UL 347

STANDARD FOR SAFETY

Medium-Voltage AC Contactors, Controllers, and Control Centers

UL Standard for Safety for Medium-Voltage AC Contactors, Controllers, and Control Centers, UL 347

Seventh Edition, Dated November 23, 2020

Summary of Topics

This revision of ANSI/UL 347 dated February 3, 2025 includes the following changes in requirements:

– Grounding switch interlock test: 4.206, 5.11.201, 5.11.207, and 6.101.3;

– Field wiring in equipment designed for use with MV 90 cable: 5.10.204

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated May 3, 2024 and October 25, 2024.

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Commitment for Amendments

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This ANSI/UL Standard for Safety consists of the Seventh Edition including revisions through February 3, 2025.

The most recent designation of ANSI/UL 347 as an American National Standard (ANSI) occurred on February 3, 2025. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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Preface

This is the harmonized ANCE, CSA Group, and ULSE standard for medium-voltage ac contactors, controllers, and control centres. It is the third edition of NMX-J-564/106-ANCE, the third edition of CSA C22.2 No. 253:20, and the seventh edition of UL 347. This edition of NMX-J-564/106-ANCE supersedes the previous edition published on January 2016. This edition of CSA C22.2 No. 253 supersedes the previous edition published on January 2016. This edition of UL 347 supersedes the previous edition published on January 29, 2016. This harmonized standard has been jointly revised on February 3, 2025. For this purpose, CSA Group and ULSE are issuing revision pages dated February 3, 2025, and ANCE is issuing a new edition dated February 3, 2025.

This harmonized Standard was prepared by the Association of Standardization and Certification, CSA Group and ULSE Inc (ULSE). The efforts and support of the medium-voltage control manufacturing industry and the CANENA Technical Harmonization Subcommittee THSC TC17 WG1 – Medium Voltage Controllers, which includes representatives of ULSE, CSA Group, ANCE, and North American medium voltage control manufacturers, are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

The present Mexican Standard was developed by the CT GTD – Generación, Transmisión y Distribución from the Comité de Normalización de la Asociación de Normalización y Certificación, A.C., CONANCE, with the collaboration of the medium-voltage controller manufacturers and users.

This Standard was reviewed by the CSA Integrated Committee on Industrial Control, under the jurisdiction of the CSA Technical Committee on Industrial Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of harmonization

This Standard was prepared by comparing UL 347, existing CSA Group standards, and ANCE and IEC 60470-2000 requirements. These requirements were reviewed, compared, and, where possible, harmonized. Where harmonization was not possible due to local installation codes, the differing requirements are noted in the text of the document. When conflicts between existing North American and IEC practices existed, the practice in North America is retained.

This Standard is published as an equivalent standard for ANCE, CSA Group, and ULSE.

An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

Formatting

This Standard is formatted to facilitate comparison to IEC 60470:1999 requirements, and to IEC 60694:1996, which is the common clauses document to which IEC 60470 is subservient. Requirements are categorized and arranged in the clause numbering structure used for IEC 60470. Where the requirements in this Standard were equivalent to those in IEC 60470, the subclause was assigned the equivalent IEC subclause number. Where this Standard does not include a subclause equivalent to those in IEC 60470, the entry "[Vacant]" was shown for the IEC 60470 subclause number. Where this Standard includes a requirement not shown in IEC 60470, the subclause was assigned a number of a higher numerical value than those used in the IEC document.

Note: IEC 60470 has since been replaced by IEC 62271-106 and IEC 60694 has since been replaced by IEC 62271-1.

In order to simplify the cross-referencing of corresponding requirements, the following clause numbering system is used:

- The clauses follow the IEC 60470 (and IEC 60694) format for clauses 1 through 7.
- Subclauses numbered .1 through .99 (but not subdivisions, e.g., those numbered .1.1, .1.2, .1.3, etc.) correspond to subclauses in IEC 60470 (and IEC 60694).
- Subclauses numbered .101 through .199 correspond to subclauses in IEC 60470.
- Subclauses numbered .201 through .299 are CANENA requirements not found or numbered in IEC 60470.

