AS/NZS 62606:2022

Australian/New Zealand Standard™

General requirements for arc fault detection devices (IEC 62606:2013+AMD1:2017 CSV (ED. 1.1) MOD)

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Consumer Electronics Suppliers Association
Consumers Federation of Australia
Electrical Regulatory Authorities Council
Engineers Australia
International Accreditation New Zealand
Joint Accreditation System of Australia and New Zealand
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Plastics Industry Pipe Association of Australia
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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee, EL-004, Electrical Accessories.

The objective of this document is to provide requirements for arc fault detection devices (AFDDs), either as a single device or as a single device incorporating a Residual Current Device (RCD) with or without overcurrent protection for households and similar uses.

This adoption has been varied to take account of Australian/New Zealand conditions and requirements with particular reference to the variations of AS/NZS 60898.1, AS/NZS 61008.1 and AS/NZS 61009.1 from the IEC editions.

The essential safety requirements of AS/NZS 3820, *Essential safety requirements for electrical equipment*, that could be applicable to AFDDs are covered by this document, taken in conjunction with any other relevant requirements affecting safety.

This document is an adoption with national modifications and has been reproduced from IEC 62606:2013 (ED. 1.1), *General requirements for arc fault detection devices* and its Amendment No. 1 (2017), which has been incorporated into the source text.

The modifications are additional requirements and are set out in Appendix ZZ.

Appendix ZZ lists the variations to IEC 62606:2013+AMD1:2017 CSV (ED. 1.1) for the application of this document in Australia and New Zealand.

As this document has been reproduced from an International document, a full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

GENERAL REQUIREMENTS FOR ARC FAULT DETECTION DEVICES

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 62606 edition 1.1 contains the first edition (2013-07) [documents 23E/785/FDIS and 23E/797/RVD] and its corrigendum 1 (2013-11), and its amendment 1 (2017-02) [documents 23E/993/FDIS and 23E/1003/RVD].

This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.

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International Standard IEC 62606 has been prepared by subcommittee 23E: Circuit-breakers and similar equipment for household use, of IEC technical committee 23: Electrical accessories.

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

In this standard, the following print types are used:

- *compliance statements: in italic type.*

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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INTRODUCTION

This International Standard aims to provide necessary requirements and testing procedures for devices to be installed by skilled people in households and similar uses to mitigate the risk of igniting an electrical fire downstream of the device.

Residual Current Devices (RCDs) are recognised as efficient to reduce the risk of fire by detection of leakage current and arcing to ground as a consequence of tracking currents within an electrical installation. However, RCDs as fuses or circuit-breakers are not able to reduce the risk of electrical fire due to series or parallel arcing between live conductors.

During a series arc fault, there is no leakage to ground therefore RCDs cannot detect such a fault. Moreover, the impedance of the series arc fault reduces the load current, which will keep the current below the tripping threshold of the circuit-breaker and the fuse. In the case of a parallel arc between phase and neutral conductor, the current is only limited by the impedance of the installation. In the worst cases of sporadic arcs, the conventional circuit breakers were not designed for that purpose.

Experience and information available confirmed that the r.m.s. current value of an earth fault current caused by an arcing fault, which is able to ignite a fire, is not limited to the rated power supply frequency of 50/60 Hz, but may contain a much higher frequency spectrum that is not taken into account for the testing of RCDs.

It has been recognised that the risk of igniting a fire within an electrical installation can also be a consequence of an overvoltage due to a broken neutral in a three phase installation.

This standard covers devices designed to be installed in a distribution board at the origin of one or several final circuits of a fixed installation.

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GENERAL REQUIREMENTS FOR ARC FAULT DETECTION DEVICES

1 Scope

This International Standard applies to arc fault detection devices (AFDDs) for household and similar uses, intended to be used in a.c. circuits, for rated voltages not exceeding 440 V a.c, with rated frequencies of 50 Hz, 60 Hz or 50/60 Hz and rated currents not exceeding 63 A.

NOTE 1 In the USA, Arc Fault Circuit Interrupters (AFCI) are considered similar to AFDDs.

An AFDD is designed by the manufacturer:

– either as a single device having opening means able to open the protected circuit in specified conditions; or
– as a single device integrating a protective device; or
– as a separate unit, according to Annex D assembled on site with a declared protective device.

The integrated protection device is either a circuit-breaker in accordance with IEC 60898-1 or an RCD in accordance with IEC 61008-1, IEC 61009-1 or IEC 62423.

These devices are intended to mitigate the risk of fire in a final circuit of a fixed installation due to the effect of arc fault currents that pose a risk of fire ignition under certain conditions if the arcing persists.

Protection against fire ignition due to overvoltage due to a broken neutral within a three phase installation to be included in this type of equipment as an additional option is under consideration in 9.22.

NOTE 2 Tracking current leads to arcing and therefore may ignite fire.

This International Standard applies to devices performing simultaneously the detection and discrimination of arcing current with regards to fire hazards and defines operating criteria under specified conditions for the opening of the circuit when the arcing current exceeds the limit values given in this standard.

AFDDs complying with this standard, with the exception of those with an uninterrupted neutral, are suitable for use in IT systems.

AFDDs energised from batteries or a circuit other than the protected circuit are not covered by this standard.

AFDDs provide isolation, they are intended to be operated by uninstructed persons and do not require maintenance.

Particular requirements may be necessary for:

– AFDDs incorporated in or intended only for association with plugs and socket-outlets or with appliance couplers for household or similar general purposes;
– AFDDs intended to be used at frequencies other than 50 Hz or 60 Hz.

NOTE 3 For AFDDs incorporated in, or intended only for socket-outlets the requirements of this standard can be used, as far as applicable, in conjunction with the requirements of IEC 60884-1 or the national requirements of the country where the product is placed on the market.

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NOTE 4 In the UK, the plug part and the socket-outlet part(s) need not comply with any IEC 60884-1 requirements. In the UK, the plug part shall comply with BS 1363-1 and the socket-outlet part(s) shall comply with BS 1363-2.

Special precautions (e.g. surge protective devices) may be necessary when excessive overvoltages are likely to occur on the supply side.

The requirements of this standard apply for standard conditions of temperature and environment. They are applicable to AFDDs intended for use in an environment with pollution degree 2. Additional requirements may be necessary for devices used in locations having more severe environmental conditions.

NOTE 5 AFDD for d.c. applications are under consideration.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 + 12 h cycle)*

IEC 60068-3-4:2001, *Environmental testing – Part 3-4: Supporting documentation and guidance – Damp heat tests*

IEC 60228, *Conductors of insulated cables*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-44:2007, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

IEC 60417, *Graphical symbols for use on equipment*, available from: <http://www.graphical-symbols.info/equipment>

IEC 60479 (all parts), *Effects of current on human beings and livestock*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695-2-10:2000, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC/TR 60755, *General requirements for residual current operated protective devices*

IEC 60898-1:2002, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation*

IEC 61000-3-2:2014, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*

IEC 61008-1:2010, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

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IEC 61009-1:2010, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

IEC 61543:1995, *Residual current-operated protective devices (RCDs) for household and similar use – Electromagnetic compatibility*
IEC 61543:1995/AMD1:2004
IEC 61543:1995/AMD2:2005

IEC 62423, *Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses*

CISPR 14-1:2009, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC/TR 60755, IEC 60898-1, IEC 61008-1, IEC 61009-1, IEC 62423 and the following apply.

NOTE Where the terms "voltage" or "current" are used, they imply r.m.s. values, unless otherwise specified.

3.1
arc
arcing
luminous discharge of electricity across an insulating medium, usually accompanied by the partial volatilization of the electrodes

Note 1 to entry: A complete sinusoidal current half cycle is not considered to be an arcing half cycle.

3.2
arc fault
arcing fault
dangerous unintentional arc

3.3
arc fault detection device
AFDD
device intended to mitigate the effects of arcing faults by disconnecting the circuit when an arc fault is detected

3.4
arc fault detection unit
AFD unit
part of the AFDD ensuring the function of detection and discrimination of dangerous earth, parallel and series arc faults and initiating the operation of the device to cause interruption of the current

Note 1 to entry: The interruption of the current can either be provided by opening means (see 4.1.1) or by a protective device integrating an AFD unit (see 4.1.2) or by a protective device assembled with an AFD unit (see 4.1.3).

3.5
detection
function consisting in sensing the presence of an arc fault current

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3.6
interruption
function consisting in bringing automatically the main contacts of the AFDD from the closed position into the open position, thereby interrupting the arc fault current(s) flowing through them

3.7
earth arc fault
arc fault where the current is flowing from active conductor to the earth

Note 1 to entry: The earth arc current may have a value close to the parallel arc current in some installations (e.g. TN installation).

3.8
parallel arc fault
arc fault where the arc current is flowing between active conductors in parallel with the load of the circuit.

