BS EN IEC 62271-106:2021

BSI Standards Publication

High-voltage switchgear and controlgear

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

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Full document details: BS EN IEC 62271-106:2021

National foreword

This British Standard is the UK implementation of EN IEC 62271-106:2021. It is identical to IEC 62271-106:2021. It supersedes BS EN 62271-106:2011, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/17, High voltage switchgear, controlgear and assemblies.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 62271-106

June 2021

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Supersedes EN 62271-106:2011 and all of its amendments and corrigenda (if any)

English Version

High-voltage switchgear and controlgear - Part 106: Alternating current contactors, contactor-based controllers and motor-starters (IEC 62271-106:2021)

Appareillage à haute tension - Partie 106: Contacteurs, combinés de démarrage à contacteurs et démarreurs de moteurs, pour courant alternatif (IEC 62271-106:2021)

Hochspannungs-Schaltgeräte und -Schaltanlagen - Teil 106: Wechselstrom-Schütze, Kombinationsstarter und Motorstarter mit Schützen (IEC 62271-106:2021)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

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European foreword

The text of document 17A/1296/FDIS, future edition 2 of IEC 62271-106, prepared by SC 17A "Switching devices" of IEC/TC 17 "High-voltage switchgear and controlgear" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62271-106:2021.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2022-02-28
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2024-05-31

This document supersedes EN 62271-106:2011 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62271-106:2021 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60034-11	NOTE	Harmonized as EN 60034-11
IEC 60060 (series)	NOTE	Harmonized as EN 60060 (series)
IEC 60255-149:2013	NOTE	Harmonized as EN 60255-149:2013 (not modified)
IEC 62271-103	NOTE	Harmonized as EN 62271-103

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60060-1	2010	High-voltage test techniques - Part 1: General definitions and test requirements	EN 60060-1	2010
IEC 60068-2-1	2007	Environmental testing - Part 2-1: Tests - Test A: Cold	EN 60068-2-1	2007
IEC 60068-2-2	2007	Environmental testing - Part 2-2: Tests - Test B: Dry heat	EN 60068-2-2	2007
IEC 60068-2-30	2005	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	2005
IEC 60076-2	-	Power transformers - Part 2: Temperature rise for liquid-immersed transformers	EN 60076-2	-
IEC 60076-11	2018	Power transformers - Part 11: Dry-type transformers	EN IEC 60076-11	2018
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)	EN 60255-21-1	1995
IEC 60282-1	-	High-voltage fuses - Part 1: Current-limiting fuses	EN IEC 60282-1	-
IEC 60417	-	Graphical symbols for use on equipment. Index, survey and compilation of the single sheets.	-	-
IEC 60644	-	Specification for high-voltage fuse-links for motor circuit applications	EN 60644	-
IEC 60947-5-1	-	Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices	EN 60947-5-1	-
IEC 61000-4-18	2019	Electromagnetic compatibility (EMC) - Part 4-18: Testing and measurement techniques - Damped oscillatory wave immunity test	EN IEC 61000-4-18	2019

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Publication	Year	Title	EN/HD	Year
IEC 61230	-	Live working - Portable equipment for earthing or earthing and short-circuiting	EN 61230	-
IEC 61812-1	-	Time relays for industrial and residential use - Part 1: Requirements and tests	EN 61812-1	-
IEC 62271-1	2017	High-voltage switchgear and controlgear - Part 1: Common specifications for alternating current switchgear and controlgear	EN 62271-1	2017
IEC 62271-100	2021	High-voltage switchgear and controlgear - Part 100: Alternating-current circuit-breakers	EN IEC 62271-100	2021
IEC 62271-102	2018	High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches	EN IEC 62271-102	2018
IEC 62271-110	2017	High-voltage switchgear and controlgear – Part 110: Inductive load switching	EN IEC 62271-110	2018
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	EN IEC 62271-200	2021

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Full document details: BS EN IEC 62271-106:2021