The purpose of this Standard is to harmonize as far as practicable all rules and requirements of a general nature in order to obtain uniformity of requirements and tests throughout the corresponding range of equipment and to avoid the need for testing to different standards.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

MEDIUM-VOLTAGE AC CONTACTORS, CONTROLLERS, AND CONTROL CENTERS

1 General

1.1 Scope

1.1.1 This standard is applicable to ac contactors applied at voltages in the range of 1 501V to 15kV, and metal-enclosed contactor-based controllers, control centers, and other control assemblies and associated equipment applied at voltages in the range of 751V to 15kV, designed for operation at frequencies of 50 or 60 Hz on three-phase systems. These requirements apply to equipment intended for use in ordinary (non-hazardous) locations and installed in accordance with the applicable local installation codes and standards (see Annex A, Item 1). These requirements, as modified by the applicable national standards for fire pump controllers, also apply to fire pump controllers (see Annex A, Item 2).

1.1.2 This standard also includes requirements for controllers intended for service entrance applications. (See Annex A, Item 3 and Clause 5.204.)

1.1.3 This standard also includes requirements for equipment incorporating solid state switching elements intended for starting, stopping, regulating, controlling, or protecting heating and other resistive loads, having ac voltage ratings in the range of 1501V to 15kV.

1.1.4 This standard also includes requirements for reduced-voltage solid-state controllers.

1.1.5 This standard does not apply to:

a) equipment for use in classified (hazardous) locations as defined in the applicable installation codes or standards;

b) components contained in contactors and contactor-based controllers for which individual component standards exist;

c) auxiliary low voltage control assemblies (see Annex A, Item 4);

d) equipment consisting solely of electronic or solid-state devices, circuits, or systems;

e) electronic variable speed motor controllers (power conversion equipment); and

f) controllers using only solid-state devices in the main circuit.

1.2 Normative references, component standards, and general requirements

1.2.1 General

Products covered by this standard shall comply with the reference installation codes and standards noted in Annex A.

For undated references to standards, such reference shall be considered to refer to the latest edition and all revisions to that edition up to the time when this standard was approved. For dated references to standards, such reference shall be considered to refer to the dated edition and all revisions published to that edition up to the time the standard was approved.

1.2.2 Component standards

1.2.2.1 Components utilized in the products covered by this standard shall comply with the appropriate standards for these components and shall be used in accordance with their recognized ratings and other limitations of use (see Annex D). A component shall comply with the ANCE, CSA Group, or UL Standards as appropriate for the country where the product shall be used.

1.2.2.2 A component need not comply with a specific requirement that:

a) involves a feature or characteristic not needed in the application of the component in the product covered in this standard, or

b) is superseded by a requirement in this standard.

1.2.3 General requirements

1.2.3.1 Canadian requirements

In Canada, general requirements as indicated in Annex A, Item 5, are also applicable.

1.2.3.2 Units of measurement

The values given in SI (metric) units shall be normative. Any other values given shall be for information purposes only.

2 Normal and Special Service Conditions

2.1 Normal service conditions

Apparatus within the scope of this standard shall be capable of operation within its performance specifications under the following conditions:

a) For equipment that is cooled by air, either ventilated or nonventilated, the temperature of the air outside of the enclosure and the ambient temperature is above 0°C but does not exceed 40°C, and its average value, measured over a period of 24 h, does not exceed 35°C.

b) The equipment is located where:

i) the influence of solar radiation is not significant, such as indoors or similarly protected locations;

ii) the altitude does not exceed 1 000 m (3 300 ft);

iii) the ambient air is not significantly polluted by dust, smoke, corrosive and/or flammable gases, vapors, or salt (for Mexico refer to Annex A item 22); and

iv) the average value of the relative humidity, measured over a period of 24 h, does not exceed 95% non-condensing.

2.2 Special service conditions

2.2.1 Altitude

Installation at altitudes above 1000 m up to 3000 m is also recognized in this standard. Variations in the design will in some cases be required. For example, considerations should be made for temperature rise,

insulation level, and mechanical parameters affected by lower ambient pressures. Manufacturers should be prepared to supply any de-rating factors to be applied to the normal service condition ratings and any necessary setting adjustments.

NOTE: Special conditions are in some cases also necessary for some types of operating mechanisms.

2.2.2 Solar radiation

If the effects of solar radiation are significant, the principles stated in Annex A, Item 11, may be used for guidance.

2.2.3 Evaluations and exceptions

Conditions that equipment will experience should be evaluated in terms of the manufacturer's designated ratings and limitations. Service conditions that are outside the limits described in Clause 2.1 should be called to the controller manufacturer's attention, since special construction or protection will in some cases be required.

