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Earth-moving machinery — Safety —

Part 1: General requirements

Engins de terrassement — Sécurité —

Partie 1: Sécurité

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html

This document was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 2, *Safety, ergonomics and general requirements*.

This second edition cancels and replaces the first edition (ISO 20474-1:2008), which has been technically revised with the following changes:

— normative references have been updated;

— references to national and regional provisions in the withdrawn ISO/TS 20474-14 have been deleted;

— new safety requirements and protective measures have been added, including the normative annexes, requirements for elevating operator's stations, for lifting devices used in object handling and for earth-moving machinery used underground in non-explosive atmospheres.

It is intended to be used in conjunction with the other parts of ISO 20474.

A list of all parts in the ISO 20474 series, published under the general title, *Earth-moving machinery — Safety,* can be found on the ISO website.

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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.

ISO 20474 provides acceptable safety requirements for earth-moving machinery. This standard does not necessarily provide requirements to meet all national and regional regulatory provisions, e.g. Japan does not allow object handling with earth-moving machinery.

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Earth-moving machinery — Safety —

Part 1: General requirements

1 Scope

This document specifies the general safety requirements for earth-moving machinery as defined in ISO 6165, each of these requirements being common to two or more earth-moving machine families. It is also applicable to machine attachments, and to derivative machinery designed primarily for equipment used to excavate, load, transport, drill, spread, compact or trench earth, rock, and other materials.

It is intended to be used in conjunction with the other parts of ISO 20474, which give the provisions that are specific to particular machine families. Those specific requirements take precedence over the requirements of this document for the machines concerned. For multipurpose machinery, all of those parts of ISO 20474 whose requirements cover the functions and applications of such machines are applicable.

EXAMPLE For a compact loader also used as a trencher, the relevant requirements of ISO 20474-1, ISO 20474-3 and ISO 20474-10 are applicable.

This document deals with all significant hazards, hazardous situations and events relevant to the earth-moving machinery within its scope (see Annex A) when used as intended or under conditions of misuse reasonably foreseeable by the manufacturer. It specifies the appropriate technical measures for eliminating or reducing risks arising from relevant hazards, hazardous situations or events during commissioning, operation and maintenance.

Specific requirements related to autonomous machines are covered in ISO 17757.

This document is not applicable to machines manufactured before the date of its publication.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3164, *Earth-moving machinery — Laboratory evaluations of protective structures — Specifications for deflection-limiting volume*

ISO 3411:2007, *Earth-moving machinery — Physical dimensions of operators and minimum operator space envelope*

ISO 3449, *Earth-moving machinery — Falling-object protective structures — Laboratory tests and performance requirements*

ISO 3450, *Earth-moving machinery — Wheeled or high-speed rubber-tracked machines — Performance requirements and test procedures for brake systems*

ISO 3457:2003, *Earth-moving machinery — Guards — Definitions and requirements*

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ISO 3471:2008, *Earth-moving machinery — Roll-over protective structures — Laboratory tests and performance requirements*

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

ISO 3864-1, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 3864-2, *Graphical symbols — Safety colours and safety signs — Part 2: Design principles for product safety labels*

ISO 4250-3, *Earth-mover tyres and rims — Part 3: Rims*

ISO 4413, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 4871, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 5006, *Earth-moving machinery — Operator's field of view — Test method and performance criteria*

ISO 5010, *Earth-moving machinery — Rubber-tyred machines — Steering requirements*

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

ISO 6014, *Earth-moving machinery — Determination of ground speed*

ISO 6165, *Earth-moving machinery — Basic types — Identification and terms and definitions*

ISO 6395, *Earth-moving machinery — Determination of sound power level — Dynamic test conditions*

ISO 6396, *Earth-moving machinery — Determination of emission sound pressure level at operator's position — Dynamic test conditions*

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

ISO 6405-2, *Earth-moving machinery — Symbols for operator controls and other displays — Part 2: Specific symbols for machines, equipment and accessories*

ISO 6682, *Earth-moving machinery — Zones of comfort and reach for controls*

ISO 6683, *Earth-moving machinery — Seat belts and seat belt anchorages — Performance requirements and tests*

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

ISO 7096:2000, *Earth-moving machinery — Laboratory evaluation of operator seat vibration*

