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**Safety of machinery - Perimeter fence guarding system -
Safety requirements**

机械安全 围栏防护系统 安全要求

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Safety of machinery - Perimeter fence guarding system - Safety requirements

1 Scope

This document specifies the conditions of use, safety requirements, and instructions for use of perimeter fence guarding systems.

This document applies to perimeter fence guarding systems used in industrial areas.

2 Normative references

The following documents contain the provisions which, through normative reference in this document, constitute the essential provisions of this document. For the dated referenced documents, only the versions with the indicated dates are applicable to this document; for the undated referenced documents, only the latest version (including all the amendments) is applicable to this document.

GB/T 15706-2012 Safety of machinery - General principles for design - Risk assessment and risk reduction

GB/T 18831-2017 Safety of machinery - Interlocking devices associated with guards - Principles for design and selection

GB/T 23821-2022 Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs

GB/T 42598 Safety of machinery - Instruction handbook - General drafting principles

3 Terms and definitions

The terms and definitions defined in GB/T 15706-2012 and the following apply to this document.

3.1 perimeter fence guarding system

Integration of perimeter fences, security doors, and interlocking devices.

NOTE: The perimeter fence guarding system is used to physically isolate a certain area or restrict people from entering the danger zone. The schematic diagram is shown in Figure 1.

3.4 interlocking device

interlock

Mechanical, electrical, or other types of devices used to prevent hazardous machine functions from operating under specified conditions (usually as long as the guarding device is not closed).

[Source: GB/T 15706-2012, 3.28.1]

3.5 safety distance

safe separation distance

S_r

The minimum distance between the protective structure and the danger zone.

[Source: GB/T 23821-2022, 3.2]

3.6 tool

Implements designed for tightening operations.

NOTE: Temporary implements such as special keys or wrenches, coins, or nail files cannot be considered tools.

[Source: GB/T 8196-2018, 3.7, with modification]

4 Conditions of use

The working environment of the perimeter fence guarding system shall not exceed the corrosive working environment requirements specified in the product manual.

The ground on which the perimeter fence guarding system is fixed shall be smooth and hardened.

5 Safety requirements

5.1 Dimensions

5.1.1 Before the height of the perimeter fence is determined, the severity and probability of occurrence of the injury shall be determined in accordance with 5.5 of GB/T 15706-2012, and the height of the danger zone (h_h) shall be measured. If the danger protected by the perimeter fence will only cause minor injuries and the probability of occurrence

is low, the height of the perimeter fence (that is, the height of the protective structure h_{ps}) shall be selected in accordance with Table 1 of GB/T 23821-2022, otherwise the height of the perimeter fence shall be selected in accordance with Table 2 of GB/T 23821-2022.

Without additional protection measures, the lower the height of the perimeter fence, the greater the distance between the perimeter fence and the danger zone. Generally, the height of the perimeter fence shall be 1600 mm, 1800 mm, 2000 mm, or 2200 mm.

NOTE: GB/T 16856-2015 5.4 provides guidelines for estimating the severity and probability of injury.

When the height of the perimeter fence is less than 1400 mm, additional protective measures shall be taken.

5.1.2 Unless the risk assessment results show that it is feasible, the height of the lower edge of the perimeter fence from the ground shall not exceed 180 mm to prevent people from entering the danger zone through the lower edge opening.

5.1.3 The grid size of the wire mesh panel of the perimeter fence and the openings of other panels shall comply with the provisions of 4.2.4 in GB/T 23821-2022.

5.2 Strength

5.2.1 The perimeter fence guarding system shall have sufficient overall structural strength and maintain impact resistance during the foreseeable life cycle. The pendulum test method described in Appendix A can be used for testing.

5.2.2 The perimeter fence shall have enough impact resistance to withstand foreseeable impacts from outside the danger zone, and shall at least meet the function of preventing people from entering the danger zone. Its basic value shall not be less than 115 J.

NOTE: 115 J is the simulation of the energy before a human body with a total mass of 90 kg hitting the perimeter fence at a speed of 1.6 m/s from outside the protective zone.

5.2.3 The perimeter fence shall have enough impact resistance to withstand foreseeable impacts from the danger zone. The impact risk and impact energy of the machine components or workpieces in the protective zone shall be assessed, and the perimeter fence with an impact resistance of not less than the foreseeable impact energy shall be selected. If the impact energy of mechanical moving parts is difficult to evaluate, a perimeter fence with an impact resistance of not less than 1600 J shall be selected.

NOTE: 1600 J is the simulation of the energy before a mechanical moving part with a total mass of 200 kg hitting the perimeter fence at a running speed of 4 m/s from the protective zone.

of dangerous machine functions, the system shall send out an audible and visual warning signal.

NOTE: This audible and visual warning is different from the warning when the machine is restarted.