CONTENTS

FOREWORD 4
1 Scope 6
2 Normative references 7
3 Terms and definitions 8
4 Normal and special service conditions 23
5 Ratings 24
6 Design and construction 38
7 Type tests 42
8 Routine tests 70
9 Guide to the selection of contactors and motor-starters for service (informative) 72
10 Information to be given with enquiries, tenders and orders (informative) 76
11 Transport, storage, installation, operating instructions and maintenance 78
12 Safety 78
13 Influence of the product on the environment 78
Annex A (normative) Identification of test objects 79
Annex B (informative) Determination of the equivalent RMS value of a short-time current during a short-circuit of a given duration 80
Annex C (normative) Method for weatherproofing test for outdoor switchgear and controlgear 81
Annex D (informative) References for auxiliary and control circuit components 82
Annex E (normative) Tolerances on test quantities during tests 83
Annex F (informative) Information and technical requirements to be given with enquires, tenders and orders 88
Annex G (informative) List of symbols and abbreviations 89
Annex H (informative) Electromagnetic compatibility on site 90
Annex I (informative) List of notes concerning certain countries 91
Annex J (informative) Extension of validity type tests 92
Annex K (informative) Exposure to pollution 93
Annex AA (normative) Records and reports of type tests for making, breaking and short-time current performance 94
Annex BB (normative) Disconnectors and earthing switches used in controllers 98
Bibliography 100

Figure 1 – Examples of speed/time curves 32
Figure 2 – Representation by two parameters of a prospective TRV of a circuit 60
Figure 3 – Representation of the specified TRV by a two-parameter reference line and a delay line 60
Figure 4 – Determination of power-frequency recovery voltage 61
Figure 5 – Test duties A and B – preferred earth point 63
Figure 6 – Test duties A and B – alternative earth point 64
Figure 7 – Test duty C – preferred earth point 64
Figure 8 – Test duty C – alternative earth point 65
Figure 9 – Characteristics for determining take-over current 66

AVA Documents Document Sharing Hub

Full document details: BS EN IEC 62271-106:2021

Figure BB.1 – Disconnector and earthing switch locations 98

Table 1 – Ratings and characteristics 25
Table 2 – Utilization categories 31
Table 3 – Characteristics dependent on starter type 37
Table 4 – Applicable type tests 44
Table 5 – Intermittent duty operating cycles 48
Table 6 – Verification of rated making and breaking capacities – Conditions for making and breaking corresponding to the several utilization categories at rated voltage U_r 52
Table 7 – Relationship between current broken I_c and OFF time 55
Table 8 – Overload current withstand requirements 56
Table 9 – Transient recovery voltage characteristics 63
Table 10 – Verification of the number of on-load operating cycles – Conditions for making and breaking corresponding to the several utilization categories 68
Table E.101 – Tolerances on test quantities for type test 83
Table G.101 – Additional list of symbols and abbreviations 89

Documents
Document Sharing Hub

Full document details: BS EN IEC 62271-106:2021

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.

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Full document details: BS EN IEC 62271-106:2021

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.

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Full document details: BS EN IEC 62271-106:2021

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;

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– 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*

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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]

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Full document details: BS EN IEC 62271-106:2021

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]

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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

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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.]

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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.

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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]

Documents
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3.5.101.6
control contact
contact included in a control circuit of a mechanical switching device and mechanically operated by this device

[SOURCE: IEC 60050-441:2000, 441-15-09]

3.5.101.7
auxiliary contact
contact included in an auxiliary circuit and mechanically operated by the switching device

[SOURCE: IEC 60050-441:2000, 441-15-10]

3.5.101.8
"a" contact
make contact
control or auxiliary contact which is closed when the main contacts of the mechanical switching device are closed and open when they are open

[SOURCE: IEC 60050-441:2000, 441-15-12]

3.5.101.9
"b" contact
break contact
control or auxiliary contact which is open when the main contacts of a mechanical switching device are closed and closed when they are open

[SOURCE: IEC 60050-441:2000, 441-15-13]

3.5.110 Fuses

3.5.110.1
fuse
device that by the fusing of one or more of its specially designed and proportioned components opens the circuit in which it is inserted by breaking the current when this exceeds a given value for a sufficient time. The fuse comprises all the parts that form the complete device

Note 1 to entry: Fuses are commonly used as the SCPD in starts and controllers (3.4.112).

