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Safety of machinery – Electrical equipment of machines – Part 32: Requirements for hoisting machines

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SAFETY OF MACHINERY – ELECTRICAL EQUIPMENT OF MACHINES –

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This commented version (CMV) of the official standard IEC 60204-32:2023 edition 3.0 allows the user to identify the changes made to the previous IEC 60204-32:2008 edition 2.0. Furthermore, comments from IEC TC 44 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 60204-32 has been prepared by IEC technical committee 44: Safety of machinery – Electrotechnical aspects. It is an International Standard.

This third edition cancels and replaces the second edition published in 2008. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) alignment to the IEC 60204-1 sixth edition (2016) especially for:
   - requirements for earthing and bonding;
   - requirements for circuit protection;
   - consideration of use of Power Drive Systems;
   - protective bonding requirements and terminology;
   - requirements pertaining to safe torque off for PDS, emergency stop, and control circuit protection;
   - symbols for actuators of control devices;
b) reference for high voltage electrical equipment;
c) cableless control system requirements;
d) EMC requirements;
e) technical documentation requirements;
f) general updating to current special national conditions, normative standards, and bibliographical references.

The text of this International Standard is based on the following documents:

Draft	Report on voting
44/1000/FDIS	44/1005/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The following differing practices of a less permanent nature exist in the countries indicated below:

4.3.1: The voltage characteristics of electricity supplied by public distribution systems in Europe are given in EN 50160:2010.

5.1: Exception is not allowed (USA).

5.1: TN-C systems are not permitted in low-voltage installations in buildings (Norway).

5.2: Terminals for the connection of the protective earthing conductors may be identified by the colour green, the letters “G” or “GR” or “GRD” or “GND”, or the word “ground” or “grounding”, or with the graphical symbol IEC 60417-519:2002-10 or any combination (USA).

5.3.1: Isolation of the neutral conductor is mandatory in TN-systems (Norway).

6.3.3 b),

13.4.5 b),

18.2.1: TT power systems are not allowed (USA).

6.3.3,

18.2,

Annex A: TN systems are not used. TT systems are the national standard (Japan)

6.3.3 b) The use of residual current protective devices with a rated residual operating current not exceeding 1 A is mandatory in TT systems as a means for fault protection by automatic disconnection of supply (Italy).

7.2.3: Disconnection of the neutral conductor is mandatory in a TN-S system (France).

7.2.3: Third paragraph: distribution of a neutral conductor with an IT system is not allowed (USA and Norway).

7.10: For evaluation of short circuit ratings, the requirements of UL 508A Supplement SB may be used (USA).

8.2.2: See IEC 60364-5-54:2011, Annex E List of notes concerning certain countries. Maximum nominal AC control circuit voltage is 120 V (USA).

9.1.2: Only stranded wires are allowed on machines, except for 0,2 mm^2 solid conductors within enclosures (USA).

12.2: The smallest power circuit conductor allowed on machines is 0,82 mm^2 (AWG 18).

Table 5: Cross-sectional area is specified in NFPA 79 using American Wire Gauge (AWG) (USA). See Annex F.

13.2.2: For the protective conductor, the colour identification GREEN (with or without YELLOW stripes) is used as equivalent to the bicolour combination GREEN-AND YELLOW (USA and Canada).

13.2.3: The colour identification WHITE or GREY is used for earthed neutral conductors instead of the colour identification BLUE (USA and Canada).

15.2.2: First paragraph: Maximum value between conductors 150 V (USA).

15.2.2: Second paragraph, fifth bullet: The full load current rating of lighting circuits does not exceed 15 A (USA).

16.4: Nameplate marking requirements (USA).

A.2.2.2: The permissible maximum value of *RA* is regulated (e.g. when U_0 > 300 V, R_A shall be less than 10 Ω, when U_0 < 300 V, R_A shall be less than 100 Ω, U_0 is the nominal AC line to earth voltage in volts (V) (Japan).

A.2.2.2: The maximum permissible value of R_A is 83 Ω (Netherlands).

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 60204 provides requirements and recommendations relating to the electrical equipment of hoisting machines so as to promote

– safety of persons and property;

– consistency of control response;

– ease of operation and maintenance.

It is important that high performance is not ~~to be~~ obtained at the expense of the essential factors mentioned above.

