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Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This Redline version provides you with a quick and easy way to compare all the changes between this standard and its 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 60947-4-1 has been prepared by subcommittee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

This fourth edition cancels and replaces the third edition published in 2009 and its Amendment 1:2012. This edition constitutes a technical revision.

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

- Scope structure and exclusions
- Editorial correction of notes and hanging paragraphs
- Reference to IEC 62683-1
- Motor protective switching device (MPSD) with its requirements
- Safety aspects related to:
  - General aspects;
  - Limited energy circuits;
  - Electronic circuits;
  - Assessment procedure for electromechanical overload protection used in safety - applications (new Annex L)
- Introduction of provisions covering the impact of higher locked rotor current to achieve high efficiency class
- Mention of dedicated wiring accessories
- Pickup power measurement
- Alignment to IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010, and IEC 60947-1:2007/AMD2:2014
- Direct current requirements for covering photovoltaic application (new Annex M)
- Load monitoring indicators (new Annex O)
- Short-circuit breaking tests of MPSD (new Annex P)
- Co-ordination under short-circuit conditions between a MPSD and another short-circuit protective device associated in the same circuit (new Annex Q)

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

FDIS	Report on voting
121A/224/FDIS	121A/233/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 of the IEC 60947 series can be found, under the general title *Low-voltage switchgear and controlgear,* on the IEC website.

This document shall be read in conjunction with IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010, IEC 60947-1:2007/AMD2:2014, *Low voltage switchgear and controlgear – Part 1: General rules*. The provisions of the general rules are applicable to this document, where specifically called for.

The provisions of the general rules dealt with IEC 60947-1 are applicable to this part of IEC 60947 series where specifically called for. Clauses and subclauses, tables, figures and annexes of the general rules thus applicable are identified by reference to IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010, and IEC 60947-1:2007/AMD2:2014. For example, 4.3.4.1 of IEC 60947-1:2007, Table 4 of IEC 60947-1:2007, or Annex A of IEC 60947-1:2007.

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

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

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INTRODUCTION

This document introduces the requirements for motor protection switching devices (MPSD).

MPSDs have been available on the market for many years. They are introduced in this document for covering the minimum safety and performance requirements of a manual motor starter with integral electromechanical or electronic short-circuit protection. This device fulfils all requirements of a starter and specific requirements of a circuit-breaker according to IEC 60947-2, mainly I_{cu} and I_{cs}, for protecting the motor and its circuit with control devices e.g. a contactor. An MPSD is not intended to support neutral pole, DC ratings, rated uninterrupted current I_u, backup protection, short-circuit tripping time-delay, selectivity category, withdrawable capability, RCD, recloser, EMC requirements of IEC 60947-2, etc.

Circuit-breakers according to Annex O of IEC 60947-2:2016 with motor overload protection characteristic according to this document but without starter ratings e.g. AC-3 are also available on the market. These devices are not covered by this document.

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters

1 Scope ~~and object~~

~~1.1 Scope~~

~~This part of IEC 60947 applies to the types of equipment listed in 1.1.1 and 1.1.2 whose main contacts are intended to be connected to circuits the rated voltage of which does not exceed 1 000 V a.c. or 1 500 V d.c.~~

~~Starters and/or contactors dealt with in this standard are not normally designed to interrupt short-circuit currents. Therefore, suitable short-circuit protection (see 9.3.4) forms part of the installation but not necessarily of the contactor or the starter.~~

~~In this context, this standard gives requirements for:~~

- ~~contactors associated with overload and/or short-circuit protective devices;~~
- ~~starters associated with separate short-circuit protective devices and/or with separate short-circuit and integrated overload protective devices;~~
- ~~contactors or starters combined, under specified conditions, with their own short-circuit protective devices. Such combinations, e.g. combination starters or protected starters are rated as units.~~

~~For circuit-breakers and fuse-combination units used as short-circuit protective devices in combination starters and in protected starters, the requirements of IEC 60947-2 and IEC 60947-3 respectively apply.~~

~~Equipment covered by this standard is as follows.~~

~~1.1.1 AC and DC contactors~~

~~AC and DC contactors intended for closing and opening electric circuits and, if combined with suitable relays (see 1.1.2), for protecting these circuits against operating overloads which may occur therein.~~

