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Earth-moving machinery — Functional safety —

Part 3: Environmental performance and test requirements of electronic and electrical components used in safety-related parts of the control system

Engins de terrassement — Sécurité fonctionnelle —

Partie 3: Exigences pour la performance environnementale et l'essai des composants électroniques et électriques utilisés dans les parties du système de commande relatives à la 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 document 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).

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This document was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 2, *Safety, ergonomics and general requirements,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 151, *Construction equipment and building material machines - Safety,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 19014-3:2018), which has been technically revised.

The main changes are as follows:

— addition of information for use;

— addition of functional status “Class E”;

— correction of typographical error “IPXK6” to “IPX6K”.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document addresses electronic and electrical systems used for functional safety in earth-moving machinery.

The structure of safety standards in the field of machinery is as follows.

Type-A standards (basic standards) give basic concepts, principles for design and general aspects that can be applied to machinery.

Type-B standards (generic safety standards) deal with one or more safety aspects, or one or more types of safeguards that can be used across a wide range of machinery.

— Type-B1 standards on particular safety aspects (e.g. safety distances, surface temperature, noise).

— Type-B2 standards on safeguards (e.g. two-hands controls, interlocking devices, pressure sensitive devices, guards).

Type-C standards (machinery safety standards) deal with detailed safety requirements for a particular machine or group of machines.

This document is a type-C standard as stated in ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance etc.).

Others can be affected by the level of machinery safety achieved in accordance with this document:

— machine users and employers (small, medium and large enterprises);

— machine users and employees (e.g. trade unions, organizations for people with special needs);

— service providers, e. g. for maintenance (small, medium and large enterprises);

— consumers (in case of machinery intended for use by consumers);

— component manufacturers.

The above-mentioned stakeholder groups have been given the possibility to participate in the drafting process of this document.

The machinery concerned and the extent to which hazards 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 type-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.

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Earth-moving machinery — Functional safety —

Part 3: Environmental performance and test requirements of electronic and electrical components used in safety-related parts of the control system

1 Scope

This document specifies the minimum requirements for environmental testing of electronic and electrical components identified as safety-related parts of the control system (SRP/CS) used on earth-moving machinery as defined in ISO 6165:2022.

To cover all the relevant safety requirements for the products in its scope, this document is used in combination with ISO 19014-1:2026, ISO 19014-2:2026, ISO 19014-4:2026, and ISO 19014-5:2026.

This document does not address explosion proofing.

NOTE National or regional requirements can apply. For information about explosion proofing, see the IEC 60079 series.

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 6165:2022, *Earth-moving machinery — Basic types — Identification and vocabulary*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13766-1:2018, *Earth-moving and building construction machinery — Electromagnetic compatibility (EMC) of machines with internal electrical power supply — Part 1: General EMC requirements under typical electromagnetic environmental conditions*

ISO 13766-2:2018, *Earth-moving and building construction machinery — Electromagnetic compatibility (EMC) of machines with internal electrical power supply — Part 2: Additional EMC requirements for functional safety*

ISO 16750-2:2023, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 2: Electrical loads*

ISO 16750-5:2023, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 5: Chemical loads*

ISO 19014-1:2026, *Earth-moving machinery — Safety — Part 1: Risk assessment methodology to determine control system performance requirements*

ISO 20653:2023, *Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access*

IEC 60068-2-1:2007, *Basic environmental testing procedures — Part 2: Tests — Test A: Cold*

IEC 60068-2-2:2007, *Basic environmental testing procedures — Part 2: Tests — Test B: Dry heat*

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IEC 60068-2-11:2021, *Basic environmental testing procedures — Part 2: Tests — Test Ka: Salt mist*

IEC 60068-2-14:2023, *Environmental testing — Part 2: Tests — Test N: Change of temperature*

IEC 60068-2-27:2008, *Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock*

IEC 60068-2-38:2021, *Environmental testing — Part 2-38: Tests — Test Z/AD: Composite temperature/humidity cyclic test*

IEC 60068-2-52:2017, *Environmental testing — Part 2-52: Tests — Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-64:2008, *Environmental testing — Part 2-64: Tests — Test Fh: Vibration, broadband random and guidance*

IEC 60529:1989+AMD1:1999, *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 6165:2022, ISO 19014-1:2026 and the following apply.

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

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

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

3.1
life cycle
time between commissioning and decommissioning of a component

4 Information for use

Limits of machine use, notable assumptions or examples of machine abuse considered in this document shall be communicated in the information for use in accordance with ISO 19014-2:2026, Clause 8 and ISO 12100:2010, 6.4 and 6.4.5.

5 Functional status classifications

5.1 Class A

All safety functions of the device under test (DUT) perform as designed during and after the test.

5.2 Class B

All safety functions of the DUT perform as designed during the test. The DUT may perform outside of the designed tolerance during the test; however, all functions shall automatically return within the specified tolerance after the test. Memory functions shall remain class A.

The functions of the DUT that are required to perform as designed during the test, and the functions that are permitted to perform beyond the specified tolerance, shall be specified by the machine manufacturer.

5.3 Class C

For DUTs that are powered and monitored, one or more safety functions of a DUT do not perform as designed during the test but return automatically to normal operation after the test.

For DUTs that are not powered and monitored, the DUT performs as designed after the test.

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