

Live working — Voltage detectors —

Part 1: Capacitive type to be used for voltages exceeding 1 kV a.c.

ICS 13.260; 29.240.99

National foreword

This British Standard is the UK implementation of EN 61243-1:2005+A1:2010. It is identical with IEC 61243-1:2003, incorporating amendment 1:2009. It supersedes BS EN 61243-1:2005 which will be withdrawn on 1 December 2012.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to the IEC text carry the number or the amendment. For example, text altered by IEC amendment 1 is indicated in the text by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee PEL/78, Tools for live working.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English version

**Live working –
Voltage detectors
Part 1: Capacitive type to be used for voltages
exceeding 1 kV a.c.
(IEC 61243-1:2003, modified)**

Travaux sous tension –
DéTECTEURS de tension
Partie 1: Type capacitif pour usage
sur des tensions alternatives
de plus de 1 kV
(CEI 61243-1:2003, modifiée)

Arbeiten unter Spannung –
Spannungsprüfer
Teil 1: Kapazitive Ausführung
für Wechselspannungen über 1 kV
(IEC 61243-1:2003, modifiziert)

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CENELEC

European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of the International Standard IEC 61243-1:2003, prepared by IEC TC 78, Live working, together with the common modifications prepared by the Technical Committee CENELEC TC 78, Equipment and tools for live working, was submitted to the formal vote and was approved by CENELEC as EN 61243-1 on 2005-03-01.

This European Standard supersedes EN 61243-1:1997 + A1:1997 + corrigendum June 1999.

The following dates were fixed:

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- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2008-03-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61243-1:2003 was approved by CENELEC as a European Standard with agreed common modifications.

Foreword to amendment A1

The text of document 78/751/CDV, future amendment 1 to IEC 61243-1:2003, prepared by IEC TC 78, Live working, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 61243-1:2005 on 2009-11-17.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

- latest date by which the amendment has to be
implemented at national level by publication of
an identical national standard or by endorsement (dop) 2010-09-01
- latest date by which the national standards conflicting
with the amendment have to be withdrawn (dow) 2012-12-01

As a consequence of endorsing amendment 1:2009 to IEC 61243-1:2003, the common modifications in EN 61243-1:2005 are now covered by the IEC text.

Endorsement notice

The text of amendment 1:2009 to the International Standard IEC 61243-1:2003 was approved by CENELEC as an amendment to the European Standard without any modification.

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INTRODUCTION

This International Standard has been prepared according to the requirements of IEC 61477, where applicable.

LIVE WORKING – VOLTAGE DETECTORS –

Part 1: Capacitive type to be used for voltages exceeding 1 kV a.c.

1 Scope

This part of IEC 61243 is applicable to portable voltage detectors, with or without built-in power sources, to be used on electrical systems for voltages of 1 kV to 765 kV a.c., and frequencies of 50 Hz and/or 60 Hz.

This part applies only to voltage detectors of capacitive type used in contact with the part to be tested, as a complete device including its insulating element or as a separate device, adaptable to an insulating stick which, as a separate tool, is not covered by this standard (see 4.4.1 for general design).

Other types of voltage detectors are not covered by this part of the standard.

Some restrictions on their use are applicable in the case of factory-assembled switchgear and on overhead systems of electrified railways (see Annex B, instructions for use).

NOTE Except where otherwise specified, all the voltages defined in this standard refer to values of phase-to-phase voltages of three-phase systems. In other systems, the applicable phase-to-phase or phase-to-earth (ground) voltages should be used to determine the operating voltage.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-1, *Environmental testing -Part 1: General and guidance*

IEC 60068-2-6:1995, *Environmental testing – Tests – Test Fc and guidance: Vibration (sinusoidal)*

IEC 60068-2-14:1984, *Environmental testing – Tests – Test N: Change of temperature*
Amendment 1 (1986)

IEC 60068-2-32:1975, *Environmental testing – Tests – Test Ed: Free fall*
Amendment 2 (1990)