Figure 1 and Figure 2 have been provided as an aid to understanding the interrelationship of the various elements of a hoisting machine and its associated equipment. Figure 1 is an overall block diagram of a typical material handling system (a group of cranes working together in a coordinated manner) and Figure 2 is a block diagram of a typical crane and associated equipment showing the various elements of the electrical equipment addressed in this document.

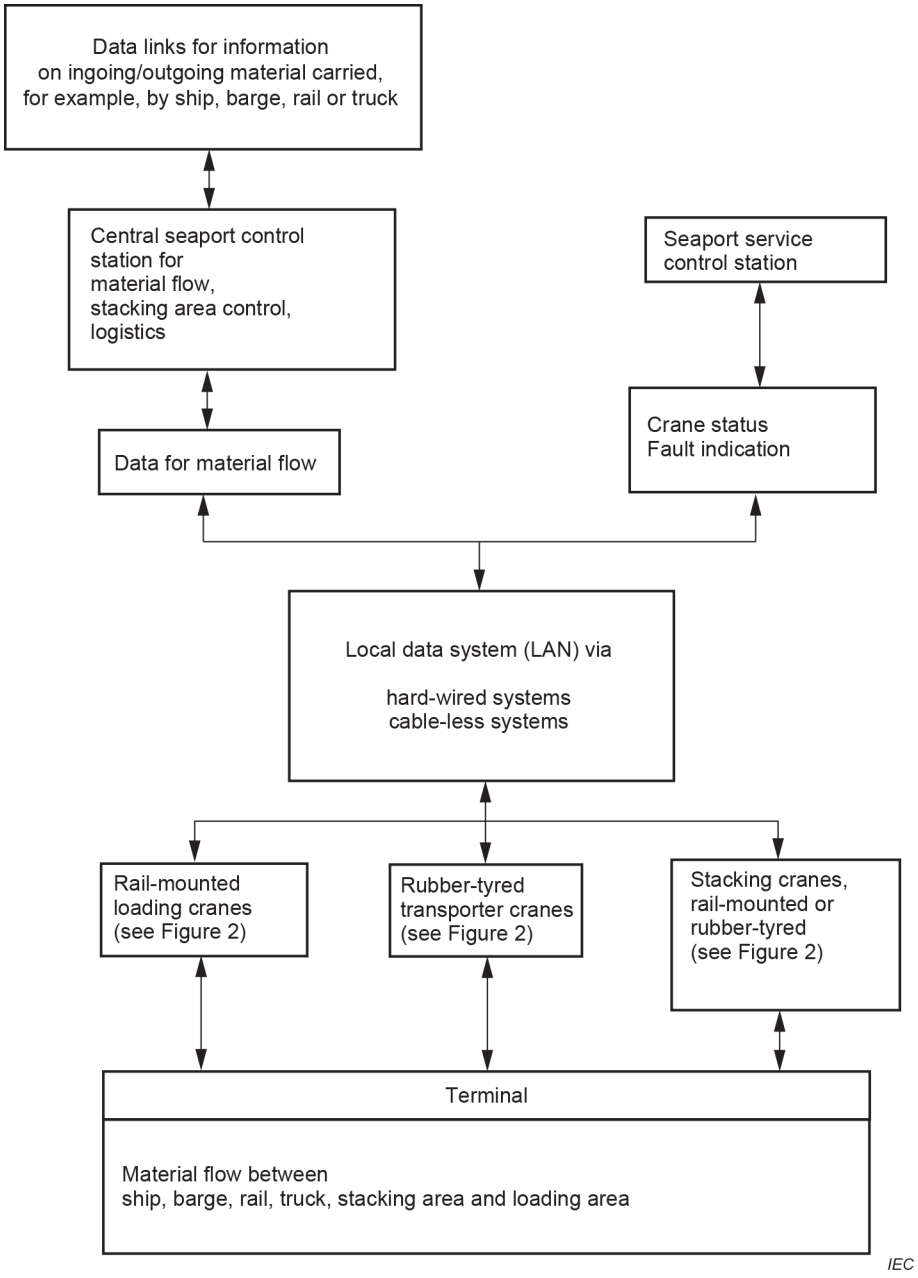

Figure 1 – Block diagram of combined working cranes in a typical material handling system in a seaport