~~NOTE For contactors combined with suitable relays and which are intended to provide short-circuit protection, the relevant conditions specified for circuit-breakers (IEC 60947-2) additionally apply.~~

~~This standard applies also to the actuators of contactor relays and to the contacts dedicated exclusively to the coil circuit of a contactor.~~

~~Contactors or starters with an electronically controlled electromagnet are also covered by this standard.~~

~~1.1.2 AC motor-starters~~

~~AC motor-starters intended to start and accelerate motors to normal speed, to ensure continuous operation of motors, to switch off the supply from the motor and to provide means for the protection of motors and associated circuits against operating overloads.~~

~~For overload relays for starters, including those based on electronic technology with or without extended functions according to Annex H, the requirements of this standard apply.~~

~~1.1.2.1 Direct-on-line (full voltage) a.c. starters~~

~~Direct-on-line starters intended to start and accelerate a motor to normal speed, to provide means for the protection of the motor and its associated circuits against operating overloads, and to switch off the supply from the motor.~~

~~This standard applies also to reversing starters.~~

~~1.1.2.2 Reduced voltage a.c. starters~~

~~Reduced voltage a.c. starters intended to start and accelerate a motor to normal speed by connecting the line voltage across the motor terminals in more than one step or by gradually increasing the voltage applied to the terminals, to provide means for the protection of the motor and its associated circuits against operating overloads, and to switch off the supply from the motor.~~

~~Automatic change-over devices may be used to control the successive switching operations from one step to the others. Such automatic change-over devices are, for example, time-delay contactor relays or specified time all-or-nothing relays, under-current devices and automatic acceleration control devices (see 5.10).~~

~~1.1.2.2.1 Star-delta starters~~

~~Star-delta starters intended to start a three-phase motor in the star connection, to ensure continuous operation in the delta connection, to provide means for the protection of the motor and its associated circuits against operating overloads, and to switch off the supply from the motor.~~

~~The star-delta starters dealt with in this standard are not intended for reversing motors rapidly and, therefore, utilization category AC-4 does not apply.~~

~~NOTE In the star connection, the current in the line and the torque of the motor are about one-third of the corresponding values for delta connection. Therefore, star-delta starters are used when the inrush current due to the starting is to be limited, or when the driven machine requires a limited torque for starting. Figure 1 indicates typical curves of starting current, of starting torque of the motor and of torque of the driven machine.~~

~~1.1.2.2.2 Two-step auto-transformer starters~~

~~Two-step auto-transformer starters, intended to start and accelerate an a.c. induction motor from rest with reduced torque to normal speed and to provide means for the protection of the motor and its associated circuits against operating overloads, and to switch off the supply from the motor.~~

~~This standard applies to auto-transformers which are part of the starter or which constitute a unit specially designed to be associated with the starter.~~

~~Auto-transformer starters with more than two steps are not covered by this standard.~~

~~The auto-transformer starters dealt with in this standard are not intended for inching duty or reversing motors rapidly and, therefore, utilization category AC-4 does not apply.~~

~~NOTE In the starting position, the current in the line and the torque of the motor related to the motor starting with rated voltage are reduced approximately as the square of the ratio (starting voltage):(rated voltage). Therefore, auto-transformer starters are used when the inrush current due to the starting is to be limited or when the driven machine requires a limited torque for starting. Figure 2 indicates typical curves of starting current, of starting torque of the motor and of torque of the driven machine.~~

1.1.2.3 Rheostatic rotor starters

Starters intended to start an a.c. induction motor having a wound rotor by cutting out resistors previously inserted in the rotor circuit, to provide means for the protection of the motor against operating overloads and to switch off the supply from the motor.

In the case of asynchronous slip-ring motors (wound-rotors), the highest voltage between open slip-rings is not greater than twice the rated insulation voltage of the switching devices inserted in the rotor circuit (see 5.3.1.1.2).

NOTE This requirement is based on the fact that the electric stresses are less severe in the rotor than in the stator and are of short duration.

This standard applies also to starters for two directions of rotation when reversal of connections is made with the motor stopped (see 5.3.5.5). Operations including inching and plugging necessitate additional requirements and are subject to agreement between manufacturer and user.

This standard applies to resistors which are part of the starter or constitute a unit specially designed to be associated with the starter.