3 Definitions

NOTE: Definitions that correspond to definitions in the International Electrotechnical Vocabulary (IEV) (IEC 60050-441:1984) have been so identified with their corresponding IEV designation.

In Canada, the definitions that are contained in the Canadian Electrical Code, Part I shall apply.

3.1 General terms

3.1.101 **controller and controlgear:** A controller consists of a contactor, overload protection, a manual externally operated disconnector, and a short-circuit protective device, mounted and wired in an enclosure specifically designed and dimensioned for its application, in which all tests are conducted, and which may also include a grounding function. An auxiliary compartment may be provided if necessary to complete the function of the controller.

NOTE: “Controlgear” is a general term covering controllers and auxiliary equipment supplied with controller vertical sections and in medium-voltage control centers.

3.1.102 **overcurrent:** A current exceeding the rated continuous current.

NOTE: Overcurrents can result from motor starting, overload, short-circuit, or ground faults.

3.1.103 **short-circuit current (often called fault current):** An overcurrent resulting from a short-circuit due to a fault or an incorrect connection in an electric circuit. [IEC 60050-441:1984, 441-11-07]

3.1.104 **overload:** Operating conditions in an electrically undamaged circuit that cause an overcurrent. [IEC 60050-441:1984, 441-11-02]

3.1.105 **conductive part:** A part which is capable of conducting current, although it is not necessarily used for carrying current. [IEC 60050-441:1984, 441-11-09, modified]

3.1.106 **ambient air temperature:** The temperature, determined under prescribed conditions, of the air surrounding the complete switching device or fuse. [IEC 60050-441:1984, 441-11-13]

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

3.1.201 **medium-voltage:** For this standard, ac voltage in the range of 1 501V to 15kV (in Canada, 751V to 15kV).

NOTE: The applicable installation codes will in some cases refer to this voltage range as “high-voltage.”

3.1.202 **medium-voltage compartment:** A compartment containing one or more medium-voltage components.

3.1.203 **low-voltage:** For this standard, ac voltage in the range of 50 to 1 500 V (in Canada, 30 to 750 V).

NOTE: The applicable installation codes refer to voltages above 600 Vrms (750 Vrms in Canada) as “high voltage”.

3.1.204 **low-voltage control compartment:** A compartment containing only low-voltage components.

3.1.205 **auxiliary compartment:** A compartment containing components and busing as needed to complete the functional requirements of an individual controller or a control center beyond the operational functions provided by individual controllers.

3.1.206 **line contactor:** Contactor whose line terminals are energized when the isolating means is closed.

3.1.207 **connected position of a drawout (withdrawable) element:** The position of a drawout (withdrawable) element in which it is fully connected to the main and secondary circuits.

3.1.208 **test position of a drawout (withdrawable) element:** The position of a drawout (withdrawable) element in which an isolating distance or segregation is established in the main circuit and in which the auxiliary circuits are connected. [IEC 60050-441:1984, 441-16-27, modified]

3.1.209 **Class E controller:** Class E controllers are intended for controlling and protecting medium-voltage electric motors or other electrical loads, including transformers, capacitors, resistive loads, and branch circuits.

3.1.210 **Class E1 controller:** Class E1 controllers utilize the main contactor to make and break all currents up to and including the breaking capacity of the controller.

3.1.211 **Class E2 controller:** Class E2 controllers utilize the main contactor to make and break load and operating overload currents and utilize medium-voltage fuses for interrupting fault currents that exceed the breaking capacity of the main contactor.

3.1.212 **medium-voltage control center (or control center):** A floor-mounted assembly of one or more enclosed vertical sections, principally containing controller(s) in medium-voltage compartments, and designed to provide power to more than one medium-voltage compartment by a common power bus.

NOTE: Also referred to as “controlgear”.

3.1.213 **assembly:** A combination of controllers or controlgear completely assembled with all internal electrical and mechanical interconnections. [IEC 60050-441:1984, 441-12-01, modified]

3.1.214 **barrier (or partition):** A part of an assembly separating one compartment from other compartments. [IEC 60050-441:1984, 441-13-05]

3.1.215 **blank space:** An unusable compartment containing no components or bus, and not intended for future installation of additional components.

3.1.216 **space for future controller unit:** An empty compartment, suitable for future installation of a specified controller. This compartment does not include connections to power bus, but is suitable for future installation of connections to power bus.

