

This is a preview - click here to buy the full publication



IEC 60204-32

Edition 3.0 2023-07  
COMMENTED VERSION

# INTERNATIONAL STANDARD



---

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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 29.020, 53.020.01

ISBN 978-2-8322-7186-5

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD .....	11
INTRODUCTION .....	14
1 Scope .....	17
2 Normative references .....	18
3 Terms, definitions and abbreviated terms .....	22
3.1 Terms and definitions .....	22
3.2 Abbreviated terms .....	34
4 General requirements .....	34
4.1 General considerations .....	34
4.2 Selection of equipment .....	35
4.2.1 General .....	35
4.2.2 Selection of power contactors .....	35
<del>4.2.3 Electrical equipment in compliance with the IEC 60439 series .....</del>	<del>36</del>
4.2.3 Switchgear .....	36
4.2.4 Selection of PDS .....	36
4.3 Electrical supply .....	36
4.3.1 General requirements .....	36
4.3.2 AC supplies .....	36
4.3.3 DC supplies .....	36
4.3.4 <del>On-board power supply</del> Special supply systems .....	37
4.4 Physical environment and operating conditions .....	37
4.4.1 General .....	37
4.4.2 Electromagnetic compatibility (EMC) .....	37
4.4.3 Ambient air temperature .....	38
4.4.4 Humidity .....	38
4.4.5 Altitude .....	38
4.4.6 Contaminants .....	39
4.4.7 Ionizing and non-ionizing radiation .....	39
4.4.8 Vibration, shock, and bump .....	39
4.5 Transportation and storage .....	39
4.6 Provisions for handling .....	39
4.7 Installation .....	39
5 Incoming supply conductor terminations and devices for disconnecting and switching off .....	39
5.1 Incoming supply conductor terminations .....	39
5.2 Terminal for connection <del>to</del> of the external protective <del>earthing system</del> conductor .....	40
5.3 Supply disconnecting and switching devices .....	41
5.3.1 General .....	41
5.3.2 Type .....	41
5.3.3 Requirements .....	42
5.3.4 Operating means of the supply disconnecting device .....	43
5.3.5 Crane-supply-switch .....	44
5.3.6 Crane-disconnector .....	45
5.3.7 Crane-switch .....	46
5.3.8 <del>Special</del> Excepted circuits .....	46

5.4	Devices for <del>switching off</del> removal of power for prevention of unexpected start-up .....	47
5.5	Devices for <del>disconnecting</del> isolating electrical equipment .....	48
5.6	Protection against unauthorized, inadvertent and/or mistaken connection .....	48
6	Protection against electric shock .....	49
6.1	General .....	49
6.2	Basic protection <del>against direct contact</del> .....	49
6.2.1	General .....	49
6.2.2	Protection by enclosures .....	49
6.2.3	Protection by insulation of live parts .....	50
6.2.4	Protection against residual voltages .....	51
6.2.5	Protection by barriers .....	51
6.2.6	Protection by placing out of reach or protection by obstacles .....	51
6.3	Fault protection <del>against indirect contact</del> .....	51
6.3.1	General .....	51
6.3.2	Prevention of the occurrence of a touch voltage .....	52
6.3.3	Protection by automatic disconnection of supply .....	52
6.4	Protection by the use of PELV .....	53
6.4.1	General requirements .....	53
6.4.2	Sources for PELV .....	54
7	Protection of equipment .....	54
7.1	General .....	54
7.2	Overcurrent protection .....	55
7.2.1	General .....	55
7.2.2	Supply conductors .....	55
7.2.3	Power circuits .....	55
7.2.4	Control circuits .....	55
7.2.5	Socket outlets and their associated conductors .....	56
7.2.6	Lighting circuits .....	56
7.2.7	Transformers .....	56
7.2.8	Location of overcurrent protective devices .....	56
7.2.9	Overcurrent protective devices .....	56
7.2.10	Rating and setting of overcurrent protective devices .....	57
7.3	Protection of motors against overheating .....	57
7.3.1	General .....	57
7.3.2	Overload protection .....	57
7.3.3	Over-temperature protection .....	58
	<del>7.3.4 Current limiting protection .....</del>	<del>58</del>
7.4	Protection against abnormal temperature <del>protection</del> .....	58
7.5	Protection against the effects of supply interruption or voltage reduction and subsequent restoration .....	58
7.6	Motor overspeed protection .....	59
7.7	Additional earth fault/residual current protection .....	59
7.8	Phase sequence protection .....	59
7.9	Protection against overvoltages due to lightning and to switching surges <del>and lightning</del> .....	59
7.10	Short-circuit current rating .....	60
8	Equipotential bonding .....	60
8.1	General .....	60

