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Interested committees:

Title: Draft BS EN 60947-4-1 Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters -
Electromechanical contactors and motor-starters

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



121A/480/CD

COMMITTEE DRAFT (CD)

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IEC 60947-4-1 ED5

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2022-02-25

CLOSING DATE FOR COMMENTS:

2022-04-22

SUPERSEDES DOCUMENTS:

121A/478/RR

IEC SC 121A : LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR	
SECRETARIAT: France	SECRETARY: Mr Michaël LAHEURTE
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 2,TC 22,SC 22G,SC 23E,TC 31,TC 61,SC 121B	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☒ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☒ SAFETY	

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TITLE:

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

NOTE FROM TC/SC OFFICERS:

SC121A Officers support circulation of CD1 for project IEC 60947-4-1 ED5.

Note that a DC circulates in parallel through 121A/466/DC up to 1st of April with the same content.

Secretary Note: NC experts are kindly requested to refer their comments to line number.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

FOREWORD

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International Standard IEC 60947-4-1 has been prepared by subcommittee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

This fifth edition cancels and replaces the fourth edition published in 2022. This edition constitutes a technical revision.

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

- Objective in the scope
- Instantaneous only motor protective switching device IMPSD (3.4.31)
- Kinds of equipment (5.2.1)
- Methods of overload protection of motors (5.2.6)
- Adoption of the AC-7d from IEC 61095 Ed. 3 (in 5.4.2)
- Separately mounted overload relay of a starter (in 5.7.3 b))
- Starter and contactor suitable for use downstream to basic drive module (6.1.2 z))
- Reference to IEC TS 63058 for environmental aspects (in 8.1.1)
- Wiring subject to movement (in 8.1.3)
- Use of voltage transient limiting device (8.1.18)
- Accessible parts subject to temperature limits (in 8.2.2.3)
- Reference to Annex X of IEC 60947-1 for the co-ordination of MPD with SCPD (8.2.5.4)
- Reference to IEC TR 63216 with different EMC environments (8.3.1)
- Reference to IEC TR 63201 for the embedded software design (8.4)
- Reference to IEC TS 63208 for cybersecurity aspects (8.5)
- Update and completion of the measurement method of the power consumption of the electromagnet (9.3.3.2.1.2)
- Update of Annex C including rational about AC-3e
- Determination of the critical load current for photovoltaic applications (M.9.7)

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

FDIS	Report on voting
121A/224/FDIS	121A/233/RVD

455
456 Full information on the voting for the approval of this International Standard can be found in
457 the report on voting indicated in the above table.

458 This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

459 A list of all parts of the IEC 60947 series can be found, under the general title *Low-voltage*
460 *switchgear and controlgear*, on the IEC website.

461 This document shall be read in conjunction with IEC 60947-1:2020, *Low voltage switchgear*
462 *and controlgear – Part 1: General rules*. The provisions of the general rules are applicable to
463 this document, where specifically called for.

464 The provisions of the general rules dealt with IEC 60947-1 are applicable to this part of
465 IEC 60947 series where specifically called for. Clauses and subclauses, tables, figures and
466 annexes of the general rules thus applicable are identified by reference to IEC 60947-1:2020.
467 For example, 5.3.4.1 of IEC 60947-1:2020, Table 4 of IEC 60947-1:2020, or Annex A of
468 IEC 60947-1:2020.

469 The committee has decided that the contents of this document will remain unchanged until the
470 stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to
471 the specific document. At this date, the document will be

- 472 • reconfirmed,
- 473 • withdrawn,
- 474 • replaced by a revised edition, or
- 475 • amended.

476 The contents of the interpretation sheet of March 2020 have been included in this copy.

477 The contents of the corrigendum of April 2020 have been included in this copy.

478

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

479

480

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

1. Scope

This part of IEC 60947 is applicable to the following equipment:

- electromechanical contactors and starters including motor protective switching device (MPSD);
- actuators of contactor relays;
- contacts dedicated exclusively to the coil circuit of this contactor or this contactor relay;
- dedicated accessories (e.g. dedicated wiring, dedicated latch accessory);

intended to be connected to distribution circuits, motors circuits and other load circuits, the rated voltage of which does not exceed 1 000 V AC or 1 500 V DC.

This document does not apply to:

- starters for DC motors¹;
- auxiliary contacts of contactors and contacts of contactor relays. These are covered by IEC 60947-5-1;
- short-circuit protective device integrated within starters other than MPSDs. This is covered by IEC 60947-2 and IEC 60947-3;
- motor overload protection function performed by control units for built-in thermal protection (PTC). They are covered by IEC 60947-8;
- the use of the equipment with additional measure within explosive atmospheres. These are given in IEC 60079 series;

The objective of this document is to state:

- the characteristics and composition of the equipment (Clause 5);
- the conditions applicable to the equipment with reference to:
 - its operation (5.2.5), protection functions (5.2.6, 5.7, 5.8),
 - its intended environments (Clause 7, 8.3.1) and applications (5.4, Annex C, Annex D, Annex G, Annex H, Annex I, Annex M, Annex O) including safety applications (Annex F, Annex K, Annex L),
 - its construction and performances (Clause 8) including requirements to reduce risks of electric shock, thermal, energy, fire and mechanical hazard, reasonably foreseeable misuse, electromagnetic compatibility, software errors and security;
- the tests intended for confirming that these conditions have been met, and the methods to be adopted for these tests (Clause 9);
- the information to be given with the equipment or in the manufacturer's literature (Clause 6).

¹ For this subject the manufacturer is responsible for taking additional measures.

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 60034-1:2017, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-12:2016, *Rotating electrical machines – Part 12: Starting performance of single-speed three-phase cage induction motors*

IEC 60034-30-1, *Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE code)*

IEC 60038, *IEC standard voltages*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60079-14, *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60364-1:2005, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-7-712, *Low voltage electrical installations – Part 7-712: Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems*

IEC 60715:2017, *Dimensions of low-voltage switchgear and controlgear – Standardized mounting on rails for mechanical support of switchgear, controlgear and accessories*

IEC 60730-1, *Automatic electrical controls – Part 1: General requirements*

IEC 60947-1:2020, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-2:2016, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 60947-5-1:2016, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61051-2, *Varistors for use in electronic equipment – Part 2: Sectional specification for surge suppression varistors*

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

IEC 61800-5-1, Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy

IEC 61810-1, *Electromechanical elementary relays – Part 1: General and safety requirements*

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2015/AMD1:2016

ISO 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3864-2, *Graphical symbols – Safety colours and safety signs – Part 2: Design principles for product safety labels*

3. Terms, definitions, symbols and abbreviated terms

3.1 General

For the purposes of this document, the terms and definitions of Clause 3 of IEC 60947-1:2020, as well as the following terms, definitions, symbol and abbreviations apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.2 Alphabetical index of terms

Reference

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auto-transformer	3.4.4.3

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603	I_{cd} current	3.5.4
604	inching (jogging)	3.4.22
605	inhibit time	3.4.28
606	instantaneous only motor protective switching device IMPSD	3.4.31
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609	L	
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660	3.3 Terms and definitions concerning contactors	
661	3.3.1	
662	(mechanical) contactor	
663	mechanical switching device having only one position of rest, operated otherwise than by	
664	hand, capable of making, carrying and breaking currents under normal circuit conditions	
665	including operating overload conditions	
666	Note 1 to entry: Mechanical contactors may be designated according to the method by which the force for closing	
667	the main contacts is provided.	
668	Note 2 to entry: The term "operated otherwise than by hand" means that the device is intended to be controlled	
669	and kept in working position from one or more external supplies.	
670	Note 3 to entry: In French, a contactor the main contacts of which are closed in the position of rest is usually	
671	called a "rupteur". The word "rupteur" has no equivalent in the English language.	
672	Note 4 to entry: A contactor is usually intended to operate frequently.	
673	Note 5 to entry: A mechanical contactor can provide a galvanic opening (3.5.10) but is not suitable for isolation	
674	unless the additional requirements defined under 8.1.7 are fulfilled. In this case the equipment can be marked in	
675	accordance with IEC 60417-6169-1 "Disconnecter; isolator".	
676	[SOURCE: IEC 60050-441:2000, 441-14-33, modified – Term "mechanical" in bracket; "may"	
677	replaced by "can" in Note 1 to entry; Notes to entry 2 to 5 have been added]	
678	3.3.2	
679	electromagnetic contactor	
680	contactor in which the force for closing the normally open main contacts or opening the	
681	normally closed main contacts is provided by an electromagnet	
682	Note 1 to entry: The electromagnet may be electronically controlled.	

3.3.3

pneumatic contactor

contactor in which the force for closing the normally open main contacts or opening the normally closed main contacts is provided by a device using compressed air, without the use of electrical means

3.3.4

electro-pneumatic contactor

contactor in which the force for closing the normally open main contacts or opening the normally closed main contacts is provided by a device using compressed air under the control of electrically operated valves

3.3.5

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, can be mechanical, electromagnetic, pneumatic, etc.

Note 2 to entry: Because of the latching, the latched contactor actually acquires a second position of rest and, according to the definition of a contactor, it is not, strictly speaking, a contactor. However, since the latched contactor in both its utilization and its design is more closely related to contactors in general than to any other classification of switching device, it is considered proper to require that it complies with the specifications for contactors wherever they are appropriate.

