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## Food machinery safety requirements

食品机械安全要求

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# Food machinery safety requirements

## 1 Scope

This document specifies the structural material requirements, equipment structure, equipment configuration and installation related to food machinery safety, as well as the implementation of standards.

This document applies to machines and equipment used in food processing.

## 2 Normative references

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, for dated reference documents, only the version corresponding to the date applies to this document; for undated reference documents, the latest version (including all amendments) applies to this document.

GB/T 150 (all parts) Pressure vessels

GB/T 1173-2013 Casting aluminum alloy

GB 2894 Safety signs and guideline for the use

GB/T 3190 Chemical composition of wrought aluminium and aluminium alloys

GB/T 3280 Cold rolled stainless steel plate, sheet and strip

GB/T 3766 Hydraulic fluid power - General rules and safety requirements for systems and their components

GB 4053 (all parts) Safety requirements for fixed steel ladders and platform

GB/T 4237 Hot rolled stainless steel plate, sheet and strip

GB 5083 General rules for designing the production facilities in accordance with safety and health requirements

GB/T 5226.1 Electrical safety of machinery - Electrical equipment of machines - Part 1: General requirements

GB/T 7932 Pneumatic fluid power - General rules and safety requirements for systems and their components

GB/T 14253 General specification for light industry machinery

GB/T 14295-2019 Air filter

GB/T 20878 Stainless and heat-resisting steels - Designation and chemical composition

GB/T 24511 Stainless steel and heat resisting steel plate, sheet and strip for pressure equipment

JB/T 7277 Specification of operating handle, handwheel and knob

QB/T 2003 Stainless steel seam welded pipe fitting for food industry

QB/T 2004 Stainless steel clamp sleeve with washer for food industry

QB/T 2467 Stainless steel tubes for the food industry

QB/T 2468 Stainless steel threaded couplings for the food industry

# 3 Terms and definitions

The following terms and definitions apply to this document.

**3.1**

**Food machinery**

Machinery and equipment used in food processing processes.

**3.2**

**Product**

Raw materials and auxiliary materials, as well as semi-finished products and finished products in food processing.

**3.3**

**Working air**

Clean air used for product heating, cooling, drying, transportation, purging, inspection equipment sealing.

**3.4**

**Area of product**

**4.1.1** Product contact surface materials shall meet product compatibility requirements. Structural materials shall also meet the requirements of corresponding usage conditions (such as product characteristics, temperature, pressure, medium characteristics, etc.).

**4.1.2** Product contact surface materials shall be safe and traceable; it shall not affect the nature, purity, or quality of the product.

**4.1.3** The contact between materials and products shall not produce substances, that are harmful or exceed the amount specified in the standards of the processed products, due to interaction.

**4.1.4** Food machinery manufacturer shall inspect and accept materials and products. Information on purchased products shall comply with product labeling requirements and compatibility requirements.

**4.1.5** When selecting materials, other risks that may endanger product safety that may exist under different use conditions shall be avoided, including but not limited to the following conditions: low temperature, ultraviolet radiation, microwaves, electromagnetic waves, γ-radiation, ozone, etc.

**4.2 Usage performance requirements**

**4.2.1** The contact between materials and products shall not cause the interaction to produce substances that pollute the product, affect the smell, color, quality of the product, or have adverse effects on the product processing process.

**4.2.2** The material shall have the properties of heat resistance, chemical resistance, mechanical resistance.

**4.2.3** When products, detergents, disinfectants come into contact with materials, the types and amounts of compounds formed on the surface of the materials or deep inside them shall not cause adverse consequences, that require additional processing of the equipment to remove these compounds.

**4.2.4** The color of materials shall not present difficulties in assessing product quality or degree of contamination.

**4.2.5** In order to adapt to different uses, materials used for parts with product contact surfaces shall have good processing performance (such as bendability, cutting ability, weldability, surface hardness, grindability, polishing, etc.), good thermal conductivity, corrosion resistance, resistance to liquid penetration, etc.

**4.3 Structural material requirements for product contact surfaces**

**4.3.1 Stainless steel**

Stainless steel materials on product contact surfaces shall meet product compatibility

requirements.

The designation and chemical composition of stainless steel materials shall comply with the requirements of GB/T 20878. Stainless steel cold-rolled plates shall comply with the requirements of GB/T 3280; stainless steel hot-rolled plates shall comply with the requirements of GB/T4237; stainless steel plate materials for pressure-bearing equipment shall comply with the requirements of GB/T 24511. Stainless steel pipes and accessories for the food industry shall comply with the relevant requirements of QB/T 2467 and QB/T 2468.

