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**Fused Deposition Modeling machines - Technical requirements
for safeguarding
(English Translation)**

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1 Scope

This Standard specifies the safeguarding requirements, measures, usage information and other technical requirements for safeguarding of fused deposition modeling machines; and also stipulates the inspection requirements for safeguarding requirements.

This Standard applies to fused deposition modeling machines (hereinafter referred to as "machines").

2 Normative References

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) or revisions do not apply to this Standard, however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB 2894 Safety signs (GB 2894-1996, neq ISO 3864:1984)

GB 5226.1 Safety of machinery - Electrical equipment of machines--Part 1:General requirements (GB 5226.1-2002, IEC 60204-1:2000, IDT)

GB/T 14896.7-2004 Non-traditional machine tools - Terminology - Part 7: Rapid prototyping machines

GB/T 15706.1-1995 Safety of machinery - Basic concept, general principles for design - Part 1: Basic terminology, methodology (eqv ISO/TR 12100-1:1992)

GB/T 15706.2-1995 Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles and specifications (eqv ISO/TR 12100-2:1992)

GB/T 16769-1997 Metal-cutting machine tools--Measurement method of sound pressure level

GB/T 18569.1-2001 Safety of machinery - Reduction of risks to health from hazardous substances emitted by machinery - Part 1: Principles and specifications for machinery manufacturers (eqv ISO 14123-1:1998)

5.1.2 Risks shall be eliminated or reduced through design as much as possible, including the use of the following measures alone or in combination:

--- Choose appropriate design structures to avoid or reduce risks;

--- Reduce the need for operators to intervene in danger zones to limit their exposure to hazards.

5.1.3 For hazards that cannot be avoided or adequately limited by design, safeguarding devices shall be used to protect personnel.

5.1.4 The operator shall be informed through effective means of the remaining risks and certain hazards that are inconvenient to protect due to insufficient guards. If it can be stated in the product instruction manual, warning signs or plates shall also be set up at dangerous locations when necessary.

5.2 Mechanical hazards and safeguarding (see 7.2 for inspection)

5.2.1

The easily accessible parts of the machine shall not have sharp edges, sharp corners, sharp edges, etc. that can cause personal injury, so as to avoid the risk of punctures and cuts.

5.2.2

Under predetermined working conditions, the machine or its components shall not accidentally overturn.

5.2.3

Reliable limiting measures shall be taken for the reciprocating parts of the machine. Each motion axis shall be equipped with reliable electrical and mechanical double limit devices to prevent the risk of slipping.

5.2.4

The machining area of the machine shall be equipped with an interlocking protective cover. For machines with a closed structure in the working area, the molding chamber shall be equipped with an interlocking door.

5.2.5

When the interlocking guard is opened, the machine shall stop working or cannot be started; and it shall be ensured that it cannot be started before the guard is closed. If the door of the molding chamber is open, the machine cannot process to prevent the risk of collision when the nozzle runs at high speed.

5.2.6

The nozzle clamping device shall be safe and reliable to ensure that the nozzle does not fall or be thrown out during high-speed movement, causing a risk of projection.

5.2.7

Multiple different safeguarding devices shall be considered in greatly hazardous locations to avoid common cause failure. Such as high temperature protection measures, electrical and mechanical double limit devices for machine movement axis, etc.

5.3 Safeguarding device (see 7.3 for inspection)

5.3.1

Safeguarding devices are provided for the involved mechanical or other hazards. It shall satisfy to:

- Meet the required mechanical strength and stiffness, and have reliable performance;
- Do not increase any additional hazards (such as causing pinching, shearing, etc.);
- Can be fixed firmly and reliably.

5.3.2

Frequently disassembled guards shall be easy to assemble and disassemble, and their mass shall not exceed 6 kg. The opening force of the guards shall be no greater than 40 N.

5.4 Control systems and devices (see 7.4 for inspection)

5.4.1

The control and manipulation system of the moving parts of the machine (referred to as the control system) shall be functionally reliable and ensure that all functions do not interfere with each other. It shall be able to withstand the expected workload and external influences, control interruption and damage to the information carrier, and shall not lead to the emergence of dangerous situations.

5.4.2

When setting up control devices, additional hazards caused by mis-operation shall be taken into consideration. Control devices prone to mis-operation shall be designed with fault tolerance in mind.

5.4.3

The machine shall be equipped with a working state selection switch for each control function, and each position is only allowed to correspond to one control method or working state (such as automatic control or adjustment, inspection). Other methods (such as code control) can also be used to select working state.

5.4.4

A "stop" control device shall be set near each "start" control device. Each operating position of the machine shall be equipped with an emergency stop device. Emergency stop devices shall comply with the relevant provisions of GB 5226.1.

5.4.5

The installation height of instruments for frequent observation of readings is generally 0.7 m~1.7 m. The installation height of instruments whose readings are not frequently observed is allowed to be 0.3 m~2.5 m.

5.5 Electrical hazards and safeguarding (see 7.5, 7.11 for inspection)

5.5.1

The protection level of the electrical box (cabinet) shall comply with the relevant provisions of GB 5226.1.

5.5.2

The machine shall be reliably grounded, the grounding insulation resistance shall be no less than 1 Mohm, and meet the continuity requirements of the protection circuit.

5.5.3

The electrical equipment (including components) in the machine molding chamber shall be electrical products with additional requirements for heat resistance (see the relevant provisions of GB 5226.1).

5.5.4

Other safeguarding requirements for machine electrical equipment shall comply with the relevant provisions of GB 5226.1.

5.6 High temperature safeguarding requirements (see 7.6, 7.12 for inspection)

5.6.1

The nozzle heating system shall adopt a reliable temperature control device that can automatically adjust the nozzle temperature. Thermal protection measures (such as installing a protective cover made of heat-insulating material) shall be taken on the outside of the nozzle and the heating system of the nozzle to prevent the risk of burns.