



BSI Standards Publication

Live working — Voltage detectors

Part 1: Capacitive type to be used for voltages exceeding 1 kV AC

National foreword

This British Standard is the UK implementation of EN IEC 61243-1:2021. It is identical to IEC 61243-1:2021. It supersedes BS EN 61243-1:2005+A1:2010, which is withdrawn.

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 committee manager.

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Amendments/corrigenda issued since publication

Date	Text affected
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English Version

Live working - Voltage detectors - Part 1: Capacitive type to be
used for voltages exceeding 1 kV AC
(IEC 61243-1:2021)

Travaux sous tension - Détecteurs de tension - Partie 1:
Type capacitif pour usage sur des tensions alternatives de
plus de 1 kV
(IEC 61243-1:2021)

Arbeiten unter Spannung - Spannungsprüfer - Teil 1:
Kapazitive Ausführung für Wechselspannungen über 1 kV
(IEC 61243-1:2021)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 78/1253/CDV, future edition 3 of IEC 61243-1, prepared by IEC/TC 78 "Live working" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61243-1:2021.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2022-02-26
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2024-05-26

This document supersedes EN 61243-1:2005 and all of its amendments and corrigenda (if any).

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

Endorsement notice

The text of the International Standard IEC 61243-1:2021 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60743:2013	NOTE	Harmonized as EN 60743:2013 (not modified)
IEC 60855-1	NOTE	Harmonized as EN 60855-1
IEC 61235	NOTE	Harmonized as EN 61235
IEC 61481 (series)	NOTE	Harmonized as EN 61481 (series)
IEC 61936-1:2010	NOTE	Harmonized as EN 61936-1:2010 (modified)
IEC 61936-1:2010/A1:2014	NOTE	Harmonized as EN 61936-1:2010/A1:2014 (not modified)

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60060-1	2010	High-voltage test techniques - Part 1: General definitions and test requirements	EN 60060-1	2010
IEC 60068-1	-	Environmental testing - Part 1: General and guidance	EN 60068-1	-
IEC 60068-2-6	-	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	-
IEC 60068-2-14	-	Environmental testing - Part 2-14: Tests - Test N: Change of temperature	EN 60068-2-14	-
IEC 60068-2-31	-	Environmental testing - Part 2-31: Tests - Test Ec: Rough handling shocks, primarily for equipment-type specimens	EN 60068-2-31	-
IEC 60068-2-75	-	Environmental testing - Part 2-75: Tests - Test Eh: Hammer tests	EN 60068-2-75	-
IEC 60071-1	2019	Insulation co-ordination - Part 1: Definitions, principles and rules	EN IEC 60071-1	2019
IEC 60417	-	Graphical symbols for use on equipment. Index, survey and compilation of the single sheets.	-	-
IEC 60942	-	Electroacoustics - Sound calibrators	EN IEC 60942	-
IEC 61000-6-2	2016	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments	EN IEC 61000-6-2	2019
IEC 61260	series	Electroacoustics - Octave-band and fractional-octave-band filters	-	-
IEC 61318	-	Live working - Conformity assessment applicable to tools, devices and equipment	EN 61318	-

EN IEC 61243-1:2021 (E)

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61326-1	-	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements	EN IEC 61326-1	-
IEC 61477	-	Live working - Minimum requirements for the utilization of tools, devices and equipment	EN 61477	-
IEC 61672-1	-	Electroacoustics - Sound level meters - Part 1: Specifications	EN 61672-1	-
IEC 62271	series	High-voltage switchgear and controlgear	EN 62271	series
ISO 286-1	-	Geometrical product specifications (GPS) - ISO code system for tolerances on linear sizes - Part 1: Basis of tolerances, deviations and fits	EN ISO 286-1	-
ISO 286-2	-	Geometrical product specifications (GPS) - ISO code system for tolerances on linear sizes - Part 2: Tables of standard tolerance classes and limit deviations for holes and shafts	EN ISO 286-2	-
ISO 3744	2010	Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane	EN ISO 3744	2010
CISPR 11	-	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement	EN 55011	-
CIE 015	-	Colorimetry	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LIVE WORKING – VOLTAGE DETECTORS –

Part 1: Capacitive type to be used for voltages
exceeding 1 kV AC

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 third edition cancels and replaces the second edition published in 2003 and Amendment 1:2009. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) The scope is more precise, stating that only bare contact to the part to be tested is reliable for these contact *voltage detectors*. The rationale is that tests on painted or coated conductors have led to wrong indications, as this non-conductive paint or coat acts as a capacitor with different capacity according to the thickness. This capacity has an effect on the *threshold voltage*.
- b) A *contact probe* is introduced as a new type of non-conductive *contact electrode*.
- c) A new type "*exclusively outdoor type*" has been defined and implemented into the requirements and test procedure.

- d) A *selector* for voltage and frequency is allowed if foreseeable misuse is excluded.
- e) The marking for *voltage detectors* with low *interference voltage* has been made more precise.
- f) The indication groups have been made more precise and requirements and tests for the "*ready to operate state*" and "*stand-by state*" added.
- g) Requirements and tests for electromagnetic compatibility have been implemented.
- h) An example for good electrical connection for the tests is introduced.
- i) A new test set-up with one bar has been added for *voltage detectors* of category L for overhead line configuration.
- j) A dielectric test for tubes and rods has been implemented for those not covered by IEC 60855-1 or IEC 61235.
- k) Old Annex E (mechanical shock test – pendulum method) has been deleted (see IEC 60068-2-75 pendulum method) and replaced by an information and a guideline on the use of the *limit mark* and the *contact electrode extension*.
- l) Annex E and Annex F have swapped places to make it easier for the reader to combine the classification of defects (Annex D) and the rationale for this classification (new Annex E).
- m) A new informative Annex H has been created to give information for further developments of *voltage detectors* due to field experiences.
- n) Editorial changes have been made to harmonize with other new published standards.

