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Safety of machinery – Electrical equipment of machines – Part 11: Requirements for ~~HV~~ equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV

INTERNATIONAL
ELECTROTECHNICAL
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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SAFETY OF MACHINERY – ELECTRICAL EQUIPMENT OF MACHINES –

Part 11: Requirements for ~~HV~~ equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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6) All users should ensure that they have the latest edition of this publication.
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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 redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60204-11 has been prepared by IEC technical committee 44: Safety of machinery – Electrotechnical aspects.

This second edition cancels and replaces the first edition, published in 2000. This edition constitutes a technical revision.

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

– aspects of risk assessment, which are mirrored from ISO 12100;
– equipotential bonding and earthing;
– EMC and power quality;
– HV switchgear and controlgear;
– creepage distances for conductors and slip-ring assemblies;
– a list of machinery using HV equipment, in Annex A.

This second edition of IEC 60204-11 has been updated and improved to reflect the experience gained with the first edition and the evolution of high-voltage equipment reflected in the relevant standards.

Regarding formal requirements, IEC 60204-11 has been aligned with

– IEC 60204-1:2016,
– IEC 61936-1:2010 and IEC 61936-1:2010/AMD1:2014,
– IEC 62271 (all parts).

This document is intended to be used in conjunction with IEC 60204-1.

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

FDIS	Report on voting
44/819/FDIS	44/828/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60204 series, published under the general title *Safety of machinery – Electrical equipment of machines,* can be found on the IEC website.

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

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IMPORTANT – The 'colour inside' logo on the cover page of this publication 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 high-voltage electrical equipment (HV equipment) of machines together with its associated low-voltage electrical equipment (LV equipment) so as to promote

– safety of persons and property,

– consistency of control response,

– ~~ease of maintenance~~ maintainability.

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

~~An example of a possible application of these requirements is a machine or group of machines used for the processing of a material where a failure in such machinery can have serious economic consequences.~~

Figure 1 is a block diagram of a machine and associated equipment showing the various elements of the electrical equipment addressed in this document. Numbers in parentheses (…) refer to clauses and subclauses in this document. It is understood that all of the elements taken together including the safeguards, software and the documentation constitute the machine or group of machines working together with usually at least one level of supervisory control.

~~More guidance on the use of this standard is given in annex F of IEC 60204-1.~~

This document should be used in conjunction with IEC 60204-1. HV equipment can include LV control parts in the same general enclosure or in separate compartments.

