



## **Masinate ohutus. Masinate elektriseadmed. Osa 32: Nõuded tõstemasinatele**

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

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 60204-32:2008 sisaldab Euroopa standardi EN 60204-32:2008 ingliskeelset teksti.

Standard on kinnitatud Eesti Standardikeskuse 20.10.2008 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.

Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 05.09.2008.

Standard on kättesaadav Eesti standardiorganisatsioonist.

This Estonian standard EVS-EN 60204-32:2008 consists of the English text of the European standard EN 60204-32:2008.

This standard is ratified with the order of Estonian Centre for Standardisation dated 20.10.2008 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.

Date of Availability of the European standard text 05.09.2008.

The standard is available from Estonian standardisation organisation.

ICS 29.020, 53.020.01

**Võtmesõnad:** control and operation, definitions, electrical equipment, hoisting machines, rules for electrical safety, tests

### Standardite reprodutseerimis- ja levitamiseõigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:  
Aru 10 Tallinn 10317 Eesti; [www.evs.ee](http://www.evs.ee); Telefon: 605 5050; E-post: [info@evs.ee](mailto:info@evs.ee)

English version

**Safety of machinery -  
Electrical equipment of machines -  
Part 32: Requirements for hoisting machines  
(IEC 60204-32:2008)**

Sécurité des machines -  
Équipement électrique des machines -  
Partie 32: Exigences  
pour les appareils de levage  
(CEI 60204-32:2008)

Sicherheit von Maschinen -  
Elektrische Ausrüstung von Maschinen -  
Teil 32: Anforderungen  
für Hebezeuge  
(IEC 60204-32:2008)

This European Standard was approved by CENELEC on 2008-07-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

**CENELEC**

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

## Foreword

The text of document 44/574/FDIS, future edition 2 of IEC 60204-32, prepared by IEC TC 44, Safety of machinery - Electrotechnical aspects, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60204-32 on 2008-07-01.

This European Standard supersedes EN 60204-32:1998.

EN 60204-32:2008 includes the following significant technical changes with respect to EN 60204-32:1998.

a) Changes to EN 60204-1:2006 have been incorporated, especially:

- deletion of Clause 11 of EN 60204-1:1997;
- modification of the structure of equipotential bonding (Clause 8);
- separation of control functions (Clause 9) and devices (Clause 10);
- structure of technical documentation (Clause 17);
- verification of protection by automatic disconnection of supply (18.2).

b) Subclause 9.2.7 on cableless controls has been modified.

The following dates were fixed:

- latest date by which the EN has to be implemented  
at national level by publication of an identical  
national standard or by endorsement (dop) 2009-04-01
- latest date by which the national standards conflicting  
with the EN have to be withdrawn (dow) 2011-07-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directives 98/37/EC and 2006/42/EC. See Annex ZZ.

Annexes ZA and ZZ have been added by CENELEC.

---

## Endorsement notice

The text of the International Standard IEC 60204-32:2008 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60038	NOTE Harmonized as HD 472 S1:1989 (modified).
IEC 60204-11	NOTE Harmonized as EN 60204-11:2000 (not modified).
IEC 60204-31	NOTE Harmonized as EN 60204-31:1998 (modified).
IEC 60228	NOTE Harmonized as EN 60228:2005 (not modified).
IEC 60269-1	NOTE Harmonized as EN 60269-1:2007 (not modified).
IEC 60320-1	NOTE Harmonized as EN 60320-1:2001 (not modified).
IEC 60335	NOTE Harmonized in EN 60335 series (partially modified).
IEC 60364	NOTE Harmonized in EN/HD 60364 series (modified).
IEC 60870-5-1	NOTE Harmonized as EN 60870-5-1:1993 (not modified).
IEC 60898	NOTE Harmonized in EN 60898 series (modified).
IEC 60909	NOTE Harmonized in EN 60909 series (not modified).
IEC 60947-5-2	NOTE Harmonized as EN 60947-5-2:2007 (not modified).
IEC 61000-6-1	NOTE Harmonized as EN 61000-6-1:2007 (not modified).
IEC 61000-6-2	NOTE Harmonized as EN 61000-6-2:2005 (not modified).
IEC 61000-6-3	NOTE Harmonized as EN 61000-6-3:2007 (not modified).
IEC 61000-6-4	NOTE Harmonized as EN 61000-6-4:2007 (not modified).
IEC 61180-2	NOTE Harmonized as EN 61180-2:1994 (not modified).
IEC 61496-1	NOTE Harmonized as EN 61496-1:2004 (modified).
IEC 61557	NOTE Harmonized in EN 61557 series (not modified).
IEC 61558-2-17	NOTE Harmonized as EN 61558-2-17:1997 (not modified).
IEC 61800	NOTE Harmonized in EN 61800 series (not modified).
IEC 61984	NOTE Harmonized as EN 61984:2001 (not modified).
IEC 62305	NOTE Harmonized in EN 62305 series (not modified).
ISO 14122-1	NOTE Harmonized as EN ISO 14122-1:2001 (not modified).
ISO 14122-2	NOTE Harmonized as EN ISO 14122-2:2001 (not modified).
ISO 14122-3	NOTE Harmonized as EN ISO 14122-3:2001 (not modified).

