

Hygienic design of packing systems for solid foodstuffs

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Introduction

This guideline discusses how to meet the general criteria for packing machines for solid foods. Criteria will be determined for the whole packing process, which includes: the packing machine, the accessories such as conveyors, the deposit and filler systems, the gas medium, the environment of the packing process, cleaning, and the operators in charge of handling ingredients and food products.

Final evaluation of the hygienic criteria for the whole packing line of solid foodstuffs is performed at the food processor's site. In the food industry, the food manufacturer is responsible for meeting food safety and hygienic requirements of the product to be packed. The food processor must clearly specify these requirements for the whole packing line, the packing machine and accessories.

The products

The products to be packed can be divided into four major groups: convenience products, ready meals, meal components and sliced products.

These products are the most critical solid foods and they are characterized by a water activity of more than 0.97, low acid, not pasteurised or sterilised after packaging, and distributed through the cool chain.

Examples of products, which must be packed according to this guideline, are given in [Table 1](#).

The packaging process

The packaging process consists of the following steps:

(a) *Product positioning*. The execution depends on the dimensions of the product and the need to orientate the product before loading. Very often guiding the product on a belt does this. For products that are more difficult to orientate a robot arm might be needed.

(b) *Product loading*. Product loading can be executed in different ways:

- using a conveyor belt;
- manually (see Hygiene performance of operating staff);
- by pick and place (using a robot).

The method used depends on the product.

(c) *Tray and pouch feeding*. Providing the tray or pouch (pre-made or formed in the machine).

(d) *Packaging*. There are four options.

Option 1 *Thermoforming and sealing*. The trays are produced in the packaging machine by thermoforming of a film. The trays are supplied by a belt to a product assembly area for loading, followed by a sealing process ([Fig. 1](#)).

1. Packaging material for the base web (thermoformable film) is unwound from the reel.
2. The film is heated in the forming die and formed into pockets.
3. The formed pockets are loaded with product 4, manually or automatically.
4. Product.
5. The top web of packaging material (id film) covers the filled pockets.
6. The air is evacuated from the sealing die and protective gas is added if required. Then the pack is sealed by the application of heat and pressure.
7. The web of packs is cut across the machine direction initially.
8. Production of the individual packs is completed after the longitudinal cutting operation.

Option 2 *Tray sealing*. In case of a tray sealing packing machine, the trays are supplied by a belt to a product assembly area for loading, followed by a sealing process.

Product ^a	a_w	pH	MA
Fresh meat	0.98–1.00	5–6	Vacuum, low O ₂
Meat products	0.85–0.98	5–6	Vacuum, low O ₂
Sliced cheese	0.85–0.98	6–8	Vacuum, low O ₂
Fish	0.98–1.00	6–8	Mix of inert gasses CO ₂ , N ₂ , CO, etc.
Ready meals	0.98–1.00	5–8	CO ₂ and N ₂ ^b
Sandwiches	>0.97	5–8	CO ₂ and N ₂ ^b
Salads	0.98–1.00	5–7	CO ₂ and N ₂ ^b
Cut veg- etables	0.98–1.00	6–8	CO ₂ and N ₂ ^b
Fruit salads	0.98–1.00	6–8	CO ₂ and N ₂ ^b
Cheese	0.96–1.00	5–8	Vacuum or MAP

^a All products must be transported, distributed and stored at cooled conditions. Depending on the product class the standard conditions are 0–3, 4 °C or lower than 7 °C.

^b Sometimes CO or Argon is used.

Option 3 *Flow wrapping*. In case of a flow wrapping packing machine, the product is supplied on a belt to a film-shaping device, which covers the product and then applies sealing in longitudinal direction, creating a tube. Then the tube is sealed in transversal direction and the packs are separated.

Option 4 *Form fill seal*. In case of a vertical form fill sealing packing machine, the product is dropped into a pre-formed vertical tube that is created by sealing a web in longitudinal direction. After landing in the tube the pack is sealed and separated (Fig. 2).

