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INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

General requirements for arc fault detection devices

Exigences générales des dispositifs pour la détection de défaut d'arcs

IEC 62606:2013-07/AMD1:2017-02(en-fr)

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FOREWORD

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

The text of this amendment is based on the following documents:

FDIS	Report on voting
23E/993/FDIS	23E/1003/RVD

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

The committee has decided that the contents of this amendment and the base publication 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- withdrawn,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
- amended.

1 Scope

Replace the existing first paragraph by the following new first paragraph:

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.

*Replace, in the fourth paragraph, the words "*final circuits*" by "*a final circuit*".*

Delete the eighth and ninth paragraphs.

Add, at the end of this clause, the following new note:

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

2 Normative references

Add the following new references:

IEC 60228, *Conductors of insulated cables*

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 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

3 Terms and definitions

3.2
arc fault
arcing fault

Replace the existing definition by the following new definition:

dangerous unintentional arc

3.4
arc fault detection unit
AFD unit

*Replace, at the end of the note, the reference "*see (4.1.3)*" by "*(see 4.1.3)*".*

4.1 According to the method of construction

4.1.1 *Replace the existing text by the following new text:*

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

4.3 According to the number of poles and current paths

Add to the existing list the following two new dashes:

– Three-pole AFDD;
– Four-pole AFDD.

Delete NOTE 1 and renumber "NOTE 2" *as* "NOTE".

5.3.1 Preferred values of rated voltage (U_n)

Replace the existing text by the following new text:

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.

5.3.3 Preferred values of rated frequency

Replace the heading of 5.3.3 by the following new heading:

5.3.3 Standard values of rated frequency

Replace, in the first paragraph, "Preferred" *by* "Standard".

Delete the second paragraph.

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 AFDDs

Replace the heading of Table 1 by the following new heading:

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

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 for U_n 230 V AFDDs and U_n = 120 V AFDDs

Replace the heading of Table 3 by the following new heading:

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

6.1 Marking

*Replace, in the first sentence of the sixth paragraph, "*c & e*" by "*c and e*".*

*Replace, in the second sentence of the sixth paragraph, "*a, b, d, f & i*" by "*a, b, d, f, i and j*".*

*Replace, in the third sentence of the sixth paragraph, "*the information under h*" by "*the information under i*".*

8.2.3 Clearances and creepage distances (see Annex B)

*Replace, in the third paragraph, "*and arrangements of 9.7.2 items b), c), d) and e)" *by* "and arrangements of 9.7.3 items b), c), d) and e)".

Replace, in the third paragraph, the existing first indent by the following new indent:

– tests according to 9.7.3 to 9.7.6 as applicable;

Replace, in NOTE 1, "9.7.6" *by* "9.7.7.2".

8.17 Performance of the AFD test device

Delete, at the end of the penultimate paragraph, the words "is operated".

Add the following new subclause:

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.

9.1.2 The characteristics of AFDDs are checked by means of tests

Table 10 – List of type tests

Add, at the end of the table, the following new row:

– Verification of the behaviour in case of partial loss of supply connections	9.23	

9.7.2.4 Condition of the AFDD after the test

Replace "9.7.7" *by* "9.7.6".

9.7.3 Insulation resistance of the main circuit

Replace the existing item c) by the following new item c):

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.

9.7.5 Insulation resistance and dielectric strength of auxiliary circuits

Replace the existing item b) by the following new item b):

b) The measurements of the insulation resistance are carried out:
   – between the auxiliary circuits connected to each other and to the frame;
   – between each of the parts of the auxiliary circuits which might be isolated from the other parts in normal service and the whole of the other parts connected together;

at a voltage of approximately 500 V d.c. after this voltage has been applied for 1 min.

The insulation resistance shall be not less than 2 MΩ.

9.7.7.1 General testing procedure for the impulse withstand voltage tests

Replace, in NOTE 1, "9.7.6.2" *by* "9.7.7.2".

9.7.7.2 Verification of clearances with the impulse withstand voltage

Add, in the first line of the first paragraph, "of" *before* "Table 7".

9.8.2 Test procedure

Replace the existing second paragraph by the following two new paragraphs:

For four-pole AFDD, the test is first made by passing the specified current through the three phase poles only.

The test is then repeated by passing the current through the pole intended for the connection of the neutral and the pole adjacent to the neutral.

9.9.1 General

Replace the existing fourth paragraph by the following new paragraph:

For an AFDD having more than one rated frequency, the tests shall be carried out at each rated frequency.

9.9.2.1 General

Add, after the first paragraph, the following new paragraph:

The AFDD being supplied with all phases, the tests shall be performed, if applicable, between one phase, chosen at random and neutral, and between two phases chosen at random.

Replace the existing second paragraph by the following new paragraph:

The tests shall be conducted by connecting a cable specimen (prepared in accordance with 9.9.2.6) in series with the AFDD according to Figure 4 for tests of 9.9.2.2 to 9.9.2.5 and according to Figure 38 for tests of 9.9.2.8 and 9.9.2.9.