3.1.217 **factory-prepared space for future controller unit:** A compartment suitable for future installation of a complete controller. This compartment includes connections to power bus.

3.1.218 **partially completed controller unit:** A compartment equipped as a complete controller, except without power fuses, CTs, and load-side power connections.

NOTE: These elements (power fuse rating, CT ratio, load-side power connections, etc.) are excepted, because they can only be sized correctly with specific motor data.

3.1.219 **spare controller unit:** A fully equipped (complete) controller, suitable for immediate use, with a specific rating, but without a specific controller (load) designation.

3.1.220 **clearance:** The distance between two conductive parts along a string stretched the shortest way between these conductive parts. [IEC 60050-441:1984, 441-17-31]

3.1.221 **control power transformer (CPT):** A transformer utilized to supply voltage for control circuits and auxiliary devices.

3.1.222 **ground (earth):** A conducting connection, whether intentional or accidental, by which an electric circuit or equipment is connected to the earth or to some conducting body of relatively large extent that serves in place of the earth.

NOTE: See Figure 8 for examples of the use of the terms “grounding” and “bonding”, with corresponding terms for Canada and Mexico.

3.1.223 **insulation class:** The classification of insulation materials for the purpose of establishing temperature limits for the use of the material.

3.1.224 **grounding kit:** A grounding terminal means intended to be field-connected or factory-installed, consisting of connectors (lugs) and hardware, such as bolts, studs, or screws, etc., and suitable for connecting a conductor 14 AWG (2.08 mm^2) or larger to equipment required to be grounded, which is in addition to the means for securing conduit or cable armor.

NOTE 1: It is not intended that a grounding kit consist merely of screws for direct attachment of grounding conductors.

NOTE 2: In Canada, a grounding kit can also be referred to as a bonding kit.

3.2 Assemblies of controlgear

[Vacant]

3.3 Parts of assemblies

[Vacant]

3.4 Switching devices

3.4.101 **switching device:** A device designed to make or break the current in one or more electric circuits. [IEC 60050-441:1984, 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. [IEC 60050-441:1984, 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, SF_6, oil.

3.4.103 **isolating means (isolating switch or disconnector):** A mechanical switching device that provides, in the open position, isolating distance in the main circuit from the source of power. [IEC 60050-441:1984, 441-14-05, modified]

3.4.103.201 **service disconnecting means:** Isolating means that disconnects all conductors into a building or other structure from the service entrance conductors.

3.4.104 **grounding (earthing) switch:** A permanently installed mechanical three-pole open air switching device used to connect the load side of a de-energized medium voltage controller power circuit to ground (earth) for maintenance purposes.

3.4.105 **contactor:** 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. [IEC 60050-441:1984, 441-14-33]

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.

NOTE: Unless otherwise identified, the term “contactor” as used in this standard refers to an “electromagnetic contactor”.

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

3.4.108 **SF_6 contactor:** [Vacant]

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. [IEC 60050-441:1984, 441-14-34]

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

3.4.110 **starter (motor controller):** A controller used to start and stop a motor.

3.4.110.1 **full-voltage starter:** A starter that connects the full line voltage across the motor terminals in one step.

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 rotating.

3.4.110.3 **two-direction starter:** [Vacant]

3.4.110.4 **reduced-voltage starter:** A starter that reduces the starting voltage of the motor, and then transitions to full voltage. Reduced-voltage starters include autotransformer, reactor, solid-state, wye-delta, part winding, and wound-rotor starters.

3.4.110.5 **autotransformer starter:** A reduced-voltage starter that uses reduced voltages derived from an autotransformer to start a motor. It includes the necessary switching devices to provide full voltage.

3.4.110.6 **rheostatic starter:** [Vacant]

3.4.110.7 **wound-rotor starter (or a rheostatic rotor starter):** [Vacant]

3.4.110.8 **reactor starter (often referred to as a primary reactor starter):** A starter that includes a reactor connected in series with the stator winding of an alternating current motor to furnish reduced voltage for starting. It includes the necessary switching devices to provide full voltage.

3.4.110.9 **electromagnetic starter (electromagnetic controller):** [Vacant]

3.4.110.10 **n-step starter:** [Vacant]

3.4.111 **controller, combination starter:** [Vacant]

3.4.112 **short-circuit protective device (SCPD):** A device intended to protect a circuit or parts of a circuit against short-circuit currents by interrupting them; in this standard, typically a medium-voltage fuse.