3.9
series arc fault
arc fault where the current is flowing through the load(s) of the final circuit protected by an AFDD

3.10
closed position
position in which the predetermined continuity of the main circuit of the AFDD is secured

3.11
open position
position in which the predetermined clearance between open contacts in the main circuit of the AFDD is secured

3.12
pole
that part of an AFDD associated exclusively with one electrically separated conducting path of its main circuit provided with contacts intended to connect and disconnect the main circuit itself and excluding those portions which provide a means for mounting and operating the poles together

3.13
switched neutral pole
pole only intended to switch the neutral and not intended to have a short-circuit capacity

3.14
isolation
isolating function
function intended to cut off the supply from the whole installation or a discrete section of it by separating it from every source of electrical energy for reasons of safety

[SOURCE: IEC 60947-1:2007, 2.1.19]

3.15
isolating distance
clearance between open contacts, meeting the safety requirements specified for isolation purposes

[SOURCE: IEC 60050-441:1984, 441-17-35, modified – "disconnectors" has been replaced by "isolation purposes".]

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3.16
making capacity
value of the a.c. component of a prospective current that an AFDD is capable of making at a stated voltage under prescribed conditions of use and behaviour

3.17
breaking capacity
value of the a.c. component of a prospective current that an AFDD is capable of breaking at a stated voltage under prescribed conditions of use and behaviour

3.18
conditional short-circuit current
I_{nc}
value of the a.c. component of a prospective current, which an AFDD, protected by a suitable short-circuit protective device (SCPD) in series can withstand under specified conditions of use and behaviour

3.19
prospective current
current that would flow in the circuit, if each main current path of the AFDD were replaced by a conductor of negligible impedance

Note 1 to entry: The prospective current may be qualified in the same manner as an actual current, for example: prospective breaking current, prospective peak current, etc.

3.20
maximum prospective peak current (of an a.c. circuit)
prospective peak current, when the initiation of the current takes place at the instant which leads to the highest possible value

3.21
short-circuit (making and breaking) capacity
alternating component of the prospective current, expressed by its r.m.s. value, which the AFDD is designed to make, to carry for its opening time and to break under specified conditions

3.22
thread forming tapping screw
tapping screw having an uninterrupted thread

Note 1 to entry: It is not a function of this thread to remove material from the hole.

Note 2 to entry: An example of a thread forming tapping screw is shown in Figure 1.

3.23
thread cutting tapping screw
tapping screw having an interrupted thread

Note 1 to entry: It is a function of this thread to remove material from the hole.

Note 2 to entry: An example of a thread cutting tapping screw is shown in Figure 2.

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4 Classification

4.1 According to the method of construction

4.1.1 AFDD as one single device, comprising an AFD unit and opening means not providing overcurrent or residual current protection.

4.1.2 AFDD as one single device, comprising an AFD unit integrated in a protective device complying with one or more of the following standards IEC 60898-1, IEC 61008-1, IEC 61009-1 or IEC 62423.

4.1.3 AFDD according to Annex D, comprised of an AFD unit and a declared protective device, intended to be assembled on site.

4.2 According to the method of mounting and connection

Panel board type AFDDs, also referred to as distribution board types, can be connected as follows:

a) AFDDs the connections of which are not associated with the mechanical mounting;

b) AFDDs the connections of which are associated with the mechanical mounting, for example:

   1) plug-in type;

   2) bolt-on type.

NOTE Some AFDDs of the plug-in type or bolt-on type on the line side only, the load terminals being usually suitable for wiring connection.

4.3 According to the number of poles and current paths

– Single-pole AFDD with two current paths (one pole plus one uninterrupted neutral);

– Two-pole AFDD;

– Three-pole AFDD;

– Four-pole AFDD.

NOTE 1 In China uninterrupted neutral AFDDs are not allowed.

4.4 AFDD providing monitoring information

AFDD providing monitoring information are under consideration

Under consideration.

5 Characteristics of AFDDs

5.1 Summary of characteristics and conditions to mitigate the risk of fire

An AFDD shall ensure detection for:

– earth arc fault (see 3.7); and

– parallel arc fault (see 3.8); and

– series arc fault (see 3.9).

The characteristics of an AFDD shall be stated in the following terms:

– rated current I_n (see 5.2.2);

– rated voltage U_n (see 5.2.1);

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– rated frequency (see 5.2.3);
– rated making and breaking capacity I_m (see 5.2.4);
– rated making and breaking capacity on one pole I_{m1} (see 5.2.5);
– degree of protection (see IEC 60529);
– rated conditional short-circuit current I_{nc} (see 5.3.6 and 5.5.2);
– rated conditional short-circuit current on one pole I_{nc1} (see 5.3.6 and 5.5.2);
– method of connection (see 4.2).

5.2 Rated quantities and other characteristics

5.2.1 Rated voltage

5.2.1.1 Rated operational voltage (U_n)

The rated operational voltage (hereafter referred to as "rated voltage") of an AFDD is the value of voltage, assigned by the manufacturer, to which its performance is referred.

The same AFDD may be assigned for a number of rated voltages.

5.2.1.2 Rated insulation voltage (U_i)

The rated insulation voltage of an AFDD is the value of voltage, assigned by the manufacturer, to which dielectric test voltages and creepage distances are referred.

Unless otherwise stated, the rated insulation voltage is the value of the maximum rated voltage of the AFDD. In no case shall the maximum rated voltage exceed the rated insulation voltage.

5.2.1.3 Rated impulse withstand voltage (U_{imp})

The rated impulse withstand voltage of an AFDD shall be equal to or higher than the standard values of rated impulse withstand voltage according to Table F.1 of IEC 60664-1:2007 and Table 4 of this standard.

5.2.2 Rated current (I_n)

The value of current, assigned to the AFDD by the manufacturer, which the AFDD can carry in uninterrupted duty.

5.2.3 Rated frequency

The rated frequency of an AFDD is the power frequency for which the AFDD is designed and to which the values of the other characteristics correspond.

The same AFDD may be assigned a number of rated frequencies.

5.2.4 Rated making and breaking capacity (I_m)

The r.m.s. value of the a.c. component of prospective current, assigned by the manufacturer, which an AFDD can make, carry and break under specified conditions.

The conditions are those specified in 9.11.2 for AFDDs classified according to 4.1.1 and in the standard of the declared protective device (e.g. IEC 60898-1, IEC 61008-1, IEC 61009-1, IEC 62423) for AFDDs classified according to 4.1.2 and 4.1.3.

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5.2.5 Rated making and breaking capacity on one pole (I_{m1})

The r.m.s. value of the a.c. component of prospective current, assigned by the manufacturer, which an AFDD can make, carry and break with one pole, under specified conditions.

5.3 Standard and preferred values

5.3.1 Preferred values of rated voltage (U_n)

Preferred values of rated voltage are as indicated in Table 22.

Table 22 – Preferred values of rated voltage

AFDD	Circuit supplying the AFDD	Rated voltage of AFDDs for use in systems 230 V or 230/400 V or 400 V V	Rated voltage of AFDDs for use in systems 120/240 V or 240 V V
Single-pole (with two current paths)	Single phase (phase to earthed middle conductor or phase to neutral)	230	120
Two-pole	Single phase (phase to neutral or phase to phase or phase to earthed middle conductor)	230, 400	120, 240
Three-pole	Three phases (3-wire or 4-wire) (400 V or 230/400 V or 230 V-system)	230 400	
Four-pole	Three phases (4-wire) (230/400 V-system)	400	

NOTE 1 In IEC 60038 the network voltage value of 230/400 V has been standardized. This value is likely to progressively supersede the values of 220/380 V and 240/415 V.

NOTE 2 Wherever in this standard there is a reference to 230 V or 400 V, they can be read as 220 V or 240 V, 380 V or 415 V, respectively.

NOTE 3 Wherever in this standard there is a reference to 120 V or 120/240 V or 240 V, they can be read as 100 V, 100/200 V or 200 V, respectively.

NOTE 4 Wherever in this standard there is a reference to 240 V three phases, it can be read as 100 V or 120/208 V.

NOTE In Japan, the phase to neutral conductor and phase to earthed conductor (grounded conductor) are considered in a different way because single phase 2-wire systems supplied from a 2-wire system source do not have a neutral point.

5.3.2 Preferred values of rated current (I_n)

Preferred values of rated current are:

6 – 8 – 10 – 13 – 16 – 20 – 25 – 32 – 40 – 50 – 63 A.

5.3.3 Standard values of rated frequency

Standard values of rated frequency are 50 Hz, 60 Hz and 50/60 Hz.

5.3.4 Minimum value of the rated making and breaking capacity (I_m)

The minimum value of the rated making and breaking capacity I_m is 10 I_n or 500 A, whichever is the greater.

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The associated power factors are given in 9.11.2 for AFDDs classified according to 4.1.1 and in the standard of the declared protective device for AFDDs classified according to 4.1.2 and 4.1.3.

5.3.5 Minimum value of the rated making and breaking capacity on one pole (I_{m1})

The minimum value of the rated making and breaking capacity on one pole I_{m1} is 10 I_n or 500 A, whichever is the greater.

The associated power factors are given in 9.11.2 for AFDDs classified according to 4.1.1 and in the standard of the declared protective device for AFDDs classified according to 4.1.2 and 4.1.3.

5.3.6 Standard and preferred values of the rated conditional short-circuit current (I_{nc}) and standard and preferred values of the rated conditional short circuit current for one pole (I_{nc1})

5.3.6.1 General

The standard and preferred values of the rated conditional short-circuit current I_{nc} and I_{nc1} are specified as follows:

5.3.6.2 Values up to and including 10 000 A

Up to and including 10 000 A, the standard values of the rated conditional short-circuit current I_{nc} and I_{nc1} are:

3 000 – 4 500 – 6 000 – 10 000 A.