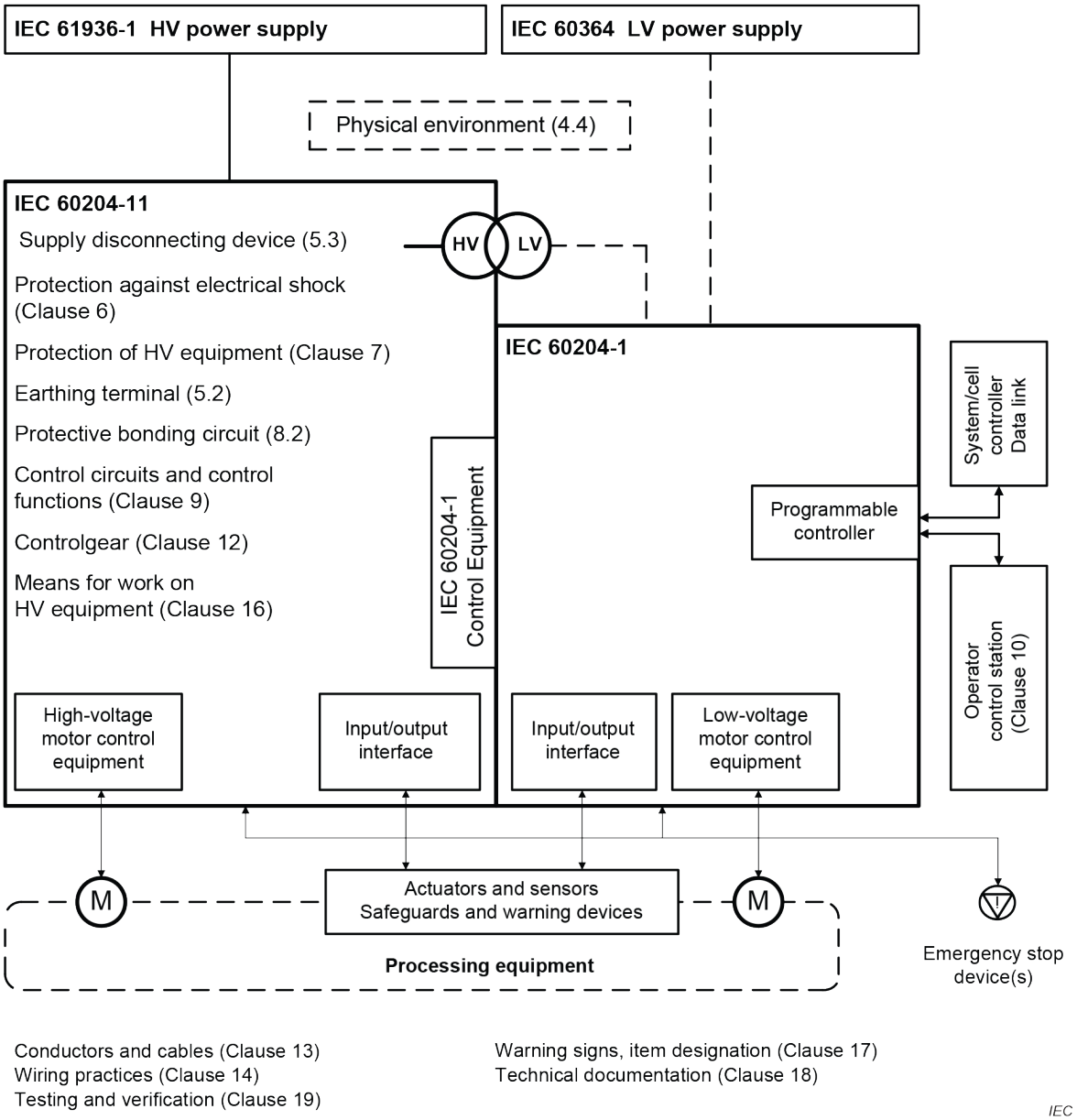

Figure 1 – Block diagram of a machine containing HV equipment

SAFETY OF MACHINERY – ELECTRICAL EQUIPMENT OF MACHINES –

Part 11: Requirements for ~~HV~~ equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV

1 Scope

This part of IEC 60204 applies to electrical and electronic equipment and systems to machines, including a group of machines working together in a co-ordinated manner, ~~but excluding higher level system aspects (i.e. communications between systems)~~ which operate at nominal voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV AC or DC with nominal frequencies not exceeding 60 Hz.

~~This part of IEC 60204 is applicable to equipment, or parts of equipment, which operate with nominal supply voltages above 1 000 V a.c. or 1 500 V d.c. and not exceeding 36 kV a.c. or d.c. with nominal frequencies not exceeding 200 Hz. For higher voltages or frequencies, special requirements may be needed.~~

In this document, the term HV equipment also covers the LV equipment forming an integral part of the equipment operating at high voltage. The requirements in this document primarily cover the parts operating at high-voltage except where explicitly stated otherwise. ~~Reference is made to IEC 60204-1 for those requirements which also apply to HV equipment.~~

NOTE 1 ~~Other~~ LV equipment not forming part of the HV equipment ~~and defined as operating at voltages not exceeding 1 000 V a.c. or 1 500 V d.c. are~~ is covered by IEC 60204-1:2016.

NOTE 2 In this document, the term "electrical" includes both electrical and electronic matters (i.e. electrical equipment means both the electrical and the electronic equipment).

NOTE 3 This document does not apply to independent high-voltage power supply installations for which separate IEC standards exist.

The electrical equipment covered by this document commences at the point of connection of the supply to the electrical equipment of the machine (see 5.1).

~~NOTE For the requirements for power supply installations, see HD 637.~~

NOTE 4 For the requirements for high-voltage power supply installations, see IEC 61936-1.

This document is ~~an application~~ a generic safety standard ~~and is not intended to limit or inhibit technological advancement~~. It does not cover all the requirements (e.g. guarding, interlocking or control) which are needed or required by other standards or regulations in order to safeguard personnel from hazards other than electrical hazards. Each type of machine has unique requirements to be accommodated to provide adequate safety.

NOTE 5 In some machines the high-voltage power supply can be produced by a step-up transformer (autotransformer), supplied by a low-voltage system (e.g. by a LV generator).