Ⓐ IEC 60071-1:2006, *Insulation co-ordination – Part 1: Definitions, principles and rules* Ⓐ

IEC 60417-DB:2002¹, *Graphical symbols for use on equipment*

IEC 60942, *Electroacoustics – Sound calibrators*

IEC 61260:1995, *Electroacoustics – Octave-band and fractional-octave-band filters*

▣^{A1} IEC 61318:2007, *Live working – Conformity assessment applicable to tools, devices and equipment* ▣^{A1}

IEC 61477:2001, *Live working – Minimum requirements for the utilization of tools, devices and equipment*
Amendment 1 (2002)²

IEC 61672-1:2002, *Electroacoustics – Sound level meters – Part 1: Specifications*

ISO 286-1:1988, *ISO system of limits and fits – Part 1: Bases of tolerances, deviations and fits*

ISO 286-2:1988, *ISO system of limits and fits – Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*

ISO 3744:1994, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane*

CIE (International Commission on Illumination) 15.2:1986, *Colorimetry*

3 Terms and definitions

▣^{A1} For the purposes of this document, the terms and definitions given in IEC 61318:2007 and the following apply. ▣^{A1}

3.1 voltage detector

▣^{A1} device used to provide clear evidence of the presence or the absence of the operating voltage

NOTE For example, voltage detectors can be described as capacitive type or resistive type.

[Definition 11.2.5 of IEC 60743, modified, and IEC 651-10-04, modified] ▣^{A1}

3.2 voltage detector of capacitive type

device whose operation is based on the current passing through the stray capacitance to earth (ground)

NOTE The term voltage detector is used in this document for voltage detector of capacitive type.

¹ “DB” refers to the IEC on-line database.

² There exists a consolidated edition 1.1 (2002) that includes edition 1 and its amendment.

3.3

designs of voltage detectors

different constructions of voltage detectors, either as a complete device with or without contact electrode extension, or as a separate device intended to be equipped with an insulating stick, with or without contact electrode extension

NOTE Some parts such as the contact electrode, the contact electrode extension (if existing), or the insulating element of a voltage detector as a complete device may be dismantled.

3.4

family of voltage detectors

 for testing purposes, a group of voltage detectors, delimited by a minimum and a maximum rated voltage, that are identical in design (including dimensions) and only differ by their nominal voltages or nominal voltage ranges 

3.5

contact electrode

bare conductive part of the conductive element which establishes the electric connection to the component to be tested

[IEV 651-10-09]

3.6

contact electrode extension

externally insulated conductive element between the indicator and the contact electrode, intended to achieve the correct position of the indicator relative to the installation being tested

3.7

indicator

part of the voltage detector which indicates the presence or absence of the operating voltage at the contact electrode

[IEV 651-10-08, modified]

3.8

adaptor

part of a voltage detector as a separate device which permits attachment of an insulating stick

3.9

insulating element

part of a voltage detector as a complete device that provides adequate safety distance and insulation to the user

3.10

insulating stick

 insulating tool essentially made of an insulating tube and/or rod with end fittings

[Definition 2.5.1 of IEC 60743 and IEV 651-02-01]

NOTE For voltage detection, an insulating stick is intended to be attached to a voltage detector as a separate device in order to provide the length to reach the installation to be tested and adequate safety distance and insulation to the user. 

3.11

limit mark

distinctive location or mark to indicate to the user the physical limit to which the voltage detector may be inserted between live parts or may touch them

3.12

hand guard

distinctive physical guard separating the handle from the insulating element

NOTE Its purpose is to prevent the hands from slipping and passing into contact with the insulating element.

3.13

testing element

built-in or external device, by means of which the functioning of the voltage detector can be checked by the user

[IEV 651-10-11, modified]

3.14

accessories

items used to lengthen the handle or the contact electrode, to improve the efficiency of the contact electrode or to enable the contact electrode to reach the part to be tested

3.15

nominal voltage

U_n

suitable approximate value of voltage used to identify a system or device

[IEV 601-01-21, modified]

NOTE The nominal voltage of the voltage detector is the parameter associated with its clear indication. A voltage detector may have more than one nominal voltage, or a nominal voltage range. Limit values of the nominal voltage range are named U_n min and U_n max.