The associated power factors are given in 9.11.2 for AFDDs classified according to 4.1.1 and in the standard of the declared protective device for AFDDs classified according to 4.1.2 and 4.1.3.

NOTE In Korea, the values of 1 000 A, 1 500 A, 2 000 A, 2 500 A, 7 500 A, 9 000 A are also considered as standard values.

5.3.6.3 Values above 10 000 A

For values above 10 000 A up to and including 25 000 A, a preferred value is 20 000 A.

The associated power factors are given in 9.11.2 for AFDDs classified according to 4.1.1 and in the standard of the declared protective device for AFDDs classified according to 4.1.2 and 4.1.3.

Values above 25 000 A are not considered in this standard.

5.3.7 Limiting values of operating criteria for AFDDs for low and high arc currents

5.3.7.1 Limit values of operating criteria for AFDDs at low arc currents up to 63 A

Table 1 – Limit values of break time for U_n = 230 V and 400 V AFDDs

Test arc current (r.m.s. values)	2,5 A	5 A	10 A	16 A	32 A	63 A
Maximum break time	1 s	0,5 s	0,25 s	0,15 s	0,12s	0,12 s

NOTE Low arc currents can occur due to insulation faults phase to earth or series arcing

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Table 2 – Limit values of break time for U_n = 120 V AFDDs

Test arc current (r.m.s. values)	5 A	10 A	16 A	32 A	63 A
Maximum break time	1 s	0,4 s	0,28 s	0,14 s	0,14 s

When the test current to which the AFDD is exposed is not one of the values in Tables 1 or 2, the allowable break time shall be determined by linear interpolation between the break time values above and below the actual test current.

5.3.7.2 Limit values of operating criteria for AFDDs at high arc currents above 63 A

Table 3 – Maximum allowed number of arcing half-cycles within 0,5 s

Test arc current [a] (r.m.s. values)	75 A	100 A	150 A	200 A	300 A	500 A
N [b]	12	10	8	8	8	8

[a] This test current is the prospective current before arcing in the testing circuit.

[b] N is the number of half cycles at the rated frequency.

NOTE High arc currents can occur due to insulation faults phase to earth or parallel arcing.

5.4 Standard value of rated impulse withstand voltage (U_{imp})

Table 4 gives the standard value of rated impulse withstand voltages as a function of the nominal voltage of the installation.

Table 4 – Rated impulse withstand voltage as a function of the nominal voltage of the installation

Rated impulse withstand voltage U_{imp} kV	**Nominal voltage of the installation**	
	Three-phase systems V	**Single-phase system with mid-point earthed** V
2,5[a]		120/240[b]
4[a]	230/400	120/240, 240[c]

NOTE 1 For test voltages to check the insulation, see Table 15.

NOTE 2 For test voltages to check the isolation distance across open contacts, see Table 16.

[a] The values 3 kV and 5 kV respectively are used for verifying the isolating distances across open contacts at the altitude of 2 000 m (see Table 16).

[b] For installation practice in Japan.

[c] For installation practice in North American countries.

In case an AFDD is intended to be connected (see 4.1.1) or integrated (see 4.1.2) or assembled (see 4.1.3) with one or several declared protective devices whose standard values of rated impulse withstand voltage are more severe than those mentioned in Table 4, the standard conditions for operation in service and for installation of the most severe protective device standard shall apply.

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5.5 Coordination with short-circuit protective devices (SCPDs)

5.5.1 General

AFDDs shall be protected against short-circuits by means of circuit-breakers or fuses complying with their relevant standards according to the installation rules of the IEC 60364 series.

Coordination between AFDDs and the SCPD shall be verified under the general conditions of 9.11 to verify that there is an adequate protection of the AFDDs against short-circuit currents up to the conditional short-circuit current I_{nc}.

5.5.2 Rated conditional short-circuit current (I_{nc}) and rated conditional short-circuit on one pole (I_{nc1})

The r.m.s. value of prospective current, assigned by the manufacturer, which an AFDD, protected by a SCPD, can withstand under specified conditions without undergoing alterations impairing its functions.

The conditions are those specified in 9.11.

5.5.3 Operating characteristics of opening means for AFDDs according to 4.1.1

5.5.3.1 General

Opening means shall meet all applicable requirements of this standard.

The following acronyms I_{m1} and I_{nc1} are used for testing on one pole only.

5.5.3.2 Rated making and breaking capacity (I_m and I_{m1})

The conditions for the rated making and breaking capacity (I_m and I_{m1}) in 5.2.4 and 5.2.5 are those specified in 9.11.2.3 and in 9.11.2.4.

The associated power factors for the minimum value of the rated making and breaking (I_m and I_{m1}) given in 5.3.4 and 5.3.5 are specified in Table 19 of 9.11.2.2.

5.5.3.3 Rated conditional short-circuit capacity (I_{nc} and I_{nc1})

The conditions for the rated conditional short circuit capacity (I_{nc} and I_{nc1}) in 5.3.6 are those specified in 9.11.2.5.

The associated power factors are specified in Table 19 of 9.11.2.2.

6 Marking and other product information

6.1 Marking

Each AFDD shall be marked in a durable manner with all or, for small apparatus, part of the following data:

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Table 5 – Marking and position of marking

	Marking or Information item	Position of the marking or information		
		Visible on product when installed	On the product	In a Leaflet
a	the manufacturer's name or trade mark;		X	X
b	type designation, catalogue number or serial number		X	X
c	rated voltage(s)	X		X
d	rated frequency; AFDDs with more than one rated frequency (e.g. 50/60 Hz) shall be marked accordingly		X	X
e	rated current	X		X
f	rated making and breaking capacity		X	X
g	the position of use, if necessary			X
h	the degree of protection (only if different from IP20);			X
i	wiring diagram		X	X
j	standard reference		X	X

The marking shall be on the AFDD itself or on a nameplate or nameplates attached to the AFDD and shall be located so that it is legible when the AFDD is installed.

The suitability for isolation, which is provided by all AFDDs of this standard, may be indicated by the symbol ⊢ (IEC 60617-7:2001-07) on the device. When affixed, this marking may be included in a wiring diagram, where it may be combined with symbols of other functions.

NOTE In Australia this marking is mandatory but is not required to be visible after installation.

When the symbol is used on its own (i.e. not in a wiring diagram), combination with symbols of other functions is not allowed.

If a degree of protection higher than IP20 according to IEC 60529 is marked on the device, it shall comply with it, whichever the method of installation. If the higher degree of protection is obtained only by a specific method of installation, and/or with the use of specific accessories (e.g. terminal covers, enclosures, etc.), this shall be specified in the manufacturer's literature.

If, for small devices, the space available does not allow all the above data to be marked, at least the information under c and e shall be marked and visible when the device is installed. The information under a, b, d, f, i and j may be marked on the side or on the back of the device and be visible only before the device is installed. Alternatively the information under i may be on the inside of any cover which has to be removed in order to connect the supply wires. Any remaining information not marked shall be given in the manufacturer's catalogues.

The open position shall be indicated by the symbol "O" (IEC 60417-5008:2002-10) and the closed position by the symbol "|" (a short straight vertical line, IEC 60417-5007:2002-10). Additional national symbols for this indication are allowed. Provisionally the use of national indications only is allowed. These indications shall be readily visible when the AFDD is installed.

Alternatively, a button remaining in its depressed position is sufficient to indicate the closed position. On the other hand, if the button does not remain depressed, an additional means indicating the position of the contacts shall be provided.

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If it is necessary to distinguish between the supply and the load terminals, they shall be clearly marked (e.g. by "line" and "load" placed near the corresponding terminals or by arrows indicating the direction of power flow).

Terminals exclusively intended for the connection of the neutral circuit shall be indicated by the letter N.

Terminals intended for the protective conductor, if any, shall be indicated by the symbol ⏚ (IEC 60417-5019:2006-08).

The marking shall be indelible, easily legible and not be placed on screws, washers or other removable parts.

The terminal shall be suitable for all types of conductors: rigid (solid or stranded) and unless otherwise specified by the manufacturer also for flexible.

For universal terminals (for rigid-solid, rigid-stranded and flexible conductors):

– no marking.

For non-universal terminals:

– terminals declared for rigid-solid conductors only shall be marked by the letters “s” or "sol";
– terminals declared for rigid (solid and stranded) only conductors shall be marked by the letter "r";

The markings should appear on the AFDD or, if the space available is not sufficient, on the smallest package unit or in technical information.

For devices according to 4.1.2, the marking required in Clause 6 of IEC 60898-1:2002 or IEC 61008-1:2010 or IEC 61009-1:2010 shall be indicated, as applicable.

Compliance is checked by inspection and by the test of 9.3, according to the testing procedure given in 9.1.1

6.2 Additional marking for AFDDs according to 4.1.1

6.2.1 Marking of AFDDs

AFDDs shall be marked with:

– Maximum rated current of the main protective device with which it may be connected (e.g. 32 A max.) for short-circuit protection. If this value depends on the declared protective devices the lowest value is marked;
– Rated making and breaking capacity on one pole (I_{m1});
– Rated conditional short circuit current (I_{nc});
– Rated conditional short-circuit current on one pole (I_{nc1}).

