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Building construction machinery and equipment — Mobile crushers —

Part 2: Safety requirements

Machines et matériels pour la construction des bâtiments — Concasseurs mobiles —

Partie 2: Exigences de sécurité

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 21873-2 was prepared by Technical Committee ISO/TC 195, *Building construction machinery and equipment*.

ISO 21873 consists of the following parts, under the general title *Building construction machinery and equipment — Mobile crushers*:

— *Part 1: Terminology and commercial specifications*

— *Part 2: Safety requirements*

Introduction

This document is a type-C standard as stated in ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the Scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or -B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

Building construction machinery and equipment — Mobile crushers —

Part 2: Safety requirements

1 Scope

This part of ISO 21873 establishes the safety requirements for mobile crushers, as defined in ISO 21873-1, used in the building construction industry for crushing concrete debris and stones.

It deals with all the significant hazards, hazardous situations and events relevant to mobile crushers when used as intended and under the conditions foreseen by the manufacturer (see Clause 4).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2860, *Earth-moving machinery — Minimum access dimensions*

ISO 2867, *Earth-moving machinery — Access systems*

ISO 3457, *Earth-moving machinery — Guards — Definitions and requirements*

ISO 3744:1994, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane*

ISO 3795, *Road vehicles, and tractors and machinery for agriculture and forestry — Determination of burning behaviour of interior materials*

ISO 4413, *Hydraulic fluid power — General rules relating to systems*

ISO 4414, *Pneumatic fluid power — General rules relating to systems*

ISO 6011:2003, *Earth-moving machinery — Visual display of machine operation*

ISO 6395, *Acoustics — Measurement of exterior noise emitted by earth-moving machinery — Dynamic test conditions*

ISO 6405-1, *Earth-moving machinery — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 6750, *Earth-moving machinery — Operator's manual — Content and format*

ISO 9244, *Earth-moving machinery — Machine safety labels — General principles*

ISO 9247, *Earth-moving machinery — Electrical wires and cables — Principles of identification and marking*

ISO 9533, *Earth-moving machinery — Machine-mounted forward and reverse audible warning alarm — Sound test method*

ISO 10264, *Earth-moving machinery — Key-locked starting systems*

ISO 10265, *Earth-moving machinery — Crawler machines — Performance requirements and test procedures for braking systems*

ISO 10533, *Earth-moving machinery — Lift-arm support devices*

ISO 10968, *Earth-moving machinery — Operator's controls*

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

ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles*

ISO 12508, *Earth-moving machinery — Operator station and maintenance areas — Bluntness of edges*

ISO 13333, *Earth-moving machinery — Dumper body support and operator's cab tilt support devices*

ISO 13766, *Earth-moving machinery — Electromagnetic compatibility*

ISO 13850, *Safety of machinery — Emergency stop — Principles for design*

ISO 14120, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 14122-3, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*

ISO 15817:2005, *Earth-moving machinery — Safety requirements for remote operator control*

ISO 15818, *Earth-moving machinery — Lifting and tying-down attachment points — Performance requirements*

ISO 15998, *Earth-moving machinery — Machine control systems (MCS) using electronic components — Performance criteria and tests for functional safety*

ISO 21507, *Earth-moving machinery — Performance requirements for non-metallic fuel tanks*

ISO 21873-1:2008, *Building construction machinery and equipment — Mobile crushers — Part 1: Terminology and commercial specifications*

IEC 60204-1, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100-1 and ISO 21873-1 apply.

4 Safety requirements and/or protective measures

4.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause. In addition, the machine shall be designed according to the principles of ISO 12100 for relevant but not significant hazards which are not dealt with by this document.

Hazards not listed in Annex A but found by risk assessment shall be addressed in accordance with ISO 12100-1 and ISO 12100-2 to reduce the hazard to an acceptable level.

Hazards identified as being “significant” by risk assessment require action to eliminate or reduce the risk. Risk assessment should be performed using the principles and methods given in ISO 14121-1 and ISO/TR 14121-2.

4.2 Access

Appropriate access systems, which shall be in accordance with ISO 2867, shall be provided at the operator's station and in areas where routine maintenance is to be performed.

4.3 Operator's station

4.3.1 General

If the travel and working controls are in different locations, the requirements of this part of ISO 21873 shall be met at each location.

4.3.2 Moving parts

Measures shall be taken to avoid accidental contact with moving parts from the operating station. This includes working equipment, attachments, and tracks (if so equipped).

4.3.3 Engine exhaust

The engine exhaust system shall release the exhaust gas away from the operator.

4.3.4 Sharp edges

The operator's working space within the operator's station, e.g. instrument panels and access to the operator's station, shall not present any sharp edges or acute angles/corners. The radius of corners and bluntness of edges shall comply with ISO 12508 to avoid sharp edges.

4.3.5 Pipes and hoses

Pipes and hoses shall be guarded in accordance with 4.19.2.

4.3.6 Construction

For self-propelled mobile crushers equipped with an operator station, all handrails shall be constructed in accordance with ISO 2867. Especially for travel, the operator station shall be large enough to prevent injury to the operator during travel over irregular surfaces. It shall include provisions for stopping the operator from falling on, or being ejected from, the machine and allowing the operator to maintain control when travelling over irregular surfaces. The operator station shall be provided with a ROPS (roll over protective structure) if there is a risk of the machine rolling over, or FOPS (falling object protective structure) if there is a risk from falling objects.

4.4 Visibility

4.4.1 Operator's field of view

If an operator's station is mounted on the machine, it shall be designed to provide sufficient visibility for the intended operation of the equipment.

4.4.2 Lighting

Machines shall be equipped with lighting devices for travel only. If required, illumination for operation should be provided by surrounding light sources. This shall be noted in the operator's manual.