Replace the existing third paragraph by the following new paragraph:

The adjustment of the test currents without arcing, in the line where the cable specimen is placed, is achieved by application of the line to neutral voltage reduced by 50 V to take into account the value of the arc voltage during the test. For three-pole AFDD, the mid-point of the resistors in Figure 38 shall be connected directly to the neutral. For tests of 9.9.2.2, and at the rated current only, the adjustment of the test current in the cable specimen without arcing is achieved by application of the rated voltage.

Delete the fourth paragraph.

9.9.2.3 Verification of correct operation in case of inserting load a with a series arc fault

Replace the title of subclause 9.9.2.3 by the following new title:

9.9.2.3 Verification of correct operation in case of inserting a load with series arc fault

9.9.2.5 Test at the temperature limits

Add, at the end of the second dash, the following new text:

For the tripping tests, the flow of rated current may be interrupted, provided that the total interruption period does not exceed 30 s. As soon as the sum of interruption periods exceeds 30 s, the AFDD shall be loaded again with rated current for 5 min before the next tripping time measurement.

9.9.2.6 Preparation of the cable specimens

Replace the existing text of item c) by the following new text:

c) A slit or incision, perpendicular to the cable specimens axis, is to be made in the insulation of the cable approximately half way along the length of the cable so as to expose the conductors without severing any strands.

Replace the existing text of item e) by the following new text:

e) The conductors are to be stripped at one end, approximately 12 mm (or 0,5 in), for connection to the test circuits.

Add the following new subclauses:

9.9.2.8 Verification of correct operation in case of arc in a three-phase system with unbalanced load

This test is applicable for a four-pole AFDD only.

The detection test shall be performed for each pole and neutral separately. Whatever the rated current value, the current in the three phases shall be adjusted at 2,5 A, 5 A and the rated current (see Figure 38), according to 9.9.2.1. The arc test shall be performed on each phase, in turn, at the previously adjusted current.

The test procedure shall be according to 9.9.2.2.

9.9.2.9 Verification of correct operation in case of arc in a three-phase system with balanced load

This test is applicable for a three-pole AFDD and a four-pole AFDD.

The detection test shall be performed for each pole, except the neutral. The load current in each phase shall be adjusted at the lowest arc current value and at the rated current of the AFDD (see Figure 38), according to 9.9.2.1.

The test procedure shall be applied according to 9.9.2.2.

9.9.3.1 Verification of correct operation in case of parallel arc with limited current

Add, after the third paragraph, the following new paragraph:

The AFDD being supplied with all phases, the tests shall be performed between a phase chosen at random and neutral (if any), and between two phases chosen at random, if applicable.

9.9.3.2 Verification of correct operation in case of parallel arc cable cutting test

Add, after the second paragraph, the following new paragraph:

The tests shall be performed between a phase chosen at random and neutral (if any), and between two phases chosen at random, if applicable.

9.9.4.1 General

Add, after the first paragraph, the following new paragraph:

The AFDD being supplied with all phases, the tests shall be performed between a phase chosen at random and neutral (if any), and between two phases chosen at random, if applicable.

9.9.4.2 Masking test with inhibition loads

Add, before the existing first paragraph, the following new paragraph:

This test applies to a single-pole AFDD with two current paths and a two-pole AFDD.

Add, after item b), the following new note:

NOTE 1 THD can be calculated with the formula of IEC 61000-3-2:2014, 3.14.2, for total harmonic distortion

$$THD = \sqrt{\sum_{h=2}^{40}\left(\frac{I_h}{I_1}\right)^2}$$

Replace the existing text of item c) by the following new text:

c) A capacitor start (air compressor type) motor, with a peak inrush current of 130 A ± 10 % for a 120 V rated voltage AFDD, is to be started under load (compressor operating without any air pressure in the air tank) and operated. For a 230 V rated voltage AFDD, a 2,2 kW capacitor start (air compressor type) motor is to be used;

Replace in d) "NOTE" *by* "NOTE 2".

Add, after the sixth paragraph, the following new paragraph:

For selecting the maximum break time in Table 1 or Table 2, the test arc current is the current in the cable specimen without arcing; it is measured by application of the rated voltage reduced by 50 V.

9.9.4.3 Masking test with EMI filter

Replace the existing text of item a) by the following new text:

a) Two EMI filters of 0,22 µF shall be installed. One filter shall be installed at one end of two resistive loads of 15 m (or 50 feet) in length and 2,5 mm^2 (or 12 AWG) in cross-section; the cable shall comply with IEC 60228. Each filter shall be on the end of approximately 2,0 m (or 6 feet) in length and of 1,5 mm^2 (or 16 AWG) in cross-section. The arcing shall be initiated as shown in Figure 12.

Replace the existing text of item b) by the following text:

b) An EMI filter as described in Figure 14 shall be installed at the end of 15 m (or 50 feet), in length and 2,5 mm^2 (or 12 AWG) in cross-section; the cable shall comply with IEC 60228. The filter shall be on the end of 2,0 m (or 6 feet) in length and 1,5 mm^2 (or 16 AWG) in cross-section flexible cable. The AFDD and the arcing shall be located as shown in Figure 13.