5.5 Interlocking devices

5.5.1 Appropriate interlocking devices shall be selected according to the provisions of GB/T 18831-2017.

5.5.2 The interlocking device shall be installed securely and meet the requirements of the instruction manual provided by the interlocking device manufacturer.

6 Instructions for use

6.1 General requirements

6.1.1 The preparation of instructions for use shall comply with the provisions of GB/T 42598.

6.1.2 The instructions for use shall contain the required information about the perimeter fence guarding system and its safety parameters and functions (such as vertical or horizontal positioning), including information on installation and maintenance, and corrosive working environment requirements (if any).

6.2 Residual risk

Information on the residual risks of the perimeter fence guarding system shall be given in the instructions for use, such as mechanical hazards, flammability of materials, and relevant test results.

6.3 Installation instructions

Instructions for the correct installation of the perimeter fence guarding system shall be given in the instructions for use. For the installation of perimeter fences, at least the following information shall be given:

- The assembly of the perimeter fence;
- The fixation of the perimeter fence. If the perimeter fence is fixed on the cement floor, the grade of concrete should be proposed;

- Other standards that need to be complied with, such as GB/T 18831 and GB/T 23821;
- Safety precautions.

6.4 Operating instructions

The instructions for use shall give the correct method of operating the perimeter fence guarding system and give warnings for reasonably foreseeable misuse (see 6.4.5 in GB/T 15706-2012).

6.5 Inspection and maintenance

Regarding required maintenance and inspections required to find defects, the instructions for use shall include at least the following:

- The loss or damage of any component in the perimeter fence guarding system, especially the situation that can lead to a decrease in safety performance, such as the desoldering of the metal wire mesh resulting in a decrease in impact resistance;
- Repair or replace parts that have been deformed or damaged and have a negative impact on safety;
- Replace worn parts;
- Fasteners (such as bolts and screws) in the perimeter fence guarding system can only be replaced with the same fasteners;
- Deterioration in the performance of the connection points or fixed points between the posts and the perimeter fence;
- Performance degradation due to corrosion, temperature changes, embrittlement, or chemical attack;
- If necessary, the moving parts shall be kept in good operation and lubricated;
- Adjustment of safety distance and hole size;
- The safety door operates smoothly and reliably;
- Use interlocking devices correctly;
- The interlocking device is installed firmly and the connecting cable is not damaged;

Appendix A

(Informative)

Pendulum impact test method for testing the impact resistance of perimeter fences

A.1 Overview

Perimeter fence guarding systems can minimize the risk of impact caused by the human body from outside the protective zone, as well as the risk of impact from components or workpieces within the danger zone. The pendulum test method can be used to test the ability of a perimeter fence guarding system to resist impacts from outside and within the protected danger zone. This appendix applies to perimeter fence materials and the complete overall perimeter fence structure.

The test methods given in this appendix are only suitable for situations where there is a risk of impact.

This test method gives guidance on soft and hard pendulums, which represent low-speed impacts (such as contact between the human body, mechanical moving parts, and perimeter fence protection systems), rather than high-speed impacts caused by splashing of mechanical parts or materials.

A.2 Principle

A.2.1 Overview

This test method is based on the impact of soft and hard pendulums to simulate the contact between the human body (soft objects) or machine parts (hard objects) and the perimeter fence guarding system.

In this test, three perimeter fence panels are installed, with the middle perimeter fence panel as the impact test object and the perimeter fences on both sides as the test bench, see Figure A.1.

equivalent to how the material would be installed in a perimeter fence.

A.3 Test procedures

A.3.1 Select a perimeter fence panel with a width of at least 1000 mm as the test object. According to the foreseeable application, the test object is installed on the test platform of perimeter fences on both sides and fixed on the ground through the posts.

A.3.2 Weigh and record the mass of the pendulum, and install the pendulum on the lifting equipment through the rigging.

A.3.3 Lift the pendulum and make the surface of the test object just contact the end point of the pendulum that is naturally drooping and in a stationary state, as the expected impact point. Adjust the position of the pendulum, make the expected impact point higher than $2/3$ of the height of the perimeter fence, but not higher than 1.6 m, and measure the height of the expected impact point.

A.3.4 Raise the height of the pendulum by lateral traction so that the height of the pendulum from the ground is the sum of the height a of the expected impact point and the falling height h of the pendulum.

A.3.5 Release the pendulum to impact the test object, and observe and record the test results.

A.4 Test results

After the test, damage to the perimeter fence or material should be assessed.

Types of damage include:

- a) Warping/bulging (permanent deformation without cracks);
- b) Initial cracks (only one side is visible);
- c) Penetrating cracks (cracks are visible from one side to the other);
- d) Penetration (projectiles penetrate the test object);
- e) The fixation of perimeter fence panels loosens;
- f) Desoldering of perimeter fence panel materials;
- g) The perimeter fence is loose at its supports.

The pendulum impact test given in this appendix is deemed to have passed if the following conditions are met:

- Deformation or cracking does not exceed the value specified to avoid injury;

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