3.16

operating voltage (in a system)

value of the voltage under normal conditions, at a given instant and a given point of the system

NOTE This value may be expected, estimated or measured.

[IEV 601-01-22]

3.17

threshold voltage

U_t

minimum voltage between the live part and earth (ground) required to give a clear indication corresponding to specific conditions as defined in the corresponding test

NOTE As defined in this part of IEC 61243, threshold voltage is related to specific test conditions. Users should be aware that their requirements for threshold voltage for field operation need to be related to the test conditions in the standard.

3.18

rated voltage

U_r

value of voltage generally agreed upon by manufacturer and customer, to which certain operating specifications are referred. The rated voltage of the voltage detector is the voltage selected from IEC 60071-1, Tables 2 and 3, column 1, which should either be equal to the nominal voltage (or the highest nominal voltage of its nominal voltage range), or the next higher voltage selected from those tables

3.19

interference voltage

voltage picked up inductively or capacitively by the part to be tested

3.20

interference field

superposed electric field which may affect the indication. It may result from the part to be tested or other adjacent parts, and may have any phase relationship

NOTE The extreme cases for the tests are:

- an in-phase interference field exists when a small change of potential in the direction of the voltage detector axis results in an incorrect indication. This occurs as a result of the dimensions and/or configuration of the part of installation to be tested (or of adjacent parts of the installation having voltages in the same phase);
- an interference field in phase opposition exists when a strong change of potential in the direction of the voltage detector axis results in an incorrect indication. This occurs as a result of the adjacent parts of the installation having voltages in phase opposition.

3.21

active signal

audible or visual phenomenon whose presence, absence or variation is considered as representing information on the condition “voltage present” or “voltage not present”

[IEV 101-12-02, modified]

NOTE A signal indicating that the voltage detector is ready to operate is not considered an active signal.

3.22

clear indication

unambiguous detection and indication of the voltage state at the contact electrode

[IEV 651-10-10]

3.23

clear perceptibility

case where the indication is unmistakably discernible by the user under specific environmental conditions when the voltage detector is in its operating position

3.24

response time

time delay between sudden change of the voltage state on the contact electrode and the associated clear indication

3.25

protection against bridging

protection against flashover or breakdown, when the insulation between the parts of installation to be tested, at different potentials, is reduced by the presence of the voltage detector

3.26

stand-by state

state at which the voltage detector is ready to work without manual switching on

3.27

indoor type

voltage detector designed for use in dry conditions, normally indoors

3.28

outdoor type

voltage detector designed for use in wet conditions, either indoors or outdoors

 Text deleted 

3.29

maintenance test

test carried out periodically on a device or equipment to ascertain and, if necessary, make certain adjustments to ensure that its performance remains within specified limits

[IEV 151-16-25 modified]

4 Requirements

4.1 General requirements

4.1.1 Safety

The voltage detector shall be designed and manufactured to be safe for the user, provided it is used in accordance with safe methods of work, and the instructions for use.

4.1.2 Indication

The voltage detector shall give a clear indication of the state "voltage present" and/or "voltage not present", by means of the change of the status of the signal. The indication shall be visual and/or audible.

4.2 Functional requirements

4.2.1 Clear indication

-  The voltage detector shall give an unambiguous indication of the presence and/or the absence of the system operating voltage as a function of the nominal voltage or nominal voltage range of the voltage detector, and its nominal frequency or nominal frequencies.

Indication may not be reliable in the vicinity of large conductive parts that create equipotential zones.

When the voltage detector is used in accordance with instructions for use, the presence of an adjacent live or earthed part shall not affect its indication.

When used in accordance with instructions for use, the voltage detector shall not indicate "voltage present" for usual values of interference voltages.