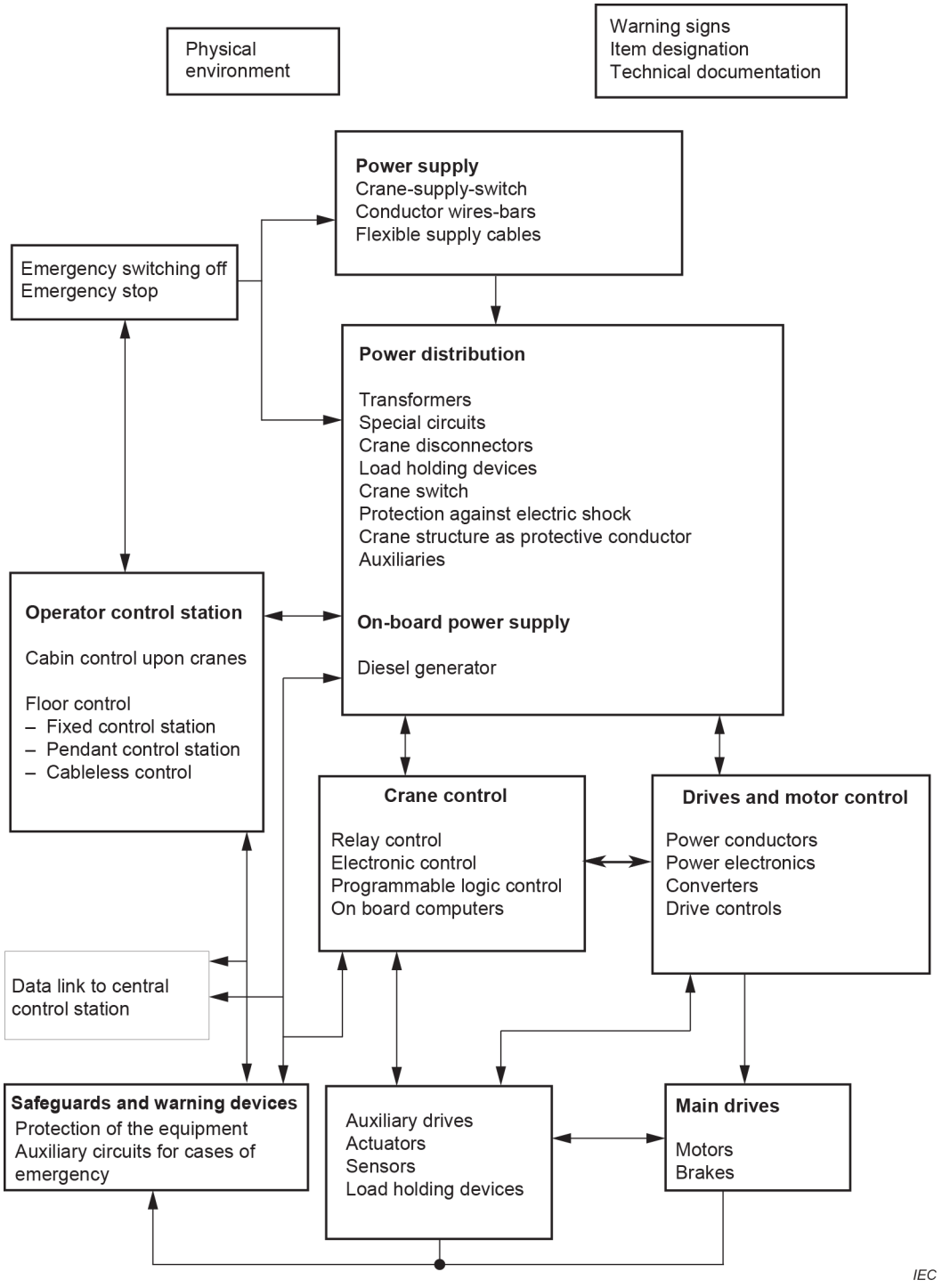

Figure 2 – Block diagram of a typical crane and its associated electrical equipment

SAFETY OF MACHINERY – ELECTRICAL EQUIPMENT OF MACHINES –

Part 32: Requirements for hoisting machines

1 Scope

This part of IEC 60204 applies to ~~the application of~~ electrical ~~and~~, electronic, programmable **1** electronic equipment and systems to hoisting machines and related equipment, including a group of hoisting machines working together in a co-ordinated manner **2**.

NOTE 1 In this document, the term “electrical” includes both electrical and electronic matters (i.e. “electrical equipment” means both the electrical, electronic and programmable electronic equipment).

NOTE 2 In the context of this document, the term “person” refers to any individual and includes those persons who are assigned and instructed by the user or user’s agent(s) in the use and care of the hoisting machine in question.

