HYGIENIC EQUIPMENT DESIGN AND MEAT PROCESSING OPERATIONS

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CUSTOMERS IN FOCUS

Protecting customers in the Meat industry (meat processors) is the highest priority today both in Europe and U.S.

As a result of this, there is an obvious demand for products that cannot be faulted in hygiene.
Hygienic design refers to those building design features that may be unique to a meat processing plant and are intended to reduce the risk of contamination by biological, physical and chemical hazards from meat processing operations.

The task of hygienic design is to minimize risks of contamination and to make easier the challenges of cleaning and maintaining the plant and equipment.
Hygienic design is concerned with:

- factory siting and construction
- design of the building structure
- selection of surface finishes
- segregation of work areas to control hazards
- flow of raw materials and product
- movement and control of people
- design and installation of the process equipment
- design and installation of services (air, water, steam, electrics etc.).
Meat processing equipment has traditionally been designed and built to be suitable for purpose.

For example, a mixer for raw meat has rarely been designed to the same hygienic level as a slicer of cooked meats.

Similarly, aseptic fillers have usually been designed to a much higher hygiene standard than can filling machines.

The reason for this has been related to the risk of a hazard being transferred from the equipment to the product produced.
Definition of “Hygienic Integration”: The process of combining or arranging two or more entities to work together while eliminating or minimizing hygiene risks.
Hygienic design is meant by hygiene regulations on production of animal products

The need for high standards in hygiene is also reflected in legislation and jurisdiction.

The product liability acts in Europe and U.S., giving manufacturers an increasing deal of responsibility in this regard.

The need for high standards in hygiene is also reflected in legislations concerning meat processing facility arrangement, building construction and process hygiene

EU 853/2004 DIRECTIVE - SPECIFIC HYGIENE RULES FOR FOOD OF ANIMAL ORIGIN
There is a generally position that it is impossible to provide hygienic design guidelines for all individual food processing equipment.

The approach of the European Committee for Standardization - CEN/TC 153 was, therefore, to define the basic hygienic design requirements and these can be presented under two headings:

- **Food contact** (defined as a surface in "direct contact with food residue, or where food residue can drip, drain, diffuse, or be drawn) (broken into 11 sections)
  and
- **Non-food contact areas** (are those that are part of the equipment e.g., legs, supports, housings, internal of devices) that do not directly contact food.

As contamination of **non-product contact surfaces** can cause indirect contamination of the food product, these surfaces cannot be ignored with regard to sanitary design.
## CEN/TC 153 basic hygienic design requirements

**I. Food contact area**
- 1. Materials of construction
- 2. Surface finish
- 3. Joints
- 4. Fasteners
- 5. Drainage
- 6. Internal angles and corners
- 7. Dead spaces
- 8. Bearings and shaft seals
- 9. Instrumentation
- 10. Doors, covers and panels
- 11. Controls

**II. Non-food contact area**
- Equipment should be designed and constructed to prevent the retention of moisture, ingress and harbourage of pests and accumulation of soils.
- The design should facilitate inspection, servicing, maintaining, cleaning and where necessary, disinfection.
- There are over **40 specific standards** within the framework of food machinery has been approved.
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EN STANDARDS

FOOD PROCESSING MACHINERY

- EN 12267:2003 Food processing machinery — Circular saw machines — Safety and hygiene requirements
- EN 12268:2003 Food processing machinery — Band saw machines — Safety and hygiene requirements
- EN 12331:2003 Food processing machinery — Mincing machines — Safety and hygiene requirements
  EN 12331:2003/A1:2005
- EN 12355:2003 Food processing machinery — Derinding-, skinning- and membrane removal machines — Safety and hygiene requirements
- EN 12463:2004 Food processing machinery — Filling machines and auxiliary machines — Safety and hygiene requirements
- EN 12505:2000 Food processing machinery — Centrifugal machines for processing edible oils and fats — Safety and hygiene requirements
- EN 12855:2003 Food processing machinery — Rotating bowl cutters — Safety and hygiene requirements
- EN 13288:2005 Food processing machinery — Bowl lifting and tilting machines — Safety and hygiene requirements
European machinery guideline 98/37/EG (the newly revised law 2006/42 EG) had already been passed and became legal in 2009.

Part 2: Hygiene Requirements

ISO 14159 “Safety of Machinery – Hygienic Requirements for the Design of Machinery”.

European Hygienic Engineering and Design Group – EHEDG
(Where the EN and ISO standards are not specific enough, the relevant EHEDG guidelines can be used as state of the art)

U.S. Norm ANSI/NSF/3-A 14159

PART 1: Hygiene requirements for the Design of Meat and Poultry Processing Equipment

This standard, which contains general sanitation requirements for processing equipment, serve as the foundation for sector-specific standards based on industry-identified needs.
The standard includes all the requirements and follows the structure of ISO 14159, but incorporates other requirements specific to meat and poultry processing.

