals compatible with the flooring specified?

2. Are your cleaning products and equipment hygienically designed?

Cleaning equipment should be hygienically designed to minimise the risk of bacterial contamination and ensure compliance with the relevant legislation.

Council Directive 93/43/EEC (June 1993) on the hygiene of foodstuffs states that

“All articles, fittings and equipment with which food comes into contact shall be kept clean and:

(a) be so constructed, be of such materials and be kept in such good order, repair and condition as to minimise any risk of contamination of the food;

(b) and enable them to be kept thoroughly cleaned and, where necessary, disinfected, sufficient for the purposes intended.”

For further detailed guidance on this point, refer to:

- **EHEDG Document 8:** ‘Hygienic Equipment Design Criteria’
<http://www.ehedg.org/?nr=110&lang=en>
- **EHEDG Guideline 32:** ‘Materials of construction for equipment in contact with food’
- **BRC Global Standards** document, section 7
- Leading industry experts at Vikan (www.vikan.com) and Holchem (www.holchem.co.uk)

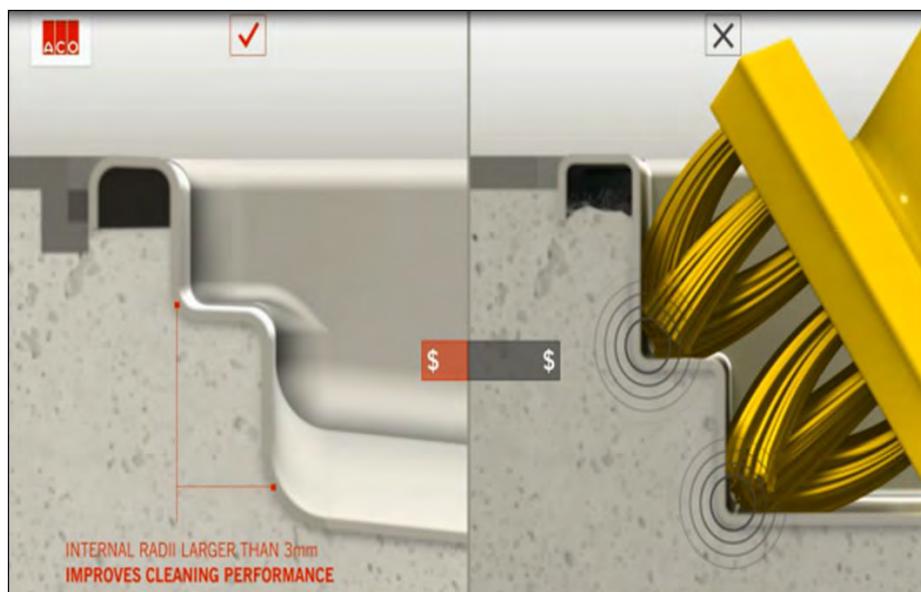
3. Is your drainage designed to make cleaning quick, easy and effective?

By making drainage easy to access and clean:

- Cleaning will be completed (not ignored)
- Cleaning time and operational costs will be reduced
- Risks to hygiene will be reduced

As a material, stainless steel can be cleaned but a stainless steel drainage system will only be cleanable if it is designed properly.

Adopting the best practice design principles already outlined in this paper will help to ensure this is the case. For example, if drainage channels do not feature curved corners with minimum radii of 3mm, it is impossible for cleaning brushes to reach every part of the drainage channel’s surface and for corners to be cleaned (see illustration below).



The impact of hygienic design is also illustrated by a recent project undertaken by the internationally renowned research institute, Fraunhofer IVV Dresden.



Fraunhofer IVV Dresden, Research Project

Commissioned by ACO, this independent study was designed to fully assess the impact of hygienic design on drainage performance. Specifically, we wanted to know how the application of hygienic design impacted upon the cleanability of drainage channels and as a consequence, hygiene and cleaning costs.

Scope

The research compared the performance of the ACO HygieneFirst channel – which incorporates the best practice design principles of EHEDG, EN1672 and EN ISO 14159 and is representative of ACO’s hygienically designed drainage range - with another channel whose design is typical of that currently used in food and drinks manufacturing environments.