4.2.1.1 Continuous indication

The voltage detector shall give continuous indication when in direct contact with a live part.

4.2.1.2 Threshold voltage

4.2.1.2.1 General

The user shall not have access to the threshold voltage setting. 

[A1] The indication "voltage present" shall appear if the voltage to earth on the part to be tested is greater than 45 % of the nominal voltage.

NOTE 1 45 % of the nominal voltage corresponds to $0,78 U_n / \sqrt{3}$.

The indication "voltage present" shall not appear if the voltage to earth on the part to be tested is equal to or less than 10 % of the nominal voltage.

NOTE 2 10 % of the nominal voltage corresponds to $0,17 U_n / \sqrt{3}$ and is the maximum phase to earth induced voltage normally encountered in the field.

To fulfil the above requirements, the threshold voltage U_t shall satisfy the following relationship:

$$0,10 U_n \text{ max} < U_t \leq 0,45 U_n \text{ min}$$

For voltage detectors with only one nominal voltage, $U_n \text{ max.}$ equals $U_n \text{ min.}$

NOTE 3 There is a theoretical limit of 4,5 to the ratio between $U_n \text{ max.}$ and $U_n \text{ min.}$ to achieve clear indication of the voltage detector. This value corresponds to the division of 0,45 by 0,1.

NOTE 4 It may happen that the induced voltage level on a specific network is higher than 10 % of the nominal voltage or of the maximum nominal voltage of the range.

It may also happen that the variations of the nominal voltage network are such that the $0,45 U_n$ or $0,45 U_n \text{ max.}$ is not the lowest possible value.

Moreover, when it is expected that the voltage detector will be used in the vicinity of large conductive parts that create equipotential zones (see 4.2.1), the customer may specify a low value of the threshold voltage.

In all these cases, manufacturer and customer should reach an agreement to set the appropriate value for the threshold voltage, while keeping it within the range specified above. The setting of the threshold voltage is further limited by the requirements for clear indication which shorten the range of possible values, and the relevant tests (clear indication) have to be passed.

4.2.1.2.2 Particular case of voltage detectors to be used on networks with low values of interference voltage

In some cases, the customer may wish to take advantage of a network with low values of interference voltage by reducing the lower limit of the threshold voltage below $0,10 U_n \text{ max.}$

NOTE 1 This particular case could help to deal with the use of the voltage detector in the vicinity of large conductive parts. In spite of this change of the threshold voltage for a lower value, the theoretical limit of 4,5 for the ratio between $U_n \text{ max.}$ and $U_n \text{ min.}$ still remains valid, and the relevant tests (clear indication) have to be passed.

In such case, the voltage detector shall have a special marking and a warning shall be included in the instructions for use to inform the users of the modification brought to the threshold voltage.

NOTE 2 The special marking should be the result of an agreement between the manufacturer and the client. **[A1]**

4.2.2 Clear perceptibility

The voltage detector shall give a clear indication under normal light and noise conditions.

The types of indications of voltage detector are divided into three groups:

- group I: Indication with at least two distinct active signals, which give an indication of the condition "voltage present" and "voltage not present". The "stand-by" state is not necessary;
- group II: Indication with at least one active signal, which gives an indication of the condition "voltage not present" and is activated by manually switching "on", and is suppressed when the contact electrode is put into contact with a live part;
- group III: Indication with at least one active signal, which gives an indication of the condition "voltage present", and shall have a stand-by state.

4.2.2.1 Visual indication

The indication shall be clearly visible to the user in the operating position and under normal light conditions.

When two visual signals are used, the indication shall not rely solely on lights of different colours for perceptibility. Additional characteristics, such as physical separation of the light sources, distinctive form of the light signals, or flashing light shall be used.

4.2.2.2 Audible indication

The indication shall be clearly audible to the user when in the operating position, and under normal noise conditions.

When two audible signals are used, the indication shall not rely solely on sounds of different sound pressure level for perceptibility. Additional characteristics, such as tone or intermittence of the audible signals shall be used.