ISO 8643, *Earth-moving machinery — Hydraulic excavator and backhoe loader boom-lowering control device — Requirements and tests*

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

ISO 9533, *Earth-moving machinery — Machine-mounted audible travel alarms and forward horns — Test methods and performance criteria*

ISO 10263-2, *Earth-moving machinery — Operator enclosure environment — Part 2: Air filter element test method*

ISO 10263-3, *Earth-moving machinery — Operator enclosure environment — Part 3: Pressurization test method*

ISO 10263-4:2009, *Earth-moving machinery — Operator enclosure environment — Part 4: Heating, ventilating and air conditioning (HVAC) test method and performance*

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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 10532, *Earth-moving machinery — Machine-mounted retrieval device — Performance requirements*

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

ISO 10570, *Earth-moving machinery — Articulated frame lock — Performance requirements*

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

ISO 11112:1995, *Earth-moving machinery — Operator's seat — Dimensions and requirements*

ISO 11862, *Earth-moving machinery — Auxiliary starting aid electrical connector*

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

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

ISO 12509, *Earth-moving machinery — Lighting, signalling and marking lights, and reflex-reflector devices*

ISO 12509:2004, *Earth-moving machinery — Lighting, signalling and marking lights, and reflex-reflector devices*

ISO 13031, *Earth-moving machinery — Quick couplers — Safety*

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

ISO 13459, *Earth-moving machinery — Trainer seat — Deflection limiting volume, space envelope and performance requirements*

ISO 13766 (all parts), *Earth-moving machinery — Electromagnetic compatibility*

ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13857, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14401-1, *Earth-moving machinery — Field of vision of surveillance and rear-view mirrors — Part 1: Test methods*

ISO 14401-2, *Earth-moving machinery — Field of vision of surveillance and rear-view mirrors — Part 2: Performance criteria*

ISO 14990-1, *Earth-moving machinery — Electrical safety of machines utilizing electric drives and related components and systems — Part 1: General requirements*

ISO 14990-2, *Earth-moving machinery — Electrical safety of machines utilizing electric drives and related components and systems — Part 2: Particular requirements for externally-powered machines*

ISO 14990-3, *Earth-moving machinery — Electrical safety of machines utilizing electric drives and related components and systems — Part 3: Particular requirements for self-powered machines*

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

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*

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ISO 16001, *Earth-moving machinery — Object detection systems and visibility aids – Performance requirements and tests*

ISO 16528-1, *Boilers and pressure vessels — Part 1: Performance requirements*

ISO 16528-2, *Boilers and pressure vessels — Part 2: Procedures for fulfilling the requirements of ISO 16528-1*

ISO 17063, *Earth-moving machinery — Braking systems of pedestrian-controlled machines — Performance requirements and test procedures*

ISO 19014-1[1)], *Earth-moving machinery — Safety — Part 1: Methodology to determine safety-related parts of the control system and performance requirements*

ISO 19014-3[1)], *Earth-moving machinery — Safety — Part 3: Environmental performance and test requirements of electronic and electrical components used in safety-related parts of the control system*

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

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

EN 1677-2:2000+A1:2008, *Components for slings — Safety — Part 2: Forged steel lifting hooks with latch, Grade 8*

EN 1679-1, *Reciprocating internal combustion engines — Safety — Part 1: Compression ignition engines*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100 and ISO 6165, and the following, apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
earth-moving machinery
self-propelled or towed machine on wheels, crawlers or legs, having *equipment* (3.3) or *attachment* (3.2), or both, primarily designed to perform excavation, loading, transportation, drilling, spreading, compacting or trenching of earth, rock and other materials

Note 1 to entry: Earth-moving machinery can be of a type either directly controlled by an operator riding or not riding on the machine, or can be remotely controlled by wired or wireless means with or without direct view on the working area

[SOURCE: ISO 6165:2012, 3.1]

3.1.1
compact machine
earth-moving machinery (3.1), except for compact excavators and compact loaders, having an *operating mass* (3.8) of 4 500 kg or less

[SOURCE: ISO 6165:2012, 3.1.1]

1) Under preparation.

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3.1.2
derivative earth-moving machinery
earth-moving machinery (3.1) that is a combination of features from other earth-moving machine families, creating a different configuration or arrangement

EXAMPLE Machine having the front-mounted equipment of a loader and a non-self-loading, rear-mounted dumper body.