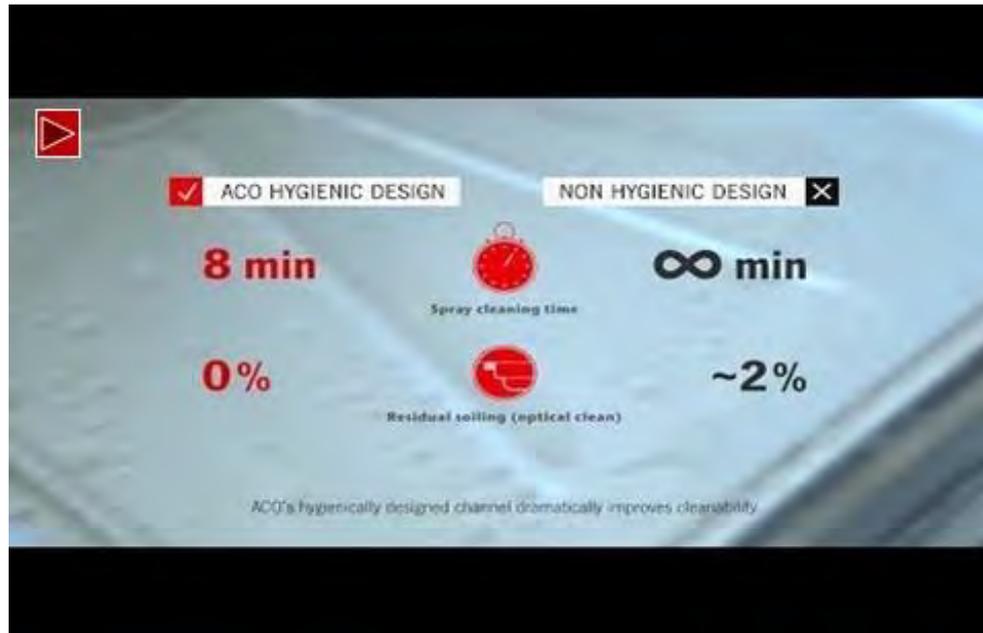
Methodology

Drainage channels were mounted horizontally on a framework and an industrial robot was used to simulate the movements of a cleaning operative. The cleaning process was captured by an optical cleaning sensor developed by Fraunhofer IVV Dresden. A fluorescence method was used to pick up any residual soiling.



Research Findings

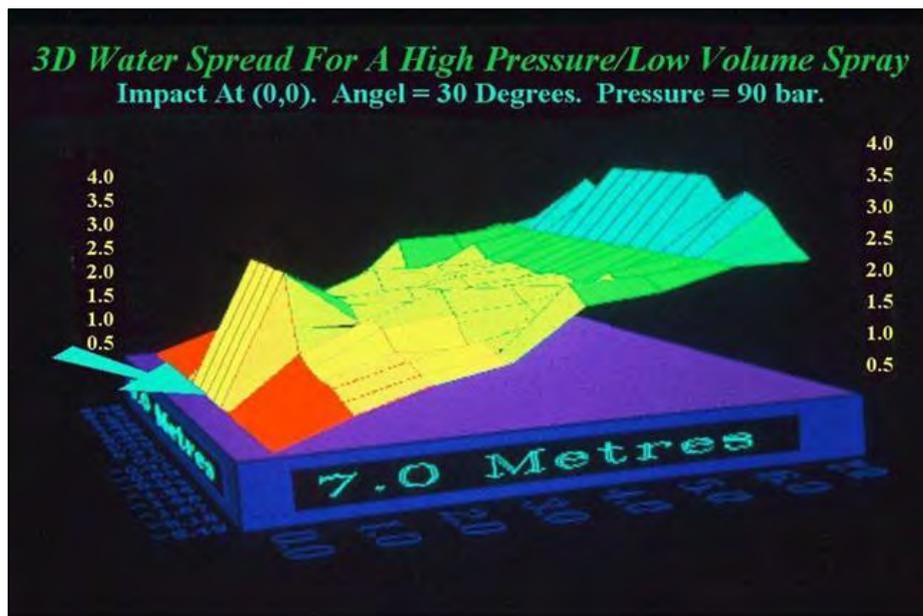
Hygienically engineered and designed drainage channels can be effectively and completely cleaned in less than 10 minutes whereas non-hygienic channel still has 2 per cent residual soiling after an extended rinsing time of up to three hours!