Add the following new subclause:

9.9.4.5 Masking test with inhibition loads for three-pole and four-pole AFDDs

A series of tests is performed with inhibition loads according to 9.9.2.9. The AFDD and arc fault tester are connected in the circuit according to Figure 39.

The AFDD shall be tested with each of the following masking loads at AFDD rated voltage and rated frequency:

a) a three-phase asynchronous motor loaded to draw 2,5 A $^{+20}_{0}$ % per AFDD pole for 400 V rated voltage AFDD and 5 A $^{+20}_{0}$ % per AFDD pole for 230 V rated voltage AFDD;

b) a variable speed drive with a three-phase asynchronous motor adjusted in such a way that the voltage applied to the motor is equal to the 80 % of the AFDD rated voltage and the ratio U_n/f^2 remains constant where U_n is the rated voltage and f the rated frequency.

The asynchronous motor consumption shall be adjusted for consuming 2,5 A $^{+20}_{0}$ % per AFDD pole for 400 V rated voltage AFDD and 5 A $^{+20}_{0}$ % per AFDD pole for 230 V rated voltage AFDD.

The switching frequency of the variable speed drive shall be between 10 kHz and 12 kHz.

Systems comprising variable speed drives, motors and cabling, shall be confirmed by the drive supplier to fulfil the requirements regarding the limit of harmonic current emissions as defined in IEC 61000-3-2 for Class A equipments. The AFDD shall clear the arcing fault as specified in Table 1 or Table 2 when using carbonized cable specimen or within 2,5 times the break time in Table 1 or Table 2 when using the arc generator.

9.9.5.1 General

Add, after the existing first paragraph, the following new paragraph:

The AFDD being supplied with all phases, the tests shall be performed between a phase, chosen at random and neutral (if any), and between two phases chosen at random, if applicable.

9.9.5.2 Cross talk test

Replace the existing first paragraph by the following new paragraph:

Two branch circuits installed as close as possible in the same panel are supplied with the same phase and neutral, if any, as described in Figure 16, one with AFDD protection and one without AFDD protection (but with conventional overcurrent protection). Both circuits are connected to a resistive load drawing a current equal to 5 A. For three-pole and four-pole AFDDs, a 3-phase resistive load with 5 A in each phase shall be used.

Replace the existing second paragraph by the following new paragraph:

An arc is initiated with an arc generator (according to 9.9.2.7) or a cable specimen (according to 9.9.2.6) in the circuit without the AFDD, according to the test conditions of 9.9.2.2. The arc conditions shall be sustained for a duration of minimum 0,5 s for 230 V and for 400 V circuits, or a duration of minimum 1 s for a 120 V circuit; the AFDD shall not trip.

9.9.5.4 Test with various disturbing loads

Replace the title by the following new title:

9.9.5.4 Test with various disturbing loads for single-pole AFDD with two current path and two-pole AFDD

R*eplace, in the existing first paragraph*, “9.9.4.1” *by* “9.9.4.2”.

Add the following new subclause:

9.9.5.5 Test with various disturbing loads for three-pole and four-pole AFDDs

The AFDD is tested as in 9.9.4.5 but without the arc fault tester shown in Figure 39.

The AFDD shall be tested with each of the following loads:

a) a three-phase (asynchronous motor) fan consuming, 2,5 A $^{+20}_{0}$ % per AFDD pole for a 400 V rated voltage AFDD and 5 A $^{+20}_{0}$ % per AFDD pole for 230 V rated voltage AFDD;

b) a variable speed drive with a three-phase (asynchronous motor) adjusted in such a way that the voltage applied to the fan is equal to the 80 % of the AFDD rated voltage and the ratio U_n/f^2 remains constant where U_n is the rated voltage and f the rated frequency.

The fan consumption shall be adjusted for consuming, 2,5 A $^{+20}_{0}$ % per AFDD pole for a 400 V rated voltage AFDD and 5 A $^{+20}_{0}$ % per AFDD pole for 230 V rated voltage AFDD.

The switching frequency of the variable speed drive shall be between 10 kHz and 12 kHz.

The variable speed drive shall not be equipped with optional EMC filters.

If an acceleration ramp is used for reaching the voltage applied to the fan, it shall not take more than 5 s.

The loads are energized during at least 10 s. Five Start/Stop operations shall be performed.

The AFDD shall not trip.

9.10.2 Test procedure

Replace the existing third dash of the third paragraph by the following new dash:

– 500, or in the case of no test device 1 000, operating cycles by tripping the AFDD. The tripping means and conditions will be decided between the manufacturer and the laboratory.

9.11.2.2 General conditions for test

Add, in item a), the following new dashes:

– a three-pole AFDD;
– a four-pole AFDD.

Replace, in item a) after the sentence "Z_2, suitably calibrated, is an impedance used to obtain one of the following currents:*", the two existing dashes by the following new dashes:*

– the rated making and breaking capacity on one pole I_{m1};
– the rated conditional short-circuit current on one pole I_{nc1}.

Replace, in the third paragraph of item e), "I_{c1}*" by "*I_{nc1}*".*