NOTE 6 In the context of this document, the term "person" refers to any individual; "personnel" are those persons who are assigned and instructed by the user or his agent(s) in the use and care of the machine in question.

This part of IEC 60204 specifically includes, but is not limited to, machines as defined in 3.29 (Annex A lists examples of machines whose electrical equipment ~~may~~ can be covered by this document).

For protection against electric shock from high-voltage equipment, this document refers to IEC 61936-1. When it comes to low-voltage equipment, this document refers to IEC 60204-1:2016.

NOTE 7 High- and low-voltage standards use different terms regarding protection against electric shock. Whereas high-voltage standards use the terms “direct contact” and “indirect contact”, low-voltage standards correspondingly use “basic protection” and “fault protection”.

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

– are used in the open air (i.e. outside buildings or other protective structures);
– use, process or produce potentially explosive material (e.g. paint or sawdust);
– are used in potentially explosive and/or flammable atmospheres;
– have special risks when producing or using certain materials;
– are used in mines.

~~Power circuits where electrical energy is directly used as a working tool are excluded from this part of IEC 60204.~~

Hazards as a result of noise and vibration are excluded from the scope of this document.

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 60034-1:1996, *Rotating electrical machines – Part 1: Rating and performance*~~

~~IEC 60050(191):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 191: Dependability and quality of service*~~

~~IEC 60050-195:1998, *International Electrotechnical Vocabulary (IEV) – Part 195: Earthing and protection against electric shock*~~

~~IEC 60050(441):1984, *International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*~~

~~IEC 60050(826):1982, *International Electrotechnical Vocabulary (IEV) – Chapter 826: Electrical installations of buildings*~~

~~IEC 60050(826):1995, amendment No. 2~~

~~IEC 60071-1:1993, *Insulation co-ordination – Part 1: Definitions, principles and rules*~~

IEC 60071-2:1996, *Insulation co-ordination – Part 2: Application guide*

IEC 60076-5~~:1976~~, *Power transformers – Part 5: Ability to withstand short-circuit*

~~IEC 60129:1984, *Alternating current disconnectors and earthing switches*~~

~~IEC 60298:1990, *A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*~~

~~IEC 60364-4-41:1992, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electric shock*~~

~~IEC 60364-4-42:1980, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 42: Protection against thermal effects*~~

IEC 60204-1:~~1997~~ 2016, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60364-5-54:~~1980~~ 2011, *Low-voltage electrical installations ~~of buildings~~ – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

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

~~IEC 60420:1990, *High-voltage alternating current switch-fuse combinations*~~

IEC 60445~~:1999~~, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals ~~and of terminations of certain designated~~, conductor terminations and conductors~~, including general rules for an alphanumeric system~~*

~~IEC 60466:1987, *A.C. insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 38 kV*~~

IEC 60529~~:1989~~, *Degrees of protection provided by enclosures (IP Code)*

~~IEC 60621-3:1979, *Electrical installations for outdoor sites under heavy conditions (including open-cast mines and quarries) – Part 3: General requirements for equipment and ancillaries*~~

~~IEC 60694:1996, *Common specifications for high-voltage switchgear and controlgear standards*~~

IEC 60865-1~~:1993~~, *Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods*

~~IEC 61230:1993, *Live working – Portable equipment for earthing or earthing and short-circuiting*~~

~~IEC 61243-1:1993, *Live working – Voltage detectors – Part 1: Capacitive type to be used for voltages exceeding 1 kV a.c.*~~

~~IEC 61310-1:1995, *Safety of machinery – Indication, marking and actuation – Part 1: Requirements for visual, auditory and tactile signals*~~

~~IEC 61310-3:1999, *Safety of machinery – Indication, marking and actuation – Part 3: Requirements for the location and operation of actuators*~~

IEC 61800 (all parts), *Adjustable speed electrical power drive systems*

IEC 61936-1:2010, *Power installations exceeding 1 kV a.c. – Part 1: Common rules*
IEC 61936-1:2010/AMD1:2014

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

IEC 62271-102, *High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches*

IEC 62271-103, *High-voltage switchgear and controlgear – Part 103: Switches for rated voltages above 1 kV up to and including 52 kV*

IEC 62271-105, *High-voltage switchgear and controlgear – Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV*

IEC 62271-107, *High-voltage switchgear and controlgear – Part 107: Alternating current fused circuit-switchers for rated voltages above 1 kV up to and including 52 kV*