The research clearly shows that the specification of hygienically designed drainage products will help any food and drink processing plant operator substantially reduce the risk of bacterial contamination at its facility, minimise ongoing cleaning costs and ultimately improve the safety of their products.

A word about powerwashing

Despite what some companies will tell you, one of the worst things you can do is power-wash your drainage. Power-washing creates ballistic droplets, basically a high velocity aerosol spray. So, if you want to spread bacteria living in your drainage around your facility, this is an excellent way to do it! (see table below).



(Source: Campden BRI)

Drainage should be designed in a way that power-washing is not required!

4. FLOORING AND FLOOR/DRAINAGE COMPATIBILITY

The flooring and drainage specified need to be compatible. At the very least, the drainage design needs to connect properly with the surrounding flooring to minimise risks to hygiene.

1. Common issues

If the flooring and the drainage is not compatible and the connection between the two is not sound, the following issues can occur:

- Cracks can occur in the flooring immediately surrounding the drainage
- Elevation of floor plate edges
- Delamination of flooring
- The performance of the both the drainage and the flooring is compromised



Floor cracks



Elevation of floor plate edges



Delamination



Compromised floor/drainage connection

2. Research based best practice guidance

Although the challenging environments present in today's food and drink manufacturing facilities require the ongoing development of new hygienic resin flooring solutions and advanced hygienically designed drainage systems, until recently there was no research into how different flooring types and drainage systems affected each other's performance and how failures can occur in the connection between the two.

As a result, ACO's in-house R&D team teamed up with leading flooring specialists SIKA to conduct in-depth research which enables us to provide clear, scientific, evidence-based specification guidance for food factory operators.

A testing method, testing parameters and procedures were developed to cover the key areas of:

- Dynamic Loading
- Thermal Loading
- Concrete Shrinkage

Testing equipment was designed and manufactured, and testing was conducted.

3. Research findings:

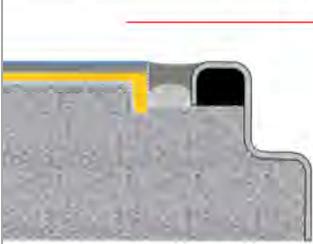
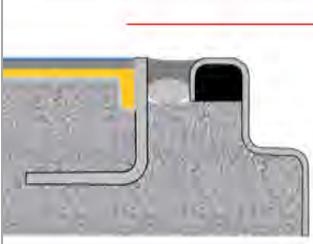
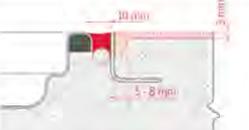
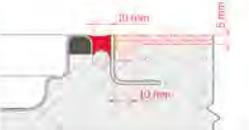
	<p>Standard edge connected directly to the floor</p> <ul style="list-style-type: none"> ▪ proved to be resistant in situations where dynamic stress is present ▪ this is often present in areas with heavy and frequent traffic ▪ the load class of the whole system has to be considered accordingly <p>Common applications: warehouses, corridors</p>
	<p>Standard edge connected to the floor with a flexible joint</p> <ul style="list-style-type: none"> ▪ the best option when exposed to temperature extremes and rapid changes of hot and cold water <p>Common applications: CIP areas, wet production, commercial kitchens</p>
	<p>Standard edge connected with a flexible joint and supporting stainless steel L-profile</p> <ul style="list-style-type: none"> ▪ sites where drainage-floor connection needs to be resistant to both thermal and dynamic shocks <p>Common applications: fork-lift / bottle washing, wet production with traffic</p>