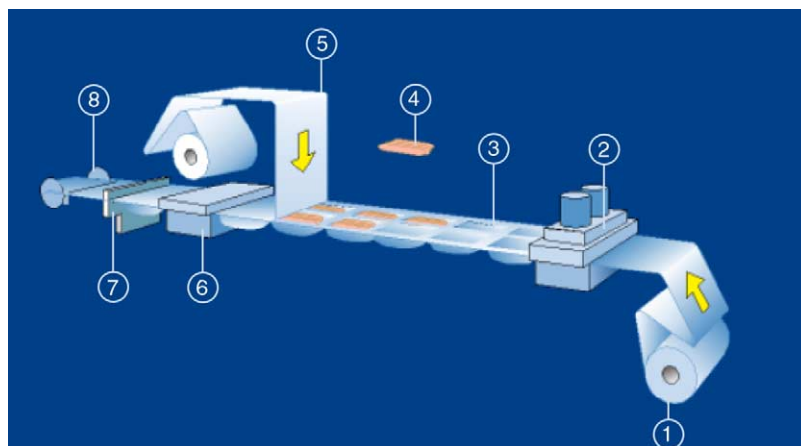


Fig. 1. Thermoforming process.

Hygiene measures

The packing machine should be installed in an environment appropriate for the handling of hygiene sensitive products. General aspects to be considered are:

- The packing machine should be placed such that it is uncluttered and free access is available around the machine.
- Unless mounted such that dust and other foreign matter cannot enter, overhead utilities (lighting, piping and ducts) should be avoided.
- Clearance under the machine must allow for adequate cleaning and inspection to be carried out effectively.
- Machines should not be positioned over drains if, in doing so, access for inspection and cleaning of the drains is restricted.
- Equipment should be adequately located in position and mounting pads or feet suitably sealed to the floor.
- Services such as air, water, and electricity shall be connected in a manner ensuring that proper hygiene of the equipment and area will be maintained.
- The exterior of non-product contact surfaces should be arranged to prevent harbouring of contamination in, and on, the equipment itself, as well as in contact areas with other equipment, floors, walls or hanging supports.

Performance of the gas supply to the packing machine

- The gas to be introduced for MAP packaging of the solid food should be of High Grade Food Quality or hospital grade.
- The connections of the gas supply installation to the packing machine should be clean and disinfected.
- All compressed air used for blowing on the product or contact surfaces is filtered to a minimum of a 0.3 µm level and dried to prevent the formation of moisture in the piping system.

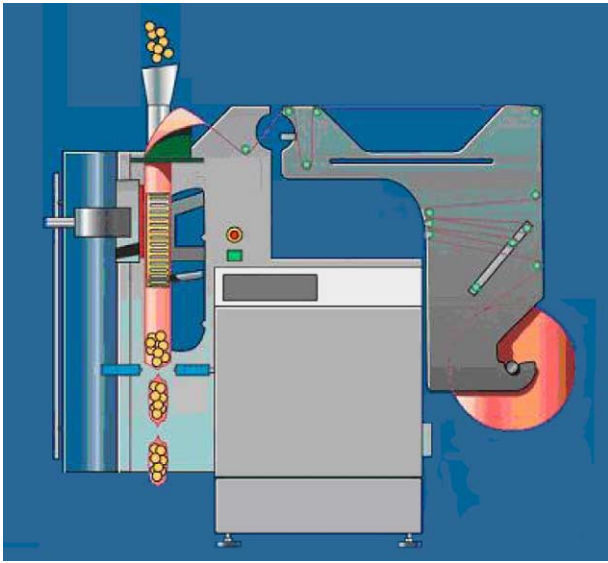


Fig. 2. Form fill seal.

Packing machine requirements

Hygienic food processing equipment should be easy to maintain to ensure it will perform as expected to prevent microbiological problems. Therefore, the equipment must be easy to clean and protect the products from contamination and must prevent the ingress of microorganisms.

Considerations

- The equipment shall be installed such that it will not cause contamination of the ingredients, raw foods and end products.
- Separation between product contact and non-product contact areas prevents cross-contamination during operations. Indirect product contact zone areas are designed as if they were product contact zone areas.

- Product contact surfaces are made to prevent build-up of product residue during operations.
- Separation between product contact areas and non-product contact areas has to be determined by a risk analysis.
- All parts of the equipment should be installed at a distance of at least 1 m from walls, ceilings and adjacent equipment to be accessible for transport systems for ingredients and packaging material and for easy access of operating staff (for inspection, cleaning and disinfecting, maintenance and to solve breakdowns).
- Surfaces with direct and indirect product contact are cleanable as measured by <1 CFU per 25 cm^2 , <1 CFU per 10 ml when the item is rinsed, acceptable RLU (device specific) when measured by residual ATP, and/or negative for residual protein or carbohydrate when using swabs to detect residual protein or carbohydrate (measured post-installation).