4.2.3 Temperature and humidity dependence of the indication

There are three categories of voltage detectors according to climatic conditions of operation: cold (C), normal (N), and warm (W).

The voltage detector shall operate correctly in the temperature range of its climatic category, according to Table 1.

The voltage detector shall operate correctly in case of sudden change of temperature in the temperature range of its climatic category.

A1 In these cases, the threshold voltage shall satisfy 4.2.1.2. **A1**

Table 1 – Climatic categories

Climatic categories		Climatic conditions ranges (operation and storage)	
		Temperature °C	Humidity %
(C)	Cold	–40 to +55	20 to 96
(N)	Normal	–25 to +55	20 to 96
(W)	Warm	–5 to +70	12 to 96

4.2.4 Frequency dependence

A voltage detector shall operate between 97 % and 103 % of its nominal frequency or of each of its nominal frequencies.

4.2.5 Response time

The response time shall be less than 1 s.

4.2.6 Power source dependability

A voltage detector with a built-in power source shall give a clear indication until the source is exhausted, unless its usage is limited by an indication of non-readiness or automatic shut-off,

as mentioned in the instructions for use.

4.2.7 Testing element

The testing element, whether a built-in or separate item, shall be capable of testing all the electrical circuits, including energy source and the functioning of the indication. When all circuits cannot be tested, any limitation shall be clearly stated in the instructions for use. These circuits shall be constructed with high reliability. When there is a built-in testing element, the voltage detector shall give an indication of "ready" or "not ready".

4.2.8 Non-response to d.c. voltage

The voltage detector shall not respond to a d.c. voltage.

4.2.9 Time rating

The voltage detector shall be able to perform without failure when subjected to the operating voltage for 5 min.

4.3 Electrical requirements

4.3.1 Insulating material

The insulating materials shall be adequately rated (nature of material, dimensions) for the nominal voltage (or the maximum nominal voltage of the voltage range) of the voltage detector.

NOTE When tubes of insulating material with circular cross section are used in the design of voltage detectors, they should meet the requirements of IEC 60855 or IEC 61235.

For a voltage detector as a complete device the user shall be provided with adequate insulation by means of an insulating element.

NOTE For a voltage detector as a separate device, the user should be provided with adequate insulation by means of an adaptable insulating stick.

4.3.2 Protection against bridging

Protection shall be such that the voltage detector cannot cause flashover or breakdown between live parts of an installation or between a live part of an installation and earth.

4.3.3 Resistance against sparking

The voltage detector shall be constructed so that the indicator cannot be damaged or shut off as a result of a low energy electric arc.

4.4 Mechanical requirements

For a voltage detector as a complete device the user shall be provided with adequate distance by means of an insulating element.

NOTE For a voltage detector as a separate device, the user should be provided with adequate distance by means of an adaptable insulating stick.

4.4.1 Design

4.4.1.1 General design

- The voltage detector as a complete device shall include at least the following elements: handle, hand guard, insulating element, limit mark, indicator and contact electrode (see Figure 1a).
- The voltage detector as a separate device shall include at least: adaptor, indicator, and contact electrode (see Figure 1b).

NOTE The insulating stick used in conjunction with the voltage detector as a separate device should fulfil the requirements of 4.3.1 and 4.4.2 even if not provided with the voltage detector.

The voltage detector shall not have any external conductive connection, or any other device to make such connection, except for the contact electrode.

4.4.1.2 Category

- The voltage detector without contact electrode extension shall have category marking L.

NOTE It is used mainly on overhead lines.

- The voltage detector with contact electrode extension shall have category marking S.

NOTE It is mainly used in indoor substations.

4.4.2 Dimensions, construction

The minimum length of the insulating element of a voltage detector as a complete device shall be in accordance with Table 2.