[SOURCE: IEC 60050-441:2000, 441-14-34, modified – “may” replaced by “can” in Note 1 to entry]

3.3.6

vacuum contactor (or starter)

contactor (or starter) in which the main contacts open and close within a highly evacuated envelope

3.3.7

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]

3.3.8

electronically controlled electromagnet

electromagnet in which the coil is controlled by a circuit with active electronic elements

3.3.9

holding power (of a contactor)

power needed to maintain the operation of the electromagnet

3.3.10

pick-up power (of a contactor)

power needed to operate the contactor from the de-energized state to the energized state

3.4 Terms and definitions concerning starters

3.4.1

motor starter

starter

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

730 [SOURCE: IEC 60050-441:2000, 441-14-38, modified – “motor stater” added as the first term
731 and Note 1 to entry has been deleted]

732 3.4.2

733 **direct-on-line starter**

734 starter which connects the line voltage across the motor terminals in one step

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

736 3.4.3

737 **reversing starter**

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

740 Note 1 to entry: An application where reversing the motor primary connections while the motor is running is called
741 plugging (see 3.4.24).

742 3.4.4

743 **reduced voltage starter**

744 starter which connects the line voltage across the motor terminals in more than one step or by
745 gradually increasing the voltage applied to the terminals

746 3.4.4.1

747 **star-delta starter**

748 starter for a three-phase induction motor such that in the starting position the stator windings
749 are connected in star and in the final running position they are connected in delta

750 [SOURCE: IEC 60050-441:2000, 441-14-44]

751 3.4.4.2

752 **auto-transformer starter**

753 starter for an induction motor which uses for starting one or more reduced voltages derived
754 from an auto-transformer

755 [SOURCE: IEC 60050-441:2000, 441-14-45]

756 3.4.4.3

757 **auto-transformer**

758 transformer in which at least two windings have a common part

759 [SOURCE: IEC 60050-421:1990, 421-01-11]

760 3.4.5

761 **rheostatic starter**

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

764 Note 1 to entry: A rheostatic starter generally consists of three basic parts which may be supplied either as a
765 composite unit or as separate units to be connected at the place of utilization:

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

770 Note 2 to entry: It applies also to starters for two directions of rotation when reversal of connections is made with
771 the motor stopped.

772 [SOURCE: IEC 60050-441:2000, 441-14-42, modified – Notes to entry have been added]

3.4.5.1

rheostatic stator starter

rheostatic starter for a squirrel cage motor which, during the starting period, cuts out successively one or several resistors previously provided in the stator circuit

3.4.5.2

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]

3.4.6

protected starter

equipment consisting of a starter, a manually-operated switching device and a short-circuit protective device, rated as a unit by the manufacturer

Note 1 to entry: The protected starter may or may not be enclosed.

Note 2 to entry: In the context of this document, the term "manufacturer" means any person, company or organization with ultimate responsibility as follows:

- to verify compliance with the appropriate standard;
- to provide the [equipment](#) information according to Clause 6.

Note 3 to entry: A manually protected starter as one unit can be a MPSD.

3.4.7

combination starter

equipment consisting of a protected starter incorporating an isolating function

Note 1 to entry: Also called "combination motor controller".

Note 2 to entry: See Figure C.6.

3.4.8

manual starter

starter in which the force for closing the main contacts is provided exclusively by manual energy

[SOURCE: IEC 60050-441:2000, 441-14-39]

3.4.9

electromagnetic starter

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

3.4.10

motor-operated starter

starter in which the force for closing the main contacts is provided by an electric motor

3.4.11

pneumatic starter

starter in which the force for closing the main contacts is provided by using compressed air, without the use of electrical means

3.4.12

electro-pneumatic starter

starter in which the force for closing the main contacts is provided by using compressed air under the control of electrically operated valves

3.4.13**single-step starter**

starter in which there is no intermediate accelerating position between the OFF and ON positions

Note 1 to entry: This starter is a direct-on-line starter.

3.4.14**two-step starter**

starter in which there is only one intermediate accelerating position between the OFF and ON positions

EXAMPLE A star-delta starter is a two-step starter.

3.4.15***n*-step starter**

starter in which there are (*n*-1) intermediate accelerating positions between the OFF and full ON positions

EXAMPLE A three-step rheostatic starter has two sections of resistors used for starting.

[SOURCE: IEC 60050-441:2000, 441-14-41, modified – “OFF” and “ON” in capital; Example and Note 1 to entry are added]

3.4.16**phase loss sensitive overload relay or release**

multipole overload relay or release which operates in the case of overload and also in case of loss of phase in accordance with specified requirements

3.4.17**under-current relay or release**

measuring relay or release which operates automatically when the current through it is reduced below a predetermined value

3.4.18**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 also takes into account the last period of acceleration following the switching operation to the ON position.

3.4.19**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 also takes into account the last period of acceleration following the switching operation to the ON position.

3.4.20**open transition (with an auto-transformer starter or star-delta starter)**

circuit arrangement such 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 as an additional step.

3.4.21**closed transition (with an auto-transformer starter or star-delta starter)**

circuit arrangement such 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 as an additional step.

3.4.22

inching (jogging)

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

3.4.23

plugging

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

3.4.24

protected switching device

equipment (for non-motor loads) consisting of a contactor or a semiconductor controller, overload protection, a manually operated switching device and a short-circuit protective device, rated as a unit by the manufacturer

Note 1 to entry: The protected switching device may or may not be enclosed.

Note 2 to entry: In the context of this document, the term “manufacturer” means any person, company or organization with ultimate responsibility as follows:

- to verify compliance with the appropriate standard;
- to provide the equipment information according to Clause 6.

Note 3 to entry: The manually operated switching device and the short-circuit protective device may be just one device and may incorporate the overload protection as well.

3.4.25

combination switching device

equipment consisting of a protected switching device incorporating an isolating function

3.4.26

stall relay (or release)

electronic overload relay or release which operates when the current has not decreased below a predetermined value for a specific period of time during start-up or when the relay or the release receives the input indicating there is no rotation of the motor after a predetermined time in accordance with specified requirements

Note 1 to entry: Explanation of stall: rotor locked during start.

Note 2 to entry: With appropriate adjustment of the current and starting time settings, such relay or release can be used to detect starts requiring longer than specified times.

3.4.27

jam relay (or release)

electronic overload relay or release which operates in the case of overload and also when the current has increased above a predetermined value for a specific period of time during operation, in accordance with specified requirements

Note 1 to entry: A jam is a high overload occurring after the completion of starting which causes the current to reach the locked rotor current value of the motor being controlled.

3.4.28

inhibit time

time-delay period during which the tripping function of the relay is inhibited (may be adjustable)

3.4.29

motor management starter

starter including extended functions with communication ability

Note 1 to entry: Interoperable device profiles for motor management starter are defined by IEC 61915-2:2011.

3.4.30**motor protective switching device****MPSD**

manually operated motor starter additionally providing resettable short-circuit protection to the motor and the circuit

Note 1 to entry: A MPSD can also be used as a manual starter, a protected starter or a combination starter.

Note 2 to entry: A MPSD can be used as a SCPD within the motor branch.

Note 3 to entry: In North America, this device is called manual motor controller suitable for tap conductor protection.

3.4.31**instantaneous only motor protective switching device****IMPSD**

motor protective switching device (MPSD) without overload protection function

Note 1 to entry: This type of device is typically used in a 3 components starter where the overload protection function is within a separately mounted overload relay.

3.4.313.4.32**dedicated wiring accessory**

prefabricated connection wiring system specifically intended for identified switchgear or controlgear

Note 1 to entry: A dedicated wiring accessory can be integrated in the switchgear or controlgear or delivered separately.

Note 2 to entry: A typical dedicated wiring accessory is for example a connection link.

3.4.323.4.33**latch accessory**

mechanical device attached to a contactor, the moving elements of which are prevented 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, can be mechanical, electromagnetic, pneumatic, etc.

[SOURCE: IEC 60050-441:2000, 441-14-34, modified – Adapted to accessories, and Note 2 to entry deleted]

3.4.34**basic drive module****BDM**

electronic power converter and related control, connected between an electric supply and a motor

Note 1 to entry: The BDM is capable of transmitting power from the electric supply to the motor and may be capable of transmitting power from the motor to the electric supply.

Note 2 to entry: The BDM controls some or all of the following aspects of power transmitted to the motor and motor output: current, frequency, voltage, speed, torque, force.

[SOURCE: IEC 61800-5-1:202x, 3.5]

3.4.35**complete drive module****CDM**

CDM module consisting of, but not limited to, the BDM and extensions such as protection devices, transformers and auxiliaries, but excluding the motor and the sensors which are mechanically coupled to the motor shaft

[SOURCE: IEC 61800-5-1:202x, 3.12]

3.5 Terms and definitions concerning characteristic quantities

3.5.1

transient recovery voltage

TRV

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

Note 1 to entry: In a vacuum contactor or starter, the highest transient recovery voltage can occur on another pole than the first pole to clear.