[SOURCE: IEC 60050-441:2000, 441-18-01]

3.5.110.2
striker
mechanical device forming part of a fuse-link which, when the fuse operates, releases the energy required to cause operation of other apparatus or indicators, or to provide interlocking

[SOURCE: IEC 60050-441:2000, 441-18-18]

3.5.110.3
pre-arcing time
melting time
interval of time between the beginning of a current large enough to cause a break in the fuse-element(s) and the instant when an arc is initiated

[SOURCE: IEC 60050-441:2000, 441-18-21]

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3.5.110.4
operating time
total clearing time
sum of the pre-arcing time and the arcing time

[SOURCE: IEC 60050-441:2000, 441-18-22]

3.5.110.5
Joule integral
$\boldsymbol{I^2t}$
integral of the square of the current over a given time interval:

$$I^2t = \int_{t_0}^{t_1} i^2 \mathrm{d}t$$

Note 1 to entry: The pre-arcing I^2t is the I^2t integral extended over the pre-arcing time of the fuse.

Note 2 to entry: The operating I^2t is the I^2t integral extended over the operating time of the fuse.

Note 3 to entry: The energy in joules liberated in one ohm of resistance in a circuit protected by a fuse is equal to the value of the operating I^2t expressed in A^2s.

[SOURCE: IEC 60050-441:2000, 441-18-23]

3.5.112
extendable power bus
main power bus

that portion of the power bus that is capable of being extended to connect two or more vertical sections or controllers

3.6 Operational characteristics of switchgear and controlgear

Subclause 3.6 of IEC 62271-1: 2017 applies with the following modifications:

3.6.101
operation <of a mechanical switching device>
transfer of the moving contact(s) from one position to an adjacent position

Note 1 to entry: For a circuit-breaker, this can be a closing operation or an opening operation.

Note 2 to entry: If distinction is necessary, an operation in the electrical sense, e.g. make or break, is referred to as a switching operation, and an operation in the mechanical sense, e.g. close or open, is referred to as a mechanical operation.

[SOURCE: IEC 60050-441:2000, 441-16-01]

3.6.102
operating cycle <of a mechanical switching device>
succession of operations from one position to another and back to the first position through all other positions, if any

Note 1 to entry: This may be a closing operation followed by an opening operation.

Note 2 to entry: A succession of operations not forming an operating cycle is referred to as an operating series.

[SOURCE: IEC 60050-441:2000, 441-16-02, modified: Notes 1 and 2 added.]

3.6.103
closing operation <of a mechanical switching device>
operation by which the device is brought from the open position to the closed position

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[SOURCE: IEC 60050-441:2000, 441-16-08]

3.6.104
opening operation <of a mechanical switching device>
operation by which the device is brought from the closed position to the open position

[SOURCE: IEC 60050-441:2000, 441-16-09]

3.6.105
closed position <of a mechanical switching device>
position in which the predetermined continuity of the main circuit of the device is secured

[SOURCE: IEC 60050-441:2000, 441-16-22]

3.6.106
open position <of a mechanical switching device>
position in which the predetermined clearance between open contacts in the main circuit of the device is secured

[SOURCE: IEC 60050-441:2000, 441-16-23]

3.6.107
position of rest <of a contactor>
position which the moving elements of the contactor take up when its electromagnet or its compressed-air device is not energized

[SOURCE: IEC 60050-441:2000, 441-16-24]

3.6.108
overload relay or release
over-current relay or release intended for protection against overloads (including, where applicable, operating transformer(s) and interconnections)

3.6.109
thermal overload relay or release
inverse time-delay overload relay or release depending for its operation (including its time delay) on the thermal action of the current flowing in the relay or release

3.6.110
current setting of an overload relay or release
value of current for which the relay or release is adjusted and in accordance with which its operating conditions are defined

3.6.111
current setting range of an overload relay or release
range between the minimum and maximum values over which the current setting of the relay or release can be adjusted

3.6.112
phase failure sensitive overload relay or release
multi-pole overload relay or release which, in accordance with specified requirements, operates at a current value lower than its current setting in the case of current unbalance

3.6.113
under-current (under-voltage) relay or release
measuring relay or release which operates automatically when the current through it (or the voltage applied to it) is reduced below a pre-determined value

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3.6.114
starting time <of a rheostatic starter>
period of time during which the starting resistors or parts of them carry current

Note 1 to entry: The starting time of a starter is shorter than the total starting time of the motor, which takes into account the last period of acceleration following the switching operation ON position.

3.6.115
starting time <of an auto-transformer starter>
period of time during which the auto-transformer carries current

Note 1 to entry: The starting time of a starter is shorter than the total starting time of the motor, which takes into account the last period of acceleration following the switching operation ON position.