Stainless steel materials shall be easy to process, non-toxic, non-absorbent, highly corrosion-resistant, insoluble in food solutions, not produce metal ions that would damage the flavor of the product, have good resistance to liquid penetration, the surface can be polished, the appearance is bright, beautiful, easy to clean.

Note 1: For general purposes, austenitic stainless steel materials are used; the material designations are 06Cr19Ni10 (S30408), 022Cr19Ni10 (S30403), 06Cr17Ni12Mo2 (S31608), 022Cr17Ni12Mo2 (S31603). When the usage requirements are harsh, the designation used is 06Cr19Ni13Mo3 (S31708) and 022Cr19Ni13Mo3 (S31703) austenitic stainless steel materials. When necessary, in order to avoid stress corrosion cracking due to the presence of chloride ions, choose 022Cr23Ni5Mo3N (S22053) austenitic-ferrite type materials (such as the conditions for long-term storage of salt solutions ).

Note 2: When martensitic stainless steel is used for special parts on product contact surfaces, such as blades, shaft parts, etc., the material designations used are 1Cr13, 2Cr13, 3Cr13, etc.

**4.3.2 Aluminum and aluminum alloys**

Aluminum and aluminum alloy materials on product contact surfaces shall meet product compatibility requirements.

Aluminum and aluminum alloys shall have certain corrosion resistance, be non-toxic and non-absorbent, be used for parts with complex shapes and product contact surfaces. Aluminum alloy materials for casting shall comply with the provisions of 4.1.8 in GB/T 1173-2013. Aluminum and aluminum alloy materials produced by pressure processing methods shall comply with the requirements of GB/T 3190.

**4.3.3 Welding materials**

The welding materials shall have properties similar to those of the materials being welded, form a tight and solid structure in the welding area, be non-toxic and corrosion-resistant.

**4.3.4 Plastics**

**4.3.4.1 Plastic materials and products**

#### 4.4.2 Fiber materials

Paper and paperboard materials and products shall meet product compatibility requirements.

Natural protein fiber materials and products shall meet product compatibility requirements.

Other fiber materials such as cotton fiber, wood fiber, linen and man-made fiber shall meet product compatibility requirements.

Fiber materials shall be non-toxic, non-shedding, insoluble in water, not interact with the product; they shall not affect the smell of the product. Fiber materials are commonly used as filter materials, screen materials, and elastic connection materials.

Note: Man-made fibers are materials made from natural plant fibers that have been chemically or physically modified.

#### 4.4.3 Glass

Glass and products shall have high mechanical strength, thermal shock resistance, thermal stability, and safety. It is used in sight glass and light entrances.

#### 4.4.4 Filter media

Filter media used for product contact include cotton fiber, wood fiber, metal wire, activated carbon, activated alumina, diatomaceous earth, semi-permeable membranes used in the food industry, etc. Filter media can be composed of several materials at the same time. It shall have good chemical stability under working conditions, be resistant to chemical corrosion, temperature changes, microbial action, be easy to clean and disinfect. It shall be non-toxic and harmless, with no shedding, toxic volatiles or other substances that may pollute the air and products. It shall not affect the odor of the product. The materials constituting the filter media shall comply with the corresponding standards.

#### 4.4.5 Bonding materials

Under working conditions, it shall be able to ensure that the bonding surface has sufficient strength and tightness, good thermal stability; it shall be non-toxic, non-volatile, non-solubility, non-affecting the odor of the product.

### 4.5 Requirements for other surface covering materials in contact with the product

The materials of other surface coverings in contact with the product (hereinafter referred to as the covering layer) shall comply with product compatibility requirements and corresponding national standards.

Lead, zinc and their alloys shall not be used; materials containing fiberglass shall not

be used; wood shall not be used (except for hardwood chopping boards used to divide raw materials and special occasions for wine production). Articles with colored paint coatings shall not be used. The cadmium, nickel, chromium, enamel, glass-lined, foamed plastics and phenolic-based plastics shall not be used as coverings.

### 4.6 Material requirements for non-product contact surfaces

**4.6.1** Non-product contact surfaces shall be made of corrosion-resistant materials, which shall have good anti-absorption and anti-penetration capabilities, durability, washability.

**4.6.2** Non-product contact surfaces are allowed to be coated with corrosion-resistant materials. If surface coated, the coating shall adhere firmly.

**4.6.3** Materials on non-product contact surfaces shall not peel or fall off, causing product contamination.

### 4.7 Other requirements

Asbestos materials shall not be used in any part of food machinery.

## 5 Equipment structure

### 5.1 Structural characteristics

**5.1.1** The equipment structure, product delivery pipelines and connecting parts shall not have any depressions or dead corners where product is retained.