---

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60034-1	- <sup>1)</sup>	Rotating electrical machines - Part 1: Rating and performance	EN 60034-1	2004 <sup>2)</sup>
IEC 60034-5	- <sup>1)</sup>	Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification	EN 60034-5	2001 <sup>2)</sup>
IEC 60034-11	- <sup>1)</sup>	Rotating electrical machines - Part 11: Thermal protection	EN 60034-11	2004 <sup>2)</sup>
IEC 60068-2-27	1987	Basic environmental testing procedures - Part 2: Tests - Test Ea and guidance: Shock	EN 60068-2-27	1993
IEC 60068-2-32 + A2	1975 1990	Environmental testing - Part 2: Tests. Test Ed: Free fall	EN 60068-2-32	1993
IEC 60072-1	- <sup>1)</sup>	Dimensions and output series for rotating electrical machines - Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1 080	-	-
IEC 60072-2	- <sup>1)</sup>	Dimensions and output series for rotating electrical machines - Part 2: Frame numbers 355 to 1 000 and flange numbers 1 180 to 2 360	-	-
IEC 60073	- <sup>1)</sup>	Basic and safety principles for man-machine interface, marking and identification - Coding principles for indicators and actuators	EN 60073	2002 <sup>2)</sup>
IEC 60309-1	- <sup>1)</sup>	Plugs, socket-outlets and couplers for industrial purposes - Part 1: General requirements	EN 60309-1 + A11	1999 <sup>2)</sup> 2004
IEC 60332	Series	Tests on electric and optical fibre cables under fire conditions	EN 60332	Series
IEC 60364-1 (mod)	- <sup>1)</sup>	Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions	HD 60364-1	2008 <sup>2)</sup>
IEC 60364-4-41 (mod)	2005	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock	HD 60364-4-41 + corr. July	2007 2007
IEC 60364-4-42	2001	Electrical installations of buildings - Part 4-42: Protection for safety - Protection against thermal effects	-	-

<sup>1)</sup> Undated reference.

<sup>2)</sup> Valid edition at date of issue.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60364-4-43	2001	Electrical installations of buildings - Part 4-43: Protection for safety - Protection against overcurrent	-	-
IEC 60364-5-52	2001	Electrical installations of buildings - Part 5-52: Selection and erection of electrical equipment - Wiring systems	-	-
IEC 60364-5-53 + A1 (mod)	2001 2002	Electrical installations of buildings - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control	- HD 60364-5-534	- 2008 <sup>3)</sup>
IEC 60364-5-54 (mod)	2002	Electrical installations of buildings - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements, protective conductors and protective bonding conductors	HD 60364-5-54	2007
IEC 60364-6 (mod)	2006	Low voltage electrical installations - Part 6: Verification	HD 60364-6	2007
IEC 60417	Data base	Graphical symbols for use on equipment	-	-
IEC 60439-1 A1	1999 2004	Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies	EN 60439-1 A1	1999 2004
IEC 60445 (mod)	- <sup>1)</sup>	Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals and conductor terminations	EN 60445	2007 <sup>2)</sup>
IEC 60446	1999	Basic and safety principles for man-machine interface, marking and identification - Identification of conductors by colours or numerals	EN 60446 <sup>4)</sup>	1999
IEC 60447	- <sup>1)</sup>	Basic and safety principles for man-machine interface, marking and identification - Actuating principles	EN 60447	2004 <sup>2)</sup>
IEC 60529 A1	1989 1999	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May A1	1991 1993 2000
IEC 60617	Data base	Graphical symbols for diagrams	-	-
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007
IEC 60898 (mod)	Series	Electrical accessories - Circuit breakers for overcurrent protection for household and similar installations	EN 60898	Series
IEC 60947-1	2007	Low-voltage switchgear and controlgear - Part 1: General rules	EN 60947-1	2007
IEC 60947-2	2006	Low-voltage switchgear and controlgear - Part 2: Circuit-breakers	EN 60947-2	2006

<sup>3)</sup> IEC 60364-5-53:2001/A1:2002, Clause 534: "Devices for protection against overvoltages" is harmonized as HD 60364-5-534.