It is recommended that the references of the main protective device with which the AFDD can be connected in series be marked.

The manufacturer shall state the Joule integral I^2t and the peak current I_p withstand capabilities of the AFDD. Where these are not stated, minimum values as given in Table 18.

For AFDDs intended to be wired with several protective devices the highest values of I^2t and I peak of the protective devices declared by the manufacturer is applied.

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Compliance is checked by inspection and by the tests of 9.3 of this standard.

6.2.2 Instructions for wiring and operation

The AFDD manufacturer's data sheet and catalogue shall mention with which declared and standardised protective device according to IEC 60898-1 and/or IEC 61009-1 and/or IEC 62423 and/or IEC 60269 it can be connected with.

The manufacturer shall provide adequate instructions with the AFDD.

These instructions shall cover at least the following:

– reference to the type(s) and catalogue number(s), covering current and voltage ratings etc. of the declared protective device(s) with which the AFDD is designed to be wired with;
– derating factor(s), if any.

7 Standard conditions for operation in service and for installation

7.1 Standard conditions

AFDDs complying with this standard shall be capable of operating under the following standard conditions shown in Table 6.

Table 6 – Standard conditions for operation in service

Influencing quantity	Standard range of application	Reference value	Test tolerances [f]
Ambient temperature [a g]	–5 °C to +40 °C [b]	20 °C	± 5 °C
Altitude	Not exceeding 2 000 m		
Relative humidity maximum value 40 °C	50 % [c]		
External magnetic field	Not exceeding 5 times the earth's magnetic field in any direction	Earth's magnetic field	[d]
Position	As stated by the manufacturer, with a tolerance of 2° in any direction [e]	As stated by the manufacturer	2 ° in any direction
Frequency	Reference value ± 5 % [f]	Rated value	± 2 %
Sinusoidal wave distortion	Not exceeding 5 %	Zero	5 %

[a] The maximum value of the mean daily temperature is +35 °C.

[b] Values outside the range are admissible where more severe climatic conditions prevail, subject to agreement between manufacturer and user.

[c] Higher relative humidities are admitted at lower temperature (for example 90 % at 20 °C).

[d] When an AFDD is installed in proximity of a strong magnetic field, supplementary requirements may be necessary.

[e] The device shall be fixed without causing deformation liable to impair its functions.

[f] The tolerances given apply unless otherwise specified in the relevant test.

[g] Extreme limits of -20 °C and +60 °C are admissible during storage and transportation, and should be taken into account in the design of the device.

In case an AFDD is connected (see 4.1.1) or integrated (see 4.1.2) or assembled (see 4.1.3) with one or several associated declared protective devices whose standard conditions for operation in service and for installation are more severe than those mentioned in Table 6, the

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standard conditions for operation in service and for installation of the most severe protective device standard shall apply.

7.2 Conditions of installation

AFDDs shall be installed in accordance with the manufacturer's instructions.

7.3 Pollution degree

AFDDs complying with this standard are intended for environment with pollution degree 2, i.e. normally, only non-conductive pollution occurs; occasionally, however, a temporary conductivity caused by condensation may be expected

8 Requirements for construction and operation

8.1 General

The AFD unit shall not reduce the main operating characteristics of the declared protective device. The AFD unit within an AFDD according to 4.1.3 and the protective device shall be from the same manufacturer or being affixed with the same trade mark.

As a consequence, the manufacturer shall declare both with which protective device the AFD unit can be associated and which AFD unit is suitable with the protective device.

An AFDD shall not be designed in such a way that the AFD unit provides a current between a phase and the neutral or protective conductor within the installation having the purpose to trip another device.

AFDDs shall be so designed and constructed that, in normal use, their performance is safe, reliable and without danger to the user or the environment.

AFDDs shall comply with this standard in accordance with the scope and the relevant classifications.

AFDDs classified according to 4.1.1 shall comply with the requirements and tests given in this standard (in particular see 6.2, 9.11.2 and 9.18.1).

In the case of AFDDs intended to be wired with several protective devices, a selection of the most stringent tests among all applicable protective device standards shall be applied.

The degree of protection of AFDDs according to 4.1.1 shall not be less than the degree of protection of the declared protective device which it is to be wired with.

Where an AFDD can be wired with several declared protective devices, the highest degree of protection of all applicable standards including this one applies.

AFDDs classified according to 4.1.2 shall comply with the relevant standard of the protective device with which it is integrated (IEC 60898-1, IEC 61008-1, IEC 61009-1, or IEC 62423 as applicable) and additionally to the requirements and tests given in this standard.

Where tests included in this standard are also included in IEC 60898-1, IEC 61008-1, IEC 61009-1, or IEC 62423, a selection of the most stringent requirements and tests among all applicable standards shall be applied only once.

AFDDs classified according to 4.1.3 shall comply with the requirements given in this standard and additionally to the requirements and tests given in Annex D as applicable.

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In case of AFDDs intended to be assembled with several protective devices, a selection of the most stringent tests among all applicable standards shall be applied.

8.2 Mechanical design

8.2.1 General

The arcing current detection and release with regards to fire hazard shall be located between the incoming and outgoing terminals of the AFDD.

It shall not be possible to alter the operating characteristics of the AFDD by means of external interventions.

It shall not be possible to disable or inhibit the AFDD function by any means.

The instructions shall state that it is not allowed to wire a circuit-breaker or an overcurrent protective device of a given rated short-circuit capacity with an AFDD according to 4.1.1 so as to result in a lower short-circuit performance.

Compliance is checked by the documentation.

8.2.2 Mechanism

The moving contacts of all poles of multipole AFDDs shall be so mechanically coupled that all poles except the switched neutral, if any, make and break substantially together, whether operated manually or automatically.

A switched neutral pole of a four pole AFDD shall not close after and shall not open before the other pole(s).

AFDDs shall have a trip-free mechanism.

It shall be possible to switch the AFDD on and off by hand.

AFDDs shall be so constructed that the moving contacts can come to rest only in the closed position or in the open position, even when the operating means is released in an intermediate position.

AFDDs shall provide in the open position an isolation distance in accordance with the requirements necessary to satisfy the isolating function.

Indication of the position of the main contacts shall be provided by one or both of the following means:

– the position of the actuator (this being preferred), or
– a separate mechanical indicator.

If a separate mechanical indicator is used to indicate the position of the main contacts, this shall show the colour red for the closed position and the colour green for the open position.

NOTE In the USA, the colours red and green are not used for contact position indication.

The means of indication of the contact position shall be reliable.

AFDDs shall be designed so that the actuator, front plate or cover can only be fitted in a manner which ensures correct indication of the contact position.

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When means are provided or specified by the manufacturer to lock the operating means in the open position, locking in that position shall only be possible when the main contacts are in the open position.

Locking of the operating means in the closed position is permitted for particular applications.

Where the operating means is used to indicate the position of the contacts, the operating means, when released, shall automatically take up the position corresponding to that of the moving contacts; in this case, the operating means shall have two distinct rest positions corresponding to the position of the contacts, but, for automatic opening, a third distinct position of the operating means may be provided, in which case it shall be necessary to reset the AFDD manually before reclosing is possible.

The action of the mechanism shall not be influenced by the position of enclosures or covers and shall be independent of any removable part.

A cover sealed in position by the manufacturer is considered to be a non-removable part.

If the cover is used as a guiding means for push-buttons, it shall not be possible to remove the buttons from the outside of the AFDD.

Operating means shall be securely fixed on their shafts and it shall not be possible to remove them without the aid of a tool.

Operating means directly fixed to covers are allowed. If the operating means has an "up-down" movement, when the AFDD is mounted as in normal use, the contacts shall be closed by the up movement.

Compliance with the above requirements is checked by inspection, by manual test and, for the trip-free mechanism, by the tests of 9.11 and 9.15 according to the testing procedure given in 9.1.1.

8.2.3 Clearances and creepage distances (see Annex B)

The minimum required clearances and creepage distances are given in Table 7 which is based on the AFDD being designed for operating in an environment with pollution degree 2.

Compliance for item 1 in Table 7 is checked by measurement and by the tests of 9.7.7.4.1and 9.7.7.4.2. The test is carried out with samples not submitted to the humidity treatment described in 9.7.2.

The clearances of items 2 and 4 may be reduced provided that the measured clearances are not shorter than the minimum allowed in IEC 60664-1:2007 for homogenous field conditions; in which case, after the humidity treatment described in 9.7.2, compliance for items 2 and 4 and arrangements of 9.7.3 items b), c), d) and e) is checked in the following order:

– tests according to 9.7.3 to 9.7.6 as applicable;
– tests according to 9.7.7.2 is applied with test voltages given in Table 15 with test arrangements of 9.7.3 items b), c), d), e).

If measurement does not show any reduced clearance, test 9.7.7.2 is not applied.

Compliance for item 3 in Table 7 is checked by measurement.

NOTE 1 All measurements required in 8.2.3 are carried out in test sequence A on 1 sample and the tests according to 9.7.7.2 are carried out on 3 samples of test sequence B.

