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Edition 1.0 2019-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Low-voltage switchgear and controlgear – Part 9-1: Active arc-fault mitigation systems – Arc quenching devices

Appareillage à basse tension – Partie 9-1: Systèmes actifs de limitation des défauts d'arc – Dispositifs d'extinction d'arc

IEC 60947-9-1:2019-01(en-fr)

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 9-1: Active arc-fault mitigation systems – Arc quenching devices

FOREWORD

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International Standard IEC 60947-9-1 has been prepared by subcommittee SC121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

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

FDIS	Report on voting
121A/254/FDIS	121A/266/RVD

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

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

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

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

- reconfirmed,
- withdrawn,
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INTRODUCTION

The effects of arc-faults inside an enclosure are more and more taken into consideration, both from user safety and time-to-repair points of view. Protection against the effects of internal arc-faults can be achieved through passive components (containment) or through active components, also known as "active arc-fault mitigation systems".

Active arc-fault mitigation systems generally use internal arc-fault control devices (IACDs), based on the effects of the arc (light, pressure, current or voltage harmonics, etc.), and an actuator to eliminate the arc-fault.

This actuator can be an upstream circuit-breaker, which is tripped to interrupt the fault current, or an arc quenching device that will transfer the fault to a dedicated low-impedance circuit, before the short-circuit current is interrupted by the upstream short-circuit protective device (SCPD).

The purpose of this document is to set the requirements for arc quenching devices, so that the necessary safety is ensured and their performance can be fairly assessed.

Special requirements for environmental withstand (e.g. ambient temperature, damp heat, shock, vibrations) are included, considering the high impact of a malfunction, either unwanted operation (creation of a short-circuit) or failure to operate.

Requirements for internal arc-fault control devices are under development and will be published as IEC 60947-9-2[1].

Requirements for integration of internal arc-fault mitigation systems in power switchgear and controlgear assemblies are under development and will be published as IEC TS 63107[2].

[1] Under preparation. Stage at the time of publication: IEC/ACD 60947-9-2:2018.

[2] Under preparation. Stage at the time of publication: IEC/PCC 63107:2018.

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 9-1: Active arc-fault mitigation systems – Arc quenching devices

1 Scope

This part of IEC 60947 covers low-voltage arc quenching devices, hereinafter referred to as AQDs, which are intended to eliminate arc-faults in low-voltage assemblies (typically low-voltage switchgear and controlgear assemblies in accordance with the IEC 61439 series), by creating a lower impedance current path, to cause the arcing current to transfer to the new current path. This new current path is maintained until a short-circuit protection device (SCPD) interrupts the short-circuit current.

AQDs are installed in low-voltage assemblies, connected to the main circuit, preferably as close as possible to all primary power sources.

Their rated voltage does not exceed 1 000 V AC or 1 500 V DC.

This document does not cover:

- sensors intended to detect arc-faults;
- devices intended to trigger the functioning of the arc quenching device;
- devices intended to interrupt arc-fault current;
- special requirements for AQDs for use in explosive atmospheres (e.g. ATEX).

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

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

IEC 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*
IEC 60947-1:2007/AMD1:2010
IEC 60947-1:2007/AMD2:2014

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

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

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010 and IEC 60947-1:2007/AMD2:2014, as well as the following 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

3.1
arc quenching device
AQD
device intended to eliminate arc-faults by creating a lower impedance current path in order to cause the arcing current to transfer to the new current path

Note 1 to entry: This note applies to the French language only.

3.2
low impedance state
closed state
state where the voltage drop across the AQD is below a defined limit

Note 1 to entry: The limit value is defined in 5.5.

3.3
open state
state of the AQD, before operation or after resetting or re-opening (see Clause 4), in which the predetermined dielectric withstand voltage requirements of the main circuit are satisfied

Note 1 to entry: This definition also covers devices without mechanical contacts, for example semi-conductor devices.

4 Classification

4.1 According to the number of operations

4.1.1 Single shot AQD

4.1.1.1 Not able to be reopened after operating

AQD that:

- is designed and intended to operate only once, and needs to be replaced or refurbished after operation;
- cannot be reopened after operation, and therefore needs to be removed or disconnected from the equipment before the main circuit can be re-energized.

4.1.1.2 Able to be reopened after operating

AQD that:

- is designed and intended to operate only once, and needs to be replaced or refurbished after operation;
- can be reopened after operation, to allow re-energization of the main circuit before replacement.

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NOTE Re-opening after operation does not provide protection against internal arcs anymore. This function is restored only after the device has been replaced.

4.1.2 Resettable AQD

AQD that is designed and intended to operate a number of times, as specified by the manufacturer.

