

INTERNATIONAL STANDARD

IEC
60470

Second edition
1999-10

High-voltage alternating current contactors and contactor-based motor-starters

*Contacteurs pour courants alternatifs haute tension
et démarreurs de moteurs à contacteurs*

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For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to publications IEC 60027: *Letter symbols to be used in electrical technology*, IEC 60417: *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets* and IEC 60617: *Graphical symbols for diagrams*.

* See web site address on title page.

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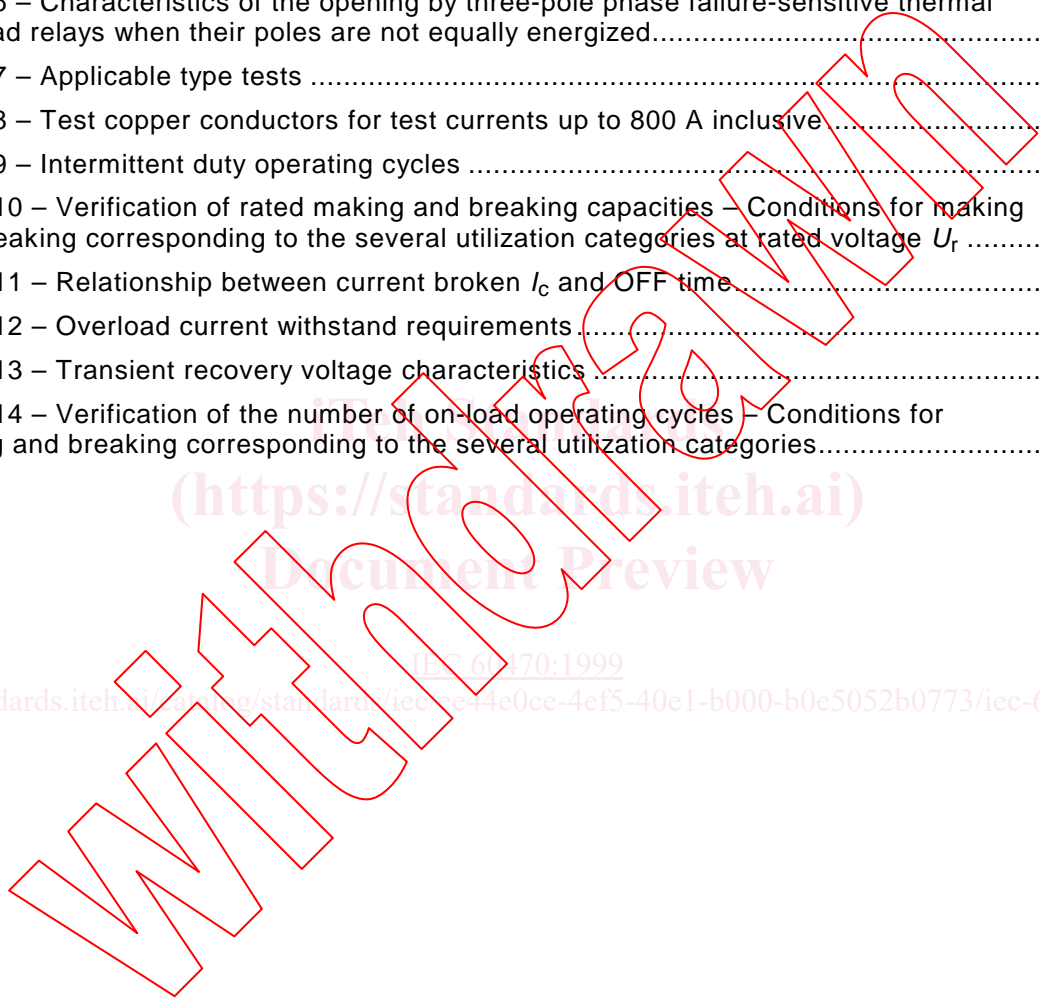
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH-VOLTAGE ALTERNATING CURRENT CONTACTORS AND CONTACTOR-BASED MOTOR-STARTERS

FOREWORD

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International Standard IEC 60470 has been prepared by subcommittee 17A: High-voltage switchgear and controlgear, of IEC technical committee 17: Switchgear and controlgear.

This standard is to be read in conjunction with IEC 60694, second edition, published in 1996, which is applicable unless otherwise specified in this standard. In order to simplify the indication of corresponding requirements, the same numbering of clauses and subclauses as in IEC 60694 is used. Amendments to these clauses and subclauses are given under the same references whilst additional subclauses are numbered from 101.