Table 2 – Minimum length of the insulating element (L_i) of a voltage detector as a complete device

U_r kV	L_i mm
$1 < U_r \leq 7,2$	320
$7,2 < U_r \leq 12$	360
$12 < U_r \leq 17,5$	370
$17,5 < U_r \leq 24$	470
$24 < U_r \leq 36$	520
$36 < U_r \leq 72,5$	830
$72,5 < U_r \leq 123$	1 300
$123 < U_r \leq 170$	1 700
$170 < U_r \leq 245$	2 300
$245 < U_r \leq 420$	3 600
$420 < U_r \leq 525$	4 300
$525 < U_r \leq 765$	6 600

NOTE 1 The nominal voltage U_n is used when the parameters to be specified are related to the installation dimensioning or to the functional performance of the voltage detector, while the rated voltage U_r is used when insulation performance of the voltage detector is concerned.

NOTE 2 The L_i values of Table 2 correspond to the minimum distance in air (obtained from Tables 1 and 2 of IEC 61936-1) plus an additional safety distance.

NOTE 3 The L_i values of Table 2 can be used as a guidance to determine the length of the insulating stick used with a voltage detector as a separate device. However, the length of the insulating stick for live working can be shortened for voltage detectors as a separate device taking into account the minimum approach distances or in accordance with national or regional regulations. **A1**

- A1)** For L_i equal to or greater than 520 mm, conductive parts not exceeding 200 mm (in total), measured from the limit mark towards the handle, are allowed within the minimum length of the insulating element if they are completely externally insulated. **A1)**

The limit mark shall be about 20 mm wide, permanent, and clearly recognisable by the user.

If there is no limit mark on a voltage detector as a separate device, the end of the adaptor shall act as the limit mark (Figure 1b).

For a voltage detector as a complete device, the handle shall be at least 115 mm in length.

NOTE The handle may be made longer for two-hand operation.

For a voltage detector as a complete device, the hand guard shall be permanently fixed and have a minimum height (h_{HG}) of 20 mm.

In order to adapt the voltage detector to different uses, the contact electrode readily may be interchangeable or completed with other types of contact electrodes depending on the type of installation and instructions for use.

4.4.3 Grip force and deflection

The voltage detector shall be designed to facilitate reliable operation with reasonable physical effort by the user.

The voltage detector shall be designed to allow a safe approach toward the installation to be tested. The deflection under its own weight shall be as low as possible.

The weight of the indicator shall be minimal and compatible with the performance requirements.

NOTE In case of a voltage detector as a separate device, the user should be aware that its choice of an insulating stick may greatly influence the grip force and deflection.

4.4.4 Vibration resistance

The indicator and the contact electrode extension shall be vibration resistant.

4.4.5 Drop resistance

The voltage detector shall be drop resistant in working conditions.

4.4.6 Shock resistance

The indicator and the contact electrode extension shall withstand mechanical shocks.

4.5 Markings

Each indicator shall have at least the following markings:

- nominal voltage and/or range of nominal voltage;
- indication group;
- A1)** – special marking for low interference voltage, when relevant; **A1)**
- nominal frequency or nominal frequencies;
- name and/or trademark of the manufacturer;
- type reference, serial number;
- indication of type "indoor" or "outdoor";
- indication of category (S or L);
- climatic category (C, N or W);
- year of production;

- symbol IEC 60417–5216(DB:2002-10) – Suitable for live working; double triangle (see Annex A);

NOTE The exact ratio of the height of the figure to the base of the triangle is 1,43. For the purpose of convenience, this ratio can be between the values of 1,4 and 1,5.

- A1** – number of the relevant IEC standard immediately adjacent to the symbol, (IEC 61243-1). **A1**

In addition, the voltage detector shall provide the user or the testing laboratory an area permitting the marking of the date of periodic testing.

In case of a voltage detector with a built-in energy source, the type of power supply shall be indicated, either on the indicator or inside the compartment designed to house it, and the polarity when required.

These markings shall be legible and permanent. The characters shall be at least 3 mm high. The markings shall not impair the quality of the voltage detector.

- A1** To be marked with the number of this IEC standard, the product shall satisfy all the requirements specified herein.

