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Building construction machinery and equipment—Common safety requirements

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Foreword

This document is drafted in accordance with the provisions of GB/T 1.1-2020 Directives for Standardization—Part 1: Rules for the Structure and Drafting of Standardizing Documents.

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Building construction machinery and equipment—Common safety requirements

1 Scope

This document specifies the general safety requirements for construction machinery and equipment.

This document applies to construction machinery and equipment including, but not limited to, concrete and mortar machinery, drilling and foundation construction equipment, tunnel construction machinery, road construction and maintenance equipment, building demolition or disposal machinery, engineering building material products machinery, as well as steel bar and prestressing machinery.

This document does not apply to earthmoving machinery, hoisting machinery, construction hoists, aerial work platforms, window cleaning machines, forklift trucks, machinery and equipment specialized for open-pit mining, and underground mining machinery and equipment for extracting solid minerals, even if such machinery and equipment may be used for construction or maintenance purposes.

This document does not apply to transport vehicles (e.g., automobiles, tractors, etc.), even if such transport vehicles may be used as the main units of construction machinery and equipment and have been specially modified to serve the application of construction machinery and equipment.

> **Note 1:** This document does not cover all specific requirements for each individual machine or machine type of construction machinery and equipment. Safety standards for specific machines or machine types are given in Annex A. When applying this document, the safety requirements specified in the standards listed in Annex A shall be taken into account.
>
> **Note 2:** Chapter 4 of this document sets forth the basic requirements, while Chapters 5 to 8 specify supplementary requirements for specific machinery and equipment.

2 Normative References

The contents of the following documents are incorporated into this document as essential provisions through normative reference in the text. For dated referenced documents, only the edition corresponding to the indicated date applies to this document; for undated referenced documents, the latest edition (including all amendments) applies.

GB/T 3766 Hydraulic Fluid Power – General Rules and Safety Requirements for Systems and Their Components

GB/T 7932 Pneumatic Fluid Power – General Rules and Safety Requirements for Systems and Their Components

GB/T 15706-2012 Safety of Machinery – General Principles for Design – Risk Assessment and Risk Reduction

GB/T 16855.1 Safety of Machinery – Safety-related Parts of Control Systems – Part 1: General Principles for Design

GB 28526 Electromechanical Safety of Machinery – Functional Safety of Safety-related Electrical, Electronic and Programmable Electronic Control Systems

3 Terms and Definitions

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

3.1 building construction machinery and equipment

Machinery and equipment used for building construction or the manufacture of engineering building material products.

Note: It includes concrete and mortar machinery, drilling and foundation construction equipment, tunnel construction machinery, road construction and maintenance equipment, building demolition or disposal machinery, engineering building material products machinery, steel bar and prestressing machinery, etc. It excludes earthmoving machinery, hoisting machinery, construction hoists, aerial work platforms, window cleaning machines, forklift trucks, machinery and equipment specialized for open-pit mining, and underground mining machinery and equipment for extracting solid minerals, even if such machinery and equipment may be used for construction or maintenance purposes.

3.11 concrete and mortar machinery

Machinery and equipment used for the preparation, conveying, spraying, pouring, compacting and cleaning of residual cement concrete or mortar.

Note: It includes concrete or mortar mixers, batching plants (towers), agitated transport equipment, conveying equipment, spraying equipment, pouring equipment, vibrators, as well as cleaning and screening equipment for residual concrete or mortar, etc.

3.12 drilling and foundation equipment

Integrated machines, interchangeable attachments, and machines fitted with interchangeable attachments, which are designed for one or more of the following applications:

— Drilling holes in soil and rock for construction, exploration, water well drilling and geological survey purposes;

— Preparation, installation and retrieval of longitudinal members for foundation works, retaining walls, cement-soil walls and soil improvement;

— Preparation and installation of diaphragm wall trenches for underground retaining walls and cut-off walls;

— Installation of components for ground improvement (e.g., drainage or grouting);

— Installation of components for soil nail or rock nail support.