3.6.116
open transition <with an auto-transformer starter>
circuit arrangement so that the supply to the motor is interrupted and reconnected when changing over from one step to another

Note 1 to entry: The transition stage is not considered an additional step.

3.6.117
closed transition <with an auto-transformer starter>
circuit arrangement so that the supply to the motor is not interrupted (even momentarily) when changing over from one step to another

Note 1 to entry: The transition stage is not considered an additional step.

3.6.118
inching
jogging
energizing a motor or solenoid repeatedly for short periods to obtain small movements of the driven mechanism

3.6.119
plugging
stopping or reversing a motor rapidly by reversing the motor primary connections while the motor is running

3.7 Characteristic quantities

Subclause 3.7 of 62271-1: 2017 applies with the following additions:

3.7.101
breaking current <of a switching device or a fuse>
current in a pole of a switching device or in a fuse at the instant of initiation of the arc during a breaking process

[SOURCE: IEC 60050-441:2000, 441-17-07]

3.7.102
breaking capacity <of a switching device or a fuse>
value of prospective current that a switching device or a fuse is capable of breaking at a stated voltage under prescribed conditions of use and behaviour

Note 1 to entry: The voltage to be stated and the conditions to be prescribed are dealt with in the relevant publications.

Note 2 to entry: For switching devices, the breaking capacity may be termed according to the kind of current included in the prescribed conditions, e.g. line charging breaking capacity, cable charging breaking capacity, single capacitor bank breaking capacity, etc.

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Full document details: BS EN IEC 62271-106:2021

[SOURCE: IEC 60050-441:2000, 441-17-08]

3.7.103
making capacity <of a switching device>
value of prospective making current that a switching device is capable of making at a stated voltage under prescribed conditions of use and behaviour

Note 1 to entry: The voltage to be stated and the conditions to be prescribed are dealt with in the relevant specifications.

[SOURCE: IEC 60050-441:2000, 441-17-09]

3.7.104
short-time withstand current
current that a circuit or a switching device in the closed position can carry during a specified short time under prescribed conditions of use and behaviour

[SOURCE: IEC 60050-441:2000, 441-17-17]

3.7.105
recovery voltage
voltage which appears across the terminals of a pole of a switching device or a fuse after the breaking of the current

Note 1 to entry: This voltage may be considered in two successive intervals of time, one during which a transient voltage exists, followed by a second one during which the power frequency or the steady-state recovery voltage alone exists.

[SOURCE: IEC 60050-441:2000, 441-17-25]

3.7.106
transient recovery voltage
TRV
recovery voltage during the time in which it has a significant transient character

Note 1 to entry: The transient recovery voltage may be oscillatory or non-oscillatory, or a combination of these, depending on the characteristics of the circuit and the switching device. It includes the voltage shift of the neutral of a polyphase circuit.

Note 2 to entry: The transient recovery voltage in three-phase circuits is, unless otherwise stated, that across the first-pole-to-clear, because this voltage is generally higher than that which appears across each of the other two poles.

[SOURCE: IEC 60050-441:2000, 441-17-26]

3.7.107
prospective transient recovery voltage <of a circuit>
transient recovery voltage following the breaking of the prospective symmetrical current by an ideal switching device

Note 1 to entry: The definition assumes that the switching device or the fuse, for which the prospective transient recovery voltage is sought, is replaced by an ideal switching device, i.e. having instantaneous transition from zero to infinite impedance at the very instant of zero current, i.e. at the "natural" zero. For circuits where the current can follow several different paths, e.g. a polyphase circuit, the definition further assumes that the breaking of the current by the ideal switching device takes place only in the pole considered.

[SOURCE: IEC 60050-441:2000, 441-17-29]

3.7.108
power frequency recovery voltage
recovery voltage after the transient voltage phenomena have subsided

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[SOURCE: IEC 60050-441:2000, 441-17-27]

3.7.109
prospective current <of a circuit and with respect to a controller situated therein>
current that would flow in the circuit if each pole of the controller were replaced by a conductor of negligible impedance

[SOURCE: IEC 60050-441:2000, 441-17-01, modified: Note 1 to entry deleted.]

3.7.110
prospective peak current
peak value of a prospective current during the transient period following initiation

Note 1 to entry: The definition assumes that the current is made by an ideal switching device, i.e. with instantaneous transition from infinite to zero impedance. For circuits where the current can follow several different paths, e.g. polyphase circuits, it further assumes that the current is made simultaneously in all poles, even if only the current in one pole is considered.