[SOURCE: IEC 60947-1:2020, 3.7.34, modified – Note 1 to entry has been modified]

3.5.2

CO operation

breaking of the circuit by the SCPD resulting from closing the circuit by the equipment under test

3.5.3

O operation

breaking of the circuit by the SCPD resulting from closing the circuit on the equipment under test which is in the closed position

Note 1 to entry: The SCPD is normally in the closed position prior closing the circuit; in some cases, the SCPD has to close the circuit (see 9.3.4.2.2, item b).

3.5.4

I_{cd} current

current representing a fault current equal to or higher than the current corresponding to the crossover point of the mean value of the published curves representing the time-current characteristics of the overload relay and the SCPD respectively

3.5.5

resetting time

time elapsed between a circuit-breaker or a starter tripping due to an over-current and subsequently reaching a condition where it can be reclosed

[SOURCE: IEC 60947-2:2016, 2.19, modified – Insertion of ““or a starter”” in definition]

3.5.6

conventional prospective current “r”

specified value of prospective short-circuit current for which the switching device is tested under specified conditions

3.5.7

I^2t characteristic of a circuit-breaker or a MPSD

information (usually a curve) giving the maximum values of I^2t related to break time as a function of prospective current (r.m.s. symmetrical for a.c.) up to the maximum prospective current corresponding to the rated service short-circuit breaking capacity and associated voltage

[SOURCE: IEC 60947-2:2016, 2.18, modified – “or a MPSD” inserted in term]

3.5.8

rated instantaneous short-circuit current setting

I_i

rated value of the current causing the operation of a release without any intentional time-delay

[SOURCE: IEC 60947-2:2016, 2.20]

3.5.9**overload current setting** I_r

current setting of an adjustable overload release

[SOURCE: IEC 60947-2:2016, 2.21, modified – Note 1 to entry has been deleted]

3.5.10**galvanic opening (of a circuit)**

prevention of electric conduction within an electric circuit intended to provide power and/or signals

Note 1 to entry: Galvanic opening can be provided e.g. by a switch or a contactor.

3.5.11**galvanic separation**

prevention of electric conduction between two electric circuits intended to exchange power and/or signals

Note 1 to entry: Galvanic separation can be provided e.g. by an isolating transformer or an opto-coupler.

[SOURCE: IEC 60050-151:2001, 151-12-26]

3.5.12**recurring peak voltage**maximum peak value of periodic excursions of the voltage waveform resulting from distortions of an AC voltage or from AC components superimposed on a DC voltageNote 1 to entry: Random overvoltage, for example due to occasional switching, are not considered to be recurring peak voltages.[SOURCE: IEC 60050-442:2014, 442-09-15]**3.5.13****rated voltage pulse slope****dV/dt**maximum admissible value of the voltage slope dV/dt of a pulse, at the ambient air temperature at such a repetition frequency that no significant increase of temperature occurs[SOURCE: IEC 60384-17:2005, 1.5.5, modified with dV/dt]**3.6 Terms and definitions concerning safety aspects****3.6.1****abnormal operating condition**

temporary operating condition that is not a normal operating condition and is not a single fault condition of the equipment itself

Note 1 to entry: An abnormal operating condition is a temporary condition which may be introduced by the equipment or by a person and may result in a failure of a component, a device or a safeguard.

Note 2 to entry: This definition is used in the context of component failure risk analysis.

3.6.2**accessible part**

part which can be touched by means of the standard test finger

[SOURCE: IEC 60050-442:1998, 442-01-15]

3.6.3

live-part

conductive part intended to be energized in normal conditions, including a neutral conductor or mid-point conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

[SOURCE: IEC 60050-195:1998, 195-02-19, modified – “conductor or” deleted, “normal conditions, including a neutral conductor or mid-point conductor” replaces “normal operation, including a neutral conductor.”]

3.6.4

hazardous-live-part < risk of burn >
surface adjacent to a hot functional surface

[SOURCE: IEC Guide 117:2010, 3.1, modified – Context added and NOTE has been deleted.]

3.6.5

hazardous-live-part < risk of electrical shock >
live part which, under certain conditions, can give a harmful electric shock

[SOURCE: IEC 60050-195:1998, 195-06-05, modified – Context added.]

3.6.6

limited energy source

source that is designed and protected that, under both normal operating conditions and single fault conditions, the current that can be delivered is not hazardous with respect to fire hazard

3.6.7

protective impedance

impedance connected between hazardous-live-parts and accessible conductive parts, of such value that the current, in normal use and under likely fault conditions, is limited to a safe value, and which is so constructed that its ability is maintained throughout the life of the equipment

[SOURCE: IEC 62477-1:2012, 3.42]

3.6.8

reasonably foreseeable misuse

use of a product or system in a way not intended by the supplier, but which can result from readily predictable human behaviour

[SOURCE: ISO/IEC Guide 51:2014, 3.7, modified – Notes to entry have been removed]

3.6.9

single fault condition

condition in which there is a fault of a single protection (but not a reinforced protection) or of a single component or a device

Note 1 to entry: If a single fault condition results in one or more other fault conditions, all are considered as one single fault condition.

[SOURCE: IEC Guide 104:2010, 3.8]

3.6.10**hot functional surface**

surface that is intentionally heated by an internal heat source and that has to be hot to carry out the function for which the equipment is intended to be used

[SOURCE: IEC Guide 117:2010, 3.5, modified – NOTE 1 and NOTE 2 have been deleted.]

3.7 Symbols and abbreviated terms

AQL	Acceptable quality level
EMC	Electromagnetic compatibility
SCPD	Short-circuit protective device
$\hat{I}$	Maximum peak value of the pick-up current of an electronically controlled electromagnet
I_c	Current made and broken (Table 7)
I_{cs}	Rated service short-circuit breaking capacity (5.3.6.2)
I_{cu}	Rated ultimate short-circuit breaking capacity (5.3.6.1)
I_e	Rated operational current (5.3.2.5)
I_{er}	Rated rotor operational current (5.3.2.7)
I_{es}	Rated stator operational current (5.3.2.6)
I_i	Instantaneous short-circuit current setting
I_{IT}	Short-circuit test current for IT system
I_q	Maximum conditional short-circuit test current
~~I_r~~	<u>Overload current setting</u>
I_{th}	Conventional free air thermal current (5.3.2.1)
I_{the}	Conventional enclosed thermal current (5.3.2.2)
I_{thr}	Conventional rotor thermal current (5.3.2.4)
I_{ths}	Conventional stator thermal current (5.3.2.3)
I_u	Rated uninterrupted current (5.3.2.8)
P_c	Nominal holding/pickup power of a conventional direct current controlled electromagnet, or the holding power for an electronically direct current controlled electromagnet
P_p	Pick-up power of a direct current controlled contactor with separate pick-up and hold-on windings
"r"	Minimum short-circuit test current
S_h	Holding power of an alternating current controlled electromagnet
S_p	Pick-up power of an alternating current controlled electromagnet
T_p	Tripping time (Table 2)
U_c	Rated control circuit voltage (5.5)
U_d	Voltage drop of a contactor pole
U_e	Rated operational voltage (5.3.1.1)
U_{er}	Rated rotor operational voltage (5.3.1.1.3)
U_{es}	Rated stator operational voltage (5.3.1.1.2)
U_i	Rated insulation voltage (5.3.1.2)
U_{imp}	Rated impulse (withstand) voltage (5.3.1.3)
U_{ir}	Rated rotor insulation voltage (5.3.1.2.3)
U_{is}	Rated stator insulation voltage (5.3.1.2.2)

1124	U_r	Power frequency or DC recovery voltage (Table 7)
1125	U_s	Rated control circuit supply voltage (5.5)
1126	Z	Pole impedance of a contactor (5.3.7)

1127 4. Classification

1128 Subclause 5.2 gives all the data which may be used as criteria for classification.

1129 5. Characteristics of contactors and starters

1130 5.1 Summary of characteristics

1131 The characteristics of a contactor or starter shall be stated in the following terms, where such
1132 terms are applicable:

- 1133 – type of equipment (5.2);
- 1134 – rated and limiting values for main circuits (5.3);

1135 NOTE 1 The rated values established for a rheostatic rotor starter are stated in accordance with 0, 5.3.1.1.3,
1136 5.3.1.2.2, 5.3.1.2.3, 5.3.2.3, 5.3.2.4, 5.3.2.6, 5.3.2.7 and 5.3.5.6 but it is not necessary to specify all the values
1137 listed.

- 1138 – utilization category (5.4);
- 1139 – control circuits (5.5);
- 1140 – auxiliary circuits (5.6);
- 1141 – types and characteristics of relays and releases (5.7);
- 1142 – co-ordination with short-circuit protective devices (5.8);
- 1143 – types and characteristics of automatic change-over devices and automatic acceleration
1144 control devices (5.10);
- 1145 – types and characteristics of auto-transformers for two-step auto-transformer starters
1146 (5.11);
- 1147 – types and characteristics of starting resistors for rheostatic rotor starters (5.12);
- 1148 – items subject to agreement between manufacturer and user; see Annex D.

1149 For information exchange in electronic format, e.g. electronic catalogue, IEC 62683-1 gives
1150 the data format of the essential characteristics of motor starters, contactors and their
1151 accessories.