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Parts of PCBs connected to the live parts protected against pollution by the use of a type 2 protection according to IEC 60664-3 are exempt from this verification.

The insulating materials are classified into material groups on the basis of their comparative tracking index (CTI) according to 4.8.1 of IEC 60664-1:2007.

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Table 7 – Minimum clearances and creepage distances *(1 of 2)*

	Minimum clearances mm			Minimum creepage distances [e, f] mm											
				Group IIIa [h] (175 V ≤ CTI < 400 V)[d]				Group II (400 V ≤ CTI < 600 V)[d]				Group I (600 V ≤ CTI) [d]			
	Rated voltage V			Working voltage [e] V											
	U_{imp}														
	2,5 kV	4 kV	4 kV												
Description	120/240 120	120/240 240	230/400 230 400	> 25 ≤ 50[i]	120	250	400	> 25 ≤ 50[i]	120	250	400	> 25 ≤ 50[i]	120	250	400
1. between live parts which are separated when the main contacts are in the open position [a]	2,0	4,0	4,0	1,20	2,00	4,0	4,0	0,90	2,00	4,0	4,0	0,60	2,00	4,0	4,0
2. between live parts of different polarity [a]	1,5	3,0	3,0	1,20	1,50	3,0	4,0	0,90	1,50	3,0	3,0	0,60	1,50	3,0	3,0
3. between circuits supplied from different sources, one of which being PELV or SELV [g]	3,0	6,0	8,0		3,0	6,0	8,0		3,0	6,0	8,0		3,0	6,0	8,0
				Rated voltage V											
				120 / 240		230 / 400		120 / 240		230 / 400		120 / 240		230 / 400	
4. between live parts and – accessible surfaces of operating means – screws or other means for fixing covers which have to be removed when mounting the AFDD – surface on which the AFDD is mounted [b] – screws or other means for fixing the AFDD [b] – metal covers or boxes [b] – other accessible metal parts [c] – metal frames supporting flush-type AFDDs	1,50	3,0	3,0	1,50		4,0		1,50		3,0		1,50		3,0	

NOTE 1 The values given for 400 V are also valid for 440 V.

NOTE 2 The parts of the neutral path, if any, are considered to be live parts.

NOTE 3 Care should be taken to provide adequate clearances and creepage distances between live parts of different polarity of AFDDs, e.g. of the plug-in type mounted close to one another. If the clearance and creepage distances requirements are not fulfilled to all the surfaces adjacent to the AFDD, appropriate information will be provided for installation purposes.

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Table 7 *(2 of 2)*

a	For auxiliary and control contacts the values are given in the relevant standard.
b	The values are doubled if clearances and creepage distances between live parts of the device and the metallic screen or the surface on which the AFDD is mounted are not dependent on the design of the AFDD only, so that they can be reduced when the AFDD is mounted in the most unfavourable condition.
c	Including a metal foil in contact with the surfaces of insulating material which are accessible after installation for normal use. The foil is pushed into corners, grooves, etc., by means of a straight unjointed test finger according to 9.6 (see Figure 3).
d	See IEC 60112:2003.
e	Interpolation is allowed in determining creepage distances corresponding to voltage values intermediate to those listed as working voltage. When interpolating, linear interpolation shall be used and values shall be rounded to the same number of digits as the values picked up from the tables. For determination of creepage distances, see Annex B.
f	Creepage distances cannot be less than the associated clearances.
g	To cover all different voltages including ELV in an auxiliary contact.
h	For material group IIIb (100 V ≤ CTI < 175 V), the values for material group IIIa multiplied by 1,6 apply.
i	For working voltages up to and including 25 V, reference may be made to IEC 60664-1:2007.

NOTE 2 Information on the requirements for design of solid insulation and appropriate testing is provided in IEC 60664-1:2007, 5.3 and 6.1.3.

NOTE 3 For clearances on printed wiring material, the following Note 3 Table F.2 in IEC 60664-1:2007 can be used: “For printed wiring material, the values for pollution degree 1 apply except that the value shall not be less than 0,04 mm, as specified in Table F.4.” For creepage distances on printed wiring material, distances in Table F.4 in IEC 60664-1:2007 can be used if protected with a coating meeting IEC 60664-3 requirements and tests.

NOTE 4 The dimensioning of clearances and creepage distances for spacings equal to or less than 2 mm for printed wiring board can be optimised under certain conditions in case of use of IEC 60664-5. Only humidity levels HL 2 and HL3 are considered.

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8.2.4 Screws, current-carrying parts and connections

8.2.4.1 Connections, whether electrical or mechanical, shall withstand the mechanical stresses occurring in normal use.

Screws operated when mounting the AFDD during installation shall not be of the thread-cutting type.

NOTE 1 Screws (or nuts) which are operated when mounting the AFDD include screws for fixing covers or cover-plates, but not connecting means for screwed conduits and for fixing the base of an AFDD.

Compliance is checked by the test of 9.4 according to the testing procedure given in 9.1.1.

NOTE 2 Screwed connections are considered as checked by the tests of 9.8, 9.11, 9.12, and 9.20.

8.2.4.2 For screws in engagement with a thread of insulating material and which are operated when mounting the AFDD during installation, correct introduction of the screw into the screw hole or nut shall be ensured.

Compliance is checked by inspection and by manual test.

NOTE The requirement with regard to correct introduction is met if introduction of the screw in a slanting manner is prevented, for example, by guiding the screw by the part to be fixed by a recess in the female thread or by the use of a screw with the leading thread removed.

8.2.4.3 Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is sufficient resilience in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

Compliance is checked by inspection.

NOTE The suitability of the material is considered in respect of the stability of the dimensions.

8.2.4.4 Current-carrying parts including parts intended for protective conductors, if any, shall be made of a metal having, under the conditions occurring in the equipment, mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use.

Examples of suitable materials are given below:

– copper;
– an alloy containing at least 58 % copper for parts worked cold, or at least 50 % copper for other parts;
– other metal or suitably coated metal, no less resistant to corrosion than copper and having mechanical properties no less suitable.

In case of using ferrous alloys or suitably coated ferrous alloys, compliance to resistance to corrosion is checked by a test of resistance to rusting (see 9.16).

The requirements of this subclause 8.2.4.4 do not apply to contacts, magnetic circuits, heater elements, bimetals, shunts, parts of electronic devices or to screws, nuts, washers, clamping plates, similar parts of terminals and parts of the test circuit.

8.2.5 Terminals for external conductors

8.2.5.1 Terminals for external conductors shall be such that the conductors may be connected so as to ensure that the necessary contact pressure is maintained permanently.

Connection arrangements intended for busbar connection are admissible, provided they are not used for the connection of cables.

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Such arrangements may be either of the plug-in or of the bolt-on type.

The terminals shall be readily accessible under the intended conditions of use.

Compliance is checked by the test of 9.5 according to the testing procedure given in 9.1.1.

8.2.5.2 AFDDs shall be provided with terminals which shall allow the connection of copper conductors having nominal cross-sectional areas as shown in Table 8.

NOTE Examples of possible designs of terminals are given in Annex IB.

The terminals of the AFDD according to 4.1.1 shall be able to clamp the range of nominal cross-sections of conductors specified in the standard of all declared protective devices for the rated currents of the declared protective devices with which it is designed to be wired.

Compliance is checked by inspection, by measurement and by fitting in turn one conductor of the smallest and one of the largest cross-sectional area as specified.

Table 8 – Connectable cross-sections of copper conductors for screw-type terminals

Rated current [b] A		**Range of nominal cross-section to be clamped** [a] mm^2	
Greater than	**Up to and including**	**Rigid (solid or stranded) conductors**	**Flexible conductors**
–	13	1 to 2,5	1 to 2,5
13	16	1 to 4	1 to 4
16	25	1,5 to 6	1,5 to 6
25	32	2,5 to 10	2,5 to 6
32	50	4 to 16	4 to 10
50	80	10 to 25	10 to 16

NOTE For AWG cross-sections, see Annex IC.

[a] It is required that, for current ratings up to and including 50 A, terminals be designed to clamp solid conductors as well as rigid stranded conductors. Nevertheless, it is permitted that terminals for conductors having cross-sections from 1 mm^2 up to 6 mm^2 be designed to clamp solid conductors only.

[b] A range of AFDDs having the same fundamental design and construction of terminals, the terminals are fitted with copper conductors of the smallest cross-section for the minimum rated current and largest cross-section for the maximum rated current, as specified, solid and stranded, as applicable.

8.2.5.3 The means for clamping the conductors in the terminals shall not serve to fix any other component, although they may hold the terminals in place or prevent them from turning.

Compliance is checked by inspection and the test of 9.5 according to the testing procedure given in 9.1.1.

8.2.5.4 Terminals for rated currents up to and including 32 A shall allow the conductors to be connected without special preparation.

Compliance is checked by inspection.

NOTE The term "special preparation" covers soldering of wire of the conductor, use of cable lugs, formation of eyelets, etc., but not the reshaping of the conductor before its introduction into the terminal or the twisting of a flexible conductor to consolidate the end.

8.2.5.5 Terminals shall have adequate mechanical strength.

Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread comparable in pitch and mechanical strength.