[SOURCE: IEC 60050-441:2000, 441-17-02]

3.7.111
maximum prospective peak current <of an AC circuit>
prospective peak current when initiation of the current takes place at the instant which leads to the highest possible value

Note 1 to entry: For a multiple device in a polyphase circuit, the maximum prospective peak current refers to a single pole only.

[SOURCE: IEC 60050-441:2000, 441-17-04]

3.7.112
prospective breaking current <for a pole of a switching device or a fuse>
prospective current evaluated at a time corresponding to the instant of the initiation of the breaking process

Note 1 to entry: Specifications concerning the instant of the initiation of the breaking process are to be found in the relevant publications. For mechanical switching devices or fuses, it is usually defined as the moment of initiation of the arc during the breaking process.

[SOURCE: IEC 60050-441:2000, 441-17-06]

3.7.113
minimum breaking current
minimum value of prospective current that a fuse-link is capable of breaking at a stated voltage under prescribed conditions of use and behaviour

[SOURCE: IEC 60050-441:2000, 441-18-29]

3.7.114
cut-off current
let-through current
maximum instantaneous value of current attained during the breaking operation of a switching device or a fuse

Note 1 to entry: This concept is of particular importance when the switching device or the fuse operates in such a manner that the prospective peak current of the circuit is not reached.

[SOURCE: IEC 60050-441:2000, 441-17-12]

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3.7.115
take-over current
current coordinate of the intersection between the release initiated opening time of the contactor and the time-current characteristic of the SCPD

[SOURCE: IEC 60050-441:2000, 441-17-16, modified: “the time current characteristics of two over-current protective devices” was replaced by: “the release initiated opening time of the contactor and the time-current characteristic of the SCPD”.]

3.7.116
minimum take-over current
current determined by the point of intersection of the time-current characteristics of the SCPD and the contactor corresponding to:

a) the maximum break time plus, where applicable, the maximum operating time of an external over-current or earth-fault relay;

b) the minimum pre-arcing time of the SCPD

Note 1 to entry: See also Figure 9.

3.7.117
maximum take-over current
current determined by the point of intersection of the time-current characteristics of the SCPD and the contactor corresponding to

a) the minimum opening time of the contactor, or minimum response time if operated by an overcurrent relay and/or time delay devices;

b) the maximum operating time of the SCPD of highest rated current

Note 1 to entry: See also Figure 9.

3.7.118
maximum acceptable power dissipation
power which is dissipated by the controller when fitted with fuses of maximum power dissipation as determined by the temperature-rise tests

3.7.119
fused short-circuit current
conditional short-circuit current when the current limiting device is a fuse

[SOURCE: IEC 60050-441:2000, 441-17-21]

3.7.120
applied voltage <for a switching device>
voltage which exists across the terminals of a pole of a switching device just before the making of the current

[SOURCE: IEC 60050-441:2000, 441-17-24]

3.7.121
vacant

3.7.122
release-initiated opening time <of the contactor>
opening time defined according to the tripping method as stated below with any time-delay device forming an integral part of the contactor adjusted to a specified setting:

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a) for a contactor tripped by any form of auxiliary power, the interval of time between the instant of energizing the opening release, the contactor being in the closed position, and the instant when the arcing contacts have separated in all poles;

b) for a contactor tripped (other than by the striker) by a current in the main circuit without the aid of any form of auxiliary power, the interval of time between the instant at which, the contactor being in the closed position, the current in the main circuit reaches the operating value of the over-current release and the instant when the arcing contacts have separated in all poles

3.7.123
minimum release-initiated opening time <of the contactor>
release-initiated opening time when the specified setting of any time-delay device forming an integral part of the contactor is its minimum setting

3.7.124
maximum release-initiated opening time <of the contactor>
release-initiated opening time when the specified setting of any time-delay device forming an integral part of the contactor is its maximum setting

3.7.125
arcing time <of a pole or a fuse>
interval of time between the instant of the initiation of the arc in a pole or a fuse and the instant of final arc extinction in that pole or that fuse

[SOURCE: IEC 60050-441:2000, 441-17-37]

3.7.126
break time <of the contactor in a release-operated controller>
interval of time between the beginning of the release-initiated opening time of the contactor and the instant of final arc extinction in all poles

Note 1 to entry: This term may be qualified by prefixing it with "minimum" or "maximum" depending upon the opening time and the arcing time used.