**5.1.2** Pipes in direct contact with products shall use stainless steel pipes, pipe fittings and valves that meet cleaning requirements. Stainless steel pipes and pipe fittings shall comply with the relevant requirements of QB/T 2467 and QB/T 2468. Pipeline control valves shall be hygienic valve structure and easy to clean and sterilize. The piping, branch pipes, other accessories connected to the mechanical device shall use sealing materials that meet the conditions of use; have a structure to prevent the intrusion of pollutants, product retention; have a structure to prevent internal leakage of the product.

**5.1.3** Reliable seals shall be installed where external parts extend into the product area, to prevent the product from being contaminated.

**5.1.4** Bearings in contact with the product shall be non-lubricating (self-lubricating). If the lubricated bearing is located in the product area, there shall be reliable sealing devices and isolation measures around the bearing, to prevent product contamination.

**5.1.5** The product area shall be isolated from the outside world. The isolation measures shall be graded according to the requirements of the product processing stage. At least a protective cover shall be added, to prevent foreign objects from falling in or pests

located at the bottom or side, if it adopts an inward opening structure, it shall be designed in an oval shape to facilitate disassembly and installation.

**5.2.9** For equipment equipped with ladders, passages, operating platforms, the selection of these fixed facilities shall meet the requirements of GB 4053 (all parts).

**5.2.10** The material and structure of the operating platform's tabletop and ladder treads shall have anti-slip properties. Straight ladders parallel to the tower wall and tank wall shall be equipped with equidistant rungs. The vertical spacing between adjacent rungs is 225 mm to 300 mm; the distance between the rungs and the tower wall and tank wall shall not be less than 180 mm to 300 mm. For straight ladders without cages, after installation and fixation, the vertical distance from the climbing surface formed by the center line of the rungs to the surface of the nearest obstacle shall not be less than 760 mm.

**5.2.11** A safety cage shall be installed, if the height of the straight ladder or falling height is above 3000 mm.

**5.2.12** When the fall height exceeds 500 mm, protective railings shall be installed on all open edges of the platform, passage or working surface; the height of the guardrail shall not be less than 1050 mm. When the height from the reference plane is not less than 20 m, the height of the guardrail shall not be less than 1200 mm. There shall be skirting boards at the connection between the guardrail and the platform.

**5.2.13** When the rising height of the stairs exceeds 500 mm, guardrails shall be installed.

**5.2.14** The area of the operating platform shall not be less than 1 $m^2$. The narrowest point shall be no less than 750 mm.

**5.2.15** The outer surface of mechanical equipment shall be smooth, without edges or sharp corners.

**5.2.16** Under normal operation without load, the noise (sound pressure level) of the equipment shall not exceed 85 dB(A).

**5.2.17** When the external surface temperature of the equipment (pipeline) exceeds 60 °C, heat insulation measures shall be taken to prevent burns.

**5.2.18** During the work process, when the operator's hands are often in contact with the product, manual operation shall not be used for starting and stopping, but non-hand contact control switches shall be used.

**5.2.19** The structural form of operating parts shall be advanced and reasonable; its technical requirements shall comply with the provisions of JB/T 7277. The control force of frequently used handwheels and handles shall be uniform; their control force shall comply with the requirements of GB/T 14253. See Table 1 for the control force values.

the requirements of easy cleaning, disinfection, sterilization, bacteria reduction.

**5.4.2** The product area shall be easily accessible; the disassembly and installation of parts that cannot be automatically cleaned in this area shall be simple and convenient.

**5.4.3** Non-detachable parts shall be able to be cleaned automatically; when cleaning without disassembly is allowed, the structure shall be easy to clean and inspect.

**5.4.4** The product contact surface where products, washing water, etc. are discharged shall have a self-draining structure or a draining function.

**5.4.5** Avoid blind spots in structure. Where blind spots cannot be avoided, appropriate discharge structures and cleaning structures shall be provided. When necessary, there shall be structures capable of disinfection, sterilization, bacteria reduction.

**5.4.6** For parts that require manual cleaning, the structure shall ensure that the operator's hands or cleaning tools can reach the required cleaning range.

**5.4.7** Grooves and corners in the product area shall be easy to clean.

**5.4.8** The width of the groove for placing the sealing ring and the keyway in contact with the product shall not be less than the depth. If the installation allows, the width of the groove shall be greater than 6.5 mm.

**5.4.9** Any internal angle equal to or less than 135° on the product contact surface shall be processed into rounded corners.