IEC 62271-200:2011, *High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

IEC 62271-201, *High-voltage switchgear and controlgear – Part 201: AC solid-insulation enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

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

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

ISO 3864-1:~~1984~~ 2011, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings*

ISO 3864-2:2016, *Graphical symbols –Safety colours and safety signs – Part 2: Design principles for product safety labels*

ISO 7010:2011, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

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

~~ISO/TR 12100-1:1992, *Safety of machinery – Basic concepts, general principles for design – Part 1: Basic terminology, methodology*~~

~~EN 50178:1997, *Electronic equipment for use in power stations*~~

~~HD 637:1999, *Power installations exceeding 1 kV a.c.*~~

IEC 60204-11

Edition 2.0 2018-07

INTERNATIONAL STANDARD

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Safety of machinery – Electrical equipment of machines – Part 11: Requirements for equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV

Sécurité des machines – Équipement électrique des machines – Partie 11: Exigences pour les équipements fonctionnant à des tensions supérieures à 1 000 V en courant alternatif ou 1 500 V en courant continu et ne dépassant pas 36 kV

IEC 60204-11:2018-07(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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– safety of persons and property,

– consistency of control response,

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Figure 1 is a block diagram of a machine and associated equipment showing the various elements of the electrical equipment addressed in this document. Numbers in parentheses (…) refer to clauses and subclauses in this document. It is understood that all of the elements taken together including the safeguards, software and the documentation constitute the machine or group of machines working together with usually at least one level of supervisory control.

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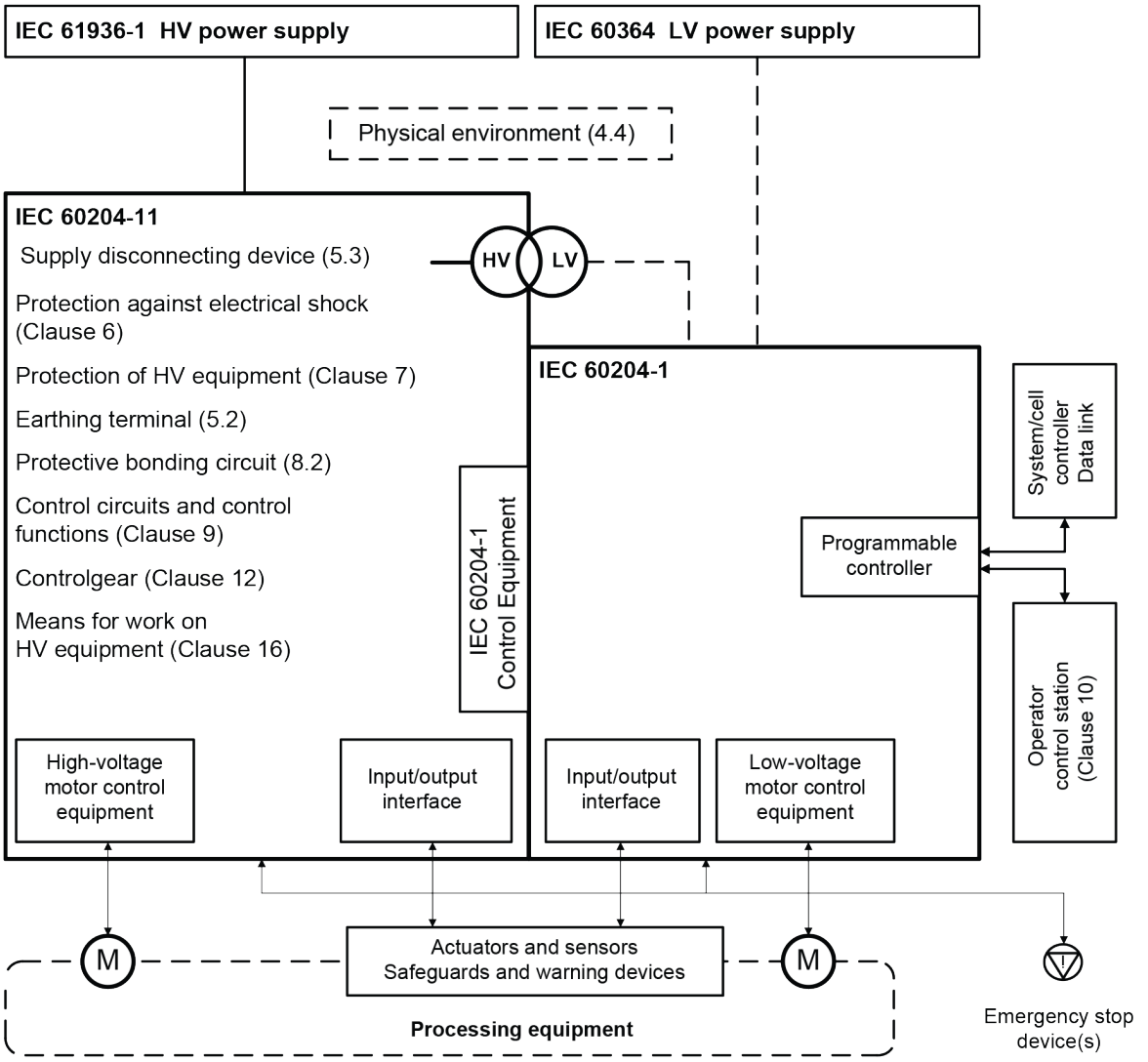

