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Agricultural and forestry machinery — Electromagnetic compatibility —

Part 2: Additional EMC requirements for functional safety

Machines agricoles et forestières — Compatibilité électromagnétique —

Partie 2: Exigences CEM supplémentaires relatives à la sécurité fonctionnelle

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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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For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 2, *Common tests,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 144, *Agricultural machinery,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 2, *Common tests*.

This first edition of ISO 14982-2, together with ISO/FDIS 14982-1:—[1)], cancels and replaces ISO 14982:1998, which has been technically revised.

The main changes are as follows:

— the provisions have been brought up to date with technological change;

— normative references have been updated to the latest editions.

A list of all parts in the ISO 14982 series can be found on the ISO website.

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.

1) Under development. Stage at the date of publication: ISO/FDIS 14982-1:2025.

Introduction

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

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

— machine manufacturers;

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

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers;

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

— service providers, e.g. for maintenance;

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

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

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 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.

Agricultural and forestry machinery — Electromagnetic compatibility —

Part 2:
Additional EMC requirements for functional safety

1 Scope

This document specifies test methods and acceptance criteria for evaluating the electromagnetic compatibility of tractors, and all kinds of mobile (including hand-held) agricultural machinery, forestry machinery, landscaping, and gardening machinery [referred to hereafter as machine(s)] as supplied by the machine manufacturer. It is applicable to machines and electrical/electronic sub-assemblies (ESA's) which are manufactured after the date of publication of this document.

It specifies additional EMC requirements under aspect of functional safety for machinery, ESA and separate ESAs.

This document is only relevant for functions of machine control system failures which when risk assessed to the relevant ISO 25119 part (or the equivalent when other electronic functional safety standards are used), are greater than or equal to AgPLr b (or the equivalent).

Electrical and electronic components or separate ESAs intended to be used in the applicable machinery control functions are also dealt with by this document.

The following electromagnetic disturbance phenomena are evaluated:

— radiated electromagnetic field by off-board sources with various field strength and frequency;

— radiated electromagnetic field by portable transmitters (antenna inside/outside) with various field strength and frequency;

— electrical field (wire conducted electrical fields);

— electrostatic discharge.

Annex A provides additional information regarding the effects of life cycle and ageing on EMC performance.

Annex B provides additional information for performing the portable transmitter test.

This document is not applicable to machines directly supplied with low voltage current from public electrical mains.

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 10605, *Road vehicles — Test methods for electrical disturbances from electrostatic discharge*

ISO 11451-1:2015, *Road vehicles — Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 1: General principles and terminology*

ISO 11451-2:2015, *Road vehicles — Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 2: Off-vehicle radiation sources*

ISO 11451-4:2013, *Road vehicles — Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 4: Bulk current injection (BCI)*

ISO 11452-2:2019, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 2: Absorber-lined shielded enclosure*

ISO 11452-3:2016, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 3: Transverse electromagnetic (TEM) cell*

ISO 11452-4:2020, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 4: Harness excitation methods*

ISO 11452-5:2002, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 5: Stripline*

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

ISO/FDIS 14982-1:—[2)], *Agricultural and forestry machinery — Electromagnetic compatibility — Part 1: General EMC requirements*

ISO 25119-1:2018, *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems — Part 1: General principles for design and development*

ISO 25119-2:2019, *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems — Part 2: Concept phase*

3 Terms, definitions, and abbreviated terms

For the purposes of this document, the terms and definitions given in ISO 12100:2010 and ISO 14982-1:— apply.

ISO and IEC maintain terminological 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/

4 General principles

The EMC requirements defined in this document shall be evaluated in terms of their effect on the functional safety of the machine in order to represent to totality of all significant technically and known such phenomena.

The performance parameters linked to these EMC phenomena thereby represent the current generally known implemented technical performance measure (magnitude).

The user of this document shall test to the levels in Clause 5 to all functions with a greater than or equal to AgPLr b as defined in ISO 25119-2:2019 (or equivalent). The machine shall either maintain the function as intended by the manufacturer or to perform a changeover into the “safe state” as implied in ISO 25119-1:2018 (or equivalent).

If analysis or simulation is used as an alternative to testing in accordance with Clause 5, data proving that the machine changes to one of the defined states mentioned above shall be included in the test report or compliance statement of this document.

For ESA testing it is required to determine the machine level behavior of immunity failures for the device under test, such as a corrupted signal from a controller can cause a loss of braking or steering.

Safety related functions require compliance to ISO/FDIS 14982-1:— and this document.

2) Under development. Stage at the date of publication: ISO/FDIS 14982-1:2025.

5 EMC phenomena

With the increasing use of electronic devices in areas where agricultural and forestry machinery operates, there is a need to ensure that the machinery is provided with adequate immunity to electromagnetic disturbances.

The electrical and high frequency disturbances as described in this document refer to electromagnetic effects caused due to technical appliances (man-made effects). These effects generally can be considered as singular ones and additionally located and restricted to defined narrow areas.