1.2 Exclusions

This standard does not apply to:

- d.c. starters;
- star-delta starters, rheostatic rotor starters, two-step auto-transformer starters intended for special applications and designed for continuous operation in the starting position;
- unbalanced rheostatic rotor starters, i.e. where the resistances do not have the same value in all phases;
- equipment designed not only for starting, but also for adjustment of speed;
- liquid starters and those of the "liquid-vapour" type;
- semiconductor contactors and starters making use of semiconductor contactors in the main circuit;
- rheostatic stator starters;
- contactors or starters designed for special applications;
- auxiliary contacts of contactors and contacts of contactor relays. These are dealt with in IEC 60947-5-1.

1.3 Object

The object of this standard is to state:

a) the characteristics of contactors and starters and associated equipment;

b) the conditions applicable to contactors and starters with reference to:

   1) their operation and behaviour,

   2) their dielectric properties,

   3) the degrees of protection provided by their enclosures, where applicable,

   4) their construction;

c) the tests intended for confirming that these conditions have been met, and the methods to be adopted for these tests;

d) the information to be given with the equipment or in the manufacturer's literature.

This part of IEC 60947 is applicable to the following equipment:

– electromechanical contactors and starters including motor protective switching device (MPSD);
– actuators of contactor relays;
– contacts dedicated exclusively to the coil circuit of this contactor or this contactor relay;
– dedicated accessories (e.g. dedicated wiring, dedicated latch accessory);

intended to be connected to distribution circuits, motors circuits and other load circuits, the rated voltage of which does not exceed 1 000 V AC or 1 500 V DC.

This document covers also the assessment procedure for electromechanical overload protection used in safety applications such as protecting a motor located in explosive atmosphere from the outside atmosphere: See Annex L.

This document does not apply to:

– starters for DC motors[1];

NOTE 1 The requirements for DC motor starters are under consideration for the next maintenance cycle.

– auxiliary contacts of contactors and contacts of contactor relays. These are covered by IEC 60947-5-1;
– starter used downstream to frequency drive[1];

NOTE 2 Additional requirements for starter used downstream to frequency drive are under consideration for the next maintenance cycle.

– short-circuit protective device integrated within starters other than MPSDs. This is covered by IEC 60947-2 and IEC 60947-3;
– the use of the product with additional measure within explosive atmospheres. These are given in IEC 60079 series;
– embedded software design rules[1];
– cyber security aspects. These are covered by IEC 62443 series.

The objective of this document is to state:

a) the characteristics of the equipment;
b) the conditions applicable to the equipment with reference to:
   1) its operation and behaviour,
   2) its dielectric properties,
   3) its degree of protection,
   4) its construction including safety measures against electric shock, fire hazard and mechanical hazard;
c) the tests intended for confirming that these conditions have been met, and the methods to be adopted for these tests;
d) the information to be given with the equipment or in the manufacturer's literature.

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

[1] For this subject the manufacturer is responsible for taking additional safety measures.

cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60034-1:~~2004~~ 2017, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-12:2016, *Rotating electrical machines – Part 12: Starting performance of single-speed three-phase cage induction motors*

IEC 60034-30-1, *Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE code)*

IEC 60038, *IEC standard voltages*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60079-14, *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

~~IEC 60300-3-5:2001, *Dependability management – Part 3-5: Application guide – Reliability test conditions and statistical test principles*~~

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

IEC 60364-7-712, *Low voltage electrical installations – Part 7-712: Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems*

~~IEC 60410:1973, *Sampling* plans *and procedures for inspection by attributes*~~

IEC 60715:2017, *Dimensions of low-voltage switchgear and controlgear – Standardized mounting on rails for mechanical support of switchgear, controlgear and accessories*

IEC 60730-1, *Automatic electrical controls – Part 1: General requirements*

IEC 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*
IEC 60947-1:2007/AMD1:2010
IEC 60947-1:2007/AMD2:2014

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

~~IEC 60947-3:2008, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*~~

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

~~IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*~~

~~IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test* Amendment 1 (2007)~~

~~IEC 61000-4-4:2004, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*~~

~~IEC 61000-4-5:2005, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*~~

~~IEC 61000-4-6:2008, *Electromagnetic compatibility (EMC) – Part 4-6:Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*~~