<sup>4)</sup> EN 60446:1999 is superseded by EN 60446:2007, which is based on IEC 60446:2007.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60947-3	- <sup>1)</sup>	Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	EN 60947-3	1999 <sup>2)</sup>
IEC 60947-4-1 A1	2000 2002	Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters	EN 60947-4-1 A1	2001 2002
IEC 60947-5-1	2003	Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices	EN 60947-5-1 + corr. July	2004 2005
IEC 61082-1	2006	Preparation of documents used in electrotechnology - Part 1: Rules	EN 61082-1	2006
IEC 61140	- <sup>1)</sup>	Protection against electric shock - Common aspects for installation and equipment	EN 61140	2002 <sup>2)</sup>
IEC 61180-2	1994	High-voltage test techniques for low-voltage equipment - Part 2: Test equipment	EN 61180-2	1994
IEC 61310	Series	Safety of machinery - Indication, marking and actuation	EN 61310	Series
IEC 61346	Series	Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations	EN 61346	Series
IEC 61557-3	- <sup>1)</sup>	Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. - Equipment for testing, measuring or monitoring of protective measures - Part 3: Loop impedance	EN 61557-3	2007 <sup>2)</sup>
IEC 61558-1	- <sup>1)</sup>	Safety of power transformers, power supplies, reactors and similar products - Part 1: General requirements and tests	EN 61558-1 + corr. August	2005 <sup>2)</sup> 2006
IEC 61558-2-6	- <sup>1)</sup>	Safety of power transformers, power supply units and similar - Part 2-6: Particular requirements for safety isolating transformers for general use	EN 61558-2-6	1997 <sup>2)</sup>
IEC 61800-5-2	2007	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional	EN 61800-5-2	2007
IEC 61984	- <sup>1)</sup>	Connectors - Safety requirements and tests	EN 61984	2001 <sup>2)</sup>
IEC 62023	- <sup>1)</sup>	Structuring of technical information and documentation	EN 62023	2000 <sup>2)</sup>
IEC 62027	- <sup>1)</sup>	Preparation of parts lists	EN 62027	2000 <sup>2)</sup>
IEC 62061	- <sup>1)</sup>	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems	EN 62061	2005 <sup>2)</sup>
IEC 62079	- <sup>1)</sup>	Preparation of instructions - Structuring, content and presentation	EN 62079	2001 <sup>2)</sup>
ISO 7000	2004	Graphical symbols for use on equipment - Index and synopsis	-	-



<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO 12100-1	- <sup>1)</sup>	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology	EN ISO 12100-1	2003 <sup>2)</sup>
ISO 12100-2	2003	Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles	EN ISO 12100-2	2003
ISO 13849-1	2006	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design	EN ISO 13849-1	2006
ISO 13849-2	2003	Safety of machinery - Safety-related parts of control systems - Part 2: Validation	EN ISO 13849-2	2003
ISO 13850	2006	Safety of machinery - Emergency stop - Principles for design	EN ISO 13850	2008
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	-	-

## **Annex ZZ** (informative)

### **Coverage of Essential Requirements of EC Directives**

## **Annex ZZA** (informative)

### **Coverage of Essential Requirements of Directive 98/37/EC**

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers the following essential requirements out of those given in Annex I of the EC Directive 98/37/EC:

- 1.2 (except 1.2.4 "Complex installations")
- 1.5.1
- 1.5.4 (for faulty electrical connection)
- 1.6.3 (for isolation of electrical supplies of machinery)
- 1.6.4 (for access to electrical equipment)
- 1.7.0
- 1.7.1
- 1.7.2 (for residual risks of electrical nature)
- 1.7.4 c) (for electrical equipment)
- 4.2.1.3

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

## **Annex ZZB** (informative)

### **Coverage of Essential Requirements of Directive 2006/42/EC**

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers the following essential requirements out of those given in Annex I of the EC Directive 2006/42/EC:

- 1.2.1
- 1.2.2
- 1.2.3
- 1.2.4.1
- 1.2.4.3
- 1.2.5
- 1.2.6
- 1.5.1
- 1.5.4 (for faulty electrical connection)
- 1.6.3 (for isolation of electrical supplies of machinery)
- 1.6.4 (for access to electrical equipment)
- 1.7.1.1
- 1.7.1.2
- 1.7.2 (for residual risks of electrical nature)
- 1.7.4.2 e) (for electrical equipment)
- 3.3 (for cableless controls)
- 4.2.1