3.4.113 **Class C1:** A device with a low probability of restrike during capacitive current breaking as demonstrated by the type tests in Clause 6.109.

3.4.114 **Class C2:** A device with a very low probability of restrike during capacitive current breaking as demonstrated by the type tests in Clause 6.109.

3.4.201 **vacuum interrupter:** An interrupter in which the contacts open and close within a highly evacuated envelope.

3.4.202 **reduced-voltage solid state controller:** A controller that includes solid state devices connected in series with the stator winding of an alternating current motor to furnish reduced voltage for starting.

NOTE: It might or might not include the necessary mechanical switching devices to provide a bypass function.

3.4.203 **automatic bypass function:** A circuit that automatically shunts the solid state devices to provide full voltage to the output terminals.

NOTE: An automatic bypass function might or might not include provisions for automatic return of control to the solid state devices.

3.4.204 **solid state resistive load controller:** A Class E2 controller that includes solid state devices connected in series with a resistive load to provide control of power consumed by the resistive load, such as heaters.

NOTE: It might or might not include the necessary mechanical switching devices to provide a bypass function.

3.5 Parts of a controller

3.5.101 **pole of a switching device:** The portion of a controller 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: A switching device is called single-pole if it has only one pole. If it has more than one pole, it may be called multi-pole (two-pole, three-pole, etc.), provided that the poles are, or can be, coupled in such a manner as to operate together.

3.5.102 **main circuit:** All the current-carrying parts of a controller included in the medium-voltage circuit it is intended to open or close.

3.5.103 **control circuit:** The circuit that carries the electric signals directing the performance of a control device, but does not carry the power that the device controls.

3.5.104 **auxiliary circuit:** All the conductive parts of controller that are intended to be included in a circuit, other than the main circuit and the control circuits of the device.

NOTE: Some auxiliary circuits fulfill supplementary functions, such as signalling, interlocking, etc., and, as such, can be part of the control circuit of another switching device.

3.5.201 **interlock (interlocking device):** A device that makes the operation of a movable element (e.g., a switching device, door, or the like) dependent upon the position or operation of one or more other movable elements. [IEC 60050-441:1984, 441-16-49, modified]

3.5.202 **drawout (withdrawable) element:** A removable part of controller that can be moved to one or more positions in which an isolating distance or a segregation between open contacts is established. [IEC 60050-441:1984, 441-13-09]

NOTE: The isolating distance or the segregation always relates to the main circuit, and in some cases refers to the auxiliary circuits or to control circuits.

3.5.203 **cover:** The unhinged portion of an enclosure that covers an opening.

3.5.204 **door:** A hinged portion of an enclosure that covers an opening.

3.5.205 **enclosure:** A surrounding case constructed to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection to the enclosed equipment against specified environmental conditions.

NOTE: See also Annex A, Item 6.

3.5.206 **vertical section:** That portion of a medium-voltage control center assembly between two successive vertical delineations. A vertical section includes top, vertical side panels, front and rear doors or covers containing power bus, low-voltage and medium-voltage compartments, or other components as required for the intended application.

3.5.207 **power bus:** A conductor or group of conductors that serves as a source of supply to two or more power circuits within or between vertical sections.

3.5.208 **extendable power bus:** That portion of the power bus that is capable of being extended to connect two or more vertical sections.

3.5.209 **non-extendable power bus:** Those portions of the power bus that are not extendable and connect power circuits within a vertical section, with short direct terminations, to not more than three controllers.

3.6 Operation

3.6.101 **operation (of a mechanical switching device):** The transfer of the moving contact(s) from one position to an adjacent position. [IEC 60050-441:1984, 441-16-01]

NOTE 1: This can be a closing operation or an opening operation.

NOTE 2: 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.