3.7.127
thermal current
current assigned for a specific time by the manufacturer on the basis of information gained from “temperature rise” tests and can be higher or lower than the continuous current ratings

3.7.128
operational current
current stated by the manufacturer and takes into account the rated voltage, the rated frequency, the rated duties, the utilization category and the type of protective enclosure

Documents
Document Sharing Hub
Full document details: BS EN IEC 62271-106:2021

3.8 Index of definitions

A-B

"a" contact (make contact)	3.5.108
ambient air temperature	3.1.106
applied voltage	3.7.120
arcing time	3.7.125
auto-transformer starter	3.4.110.5
auxiliary circuit	3.5.104
"b" contact (break contact	3.5.109
breaking capacity	3.7.102
breaking current (of a switching device or fuse)	3.7.101
breaking time	3.7.126

C-D

capacitor controller	3.4.111.2
closed position	3.6.105
closed transition (with an auto-transformer starter)	3.6.117
closing operation	3.6.103
conductive part	3.1.105
control circuit	3.5.103
control contact	3.5.106
controlgear	3.1.101
controller (combination starter)	3.4.111
contactor	3.4.105
contactor class C1	3.4.113
contactor class C2	3.4.114
current setting of an overload relay or release	3.6.110
current setting range of an overload relay or release	3.6.111
cut-off current (let-through current)	3.7.114
direct-on-line starter	3.4.110.1
disconnector	3.4.103

E-N

earthing switch	3.4.104
electromagnetic contactor	3.4.106
electromagnetic starter	3.4.110.9
fuse	3.5.110.1
fused short-circuit current	3.7.119
inching (jogging)	3.6.118
joule integral (I^2t)	3.5.110.5
latched contactor	3.4.109
main circuit	3.5.102
main contact	3.5.105
making capacity	3.7.103
maximum acceptable power dissipation	3.7.118
maximum prospective peak current	3.7.111
maximum release initiated opening time	3.7.124
maximum take-over current	3.7.117
mechanical switching device	3.4.102
minimum breaking current	3.7.114
minimum release initiated opening time	3.7.123
minimum take-over current	3.7.116
n-step starter	3.4.110.10

Documents
Document Sharing Hub
Full document details: BS EN IEC 62271-106:2021

O-P

open position	3.6.106
open transition (with and auto-transformer starter)	3.6.116
opening operation	3.6.104
operating cycle	3.6.102
operating time (total clearing time)	3.5.110.4
operation	3.6.101
operational current	3.7.128
over-current	3.1.102
overload	3.1.104
overload relay (overload release)	3.6.108
phase failure sensitive overload relay or release	3.6.112
plugging	3.6.119
pole of switching device	3.5.101
position of rest	3.6.107
power frequency recovery voltage	3.7.108
pre-arcing time (melting time)	3.5.110.3
prospect breaking current	3.7.112
prospective current	3.7.109
prospective peak current	3.7.110
prospective transient recovery voltage	3.7.107

R-V

reactor starter (primary reactor starter)	3.4.110.8
recovery voltage	3.7.105
reduced ^{0}kva (voltage) starter	3.4.110.4
release initiated opening time	3.7.122
reversing starter	3.4.110.2
rheostatic starter	3.4.110.6
rheostatic rotor starter	3.4.110.7
SF_6 contactor	3.4.107
short-circuit current	3.1.103
short-circuit protective device (SCPD)	3.4.112
short-time withstand current	3.7.104
starter	3.4.110
starting time (of a rheostatic starter)	3.6.114
starting time (of an autotransformer)	3.6.115
striker	3.5.110.2
switching device	3.4.101
take-over current	3.7.115
thermal current	3.7.127
thermal overload relay or release	3.6.109
transformer controller	3.4.111.1
transient recovery voltage (TRV)	3.7.106
two-directional starter	3.4.110.3
under-current (under-voltage) relay or release	3.6.113
vacuum contactor	3.4.107

4 Normal and special service conditions

4.1 Normal service conditions

4.1.1 General

Subclause 4.1.1 of IEC 62271-1:2017 applies.

Documents
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Full document details: BS EN IEC 62271-106:2021

4.1.2 Indoor switchgear and controlgear

Subclause 4.1.2 of IEC 62271-1:2017 applies.