[SOURCE: ISO 6165:2012, 3.11.1]

3.2
attachment
working tool
assembly of components that can be mounted onto the *base machine* (3.15) or *equipment* (3.3) for specific use

[SOURCE: ISO 6746-2:2003, 3.5]

3.3
equipment
set of components mounted onto the *base machine* (3.15) that allows an *attachment* (3.2) to perform the primary design function of the machine

[SOURCE: ISO 6746-2:2003, 3.4]

3.4
quick coupler
quick hitch
attachment bracket
device mounted on the *earth-moving machinery* (3.1) to allow the quick interchange of *attachments* (3.2)

[SOURCE: ISO 13031:2016, 3.1]

3.5
object handling
application of *earth-moving machinery* (3.1) comprising lifting, lowering and transporting of a load by use of lifting accessories, whereby the assistance of a person or the operator of the machine is required for hooking, unhooking or stabilizing (while transporting) the load

Note 1 to entry: If the load is picked up by a self-acting device and no assistance of a person is required for hooking, unhooking and stabilizing the load, this work is considered as a usual earth-moving application.

Note 2 to entry: Lifting accessories include wire ropes, chains or textile straps; loads in object handling applications include pipes and vessels; examples of self-acting devices are grabs, clamshell buckets, log clamps, vacuum lifting devices, magnetic plates and forks.

3.6
maximum rated operating capacity
maximum rated lift capacity
<object handling> maximum load which can be lifted in at least one position of the working range as specified by the manufacturer (e.g. on the rated object handling capacity table) in the most stable configuration (such as with outriggers down)

Note 1 to entry: A definition of *rated operating capacity* for loaders given in ISO 14397-1 is used in ISO 20474-3 and ISO 20474-4.

Note 2 to entry: *Rated lift capacity* forms the subject of ISO 10567 and is the term used in ISO 20474-5.

3.7
routine maintenance
maintenance that is specified in the periodic maintenance schedule of the operator's manual for performing scheduled daily/weekly/monthly maintenance on the machine

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3.8
operating mass
mass of the *base machine* (3.15), with *equipment* (3.3) and empty *attachment* (3.2) in the most usual configuration as specified by the manufacturer, and with the operator (75 kg), full fuel tank and all fluid systems (i.e. hydraulic oil, transmission oil, engine oil, engine coolant) at the levels specified by the manufacturer and, when applicable, with sprinkler water tank(s) half full

[SOURCE: ISO 6016:2008, 3.2.1, modified — Notes to the definition have not been included.]

3.9
relevant hazard
hazard which is identified as being present at, or associated with, the machine

[SOURCE: ISO 12100:2010, 3.7]

3.10
significant hazard
hazard which has been identified as relevant and which requires specific action by the designer to eliminate or to reduce the risk according to the risk assessment

[SOURCE: ISO 12100:2010, 3.8]

3.11
lifting device
device fixed or incorporated to the *attachment/working tool* (3.2) or *equipment* (3.3) of the *earth-moving machinery* (3.1) used for object handling, excluding *attachable hook* (3.14)

3.12
sling
assembly of slinging components, e.g. chain, wire rope or textile material, joined to upper or lower terminals suitable for attaching loads to the lifting point

3.13
rated lifting load
RLL
maximum mass for which the *lifting device* (3.11) is designed

Note 1 to entry: The RLL can be different from the rated operating capacity/lift capacity of the machine.

3.14
attachable hook
component intended to be fixed to the *attachment* (3.2) (working tool) or the *equipment* (3.3) of the *earth-moving machinery* (3.1), either welded or bolted

3.15
base machine
earth-moving machinery (3.1) with a cab or canopy and operator protective structures if required, without *equipment* (3.3) or *attachments* (3.2) but possessing the necessary mountings for such *equipment* (3.3) and *attachments* (3.2)

[SOURCE: ISO 6016:2008, 3.1.1]

4 Safety requirements and protective measures

4.1 General

Machinery shall comply with the safety requirements of this clause, in as far as those are not modified by the specific requirements of another part of ISO 20474.

In addition, the machine shall be designed according to the principles of ISO 12100.

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