1152 NOTE 2 In the case of a star-delta starter, the currents relate to the delta connection and, in the case of a two-
1153 step auto-transformer or rheostatic rotor starter, to the ON position.

5.2 Type of equipment

5.2.1 Kind of equipment

This document covers two types of equipment:

– contactor;

– starter.

The following starting methods are described:

– direct-on-line AC starter;

– star-delta starter;

– two-step auto-transformer starter;

– rheostatic rotor starter.

The following types of starter are specifically specified

– combination starter;

– or-protected starter.

– reversing starter.

– Motor management starter;

– motor protective switching device (MPSD);

– Instantaneous only motor protective switching device (IMPSD).

Note 1 Instantaneous only motor protective switching device (IMPSD) are related to motor protective switching device (MPSD) and usually share the same platform.

In this document, requirements for MPSD are also covering IMPSD where applicable.

5.2.2 Number of poles

5.2.3 Kind of current (AC or DC)

5.2.4 Interrupting medium (air, oil, gas, vacuum, etc.)

5.2.5 Operating conditions of the equipment

5.2.5.1 Method of operation

For example: manually operated, electromagnetically controlled, motor-operated, pneumatic ally controlled, electro-pneumatic controlled.

5.2.5.2 Method of control

For example:

– automatic (by pilot switch or sequence control);

– non-automatic (such as by hand operation or by push-buttons);

– semi-automatic (i.e. partly automatic, partly non-automatic).

5.2.5.3 Method of change-over for particular types of starters

The change-over for star-delta starters, rheostatic rotor starters or auto-transformer starters may be automatic, non-automatic or semi-automatic (see Figure C.11 and Figure C.13).

5.2.5.4 Method of connecting for particular types of starters

For example: open transition starter, closed transition starter.

5.2.6 Methods of overload protection of motors

5.2.6.1 Motor overload detection

The detection of the overload condition of the motor is performed by the motor overload relay or release of the starter according to its current setting (5.7.4) and time-current characteristic (5.7.5) of the motor overload relay or release of the starter.

5.2.6.2 Motor switching

The switching element of the starter shall be capable of making the starting current of the motor. Once the overload condition of the motor is reached, the switching element shall be suitable for breaking the motor overload current detected by the overload relay or release of the starter. In case of an associated switching device, it shall be declared with an appropriate motor utilization category.

5.3 Rated and limiting values for main circuits

5.3.1 Rated voltages

5.3.1.1 Rated operational voltage (U_e)

5.3.1.1.1 General

Subclause 5.3.1.1 of IEC 60947-1:2020 applies.

When the contactor or starter is declared as suitable for use downstream to a basic drive module, the working voltage value includes recurring peaks.

5.3.1.1.2 Rated stator operational voltage (U_{es})

For rheostatic rotor starters, a rated stator operational voltage is a value of voltage which, when combined with a rated stator operational current, determines the application of the stator circuit including its mechanical switching devices and to which are referred the making and breaking capacities, the type of duty and the starting characteristics. In no case shall the maximum rated operational voltage exceed the corresponding rated insulation voltage.

NOTE The rated stator operational voltage is expressed as the voltage between phases.

5.3.1.1.3 Rated rotor operational voltage (U_{er})

For rheostatic rotor starters, the value of rated rotor operational voltage is that of the voltage which, when combined with a rated rotor operational 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.

This voltage 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 insulation voltage of the switching devices inserted in the rotor circuit shall be at least 50 % of the highest voltage between open slip-rings.

NOTE Electrical stresses are lower and shorter in the rotor than in the stator.

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

1230 The maximum voltage between the different live parts (e.g. switching devices, resistors,
1231 connecting parts, etc.) of the rotor circuit of the starter will vary and account may be taken of
1232 this fact in choosing the equipment and its disposition.

1233 **5.3.1.2 Rated insulation voltage (U_i)**

1234 **5.3.1.2.1 General**

1235 Subclause 5.3.1.2 of IEC 60947-1:2020 applies.

1236 **5.3.1.2.2 Rated stator insulation voltage (U_{is})**

1237 For rheostatic rotor starters, the rated stator insulation voltage is the value of voltage which is
1238 designated for the devices inserted in the stator supply, as well as the unit they are part of,
1239 and to which dielectric tests and creepage distances are referred.

1240 Unless otherwise stated, the rated stator insulation voltage is the value of the maximum rated
1241 stator operational voltage of the starter.

1242 **5.3.1.2.3 Rated rotor insulation voltage (U_{ir})**

1243 For rheostatic rotor starters, the rated rotor insulation voltage is the value of voltage which is
1244 designated to the devices inserted in the rotor circuit, as well as the unit they are part of
1245 (connecting links, resistors, enclosure), and to which dielectric tests and creepage distances
1246 are referred.

1247 **5.3.1.3 Rated impulse withstand voltage (U_{imp})**

1248 Subclause 5.3.1.3 of IEC 60947-1:2020 applies.

1249 **5.3.1.4 Rated starting voltage of an auto-transformer starter**

1250 The rated starting voltage of an auto-transformer starter is the reduced voltage derived from
1251 the transformer.

1252 Preferred values of rated starting voltage are 50 %, 65 % or 80 % of the rated operational
1253 voltage.

1254 **5.3.2 Currents or powers**

1255 **5.3.2.1 Conventional free air thermal current (I_{th})**

1256 Subclause 5.3.2.1 of IEC 60947-1:2020 applies.

1257 **5.3.2.2 Conventional enclosed thermal current (I_{the})**

1258 Subclause 5.3.2.2 of IEC 60947-1:2020 applies.

1259 **5.3.2.3 Conventional stator thermal current (I_{ths})**

1260 The conventional stator thermal current of a starter may be either free air current I_{ths} or
1261 enclosed current I_{thes} , in line with 5.3.2.1 and 5.3.2.2.

1262 For a rheostatic rotor starter, the stator thermal current is the maximum current it can carry on
1263 eight-hour duty (see 5.3.4.1) without the temperature-rise of its several parts exceeding the
1264 limits specified in 8.2.2 when tested in accordance with 9.3.3.3.

5.3.2.4 Conventional rotor thermal current (I_{thr})

The conventional rotor thermal current of a starter may be either free air current I_{thr} or enclosed current I_{ther} , in line with 5.3.2.1 and 5.3.2.2.

For rheostatic rotor starters, the rotor thermal current is the maximum current that those parts of the starter through which the rotor current flows in the ON position, precisely after cutting out resistors, can carry on eight-hour duty (see 5.3.4.1) without their temperature-rise exceeding the limits specified in 8.2.2 when tested in accordance with 9.3.3.3.

NOTE 1 For those elements (switching devices, connecting links, resistors) through which a current of practically no value flows in the ON position, it can be verified that, for the rated duties (see 5.3.4) stated in 6.1.2 f), the value of integral

$$\int_0^t i^2 dt$$

does not lead to temperature-rises higher than those appearing in 8.2.2.

NOTE 2 When resistors are built-in into the starter, the temperature-rise can be taken into account.

5.3.2.5 Rated operational currents (I_e) or rated operational powers

A rated operational current of a contactor or a starter is stated in 6.1.2 f) and takes into account the rated operational voltage (see 5.3.1.1), the conventional free air or enclosed thermal current, the rated current of the overload relay, the rated frequency (see 5.3.3), the rated duty (see 5.3.4), the utilization category (see 5.4) and the type of protective enclosure, if any.

In the case of equipment for direct switching of individual motors, the indication of a rated operational current may be replaced or supplemented by an indication of the maximum rated power output, at the rated operational voltage considered, of the motor for which the equipment is intended. The manufacturer's published literature shall be prepared to state the relationship assumed between the current and the power.

NOTE Annex G gives values concerning the relationship between rated operational currents and rated operational powers.

For starters, the rated operational current (I_e) is the current in the ON position of the starter.

5.3.2.6 Rated stator operational current (I_{es}) or rated stator operational power

For rheostatic rotor starters, a rated stator operational current is stated in the manufacturer's published literature and takes into account the rated current of the overload relay installed in this starter, the rated stator operational voltage (see 5.3.1.1.1), the conventional free air or enclosed thermal current, the rated frequency (see 5.3.3), the rated duty (see 5.3.4), the starting characteristics (see 5.3.5.6) and the type of protective enclosure.

The indication of a rated stator operational current may be replaced by the indication of the maximum rated power output, at the rated stator operational voltage considered, of the motor for which the stator elements of the starter are intended. The manufacturer's published literature shall be prepared to state the relationship assumed between the motor power and the stator current.

5.3.2.7 Rated rotor operational current (I_{er})

For rheostatic rotor starters, a rated rotor operational current is stated in the manufacturer's published literature and takes into account the rated rotor operational voltage (see 5.3.1.1.2), the conventional free air or enclosed rotor thermal current, the rated frequency (see 5.3.3),

1307 the rated duty (see 5.3.4), the starting characteristics (see 5.3.5.6) and the type of protective
1308 enclosure.

1309 It is taken as equal to the current flowing in the connections to the rotor when the latter is
1310 short-circuited and the motor is running at full load and the stator is supplied at its rated
1311 voltage and rated frequency.

