

© Copyright SEK. Reproduction in any form without permission is prohibited.

Maskinsäkerhet – Maskiners elutrustning – Del 32: Särskilda fordringar på maskiner för lyftning

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

Som svensk standard gäller europastandarden EN 60204-32:2008. Den svenska standarden innehåller den officiella engelska språkversionen av EN 60204-32:2008.

Nationellt förord

Europastandarden EN 60204-32:2008

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 60204-32, Second edition, 2008 - Safety of machinery - Electrical equipment of machines - Part 32: Requirements for hoisting machines**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 60204-32, utgåva 1, 1999, gäller ej fr o m 2011-07-01.

Standarder underlättar utvecklingen och höjer elsäkerheten

Det finns många fördelar med att ha gemensamma tekniska regler för bl a säkerhet, prestanda, dokumentation, utförande och skötsel av elprodukter, elanläggningar och metoder. Genom att utforma sådana standarder blir säkerhetskraven tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

SEK är Sveriges röst i standardiseringsarbetet inom elområdet

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

Stora delar av arbetet sker internationellt

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

Var med och påverka!

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

SEK Svensk Elstandard

Box 1284
164 29 Kista
Tel 08-444 14 00
www.elstandard.se

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	- ¹⁾	Rotating electrical machines - Part 1: Rating and performance	EN 60034-1	2004 ²⁾
IEC 60034-5	- ¹⁾	Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification	EN 60034-5	2001 ²⁾
IEC 60034-11	- ¹⁾	Rotating electrical machines - Part 11: Thermal protection	EN 60034-11	2004 ²⁾
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	- ¹⁾	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	- ¹⁾	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	- ¹⁾	Basic and safety principles for man-machine interface, marking and identification - Coding principles for indicators and actuators	EN 60073	2002 ²⁾
IEC 60309-1	- ¹⁾	Plugs, socket-outlets and couplers for industrial purposes - Part 1: General requirements	EN 60309-1 + A11	1999 ²⁾ 2004
IEC 60332	Series	Tests on electric and optical fibre cables under fire conditions	EN 60332	Series
IEC 60364-1 (mod)	- ¹⁾	Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions	HD 60364-1	2008 ²⁾
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	-	-

¹⁾ Undated reference.

²⁾ 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 ³⁾
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)	- ¹⁾	Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals and conductor terminations	EN 60445	2007 ²⁾
IEC 60446	1999	Basic and safety principles for man-machine interface, marking and identification - Identification of conductors by colours or numerals	EN 60446 ⁴⁾	1999
IEC 60447	- ¹⁾	Basic and safety principles for man-machine interface, marking and identification - Actuating principles	EN 60447	2004 ²⁾
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

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

⁴⁾ 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	- ¹⁾	Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	EN 60947-3	1999 ²⁾
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	- ¹⁾	Protection against electric shock - Common aspects for installation and equipment	EN 61140	2002 ²⁾
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	- ¹⁾	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 ²⁾
IEC 61558-1	- ¹⁾	Safety of power transformers, power supplies, reactors and similar products - Part 1: General requirements and tests	EN 61558-1 + corr. August	2005 ²⁾ 2006
IEC 61558-2-6	- ¹⁾	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 ²⁾
IEC 61800-5-2	2007	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional	EN 61800-5-2	2007
IEC 61984	- ¹⁾	Connectors - Safety requirements and tests	EN 61984	2001 ²⁾
IEC 62023	- ¹⁾	Structuring of technical information and documentation	EN 62023	2000 ²⁾
IEC 62027	- ¹⁾	Preparation of parts lists	EN 62027	2000 ²⁾
IEC 62061	- ¹⁾	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems	EN 62061	2005 ²⁾
IEC 62079	- ¹⁾	Preparation of instructions - Structuring, content and presentation	EN 62079	2001 ²⁾
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	- ¹⁾	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology	EN ISO 12100-1	2003 ²⁾
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	-	-

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

CONTENTS

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 mm² 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.