**5.4.10** The fillet radius shall generally not be less than 6.5 mm, except for the following circumstances:

a) The fillet radius of the overlapping connections (welding or bonding), welding of inserts, inner corners of keyways, inner corners of sealing gasket placement grooves shall not be less than 1.5 mm;

b) The fillet radius of the inner corners of pilot valves, one-way valves, triangular valves, stop valves shall not be less than 1.6 mm;

c) The minimum fillet radius of throttle valves, air diverters, valves, etc. shall not be less than 0.8 mm;

d) Material pumps, pressure gauges, flow meters, liquid level indicating devices, etc., due to their functional requirements, shall have a radius of less than 0.8 mm and shall be easy to access and easy to manually clean and inspect.

**5.4.11** The soft joints in contact with the product shall have no wrinkles on the surface when stretched.

**5.4.12** Overlap welding is allowed under the following circumstances:

a) Side walls with an inclination angle between 15° and 45° to the vertical direction;

b) A horizontal upper surface that can be mechanically cleaned;

c) The thickness of a single piece of material shall not exceed 0.4 mm.

**5.4.13** When the thickness of the thinner workpiece among the materials to be welded is greater than or equal to 5 mm, insert welding shall not be added.

**5.4.14** The welded joints on the working air contact surface shall be continuous and tight; it shall not form dead corners that are difficult to clean.

**5.4.15** Water-absorbent padding shall not be used for parts in contact with the product.

**5.4.16** The bottom of the equipment (such as barrels, tanks, grooves, pots) shall have a certain slope toward the discharge outlet, to facilitate the draining of the cleaning liquid. The horizontal section of the exhaust pipe shall be inclined downward by not less than 2.5°, to make the condensed liquid only flow outward.

**5.4.17** For evaporation and concentration devices that use stainless steel coil heating, if no automatic cleaning device is provided, the coil settings shall meet the following requirements:

a) The distance between coils is greater than or equal to 70 mm;

b) The distance between the coil and the inner wall is greater than or equal to 80 mm;

c) The distance between each row of coils is greater than or equal to 90 mm.

**5.5 Cleaning in place and steam in place**

**5.5.1** Cleaning in place (CIP) requirements are as follows:

a) Food contact surfaces for online cleaning shall not have blind spots or spaces that cannot be completely cleaned;

b) There shall be a structure for discharging washing water and product materials;

c) There shall be a certain method to confirm the cleanability;

d) Appropriate cleaning conditions shall be determined and provided to users.

**5.5.2** The requirements for steam in place (SIP) are as follows:

a) The product contact surface for steam in place shall not have blind spots or spaces that cannot be reached by disinfection steam;

b) There shall be a structure for discharging washing water and product materials;

**5.7.1** When the equipment cannot be cleaned automatically, the parts that need to be cleaned shall be easy to disassemble and clean.

**5.7.2** The parts of the equipment that need to be disassembled shall be easily accessible; disassembly can be completed without the use of special tools; reinstallation shall be easy. In the connection of material pipelines, stainless steel pipes and pipe components for the food industry shall be used, or steel pipes and accessories of the same level of hygienic structure shall be used. Stainless steel threaded pipe joints for the food industry shall comply with the requirements of QB/T 2468; stainless steel butt welded pipe fittings for the food industry shall comply with the requirements of QB/T 2003; stainless steel clamp bushings with washers for the food industry shall comply with the requirements of QB/T 2004. Various technical requirements for pipes and fittings shall comply with corresponding standards.

**5.7.3** The clamping mechanism shall adopt wing nuts and buckles operated by a single handle.

**5.7.4** The lids and doors of various containers shall be easy to disassemble and easy to clean and inspect.

**5.8 Inspectability**

**5.8.1** Parts located in the product area shall be easy to inspect after cleaning. Perform inspection cleaning when necessary.

**5.8.2** Special parts that need to be cleaned shall be easy to disassemble and inspect.

**5.8.3** Accessories or parts shall be installed so that the operator can easily see whether they are installed correctly. If necessary, there shall be designs or markings to prevent mis-installation.

# 6 Equipment configuration and installation

**6.1** The design, processing, use, safety, cleanliness requirements of main process equipment and auxiliary equipment and their parts and components shall comply with the requirements of GB 5083.

**6.2** The location of equipment, floors, walls and other equipment, the configuration and fixation of equipment pipelines, the connection of equipment and sewage systems shall not constitute obstacles to the performance and inspection of cleaning work, nor shall they pose a threat to product safety.

**6.3** The configuration and connection locations of pipe supports, that transport media that are different from the product (such as hydraulic oil, refrigerant, etc.), shall avoid contamination of the product due to accidental failures or leaks during the work process; they shall not hinder equipment cleaning.

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