1312 When the rotor part of a rheostatic rotor starter is rated separately, the indication of a rated
1313 rotor operational current may be supplemented by the maximum rated power output, for
1314 motors having the rated rotor operational voltage considered, of the motor for which that part
1315 of the starter (switching devices, connecting links, relays, resistors) is intended. This power
1316 varies in particular with the breakaway torque foreseen and consequently takes into account
1317 the starting characteristics (see 5.3.5.6).

1318 **5.3.2.8 Rated uninterrupted current (I_u)**

1319 Subclause 5.3.2.4 of IEC 60947-1:2020 applies.

1320 **5.3.3 Rated frequency**

1321 Subclause 5.3.3 of IEC 60947-1:2020 applies.

1322 **5.3.4 Rated duties**

1323 **5.3.4.1 Eight-hour duty (continuous duty)**

1324 Subclause 5.3.4.1 of IEC 60947-1:2020 applies with the following addition.

1325 For a star-delta starter, a two-step auto-transformer starter or a rheostatic rotor-starter, the
1326 continuous duty is the duty in which the starter is in the ON position and the main contacts of
1327 the switching devices which constitute it, which are closed in this position, remain closed
1328 while each of them carries a steady current long enough for the starter to reach thermal
1329 equilibrium, but not for more than 8 h without interruption.

1330 **5.3.4.2 Uninterrupted duty**

1331 Subclause 5.3.4.2 of IEC 60947-1:2020 applies with the following addition.

1332 For a star-delta starter, a two-step auto-transformer starter or a rheostatic rotor starter, the
1333 uninterrupted duty is the duty in which the starter is in the ON position and the main contacts
1334 of the switching devices which constitute it, which are closed in this position, remain closed
1335 without interruption while each of them carries a steady current for periods of more than 8 h
1336 (weeks, months or even years).

1337 **5.3.4.3 Intermittent periodic duty or intermittent duty**

1338 Subclause 5.3.4.3 of IEC 60947-1:2020 applies with the following addition.

1339 For a reduced voltage starter, the intermittent duty is the duty in which the starter is in the ON
1340 position and the main contacts of the switching devices which constitute it remain closed for
1341 periods bearing a definite relation to the no-load periods, both periods being too short to allow
1342 the starter to reach thermal equilibrium.

1343 Preferred classes of intermittent duty are:

- 1344 – for contactors: 1, 3, 12, 30, 120, 300 and 1 200 (operating cycles per hour);
- 1345 – for starters: 1, 3, 12 and 30 (operating cycles per hour).

1346 It is recalled that an operating cycle is a complete working cycle comprising one closing
1347 operation and one opening operation.

1348 For starters, an operating cycle comprises starting, running to full speed and switching off the
1349 supply from the motor.

1350 NOTE In the case of starters for intermittent duty, the difference between the thermal time-constant of the
1351 overload relay and that of the motor can render a thermal relay unsuited for overload protection. For installations
1352 intended for intermittent duty, the question of overload protection is subject to agreement between manufacturer
1353 and user.

1354 **5.3.4.4 Temporary duty**

1355 Subclause [5.3.4.4](#) of IEC 60947-1:2020 applies.

1356 **5.3.4.5 Periodic duty**

1357 Subclause [5.3.4.5](#) of IEC 60947-1:2020 applies.

1358 **5.3.5 Normal load and overload characteristics**

1359 **5.3.5.1 General**

1360 Subclause [5.3.5](#) of IEC 60947-1:2020 applies with the following additions.

1361 **5.3.5.2 Ability to withstand motor overload currents**

1362 Requirements to meet these conditions are given for contactors [or Instantaneous only motor](#)
1363 [protective switching device IMPSD](#) in 8.2.4.4.

1364 **5.3.5.3 Ability to make and break load currents**

1365 Requirements for the various utilization categories (see 5.4) are given in 8.2.4.1. The rated
1366 making and breaking capacities are only valid when the contactor or the starter is operated in
1367 accordance with the requirements of 8.2.1.1 and 8.2.1.2.

1368 **5.3.5.3.5.4 Conventional operational performance**

1369 This performance is specified as a series of making and breaking operations in 8.2.4.2.

1370 **5.3.5.4.5.3.5.5 Starting and stopping characteristics of starters (see Figure C.14)**

1371 **5.3.5.4.15.3.5.5.1 General**

1372 Typical service conditions for starters are:

- 1373 a) one direction of rotation with the motor being switched off during running in normal service
1374 conditions (utilization categories AC-2, AC-3 and AC-3e);
- 1375 b) two directions of rotation, but the running in the second direction is realized after the
1376 starter has been switched off and the motor has completely stopped (utilization categories
1377 AC-2, AC-3 and AC-3e);
- 1378 c) one direction of rotation, or two directions of rotation as in item b), but with the possibility
1379 of infrequent inching (jogging). For this service condition, direct-on-line starters are
1380 usually employed (utilization category AC-3 and AC-3e);
- 1381 d) one direction of rotation with frequent inching (jogging). Usually direct-on-line starters
1382 (utilization category AC-4) are used for this duty;
- 1383 e) one or two directions of rotation, but with the possibility of infrequent plugging for stopping
1384 the motor, plugging being associated, if so provided, with rotor resistor braking (reversing

starter with braking). Usually a rheostatic rotor starter is used for this duty condition (utilization category AC-2);

- f) two directions of rotation, but with the possibility of reversing the supply connections to the motor while it is running in the first direction (plugging), in order to obtain its rotation in the other direction, with switching off the motor running in normal service conditions. Usually a direct-on-line reversing starter while running is used for this duty condition (utilization category AC-4).

Unless otherwise stated, starters are designed on the basis of the starting characteristics of the motors compatible with the making capacities of Table 7. These making capacities cover both the transient and steady-state starting currents of the great majority of standard motors. However, the starting currents for some large motors may attain peak values corresponding to power factors considerably lower than those specified for the test circuit in Table 7. In these cases, the operational current of the contactor or starter should be decreased to a value lower than its rated value such that the making capacity of the contactor or starter is not exceeded.

5.3.5.4.25.3.5.5.2 Starting characteristics of rheostatic rotor starters

A distinction shall be drawn between the currents and voltages in the stator and rotor circuits of slip-ring motors. However, the changes of the current values in stator and rotor circuits, caused by the various steps of the starting process, are nearly proportional under normal operating conditions.

The following definitions deal mainly with the characteristics of the rotor circuit:

U_{er} is the rated rotor operational voltage;

I_{er} is the rated rotor operational current;

Z_r is the characteristic impedance of the rotor of an AC slip-ring induction motor;

where

$$Z_r = \frac{U_{er}}{\sqrt{3} \times I_{er}};$$

I_1 is the current in the rotor circuit immediately before shorting out a resistor section;

I_2 is the current in the rotor circuit immediately after shorting out a resistor section;

$I_m = 1/2 (I_1 + I_2)$;

T_e is the rated motor operational torque;

t_s is the starting time;

k is the severity of start = $\frac{I_m}{I_{er}}$.

It is recognized that many rheostatic rotor starter applications have very specific starting requirements which may result not only in a different number of starting steps and different values of I_1 and I_2 , but also in the values of I_1 and I_2 being different for individual resistor sections. Therefore, no attempt has been made to lay down standard parameters, but the following factors should be taken into consideration:

- for most applications, between two and six starting steps are adequate depending upon load torque, inertia and the severity of start required;
- the resistor sections should be designed to have adequate thermal ratings bearing in mind the starting time of the drive, which will be dependent upon load torque and load inertia.

5.3.5.4.35.3.5.5.3 Standard conditions for making and breaking corresponding to the starting characteristics for rheostatic rotor starters

These conditions are given in Table 7 and apply to starting with high torque.

1428 The conditions for making and breaking as given in Table 7 for AC-2 utilization category are
1429 considered as standard.

1430 The starter circuit shall be designed to open all rotor resistor switching devices before or
1431 approximately simultaneously with the opening of the stator switching device. Otherwise, the
1432 stator switching device shall comply with AC-3 requirements.

1433 **5.3.5.4.45.3.5.5.4 Starting characteristics for two-step auto-transformer starters**

1434 Unless otherwise stated, the auto-transformer starters and specifically the auto-transformers
1435 are designed on the condition that the starting time for all classes of duty (see 5.3.4) shall not
1436 exceed 15 s. The number of starting cycles per hour assumes equal periods between starts
1437 except that, in the event of two operating cycles being made in rapid succession, the starter
1438 and the auto-transformer shall be allowed to cool to ambient air temperature before a further
1439 start is made.

1440 When a starting time in excess of 15 s is required, this shall be the subject of agreement
1441 between manufacturer and user.

1442 **5.3.6 Short-circuit characteristics**

1443 **5.3.6.1 Rated ultimate short-circuit breaking capacity of a MPSD (I_{cu})**

1444 The rated ultimate short-circuit breaking capacity of a MPSD is the value of ultimate short-
1445 circuit breaking capacity assigned to that MPSD [in 6.1.2_m](#)) for the corresponding rated
1446 operational voltage, under the conditions specified in P.3. It is expressed as the value of the
1447 prospective breaking current, in kA (RMS value of the AC component in the case of
1448 alternating current).

