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Agricultural machinery, tractors, and earth-moving machinery- — Safety of electrical and electronic components and systems operating at 32 V ~~DC~~ to 75- V DC and 21 V ~~AC~~ to 50- V AC

Matériel agricole, tracteurs et engins de terrassement — Sécurité des composants et systèmes électriques et électroniques fonctionnant sous 32 V à 75 V DC et 21 V à 50 V AC

~~*Élément introductif — Élément central — Élément complémentaire*~~

FDIS stage

Contents

Foreword ix
Introduction x
1 Scope 1
2 Normative references 2
3 Terms, definitions and abbreviated terms 3
3.1 Terms and definitions 3
3.2 Abbreviated terms 9
4 General requirements 10
4.1 V-model 10
4.2 Voltages 10
4.3 Environmental and operational requirements 11
4.4 Components and devices 11
5 Protection against electric shock hazards 11
5.1 Overview 11
5.2 General 11
5.2.1 Fundamental requirements 11
5.2.2 Determination of shock protection requirements 12
5.3 Protective measures 13
5.4 Basic protection 13
5.4.1 General 13
5.4.2 Basic insulation 13
5.4.3 Enclosures or barriers 13
5.4.4 Limitation of touch current or capacitive discharge energy 14
5.4.5 Limitation of voltage 14
5.5 Fault protection 15
5.5.1 General 15
5.5.2 PEPB 16
5.5.3 Automatic disconnection of power supply 21
5.5.4 Supplementary insulation 21
5.5.5 Basic protection between circuits 21
5.6 Enhanced protection 22
5.6.1 General 22
5.6.2 Reinforced insulation and protective separation between circuit 22
5.6.3 Protection by means of protective impedance and limited capacitive discharge energy 23
5.7 Equipment protective combinations 23
5.8 Separation of VC-A2- and VC-B1-systems from VC-B2 (and higher) systems 24
5.9 Protection against residual voltages 24
5.9.1 Basic protection 24
5.9.2 Protection by power supply disruption 25
5.10 Connector human contact 25
5.10.1 General 25
5.10.2 Mated non-enclosed connectors 25
5.10.3 Non-mated, non-enclosed connectors 26
5.10.4 Enclosed connectors 26
5.10.5 Tractor implement plug/socket combinations (or similar mobile machinery implement and attachment combinations) 26
5.11 Water depth 27

6 Wiring practices 27
6.1 Conductor and cable runs 27
6.2 Colour 28
6.3 Cable protection inside an enclosure 28
6.4 Power supply voltage differences 28

7 Overcurrent protection (OCP) 29
7.1 Overview 29
7.2 General 29
7.2.1 Transformers 29
7.2.2 Power converters 29
7.2.3 OCP implementation 29
7.2.4 Rating and setting of OCP 30
7.2.5 Placement of OCP 30
7.2.6 Protection via engine shutoff 30
7.3 Chassis faults/residual currents 30

8 Disconnection and connection 30
8.1 General disconnecting devices 30
8.2 Specifics of disconnecting 30
8.2.1 VC-B1 30
8.2.2 Power converter disconnects 31
8.2.3 Manually actuated disconnecting devices 31
8.2.4 Disconnecting multiple power supplies 32
8.3 Prevention of unintended start-up 32
8.4 Charging power supplies and recuperation 33
Electrical power supplies 33
8.4.1 33
8.4.2 Powered interchangeable towed machinery and towed machines 33
8.4.3 PTO 33
8.5 Pre-charge protective measures 33

9 Connectors 34
9.1 General 34
9.2 Negative connectors and terminals 34
9.3 Connector mating 34
9.3.1 Incompletely mated connectors 34
9.3.2 Connecting and disconnecting under load 34
9.4 Power cable connections 35
9.5 Terminals for the PEPB cables 35
9.6 Plug/socket combination 36

10 Electric motors and generators 36
10.1 General 36
10.2 Enclosures 37
10.3 Mounting and compartments 37
10.4 Overheating protection 37
10.5 Overspeed protection 37
10.6 Towing and coasting 38
10.7 Bonding 38
10.7.1 Motors and generators 38
10.7.2 Exempted from marking requirement 38