Figure 1 – Block diagram of a machine containing HV equipment

SAFETY OF MACHINERY – ELECTRICAL EQUIPMENT OF MACHINES –

Part 11: Requirements for equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV

1 Scope

This part of IEC 60204 applies to electrical and electronic equipment and systems to machines, including a group of machines working together in a co-ordinated manner, which operate at nominal voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV AC or DC with nominal frequencies not exceeding 60 Hz.

In this document, the term HV equipment also covers the LV equipment forming an integral part of the equipment operating at high voltage. The requirements in this document primarily cover the parts operating at high-voltage except where explicitly stated otherwise.

NOTE 1 LV equipment not forming part of the HV equipment is covered by IEC 60204-1:2016.

NOTE 2 In this document, the term "electrical" includes both electrical and electronic matters (i.e. electrical equipment means both the electrical and the electronic equipment).

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IEC 60076-5, *Power transformers – Part 5: Ability to withstand short-circuit*

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

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

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

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

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

IEC 60865-1, *Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods*

IEC 61800 (all parts), *Adjustable speed electrical power drive systems*

IEC 61936-1:2010, *Power installations exceeding 1 kV a.c. – Part 1: Common rules*
IEC 61936-1:2010/AMD1:2014

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

IEC 62271-102, *High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches*

IEC 62271-103, *High-voltage switchgear and controlgear – Part 103: Switches for rated voltages above 1 kV up to and including 52 kV*

IEC 62271-105, *High-voltage switchgear and controlgear – Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV*

IEC 62271-107, *High-voltage switchgear and controlgear – Part 107: Alternating current fused circuit-switchers for rated voltages above 1 kV up to and including 52 kV*

IEC 62271-200:2011, *High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

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

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

ISO 3864-1:2011, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings*

ISO 3864-2:2016, *Graphical symbols –Safety colours and safety signs – Part 2: Design principles for product safety labels*

ISO 7010:2011, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

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

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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SÉCURITÉ DES MACHINES – ÉQUIPEMENT ÉLECTRIQUE DES MACHINES –

Partie 11: Exigences pour les équipements fonctionnant à des tensions supérieures à 1 000 V en courant alternatif ou 1 500 V en courant continu et ne dépassant pas 36 kV

AVANT-PROPOS

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La Norme internationale IEC 60204-11 a été établie par le comité d'études 44 de l'IEC: Sécurité des machines – Aspects électrotechniques.

Cette deuxième édition annule et remplace la première édition parue en 2000. Cette édition constitue une révision technique.

Cette édition contient des modifications techniques majeures par rapport à l'édition précédente qui concernent:

– les aspects liés à l'appréciation du risque, tirés de l'ISO 12100;
– les liaisons équipotentielles et la mise à la terre;

– la CEM et la qualité de la puissance;
– les appareillages à haute tension;
– les lignes de fuite pour conducteurs et ensembles de bagues collectrices;
– une liste des machines utilisant des équipements HT dans l'Annexe A.

Cette deuxième édition de l'IEC 60204-11 a été mise à jour et améliorée sur la base de l'expérience acquise avec la première édition et sur la base de l'évolution des équipements haute tension décrits dans les normes applicables.

