IEC 61243-1

Edition 2.1 2009-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Live working – Voltage detectors –
Part 1: Capacitive type to be used for voltages exceeding 1 kV a.c.

Travaux sous tension – Détecteurs de tension –
Partie 1: Type capacitif pour usage sur des tensions alternatives de plus de 1 kV

IEC 61243-1:2003+A1:2009

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LIVE WORKING – VOLTAGE DETECTORS –

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

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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International Standard IEC 61243-1 has been prepared by IEC technical committee 78: Live working.

This edition includes the following major technical changes from the previous edition:

a) the Scope has been extended to cover the use on electrical systems for voltages up to 765 kV a.c.;

b) the notion of family of voltage detectors which are identical in terms of design and dimensions and only differ by their nominal voltages (or nominal voltage ranges) has been included;

c) the classification in terms of the setting of the threshold voltage to give a clear indication has been eliminated;

d) a new test set-up with bars has been introduced. Depending on the nominal voltage of the voltage detector, it is required or becomes an alternative test set-up for checking the influence of interference fields, the influence of interference voltages, the protection against bridging and the spark resistance;

e) the revision of specific dielectric tests has been included;

f) some test procedures (clear perceptibility of audible indication, drop resistance, climatic dependence) have been improved and completed.

This consolidated version of IEC 61243-1 consists of the second edition (2003) [documents 78/527/FDIS and 78/537/RVD], its amendment 1 (2009) [documents 78/751/CDV and 78/794/RVC] and its corrigendum of October 2005.

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience.

It bears the edition number 2.1.

A vertical line in the margin shows where the base publication has been modified by amendment 1.

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

IEC 61243 consists of the following parts, under the general title *Live working – Voltage detectors:*

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

Part 2: Resistive type to be used for voltages of 1 kV to 36 kV a.c.

Part 3: Two-pole low-voltage type

Part 5: Voltage detecting systems (VDS)

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the maintenance result 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.

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:2002[1], *Graphical symbols for use on equipment*

IEC 60942, *Electroacoustics – Sound calibrators*

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

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[1] "DB" refers to the IEC on-line database.

IEC 61318:2007, *Live working – Conformity assessment applicable to tools, devices and equipment*

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

For the purposes of this document, the terms and definitions given in IEC 61318:2007 and the following apply.

3.1
voltage detector
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 IEV 651-10-04, modified]

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.

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

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

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

3.33
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.

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 max. equals U_n min.

NOTE 3 There is a theoretical limit of 4,5 to the ratio between U_n max. and U_n 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 max. is not the lowest possible value.

Moreover, when is it 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 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 max. and U_n 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.

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.