4.1.3 Outdoor switchgear and controlgear

Subclause 4.1.3 of IEC 62271-1:2017 applies with the following modifications.

Starters and controllers are designed for indoor installation; typically, for outdoor installations this equipment is housed in an additional protective enclosure, refer to 9.102.6.

4.2 Special service conditions

4.2.1 General

Subclause 4.2.1 of IEC 62271-1:2017 applies.

4.2.2 Altitude

Subclause 4.2.2 of IEC 62271-1:2017 applies with the following addition:

Above 1 000 m and below sea level it is often necessary to make adjustments to the contactor. See 9.102.7.

4.2.3 Exposure to pollution

Subclause 4.2.3 of IEC 62271-1:2017 applies.

4.2.4 Temperature and humidity

Subclause 4.2.4 of IEC 62271-1:2017 applies.

4.2.5 Exposure to abnormal vibrations, shock or tilting

Subclause 4.2.5 of IEC 62271-1:2017 applies.

4.2.6 Wind speed

Subclause 4.2.6 of IEC 62271-1:2017 applies.

4.2.7 Other parameters

Subclause 4.2.7 of IEC 62271-1:2017 applies.

5 Ratings

5.1 General

Subclause 5.1 of IEC 62271-1: 2017 applies with the following additions and exceptions.

A contactor, starter or controller when installed, maintained and adjusted for normal service condition shall be able to withstand all the stresses that occur in service, provided that these do not exceed its rated characteristics.

The characteristics of a contactor, starter or controller, including its operating devices and auxiliary equipment that shall be used to determine the ratings, are given in Table 1.

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Full document details: BS EN IEC 62271-106:2021

Under this heading, consideration is also given to the characteristics which are not necessarily ratings but need to be taken into consideration in the specification and design stages.

The use of an SCPD other than that utilized in the type tests may change the ratings of the combination. In this case, the new ratings shall be assigned by the manufacturer.

NOTE Ratings can differ between the table columns.

Table 1 – Ratings and characteristics

Rating/characteristic		Contactor 3.4.105	Starter 3.4.110	Controller 3.4.111
(A) *Rated characteristics*				
a) Rated voltage (U_r)	5.2	X	X	X
b) Rated insulation levels (U_d, U_p, U_s)	5.3	X	X	X
c) Rated frequency (f_r)	5.4	X	X	X
d) Rated continuous current (I_r)	5.5			X
e) Rated operational current (I_e) or rated operational power	5.101	X	X	
f) Rated short-time withstand current (I_k)	5.6	X	X	X
g) Rated peak withstand current (I_p)	5.7	X	X	X
h) Rated duration of short-circuit (t_k)	5.8	X	X	X
i) Rated short-circuit breaking current (I_{sc})	5.107			X
j) Rated short-circuit making current (I_{ma})	5.107			(X)
k) Rated duties	5.102	X	X	X
l) Rated load and overload characteristics, by utilization category	5.103, 5.104	X	X	X
m) Rated supply voltage of operating devices, and of auxiliary and control circuits (U_a)	5.9	X	X	X
n) Rated supply frequency of operating devices and of auxiliary circuits (f_a)	5.10	X	X	X
o) Rated pressure of compressed gas supply for insulation and/or operation	5.11	X	X	
(B) *Characteristics to be given on request*				
a) Thermal current (I_{th})	9.102.5	X	X	X
b) Electrical endurance	5.106	X		
c) Coordination with short-circuit protective devices	5.107	X	X	X
d) Damage classification	5.107.2.3	X	X	X
e) Short-circuit breaking capacity	5.107, 7.104	X	X	
f) Short-circuit making capacity	5.107, 7.104	X	X	
g) Motor switching characteristics	7.108	X		
h) Take-over current for release-operated controller	5.107.2.2			X
i) Rated capacitive switching current	5.112	X		X
(C) *Characteristics dependent on starter type*				
a) Automatic change-over devices and automatic acceleration control devices	5.108		X	X
b) Starting auto-transformer or reactor characteristics	5.109		X	X
c) Starting resistor characteristics	5.110		X	X
X: applicable for this configuration				
(X): applicable, but see 5.102.2 regarding intermittent duty				

5.2 Rated voltage (U_r)

Subclause 5.2 of IEC 62271-1: 2017 does not apply.