[Source: GB/T 43746.1-2024, 3.1]

3.1.3 tunneling construction machinery

Machines used for the excavation and construction of tunnels and shafts.

3.1.4 road construction and maintenance equipment

Machinery and equipment used for the construction and maintenance of roads, highways, runways, parking aprons, etc.

Note: It includes machinery and equipment dedicated to road construction and maintenance, such as stabilized soil machinery and equipment, machinery and equipment for asphalt binders, machinery and equipment for asphalt mixtures, machinery and equipment for asphalt concrete pavement construction, machinery and equipment for cement concrete pavement construction, machinery and equipment for pavement finishing operations, pavement cleaning machinery, machinery and equipment for weed and shrub removal, machinery and equipment for road winter maintenance, and machinery and equipment for road repair.

3.1.5 building demolition or processing machinery

Machines used for the demolition or processing of buildings, civil engineering structures, road components or other sites (e.g., demolition, cutting, loosening and separation in quarries).

Note: It includes building demolition machinery, mobile crushers and screening machinery, etc.

3.1.6 construction components machinery

Machinery and equipment that use cementitious materials to produce building material products.

Note: It includes precast concrete component production equipment, production equipment for small concrete products such as bricks, concrete pipe-making machinery, lightweight concrete product production equipment, machinery for producing building material products using non-cementitious binders, deep-processing machinery and supporting equipment for building material products, etc.

3.1.7 steel reinforcement and prestressing machinery

Machinery and equipment used to process steel reinforcement, prestressing tendons, steel strands and cables (rods) into the lengths, bent shapes or installation assemblies required for the installation and construction of steel reinforcement works and prestressing works.

Note: It includes steel reinforcement strengthening machinery, steel reinforcement forming machinery, steel reinforcement connecting machinery and prestressing machinery, etc.

3.2 mobile machine

A machine whose entire unit can move on the ground (floor) or rails.

Note: Mobile machines mainly include:

— Machinery that requires mobility for operation;

— Machinery that requires continuous or semi-continuous movement between a series of fixed work positions;

— Machinery that does not require movement during operation but has configurations that facilitate easy relocation from one place to another.

3.2.1 autonomous mobile machine

A mobile machine with an autonomous mode.

Note: In autonomous mode, all intrinsically safe functions of the mobile machine can be guaranteed within its travel and operation areas without the need for continuous operator interaction.

3.2.2 supervisor

Personnel responsible for supervising autonomous mobile machines.

3.2.3 supervisory function

A function that enables remote, non-permanent supervision of autonomous mobile machines via devices capable of receiving information or alarms and transmitting limited instructions to the machines.

3.3 lifting operation

A movement that changes the vertical height of a load consisting of goods and/or personnel at a specific time.

3.4 exposed person

A person who is fully or partially located within a hazard zone.

3.5 operator

Personnel who operate or move a machine.

Note: The term “operator” as used in this document sometimes also includes personnel who install, dismantle, adjust, set up, inspect, maintain, clean and repair the machine.

3.6 driver

An operator responsible for moving a machine.

Note: A driver may control the travel of a machine while on board the machine, walking alongside it, or via remote control.

3.7 working tool

A detachable part or device on a machine that is directly used for construction or processing operations.

Note: Examples include cutting grinding wheels, drill bits, etc.

3.8 interchangeable equipment

A device that can be detached from and reattached to construction machinery and equipment or traction machinery, used to alter the functions of the machine or traction machinery or add new functions, and which is not classified as a working tool.

Note: Interchangeable equipment is assembled with the machine or traction machinery by the operator themselves.

3.9 interchangeable auxiliary equipment

A device that can be connected to construction machinery and equipment, agricultural machinery, earthmoving machinery or hoisting machinery for use in construction operations.

3.10 hold-to-run control device

A control device that only triggers and maintains machine functions while the manual control device (actuator/operator/executor/actuator) is being actuated.