3.6.102 **operating cycle (of a mechanical switching device):** [Vacant]

3.6.103 **closing operation "C" (of a mechanical switching device):** An operation by which the device is brought from the open position to the closed position. [IEC 60050-441:1984, 441-16-08]

3.6.104 **opening operation "O" (of a mechanical switching device):** An operation by which the device is brought from the closed position to the open position. [IEC 60050-441:1984, 441-16-09]

3.6.105 **closed position (of a mechanical switching device):** The position in which the predetermined continuity of the main circuit of the device is secured. [IEC 60050-441:1984, 441-16-22]

3.6.106 **open position (of a mechanical switching device):** The position in which the predetermined clearance between open contacts in the main circuit of the device is secured. [IEC 60050-441:1984, 441-16-23]

3.6.107 **position of rest (of a contactor):** The position which the moving elements of the contactor take up when its electromagnet is not energized. [IEC 60050-441:1984, 441-16-24 modified]

3.6.108 **overload relay or release:** [Vacant]

3.6.109 **thermal overload relay or release:** [Vacant]

3.6.110 **current setting of an overload relay or release:** [Vacant]

3.6.111 **current setting range of an overload relay or release:** [Vacant]

3.6.112 **phase failure sensitive overload relay or release:** [Vacant]

3.6.113 **under-current (under-voltage) relay or release:** [Vacant]

3.6.114 **starting time (of a rheostatic starter):** [Vacant]

3.6.115 **starting time (of a reduced-voltage starter):** [Vacant]

3.6.116 **open transition (of an autotransformer starter):** [Vacant]

3.6.117 **closed transition (of an autotransformer starter):** [Vacant]

3.6.118 **inching (jogging):** [Vacant]

3.6.119 **plugging:** [Vacant]

3.7 Characteristic quantities

3.7.1 **isolating distance (gap):** The clearance between the line and load side contacts of the isolating means when in the open position.

3.7.2 **degree of protection:** The extent of protection provided by an enclosure against access to hazardous parts, against ingress of solid foreign objects, and/or ingress of water, and verified by standardized test methods (see Annex A Item 12).

3.7.101 **breaking current (of a switching device or a fuse):**

3.7.102 **breaking capacity (of a switching device or a fuse):** A 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 behavior. [IEC 60050-441:1984, 441-17-08]

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

NOTE 2: For switching devices, the breaking capacity can 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.

3.7.103 **making capacity (of a switching device):** A value of prospective making current that a switching device is capable of making at a stated voltage under prescribed conditions of use and behavior. [IEC 60050-441:1984, 441-17-09]

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

3.7.104 **take-over current:** See Clause 3.7.115.

3.7.105 **short-time withstand current:** The 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 behavior. [IEC 60050-441:1984, 441-17-17]

3.7.106 **recovery voltage:** The voltage that appears across the terminals of a pole of a switching device or a fuse after the breaking of the current. [IEC 60050-441:1984, 441-17-25, modified]

NOTE: This voltage can be considered in two successive intervals of time, the first in which a transient voltage is superimposed on an essentially constant power-frequency voltage, followed by a second interval in which the power-frequency or the steady-state recovery voltage alone exists.

3.7.107 **transient recovery voltage (TRV):** The recovery voltage during the time in which it has a significant transient character. [IEC 60050-441:1984, 441-17-26]

NOTE 1: The transient recovery voltage can 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: 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.

3.7.108 **power-frequency recovery voltage:** The recovery voltage after the transient voltage phenomena have subsided. [IEC 60050-441:1984, 441-17-27] See Figure 6.

3.7.109 **prospective current (of a circuit and with respect to a combination situated therein):** The current that would flow in the circuit if each pole of the combination were replaced by a conductor of negligible impedance. [IEC 60050-441:1984, 441-17-01, modified]

NOTE: For testing, the prospective current is determined by calibrating the test circuit with a short circuit placed directly across the incoming terminals of the test specimen.

3.7.110 **prospective peak current:** The peak value of a prospective current during the transient period following initiation. [IEC 60050-441:1984, 441-17-02, modified]

NOTE 1: For testing, the prospective current is determined by calibrating the test circuit with a short circuit placed directly across the incoming terminals of the test specimen.

NOTE 2: 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.

3.7.111 **maximum prospective peak current (of an ac circuit):** The prospective peak current when initiation of the current takes place at the instant which leads to the highest possible value. [IEC 60050-441:1984, 441-17-04]

NOTE: For a multi-pole device in a polyphase circuit, the maximum prospective peak current refers to a single pole only.

3.7.112 **prospective breaking current (of a switching device or fuse):** [Vacant]

3.7.113 **minimum breaking current:** [Vacant]

3.7.114 **let-through current (sometimes called cut-off current):** The maximum instantaneous value of current attained during the breaking operation of a switching device or a fuse.