1449 **5.3.6.2 Rated service short-circuit breaking capacity of a MPSD (I_{cs})**

1450 The rated service short-circuit breaking capacity of a MPSD is the value of service short-
1451 circuit breaking capacity assigned to that MPSD [in 6.1.2_m](#)) for the corresponding rated
1452 operational voltage U_e , under the conditions specified in P.2. It is expressed as a value of
1453 prospective breaking current, in kA, or as a % of I_{cu} (for example $I_{cs} = 25 \% I_{cu}$).

1454 I_{cs} shall be at least equal to 25 % of I_{cu} .

1455 **5.3.6.3 Rated conditional short-circuit current**

1456 Subclause [5.3.6.4](#) of IEC 60947-1:2020 applies.

1457 **5.3.7 Pole impedance of a contactor (Z) [or starter](#)**

1458 The pole impedance may be stated [in 6.1.2_h](#)) and is determined by measuring the voltage
1459 drop resulting of the current flowing through the pole.

1460 **5.4 Utilization category**

1461 **5.4.1 General**

1462 Subclause [5.4](#) of IEC 60947-1:2020 applies with the following additions.

1463 For contactors and starters, the utilization categories as given in Table 1 are considered
1464 standard. Any other type of utilization shall be based on agreement between manufacturer
1465 and user, but information given in the manufacturer's catalogue or tender may constitute such
1466 an agreement.

Each utilization category is characterized by the values of the currents, voltages, power-factors or time-constants and other data of Table 7 and Table 10, and by the test conditions specified in this document.

For contactors or starters defined by their utilization category, it is therefore unnecessary to specify separately the rated making and breaking capacities as these values depend directly on the utilization category as shown in Table 7.

The voltage for all utilization categories is the rated operational voltage of a contactor or a starter other than a rheostatic rotor starter, and the rated stator operational voltage for a rheostatic rotor starter.

All direct-on-line starters belong to one or more of the following utilization categories: AC-3, AC-3e, AC-4, AC-7b, AC-8a and AC-8b.

All star-delta and two-step auto-transformer starters belong to utilization category AC-3.

Rheostatic rotor starters belong to utilization category AC-2.

5.4.2 Assignment of utilization categories based on the results of tests

a) A contactor or starter which has been tested for one utilization category or at any combination of parameters (such as highest operational voltage and current, etc.) can be assigned other utilization categories without testing, provided that the test currents, voltages, power-factors or time-constants, number of operating cycles, on and off times given in Table 7 and Table 10, and the test circuit for the assigned utilization categories are not more severe than those at which the contactor or starter has been tested and the temperature-rise has been verified at a current not less than the highest assigned rated operational current in continuous duty.

For example, when tested for utilization category AC-4, a contactor may be assigned utilization category AC-3 provided I_e for AC-3 is not higher than $1,2 I_e$ for AC-4 at the same rated operational voltage.

b) DC-3 and DC-5 contactors are assumed to be capable of opening and closing loads other than those on which they have been tested provided that:

- the voltage and current do not exceed the specified values of U_e and I_e ;
- the energy J stored in the actual load is equal to or less than the energy J_c stored in the load with which they were tested.

The values of the energy stored in the test circuit are as follows:

Utilization category	Stored energy J_c
DC-3	$0,005\ 25 \times U_e \times I_e$
DC-5	$0,031\ 5 \times U_e \times I_e$

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The values of the constants 0,005 25 and 0,031 5 are derived from:

$$J_c = 1/2 LI^2$$

where the time-constant has been replaced by:

$2,5 \times 10^{-3}$ s (DC-3) and:

15×10^{-3} s (DC-5)

and where $U = 1,05 U_e$, $I = 4 I_e$ and L is the inductance of the test circuit (see Table 7).

1505

Table 1 – Utilization categories

Kind of current	Utilization categories	Additional category designation	Typical load
AC	AC-1	General use	Non-inductive or slightly inductive loads
	AC-2		Slip-ring motors or mixed resistive and inductive loads, including moderate overloads
	AC-3		Squirrel-cage motors ^d : starting, switching off motors during running, reversing ^a
	AC-3e ^e		Squirrel-cage motors with higher locked rotor current ^e : starting, switching off motors during running, reversing ^a
	AC-4		Squirrel-cage motors ^d : starting, plugging, inching
	AC-5a	Ballast Incandescent	Discharge lamps
	AC-5b		AC incandescent lamps
	AC-6a		Transformers
	AC-6b <u>or</u> <u>AC-7c</u> ^c		Capacitor banks
	AC-7a ^c		Slightly inductive loads for household appliances and similar applications
	AC-7b ^c <u>AC-7d</u> ^c		Motor-loads for household applications <u>LED lamp</u>
	AC-8a		Hermetic refrigerant compressor motor ^b control with manual resetting of overload releases
	AC-8b		Hermetic refrigerant compressor motor ^b control with automatic resetting of overload releases
DC	DC-1		Non-inductive or slightly inductive loads
	DC-3		Shunt-motors: starting, plugging, inching, dynamic breaking of DC motors
	DC-5		Series-motors: starting, plugging, inching, dynamic breaking of DC motors
	DC-6		DC incandescent lamps
^a AC-3 category may be used for occasional inching (jogging) or plugging for limited time periods such as machine set-up; during such limited time periods, the number of such operations should not exceed five per minute or more than ten in a 10-min period.			
^b A hermetic refrigerant compressor motor is a combination consisting of a compressor and a motor, both of which are enclosed in the same housing, with no external shaft or shaft seals, the motor operating in the refrigerant.			
^c <u>See</u> IEC 61095.			
^d Asynchronous motor of design N and H according to IEC 60034-12:2016.			
^e Asynchronous motor of design NE and HE, according to IEC 60034-12:2016, having extended / higher locked rotor apparent power and current than design N and H respectively, to achieve a higher efficiency class according to IEC 60034-30-1.			

1506

1507 5.5 Control circuits

1508 Subclause 5.5 of IEC 60947-1:2020 applies with the following additions.

1509 The list of characteristics given in 5.5.1 of IEC 60947-1:2020 shall be completed by:

1510 – range of the rated control circuit supply voltage U_s when applicable;

1511 – limited energy (if the source is in accordance with 8.1.14);

1512 – SELV (PELV) supply (in accordance with Annex N of IEC 60947-1:2020);

1513 – the power consumption of the electromagnet of a contactor, necessary for determining the
1514 characteristics of the power supply of the control circuit, which is given by:

- 1515 • holding power,
- 1516 • pick-up power.

1517 NOTE In the USA and Canada, control circuits are characterised as Class 2 sources as defined in NFPA 70,
1518 National Electrical Code and CSA C22.1, Canadian Electrical Code (CE Code) in lieu of or in addition to SELV
1519 (PELV) sources.

1520 5.6 Auxiliary circuits

1521 Subclause [5.6](#) of IEC 60947-1:2020 applies.

1522 Digital inputs and/or digital outputs contained in contactors and motor-starters and intended to
1523 be compatible with PLCs shall fulfil the requirements of Annex S of IEC 60947-1:2020.

1524 5.7 Characteristics of relay and release of overload relays and of motor protective 1525 switching device (MPSD)

1526 NOTE The words "overload relay" will be taken to apply equally to an overload relay or an overload release, as
1527 appropriate.

1528 5.7.1 Summary of characteristics

1529 The characteristics of relays and releases shall be stated in the following terms, whenever
1530 applicable:

- 1531 – types of relay or release (see 5.7.2);
- 1532 – characteristic values (see 5.7.3);
- 1533 – designation and current settings of overload relays (see 5.7.4);
- 1534 – time-current characteristics of overload relays (see 5.7.5);
- 1535 – influence of ambient air temperature (see 5.7.6);
- 1536 – extended functions as given in Annex H;
- 1537 – load monitoring indicators as given in Annex O.

1538 5.7.2 Types of relay or release

- 1539 a) Release with shunt-coil (shunt trip).
- 1540 b) Under-voltage and under-current opening relay or release.
- 1541 c) Overload time-delay relay the time-lag of which is:
 - 1542 • substantially independent of previous load;
 - 1543 • dependent on previous load;
 - 1544 • dependent on previous load and also phase loss sensitive overload relay or release.
- 1545 d) relay or release integral to the starter or separately mounted
- 1546 e) Instantaneous overload relay or release;
- 1547 f) Instantaneous short-circuit relays or releases.

1548 NOTE A MPSD has a combination of relays or releases from c) and e) above.

- 1549 g) Stall relay or release.
- 1550 h) Relays with extended functions (see Annex T of IEC 60947-1:2020)
- 1551 i) Other relays or releases (e.g. control relay associated with devices for the thermal
1552 protection of the motor).