The equipment covered by this document commences at the point of connection of the supply to the electrical equipment of the hoisting machine (crane-supply-switch) and includes systems for power supply and control feeders situated outside of the hoisting machine, for example, flexible cables or conductor wires or conductor bars (see Figure 3).

NOTE 3 ~~For the requirements for the electrical supply installation in buildings, see IEC 60364.~~ The requirements for the electrical supply installation of electrical equipment of a hoisting machine are given in IEC 60364.

This document is applicable to equipment or parts of equipment not exceeding 1 000 V AC or 1 500 V DC between lines and with nominal frequencies not exceeding 200 Hz.

NOTE 4 ~~For higher voltages, see IEC 60204-11.~~ Special requirements for electrical equipment of hoisting machines intended to be operated at higher voltages can be found in IEC 60204-11. **3**

This document does not cover all the requirements (for example guarding, interlocking, or control) that are needed or required by other standards or regulations in order to protect persons from hazards other than electrical hazards. Each type of hoisting machine has unique requirements to be accommodated to provide adequate safety. This document does not cover noise risks.

Additional and special requirements can apply to the electrical equipment of hoisting machines including those that

~~– are intended for use in open air (i.e., outside buildings or other protective structures);~~

– handle or transport potentially explosive material (e.g. paint or sawdust);

– are intended for use in potentially explosive and/or flammable atmospheres;

– have special risks when transporting or moving certain materials;

– are intended for use in mines.

For the purposes of this document, hoisting machines include cranes of all types, winches of all types and storage and retrieval machines. The following product groups are included:

– overhead travelling cranes;

– mobile cranes;

– tower cranes;

– slewing luffing cranes;

– gantry cranes;

– offshore cranes;
– floating cranes;
– winches of all types;
– hoists and accessories;
– loader cranes;
– cable cranes;
– load holding devices;
– storage and retrieval machines;
– monorail hoists;
– straddle carriers;
– rubber tyred gantry cranes (RTGs).

NOTE 5 A definition of the different crane types can be found in ISO 4306-1.

This document does not cover individual items of electrical equipment other than their selection for use and their erection.

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.

IEC 60034-1:2017, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-5, *Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification*

IEC 60034-11, *Rotating electrical machines – Part 11: Thermal protection*

IEC 60068-2-27:~~1987~~2008, ~~*Basic*~~ *Environmental testing* ~~*procedures*~~ *– Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-31:2008, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

~~IEC 60068-2-32:1975, *Basic environmental testing procedures – Part 2-32: Tests – Test Ed: Free fall*~~
~~Amendment 2 (1990)~~

IEC 60072-1, *Rotating electrical machines – Dimensions and output series – Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1080*

IEC 60072-2, *Dimensions and output series for rotating electrical machines – Part 2: Frame numbers 355 to 1000 and flange numbers 1180 to 2360*

IEC 60072-3, *Dimensions and output series for rotating electrical machines – Part 3: Small built-in motors – Flange numbers BF10 to BF50*

IEC 60073:2002, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators*

IEC 60309-1, *Plugs, fixed or portable socket-outlets and ~~couplers~~ appliance inlets for industrial purposes – Part 1: General requirements*

~~IEC 60332 (all parts), *Tests on electric and optical fibre cables under fire conditions*~~

IEC 60364-1:2005, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*
IEC 60364-4-41:2005/AMD1:2017

~~IEC 60364-4-42:2001, *Electrical installations of buildings – Part 4-42: Protection for safety – Protection against thermal effects*~~

IEC 60364-4-43:~~2001~~2008, *Low-voltage electrical installations ~~of buildings~~ – Part 4-43: Protection for safety – Protection against overcurrent*

IEC 60364-5-52:~~2001~~2009, *Low-voltage electrical installations ~~of buildings~~ – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

IEC 60364-5-53:~~2002~~2019, *Low-voltage electrical installations ~~of buildings~~ – Part 5-53: Selection and erection of electrical equipment – Devices for protection for safety, isolation, switching, control and monitoring*

IEC 60364-5-54:~~2002~~2011, *Low-voltage electrical installations ~~of buildings~~ –Part 5-54: Selection and erection of electrical equipment – Earthing arrangements~~, protective conductors~~ and protective ~~bonding~~ conductors*

IEC 60364-6:~~2006~~2016, *Low-voltage electrical installations – Part 6: Verification*