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

**WARNING:** Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

---

## CONTENTS

FOREWORD.....	9
INTRODUCTION.....	11
1 Scope.....	14
2 Normative references.....	15
3 Terms and definitions .....	18
4 General requirements .....	26
4.1 General considerations .....	26
4.2 Selection of equipment .....	27
4.2.1 General .....	27
4.2.2 Selection of power contactors .....	27
4.2.3 Electrical equipment in compliance with the IEC 60439 series .....	27
4.3 Electrical supply .....	27
4.3.1 General .....	27
4.3.2 AC supplies .....	27
4.3.3 DC supplies .....	28
4.3.4 On-board power supply .....	28
4.4 Physical environment and operating conditions .....	29
4.4.1 General .....	29
4.4.2 Electromagnetic compatibility (EMC) .....	29
4.4.3 Ambient air temperature.....	30
4.4.4 Humidity .....	30
4.4.5 Altitude .....	30
4.4.6 Contaminants .....	30
4.4.7 Ionizing and non-ionizing radiation .....	30
4.4.8 Vibration, shock, and bump.....	30
4.5 Transportation and storage .....	30
4.6 Provisions for handling .....	31
4.7 Installation.....	31
5 Incoming supply conductor terminations and devices for disconnecting and switching off .....	31
5.1 Incoming supply conductor terminations.....	31
5.2 Terminal for connection to the external protective earthing system .....	31
5.3 Supply disconnecting and switching devices.....	32
5.3.1 General .....	32
5.3.2 Type .....	32
5.3.3 Requirements .....	34
5.3.4 Operating means .....	34
5.3.5 Crane-supply-switch.....	34
5.3.6 Crane-disconnector.....	35
5.3.7 Crane-switch.....	36
5.3.8 Special circuits .....	37
5.4 Devices for switching off for prevention of unexpected start-up.....	37
5.5 Devices for disconnecting electrical equipment .....	38
5.6 Protection against unauthorized, inadvertent and/or mistaken connection .....	39
6 Protection against electric shock .....	39
6.1 General .....	39

6.2	Protection against direct contact .....	39
6.2.1	General .....	39
6.2.2	Protection by enclosures .....	39
6.2.3	Protection by insulation of live parts .....	40
6.2.4	Protection against residual voltages .....	41
6.2.5	Protection by barriers .....	41
6.2.6	Protection by placing out of reach or protection by obstacles .....	41
6.3	Protection against indirect contact .....	41
6.3.1	General .....	41
6.3.2	Prevention of the occurrence of a touch voltage .....	42
6.3.3	Protection by automatic disconnection of supply .....	42
6.4	Protection by the use of PELV .....	43
6.4.1	General requirements .....	43
6.4.2	Sources for PELV .....	43
7	Protection of equipment .....	43
7.1	General .....	43
7.2	Overcurrent protection .....	44
7.2.1	General .....	44
7.2.2	Supply conductors .....	44
7.2.3	Power circuits .....	44
7.2.4	Control circuits .....	45
7.2.5	Socket outlets and their associated conductors .....	45
7.2.6	Lighting circuits .....	45
7.2.7	Transformers .....	45
7.2.8	Location of overcurrent protective devices .....	45
7.2.9	Overcurrent protective devices .....	45
7.2.10	Rating and setting of overcurrent protective devices .....	46
7.3	Protection of motors against overheating .....	46
7.3.1	General .....	46
7.3.2	Overload protection .....	47
7.3.3	Over-temperature protection .....	47
7.3.4	Current limiting protection .....	47
7.4	Abnormal temperature protection .....	47
7.5	Protection against supply interruption or voltage reduction and subsequent restoration .....	47
7.6	Motor overspeed protection .....	48
7.7	Earth fault/residual current protection .....	48
7.8	Phase-sequence protection .....	48
7.9	Protection against switching surges and lightning .....	48
8	Equipotential bonding .....	49
8.1	General .....	49
8.2	Protective bonding circuit .....	51
8.2.1	General .....	51
8.2.2	Protective conductors .....	51
8.2.3	Continuity of the protective bonding circuit .....	52
8.2.4	Exclusion of switching devices from the protective bonding circuit .....	52
8.2.5	Parts that need not be connected to the protective bonding circuit .....	53
8.2.6	Protective conductor connecting points .....	53

8.2.7	Additional protective bonding requirements for electrical equipment having earth leakage currents higher than 10 mA a.c. or d.c.	53
8.3	Functional bonding	54
8.4	Measures to limit the effects of high leakage current	54
9	Control circuits and control functions	54
9.1	Control circuits	54
9.1.1	Control circuit supply	54
9.1.2	Control circuit voltages	54
9.1.3	Protection	55
9.2	Control functions	55
9.2.1	Start functions	55
9.2.2	Stop functions	55
9.2.3	Operating modes	55
9.2.4	Suspension of safeguarding	55
9.2.5	Operation	56
9.2.6	Other control functions	58
9.2.7	Cableless controls	59
9.3	Protective interlocks	61
9.3.1	Reclosing or resetting of an interlocking safeguard	61
9.3.2	Exceeding operating limits	61
9.3.3	Operation of auxiliary functions	62
9.3.4	Interlocks between different operations and for contrary motions	62
9.3.5	Reverse current braking	62
9.4	Control functions in the event of failure	62
9.4.1	General requirements	62
9.4.2	Measures to minimize risk in the event of failure	63
9.4.3	Protection against mal-operation due to earth faults, voltage interruptions, and loss of circuit continuity	64
9.4.4	Protection against mal-operation of a motion control system	66
10	Operator interface and hoisting machine mounted control devices	66
10.1	General	66
10.1.1	General device requirements	66
10.1.2	Location and mounting	66
10.1.3	Protection	67
10.1.4	Position sensors	67
10.1.5	Portable and pendant control stations	67
10.2	Push-buttons	67
10.2.1	Colours	67
10.2.2	Markings	68
10.3	Indicator lights and displays	69
10.3.1	General	69
10.3.2	Colours	69
10.3.3	Flashing lights and displays	70
10.4	Illuminated push-buttons	70
10.5	Rotary control devices	70
10.6	Start devices	70
10.7	Emergency stop devices	70
10.7.1	Location of emergency stop devices	70
10.7.2	Types of emergency stop device	71