Product contact surfaces and coatings

Surfaces of the machine parts that come in direct contact with high-risk ingredients must be made from non-toxic materials and must have finishes which are impervious, non-absorbing, washable, smooth and crack free to resist microbial settlement and to be easily cleaned and disinfected. Surfaces must have:

- Cleanability to a microbial level;
- Accessibility for inspection, maintenance and cleaning;
- No niches and hollow areas (see Fig. 3);
- No product or liquid collection;
- Hygienic operational performance.

Conveyors with product contact

Conveyor belts must be made from non-toxic materials and have finishes which are impervious, non-absorbing, washable, smooth, crack free in order to resist microbial



Previous design



Hygienic design

Fig. 3. No niches.

settlement and facilitate cleaning and disinfection. The quality of the surface finish must be such that, under the conditions of the food packing process, formation of bio-film cannot occur or is reduced to a minimum whereby the film can be removed. All belting should be easily removable or the belt tension reduced easily without tools so that the surfaces underneath can be cleaned. Belt tension should be adequate throughout operations to prevent water pooling on belts.

Cleaning and decontamination

Special considerations:

- Equipment, which is difficult to clean, needs more stringent procedures. Effective cleaning products must be used and more attention must be paid to the cleaning operation, including visual checks afterwards.
- Dismantled equipment parts as well as cleaning tools should be cleaned in a room that meets the requirements for safe handling of raw materials, intermediate and end products.
- Cleaning of the process environment: all raw materials, products and packaging materials must be removed from the washing area prior to wet cleaning of equipment and the surroundings. If this is practically impossible, watertight coverings have to be provided in the area.

Monitoring and control

Protocols for hygiene monitoring and control of packing systems can only be defined once the system design meets the requirements of this guideline.

Hygiene performance of operating staff

Operators should be given instructions before commencing work. Such instructions should include the basics of personal hygiene, hygienic handling of foods, with emphasis on precautions necessary to prevent contamination of food.

Hands must be washed frequently and thoroughly using a suitable hand cleansing preparation and running, warm, potable water. Hands must be washed before entering a food handling area, immediately after using the toilet, and after handling any material which might be capable of transmitting disease. There must be adequate supervision to ensure that this is done.

The use of gloves for product safety purposes is of dubious benefit. Thorough and frequent hand washing has been shown to be just as effective provided that nails are well trimmed. In case of a cut or minor infection or any condition which might pose a threat to the product, effective covering of the hands is essential and gloves may be appropriate in these cases. It should be noted that the wearing of gloves does not reduce the need for frequent hand washing.

Operators should be supplied with a complete set of hygienically laundered protective coating or with disposable

clothing for one-time use. This must be worn only for the intended purpose and must not be worn in other departments. Clothing must be changed at least daily. It is the company's responsibility to provide clean clothing, which may be facilitated by using a laundry service. In the changing room, there must be physical separation of work clothes and outdoor clothes. Every operator has to wear disposable hair and, if needed, beard protection.

There should be an area designed with suitable drainage for boot washing operations. Manual cleaning (preferably during the cleaning shift) and industrial washing machines are satisfactory boot washing methods.

Heating ventilation and conditioning

Requirements for room air are:

- Complete air-conditioning (with room temperature at 12 °C), operating at overpressure, with all air circulating through filters 5–25 Pa, a complete volume change every hour. A pressure difference between high risk to lower care zones should be 5–15 Pa or have an air velocity 1.5 m/s or greater through openings. Supplied air should comply with the desired standard, typically final filtration F9 for room air and H11 for process equipment air.
- During cleaning operations, the air used has to go directly to the exhaust and after cleaning operations ambient air has to be recycled to increase environmental drying as necessary. Air should have a relative humidity of 60–70%.

Normative references

The following documents underpin this guideline. Although current at the time of publication please check for more recent editions.

EN 1672-2:1997. Food processing machinery—Basic concepts—Part 2: Hygienic Requirements.

EN ISO 14159:2002. (E) Safety of machinery—Hygiene requirements for the design of machinery.

EN ISO 12100-1:2003. Safety of machinery—Basic concepts, general principles for design—Part 1: Basic terminology, methodology (ISO 12100-1:2003).

EN ISO 12100-2:2003. Safety of machinery—Basic concepts, general principles for design—Part 2: Technical principles (ISO 12100-2:2003).

Definitions

The definitions in the EHEDG Glossary (see www.ehedg.org/glossary.pdf) apply to this guideline.