[Source: GB/T 15706-2012, 3.28.3, with modifications]

4 Basic Safety Requirements

4.1 General Provisions

4.1.1 General Requirements

4.1.1.1 Construction machinery and equipment (hereinafter referred to as "machines") shall be designed and manufactured to be fit for their intended functions, and shall not pose risks to personnel during operation, adjustment, inspection and maintenance under foreseeable conditions and reasonably foreseeable misuse.

For any hazards arising at different phases of the machine's intended service life, protective measures shall be adopted to eliminate or reduce the associated risks, including the phases of transportation, installation, dismantling, operation, decommissioning and disposal.

Note 1: Chapter 5 of GB/T 15706-2012 specifies the principles of risk assessment, and its Annex B provides examples of hazards, hazardous situations and hazardous events.

Note 2: GB/T 16856 describes a number of practical application methods suitable for each phase of risk assessment.

4.1.1.2 Protective measures for eliminating hazards or reducing hazard-related risks shall be implemented in the following sequence: intrinsically safe design and manufacturing measures, safety guards and/or supplementary protective measures, and operating information.

Note 1: Intrinsically safe design and manufacturing measures refer to protective measures that eliminate hazards or reduce associated risks by modifying the design or operational characteristics of the machine, rather than by using guards or protective devices. This is the first and most critical step in the risk reduction process.

Where it is not feasible to eliminate hazards or sufficiently reduce associated risks by means of intrinsically safe design and manufacturing measures, taking into account intended use and reasonably foreseeable misuse, appropriately selected safety guards and supplementary protective measures may be adopted to reduce risks. See Clause 4.4 for safety guards and supplementary protective measures.

If residual risks still exist despite the adoption of intrinsically safe design and manufacturing measures, safety guards and supplementary protective measures, such residual risks shall be clearly specified in the operating

information. The operating information shall include, but not be limited to, the following content:

— Machine operating procedures that match the expected competence level of machine operators or other exposed personnel;

— Detailed descriptions of recommended safe machine operation methods and relevant training requirements;

— Sufficient information including warnings of residual risks at different phases of the machine's service life;

— Descriptions of recommended personal protective equipment (PPE), including detailed information on its necessity and the training required for its use.

Note 2: Terms and equipping specifications for personal protective equipment are specified in GB/T 12903 and GB 39800.1.

Operating information shall not be used as a substitute for the proper application of intrinsically safe design and manufacturing measures, safety guards or supplementary protective measures.

See Clause 4.7 for operating information.

4.1.1.3 Where a machine uses agricultural machinery, earthmoving machinery, hoisting machinery or other mechanical equipment as its host machine, such host machine shall comply not only with its respective standards but also with the provisions of this document.

4.1.2 Materials and Products Produced by Machines

Materials used by the machine (including those used during machine operation) and products produced by the machine shall not endanger the safety and health of personnel. In particular, when fluids are used, the machine shall be designed and manufactured to prevent risks arising from their addition, use, recovery or discharge.

For this purpose, the properties of materials used by and products produced by the machine shall be taken into consideration, such as toxicity, hazardous substances and radiation.

Note: GB/T 26546 provides an environmental impact table for certain materials used in machines.

4.1.3 Lighting

4.1.3.1 If insufficient lighting may give rise to risks, the machine shall be equipped with adequate lighting suitable for the relevant operations, regardless of the ambient illumination level.

4.1.3.2 For areas of internal components requiring frequent inspection, adjustment and maintenance, suitable lighting shall be provided, or a reminder to use suitable lighting shall be included in the instruction manuals.

4.1.3.3 Lighting shall not produce flicker, glare, shadows or stroboscopic effects that could lead to risks. If it is necessary to adjust the light source or its orientation, the light source shall be positioned such that it does not pose any risks to the person making the adjustment.

4.1.4 Design for Facilitating Handling

4.1.4.1 A machine or each of its components shall satisfy the following two conditions:

— Be capable of being handled and transported safely;

— Be packaged or designed to ensure safe storage without damage.