10.7.3	Colour of actuators .....	71
10.7.4	Local operation of the crane-supply-switch and the crane-disconnector to effect emergency stop .....	71
10.8	Emergency switching-off devices .....	71
10.8.1	Location of emergency switching-off devices .....	71
10.8.2	Types of emergency switching off device .....	71
10.8.3	Colour of actuators .....	72
10.8.4	Local operation of the crane-supply-switch and the crane-disconnector to effect emergency switching off .....	72
10.9	Enabling control device .....	72
11	Controlgear: location, mounting, and enclosures .....	72
11.1	General requirements .....	72
11.2	Location and mounting .....	73
11.2.1	Accessibility and maintenance .....	73
11.2.2	Physical separation or grouping .....	73
11.2.3	Heating effects .....	74
11.3	Degrees of protection .....	74
11.4	Enclosures, doors and openings .....	74
11.5	Access to switchgear and to controlgear .....	75
11.5.1	General .....	75
11.5.2	Access to gangways .....	75
11.5.3	Gangways in front of switchgear and controlgear .....	76
11.5.4	Gangway and door restrictions .....	76
12	Conductors and cables .....	76
12.1	General requirements .....	76
12.2	Conductors .....	76
12.3	Insulation .....	77
12.4	Current-carrying capacity in normal service .....	78
12.5	Voltage drop .....	79
12.6	Flexible cables .....	80
12.6.1	General .....	80
12.6.2	Mechanical rating .....	80
12.6.3	Current-carrying capacity of cables wound on drums .....	80
12.7	Conductor wires, conductor bars and slip-ring assemblies .....	81
12.7.1	Protection against direct contact .....	81
12.7.2	Protective conductor circuit .....	83
12.7.3	Protective conductor current collectors .....	83
12.7.4	Removable current collectors with a disconnector function .....	83
12.7.5	Clearances in air .....	83
12.7.6	Creepage distances .....	83
12.7.7	Conductor system sectioning .....	84
12.7.8	Construction and installation of conductor wire, conductor bar systems and slip-ring assemblies .....	84
13	Wiring practices .....	84
13.1	Connections and routing .....	84
13.1.1	General requirements .....	84
13.1.2	Conductor and cable runs .....	85
13.1.3	Conductors of different circuits .....	85
13.1.4	Connection between pick-up and pick-up converter of an inductive power supply system .....	85

13.2	Identification of conductors .....	86
13.2.1	General requirements .....	86
13.2.2	Identification of the protective conductor .....	86
13.2.3	Identification of the neutral conductor .....	86
13.2.4	Identification by colour .....	86
13.3	Wiring inside enclosures .....	87
13.4	Wiring outside enclosures .....	87
13.4.1	General requirements .....	87
13.4.2	External ducts .....	87
13.4.3	Connection to the hoisting machine and to moving elements on the hoisting machine .....	88
13.4.4	Interconnection of devices on the hoisting machine .....	89
13.4.5	Plug/socket combinations .....	89
13.4.6	Dismantling for shipment .....	90
13.4.7	Additional conductors .....	90
13.5	Ducts, connection boxes and other boxes .....	90
13.5.1	General requirements .....	90
13.5.2	Percentage fill of ducts .....	91
13.5.3	Rigid metal conduits and fittings .....	91
13.5.4	Flexible metal conduits and fittings .....	91
13.5.5	Flexible non-metallic conduits and fittings .....	91
13.5.6	Cable trunking systems .....	91
13.5.7	Hoisting machine compartments and cable trunking systems .....	92
13.5.8	Connection boxes and other boxes .....	92
13.5.9	Motor connection boxes .....	92
14	Electric motors and associated equipment .....	92
14.1	General requirements .....	92
14.2	Motor enclosures .....	92
14.3	Motor dimensions .....	92
14.4	Motor mounting and compartments .....	92
14.5	Criteria for motor selection .....	93
14.6	Protective devices for mechanical brakes .....	93
14.7	Electrically operated mechanical brakes .....	93
15	Accessories and lighting .....	94
15.1	Accessories .....	94
15.2	Local lighting on the hoisting machine and for the equipment .....	94
15.2.1	General .....	94
15.2.2	Supply .....	94
15.2.3	Protection .....	95
15.2.4	Fittings .....	95
16	Marking, warning signs and reference designations .....	95
16.1	General .....	95
16.2	Warning signs .....	95
16.2.1	Electric shock hazard .....	95
16.2.2	Hot surfaces hazard .....	95
16.3	Functional identification .....	96
16.4	Marking of equipment .....	96
16.5	Reference designations .....	96
17	Documentation .....	96