4.2 According to the mounting characteristics

4.2.1 Fixed AQD

AQD directly mounted and connected in the assembly, so that it is necessary for the operator to come into contact with the main circuit conductors to replace it.

4.2.2 Withdrawable or plug-in AQD

AQD mounted in a draw-out cradle, or plugged on a fixed base, so that it can be easily replaced after operation, or maintained, without the operator coming into contact with the main circuit conductors.

5 Characteristics

5.1 Rated operational voltage (U_e)

Subclause 4.3.1.1 of IEC 60947-1:2007 applies.

5.2 Rated insulation voltage (U_i)

Subclause 4.3.1.2 of IEC 60947-1:2007 applies.

5.3 Rated impulse withstand voltage (U_{imp})

Subclause 4.3.1.3 of IEC 60947-1:2007 applies.

5.4 Rated short-time withstand current (I_{cw})

The rated short-time withstand current of an AQD is the RMS value of current that the device is able to make and carry without damage for a given duration, under the test conditions specified in Clause 9.

There may be different values of current associated with different durations.

The duration associated with the rated short-time withstand current shall be at least 0,05 s, preferred values being as follows:

0,05 s - 0,1 s – 0,2 s – 0,3 s – 0,5 s – 1 s

5.5 Maximum voltage drop in low-impedance state

Maximum peak value of voltage between the main circuit terminals of the AQD, in the low-impedance state, when carrying the current corresponding to its rated short-time withstand current. This value shall be not greater than 34 V (peak).

NOTE The value of 34 V (peak) has been defined to ensure proper arc quenching (see Annex A).

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5.6 Maximum operating time

Maximum time between receiving the triggering signal and the AQD steadily reaching the low-impedance state.

NOTE "Steadily" means that the voltage drop stays below the maximum value stated by the manufacturer (see 5.5).

5.7 Number of operating cycles (of a resettable AQD)

Number of trip-reset cycles assigned by the manufacturer to a resettable AQD and minimum interval between two operations.

5.8 Maximum permissible temperature of the AQD main circuit terminals

Maximum value of permissible temperature of the AQD main circuit terminals based on the material properties (see 8.1).

6 Product information

6.1 Nature of information

Subclause 5.1 of IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010 and IEC 60947-1:2007/AMD2:2014 applies, as far as appropriate for a particular design.

6.2 Marking

An AQD shall be marked in a durable manner; data to be provided and corresponding locations are given in Table 1.

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Table 1 – Product information

Item	Information	Marking location
1	Manufacturer's name or trademark	Marked
2	Type designation or catalogue reference	Marked
3	IEC 60947-9-1, if the manufacturer claims compliance with the standard	Marked
4	Rated operational voltage(s) U_e	Marked
5	Rated impulse withstand voltage (U_{imp})	Marked
6	Value (or range) of the rated frequency (for example 50 Hz), and/or the indication "direct current", or the symbol ⎓ (IEC 60417-5031:2002)	Marked
7	Rated short-time withstand current (I_{cw}), and associated duration(s)	Marked
8	Rated control circuit voltage (U_s), if applicable	Marked
9	Instructions for integrating the AQD in the arc-fault mitigation system, including the characteristics of the triggering signal (e.g. voltage, frequency, current, duration), and max cable or optic fibre length	Literature
10	Maximum operating time	Literature
11	Maximum voltage drop in the low-impedance state	Literature
12	Maximum number of operating cycles, and minimum interval between two operations, for resettable devices	Literature
13	Rated insulation voltage (U_i), if higher than the rated operational voltage	Literature
14	Pollution degree if other than 3	Literature
15	Value of tightening torque for the terminals, if applicable	Literature
16	Instructions for installation with regard to withstanding prospective short-circuit current and minimizing arc-quenching circuit impedance	Literature
17	Maximum permissible temperature of the AQD main circuit terminals	Literature
Key		
Marked	marked externally on the AQD and visible with the AQD compartment door open	
Literature	provided in the manufacturer's literature	

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

Subclause 5.3 of IEC 60947-1:2007 and IEC 60947-1:2007/AMD2:2014 applies with the following addition:

Additional information for the decommissioning and dismantling of the AQD shall be provided to the user in case of a foreseeable hazardous condition, for example due to stored energy or hazardous substances.

7 Normal service, mounting and transport conditions

Clause 6 of IEC 60947-1:2007 and IEC 60947-1:2007/AMD2:2014 applies, except that the device shall be able to operate up to an ambient temperature of 70 °C.

NOTE The ambient temperature is that existing in the vicinity of the AQD and not the ambient temperature around the assembly.

8 Constructional and performance requirements

8.1 Constructional requirements

Subclause 7.1 of IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010 and IEC 60947-1:2007/AMD2:2014 applies with the following additions:

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