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Compliance is checked by inspection and by the tests of 9.4 and 9.5.1 according to the testing procedure given in 9.1.1.

8.2.5.6 Terminals shall be so designed that they clamp the conductor without undue damage to the conductor.

Compliance is checked by inspection and by the test of 9.5.2 according to the testing procedure given in 9.1.1.

8.2.5.7 Terminals shall be so designed that they clamp the conductor reliably and between metal surfaces.

Compliance is checked by inspection and by the tests of 9.4 and 9.5.1 according to the testing procedure given in 9.1.1.

8.2.5.8 Terminals shall be so designed or positioned that neither a rigid solid conductor nor a wire of a stranded conductor can slip out while the clamping screws or nuts are tightened.

This requirement does not apply to lug terminals.

Compliance is checked by the test of 9.5.3 according to the testing procedure given in 9.1.1.

8.2.5.9 Terminals shall be so fixed or located that, when the clamping screws or nuts are tightened or loosened, their fixings do not become loose.

These requirements do not imply that the terminals shall be so designed that their rotation or displacement is prevented, but any movement shall be sufficiently limited so as to prevent non-compliance with the requirements of this standard.

The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that:

– the sealing compound or resin is not subject to stress during normal use;
– the effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the most unfavourable conditions specified in this standard.

Compliance is checked by inspection, by measurement and by the test of 9.4 according to the testing procedure given in 9.1.1.

8.2.5.10 Clamping screws or nuts of terminals intended for the connection of protective conductors shall be adequately secured against accidental loosening and it shall not be possible to unclamp them without a tool.

Compliance is checked by manual test.

In general, the designs of terminals of which examples are shown in Annex IB provide sufficient resilience to comply with this requirement; for other designs special provisions, such as the use of an adequately resilient part which is not likely to be removed inadvertently, may be necessary.

8.2.5.11 Screws and nuts of terminals intended for the connection of external conductors shall be in engagement with a metal thread and the screws shall not be of the tapping screw type.

8.3 Protection against electric shock

AFDDs shall be so designed that, when they are mounted and wired as for normal use, live parts are not accessible.

NOTE The term "normal use" implies that AFDDs be installed according to the manufacturer's instructions.

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A part is considered to be "accessible" if it can be touched by the standard test finger (see 9.6).

For AFDDs other than those of the plug-in type, external parts, other than screws or other means for fixing covers and labels, which are accessible when AFDDs are mounted and wired as in normal conditions of use, shall either be of insulating material, or be lined throughout with insulating material, unless the live parts are within an internal enclosure of insulating material.

Linings shall be fixed in such a way that they are not likely to be lost during installation of AFDDs. They shall have adequate thickness and mechanical strength and shall provide adequate protection at places where sharp edges occur.

Inlet openings for cables or conduits shall either be of insulating material or be provided with bushings or similar devices of insulating material. Such devices shall be reliably fixed and shall have adequate mechanical strength.

For plug-in AFDDs external parts other than screws or other means for fixing covers, which are accessible for normal use, shall be of insulating material.

Metallic operating means shall be insulated from live parts and their conductive parts, which otherwise would be "exposed conductive parts", shall be covered by insulating material, with the exception of means for coupling insulated operating means of several poles.

Metal parts of the mechanism shall not be accessible. In addition, they shall be insulated from accessible metal parts, from metal frames supporting the base of flush-type AFDDs, from screws or other means for fixing the base to its support and from metal plates used as support.

It shall be possible to replace plug-in AFDDs easily without touching live parts.

Lacquer and enamel are not considered to provide adequate insulation for the purpose of this subclause.

Compliance is checked by inspection and by the test of 9.6 according to the testing procedure given in 9.1.1.

8.4 Dielectric properties and isolating capability

AFDDs shall have adequate dielectric properties and shall ensure isolation.

Control circuits connected to the main circuit shall not be damaged by high d.c. voltage due to insulation measurements which are normally carried out after AFDDs are installed.

Compliance is checked by the tests of 9.7 according to the testing procedure given in 9.1.1.

8.5 Temperature rise

8.5.1 Temperature-rise limits

The temperature-rises of the parts of an AFDD specified in Table 9, measured under the conditions specified in 9.8.2, shall not exceed the limiting values stated in Table 9.

The AFDD shall not suffer damage impairing its functions and its safe use.

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Table 9 – Temperature-rise values

Parts [a, b]	Temperature-rise K
Terminals for external connections [c]	65
External parts liable to be touched during manual operation of the AFDD, including operating means of insulating material and metallic means for coupling insulated operating means of several poles	40
External metallic parts of operating means	25
Other external parts, including that face of the AFDD in direct contact with the mounting surface	60

[a] No value is specified for the contacts, since the design of most AFDDs is such that a direct measurement of the temperature of those parts cannot be made without the risk of causing alterations or displacement of parts likely to affect the reproducibility of the tests.

The test of reliability (see 9.19) is considered to be sufficient for checking indirectly the behaviour of the contacts with respect to undue temperature-rises in service.

[b] No value is specified for parts other than those listed, but no damage shall be caused to adjacent parts of insulating materials, and the operation of the AFDD shall not be impaired.

[c] For plug-in type AFDDs the terminals of the base on which they are installed.

In case an AFDD is wired (see 4.1.1) or integrated (see 4.1.2) or assembled (see 4.1.3) with one or several associated declared protective devices whose standard conditions for temperature rise are more severe than those mentioned in Table 9, the standard conditions for operation in service and for installation of the most severe protective device standard shall apply (IEC 60898, IEC 61008, IEC 61009 and IEC 62423).

8.5.2 Ambient air temperature

The temperature-rise limits given in Table 9 are applicable only if the ambient air temperature remains between the limits given in Table 6.

8.6 Operating characteristics

8.6.1 Operating characteristics of the protective device part

AFDDs classified according to 4.1.2 shall comply with the operating characteristics of the relevant standard of the protective device in which it is integrated (IEC 60898-1, IEC 61008-1, IEC 61009-1, or IEC 62423 as applicable).

Compliance is checked by carrying out all the relevant tests of the specified relevant standard.

AFDDs classified according to 4.1.3 shall comply with the operating characteristics of the relevant standard of the protective device to which it is assembled (IEC 60898, IEC 61008-1, IEC 61009-1, or IEC 62423 as applicable).

Compliance is checked by carrying out all the relevant tests provided in the specified relevant standard and in Annex D.

8.6.2 Operating characteristics

8.6.2.1 General

The operating characteristics of AFDDs shall comply with the following requirements.

Compliance of the following subclauses is checked by the tests given in 9.9.

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8.6.2.2 Operation in case of a series arc fault

The operation of AFDDs to an arc fault current shall be in accordance with breaking time shown in Table 1 or 2 as applicable

Compliance is checked by the tests of 9.9.2.

8.6.2.3 Operation in case of a parallel arc fault

The operation of AFDDs in case of a parallel arc fault shall be in accordance with the number of arcing half cycles in Table 3.

Compliance is checked by the tests of 9.9.3.

8.7 Mechanical and electrical endurance

AFDDs shall be capable of performing an adequate number of mechanical and electrical operations.

Compliance is checked by the test of 9.10 according to the testing procedure given in 9.1.1.

8.8 Performance at short-circuits currents

AFDDs shall be capable of performing a specified number of short-circuit operations during which they shall neither endanger the operator nor initiate a flashover between live conductive parts or between live conductive parts and earth.

Compliance is checked by the tests of 9.11 according to the testing procedure given in 9.1.1.

8.9 Resistance to mechanical shock and impact

AFDDs shall have adequate mechanical behaviour so as to withstand the stresses imposed during installation and use.

Compliance is checked by the test of 9.12 according to the testing procedure given in 9.1.1.

8.10 Resistance to heat

AFDDs shall be sufficiently resistant to heat.

Compliance is checked by the test of 9.13 according to the testing procedure given in 9.1.1.

8.11 Resistance to abnormal heat and to fire

External parts of AFDDs made of insulating material shall not be liable to ignite and to spread fire if current-carrying parts in their vicinity, under fault or overload conditions, attain a high temperature. The resistance to abnormal heat and to fire of the other parts made of insulating material is considered as checked by the other tests of this standard.

Compliance is checked by the test of 9.14 according to the testing procedure given in 9.1.1.

8.12 Behaviour of AFDDs in case of overcurrents in the main circuit

AFDDs shall fulfil the specified conditions of overcurrents.

Compliance is checked by the test of 9.17 according to the testing procedure given in 9.1.1.

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8.13 Behaviour of AFDDs in case of current surges caused by impulse voltages

AFDDs shall adequately withstand the current surges to earth due to the loading of the capacitances of the installation and the current surges to earth due to flashover in the installation.

Compliance is checked by the tests of 9.18 according to the testing procedure given in 9.1.1.

8.14 Reliability

AFDDs shall operate reliably even after long service, taking into account the ageing of their components.

Compliance is checked by the tests of 9.19 and 9.20 according to the testing procedure given in 9.1.1.

8.15 Electromagnetic compatibility (EMC)

AFDDs shall comply with relevant EMC requirements.

Compliance is checked by the tests of 9.21 according to the testing procedure given in 9.1.1.