4.1.4.2 If the weight, dimensions or shape of a machine or its components hinder manual handling, the machine or its components shall meet one of the following conditions:

— Be equipped with lifting devices or accessories for lifting devices (e.g., slings, lifting eyes, etc.);

— Be designed to allow installation of the aforementioned lifting devices or accessories;

— Have a shape that facilitates the use of standard lifting devices.

4.1.4.3 If a machine or any of its components requires manual handling, it shall meet one of the following conditions:

— Be easy to move;

— Be equipped with features suitable for safe lifting and movement.

4.1.4.4 Where handling of working tools and/or machine components involves hazards, special arrangements for their placement and layout shall be made even if they are lightweight.

4.1.4.5 During transportation of a machine or its components, no sudden movement or instability hazards shall occur provided that the machine or its components are handled in accordance with the instruction manual. For additional requirements related to stability, see 4.3.1.

4.1.5 Ergonomics

4.1.5.1 Machines shall be designed in compliance with ergonomic principles to reduce the psychological and physical stress and fatigue on operators.

4.1.5.2 Due consideration shall be given to the appropriate body dimensions, strength, postures, movement ranges and motion repetition frequencies of the intended user group of the machine.

4.1.5.3 All elements of the human-machine interface, e.g., controls, signals or data display elements, shall be designed to be easily understandable, to enable clear and unambiguous interaction between the operator and the machine.

Note: For the application of visual, auditory and tactile signals as well as ergonomic principles in risk assessment and risk reduction, refer to GB/T 18209.1 and GB/T 36954.

4.1.5.4 When designing a machine, the designer shall pay special attention to the following ergonomic requirements:

a) Avoid the need for operators to adopt strained postures and movements during machine operation (e.g., provide facilities to adjust the machine to suit different operators);

b) The design of the machine, especially hand-held and mobile machines, shall take into account the limits of human physical capacity, the operation of control devices, and the anatomical structure of the human hands, arms and legs, to ensure ease of operation;

c) Minimize noise, vibration and thermal effects (e.g., extreme temperatures) as much as possible;

d) Avoid linking the operator’s work rhythm to the automatic continuous cycle of the machine.

For additional requirements related to lighting and control devices, see 4.1.3 and 4.2.2.

4.1.6 Operating Positions

4.1.6.1 Operating positions shall be designed and manufactured to avoid any risks arising from exhaust gas or oxygen

deficiency.

4.1.6.2 If the machine is intended for use in hazardous environments that pose risks to the health and safety of operators, or if the machine itself generates hazardous environments, adequate measures shall be provided to ensure good working conditions for operators and protect them from any foreseeable hazards.

4.1.6.3 If working conditions and space permit and no additional risks are introduced, operating positions shall be located in a suitable operator compartment where possible. The operator compartment shall be designed, manufactured or equipped to meet the requirements of 4.1.6.1 and 4.1.6.2. Exits of the operator compartment shall allow for rapid evacuation by operators. For additional requirements related to lighting, ergonomics and control devices, see 4.1.3, 4.1.5 and 4.2.2.

4.1.7 Operator Seats

4.1.7.1 If working conditions and space permit and no additional risks are introduced, operating positions that form an integral part of the machine shall be designed to accommodate the installation of seats.

4.1.7.2 If operators are intended to work in a seated position during operation, and the operating position is an integral part of the machine, a seat shall be supplied together with the machine.

4.1.7.3 The operator’s seat shall enable the operator to maintain a stable posture. The seat and its distance from the control devices shall be adaptable to the operator.

4.1.7.4 If the machine is subject to vibration, the seat shall be designed and manufactured to reduce the vibration transmitted to the operator to the lowest level reasonably practicable. The seat supports and mounting components shall be capable of withstanding all stresses they may be subjected to. If the operator’s feet cannot rest on the floor, an anti-slip footrest shall be provided.