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The rated voltage indicates the upper limit of the highest voltage of the system for which the device is intended. Standard values of rated voltages are:

2,5 kV – 3,6 kV – 5,0 kV – 7,2 kV – 12 kV – 15 kV – 17,5 kV – 24 kV

For rheostatic rotor starters, the rated voltage refers to the stator.

Contactors or starters that are part of a controller or a switchgear or controlgear assembly shall have a rated voltage that is greater or equal to that of the assembly.

5.2.101 Rated rotor voltage (U_{ro})

For rheostatic rotor starters, the value of the rated voltage is that of the voltage which, when combined with a rated rotor current, determines the application of the rotor circuit including its mechanical switching devices and to which are referred the making and breaking capacities, the type of duty and the starting characteristics.

It is taken as equal to the voltage measured between slip-rings, with the motor stopped and the rotor open-circuited, when the stator is supplied at its rated voltage.

The rated rotor voltage is only applied for a short duration during the starting period. For this reason, it is permissible that the rated rotor voltage exceeds the rated rotor insulation voltage by up to 100 %.

The maximum voltage between the different live parts (for example switching devices, resistors, connecting parts, etc.) of the rotor circuit of the starter will vary and account shall be taken of this fact in choosing the equipment and its disposition.

5.2.102 Rated starting voltage (U_{tap}) of an auto-transformer starter

The rated starting voltage of an auto-transformer starter is the reduced voltage derived from the transformer.

Preferred values of rated starting voltage (U_{tap}) are 50 %, 65 % or 80 % of the rated voltage.

5.2.103 Rated starting voltage (U_{tap}) of a reactor starter

The rated starting voltage of a reactor starter is the reduced voltage derived from the impedance of the reactor and the motor current before rotation.

Preferred values of rated starting voltage (U_{tap}) are 50 %, 65 % or 80 % of the rated voltage.

5.3 Rated insulation level (U_d, U_p, U_s)

Subclause 5.3 of IEC 62271-1:2017 applies with the following modifications.

a) The insulation levels for systems rated 2,5 kV are those defined for 3,6 kV rated voltage and for systems rated 5,0 kV are those defined for 7,2 kV rated voltage;

b) For rheostatic rotor starters, the rated insulation level refers to the stator.

When the contactors or starters are part of a controller, switchgear or controlgear assembly, the rated insulation level is the one of the assembly.

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5.3.101 Rated rotor insulation level

For rheostatic rotor starters, the rated rotor insulation level is that which is assigned to the devices inserted in the rotor circuit as well as the unit they are part of (connecting links, resistors, enclosure), and to which dielectric tests and creepage distances are referred.

5.4 Rated frequency (f_r)

Subclause 5.4 of IEC 62271-1:2017 does not apply.

The rated frequency is the supply frequency for which the device is designed and to which the other characteristic values correspond. The standard values of the rated frequency are 50 Hz and 60 Hz.

5.5 Rated continuous current (I_r)

Subclause 5.5 of IEC 62271-1:2017 applies.

NOTE The term continuous current replaces the term thermal current which was used in the former editions.

A rated continuous current is normally not assigned to the contactor or starter, however maximum (operational) currents maybe assigned to them. See 5.101.

When contactors or starters are combined into larger assemblies, the rated continuous current of the connecting busbars shall be in accordance with IEC 62271-200. The connecting busbars are sometime referred to as "extendable bus".

See also thermal current (3.7.127).

5.6 Rated short-time withstand current (I_k)

Subclause 5.6 of IEC 62271-1:2017 applies with the following addition.

For a contactor, or starter, this is the RMS value of the current which can be carried in a closed position for a time sufficient for an external SCPD to operate. Alternatively, the value of current may be assigned for use of a specified SCPD. In this case, the value of the current need not be selected from the R10 series. For a controller, this is the prospective RMS value of current.

5.7 Rated peak withstand current (I_p)

Subclause 5.7 of IEC 62271-1:2017 applies.

5.8 Rated duration of short-circuit (t_k)

Subclause 5.8 of IEC 62271-1:2017 applies with the following addition.

Alternatively, the interval of time for which a contactor, or starter, can carry its short-time withstand current may be that resulting from operation of the specified SCPD.

5.9 Rated supply voltage of auxiliary and control circuits (U_a)

Subclause 5.9 of IEC 62271-1:2017 applies with the following additions.

5.9.1 General

Subclause 5.9.1 of IEC 62271-1 applies with the following addition.

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