5.7.3 Characteristic values

- a) Release with shunt-coil, under-voltage (under-current), over-voltage (instantaneous over current), current or voltage imbalance and phase reversal opening relay or release:
- rated voltage (current);
 - rated frequency;
 - operating time (when applicable);
 - inhibit time (when applicable).
- b) Motor overload relay and release of a starter (including the overload protection function of a MPSD):
- designation and current settings (see 5.7.4);
 - associated current transformers when applicable;
 - rated frequency, when necessary (for example in the case of a current transformer operated overload relay);
 - time-current characteristics (or range of characteristics), when necessary;
 - trip class according to classification in Table 2, or the value of the maximum tripping time, in seconds, under the conditions specified in 8.2.1.5.1, Table 3, column D, when this time exceeds 40 s;
 - nature of the relay: thermal, magnetic, electronic or electronic without thermal memory (electronic relay not fulfilling the thermal memory test verification according 8.2.1.5.1.2 shall be marked ~~Thm~~);
 - nature of the reset: in case of manual/automatic, the set position shall be indicated;
 - tripping time of overload relays class 10A if longer than 2 min at –5 °C or below (see 8.2.1.5.1.1, item c);
 - for a separately mounted overload relay
 - rated conditional short-circuit current (see 5.3.6.3);
 - type of co-ordination according to 8.2.5.1 for an electronic overload relay or co-ordination type 1 for a thermal overload relay;
 - associated SCPD or IMPSD type, current rating and characteristics.
 - characteristics of the control circuit according to 5.5
 - associated switching device with suitable rated making and breaking capacities for motor load according to Table 7.
- c) Release with residual current sensing relay:
- rated current;
 - ground/earth fault current setting;
 - operating time or time-current characteristic according to Table T.1 of IEC 60947-1: 2020;
 - inhibit time (when applicable);
 - type designation (see T.4 of IEC 60947-1: 2020).
- d) Short-circuit release of an MPSD:
- rated operational currents (I_e) or rated operational powers;
 - rated frequency;
 - current setting (or range of settings) if applicable.

1595

Table 2 – Trip classes of overload relays

Trip class	Tripping time T_p under the conditions specified in 8.2.1.5.1, Table 3, column D ^a	Tripping time T_p under the conditions specified in 8.2.1.5.1, Table 3, column D for tighter tolerances (tolerance band E) ^a
	s	S
2	–	$T_p \leq 2$
3	–	$2 < T_p \leq 3$
5	$0,5 < T_p \leq 5$	$3 < T_p \leq 5$
10A	$2 < T_p \leq 10$	–
10	$4 < T_p \leq 10$	$5 < T_p \leq 10$
20	$6 < T_p \leq 20$	$10 < T_p \leq 20$
30	$9 < T_p \leq 30$	$20 < T_p \leq 30$
40	–	$30 < T_p \leq 40$
NOTE 1 Depending on the nature of the relay, the tripping conditions are given in 8.2.1.5. NOTE 2 In the case of a rheostatic rotor starter, the overload relay is commonly inserted in the stator circuit. As a result, it cannot efficiently protect the rotor circuit and more particularly the resistors (generally more easily damageable than the rotor itself or the switching devices in case of a faulty start); protection of the rotor circuit is the subject of a specific agreement between manufacturer and user (see, inter alia, 8.2.1.1.3). NOTE 3 In the case of a two-step auto-transformer starter, the starting auto-transformer is normally designed for use during the starting period only: as a result, it cannot be efficiently protected by the overload relay in the event of faulty starting. Protection of the auto-transformer is the subject of specific agreement between manufacturer and user (see 8.2.1.1.4). NOTE 4 The lower limiting values of T_p are selected to allow for differing heater characteristics and manufacturing tolerances. ^a The letter E <u>shall be added to the</u> trip classes to indicate compliance with the band E.		

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5.7.4 Designation and current settings of overload relays

Overload relays are designated by their current setting (or the upper and lower limits of the current setting range, if adjustable) and their trip class.

The current setting (or current setting range) shall be marked on the relays or displayed.

However, if the current setting is influenced by the conditions of use or other factors which cannot readily be marked on the relay, then the relay or any interchangeable parts thereof (e.g. heaters, operating coils or current transformers) shall carry a number or an identifying mark which makes it possible to obtain the relevant information from the manufacturer's published literature or, preferably, from data furnished with the starter.

In the case of current transformer operated overload relays, the marking or displayed current setting may refer either to the primary current of the current transformer through which they are supplied or to the current setting of the overload relays. In either case, the ratio of the current transformer shall be stated.

5.7.5 Time-current characteristics of overload relays

Typical time-current characteristics shall be given in the form of curves supplied with the overload relay. These curves shall indicate how the tripping time, starting from the cold state (see 5.7.6), varies with the current up to a value of at least eight times the full-load current of the motor with which it is intended that the relay be used. The manufacturer's published literature shall be prepared to indicate, by suitable means, the general tolerances applicable

to these curves and the conductor cross-sections used for establishing these curves (see 9.3.3.2.2, item c)).

NOTE The current is plotted as abscissa and the time as ordinates, using logarithmic scales. The current is plotted as multiples of the setting current I_r and the time in seconds on the standard graph sheet detailed in 5.6.1 and Figure 1 of IEC 60269-1:2006 and in Figure 104, Figure 504 and Figure 505 of IEC 60269-2:2013.

5.7.6 Influence of ambient air temperature

The time-current characteristics (see 5.7.5) refer to a stated value of ambient air temperature, and are based on no previous loading of the overload relay (i.e. from an initial cold state). This value of the ambient air temperature shall be clearly given on the time curves; the preferred values are +20 °C or +40 °C.

The overload relays shall be able to operate within the ambient air temperature range of –5 °C to +40 °C, and the manufacturer's [published literature](#) shall be prepared to state the effect of variation in ambient air temperature on the characteristics of overload relays.

5.8 Co-ordination with short-circuit protective devices

The co-ordination of contactors and starters is characterized by the type, ratings and characteristics of the short-circuit protective devices (SCPD) that provide protection of the contactor and starter against short-circuit currents. Requirements are given in 8.2.5.1 and 8.2.5.2 of this document, and in [5.8](#) of IEC 60947-1:2020.

Requirements for AC-3e rated starters with type 2 co-ordination are given in 8.2.5.3.

When a MPSD is used as a manual starter without associated contactor, this subclause [does not apply](#).

5.9 Void

5.10 Types and characteristics of automatic change-over devices and automatic acceleration control devices

5.10.1 Types

a) Time-delay devices, e.g. time-delay contactor relays according to IEC 60947-5-1 applicable to control-circuit devices or specified-time all-or-nothing relays according to IEC 61810-1.

b) Undercurrent devices (undercurrent relays).

c) Other devices for automatic acceleration control:

- devices dependent on voltage;
- devices dependent on power;
- devices dependent on speed.

5.10.2 Characteristics

a) The characteristics of time-delay devices are:

- the rated time-delay or its range, if adjustable;
- for time-delay devices fitted with a coil, the rated voltage, when it differs from the starter line voltage.

b) The characteristics of the undercurrent devices are:

- the rated current (thermal current and/or rated short-time withstand current, according to the indications given [in the manufacturer's published literature](#));
- the current setting or its range, if adjustable.

- 1658 c) The characteristics of the other devices shall be determined by agreement between
1659 manufacturer and user.

1660 **5.11 Types and characteristics of auto-transformers for two-step** 1661 **auto-transformer starters**

1662 Account being taken of the starting characteristics (see 5.3.5.6.3), starting auto-transformers
1663 shall be characterized by:

- 1664 – the rated voltage of the auto-transformer;
- 1665 – the number of taps available for adjusting the starting torque and current;
- 1666 – the starting voltage, i.e. the voltage at the tapping terminals, as a percentage of the rated
1667 voltage of the auto-transformer;
- 1668 – the current they can carry for a specified duration;
- 1669 – the rated duty (see 5.3.4);
- the method of cooling { air-cooling;
oil-cooling.

1670 The auto-transformer can be:

- 1671 – either built-in into the starter, in which case the resulting temperature-rise has to be taken
1672 into account in determining the ratings of the starter;
- 1673 – or provided separately, in which case the nature and dimensions of the connecting links
1674 have to be specified by agreement between the manufacturer of the transformer and the
1675 manufacturer of the starter.

1676 **5.12 Types and characteristics of starting resistors for rheostatic rotor starters**

1677 Account being taken of the starting characteristics (see 5.3.5.6.2), the starting resistors shall
1678 be characterized by:

- 1679 – the rated rotor insulation voltage (U_{ir});
- 1680 – their resistance value;
- 1681 – the mean thermal current, defined by the value of steady current they can carry for a
1682 specified duration;
- 1683 – the rated duty (see 5.3.4);
- the method of cooling { free air;
forced air;
oil-immersion.

1684 They can be:

- 1685 – either built-in into the starter, in which case the resulting temperature-rise has to be
1686 limited in order not to cause any damage to the other parts of the starter;
- 1687 – or provided separately, in which case the nature and dimensions of the connecting links
1688 have to be specified by agreement between the manufacturer of the resistors and the
1689 manufacturer of the starter.

1690 **6. Equipment information**

1691 **6.1 Nature of information**

1692 **6.1.1 Identification**

- 1693 a) manufacturer's name or trade mark;

- b) type designation or serial number;
- c) number of this document, if the manufacturer claims compliance.