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61051-2, *Varistors for use in electronic equipment – Part 2: Sectional specification for surge suppression varistors*

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

~~IEC 61439-1:2009, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*~~

~~IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*~~

~~IEC 61511 (all parts), *Functional safety – Safety instrumented systems for the process industry sector*~~

~~IEC 61513:2001, *Nuclear power plants - Instrumentation and control for systems important to safety – General requirements for systems*~~

~~IEC 61649:2008, *Weibull analysis*~~

IEC 61810-1~~:2008~~, *Electromechanical elementary relays – Part 1: General and safety requirements* ~~(available in English only)~~

~~IEC 62061:2005, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*~~

~~CISPR 11:2003, *Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement*~~
~~Amendment 1 (2004)~~
~~Amendment 2 (2006)~~

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2015/AMD1:2016

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

ISO 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

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

IEC 60947-4-1

Edition 4.0 2018-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Low-voltage switchgear and controlgear –
Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters

Appareillage à basse tension –
Partie 4-1: Contacteurs et démarreurs de moteurs – Contacteurs et démarreurs électromécaniques



IEC 60947-4-1:2018-10(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters

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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International Standard IEC 60947-4-1 has been prepared by subcommittee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

This fourth edition cancels and replaces the third edition published in 2009 and its Amendment 1:2012. This edition constitutes a technical revision.

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

- Scope structure and exclusions
- Editorial correction of notes and hanging paragraphs
- Reference to IEC 62683-1
- Motor protective switching device (MPSD) with its requirements

- Safety aspects related to:
  - General aspects;
  - Limited energy circuits;
  - Electronic circuits;
  - Assessment procedure for electromechanical overload protection used in safety - applications (new Annex L)
- Introduction of provisions covering the impact of higher locked rotor current to achieve high efficiency class
- Mention of dedicated wiring accessories
- Pickup power measurement
- Alignment to IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010, and IEC 60947-1:2007/AMD2:2014
- Direct current requirements for covering photovoltaic application (new Annex M)
- Load monitoring indicators (new Annex O)
- Short-circuit breaking tests of MPSD (new Annex P)
- Co-ordination under short-circuit conditions between a MPSD and another short-circuit protective device associated in the same circuit (new Annex Q)

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

FDIS	Report on voting
121A/224/FDIS	121A/233/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 of the IEC 60947 series can be found, under the general title *Low-voltage switchgear and controlgear,* on the IEC website.

This document shall be read in conjunction with IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010, IEC 60947-1:2007/AMD2:2014, *Low voltage switchgear and controlgear – Part 1: General rules*. The provisions of the general rules are applicable to this document, where specifically called for.

The provisions of the general rules dealt with IEC 60947-1 are applicable to this part of IEC 60947 series where specifically called for. Clauses and subclauses, tables, figures and annexes of the general rules thus applicable are identified by reference to IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010, and IEC 60947-1:2007/AMD2:2014. For example, 4.3.4.1 of IEC 60947-1:2007, Table 4 of IEC 60947-1:2007, or Annex A of IEC 60947-1:2007.

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

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

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 document introduces the requirements for motor protection switching devices (MPSD).

MPSDs have been available on the market for many years. They are introduced in this document for covering the minimum safety and performance requirements of a manual motor starter with integral electromechanical or electronic short-circuit protection. This device fulfils all requirements of a starter and specific requirements of a circuit-breaker according to IEC 60947-2, mainly I_{cu} and I_{cs}, for protecting the motor and its circuit with control devices e.g. a contactor. An MPSD is not intended to support neutral pole, DC ratings, rated uninterrupted current I_u, backup protection, short-circuit tripping time-delay, selectivity category, withdrawable capability, RCD, recloser, EMC requirements of IEC 60947-2, etc.

Circuit-breakers according to Annex O of IEC 60947-2:2016 with motor overload protection characteristic according to this document but without starter ratings e.g. AC-3 are also available on the market. These devices are not covered by this document.

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters

1 Scope

This part of IEC 60947 is applicable to the following equipment:

– electromechanical contactors and starters including motor protective switching device (MPSD);
– actuators of contactor relays;
– contacts dedicated exclusively to the coil circuit of this contactor or this contactor relay;
– dedicated accessories (e.g. dedicated wiring, dedicated latch accessory);

intended to be connected to distribution circuits, motors circuits and other load circuits, the rated voltage of which does not exceed 1 000 V AC or 1 500 V DC.