8.2	Protective bonding circuit.....	63
8.2.1	General.....	63
8.2.2	Protective conductors .....	63
8.2.3	Continuity of the protective bonding circuit .....	64
8.2.4	Exclusion of switching devices from the protective bonding circuit.....	65
8.2.5	Parts that need not be connected to the protective bonding circuit .....	65
8.2.6	Protective conductor connecting points .....	66
8.2.7	Mobile hoisting machines.....	66
8.2.8	Additional <del>protective bonding</del> requirements for electrical equipment having earth leakage currents higher than 10 mA AC or DC .....	66
8.3	Functional bonding .....	67
8.4	Measures to restrict the effects of high leakage current.....	67
9	Control circuits and control functions .....	68
9.1	Control circuits .....	68
9.1.1	General.....	68
9.1.2	Control circuit supply .....	68
9.1.3	Control circuit voltages .....	68
9.1.4	Protection .....	69
9.2	Control functions .....	69
9.2.1	General.....	69
<del>9.2.1</del>	<del>Start functions .....</del>	<del>69</del>
9.2.2	Categories of Stop functions .....	69
9.2.3	Operating modes.....	69
9.2.4	Suspension of safeguarding.....	70
9.2.5	Operation.....	70
9.2.6	Other control functions .....	73
9.2.7	Cableless controls system (CCS).....	73
9.3	Protective interlocks .....	76
9.3.1	General.....	76
9.3.2	Reclosing or resetting of an interlocking safeguard.....	77
9.3.3	Exceeding operating limits.....	77
9.3.4	Operation of auxiliary functions.....	77
9.3.5	Interlocks between different operations and for contrary motions.....	77
9.3.6	Reverse current braking.....	77
9.4	Control functions in the event of failure .....	78
9.4.1	General requirements .....	78
9.4.2	Measures to minimize risk in the event of failure.....	78
<del>9.4.3</del>	<del>Protection against mal-operation due to earth faults, voltage interruptions, and loss of circuit continuity.....</del>	<del>81</del>
9.4.3	Protection against malfunction of control circuits .....	81
9.4.4	Protection against maloperation of a motion control system .....	87
10	Operator interface and hoisting machine mounted control devices .....	88
10.1	General.....	88
10.1.1	General <del>device</del> requirements .....	88
10.1.2	Location and mounting.....	88
10.1.3	Protection .....	88
10.1.4	Position sensors.....	89
10.1.5	Portable and pendant control stations .....	89
10.2	<del>Push-buttons</del> Actuators.....	89