8.16 Masking test for correct operation behaviour in presence of various appliances connected to the load side

AFDDs shall not be blinded and shall be able to continue to detect arc faults in case of various appliances connected to the load side

Compliance is checked by the tests of 9.9.4.

8.17 Performance of the AFD test device

An AFDD shall be provided with a manual or an automatically initiated test function or both that checks the arc detection circuit.

The automatic test function shall be performed at every switch on and at intervals not exceeding at least once a day.

During automatic testing, it is not required to open the contacts by performing the test.

NOTE 1 The mechanical parts of the mechanism are verified by the endurance tests and the contacts are verified by the short circuit tests. For that reason these parts are expected to be high reliable and need not to be included in a periodic test.

In case of manual test, the device shall trip.

NOTE 2 Additional requirements and testing procedure for testing the performance manually or automatically are under consideration.

In case a malfunction is detected during automatic testing, the AFDD shall trip and indicate the result.

AFDDs including an RCD function need a test device according to the relevant product standard.

The protective conductor of the installation shall not become live (the touch current and/or the touch voltage shall be limited below the dangerous levels according to IEC 60364 and IEC 60479 series of standards) during the function test.

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For verification, the manufacturer shall provide the necessary documentation of the test function circuit.

8.18 Performance in case of partial loss of supply connections

Three-pole AFDDs and four-pole AFDDs shall also perform as required for series, parallel and earth arc fault when connected as follows:

– for three-pole AFDD, with two phases only;
– for four-pole AFDD: with three phases without neutral, with two phases only, and one phase and neutral.

Compliance is checked by the tests of 9.23.

9 Testing procedure

9.1 General

9.1.1 General testing procedure for the different type of AFDDs

AFDDs classified according to 4.1.1 shall be connected in series with the declared protective device(s) which complies with IEC 60898-1 or IEC 61009-1 or IEC 62423 or IEC 60269, for the testing in 9.11.2.5.

For AFDDs intended to be wired with several protective devices, the testing procedure is applied with the highest values of I^2t and I peak of the protective devices declared by the manufacturer.

The declared protective device(s) shall comply with the type tests of:

– IEC 60898-1 for circuit-breakers;
– IEC 61009-1 or IEC 62423 for RCBOs;
– IEC 60269 series for fuses;

as applicable.

AFDDs classified according to 4.1.2 shall first be tested according to IEC 60898-1, IEC 61008-1, IEC 61009-1, or IEC 62423, as applicable.

After completion of the tests given either in IEC 60898-1, IEC 61008-1, IEC 61009-1, or IEC 62423, the additional tests given in this standard shall be applied in order to show conformity to this standard

In case tests included in this standard were also included in IEC 60898-1, IEC 61008-1, IEC 61009-1, or IEC 62423, the most severe tests among all applicable standards shall be applied only once but the acceptance criteria combines the acceptance criteria of all applicable standard

AFDDs classified according to 4.1.3 shall first be assembled as declared by the manufacturer with the declared protective device(s) (according to manufacturers' instructions) which complies/comply with IEC 60898-1, IEC 61008-1, IEC 61009-1, or IEC 62423, as applicable.

Afterward, the testing procedure given in this standard together with the additional requirements and test given in Annex D shall be applied.

In case of AFDDs intended to be assembled with several protective devices, the testing procedure has to be either repeated with each protective device declared by the manufacturer.

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or the most stringent tests among all applicable standards shall be applied only once but the acceptance criteria combines the acceptance criteria of any applicable standard.

Annex A provides the test sequence and number of samples for testing the AFDDs.

9.1.2 The characteristics of AFDDs are checked by means of type tests

Type tests required by this standard are listed in Table 10:

Table 10 – List of type tests

Test	Subclause
– Indelibility of marking	9.3 [a]
– Reliability of screws, current-carrying parts and connections	9.4 [a]
– Reliability of terminals for external conductors	9.5 [a]
– Protection against electric shock	9.6 [a]
– Dielectric properties	9.7 [a]
– Temperature-rise	9.8
– Operating characteristics	9.9
– Mechanical and electrical endurance	9.10 [a]
– Behaviour under short-circuit conditions	9.11
– Resistance to mechanical shock and impact	9.12 [a]
– Resistance to heat	9.13 [a]
– Resistance to abnormal heat and to fire	9.14 [a]
– Verification of the trip-free mechanism	9.15
– Test of resistance to rusting	9.16
– Verification of limiting values of the non-operating current under overcurrent conditions	9.17
– Behaviour in case of surges caused by impulse voltage	9.18
– Verification of reliability	9.19
– Verification of ageing of electronic components	9.20
– Electromagnetic compatibility	9.21
– Verification of protection due to overvoltage due to a broken neutral in a three phase system	9.22
– Verification of the behaviour in case of partial loss of supply connections	9.23
[a] For AFDDs classified according to 4.1.2, these tests are already covered by the tests according to the relevant standard for RCDs or circuit breakers and need not to be repeated here.	

9.1.3 For certification purposes, type tests are carried out in test sequences.

NOTE The term "certification" denotes either:

– the manufacturer's declaration of conformity; or

– third-party certification, for example by an independent certification body.

The test sequences and the number of samples to be submitted are stated in Annex A.

Unless otherwise specified, each test sequence is made on a new AFDD, the influencing quantities having their normal reference values (see Table 6).

9.1.4 Routine tests to be carried out by the manufacturer on each device

Routine tests of AFDDs are given in Annex E.

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The routine test of the operating characteristics of declared protective devices for AFDDs classified 4.1.2 and 4.1.3 shall be tested according to declared protective device standards IEC 60898-1, IEC 61008-1, IEC 61009-1 or IEC 62423, as applicable.

9.2 Test conditions

The AFDD is mounted individually according to manufacturer's instructions and in free air, at an ambient temperature between 20 °C and 25 °C, unless otherwise specified, and is protected against undue external heating or cooling.

AFDDs designed for installation in individual enclosures are tested in the smallest of such enclosures specified by the manufacturer.

NOTE 1 An individual enclosure is an enclosure designed to accept one device only.

Unless otherwise specified due to the declared protective device, the AFDD is wired with the appropriate cable having the cross-section specified in Table 11 and is fixed on a dull black painted plywood board of not less than 20 mm, the method of fixing shall comply with the requirements relating to the indications of the manufacturer concerning mounting.

Table 11 – Test copper conductors corresponding to the rated currents

Rated current I_n A	$I_n \leq 6$	$6 < I_n \leq 13$	$13 < I_n \leq 20$	$20 < I_n \leq 25$	$25 < I_n \leq 32$	$32 < I_n \leq 50$	$50 < I_n \leq 63$
S mm^2	1	1,5	2,5	4	6	10	16

NOTE 2 For AWG copper conductors, see Annex IC.

Where tolerances are not specified, type tests are carried out at values not less severe than those specified in this standard. Unless otherwise specified, tests are carried out at the rated frequency ± 5 %.

During the tests no maintenance or dismantling of the samples are allowed.

For the tests of 9.8, 9.9, 9.19.3 and 9.20, the AFDD is connected as follows:

– the connections are made by means of single-core, PVC-insulated copper cables;
– the connections are in free air and spaced not less than the distance existing between the terminals;
– the minimum length of each temporary connection from terminal to terminal is:
  - 1 m for cross-sections ≤ 10 mm^2;
  - 2 m for cross-sections > 10 mm^2.

The tightening torques to be applied to the terminal screws are two-thirds of those specified in Table 12.

For AFDDs with dependent manual operation, an operating speed of 0,1 m/s ± 25 % shall be used during actuation for the tests of 9.10 and 9.11. The speed is measured at the extremity when and where the operating means of the test apparatus touches the actuating means of the AFDD under test. For rotary knobs, the angular velocity shall correspond substantially to the above conditions, referred to the speed of the operating means (at its extremities) of the AFDD under test.

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9.3 Test of indelibility of marking

The test is made by rubbing the marking by hand for 15 s with a piece of cotton soaked with water and again for 15 s with a piece of cotton soaked with aliphatic solvent hexane (with a content of aromatics of maximum 0,1 % volume, a kauributanol value of 29, initial boiling point approximately 65 °C, dry point approximately 69 °C and specific gravity of 0,68 g/cm^3).

NOTE Aliphatic solvent hexane having both the main composition required by the standards and CAS No. 110-54-3 is acceptable.

Marking made by impressing, moulding or engraving is not subjected to this test.

After this test, the marking shall be easily legible. The marking shall also remain easily legible after all the tests of this standard.

It shall not be possible to easily remove labels and they shall show no curling.

9.4 Test of reliability of screws, current-carrying parts and connections

Compliance with the requirements of 8.2.4 is checked by inspection and, for screws and nuts which are operated when mounting and connecting the AFDD, by the following test.

The screws or nuts are tightened and loosened:

– 10 times for screws in engagement with a thread of insulating material;
– 5 times in all other cases.

Screws or nuts in engagement with a thread of insulating material are completely removed and reinserted each time.

The test is made by means of a suitable test screwdriver or spanner applying a torque as shown in Table 12.

The screws and nuts shall be tightened in one smooth and continuous motion.

The test is made with rigid conductors only, having the largest cross-sectional areas specified in Table 8, solid or stranded, whichever is the most unfavourable. The conductor is moved each time the screw or nut is loosened.