17.1	General .....	96
17.2	Information to be provided .....	97
17.3	Requirements applicable to all documentation.....	97
17.4	Installation documents .....	98
17.5	Overview diagrams and function diagrams .....	98
17.6	Circuit diagrams .....	99
17.7	Operating manual .....	99
17.8	Maintenance manual.....	99
17.9	Parts list.....	99
18	Verification .....	100
18.1	General .....	100
18.2	Verification of conditions for protection by automatic disconnection of supply .....	100
18.2.1	General .....	100
18.2.2	Test methods in TN-systems.....	100
18.2.3	Application of the test methods for TN-systems .....	101
18.3	Insulation resistance tests .....	103
18.4	Voltage tests .....	103
18.5	Protection against residual voltages .....	104
18.6	Functional tests .....	104
18.7	Retesting.....	104
Annex A	(normative) Protection against indirect contact in TN-systems.....	105
Annex B	(informative) Inquiry form for the electrical equipment of hoisting machines .....	109
Annex C	(informative) Current-carrying capacity and overcurrent protection of conductors and cables in the electrical equipment of machines.....	112
Annex D	(informative) Conductor selection for intermittent duty .....	117
Annex E	(informative) Explanation of emergency operation functions .....	120
Annex F	(informative) Comparison of typical conductor cross-sectional areas .....	121
Bibliography	.....	123
Index	.....	128
Figure 1	– Block diagram of combined working cranes in a typical material handling system in a seaport .....	12
Figure 2	– Block diagram of a typical crane and its associated electrical equipment .....	13
Figure 3	– Examples of electrical supply systems .....	33
Figure 4	– Example of equipotential bonding for electrical equipment of a hoisting machine .....	50
Figure 5	– Protection against mal-operation due to earth faults – Method a).....	65
Figure 6	– Protection against mal-operation due to earth faults – Method b).....	65
Figure 7	– Limits of arm's reach .....	82
Figure A.1	– Typical arrangement for fault loop impedance measurement.....	108
Figure C.1	– Methods of conductor and cable installation independent of number of conductors/cables .....	113
Figure C.2	– Parameters of conductors and protective devices .....	115

Figure D.1 – Example of current and time of the segments of the operating cycle of a variable speed a.c. hoist drive .....	119
Table 1 – Minimum cross-sectional area of the external protective copper conductor .....	32
Table 2 – Colour-coding for push-button actuators and their meanings .....	68
Table 3 – Symbols for push-buttons .....	69
Table 4 – Colours for indicator lights and their meanings with respect to the condition of the hoisting machine .....	69
Table 5 – Minimum cross-sectional areas of copper conductors .....	77
Table 6 – Classification of conductors .....	77
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 .....	79
Table 8 – Derating factors for cables wound on drums .....	81
Table 9 – Minimum permitted bending radii for the forced guiding of flexible cables .....	89
Table 10 – Application of the test methods for TN-systems .....	101
Table 11 – Examples of maximum cable length from each protective device to its load .....	102
Table A.1 – Maximum disconnecting times for TN systems .....	105
Table C.1 – Correction factors .....	112
Table C.2 – Derating factors from $I_Z$ for grouping .....	114
Table C.3 – Derating factors from $I_Z$ for multi-core cables up to 10 mm <sup>2</sup> .....	114
Table C.4 – Maximum allowable conductor temperatures under normal and short-circuit conditions .....	116
Table D.1 – Correction factor for 10 min cycle .....	118
Table D.2 – Thermal time constant of conductors .....	118
Table F.1 – Comparison of conductor sizes .....	121