10.2.1	Colours .....	89
10.2.2	Markings .....	90
10.3	Indicator lights, displays and audible devices .....	91
10.3.1	General.....	91
10.3.2	Colours .....	92
10.3.3	Flashing lights and displays .....	92
10.4	Illuminated push-buttons .....	92
10.5	Rotary control devices .....	92
10.6	Start devices .....	93
10.7	Emergency stop devices .....	93
10.7.1	Location of emergency stop devices.....	93
10.7.2	Types of emergency stop device .....	93
10.7.3	Colour of actuators .....	94
10.7.4	Local operation of the crane-supply-switch and the crane-disconnector to effect emergency stop.....	94
10.8	Emergency switching-off devices.....	94
10.8.1	Location of emergency switching-off devices .....	94
10.8.2	Types of emergency switching-off device .....	94
10.8.3	Colour of actuators .....	94
10.8.4	Local operation of the crane-supply-switch and the crane-disconnector to effect emergency switching-off.....	95
10.9	Enabling control device.....	95
11	Controlgear: location, mounting and enclosures .....	95
11.1	General requirements .....	95
11.2	Location and mounting.....	95
11.2.1	Accessibility and maintenance .....	95
11.2.2	Physical separation or grouping .....	96
11.2.3	Heating effects .....	96
11.3	Degrees of protection .....	97
11.4	Enclosures, doors and openings.....	97
11.5	Access to switchgear and to controlgear.....	99
11.5.1	General.....	99
11.5.2	Access to gangways .....	99
11.5.3	Gangway in front of switchgear and controlgear .....	99
	<del>11.5.4 Gangway and door restrictions .....</del>	<del>99</del>
12	Conductors and cables.....	100
12.1	General requirements .....	100
12.2	Conductors.....	100
12.3	Insulation .....	101
12.4	Current-carrying capacity in normal service .....	102
12.5	Conductor and cable voltage drop .....	103
12.6	Flexible cables .....	104
12.6.1	General.....	104
12.6.2	Mechanical rating .....	104
12.6.3	Current-carrying capacity of cables wound on drums .....	104
12.7	Conductor wires, conductor bars and slip-ring assemblies.....	105
12.7.1	<del>Protection against direct contact</del> Basic protection .....	105
12.7.2	Protective conductor circuit.....	108
12.7.3	Protective conductor current collectors.....	108

12.7.4	Removable current collectors with a disconnecter function.....	109
12.7.5	Clearances in air .....	109
12.7.6	Creepage distances.....	109
12.7.7	Conductor system sectioning .....	109
12.7.8	Construction and installation of conductor wire, conductor bar systems and slip-ring assemblies .....	109
13	Wiring practices .....	110
13.1	Connections and routing .....	110
13.1.1	General requirements .....	110
13.1.2	Conductor and cable runs .....	110
13.1.3	Conductors of different circuits.....	111
13.1.4	AC circuits – Electromagnetic effects (prevention of eddy currents).....	111
13.1.5	Connection between pick-up and pick-up converter of an inductive power supply system .....	111
13.2	Identification of conductors .....	111
13.2.1	General requirements .....	111
13.2.2	Identification of the protective conductor / protective bonding conductor.....	112
13.2.3	Identification of the neutral conductor.....	112
13.2.4	Identification by colour.....	113
13.3	Wiring inside enclosures .....	113
13.4	Wiring outside enclosures .....	114
13.4.1	General requirements .....	114
13.4.2	External ducts .....	114
13.4.3	Connection to the hoisting machine and to moving elements on the hoisting machine .....	114
13.4.4	Interconnection of devices on the hoisting machine .....	116
13.4.5	Plug/socket combinations .....	116
13.4.6	Dismantling for shipment .....	117
13.4.7	Additional conductors .....	117
13.5	Ducts, connection boxes and other boxes.....	117
13.5.1	General requirements .....	117
13.5.2	Percentage fill of ducts .....	117
13.5.3	Rigid metal conduits and fittings.....	117
13.5.4	Flexible metal conduits and fittings.....	118
13.5.5	Flexible non-metallic conduits and fittings .....	118
13.5.6	Cable trunking systems.....	118
13.5.7	Hoisting machine compartments and cable trunking systems .....	118
13.5.8	Connection boxes and other boxes .....	118
13.5.9	Motor connection boxes.....	119
14	Electric motors and associated equipment .....	119
14.1	General requirements .....	119
14.2	Motor enclosures .....	119
14.3	Motor dimensions .....	119
14.4	Motor mounting and compartments.....	119
14.5	Criteria for motor selection.....	120
14.6	Protective devices for mechanical brakes .....	120
14.7	Electrically operated mechanical brakes .....	120
15	Accessories Socket-outlets and lighting .....	120
15.1	Socket-outlets for accessories .....	120