Table 12 – Screw thread diameters and applied torques

Nominal diameter of thread mm		**Torque** Nm		
Greater than	**Up to and including**	**I**	**II**	**III**
–	2,8	0,2	0,4	0,4
2,8	3,0	0,25	0,5	0,5
3,0	3,2	0,3	0,6	0,6
3,2	3,6	0,4	0,8	0,8
3,6	4,1	0,7	1,2	1,2
4,1	4,7	0,8	1,8	1,8
4,7	5,3	0,8	2,0	2,0
5,3	6,0	1,2	2,5	3,0
6,0	8,0	2,5	3,5	6,0
8,0	10,0	–	4,0	10,0

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Column I applies to screws without heads if the screw, when tightened, does not protrude from the hole, and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

Column II applies to other screws which are tightened by means of a screwdriver.

Column III applies to screws and nuts which are tightened by means other than a screwdriver.

Where a screw has a hexagonal head with a slot for tightening with a screwdriver and the values in columns II and III are different, the test is carried out twice, first applying to the hexagonal head the torque specified in column III and then, on another sample, applying the torque specified in column II by means of a screwdriver. If the values in columns II and III are the same, only the test with the screwdriver is carried out.

During the test, the screwed connections shall not become loose and there shall be no damage, such as breakage of screws or deterioration to the head slots, threads, washers or stirrups, which will impair the further use of the AFDD.

Moreover, enclosures and covers shall not be damaged.

9.5 Test of reliability of terminals for external conductors

9.5.1 The terminals are fitted with copper conductors of the same type (solid, stranded or flexible) of the smallest and largest cross-sections specified in Table 8.

The terminal shall be suitable for all types of conductors: rigid (solid or stranded) and flexible, unless otherwise specified by the manufacturer.

Terminals shall be tested with the minimum and maximum cross-section of each type of conductors on new terminals as follows:

– Tests for solid conductors shall use conductors having cross-sections from 1 mm^2 up to 6 mm^2, as applicable;
– Tests for stranded conductors shall use conductors having cross-sections from 1,5 mm^2 up to 25 mm^2, as applicable;
– Tests for flexible conductors shall use conductors having cross-sections from 1 mm^2 up to 16 mm^2, as applicable.

The conductor is inserted into a new terminal for the minimum distance prescribed or, where no distance is prescribed, until it just projects from the far side, and in the position most likely to assist the wire to escape.

The clamping screws are then tightened with a torque equal to two-thirds of that shown in the appropriate column of Table 12.

Each conductor is then subjected to a pull of the value, in Newton, shown in Table 13, according to the relevant cross-section of the tested conductor.

The pull is applied without jerks, for 1 min, in the direction of the axis of the conductor space.

When it is necessary, the tested values, for the different cross-sections with the relevant pulling force, shall be clearly indicated in the test report.

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Table 13 – Pulling forces

Cross-section of the conductor inserted in the terminal mm^2	1 up to and including 4	Above 4 up to and including 6	Above 6 up to and including 10	Above 10 up to and including 16	Above 16 up to and including 50
Pull N	50	60	80	90	100

During the test, the conductor shall not move noticeably in the terminal.

9.5.2 The terminals are fitted with copper conductors of the smallest and largest cross-sections specified in Table 8, solid or stranded, whichever is the more unfavourable, and the terminal screws are tightened with a torque equal to two-thirds of that shown in the appropriate column of Table 12.

The terminal screws are then loosened and the part of the conductor which may have been affected by the terminal is inspected.

The conductors shall show no undue damage or severed wires.

NOTE Conductors are considered to be unduly damaged if they show deep or sharp indentations.

During the test, terminals shall not become loose and there shall be no damage, such as breakage of screws or damage to the head slots, threads, washers or stirrups, which will impair the further use of the terminal.

9.5.3 The terminals are fitted with the largest cross-section area specified in Table 8, for stranded and/or flexible copper conductors.

Before insertion in the terminal, the strands of the conductor are suitably reshaped.

The conductor is inserted into the terminal until the conductor reaches the bottom of the terminal or just projects from the far side of the terminal and in the position most likely to permit a strand (or strands) to escape. The clamping screw or nut is then tightened with a torque equal to two-thirds of that shown in the appropriate column of Table 12.

After the test, no strand of the conductor shall have escaped outside the retaining device.

9.6 Verification of protection against electric shock

This requirement is applicable to those parts of AFDDs which are exposed to the operator when mounted as for normal use.

The test is made with the standard test finger shown in Figure 3, on the AFDD mounted as for normal use (see note of 8.3) and fitted with conductors of the smallest and largest cross-sections which may be connected to the AFDD.

The standard test finger shall be so designed that each of the jointed sections can be turned through an angle of 90° with respect to the axis of the finger, in the same direction only.

The standard test finger is applied in every possible bending position of a real finger, an electrical contact indicator being used to show contact with live parts.

It is recommended that a lamp be used for the indication of contact and that the voltage be not less than 40 V. The standard test finger shall not touch live parts.

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AFDDs with enclosures or covers of thermoplastic material are subjected to the following additional test, which is carried out at an ambient temperature of 35 °C ± 2 °C, the AFDD being at this temperature.

AFDDs are subjected for 1 min to a force of 75 N, applied through the tip of a straight unjointed test finger of the same dimensions as the standard test finger. This finger is applied to all places where yielding of insulating material could impair the safety of the AFDD, but is not applied to knock-outs.

During this test, enclosures or covers shall not deform to such an extent that live parts can be touched with the unjointed test finger.

Unenclosed AFDDs having parts not intended to be covered by an enclosure are submitted to the test with a metal front panel, and mounted as for normal use.

9.7 Test of dielectric properties

9.7.1 General

AFDDs shall be tested according to the following subclauses.

9.7.2 Resistance to humidity

9.7.2.1 Preparation of the AFDD for test

Parts of the AFDD which can be removed without the aid of a tool are removed and subjected to the humidity treatment with the main part; spring lids are kept open during this treatment.

Inlet openings, if any, are left open; if knock-outs are provided, one of them is opened.

9.7.2.2 Test conditions

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity equal to 93 % ± 5 %.

The temperature of the air in which the sample is placed is maintained within ± 2 °C of any convenient value *T* between 20 °C and 30 °C.

Before being placed in the humidity cabinet, the sample is brought to a temperature between *T* °C and *T* °C + 4 °C.

9.7.2.3 Test procedure

The sample is kept in the cabinet for 48 h.

NOTE An example for obtaining a relative humidity between 91 % and 95 % consists of placing in the humidity cabinet a saturated solution of sodium sulphate (Na_2SO_4) or potassium nitrate (KNO_3) in water having a sufficiently large surface in contact with the air.

In order to achieve the specified conditions within the cabinet, it is recommended to ensure constant circulation of the air within and to use a cabinet which is thermally insulated.

9.7.2.4 Condition of the AFDD after the test

After this treatment, the sample shall show no damage within the meaning of this standard and shall withstand the tests of 9.7.3, 9.7.4, 9.7.5, 9.7.6 and 9.7.7.2 (if applicable).

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9.7.3 Insulation resistance of the main circuit

The AFDD having been treated as specified in 9.7.2 is then removed from the cabinet.

After an interval between 30 min and 60 min following this treatment, the insulation resistance is measured 5 s after application of a d.c. voltage of approximately 500 V, successively as follows:

a) with the AFDD in the open position, between each pair of terminals which are electrically connected together when the AFDD is in the closed position, in turn on each pole;

b) with the AFDD in the closed position, in turn between each pole and the others connected together, electronic components connected between current paths being disconnected for the test;

c) with the AFDD in the closed position, between all poles connected together and the frame, including a metal foil or part in contact with the outer surface of the housing of insulating material but with the terminal areas kept completely free to avoid flashover between terminals and the metal foil;

d) between metal parts of the mechanism and the frame;

NOTE Access to the metal part of the mechanism may be specifically provided for this measurement.

e) for AFDDs with a metal enclosure having an internal lining of insulating material, between the frame and a metal foil in contact with the inner surface of the lining of insulating material, including bushings and similar devices.

Measurements a), b) and c) are carried out after having connected all auxiliary circuits to the frame.

The term "frame" includes:

– all accessible metal parts and a metal foil in contact with the surfaces of insulating material which are accessible after installation as for normal use;

– the surface on which the base of the AFDD is mounted, covered, if necessary, with metal foil;

– screws and other devices for fixing the base to its support;

– screws for fixing covers which have to be removed when mounting the AFDD;

– metal parts of operating means referred to in 8.3.

If the AFDD is provided with a terminal intended for the connection of protective conductors, this is connected to the frame.

For the measurements according to b), c), d) and e), the metal foil is applied in such a way that the sealing compound, if any, is effectively tested.

The insulation resistance shall not be less than:

– 2 MΩ for the measurements according to a) and b);

– 5 MΩ for the other measurements.

9.7.4 Dielectric strength of the main circuit

After the AFDD has passed the tests of 9.7.3, the test voltage specified is applied for 1 min between the parts indicated in 9.7.3, electronic components, if any, being disconnected for the test.

The test voltage shall have a practically sinusoidal waveform, and a frequency between 45 Hz and 65 Hz.

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