6.1.2 Characteristics, basic rated values and utilization

Characteristics:

- d) rated operational voltages (see 5.3.1.1)
- e) polarity of terminals, if applicable;
- f) - utilization category and rated operational currents (or rated powers), at the rated operational voltages of the equipment (see 5.3.2.5 and 5.4) and;
- rated making and breaking capacities. These indications may be replaced, where applicable, by the indication of the utilization category in Table 7 and in Table M.2 and.
- rated duty with the indication of the class of intermittent duty, if any (see 5.3.4), and the off time as specified in footnote d) of Table 10, if necessary;
- g) either the value of the rated frequency 50/60 Hz or the symbol $\overline{\overline{\overline{}}}$ (IEC 60417-5031), or other rated frequencies e.g. 16 2/3 Hz, 400 Hz;
- h) if declared, the pole impedance of the switching device (Z) (See 5.3.7);
- i) environmental information (See 6.4);

Safety and installation:

- j) - rated insulation voltage (see 5.3.1.2) and;
- rated impulse withstand voltage (see 5.3.1.3);
- k) - IP code according to Annex C of IEC 60947-1:2020;
- l) pollution degree (see Clause 7);
- m) short-circuit rating:
 - for contactor or starter: rated conditional short-circuit current (see 5.3.6) and type of co-ordination (see 8.2.5.1) and type, current rating and characteristics of the associated SCPD;
 - for combination starter, combination switching device, protected starter or protected switching device: rated conditional short-circuit current (see 5.3.6) and type of co-ordination (see 8.2.5.1);
 - for MPSD, rated ultimate short-circuit breaking capacity (I_{cu}) and rated service short-circuit breaking capacity (I_{cs}) (see 8.2.4.7), value of the instantaneous short-circuit current setting I_i for non-adjustable releases and, suitability for IT systems (see P.4.5).
- n) maximum permissible altitude of the site of installation, if greater than 2 000 m.
- o) conductor connection on terminal:
 - length of insulation to be removed before insertion of the conductor into the terminal;
 - maximum number of conductors which may be clamped.

For non-universal screwless terminals:

- “s” or “sol” for terminals declared for rigid-solid conductors;
- “r” for terminals declared for rigid (solid and stranded) conductors;
- “f” for terminals declared for flexible conductors.
- p) reference of the different parts of the starter to be associated including the dedicated wiring accessories which can be used for wiring the starter or the combination of contactors;

Control circuits:

1738 The following information concerning control circuits shall be placed either on the coil or on
1739 the equipment:

1740 q) - rated control circuit voltage (U_c), nature of current and rated frequency and;
1741 - if necessary, nature of current, rated frequency and rated control circuit supply voltage
1742 or its range if applicable.

1743 In the case of electronically controlled electromagnets, other information may also be
1744 necessary, for example control circuit configuration (see 5.5 of this document and Annex U of
1745 IEC 60947-1:2020).

1746 Power consumption

1747 r) if declared, the power consumption of the control circuit such as holding power, pickup
1748 power according to 8.2.4.5.

1749 *Air supply systems for starters or contactors operated by compressed air:*

1750 s) rated supply pressure of the compressed air and limits of variation of this pressure, if they
1751 are different from those specified in 8.2.1.2.

1752 *Auxiliary circuits:*

1753 t) ratings of auxiliary circuits (see 5.6).

1754 *Over-current relays and releases:*

1755 u) characteristics according to 5.7.2, 5.7.5 and 5.7.6;

1756 v) characteristics according to 5.7.3 and 5.7.4.

1757 *Additional information for certain types of contactor and starter:*

1758 *Rheostatic rotor starters:*

1759 w) - circuit diagram and;
1760 - severity of start (see 5.3.5.6.1) and;
1761 - starting time (see 5.3.5.6.1).

1762 *Auto-transformer starters:*

1763 x) rated starting voltage(s), i.e. voltage(s) at the tapping terminals.

1764 NOTE 2 This value can be expressed as a percentage of the rated operational voltage of the starter.

1765 *EMC:*

1766 y) - When different than the standard industrial environment E-III, information about the
1767 applicable electromagnetic environment E-II Light-industrial or E-IV Power distribution
1768 (See 8.3.1) and
1769 - equipment class A or B of CISPR 11 and
1770 - special requirements, if applicable, for example shielded or twisted conductors.

1771 NOTE 3 Unshielded or untwisted conductors are considered as normal installation conditions.

1772 Suitability for use within a complete drive module:

1773 z) Type and designation of the associated basic drive module (BDM) compliant with IEC
1774 61800-5-1 with the appropriate setting limits and the maximum wiring length to the starter
1775 or
1776 - the maximum rated voltage,

- the maximum recurring peak voltage,
- the maximum pulse frequency and
- the rated voltage pulse slope,
- obtained in the condition of 9.3.3.3.10 ;

6.2 Marking

Subclause 6.2 of IEC 60947-1:2020 applies to contactors, starters and separately mounted overload relays with the following additions. This is also covering data under item a) and b) of 6.1.1.

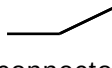
Data under items d) to z) in 6.1.2 shall be included on the equipment or in the manufacturer's published literature.

Data under items c) in 6.1.1, e), k) (if the degree of protection is different than IP00) and v) in 6.1.2 shall be marked on the equipment; time-current characteristics (or range of characteristics) may be provided in the manufacturer's published literature.

The manufacturer's published literature may be provided digitally for example using an electronically readable identifier on the equipment or its packaging (IEC 63365 under development).

NOTE In the USA and Canada, on multiple equipment, the additional category designation given in Table 1 is marked on the equipment.

MPSD shall be marked in addition, in a place such that they are visible and legible when the MPSD is installed, for the:

- suitability for isolation, if applicable, with the symbol  (IEC 60617- S00287 "Circuit breaker" combined with IEC 60417-6169-1 "Disconnecter; isolator");
- indication of the open and closed positions, with  (IEC 60417-5008 "OFF" (power)) and  (IEC 60417-5007 "ON" (power)) respectively, if symbols are used (see 8.1.6.1 of IEC 60947-1:2020);

The following data shall be marked externally on the MPSD in a place such they may be visible and legible when the MPSD is installed:

- range of the rated instantaneous short-circuit current setting I_i for adjustable releases.

For dedicated accessories used for wiring the starter or the combination of contactors, data under 6.1.1 c), 6.1.2 j) and the current I_{th} , if applicable, shall be provided in the manufacturer's published literature.

6.3 Instructions for installation, operation, maintenance, decommissioning and dismantling

Subclause 6.3 of IEC 60947-1:2020 applies with the following addition.

The instructions, as part the manufacturer's published literature, shall also cover the dedicated wiring accessories.

Additional information for the decommissioning and dismantling of the device shall be maintained available to the user in case of foreseeable hazardous condition of the device, for example due to stored energy, instability or falling of objects, etc.

1816 In the case of protected starters, the necessary mounting and wiring instructions shall also be
1817 provided.

1818 A starter incorporating an automatic reset overload relay capable of being connected to
1819 enable automatic restarting, shall be provided, with the information necessary to alert the user
1820 to the possibility of automatic restarting.

1821 In case of a separately mounted overload relay, instruction shall provide:

1822 - The determination method of the short-circuit protection of the complete starter: Its I_q
1823 according to 5.3.6.3 corresponding to the lowest I_q of its components, the type of
1824 SCPD to be used, the cable cross-sections of the power circuit and the maximum
1825 crossover current I_{cd} according to B.4.5.

1826 - The maximum rated values of the control circuit of the contactor to be associated
1827 according to 6.1.2 q)

1828 When the contactor or starter is declared as suitable for use downstream to basic drive
1829 module, appropriate instruction shall be provided for assessing the use conditions according
1830 to the conditions given in 6.1.2 z) and for verifying the length of connection to the motor is
1831 below the limit given in the instruction manual of the BDM in order to limit the reflected wave
1832 phenomena.

1833 For enclosed combination starters provided with a defeating mechanism of the door or cover
1834 interlocking as described in 8.1.11.1, the instruction shall include information about the
1835 associated defeating method.

1836 If the construction requires energization by an external source that is not a limited energy
1837 source as defined in 8.1.14, the appropriate information for short-circuit and overcurrent
1838 protection of the ports shall be provided.

1839 For each relevant potential hazard, safety signs, graphical symbols or safety notes of the
1840 hazard for example by using e.g. IEC 60417-5036 shall be provided on the instructions.
1841 Signal words shall be defined according to ISO 3864-2.

1842 NOTE ISO/IEC 82079-1 provide guidance for developing safety instructions.

1843 **6.4 Environmental information**

1844 Material declarations according to IEC TS 63058 shall be provided when required by
1845 agreement between manufacturer and user.

1846 NOTE IEC TS 63058 provides methods for assessing the environmental impact of switchgear and controlgear,
1847 guidance on environmentally conscious design and on information needed for end-of-life treatments.

1848 **7. Normal service, mounting and transport conditions**

1849 Clause 7 of IEC 60947-1:2020 applies with the following addition.

1850 Unless otherwise stated in the manufacturer's published literature, a contactor or a starter is
1851 for use in pollution degree 3 environmental conditions, as defined in 7.1.3.2 of IEC 60947-
1852 1:2020. However, other pollution degrees may be considered to apply, depending upon the
1853 micro-environment.

1854 Rail mounting shall be specified according to IEC 60715:2017, when relevant.

1855 Standard conditions of vibration are defined in footnote ^b of Table Q.1 of IEC 60947-1:2020.