15.2	Local lighting <del>on</del> of the hoisting machine and <del>for</del> of the equipment .....	121
15.2.1	General.....	121
15.2.2	Supply .....	121
15.2.3	Protection .....	122
15.2.4	Fittings.....	122
16	Marking, warning signs and reference designations.....	122
16.1	General.....	122
16.2	Warning signs .....	122
16.2.1	Electric shock hazard .....	122
16.2.2	Hot surfaces hazard .....	123
16.2.3	Hazard from energy storage system.....	123
16.3	Functional identification .....	123
16.4	Marking of enclosures of electrical equipment.....	123
16.5	Reference designations .....	124
17	Technical documentation.....	124
	<del>17.2 Information to be provided .....</del>	
	<del>17.3 Requirements applicable to all documentation .....</del>	
	<del>17.4 Installation documents .....</del>	
	<del>17.5 Overview diagrams and function diagrams.....</del>	
	<del>17.6 Circuit diagrams .....</del>	
	<del>17.7 Operating manual .....</del>	
	<del>17.8 Maintenance manual.....</del>	
	<del>17.9 Parts list.....</del>	
17.1	General.....	124
17.2	Information related to the electrical equipment.....	128
18	Verification .....	129
18.1	General.....	129
18.2	Verification of conditions for protection by automatic disconnection of supply .....	130
18.2.1	General.....	130
	<del>18.2.2 Test methods in TN-systems.....</del>	
18.2.2	Test 1 – Verification of the continuity of the protective bonding circuit.....	130
18.2.3	Test 2 – Fault loop impedance verification and suitability of the associated overcurrent protective device .....	130
18.2.4	Application of the test methods for TN-systems .....	131
18.3	Insulation resistance tests.....	134
18.4	Voltage tests .....	135
18.5	Protection against residual voltages .....	135
18.6	Functional tests .....	135
18.7	Retesting.....	135
	<del>Annex A (normative) Protection against indirect contact in TN-systems.....</del>	
Annex A	(normative) Fault protection by automatic disconnection of supply .....	140
A.1	Fault protection for machines supplied from TN-systems.....	140
A.1.1	General.....	140
A.1.2	Conditions for protection by automatic disconnection of the supply by overcurrent protective devices .....	140
A.1.3	Condition for protection by reducing the touch voltage below 50 V .....	141
A.1.4	Verification of conditions for protection by automatic disconnection of the supply .....	142

A.2	Fault protection for machines supplied from TT-systems .....	144
A.2.1	Connection to earth .....	144
A.2.2	Fault protection for TT systems .....	144
A.2.3	Verification of protection by automatic disconnection of supply using a residual current protective device (RCD) .....	145
A.2.4	Measurement of the fault loop impedance ( $Z_S$ ) .....	146
Annex B (informative)	Enquiry form for the electrical equipment of hoisting machines .....	148
Annex C (informative)	Current-carrying capacity and overcurrent protection of conductors and cables in the electrical equipment of machines .....	152
C.1	General .....	152
C.2	General operating conditions .....	152
C.2.1	Ambient air temperature .....	152
C.2.2	Methods of installation .....	152
C.2.3	Grouping .....	153
C.2.4	Classification of conductors .....	155
C.3	Co-ordination between conductors and protective devices providing overload protection .....	155
C.4	Overcurrent protection of conductors .....	156
Annex D (informative)	Conductor selection for intermittent duty .....	158
D.1	General .....	158
D.2	Intermittent duty with 10-min cycle .....	158
D.3	Intermittent duty with any cycle time .....	159
D.4	Calculation of thermal equivalent current .....	160
Annex E (informative)	Explanation of emergency operation functions .....	162
E.1	Emergency operations .....	162
E.2	Emergency stop .....	162
E.3	Emergency start .....	162
E.4	Emergency switching-off .....	162
E.5	Emergency switching-on .....	162
Annex F (informative)	Comparison of typical conductor cross-sectional areas .....	163
Annex G (informative)	Measures to reduce the effects of electromagnetic influences .....	165
G.1	General .....	165
G.2	Mitigation of electromagnetic interference (EMI) .....	165
G.2.1	General .....	165
G.2.2	Measures to reduce EMI .....	166
G.3	Separation and segregation of cables .....	166
G.4	Power supply of a machine by parallel sources .....	170
G.5	Supply impedance where a Power Drive System (PDS) is used .....	170
G.6	Emission levels for electrical equipment for PDS .....	170
G.7	Conducted disturbances .....	171
G.8	Immunity requirements – Performance criteria .....	172
Annex H (informative)	Documentation and information .....	173
Bibliography	.....	175
<b>Index</b>	.....	
List of comments	.....	182