Concernant les exigences de forme, l'IEC 60204-11 a été alignée sur

– l'IEC 60204-1:2016,
– l'IEC 61936-1:2010 et l'IEC 61936-1:2010/AMD1:2014,
– l'IEC 62271 (toutes les parties).

Cette norme est destinée à être utilisée conjointement avec l'IEC 60204-1.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
44/819/FDIS	44/828/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60204, publiée sous le titre général *Sécurité des machines – Équipement électrique des machines*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous «http://webstore.iec.ch» dans les données relatives au document recherché. À cette date, le document sera

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INTRODUCTION

La présente partie de l'IEC 60204 donne les exigences et recommandations relatives à l'équipement électrique haute tension (équipement HT) ainsi qu'à l'équipement électrique basse tension (équipement BT) des machines en vue d'améliorer

– la sécurité des personnes et des biens,

– la cohérence de réponse des commandes,

– la maintenabilité.

La Figure 1 est un schéma fonctionnel d'une machine et de l'équipement associé représentant les différents éléments de l'équipement électrique traité dans le présent document. Les chiffres entre parenthèses (…) se rapportent aux articles et aux paragraphes du présent document. Il est admis que la totalité des éléments pris ensemble, y compris les moyens de protection, les logiciels et la documentation, constitue la machine ou le groupe de machines fonctionnant ensemble avec habituellement au moins un niveau de supervision.

Il convient d'utiliser le présent document conjointement avec l'IEC 60204-1. Les équipements HT peuvent comprendre les parties BT de commande situées dans la même enveloppe générale ou dans des compartiments séparés.