This document covers also the assessment procedure for electromechanical overload protection used in safety applications such as protecting a motor located in explosive atmosphere from the outside atmosphere: See Annex L.

This document does not apply to:

– starters for DC motors[1];

NOTE 1 The requirements for DC motor starters are under consideration for the next maintenance cycle.

– auxiliary contacts of contactors and contacts of contactor relays. These are covered by IEC 60947-5-1;
– starter used downstream to frequency drive[1];

NOTE 2 Additional requirements for starter used downstream to frequency drive are under consideration for the next maintenance cycle.

– short-circuit protective device integrated within starters other than MPSDs. This is covered by IEC 60947-2 and IEC 60947-3;
– the use of the product with additional measure within explosive atmospheres. These are given in IEC 60079 series;
– embedded software design rules[1];
– cyber security aspects. These are covered by IEC 62443 series.

The objective of this document is to state:

a) the characteristics of the equipment;
b) the conditions applicable to the equipment with reference to:
   1) its operation and behaviour,
   2) its dielectric properties,
   3) its degree of protection,

[1] For this subject the manufacturer is responsible for taking additional safety measures.

4) its construction including safety measures against electric shock, fire hazard and mechanical hazard;

c) the tests intended for confirming that these conditions have been met, and the methods to be adopted for these tests;

d) the information to be given with the equipment or in the manufacturer's literature.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 60034-12:2016, *Rotating electrical machines – Part 12: Starting performance of single-speed three-phase cage induction motors*

IEC 60034-30-1, *Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE code)*

IEC 60038, *IEC standard voltages*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60079-14, *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

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

IEC 60364-7-712, *Low voltage electrical installations – Part 7-712: Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems*

IEC 60715:2017, *Dimensions of low-voltage switchgear and controlgear – Standardized mounting on rails for mechanical support of switchgear, controlgear and accessories*

IEC 60730-1, *Automatic electrical controls – Part 1: General requirements*

IEC 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*
IEC 60947-1:2007/AMD1:2010
IEC 60947-1:2007/AMD2:2014

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

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

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61051-2, *Varistors for use in electronic equipment – Part 2: Sectional specification for surge suppression varistors*

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

IEC 61810-1, *Electromechanical elementary relays – Part 1: General and safety requirements*

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2015/AMD1:2016

ISO 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

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

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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APPAREILLAGE À BASSE TENSION –

Partie 4-1: Contacteurs et démarreurs de moteurs – Contacteurs et démarreurs électromécaniques

AVANT-PROPOS

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La Norme internationale IEC 60947-4-1 a été établie par le sous-comité 121A: Appareillage à basse tension, du comité d'études 121 de l'IEC: Appareillages et ensembles d'appareillages basse tension.

Cette quatrième édition annule et remplace la troisième édition parue en 2009, ainsi que son Amendement 1:2012. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- Structure du domaine d'application et exclusions
- Corrections rédactionnelles des notes et des alinéas suspendus

- Référence à l'IEC 62683-1
- Appareil de connexion de protection des moteurs (ACPM) accompagné de ses exigences
- Aspects relatifs à la sécurité:
  - Aspects généraux;
  - Circuits limités en énergie;
  - Circuits électroniques;
  - Procédure d'évaluation de la protection électromécanique contre les surcharges utilisée dans des applications de sécurité (nouvelle Annexe L)
- Introduction des dispositions relatives à l'impact du courant rotor bloqué plus élevé afin d'atteindre une classe de rendement supérieure
- Mention des accessoires de câblage dédiés
- Mesurage de la puissance d'appel
- Alignement avec l'IEC 60947-1:2007, l'IEC 60947-1:2007/AMD1:2010, et l'IEC 60947-1:2007/AMD2:2014
- Exigences en matière de courant continu pour couvrir les applications photovoltaïques (nouvelle Annexe M)
- Indicateurs de surveillance de charge (nouvelle Annexe O)
- Essais de coupure en court-circuit de l'ACPM (nouvelle Annexe P)
- Coordination dans les conditions de court-circuit entre un ACPM et un autre dispositif de protection contre les courts-circuits associés dans le même circuit (nouvelle Annexe Q)

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

FDIS	Rapport de vote
121A/224/FDIS	121A/233/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 60947, publiées sous le titre général *Appareillage à basse tension,* peut être consultée sur le site web de l'IEC.