Figure 1 – Block diagram of combined working cranes in a typical material handling system in a seaport..... 15



Figure 2 – Block diagram of a typical crane and its associated electrical equipment .....	16
Figure 3 – Examples of electrical supply systems.....	42
Figure 4 – Disconnecter isolator .....	44
Figure 5 – Disconnecting circuit breaker .....	44
Figure 6 – Example of equipotential bonding for electrical equipment of a hoisting machine.....	62
Figure 7 – Symbol IEC 60417-5019: Protective earth.....	66
Figure 8 – Symbol IEC 60417-5020: Frame or chassis .....	67
Figure 9 – Method a) Earthed control circuit fed by a transformer .....	82
Figure 10 – Method b1) Non-earthed control circuit fed by transformer.....	83
Figure 11 – Method b2) Non-earthed control circuit fed by transformer.....	83
Figure 12 – Method b3) Non-earthed control circuit fed by transformer.....	84
Figure 13 – Method c) Control circuits fed by transformer with an earthed centre-tap winding.....	84
Figure 14 – Method d1a) Control circuit without transformer connected between a phase and the neutral of an earthed supply system .....	85
Figure 15 – Method d1b) control circuit without transformer connected between two phases of an earthed supply system .....	86
Figure 16 – Method d2a) Control circuit without transformer connected between phase and neutral of a non-earthed supply system .....	86
Figure 17 – Method d2b) control circuit without transformer connected between two phases of a non-earthed supply system .....	87
Figure 18 – Limit of arm’s reach in cases where the distance from the middle of the hoisting device-rail to the edge of the girder is less than 300 mm.....	107
Figure 19 – Limit of arm’s reach in cases where the distance from the middle of the hoisting device-rail to the edge of the girder is at least 300 mm .....	107
Figure 20 – Limit of arm’s reach in cases of using additional obstacles .....	108
Figure 21– Symbol IEC 60417-5019.....	112
Figure 22 – Symbol IEC 60417-5021.....	112
Figure 23 – Symbol ISO 7010-W012 .....	122
Figure 24 – Symbol ISO 7010-W017 .....	123
Figure 25 – Warning sign: energy storage system .....	123
Figure A.1 – Typical arrangement for fault loop impedance ( $Z_S$ ) measurement in TN systems .....	143
Figure A.2 – Typical arrangement for fault loop impedance ( $Z_S$ ) measurement for power drive system circuits in TN systems .....	143
Figure A.3 – Typical arrangement for fault loop impedance ( $Z_S$ ) measurement in TT systems .....	146
Figure A.4 – Typical arrangement for fault loop impedance ( $Z_S$ ) measurement for Power Drive System circuits in TT systems .....	147
Figure C.1 – Methods of conductor and cable installation independent of number of conductors/cables .....	153
Figure C.2 – Parameters of conductors and protective devices .....	155
Figure D.1 – An example of current and time of the segments of the operating cycle of a variable speed AC hoist drive .....	160
Figure G.1 – By-pass conductor for screen reinforcement.....	166
Figure G.2 – Examples of vertical separation and segregation.....	168