Table summarizing ACO and Sika research into floor connections

Floor type	Resistance to exposure scenarios ¹⁾		
	<p>Standard edge connected directly to the floor</p> <ul style="list-style-type: none"> Resistant to dynamic stress (thermal load < +25°C) For areas with frequent heavy traffic <p>Typical applications:</p> <ul style="list-style-type: none"> Warehouse Corridors 	<p>Standard edge connected to the floor with flexible joint</p> <ul style="list-style-type: none"> Resilient to temperature extremes caused by alternating hot and cold water <p>Typical applications:</p> <ul style="list-style-type: none"> Cleaning in place (CIP) Kitchen 	<p>L shape edge</p> <ul style="list-style-type: none"> Resistant to both thermal and dynamic shocks <p>Typical applications:</p> <ul style="list-style-type: none"> Beverage production Packaging plant Bottle washing plant 
<p>Sika[®]floor-327 + Colored Quartz + Sika[®]floor-169</p>			
<p>Sika[®]floor-21 PurCem[®]</p>			

1) The results are according to a floor to drain connection testing carried out by ACO and Sika

2) Water exposure directly into the channel < +90°C (Max. exposure of the flooring system < +50°C)



5. ADOPTING AN EVIDENCE, RESEARCH LED APPROACH

How many supplier claims about the performance of their products are based on proven facts and how many of their products embody independent best practice design principles? If you're not sure, then you may not be specifying the optimum equipment your business needs for the best outcomes in terms of hygiene, health and safety, and operational costs.

At ACO, we have a commitment to evidence-led product development is a core part of our overall business strategy and the 'Hygiene First' approach we apply to hygiene-sensitive applications. It is important to us that our product designs and the advice we give to our clients is based on the findings of robust academic research that not only enables us to improve the drainage systems we provide but also gives our clients the additional knowledge they need to optimise food safety and operational costs.

How you choose to obtain independent best practice guidance and evidence to inform the specification of your manufacturing facilities infrastructure and equipment is ultimately up to you. What's important is that you do. Failure to take an evidence-led approach could compromise hygiene, increase costs and importantly, if something goes wrong, impact the continuity of your business.

EHEDG: An impartial sources of expert advice & guidance

A leading source of independent guidance is the **European Hygienic Engineering and Design Group (EHEDG)** which comprises a group of research institutes, academic bodies, equipment manufacturers and food manufacturers including Nestle, Coca Cola and Heinz.

A not-for-profit organisation whose remit is to improve hygienic engineering and design standards in all aspects of food manufacture, EHEDG provides food and drink companies with a wealth of best practice guidance and has produced more than 45 EHEDG 'Docs' on a diverse list of topics ranging from drainage design to the continuous UHT sterilisation of food.

For more information visit www.ehedg.org



6. SOURCES OF FURTHER INFORMATION

Publications

- EHEDG Document 44: 'Hygienic design principles for food factories'
- EHEDG Guideline 32: 'Materials of construction for equipment in contact with food'
- EHEDG publication: "Hygienic Design of Food Factories"
- EHEDG Document 8: 'Hygienic Equipment Design Criteria'
- BS EN1672-2:2005+A1:2009 'Food processing machinery. Basic concepts. Hygiene requirements'
- EN ISO 14159:2002 'Safety of machinery - Hygiene requirements for the design of machinery'
- Applied and Environmental Biology, Volume 72

Websites

- www.hygienefirst.com
- www.ivv.fraunhofer.de
- www.ehedg.org
- www.holchem.co.uk
- www.vikan.com/uk
- www.sika.com

Educational videos

- www.youtube.com/watch?v=s9xlrvy55o
- www.youtube.com/watch?v=fSTurFyw0uA
- www.youtube.com/watch?v=L-F01yQrczA

Project specific advice and guidance

Project specific advice and guidance regarding drainage can also be obtained from the in-house technical design team at ACO Building Drainage.

To contact the:

- Call +44 (0) 1462 810400
- Email abdtechnical@aco.co.uk

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