3.7.115 **take-over current:** The current coordinate of the intersection between the time-current characteristics of two overcurrent protective devices. [IEC 60050-441:1984, 441-17-16]

NOTE: Historically referred to as cross over current.

3.7.116 **minimum take-over current:** Current determined by the point of intersection of the time-current characteristics of the medium-voltage fuse and the contactor corresponding to:

a) the maximum break time plus, where applicable, the maximum operating time of an external overcurrent or ground-fault relay, and

b) the minimum pre-arcing time of the medium-voltage fuse.

See also Figure 7.

3.7.117 **maximum take-over current:** Current determined by the point of intersection of the time-current characteristics of the medium-voltage fuse 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; and

b) the maximum operating time of the medium-voltage fuse of highest rated current.

See also Figure 7.

3.7.118 **maximum acceptable power dissipation:** [Vacant]

3.7.119 **fused short-circuit current:** [Vacant]

3.7.120 **applied voltage (for a switching device):** The voltage that exists across the terminals of a pole of a switching device just before the making of the current. [IEC 60050-441:1984, 441-17-24]

NOTE: This is normally the line-to-line voltage divided by 1.732.

3.7.121 **prospective transient recovery voltage (of a circuit):** [Vacant]

3.7.122 **opening time (of a contactor):** The opening time of a contactor is defined according to the tripping method as stated below, including any time-delay device forming an integral part of the contactor, adjusted to a specified setting:

a) For an electromagnetic contactor, the opening time is the interval of time between the instant at which the control circuit initiates contactor opening and the instant when the arcing contacts have separated in all poles.

b) For a latched contactor, the opening time is the interval of time between the instant of energizing the opening release and the instant when the arcing contacts have separated in all poles.

3.7.123 **minimum opening time (of the contactor):** [Vacant]

3.7.124 **maximum opening time (of the contactor):** [Vacant]

3.7.125 **arcing time (of a pole or a fuse):** The 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 of that pole or the fuse. [IEC 60050-441:1984, 441-17-37]

3.7.126 **break time (of the contactor):** The interval of time between the beginning of the opening time of the contactor and the instant of final arc extinction in all poles.

3.7.201 **supply voltage:** The voltage to which the line terminals of a device are connected.

3.7.202 **creepage distance:** The shortest distance along the surface of an insulating material between two conductive parts.

3.7.203 **disruptive discharge:** The phenomena associated with the failure of insulation under electric stress; these include a collapse of voltage and the passage of current. The term applies to electrical breakdown in solid, liquid, and gaseous dielectrics, and combinations of these dielectrics.

3.7.204 **ultimate trip current:** The minimum value of continuously applied current that will cause an overload relay to operate (trip).

3.101 Fuses

3.101.1 **fuse:** A device that, by the melting and severing 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. [IEC 60050-441:1984, 441-18-01, modified]

3.101.2 **striker:** [Vacant]

3.101.3 **pre-arcing time:** The 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. [IEC 60050-441:1984, 441-18-21]

NOTE: Pre-arcing time is also referred to as melting time.

3.101.4 **total clearing time (sometimes called operating time):** The sum of the pre-arcing time and the arcing time. [IEC 60050-441:1984, 441-18-22, modified]

3.101.5 **joule integral (I^2t):** [Vacant]

3.201 Medium-voltage fuse

3.201.1 **medium-voltage fuse:** A current-limiting fuse intended for use in medium-voltage circuits, capable of interrupting all currents from the rated maximum interrupting current down to the rated minimum interrupting current (where applicable).

NOTE: See Annex D, Item 23 , which categorizes different types of current-limiting fuses based on their minimum interrupting current capability:

a) Backup current-limiting fuse: a current-limiting fuse capable of interrupting all currents from its rated maximum interrupting current down to its rated minimum interrupting current.

b) Full-range current-limiting fuse: a current-limiting fuse capable of interrupting, under specified conditions, all currents from its rated maximum interrupting current down to the minimum continuous current that can cause the fusible element to melt.

c) General-purpose current-limiting fuse: a current-limiting fuse capable of interrupting all currents from its rated interrupting current down to the current that causes melting of the fusible element(s) in one hour or more.

3.201.2 **foldback action:** A protective feature (a type of overload protection) that may be incorporated in reduced-voltage solid-state controllers. When the load attempts to draw excessive overcurrent through the solid-state portion of the controller, this action reduces both output voltage and current to lower values so as to avoid damage to the solid-state portion of the controller.

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