Figure G.3 – Examples of horizontal separation and segregation .....	168
Figure G.4 – Cable arrangements in metal cable trays.....	169
Figure G.5 – Connections between metal cable trays or cable trunking systems.....	169
Figure G.6 – Interruption of metal cable trays at fire barriers .....	170
Table 1 – Minimum cross-sectional area of <del>the external</del> protective copper conductors .....	40
<del>Table 2 – Colour coding for push button actuators and their meanings .....</del>	<del>.....</del>
<del>Table 3 – Symbols for push buttons.....</del>	<del>.....</del>
Table 2 – Symbols for actuators (power).....	91
Table 3 – Symbols for actuators (machine operation) .....	91
Table 4 – Colours for indicator lights and their meanings with respect to the condition of the hoisting machine .....	92
Table 5 – Minimum cross-sectional areas of copper conductors .....	101
Table 6 – Classification of conductors.....	101
Table 7 – Examples of current-carrying capacity ( $I_Z$ ) of PVC-insulated copper conductors or cables under steady-state conditions in an ambient air temperature of +40 °C for different methods of installation.....	103
Table 8 – Derating factors for cables wound on drums.....	105
Table 9 – Minimum permitted bending radii for the forced guiding of flexible cables.....	115
Table 10 – Application of the test methods for TN-systems.....	132
Table 11 – Examples of maximum cable length from each protective device to <del>its</del> their loads for TN-systems .....	133
<del>Table A.1 – Maximum disconnecting times for TN systems .....</del>	<del>.....</del>
Table A.1 – Maximum disconnecting times for TN systems .....	140
Table A.2 – Maximum disconnecting time for TT-systems.....	145
Table C.1 – Correction factors .....	152
Table C.2 – Derating factors <del>from</del> for $I_Z$ for grouping .....	154
Table C.3 – Derating factors <del>from</del> for $I_Z$ for multi-core cables up to 10 mm <sup>2</sup> .....	154
Table C.4 – Classification of conductors .....	155
Table C.5 – Maximum allowable conductor temperatures under normal and short-circuit conditions .....	156
Table D.1 – Correction factor for 10 min cycle.....	159
Table D.2 – Thermal time constant of conductors.....	159
Table F.1 – Comparison of conductor sizes.....	163
Table G.1 – Minimum separation distances using metallic containment as illustrated in Figure G.2 .....	167
Table G.2 – Limits for the interference voltage for the environments / categories.....	170
Table G.3 – Limits for propagated electromagnetic disturbance .....	171
Table G.4 – Limits for conducted disturbances .....	171
Table G.5 – Immunity requirements – performance criteria .....	172
Table H.1 – Documentation and information that can be applicable.....	173

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### SAFETY OF MACHINERY – ELECTRICAL EQUIPMENT OF MACHINES –

#### Part 32: Requirements for hoisting machines

#### 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

**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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://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<sup>2</sup> solid conductors within enclosures (USA).  
12.2: The smallest power circuit conductor allowed on machines is 0,82 mm<sup>2</sup> (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  $R_A$  is regulated (e.g. when  $U_0 > 300$  V,  $R_A$  shall be less than 10  $\Omega$ , when  $U_0 < 300$  V,  $R_A$  shall be less than 100  $\Omega$ ,  $U_0$  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  $\Omega$  (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](http://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.