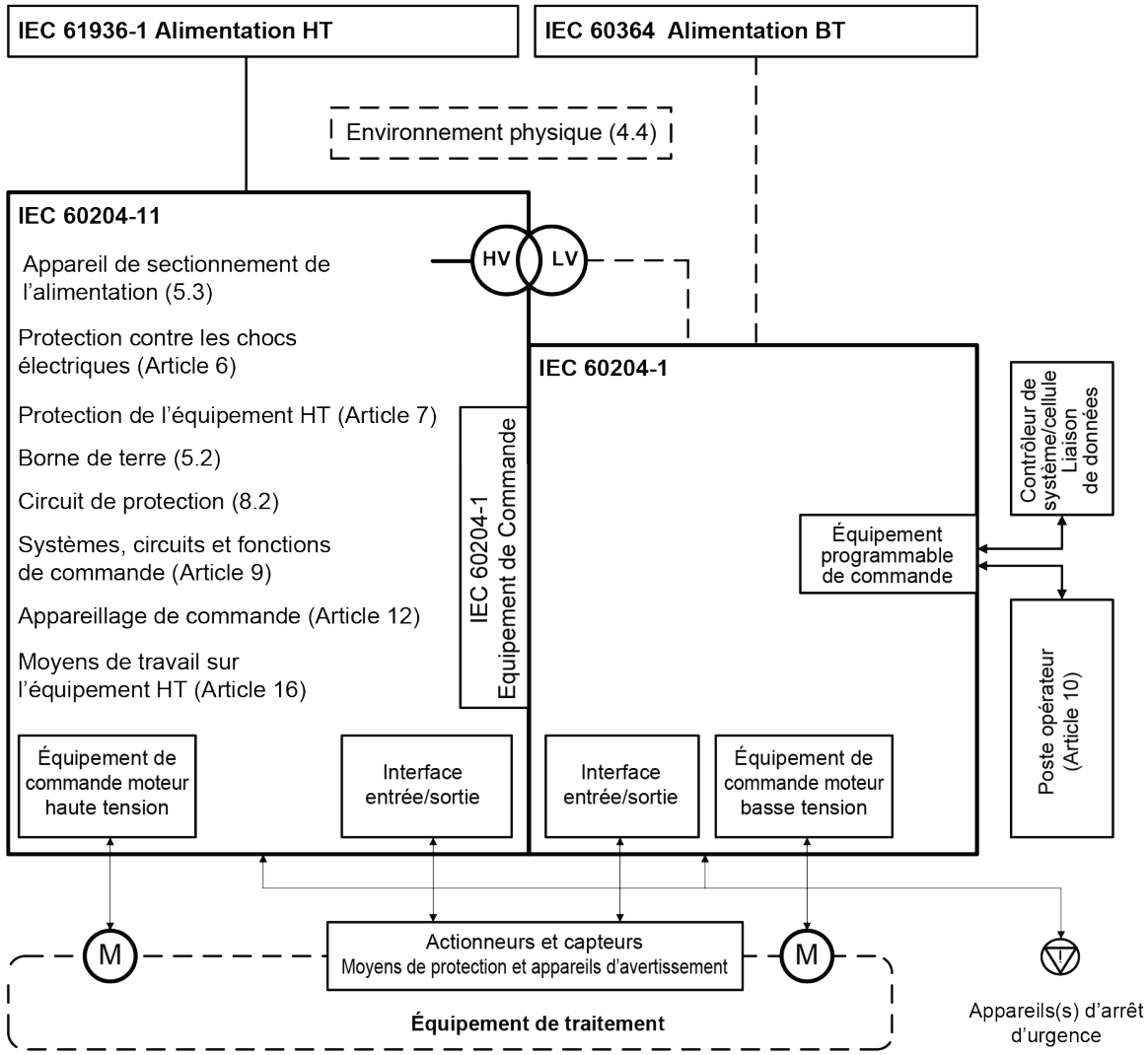

Figure 1 – Schéma fonctionnel d'une machine comportant des équipements HT

SÉCURITÉ DES MACHINES – ÉQUIPEMENT ÉLECTRIQUE DES MACHINES –

Partie 11: Exigences pour les équipements fonctionnant à des tensions supérieures à 1 000 V en courant alternatif ou 1 500 V en courant continu et ne dépassant pas 36 kV

1 Domaine d'application

La présente partie de l'IEC 60204 est applicable aux équipements et systèmes électriques et électroniques des machines, y compris à un groupe de machines fonctionnant de manière coordonnée, qui fonctionnent à une tension nominale supérieure à 1 000 V en courant alternatif ou 1 500 V en courant continu et non supérieure à 36 kV en courant alternatif ou continu et pour des fréquences nominales n'excédant pas 60 Hz.

Dans le présent document, le terme «équipement HT» couvre aussi l'équipement BT faisant partie intégrante de l'équipement fonctionnant en haute tension. Les exigences du présent document couvrent essentiellement les parties fonctionnant en haute tension, sauf spécification explicite contraire.

NOTE 1 Les équipements BT qui ne font pas partie de l'équipement HT sont couverts par l'IEC 60204-1:2016.

NOTE 2 Dans le présent document, le terme «électrique» est utilisé dans le sens général d'électrique et d'électronique (c'est-à-dire que le terme «équipement électrique» désigne à la fois l'équipement électrique et l'équipement électronique).

NOTE 3 Le présent document ne s'applique pas aux installations électriques haute tension indépendantes pour lesquelles des normes IEC spécifiques existent.

L'équipement électrique défini dans le présent document commence au point de raccordement de l'alimentation à l'équipement électrique de la machine (voir 5.1).

NOTE 4 Pour les exigences d'installations électriques haute tension, voir l'IEC 61936-1.

Le présent document est une norme générique de sécurité. Elle ne couvre pas toutes les exigences (par exemple, protection, verrouillage ou commande) qui sont nécessaires ou exigées par d'autres normes ou réglementations destinées à protéger les personnes contre des phénomènes dangereux autres que les phénomènes dangereux électriques. Chaque type de machine est couvert par des exigences qui lui sont propres et qui sont à prendre en compte pour obtenir une sécurité adéquate.

NOTE 5 Dans certaines machines, l'alimentation à haute tension peut être produite par un transformateur élévateur (autotransformateur) alimenté par un système basse tension (par exemple, par un générateur basse tension).

NOTE 6 Dans le cadre du présent document, le terme «personne» s'applique à n'importe quel individu et le terme «personnel» fait référence aux personnes désignées et formées par l'utilisateur ou par son ou ses agent(s) à l'utilisation ou l'entretien de la machine concernée.

Le présent document inclut, entre autres, les machines, comme défini en 3.29 (l'Annexe A énumère des exemples de machines dont l'équipement électrique peut être couvert par le présent document).

Concernant la protection contre les chocs électriques provenant d'équipements haute tension, le présent document fait référence à l'IEC 61936-1. Lorsqu'il s'agit d'équipements basse tension, le présent document fait référence à l'IEC 60204-1:2016.

NOTE 7 Les normes relatives aux hautes et basses tensions utilisent différents termes concernant la protection contre les chocs électriques. Tandis que les normes relatives à la haute tension utilisent les termes «contact direct» et «contact indirect», les normes relatives à la basse tension utilisent respectivement «protection principale» et «protection en cas de défaut».

