IEC 62271-106

Edition 2.0 2021-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

High-voltage switchgear and controlgear –
Part 106: Alternating current contactors, contactor-based controllers and motorstarters

Appareillage à haute tension –
Partie 106: Contacteurs, combinés de démarrage à contacteurs et démarreurs de moteurs, pour courant alternatif

IEC 62271-106:2021-04(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 29.130.10

ISBN 978-2-8322-1034-4

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 106: Alternating current contactors, contactor-based controllers and motor-starters

FOREWORD

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International Standard IEC 62271-106 has been prepared by subcommittee 17A: Switching devices, of IEC technical committee 17: High-voltage switchgear and controlgear.

This second edition cancels and replaces the first edition published in 2011. It constitutes a technical revision.

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

- document numbered to correspond to IEC 62271-1 2017.

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

FDIS	Report on voting
17A/1296/FDIS	17A/1301/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.

This standard is to be read in conjunction with IEC 62271-1:2017. In order to simplify the indication of corresponding requirements, the same numbering of clauses and subclauses is used as in IEC 62271-1. Modifications to these clauses and subclauses are given under the same numbering, whilst additional subclauses are numbered from 101.

A list of all parts of the IEC 62271 series under the general title, *High-voltage switchgear and controlgear*, 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

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- withdrawn,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

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 106: Alternating current contactors, contactor-based controllers and motor-starters

1 Scope

This part of IEC 62271 applies to AC contactors and/or contactor-based controllers and motor-starters designed for indoor installation and operation at frequencies up to and including 60 Hz on systems having voltages above 1 kV and up to and including 24 kV. This document also includes additional requirements for outdoor installations where the equipment is housed in an additional protective enclosure.

It is applicable only to three-pole devices for use in three-phase systems, and single-pole devices 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 document typically do not have adequate short-circuit interruption capability. In this context, this document gives requirements for:

– starters associated with separate short-circuit protective devices;
– controllers – contactors combined with short-circuit protective devices (SCPD).

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

This document 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.

This document 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 document 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 60255-149.

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 62271-200.

NOTE 4 Disconnectors and earthing switches are covered by IEC 62271-102.

NOTE 5 High-voltage switches above 1 kV and less than 52 kV are covered by IEC 62271-103.

The object of this document is to state:

a) the characteristics of contactors and starters and associated equipment;
b) the conditions with which contactors or starters 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 controllers, 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.

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 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60076-2, *Power transformers – Part 2: Temperature rise for liquid-immersed transformers*

IEC 60076-11:2018, *Power transformers – Part 11: Dry-type transformers*

IEC 60255-21-1:1988, *Electrical relays – Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment – Section One: Vibration tests (sinusoidal)*

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

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

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

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

IEC 61000-4-18:2019, *Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test*

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

IEC 61812-1, *Time relays for industrial use and residential use – Part 1: Requirements and tests*

IEC 62271-1:2017, *High-voltage switchgear and controlgear – Part 1: Common specifications for alternating current switchgear and controlgear*

IEC 62271-100:2021, *High-voltage switchgear and controlgear – Part 100: Alternating current circuit-breakers*

IEC 62271-102:2018, *High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches*

IEC 62271-110:2017, *High-voltage switchgear and controlgear – Part 110: Inductive load switching*

IEC 62271-200:2021, *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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in Clause 3 of IEC 62271-1:2017, as well as the following, apply.

3.1 General terms and definitions

Subclause 3.1 of IEC 62271-1: 2017 applies with the following additions:

3.1.101
controlgear
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

[SOURCE: IEC 60050-441:2000, 441-11-03]

3.1.102
overcurrent
current exceeding the rated current

[SOURCE: IEC 60050-441:2000, 441-11-06]

3.1.103
short-circuit current
over-current resulting from a short circuit due to a fault or an incorrect connection in an electric circuit

[SOURCE: IEC 60050-441:2000, 441-11-07]

3.1.104
overload
operating conditions in an electrically undamaged circuit, which cause an over-current

[SOURCE: IEC 60050-441:2000, 441-11-08]

3.1.105
conductive part
part which is capable of conducting current although it may not necessarily be used for carrying service current

[SOURCE: IEC 60050-441:2000, 441-11-09]

3.1.106
ambient air temperature
temperature, determined under prescribed conditions, of the air surrounding the complete switching device or fuse

Note 1 to entry: For switching devices or fuses installed inside an enclosure, it is the temperature of the air outside the enclosure.

[SOURCE: IEC 60050-441:2000, 441-11-13]

3.2 Assemblies of switchgear and controlgear

Subclause 3.2 of IEC 62271-1: 2017 applies.

3.3 Parts of assemblies

Subclause 3.3 of IEC 62271-1: 2017 applies.

3.4 Switching devices

Subclause 3.4 of IEC 62271-1: 2017 applies with the following modifications.

3.4.101
switching device
device designed to make or break the current in one or more electric circuits

[SOURCE: IEC 60050-441:2000, 441-14-01]

3.4.102
mechanical switching device
switching device (such as a contactor or a disconnector) designed to close and open one or more electric circuits by means of separable contacts

[SOURCE: IEC 60050-441:2000, 441-14-02, modified: Note 1 to entry deleted.]

3.4.103
disconnector
mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements

Note 1 to entry: 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.

Note 2 to entry: A withdrawable contactor assembly may be used as a disconnector.

Note 3 to entry: In North America, this device is also called an isolating means or an isolating switch.

[SOURCE: IEC 60050-441:2000, 441-14-05, modified: Note 2 and 3 added.]