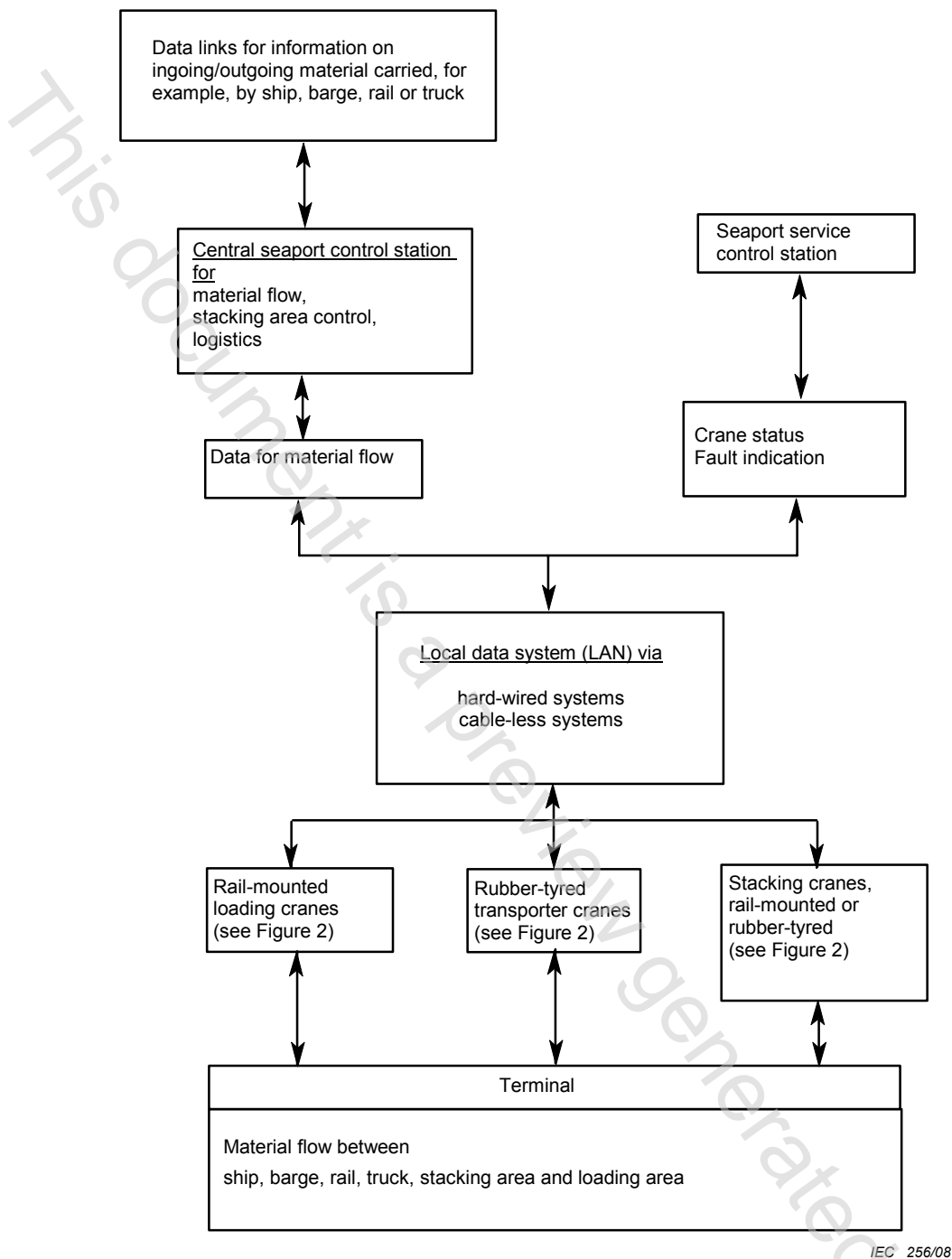
## INTRODUCTION

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

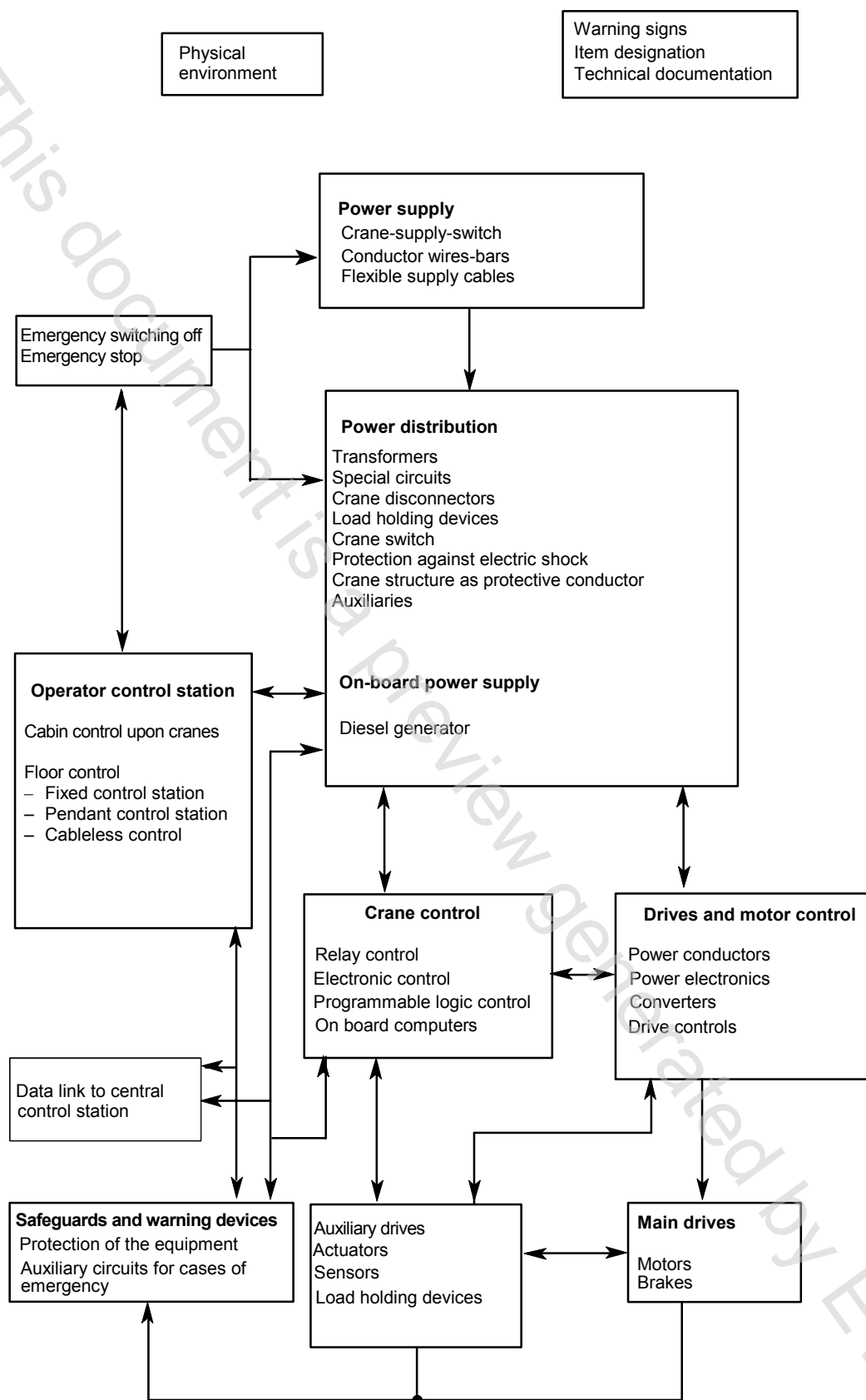
- safety of persons and property;
- consistency of control response;
- ease of maintenance.

High performance is not to be obtained at the expense of the essential factors mentioned above.

Figures 1 and 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 standard.



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



IEC 257/08

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 equipment and systems to hoisting machines and related equipment.

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

NOTE 2 In the context of this standard, 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 standard commences at the point of connection of the supply to the electrical equipment of the hoisting machine (crane-supply-switch) including 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.

This standard is applicable to equipment or parts of equipment not exceeding 1 000 V a.c. or 1 500 V d.c. between lines and with nominal frequencies not exceeding 200 Hz.

NOTE 4 For higher voltages, see IEC 60204-11.

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 (for example, paint or sawdust);
- are intended for use in potentially explosive and/or flammable atmospheres;
- are intended for use in mines.

For the purposes of this standard, 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).

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

## 2 Normative references

The following referenced documents are indispensable for the application 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, *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, *Basic environmental testing procedures – Part 2-27: Tests – Test Ea and guidance: Shock*

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

IEC 60072-1, *Dimensions and output series for rotating electrical machines – 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 60073, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators*

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

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

IEC 60364-1, *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 60364-4-42:2001, *Electrical installations of buildings – Part 4-42: Protection for safety – Protection against thermal effects*

IEC 60364-4-43:2001, *Electrical installations of buildings – Part 4-43: Protection for safety – Protection against overcurrent*

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

IEC 60364-5-53:2002, *Electrical installations of buildings – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control*

IEC 60364-5-54:2002, *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, *Low-voltage electrical installations – Part 6: Verification*

IEC 60417, *Graphical symbols for use on equipment*

IEC 60439-1:1999, *Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested and partially type-tested assemblies*<sup>1</sup>  
Amendment 1 (2004)

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

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

IEC 60447, *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*

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

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, *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, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*  
Amendment 1 (2002)<sup>2</sup>

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

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

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

---

<sup>1</sup> There exists a consolidated edition 4.1 (2004) that includes edition 4 and its amendment.

<sup>2</sup> There exists a consolidated edition 2.1 (2002) that includes edition 2 and its amendment.



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

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

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

IEC 61558-2-6, *Safety of power transformers, power supply units and similar – Part 2-6: Particular requirements for safety isolating transformers for general use*

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*

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

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, *Safety of machinery – Emergency stop – 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*