4.5 Controls and indicators

4.5.1 General

Self-propelled mobile crushers equipped with an operator station for travel shall have the controls located, designed and manufactured in accordance with ISO 10968.

A mobile crusher shall be equipped with components to allow isolation of the main power source (lockout/tag-out of the machine). This can be accomplished by providing a locking battery disconnect and/or e-stop switch. These lockout/tag-out provisions shall be noted in the operator's manual.

The controls shall include a pre-start warning alerting that a function is about to start in case the operator cannot verify that personnel are clear of all hazard zones from any control position. An acoustic and/or visual warning signal shall be activated prior to the start of a function for a duration sufficient to allow personnel to leave the hazard zone.

Remote controls used for machine travel and operation shall comply with ISO 15817.

The remote control shall

a) provide neutral control positions in accordance with ISO 10968, and

b) identify each control and explain it in the operator's manual (see ISO 6405-1 and ISO 7000).

4.5.2 Emergency stop

Self-propelled mobile crushers equipped with an operator station for travel shall have an emergency stop conforming to ISO 13850 located in close proximity to the travel controls.

All mobile crushers shall have at least one emergency stop mounted on each side of the machine that is accessible while standing on the ground. Emergency stops shall not be located such that personnel have to enter a hazard zone in order for them to be activated. Emergency stops shall have a provision for isolating the main energy source (lockout provisions), if no other lockout provisions are provided on the machine.

4.5.3 Starting systems

Mobile crushers equipped with an on-board power supply (e.g. diesel engine) shall be equipped with a starting system that complies with ISO 10264.

4.5.4 Inadvertent activation

Controls shall be located, deactivated or guarded so as to minimize the risk of inadvertent activation when the operator enters or exits the operator station or operating position within the operator station.

Controls shall be placed automatically in a neutral (or safe) starting condition when the mobile crusher is shut down so as to prevent accidental activation at re-start.

Where there is more than one control position, the control system shall be designed such that one control position will preclude the use of controls in other positions. This does not include stop controls or emergency stops.

4.5.5 Uncontrolled motion

Controls for machine functions shall be designed to limit movement from the holding position unless activated by the operator. Motion due to drift or creep shall be limited so that it will not create a risk to exposed personnel. This shall apply whether the power supply is working or stopped.

4.5.6 Control panels, instrument and symbols

4.5.6.1 Control panels

Control panels for self-propelled mobile crushers equipped with plant-mounted operator stations shall be located to minimize visual obstructions. Switches, instruments and indicator lights on plant-mounted panels shall be designed for visibility in low light conditions. The colour of switches shall comply with IEC 60204-1.

4.5.6.2 Operating instrumentation

Control indicators for proper operation shall comply with ISO 6011.

4.5.6.3 Symbols

Symbols for use on operator controls and other displays shall be in accordance with ISO 6405-1 or ISO 7000.

4.6 Steering systems

The steering system shall be such that the movement of the steering control corresponds to the intended direction of steering.

4.7 Brake systems

Wheel-mounted, self-propelled and towed mobile crushers shall be equipped with service, emergency, and parking brake systems.

Self-propelled mobile crushers equipped with tracks shall be provided with service and parking brake systems.

The service brakes for track-mounted mobile crushers shall be individually controlled, one for each track, and may be combined with the steering system.

All systems shall be designed to perform adequately under all intended service conditions, including load, speed, terrain and slope.

Brake systems for track-mounted mobile crushers shall comply with ISO 10265.

The parking brakes shall be of a size sufficient to withstand the maximum tractive effort of the drive system without damage.

4.8 Feeding units (hopper, feeder)

If a platform is mounted in close proximity to the feed device, a guard shall be provided to prevent the operator from falling into the feed device. The minimum height of the guard is to be 1,1 m above the walking surface of the platform. If a handrail is used as a guard, it shall conform to ISO 14122-3. An emergency stop device shall be mounted with easy access for personnel standing on the platform facing the crusher and/or feed device. The emergency stop device shall be as specified in 4.5.2. A guard shall be provided to protect the operator from material ejected from the crusher. Parts transmitting power to the feed device (flywheels, drive belts, etc.) shall be guarded. If inspection openings are added to drive guards, they shall be enclosed by a cover that is keyed or requires the use of tools to open.

The following shall be noted in the operator's manual.

— “Stop the feed device, shut down power to the machine and lockout/tag-out the energy sources before entering the feed device for any reason.” This should also be indicated by the use of a machine safety label affixed to the equipment.

— “Stand clear of the feed hopper to avoid injury due to falling material.” This should also be indicated by the use of a machine safety label affixed to the equipment.

— Location of pinch points that can cause injury, with particular mention of the surging action of a vibratory feeder when started and stopped. Pinch points should also be indicated by the use of a machine safety label affixed to the equipment.

— “Stop equipment and shut down power to the machine and lockout/tag-out the energy sources before performing any maintenance on the equipment.” This should also be indicated by the use of a machine safety label affixed to the equipment.

— “All guards shall be in place before starting the feeder.” This should also be indicated by the use of a machine safety label affixed to the equipment.

4.9 Crushing units

4.9.1 Operator's manual

The following shall be included in the operator's manual:

— the types of material the crusher is intended to process;

— the maximum feed size for material fed to crusher;

— a procedure for safely removing blockages and foreseen risks associated with the particular activity (see Annex C).

The operator's manual shall also indicate the proper set-up, operation and maintenance of the guards for the crushing units specified in 4.9.2 to 4.9.6.

See below for indications specific to a crushing unit that are also to be included in the operator's manual.

4.9.2 Guard on feed opening

The feed opening of the crusher shall be provided with a guard to minimize hazards caused by ejected material.