11 Non-motor loads (components) 38
11.1 General 38

~~11.2 Accessories 39~~

~~12 Insulation coordination 39~~
~~12.1 General 39~~
~~12.2 Cable insulation 39~~
~~12.2.1 Temperature and loading 39~~
~~12.2.2 Inspection 40~~
~~12.2.3 Shielding 40~~
~~12.2.4 Different voltages 40~~

~~13 Verification and validation 40~~
~~13.1 General 40~~

~~14 Information for use 40~~
~~14.1 General 40~~
~~14.2 Markings 41~~
~~14.2.1 First responder information 41~~
~~14.2.2 Shock hazard symbols 41~~
~~14.2.3 Operating voltage 41~~
~~14.2.4 Live parts accessible during installation and maintenance 41~~
~~14.2.5 Bonding 41~~
~~14.2.6 Residual voltage 41~~
~~14.2.7 Power supply disruption 41~~
~~14.2.8 Disconnected plug/socket combinations 42~~
~~14.2.9 Maximum water depth 42~~
~~14.2.10 Connection markings 42~~
~~14.2.11 Conductor and cable colour markings 42~~
~~14.2.12 Bolted joints 42~~
~~14.2.13 Disconnection of electrical power supplies 42~~
~~14.2.14 Multiple disconnects 42~~
~~14.2.15 Unintended start-up 43~~
~~14.2.16 External charging 43~~
~~14.2.17 Towing 43~~
~~14.2.18 Connecting and disconnecting under load 43~~
~~14.2.19 Phase cable connections 43~~
~~14.2.20 Bonding of motors and generators EPB 43~~
~~14.2.21 Shipping, dealer setup and transport 43~~
~~14.2.22 Electrical ratings 43~~
~~14.2.23 Protection systems 44~~
~~14.2.24 General purpose socket-outlets 44~~
~~14.2.25 Magnetic hazard symbols 44~~
~~14.3 Manuals and technical documentation 44~~
~~14.3.1 General 44~~
~~14.3.2 Operator's manual 45~~
~~14.3.3 Service manuals 46~~

~~Annex A (informative) List of significant hazards 48~~

~~Annex B (informative) V-Model 50~~

~~Annex C (informative) Shock protection requirements 51~~

~~Annex D (informative) Protection classes 54~~

~~D.1 Equipment protective class combinations 54~~

~~D.2 Protective methods for Class I equipment 55~~

D.3 Protective measures for Class II equipment 55
D.4 Protective measures for Class III equipment 55
Annex E (informative) Documentation 56
Bibliography 58

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Contefnts

Foreword ix
Introduction x
1 Scope 1
2 Normative references 2
3 Terms, definitions and abbreviated terms 3
4 General requirements 10
5 Protection against electric shock hazards 11
6 Wiring practices 31
7 Overcurrent protection (OCP) 32
8 Disconnection and connection 34
9 Connectors 37
10 Electric motors and generators 40
11 Non-motor loads (components) 42
12 Insulation coordination 43
13 Verification and validation 44
14 Information for use 44
Annex A (informative) List of significant hazards 52
Annex B (informative) V-Model 54
Annex C (informative) Shock protection requirements 55
Annex D (informative) Protection classes 58
Annex E (informative) Documentation 62
Bibliography 64

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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at ~~www.iso.org/patents~~.www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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

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~~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 19, *Agricultural electronics*, in collaboration with ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 3, *Machine characteristics, electrical and electronic systems, operation and maintenance*.

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.

Introduction

Electrification technology can provide increased flexibility in mobile machinery configuration. It offers efficiency gains and enhanced power delivery options, which are not possible with current mechanical and hydraulic systems.

Traditional agricultural and earth-moving machinery electrical systems operate in VC-A1, 0- V DC to 32 V DC and 0- V AC to 21 V AC. VC-B2 mobile machinery operate in the 75- V DC to 1 500 V DC and 50- V AC to 1 000 V AC and are covered by ISO 16230-1 for agricultural machines and ISO 14990 series for earth-moving machines. This document covers mobile machinery with systems operating in VC-A2 and VC-B1 (see ~~Table 1).~~Table 1). Some of the content of this document is based on IEC 60204-1 and IEC 62477-1, adapted to the specific application of agricultural and earth-moving machinery. Non-electrical hazards are addressed by ISO 4254 series for agricultural machinery, ISO 26322 series for tractors used in agriculture and forestry, and ISO 20474 series for earth-moving machinery.