This second edition cancels and replaces the first edition of IEC 60470 published in 1974 and its amendment 1 (1995), as well as IEC 60632-1.

The text of this standard is based on the following documents:

FDIS	Report on voting
17A/545/FDIS	17A/554/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.

Annex A forms an integral part of this standard.

A bilingual version of this publication may be issued at a later date.

The committee has decided that this publication remains valid until 2011. At this date, in accordance with the committee's decision, the publication will be

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- withdrawn;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

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HIGH-VOLTAGE ALTERNATING CURRENT CONTACTORS AND CONTACTOR-BASED MOTOR-STARTERS

1 General

1.1 Scope and object

This International Standard is applicable to a.c. contactors and/or contactor-based motor-starters designed for indoor installation and operation at frequencies up to and including 60 Hz on systems having voltages above 1 000 V but not exceeding 12 000 V.

It is applicable only to three-pole contactors and starters for use in three-phase systems, and single-pole contactors and starters for use in single-phase systems. Two-pole contactors and starters for use in single-phase systems are subject to agreement between manufacturer and user.

Contactors and/or starters dealt with in this standard are not normally designed to interrupt short-circuit currents. Therefore, suitable short-circuit protection (see 3.4.110.12 and note 2 below) 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 (SCPD);
- 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, for example combination starters (see 3.4.110.9), are rated as units.

Contactors intended for closing and opening electric circuits and, if combined with suitable relays, for protecting these circuits against operating overloads which may occur therein, are covered in this standard.

This standard is also applicable to the operating devices of contactors and to their auxiliary equipment.

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 are dealt with.

Motor-starter types included are

- direct-on-line starters;
- reversing starters;
- two-direction starters;
- reduced kVA (voltage) starters;

- auto-transformer starters;
- rheostatic starters;
- reactor starters.

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, are covered by this standard.

This standard does not apply to

- circuit-breaker-based motor-starters;
- single-pole operation of multi-pole contactors or starters;
- two-step auto-transformer starters 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.

This standard does not deal with components contained in contactors and contactor-based motor-starters, for which individual specifications exist.

NOTE 1 Thermal electrical relays are covered by IEC 60255-8.

NOTE 2 High-voltage current-limiting fuses are covered by IEC 60282-1 and IEC 60644.

NOTE 3 Metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV are covered by IEC 60298.

NOTE 4 Disconnectors and earthing switches are covered by IEC 60129.

NOTE 5 High-voltage switches above 1 kV and less than 52 kV are covered by IEC 60265-1.

The object of this standard is to state

- a) the characteristics of contactors and starters and associated equipment;
- b) the conditions with which contactors or starters shall comply 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,
 - 5) for combinations, interactions between the various components, for example SCPD co-ordination;
- 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.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60034-11:1978, *Rotating electrical machines – 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 60056:1987, *High-voltage alternating-current circuit-breakers*

IEC 60076-2:1993, *Power transformers – Part 2: Temperature rise*

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

IEC 60255-8:1990, *Electrical relays – Part 8: Thermal electrical relays*

IEC 60265-1:1983, *High-voltage switches – Part 1: High-voltage switches for rated voltages above 1 kV and less than 52 kV*

IEC 60282-1:1994, *High-voltage fuses – Part 1: Current-limiting fuses*

IEC 60298:1990, *A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*
Amendment 1 (1994)

IEC 60417, (all parts) *Graphical symbols for use on equipment – Index, survey and compilation of the single sheets*

IEC 60644:1979, *Specification for high-voltage fuse-links for motor circuit applications*

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

IEC 60726:1982, *Dry-type power transformers*

IEC 60947-5-1:1997, *Low-voltage switchgear and controlgear – Part 5: Control circuit devices and switching elements – Section one: Electromechanical control circuit devices*

IEC 61233:1994, *High-voltage alternating current circuit-breakers – Inductive load switching*

IEC 61812-1:1996, *Specified time relays for industrial use – Part 1: Requirements and tests*

2 Normal and special service conditions

2.1 Normal service conditions

Subclause 2.1 of IEC 60694 is applicable with the following modification.

For outdoor installations refer to 8.102.6.

2.2 Special service conditions

Subclause 2.2 of IEC 60694 is applicable with the following modification.

2.2.1 Altitude

Altitude classes of 1 000 m, 2 000 m and 3 000 m are recognized. See 8.102.7.

NOTE These classes are necessary for some types of operating mechanism.