While these effects on machinery cannot be considered as being general, their consequences on machinery still need to be considered. They might be generated within a large frequency range with different electrical characteristics or by conduction or radiation, and then imparted to other electrical/electronic devices and systems by conduction or radiation. Narrowband, and sometimes broadband, signals generated by sources of interference inside or outside the machinery may also be coupled in electrical/electronic systems and influence the normal function of electrical/electronic devices. These strong electromagnetic disturbances may cause systematic or "common cause" faults.

Electrostatic discharges are relevant to the machinery because control elements can be positioned outside the operator station where potential differences may emerge at contact points. Conducted transients in power supply wiring shall be considered because the machinery may contain open systems, in which several devices or components may be combined to complement machine functionality.

This document provides information on the kind and the level of effects as presently known. Indicative test methods and criteria may derive from these values, given that possible test levels acceptable for the machinery and, in the case of testing conducted on a voluntary basis, considering the unique characteristics and operating parameters of the machinery. However, the functions of the machinery are not evaluated by testing alone. Functional safety with respect to EMC phenomena can also be achieved by organizational measures on the job site where the machinery is located and in use.

Because the machinery has a number of systems that may consist of components that may be used on a variety of different machine types, the approach of defining "electrical/electronic sub-assemblies (ESA's) or separate technical units" for these components may be applied for the immunity and emissions test methods. This allows these components to be evaluated by comparable (or alternative) test methods in existing laboratory facilities consisting of specially equipped shielded rooms. When electrical/electronic sub-assembly tests are performed, it is necessary to consider, the additional effects imparted by the wiring systems used to connect the sub-assemblies to the machine.

Electrical/electronic/programmable electronic systems, intended for use as a safety-related part of a machine control system as defined in ISO 25119-1:2018 have a specification of intended functionality. If a disturbed function will become dangerous or not is sometimes unknown to the manufacturer of the electrical/electronic/programmable electronic systems because it depends on the future application in a safety-related system of the whole machine.

Testing according to this document is required to be performed so that the behaviour of the PES in that safety-related system can be demonstrated.

The following present known technically induced EMC phenomena and quantify these, indicating their typical values under the aspect of functional safety.

Compliance with the requirements of this document shall be proven by means of any one or a combination of:

— testing of the complete machine as per Clauses 6 and 7, or;

— testing safety relevant ESA as per Clauses 8, and 9, e.g.: if the availability of an immunity test site proves restrictive due to machine size, regional environmental conditions or legal requirements. Additional reasons for ESA only testing may include, new or updated ESA's, add on ESA's, optional configurations, or aftermarket ESA's.

If the entire machine is not tested, then the use of options b) and c) shall require a combination of the testing described, and sufficient analysis of the combined machine(s) and ESA(s) to ensure proper performance to this document, when combined.

a) The requirements of this document are deemed to be fulfilled for a complete machine when the requirements identified in Clauses 6 and 7 as applicable, are fulfilled. If the machine manufacturer has chosen this alternative, no routine tests of the electrical/electronic systems or ESA's are required.

b) The requirements of this document are deemed to be fulfilled if it is confirmed by the machine manufacturer that all electrical/electronic systems or ESA's fulfil the requirements identified in Clauses 8 and 9, and has been installed taking into account the recommended requirements of the ESA manufacturer and risk assessment by the system integrator.

c) The requirements of this document are deemed to be fulfilled for a machine meeting the requirements of Clauses 6 and 7, and in which an electrical / electronic system, ESA, tractor/towed implement, or other types of implement combinations, which also complies with Clauses 8 and 9, and has been installed taking into account the recommended requirements of the ESA manufacturer and risk assessment by the system integrator.

d) The requirements of this document are also deemed to be fulfilled when the machine has no such equipment for which an immunity or interference test is required. In this case, no tests are necessary.

Evaluations not restricted by the above may be made, however remaining gaps in the requirements shall be evaluated at the ESA level.

NOTE In most regions of the world, radiated immunity testing for large machines in open area test sites is legally prohibited. Below 3 GHz conducted testing methods are available as a substitute. Above 3 GHz there is no alternative to radiated immunity testing, and it is possible to perform the radiated immunity testing on ESA level in an anechoic chamber.

When testing the ESA, it is recommended that the integrity of the final system performing safety-related functions supports the overall safety requirements specification for the machine. See ISO 13849-2:2012, 4.1.

6 Specifications for the immunity of machines to electromagnetic radiation

6.1 Test method

Immunity testing shall be conducted utilizing the test principles outlined in ISO 11451-1:2015.

The position of the machine reference points shall take into account the diversity of the geometric arrangements of the machines to be tested. The determination of the reference point(s) and the operating mode(s) shall be machine-specific and noted in the test report.

The antenna may be positioned farther from the machine in order to increase the area of illumination provided the desired field strength at the reference point of the machine is achieved.

The EMC performance of headers, attachments and trailed machines (that are only operated by using a carrier machine) may be affected by the carrier machine and thus may be tested independently.

In a separate test, the header, attachment or trailed machine is operated and brought in the specified functional state, and subjected to the tests for machines with a suitable device which substitutes the carrier vehicle in the anechoic chamber.

All safety-relevant functions, with the corresponding operating modes and fail safe states shall be defined in the test plan.