Des exigences complémentaires et spécifiques peuvent s'appliquer à l'équipement électrique des machines qui

– sont utilisées à l'air libre (c'est-à-dire à l'extérieur de bâtiments ou d'autres structures de protection);
– utilisent, transforment ou produisent des matériaux potentiellement explosifs (par exemple de la peinture ou de la sciure);
– sont utilisées dans des atmosphères potentiellement explosives et/ou inflammables;
– présentent des risques particuliers lors de la fabrication ou de l'utilisation de certains matériaux;
– sont utilisées dans les mines.

Les phénomènes dangereux résultant de bruits et de vibrations sont exclus du domaine d'application du présent document.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60071-2:1996, *Coordination de l'isolement – Partie 2: Guide d'application*

IEC 60076-5, *Transformateurs de puissance – Partie 5: Tenue au court-circuit*

IEC 60204-1:2016, *Sécurité des machines – Équipement électrique des machines – Partie 1: Exigences générales*

IEC 60364-5-54:2011, *Installations électriques basse-tension – Partie 5-54: Choix et mise en œuvre des matériels électriques – Installations de mise à la terre et conducteurs de protection*

IEC 60417, *Symboles graphiques utilisables sur le matériel* (disponible à l'adresse http://www.graphical-symbols.info/equipment)

IEC 60445, *Principes fondamentaux et de sécurité pour les interfaces hommes-machines, le marquage et l'identification – Identification des bornes de matériels, des extrémités de conducteurs et des conducteurs*

IEC 60529, *Degrés de protection procurés par les enveloppes (Code IP)*

IEC 60865-1, *Courants de court-circuit – Calcul des effets – Partie 1: Définitions et méthodes de calcul*

IEC 61800 (toutes les parties), *Entraînements électriques de puissance à vitesse variable*

IEC 61936-1:2010, *Installations électriques en courant alternatif de puissance supérieure à 1 kV – Partie 1: Règles communes*
IEC 61936-1:2010/AMD1:2014

IEC 62061, *Sécurité des machines – Sécurité fonctionnelle des systèmes de commande électriques, électroniques et électroniques programmables relatifs à la sécurité*

IEC 62271-102, *Appareillage à haute tension – Partie 102: Sectionneurs et sectionneurs de terre à courant alternatif*

IEC 62271-103, *Appareillage à haute tension – Partie 103: Interrupteurs pour tensions assignées supérieures à 1 kV et inférieures ou égales à 52 kV*

IEC 62271-105, *Appareillage à haute tension – Partie 105: Combinés interrupteurs-fusibles pour courant alternatif de tensions assignées supérieures à 1 kV et jusqu'à 52 kV inclus*

IEC 62271-107, *Appareillage à haute tension – Partie 107: Circuits-switchers fusiblés pour courant alternatif de tension assignée supérieure à 1 kV et jusqu'à 52 kV inclus*

IEC 62271-200:2011, *Appareillage à haute tension – Partie 200: Appareillage sous enveloppe métallique pour courant alternatif de tensions assignées supérieures à 1 kV et inférieures ou égales à 52 kV*

IEC 62271-201, *Appareillage à haute tension – Partie 201: Appareillage sous enveloppe isolante solide pour courant alternatif de tensions assignées supérieures à 1 kV et inférieures ou égales à 52 kV*

IEC 62745, *Sécurité des machines – Exigences pour les systèmes de commande sans fil des machines*

ISO 13849-1, *Sécurité des machines – Parties des systèmes de commande relatives à la sécurité – Partie 1: Principes généraux de conception*

ISO 3864-1:2011, *Symboles graphiques – Couleurs de sécurité et signaux de sécurité – Partie 1: Principes de conception pour les signaux de sécurité et les marquages de sécurité*

ISO 3864-2:2016, *Symboles graphiques – Couleurs de sécurité et signaux de sécurité – Partie 2: Principes de conception pour l'étiquetage de sécurité des produits*

ISO 7010:2011, *Symboles graphiques – Couleurs de sécurité et signaux de sécurité – Signaux de sécurité enregistrés*

ISO 12100, *Sécurité des machines – Principes généraux de conception – Appréciation du risque et réduction du risque*

EN 50178, *Electronic equipment for use in power installations* (disponible en anglais seulement)