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**Niskonapetostne stikalne in krmilne naprave – 4-1. del: Kontaktorji in  
motorski zaganjalniki – Elektromehanski krmilniki in zaganjalniki motorjev**

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

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EUROPEAN STANDARD

**EN 60947-4-1**

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EUROPÄISCHE NORM

February 2001

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Supersedes EN 60947-4-1:1992 + A1:1995 + A2:1997

English version

**Low-voltage switchgear and controlgear  
Part 4-1: Contactors and motor-starters -  
Electromechanical contactors and motor-starters  
(IEC 60947-4-1:2000)**

Appareillage à basse tension  
Partie 4-1: Contacteurs et démarreurs de  
moteurs – Contacteurs et démarreurs  
électromécaniques  
(CEI 60947-4-1:2000)

Niederspannungsschaltgeräte  
Teil 4-1: Schütze und Motorstarter -  
Elektromechanische Schütze und  
Motorstarter  
(IEC 60947-4-1:2000)

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This European Standard was approved by CENELEC on 2000-09-01. 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.

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**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 17B/1049/FDIS, future amendment to IEC 60947-4-1:1990, prepared by SC 17B, Low-voltage switchgear and controlgear, of IEC TC 17, Switchgear and controlgear, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A3 to EN 60947-4-1:1992 on 2000-09-01.

The text of this document, together with that of IEC 60947-4-1:1990, its corrigendum 1991 and its amendments 1:1994 and 2:1996, was published by IEC as the second edition of IEC 60947-4-1 in November 2000. According to a decision of principle taken by the Technical Board of CENELEC, the approval of EN 60947-4-1:1992/A3 has been converted into the approval of a new EN 60947-4-1.

This European Standard supersedes EN 60947-4-1:1992 + corrigendum June 1997 + A1:1995 + corrigendum June 1997 + A2:1997.

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) 2001-08-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2003-09-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes A, B and ZA are normative and annexes C and D are informative.

Annex ZA has been added by CENELEC.

[SIST EN 60947-4-1:2002](http://www.cenelec.eu)

In this standard the following print types are used:

- requirements: in roman type;
- *test specifications: in italic type;*
- notes: in smaller roman type.

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## Endorsement notice

The text of the International Standard IEC 60947-4-1:2000 was approved by CENELEC as a European Standard without any modification.

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## Annex ZA (normative)

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

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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 (mod)	1996	Rotating electrical machines Part 1: Rating and performance	EN 60034-1 + corr. February	1998 2000
IEC 60034-11	1978	Part 11: Built-in thermal protection -- Chapter 1: Rules for protection of rotating electrical machines	-	-
IEC 60050-441	1984	International Electrotechnical Vocabulary (IEV) Chapter 441: Switchgear, controlgear and fuses	-	-
IEC 60076-1 (mod)	1993	Power transformers Part 1: General	EN 60076-1 + A11	1997 1997
IEC 60085	1984	Thermal evaluation and classification of electrical insulation	HD 566 S1	1990
IEC 60112	1979	Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions	HD 214 S2	1980
IEC 60255-8 (mod)	1990	Electrical relays Part 8: Thermal electrical relays	EN 60255-8	1998
IEC 60269-1	1998	Low-voltage fuses Part 1: General requirements	EN 60269-1	1998
IEC 60269-2	1986	Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application)	EN 60269-2	1995
IEC 60269-2-1 (mod)	1998	Part 2-1: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) -- Sections I to V: Examples of types of standardized fuses	HD 630.2.1 S4	2000

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60410	1973	Sampling plans and procedures for inspection by attributes	-	-
IEC 60947-1 (mod)	1999	Low-voltage switchgear and controlgear Part 1: General rules	EN 60947-1 + corr. October	1999 1999
IEC 60947-2	1995	Part 2: Circuit-breakers	EN 60947-2 + corr. June	1996 1997
IEC 60947-3	1999	Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	EN 60947-3	1999
IEC 60947-5-1	1997	Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices	EN 60947-5-1 + A12	1997 1999
IEC 61000-4-2	1995	Electromagnetic compatibility (EMC) Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	1995
IEC 61000-4-3 (mod)	1995	Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	1996
IEC 61000-4-4	1995	Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	1995
IEC 61000-4-5	1995	Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	1995
IEC 61095	1992	Electromechanical contactors for household and similar purposes	EN 61095 + corr. March + A11	1993 1993 1996
IEC 61810-1	1998	Electromechanical non-specified time all-or-nothing relays Part 1: General requirements	EN 61810-1	1998
CISPR 11 (mod)	1997	Industrial, scientific and medical (ISM) radio-frequency equipment - Radio disturbance characteristics - Limits and methods of measurement	EN 55011	1998

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INTERNATIONAL  
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2000-11

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**Appareillage à basse tension –**

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

**Low-voltage switchgear and controlgear –**

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

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Международная Электротехническая Комиссия

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

## FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
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- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60947-4-1 has been prepared by subcommittee 17B: Low-voltage switchgear and controlgear, of IEC technical committee 17: Switchgear and controlgear.

This standard should be used in conjunction with IEC 60947-1.

This second edition cancels and replaces the first edition published in 1990, the corrigendum (1991), amendment 1 (1994), amendment 2 (1996) and amendment 3 (2000).

The text of this standard is based on first edition, amendment 1, amendment 2 and the following documents: <https://standards.iteh.ai/catalog/standards/sist/6e4f0cfb-9202-4cb9-9589-ad0a83b674e8/sist-en-60947-4-1-2002>

FDIS	Report on voting
17B/1049/FDIS	17B/1083/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of this publication will remain unchanged until 2003. At this date, the publication will be

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

The provisions of the general rules dealt with in part 1 (IEC 60947-1) are applicable to this standard, where specifically called for. Clauses and subclauses, tables, figures and annexes of the general rules thus applicable are identified by reference to part 1, e.g. 1.2.3 of part 1, table 4 of part 1 or annex A of part 1.

Annexes A and B form an integral part of this standard.

Annexes C and D are for information only.

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## LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

#### 1 Scope and object

This part of IEC 60947 applies to the types of equipment listed in 1.1 and 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) shall form 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 (see 3.2.7) or protected starters (see 3.2.8) are rated as units.

Circuit-breakers and fuse-combination units used as short-circuit protective devices in combination starters and in protected starters shall comply with the requirements of IEC 60947-2 and IEC 60947-3, as the case may be.

Equipment covered by this standard is as follows.

#### 1.1 AC and d.c. contactors

AC and d.c. contactors intended for closing and opening electric circuits and, if combined with suitable relays (see 1.2), for protecting these circuits against operating overloads which may occur therein.

NOTE Contactors combined with suitable relays and which are intended to provide short-circuit protection shall additionally satisfy the relevant conditions specified for circuit-breakers (IEC 60947-2).

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

#### 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.



Starters the operation of which depends on thermal electrical relays for motor protection complying with IEC 60255-8, or motor-incorporated thermal protective devices dealt with in IEC 60034-11 do not necessarily meet all the relevant requirements of this standard.

Overload relays for starters, including those based on solid state technology, shall meet the requirements of this standard.

### 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.

### 1.2.2 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).

#### 1.2.2.1 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.

#### 1.2.2.2 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.

### 1.2.3 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 shall be 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 shall be 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.

### 1.3 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.