Le présent document doit être lu conjointement avec l'IEC 60947-1:2007, l'IEC 60947-1:2007/AMD1:2010, l'IEC 60947-1:2007/AMD2:2014, *Appareillage à basse tension – Partie 1: Règles générales*. Les dispositions des règles générales sont applicables au présent document, lorsque cela est spécifiquement mentionné.

Les dispositions des règles générales présentées dans l'IEC 60947-1 sont applicables à la présente partie de la série IEC 60947, lorsque cela est spécifiquement mentionné. Les articles et paragraphes, les tableaux, les figures et les annexes des règles générales qui sont donc applicables sont identifiés en référence à l'IEC 60947-1:2007, à l'IEC 60947-1:2007/AMD1:2010 et à l'IEC 60947-1:2007/AMD2:2014. Par exemple, 4.3.4.1 de l'IEC 60947-1:2007, Tableau 4 de l'IEC 60947-1:2007 ou Annexe A de l'IEC 60947-1:2007.

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

Ce document introduit les exigences relatives aux appareils de connexion de protection des moteurs (ACPM).

Les ACPM sont disponibles sur le marché depuis de nombreuses années. Ils sont présentés dans ce document pour couvrir les exigences minimales de sécurité et de performances d'un démarreur moteur à main comportant une protection intégrale, électromécanique ou électronique, contre les courts-circuits. Cet appareil satisfait à toutes les exigences d'un démarreur et aux exigences spécifiques d'un disjoncteur conformément à l'IEC 60947-2 (plus particulièrement I_{cu} et I_{cs}) pour la protection du moteur et de ses circuits avec des appareils de commande (un contacteur, par exemple). Un ACPM n'a pas vocation à prendre en charge les exigences en matière de pôle neutre, de courants continus assignés, de courant assigné ininterrompu I_u, de protection de secours, de retard de déclenchement de court-circuit, de catégorie de sélectivité, de capacité débrochable, de dispositif à courant différentiel résiduel, de disjoncteur à réenclenchement et de CEM de l'IEC 60947-2, etc.

Les disjoncteurs conformes à l'Annexe O de l'IEC 60947-2:2016 présentant des caractéristiques de protection du moteur contre les surcharges selon le présent document, mais sans caractéristiques assignées de démarreur (AC-3, par exemple), sont également disponibles sur le marché. Ces appareils ne sont pas couverts par le présent document.

APPAREILLAGE À BASSE TENSION –

Partie 4-1: Contacteurs et démarreurs de moteurs – Contacteurs et démarreurs électromécaniques

1 Domaine d'application

La présente partie de l'IEC 60947 s'applique aux équipements suivants:

– contacteurs électromécaniques et démarreurs, y compris les appareils de connexion de protection des moteurs (ACPM);
– organes de commande de contacteurs auxiliaires;
– contacts destinés exclusivement au circuit de la bobine de ce contacteur ou ce contacteur auxiliaire;
– accessoires dédiés (câblage dédié, accessoires d'accrochage dédié, par exemple);

destinés à être connectés à des circuits de distribution, des circuits de moteur et à d'autres circuits de charge, dont la tension assignée ne dépasse pas 1 000 V en courant alternatif ou 1 500 V en courant continu.

Le présent document couvre également la procédure d'évaluation de la protection électromécanique contre les surcharges utilisée dans des applications de sécurité, telle que la protection d'un moteur situé dans une atmosphère explosive provenant de l'atmosphère extérieure. Voir l'Annexe L.

Le présent document ne s'applique pas:

– aux démarreurs de moteurs en courant continu[1];

NOTE 1 Des exigences relatives aux démarreurs moteurs en courant continu sont à l'étude pour le prochain cycle de maintenance.

– aux contacts auxiliaires des contacteurs et aux contacts des contacteurs auxiliaires. Ils sont couverts par l'IEC 60947-5-1;
– aux démarreurs utilisés en aval d'un entraînement à fréquence variable[1];

NOTE 2 Des exigences supplémentaires relatives aux démarreurs utilisés en aval d'un entraînement à fréquence variable sont à l'étude pour le prochain cycle de maintenance.