PART 2: Hygiene requirements for the Design of Hand Tools used in Meat and Poultry Processing

PART 3: Assessment for Cleanability of Belting Materials used in Meat and Poultry Equipment
The American Meat Institute, trade organisation in the US responsible for meat products has also formulated appropriate guidelines in its “10 principles of sanitary design”

1. Cleanable to a microbiological level;
2. Made of compatible materials;
3. Accessible for inspection, maintenance, cleaning and sanitation;
4. No product or liquid collection;
5. Hollow areas should be hermetically sealed;
6. No niches;
7. Sanitary operational performance;
8. Hygienic design of maintenance enclosures;
9. Hygienic compatibility with other plant systems;
10. Validated cleaning and sanitizing protocols;
The following hygiene rules must be observed:

- (a) “... materials can be clean before each use”;
- (b) “all surfaces including their joinings must be smooth, and must have neither ridges nor crevices which could harbour organic materials”;
- (c) “... reduce ..., edges and recesses to a minimum...”;
- (d) “... easily cleaned and disinfected, ... possible after removing easily dismantled parts ... curves of a radius sufficient to allow thorough cleaning;
- (e) liquid deriving from foodstuffs as well as cleaning, disinfecting and rinsing fluids should be able to be discharged from the machine without impediment (possible in a 'clean' position);
- (f) machinery must be so designed and constructed as to prevent any liquids or living creatures, in particular insects, entering, or any organic matter accumulating in areas that cannot be cleaned (e.g. for machinery not mounted on feet or casters, by placing a seal between the machinery and its base, by the use of sealed units, etc.);
- (g) machinery must be so designed and constructed that no ancillary substances (e.g. lubricants, etc.) can come into contact with foodstuffs. Where necessary, machinery must be designed and constructed so that continuing compliance with this requirement can be checked.

Directive has given the industry the possibility to further define the state of the art of hygiene for food equipment.
Both the designer and the user of the equipment have a responsibility to assess the risks of hazard could be transferred from the equipment to the product.

To help equipment manufacturers meet this challenge and produce the equipment in a cost effective manner, food manufacturers should enter a dialogue with equipment manufacturers to consider the following:
The intended use of the equipment. Will the equipment be used for one specific purpose only, for which the hazards are readily identifiable, or could the machine be used for a wide range of products in many industries (e.g. a pump)?

The product type to be processed. Will the product be already contaminated (e.g. a raw material) or will it be 'preserved' or 'aseptic'?

The degree of further product processing: Will the product processed by the equipment subsequently undergo a further process which functions as a hazard elimination step (e.g. a heat treatment) or is the process for which the machine is intended the final process?

The degree of cleaning and/or inspection. Is the equipment to be cleaned and/or inspected after every use, routinely during the day, every day or every week etc.?

The use of the machine. Is the equipment likely to be well maintained or used infrequently, is it designed for high or continuous use or is it liable to abuse?
SURFACE HYGIENE WITH RESPECT TO RETENTION OF MICROORGANISM

A. Packer, P. Kelly, K. A. Whitehead and J. Verran

Most food equipment is made of stainless steel because it is resistant to corrosion and can be polished so that food and dirt cannot easily cling to it. In addition, welds must be smooth, corners rounded and the equipment designed so that it can be taken apart and inspected.

- Generally acknowledged that surface roughness affects retention of microorganisms.
- Average roughness ($R_a$) used as indicator of surface hygiene.
- A surface with $R_a$ value below 0.8 $\mu$m is considered capable of maintaining a hygienic status.
- $R_a$ value doesn’t describe surface features like scratches.
Lockers

- Poor design
- Good design

...the wall-mounted devices and enclosures are installed at a distance for cleaning purposes. With the HD wall spacer bracket.

...enclosures with cable entry from below are mounted on the new HD supporting structure rather than on a base/plinth or a mounting angle frame.
Hygienic design of essential external and internal components must follow the principles of quick and comprehensive cleaning.
Examples of **hygienic** and **non hygienic** design of machine parts

**Figure 4:** Example of a "usit ring" with a hexagon cap nut (source: Freudenberg)

**Figure 7:** Example of non hygienic cable glands

**Figure 8:** Example of a hygienic cable gland with EHEDG EL Class 1 certificate (source: Plitsch)

**Figure 14:** Example of different type of hinges
Control panels are often close to the product and the operator has to touch the panel and the sometimes the product as well. For this reason there is a high risk of cross contamination. For this reason these control panels have to be cleanable. Touch screens have to be cleanable in the same way, as the rest of the machinery.
Design measures to improve hygiene:

- special coatings
- coloured surfaces
- edge sealing
- hygienic hinge design

avoid any dead space thus enabling any contaminants rinsing away leaving behind no residues without dismantling.

THANK YOU FOR ATTENTION