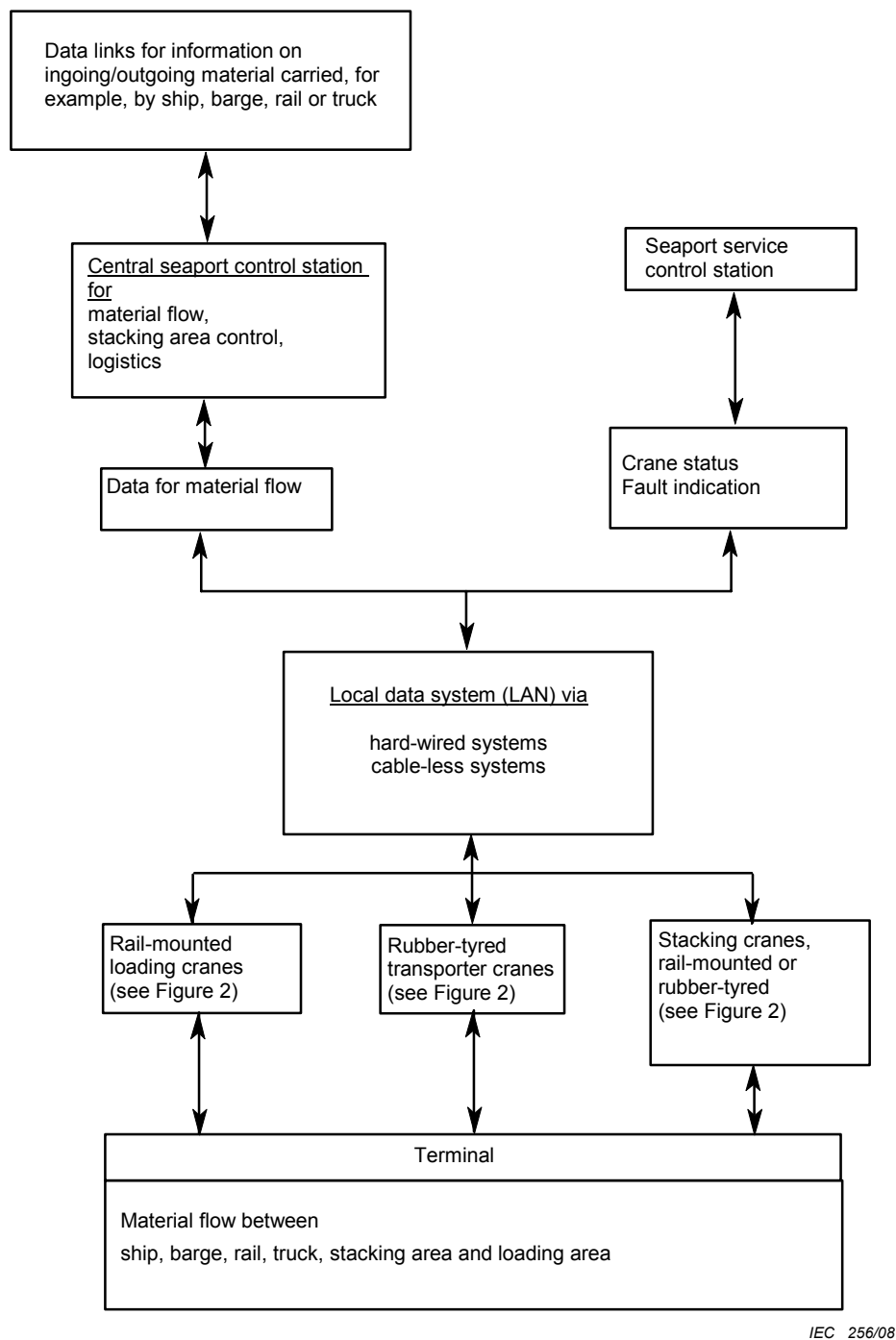
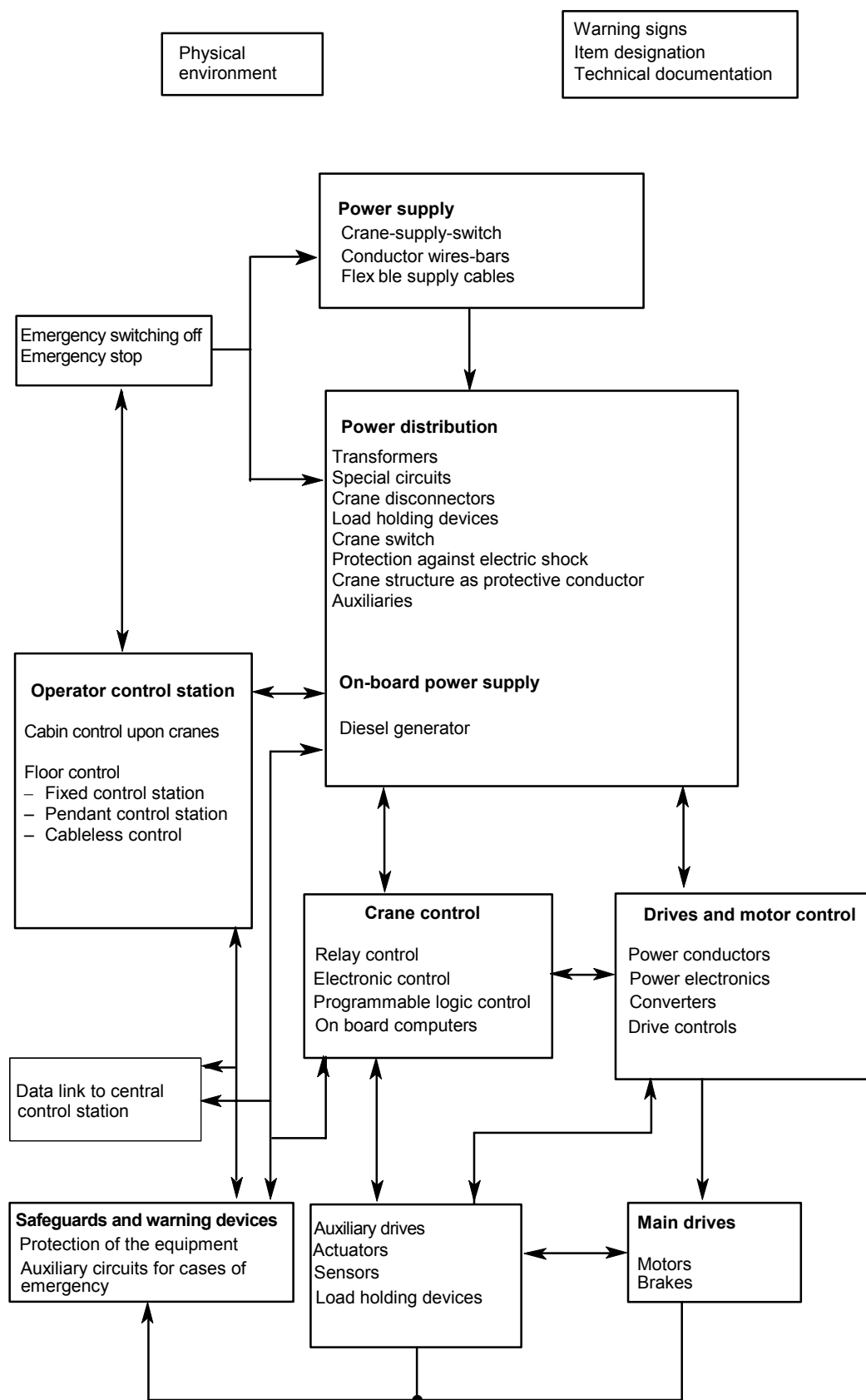


Figure 1 – Block diagram of combined working cranes in a typical material handling system in a seaport



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*