3 Definitions

For the purpose of this International Standard, clause 3 of IEC 60694 applies with the following additional definitions.

3.1 General terms

3.1.101

controlgear

a general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended in principle for the control of electric energy consuming equipment [IEV 441-11-03]

3.1.102

over-current

a current exceeding the rated current [IEV 441-11-06]

3.1.103

short-circuit current

an over-current resulting from a short circuit due to a fault or an incorrect connection in an electric circuit [IEV 441-11-07]

3.1.104

overload

operating conditions in an electrically undamaged circuit, which cause an over-current [IEV 441-11-08]

3.1.105

conductive part

a part which is capable of conducting current although it may not necessarily be used for carrying service current [IEV 441-11-09]

3.1.106

ambient air temperature

the temperature, determined under prescribed conditions, of the air surrounding the complete switching device or fuse [IEV 441-11-13]

NOTE For switching devices or fuses installed inside an enclosure, it is the temperature of the air outside the enclosure.

3.2 Assemblies of switchgear and controlgear

No particular definitions.

3.3 Parts of assemblies

No particular definitions.

3.4 Switching devices

3.4.101

switching device

a device designed to make or break the current in one or more electric circuits [IEV 441-14-01]

3.4.102

mechanical switching device

a switching device designed to close and open one or more electric circuits by means of separable contacts [IEV 441-14-02]

NOTE Any mechanical switching device may be designated according to the medium in which its contacts open and close, e.g. air, SF₆, oil.

3.4.103

disconnector

a mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements [IEV 441-14-05]

NOTE A disconnector is capable of opening and closing a circuit either when negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the poles of the disconnector occurs. It is also capable of carrying currents under normal circuit conditions and carrying for a specified time currents under abnormal conditions such as those of short circuit.

3.4.104

earthing switch

a mechanical switching device for earthing parts of a circuit, capable of withstanding for a specified time currents under abnormal conditions such as those of short circuit, but not required to carry current under normal conditions of the circuit [IEV 441-14-11]

NOTE An earthing switch may have a short-circuit making capacity.

3.4.105

contactor (mechanical)

a mechanical switching device having only one position of rest, operated otherwise than by hand, capable of making, carrying and breaking currents under normal circuit conditions including operating overload conditions [IEV 441-14-33]

NOTE 1 A contactor may also be capable of making and breaking short-circuit currents.

NOTE 2 A contactor is usually intended to operate frequently.

3.4.106

electromagnetic contactor

a contactor in which the force for closing the normally open main contacts or for opening the normally closed main contacts is provided by an electromagnet

3.4.107

vacuum contactor

a contactor in which the main contacts open and close within a highly evacuated envelope

3.4.108**SF₆ contactor**

a contactor in which the main contacts open and close within an SF₆ gas-filled compartment

3.4.109**latched contactor**

a contactor, the moving elements of which are prevented by means of a latching arrangement from returning to the position of rest when the operating means are de-energized [IEV 441-14-34]

NOTE The latching, and the release of the latching, may be mechanical, electromagnetic, pneumatic, etc.

3.4.110**starter**

the combination of all the switching means necessary to start and stop a motor in combination with suitable overload protection [IEV 441-14-38]

NOTE Starters may be designated according to the method by which the force for closing the main contacts is provided.

3.4.110.1**direct-on-line starter**

a starter which connects the line voltage across the motor terminals in one step [IEV 441-14-40]

3.4.110.2**reversing starter**

a starter intended to cause the motor to reverse the direction of rotation by reversing the motor primary connections even when the motor is running

3.4.110.3**two-direction starter**

a starter intended to cause the motor to reverse the direction of rotation by reversing the motor primary connections only when the motor is not running

3.4.110.4**reduced kVA (voltage) starter**

a starter which reduces the starting kVA of the motor

NOTE Reduced kVA starters may include auto-transformer, reactor, rheostatic starters.

3.4.110.5**auto-transformer starter**

a starter which uses one or more reduced voltages derived from an auto-transformer

3.4.110.6**rheostatic starter**

a starter utilizing one or several resistors for obtaining, during starting, stated motor torque characteristics and for limiting the current [IEV 441-14-42]

NOTE A rheostatic starter generally consists of three basic parts, which may be supplied either as a composite unit or as separate units to be connected at the place of utilization:

- the mechanical switching devices for supplying the stator (generally associated with an overload protective device);
- the resistor(s) inserted in the rotor circuit;
- the mechanical switching devices for cutting out the resistor(s) successively.