IEC 60417, *Graphical symbols for use on equipment* (available at https://www.graphical-symbols.info/equipment)

~~IEC 60439-1:1999, *Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested and partially type-tested assemblies*[1].~~
~~Amendment 1 (2004)~~

IEC 60445:2021, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

~~IEC 60446:1999, *Basic and safety principles for man-machine interface, marking and identification – Identification of conductors by colours or alphanumerics*~~

IEC 60447:2004, *Basic and safety principles for man-machine interface, marking and identification – Actuating principles*

IEC 60529~~:2001~~, *Degrees of protection provided by enclosures (IP Code)*

~~IEC 60617, *Graphical symbols for diagrams*~~

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~~[1] There exists a consolidated edition 4.1 (2004) that includes edition 4 and its amendment.~~

IEC 60664-1~~:2007~~, *Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests*

IEC 60755:2017, *General safety requirements for residual current operated protective devices*

~~IEC 60898 (all parts), *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations*~~

IEC 60947-1~~:2007~~, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-2:~~2006~~2016, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 60947-3, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors, and fuse-combination units*

IEC 60947-4-1:~~2000~~2018, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*
~~Amendment 1 (2002)[1]~~

IEC 60947-5-1:~~2003~~2016, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

IEC 60947-5-5, *Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function*

IEC 60947-6-2, *Low-voltage switchgear and controlgear – Part 6-2: Multiple function equipment – Control and protective switching devices (or equipment) (CPS)*

~~IEC 61082-1:2006, *Preparation of documents used in electrotechnology – Part 1: Rules*~~

IEC 61140, *Protection against electric shock – Common aspects for installations and equipment*

~~IEC 61180-2:1994, *High-voltage techniques for low-voltage equipment – Part 2: Test equipment*~~

IEC 61204-7, *Low-voltage switch mode power supplies – Part 7: Safety requirements*

IEC 61310 (all parts), *Safety of machinery – Indication, marking and actuation*

~~IEC 61346 (all parts), *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations*~~

IEC 61439-1, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

IEC 61557-3, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 3: Loop impedance*

IEC 61557-9:2014, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 9: Equipment for insulation fault detection in IT systems*

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~~[1] There exists a consolidated edition 2.1 (2002) that includes edition 2 and its amendment.~~

IEC 61558-1, *Safety of ~~power transformers, power supplies, reactors and similar products~~ transformers, reactors, power supply units and combinations thereof – Part 1: General requirements and tests*

IEC 61558-2-2, *Safety of power transformers, power supplies, reactors and combinations thereof – Part 2-2: Particular requirements and tests for control transformers and power supply units incorporating control transformers*

IEC 61558-2-6, *Safety of ~~power transformers, power supply units and similar~~ transformers, reactors, power supply units and combinations thereof – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers for general ~~use~~ applications*

IEC 61558-2-16, *Safety of transformers, reactors, power supply units and combinations thereof – Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units for general applications*

IEC 61800-3, *Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods for PDS and machine tools*

IEC 61800-5-1, *Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy*

IEC 61800-5-2~~:2007~~, *Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*

IEC 61984, *Connectors – Safety requirements and tests*

IEC 62023, *Structuring of technical information and documentation*

~~IEC 62027, *Preparation of parts lists*~~

IEC 62061, *Safety of machinery – Functional safety of safety-related ~~electrical, electronic and programmable electronic~~ control systems*

~~IEC 62079, *Preparation of instructions – Structuring, content and presentation*~~

IEC 62745:2017, *Safety of machinery – Requirements for cableless control systems of machinery*

~~ISO 7000:2004, *Graphical symbols for use on equipment – Index and synopsis*~~

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*, available at https://www.iso.org/obp

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

~~ISO 12100-1:*Safety of machinery – Part 1: Basic terminology, methodology*~~

~~ISO 12100-2:2003, *Safety of machinery – Basic concepts, General principles for design – Part 2: Technical principles*~~

ISO 13849-1~~:2006~~, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 13849-2~~:2003~~, *Safety of machinery – Safety-related parts of control systems – Part 2: Validation*

ISO 13850:~~2006~~2015, *Safety of machinery – Emergency stop function – Principles for design*

~~*ISO 13851:2002, Safety of machinery – Two-hand control devices – Functional aspects and design principles*~~

~~*ISO 13852:1996, Safety of machinery – Safety distances to prevent danger zones being reached by the upper limbs*~~

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