3.4.104
earthing switch
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

Note 1 to entry: An earthing switch may have a short-circuit making capacity.

[SOURCE: IEC 60050-441:2000, 441-14-11]

3.4.105
contactor <mechanical>
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

Note 1 to entry: Contactors may be designated according to the method by which the force for closing the main contacts is provided.

[SOURCE: IEC 60050-441:2000, 441-14-33]

3.4.106
electromagnetic contactor
contactor in which the force for closing or opening the main contacts is provided by an electromagnet

3.4.107
vacuum contactor
contactor in which the main contacts open and close within a highly evacuated envelope

3.4.108
SF_6 contactor
contactor in which the main contacts open and close within an SF_6 gas-filled compartment

3.4.109
latched contactor
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

Note 1 to entry: The latching, and the release of the latching, may be mechanical, electromagnetic, pneumatic, etc.

[SOURCE: IEC 60050-441:2000, 441-14-34, modified: Note 2 to entry deleted.]

3.4.110
starter
combination of all the switching means necessary to start and stop a motor in combination with suitable overload protection

[SOURCE: IEC 60050-441:2000, 441-14-38, modified: Note 1 to entry deleted.]

3.4.110.1
direct-on-line starter
starter which connects the line voltage across the motor terminals in one step

[SOURCE: IEC 60050-441:2000, 441-14-40]

3.4.110.2
reversing starter
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
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
starter which reduces the starting kVA of the motor

Note 1 to entry: Reduced kVA starters may include auto-transformer, reactor, rheostatic starters.

3.4.110.5
auto-transformer starter
starter which uses one or more reduced voltages derived from an auto-transformer

3.4.110.6
rheostatic starter
starter utilizing one or several resistors for obtaining, during starting, stated motor torque characteristics and for limiting the current

Note 1 to entry: 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.

[SOURCE: IEC 60050-441:2000, 441-14-42, modified: Note 1 to entry added.]

3.4.110.7
rheostatic rotor starter
rheostatic starter for an asynchronous wound-rotor motor which, during the starting period, cuts out successively one or several resistors previously provided in the rotor circuit

[SOURCE: IEC 60050-441:2000, 441-14-43]

3.4.110.8
reactor starter
primary reactor starter
starter that includes a reactor connected in series with the stator winding of an alternating current motor to furnish reduced voltage for starting

3.4.110.9
electromagnetic starter
starter in which the force for closing the main contacts is provided by an electromagnet

3.4.110.10
***n*-step starter**
starter in which there are (n – 1) intermediate accelerating positions between the off and full on positions

Note 1 to entry: A starter in which there is no intermediate accelerating position between the OFF and ON positions is a single step or direct-on-line starter (see 3.4.110.1).

Note 2 to entry: A starter in which there is only one intermediate accelerating position between the OFF and ON positions is known as a two-step starter.

Note 3 to entry: A three-step rheostatic starter has two sections of resistors used for starting.

[SOURCE: IEC 60050-441:2000, 441-14-41]

3.4.111
controller
combination starter
equipment consisting of a contactor, overload protection, a disconnector and a short-circuit protective device (SCPD), mounted and wired in one common enclosure

Note 1 to entry: A controller may be used for functions other than motor starting, for example transformer control and protection, or capacitor control.

3.4.111.1
transformer controller
combination of all the switching means necessary to energize and de-energize a transformer in combination with suitable overload protection

3.4.111.2
capacitor controller
combination of all the switching means necessary to energize and de-energize a capacitor or capacitor bank in combination with suitable protection

3.4.112
short-circuit protective device
SCPD
device intended to protect a circuit or parts of a circuit against short-circuit currents by interrupting them

Note 1 to entry: Usually this function is provided by fuses.

3.4.113
contactor class C1
contactor with a low probability of restrike during capacitive current breaking as demonstrated by the type tests

3.4.114
contactor class C2
contactor with a very low probability of restrike during capacitive current breaking as demonstrated by type tests

3.5 Parts of switchgear and controlgear

Subclause 3.5 of 62271-1:2017 applies with the following modifications:

3.5.101 Parts of contactors, starters and controllers

3.5.101.1
pole of a switching device
portion of a switching device associated exclusively with one electrically separated conducting path of its main circuit and excluding those portions which provide a means for mounting and operating all poles together

Note 1 to entry: A switching device is called single-pole if it has only one pole. If it has more than one pole, it may be called multipole (two-pole, three-pole, etc.) provided the poles are or can be coupled in such a manner as to operate together.

[SOURCE: IEC 60050-441:2000, 441-15-01]

3.5.101.2
main circuit <of a switching device>
all the conductive parts of a switching device included in the circuit which it is designed to close or open

[SOURCE: IEC 60050-441:2000, 441-15-02]

3.5.101.3
control circuit <of a switching device>
all the conductive parts (other than the main circuit) of a switching device which are included in a circuit used for the closing operation or opening operation, or both, of the device

[SOURCE: IEC 60050-441:2000, 441-15-03]

3.5.101.4
auxiliary circuit <of a switching device>
all the conductive parts of a switching device which are intended to be included in a circuit other than the main circuit and the control circuits of the device

Note 1 to entry: Some auxiliary circuits fulfil supplementary functions such as signalling, interlocking, etc., and, as such, they may be part of the control circuit of another switching device.

[SOURCE: IEC 60050-441:2000, 441-15-04]

3.5.101.5
main contact
contact included in the main circuit of a mechanical switching device, intended to carry, in the closed position, the current of the main circuit

[SOURCE: IEC 60050-441:2000, 441-15-07]