Even though this document addresses most hazards associated with the use of electrical systems within the voltage ranges in the scope of this document, owing to the possible presence of additional electrical hazards, conformance with it cannot be taken as an absolute guarantee of electrical safety. Areas of concern are included in the list of significant hazards found in ~~Annex A.~~Annex A.

Having a background in the IEC approach to electrical system safety helps the user make better decisions about the application of this document.

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

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); and

— ~~—~~health and safety bodies (regulators, accident prevention organisations, 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 (small, medium and large enterprises);

— ~~—~~machine users/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).

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 machinery, tractors, and earth-moving machinery — Safety of electrical and electronic components and systems operating at 32 V DC to 75 V DC and 21 V AC to 50 V AC

1 Scope

This document primarily specifies both general design requirements and guidelines for protection of operators and bystanders against electric shock and electrically induced fire, for voltage classes A2 (32 V DC to 60 V DC and 21 V AC to 30 V AC) and B1 (60 V DC to 75 V DC and 30 V AC to 50 V AC), including waveforms synthesized by power electronic converters. This document is limited to addressing hazards that are not as commonly found in 12 V DC and 24 V DC systems, including those related to higher power converters and drive motors.

NOTE 1 Although protection against electrically induced fire hazards is addressed sparingly, conformance to content of this document has the impact of reducing the occurrence and hazards associated with fire.

This document is applicable to electric systems used on:

— tractors, self-propelled ride-on machines, interchangeable towed machinery, semi-mounted implements, and mounted implements used in or with agriculture and forestry; and

— earth-moving machinery (EMM) as defined in ISO 6165 and attachments.

For mobile machinery with multiple rated voltages, with at least one system rated greater than VC-B1, this document addresses the risks associated with the interactions between VC-A2 and VC-B1 systems and those systems which are nearby and rated greater than VC-B1.

NOTE 2 Electrical safety requirements for greater than VC-B1 are described in ISO 16230-1 for agricultural machines and ISO 14990 series for earth-moving machines.

NOTE 3 Although 12 V DC and 24 V DC systems are generally below the limits of this document, meeting appropriate requirements of this document ensures that proper protection exists between the covered systems and lower voltage systems.

This document is applicable to mobile machinery that are either externally powered or self-powered or both.

Alternative safety requirements can be necessary for special equipment or components such as underground mining equipment. This document does not address the additional risks for mobile machinery operating in potentially explosive atmospheres.

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

This document is not applicable to mobile machinery 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 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 6405-1:2017, *Earth-moving machinery — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 7010~~,~~[1)], *Graphical symbols — Safety colours and safety signs — Registered safety signs*

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

ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14990-1:2016, *Earth-moving machinery — Electrical safety of machines utilizing electric drives and related components and systems — Part 1: General requirements*

ISO 14990-2~~:2016~~, *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~~:2016~~, *Earth-moving machinery — Electrical safety of machines utilizing electric drives and related components and systems — Part 3: Particular requirements for self-powered machines*

ISO 15003, *Agricultural engineering — Electrical and electronic equipment — Testing resistance to environmental conditions*

ISO 16230-1:2015, *Agricultural machinery and tractors — Safety of higher voltage electrical and electronic components and systems — Part 1: General requirements*

~~ISO 17840-4, *Road vehicles — Information for first and second responders — Part 4: Propulsion energy identification*~~

ISO 19014-3, *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*

IEC 60034-1, *Rotating electrical machines — Part 1: Rating and performance*

IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60309-1, *Plugs, socket-outlets, and couplers for industrial purposes — Part 1: General requirements*

IEC 60364-5-54:2011/AMD1:2021, *Low-voltage electrical installations — Part 5-54: Selection and erection of electrical equipment — Earthing arrangements and protective conductors*

IEC ~~60417~~,60417[1)], *Graphical symbols for use on equipment*

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

[1)] The graphical symbol collections of ISO 7010 and IEC 60417 can be previewed and purchased on the Online Browsing Platform (OBP), www.iso.org/obp.