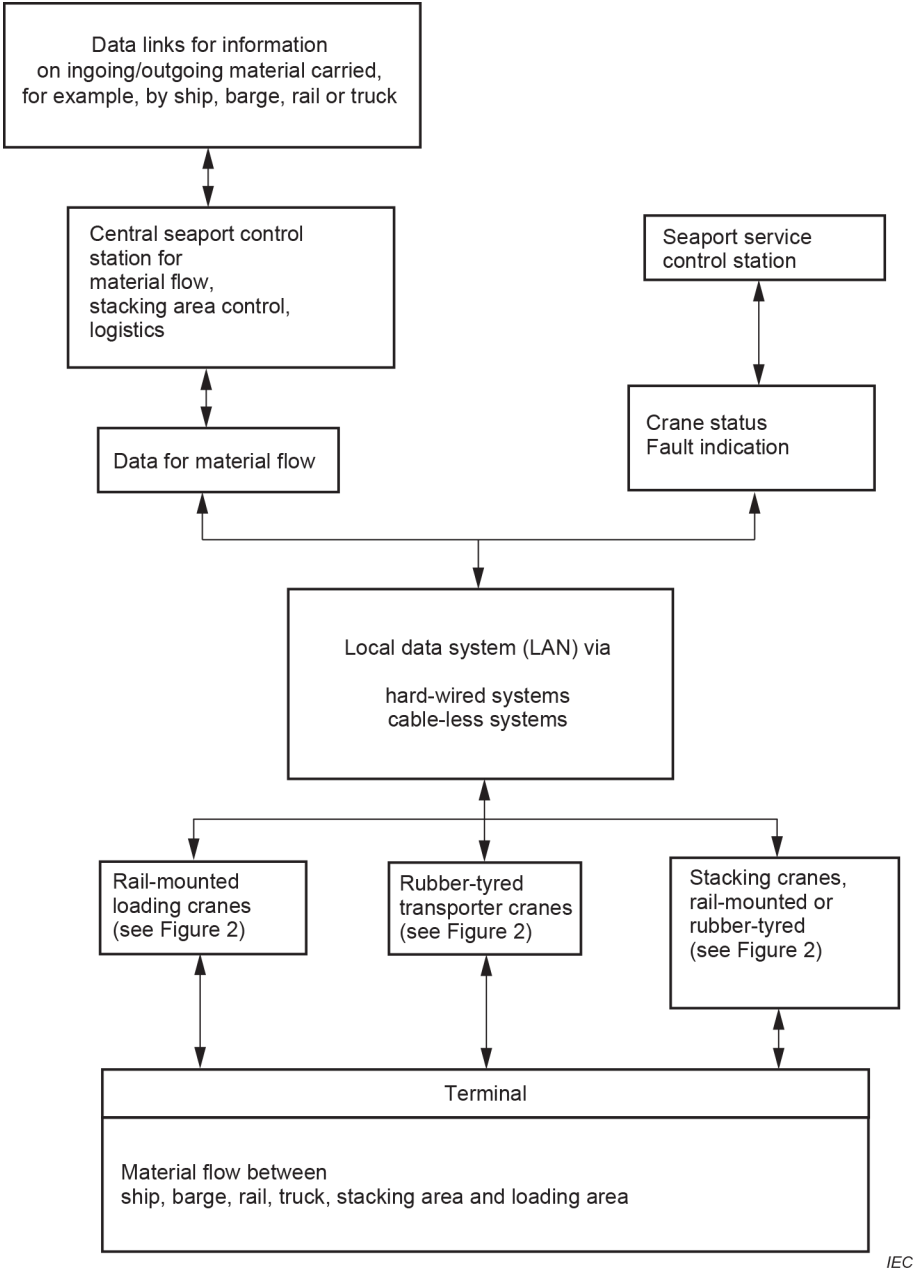
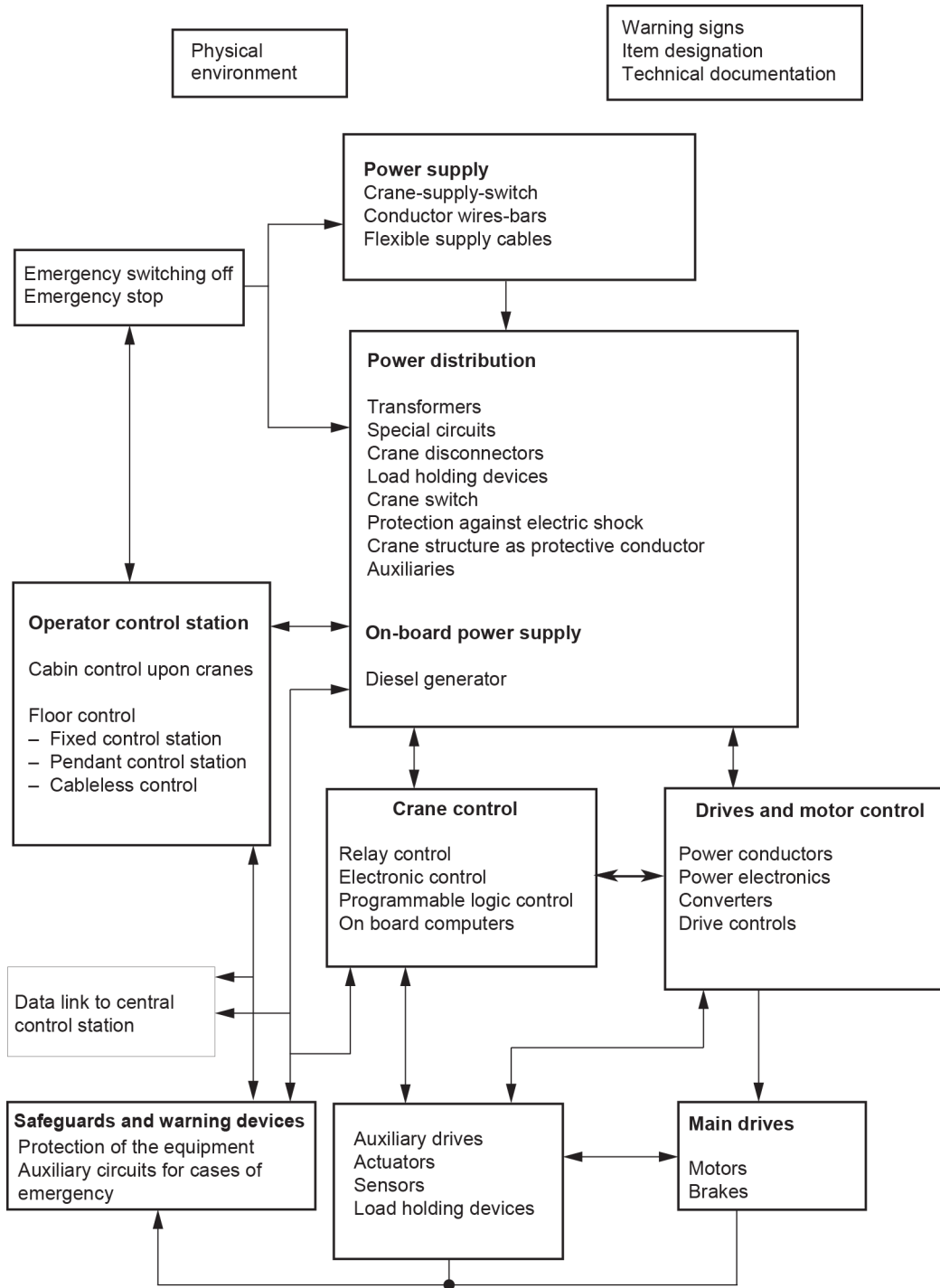


Figure 1 – Block diagram of combined working cranes in a typical material handling system in a seaport



IEC

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 60364-4-43:20042008, *Low-voltage electrical installations ~~of buildings~~ – Part 4-43: Protection for safety – Protection against overcurrent*

IEC 60364-5-52:20042009, *Low-voltage electrical installations ~~of buildings~~ – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

IEC 60364-5-53:20022019, *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 60364-5-54:20022011, *Low-voltage electrical installations ~~of buildings~~ – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements, ~~protective conductors~~ and protective ~~bonding~~ conductors*

IEC 60364-6:20062016, *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<sup>4</sup>. 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 60529:2004, *Degrees of protection provided by enclosures (IP Code)*

~~IEC 60617, Graphical symbols for diagrams~~

---

<sup>4</sup> ~~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)<sup>4</sup>~~

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*

---

<sup>4</sup> ~~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*