– aux dispositifs de protection contre les courts-circuits intégrés dans les démarreurs autres que des ACPM. Ils sont couverts par l'IEC 60947-2 et l'IEC 60947-3;
– à l'utilisation du produit avec des dispositifs supplémentaires en atmosphères explosives. Elle est spécifiée par la série IEC 60079;
– aux règles de conception de logiciels intégrés[1];
– aux aspects liés à la cybersécurité. Ils sont couverts par la série IEC 62443.

Le présent document a pour objet de fixer:

a) les caractéristiques du matériel;
b) les conditions applicables au matériel relativement:
   1) à son fonctionnement et son comportement,

[1] À ce sujet, le fabricant est chargé de prendre des mesures de sécurité supplémentaires.

2) à ses propriétés diélectriques,

3) à son degré de protection,

4) à sa construction, y compris les mesures de sécurité contre les chocs électriques, les dangers d'incendie et les dangers mécaniques;

c) les essais destinés à vérifier si ces conditions sont réalisées, ainsi que les méthodes à adopter pour ces essais;

d) les renseignements à fournir avec les matériels ou dans la documentation du fabricant.

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 60034-1:2017, *Machines électriques tournantes – Partie 1: Caractéristiques assignées et caractéristiques de fonctionnement*

IEC 60034-12:2016, *Machines électriques tournantes – Partie 12: Caractéristiques de démarrage des moteurs triphasés à induction à cage à une seule vitesse*

IEC 60034-30-1, *Machines électriques tournantes – Partie 30-1: Classes de rendement pour les moteurs à courant alternatif alimentés par le réseau (code IE)*

IEC 60038, *Tensions normales de la CEI*

IEC 60068-2-14:2009, *Essais d'environnement – Partie 2-14: Essais – Essai N: Variation de température*

IEC 60079-14, *Atmosphères explosives – Partie 14: Conception, sélection et construction des installations électriques*

IEC 60085:2007, *Isolation électrique – Evaluation et désignation thermiques*

IEC 60364-1:2005, *Installations électriques à basse tension – Partie 1: Principes fondamentaux, détermination des caractéristiques générales, définitions*

IEC 60364-7-712, *Installations électriques à basse tension – Partie 7-712: Exigences applicables aux installations ou emplacements spéciaux – Installations d'énergie solaire photovoltaïque (PV)*

IEC 60715:2017, *Dimensions de l'appareillage à basse tension – Montage normalisé sur profilés-supports pour le support mécanique des appareillages et de leurs accessoires*

IEC 60730-1, *Dispositifs de commande électrique automatiques – Partie 1: Exigences générales*

IEC 60947-1:2007, *Appareillage à basse tension – Partie 1: Règles générales*
IEC 60947-1:2007/AMD1:2010
IEC 60947-1:2007/AMD2:2014

IEC 60947-2:2016, *Appareillage à basse tension – Partie 2: Disjoncteurs*

IEC 60947-5-1:2016, *Appareillage à basse tension – Partie 5-1: Appareils et éléments de commutation pour circuits de commande – Appareils électromécaniques pour circuits de commande*

IEC 61000-6-2, *Compatibilité électromagnétique (CEM) – Partie 6-2: Normes génériques – Norme d'immunité pour les environnements industriels*

IEC 61051-2, *Varistances utilisées dans les équipements électroniques – Deuxième partie: Spécification intermédiaire pour varistances pour limitations de surtensions transitoires*

IEC 61140:2016, *Protection contre les chocs électriques – Aspects communs aux installations et aux matériels*

IEC 61439 (toutes les parties), *Ensembles d'appareillage à basse tension*

IEC 61810-1, *Relais électromécaniques élémentaires – Partie 1: Exigences générales et de sécurité*

CISPR 11:2015, *Appareils industriels, scientifiques et médicaux – Caractéristiques de perturbations radioélectriques – Limites et méthodes de mesure*
CISPR 11:2015/AMD1:2016

ISO 2859-1:1999, *Règles d'échantillonnage pour les contrôles par attributs – Partie 1: Procédures d'échantillonnage pour les contrôles lot par lot, indexés d'après le niveau de qualité acceptable (NQA)*

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