With every voltage detector or with every batch of voltage detectors to be delivered, the manufacturer shall provide information related to the number of the IEC standard with the year of publication. **A1**

4.6 Instructions for use

Each voltage detector shall be accompanied by the manufacturer's instructions for use (see Annex B). These instructions shall be prepared in accordance with the general provisions given in IEC 61477.

5 Specific requirements

5.1 For insulating element of a voltage detector as a complete device

5.1.1 Dielectric strength

The insulating element shall be rated so that no flashover or breakdown occurs in use.

5.1.2 Leakage current

The insulating element of the indoor type voltage detector shall be so rated that leakage current shall be limited under dry conditions.

The insulating element of the outdoor type voltage detector shall be so rated that leakage current shall be limited under dry and wet conditions.

5.2 For indicator casing of voltage detector as a separate device

The indicator casing shall be rated so that no flashover or breakdown occurs in use.

6 Tests

6.1 General

- A1** This standard provides testing provisions to demonstrate compliance of the product to the requirements of Clauses 4 and 5. These testing provisions are primarily intended to be used as type tests for validation of the design input. Where relevant, alternative means (calculation, examination, tests, etc.) are specified within the test subclauses for the purpose of voltage detectors having completed the production phase. **A1**

Tests shall be performed on a voltage detector which has been completely assembled, including the contact electrode extension when required, in accordance with the instructions for use.

When several contact electrodes or contact electrode extensions are used, the following electrical and mechanical tests shall be performed with each contact electrode or contact electrode extension:

- measurement of threshold voltage (see 6.2.1.2),
- influence of in-phase interference field (see 6.2.1.3),
- influence of phase opposition interference field (see 6.2.1.4),
- influence of interference voltage (see 6.2.1.5),
- protection against bridging for indoor/outdoor type voltage detector (see 6.3.1),
- protection against bridging for outdoor type voltage detector (see 6.3.2) and
- spark resistance (see 6.3.3).

If the insulating stick is not provided by the manufacturer (in case of a voltage detector as a separate device), an insulating stick complying with 4.3.1 and 4.4.2 shall be used for the tests.

Atmospheric conditions shall be in accordance with IEC 60068-1.

Except when otherwise stated:

- tests are carried out under the following standard atmospheric conditions:
 - 1) ambient temperature: 15 °C to 35 °C;
 - 2) relative humidity: 25 % to 75 %;
 - 3) atmospheric pressure: 86 kPa to 106 kPa.
- tolerances for dimensions below 3 150 mm shall comply with Js18 level according to ISO 286-1 and ISO 286-2. For larger dimensions, tolerance shall be $\pm 1\%$.

The voltage detector shall be subjected to atmospheric conditions for at least 4 h before being submitted to the group of tests.

6.1.1 Tests under wet conditions

Before the electrical tests, each voltage detector shall be cleaned with isopropanol and then dried in air for 15 min.

The tests shall be conducted in accordance with 9.1 of IEC 60060-1 (standard wet test procedure), with the following exception: the openings in the collecting vessel designed to measure the wetting rate shall be less than, or equal to, the horizontal cross-section of the indicator.

6.1.2 Type test

The type test shall be performed on three complete voltage detectors. Tests shall be performed in the sequence defined in Annex C. If more than one voltage detector does not pass, the test has failed. If only one voltage detector fails, the entire sequence for the type test shall be repeated on three other voltage detectors. If, again, any of the voltage detectors does not pass, the type test is considered to have failed.

In case of voltage detectors of the same family the following applies.

- A1 – The type tests shall be performed at the lowest and at the highest nominal voltages delimiting the family of voltage detectors. Within the limits of the family, bridging tests (6.3.1 and 6.3.2) shall be performed for each distance d_1 of Table 8 under the highest voltage of each voltage range. Mechanical tests shall be done only once covering the worst conditions. A1
- The test for clear indication (see 6.2.1) shall be carried out at each nominal voltage or each nominal voltage range. Each time the test set-up changes within the range of the nominal voltages of the voltage detector the corresponding test shall be carried out.