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

CDV	Report on voting
78/1253/CDV	78/1294/RVC

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

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

Terms defined in Clause 3 are given in *italic* print throughout this document.

A list of all parts in the IEC 61243 series, published under the general title *Live working – Voltage detectors*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This document 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 AC

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 800 kV AC, and frequencies of 50 Hz and/or 60 Hz.

This document applies only to *voltage detectors* of capacitive type used in contact with the bare 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 document (see 4.4.2.1 for general design).

Other types of *voltage detectors* are not covered by this document.

NOTE Self ranging *voltage detectors* (formally "multi range *voltage detectors*") are not covered by this document.

Some restrictions or formal interdictions on their use are applicable in case of switchgear of IEC 62271 series design, due to insulation coordination, on overhead line systems of electrified railways (see Annex B) and systems without neutral reference. For systems without neutral reference, the insulating level is adapted to the maximum possible voltage to the earth (ground).

Products designed and manufactured according to this document contribute to the safety of users provided they are used by persons trained for the work, in accordance with the hot stick working method and the instructions for use.

Except where otherwise specified, all the voltages defined in this document 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 are used to determine the *operating voltage*.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1:2010, *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, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60071-1:2019, *Insulation co-ordination – Part 1: Definitions, principles and rules*

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

IEC 60942, *Electroacoustics – Sound calibrators*

IEC 61000-6-2:2016 *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61260 (all parts), *Electroacoustics – Octave-band and fractional-octave-band filters*

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

IEC 61326-1, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

IEC 61477, *Live working – Minimum requirements for the utilization of tools, devices and equipment*

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

IEC 62271 (all parts), *High-voltage switchgear and controlgear*

ISO 286-1, *Geometrical product specifications (GPS) – ISO code system for tolerances on linear sizes – Part 1: Basis of tolerances, deviations and fits*

ISO 286-2, *Geometrical product specifications (GPS) – ISO code system for tolerances on linear sizes – Part 2: Tables of standard tolerance classes and limit deviations for holes and shafts*

ISO 3744:2010, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering method for an essentially free field over a reflecting plane*

CISPR 11, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

CIE 015.2, *Colorimetry*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

accessory

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

3.2

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"

Note 1 to entry: A signal indicating that the *voltage detector* is ready to operate is not considered as an *active signal*.

[SOURCE: IEC 60050-101:1998, 101-12-02, modified – The term "signal" has been replaced by "*active signal*". In the definition, "physical" has been replaced by "audible or visual" and "on the condition "voltage present" or "voltage not present"" has been added.]

3.3

adaptor

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

3.4

clear indication

unambiguous detection and indication of the voltage state at the *contact electrode* or *contact probe*

3.5

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

3.6

contact electrode

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

Note 1 to entry: The task of the *contact electrode* is to give the user the feedback that he or she is in touch with the part to be tested.

3.7

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

3.8

contact probe

part which establishes the physical contact with the bare part to be tested

Note 1 to entry: The contact of the *contact probe* with the part to be tested is conductive, all the other part of the *contact probe* is non-conductive.

Note 2 to entry: The *contact probe* with non-conductive part establishes the mechanical positioning of the detector in order to guarantee the contact between the component to be tested and the *contact electrode*.

3.9

design

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*

3.10

exclusively outdoor type

<*voltage detector*> designed for outdoor use exclusively in wet and dry conditions

Note 1 to entry: It is a special type of *voltage detector* designed for outdoor installations when large *contact electrodes* are required.

3.11**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*

3.12**hand guard**

distinctive physical guard separating the handle from the *insulating element*

Note 1 to entry: Its purpose is to prevent the hands from slipping and passing into contact with the *insulating element*.

3.13**indicator**

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

3.14**indoor type**

<*voltage detector*> designed for use in dry conditions, normally indoors

3.15**insulating element**

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

3.16**insulating stick**

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

[SOURCE: IEC 60050-651:2014, 651-22-01]

3.17**interference field**

superposed electric field which may affect the indication

Note 1 to entry: It may result from the part to be tested or other adjacent parts and may have any phase relationship.

Note 2 to entry: The extreme cases for the tests areas follows.

- 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 the 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.

3.18**interference voltage**

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

3.19**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

3.20**maintenance test**

test carried out periodically on a *voltage detector* or parts of it to ascertain and ensure that its performance remains within specified limits, after having made certain adjustments, if necessary

[SOURCE: IEC 60050-151:2001, 151-16-25, modified – In the definition, "an item" is replaced by "a *voltage detector* or parts of it", "to verify" is replaced by "to ascertain and ensure".]

3.21**nominal voltage** U_n

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

Note 1 to entry: The *nominal voltage* of the *voltage detector* is the parameter associated with its *clear indication*.

[SOURCE: IEC 60050-601:1985, 601-01-21, modified – "or device" has been added at the end of the definition.]

3.22**operating voltage**

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

Note 1 to entry: This value is measured (normally), estimated or expected.

[SOURCE: IEC 60050-601:1985, 601-01-22, modified – The domain <in a system> has been added.]

3.23**outdoor type**

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

3.24**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*

3.25**rated voltage** U_r

value of voltage generally agreed upon by manufacturer and customer, to which certain operating specifications are referred

Note 1 to entry: The *rated voltage* of the *voltage detector* is the voltage selected from IEC 60071-1:2019, 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.

3.26**ready to operate state**

state at which the *voltage detector* has been switched on and tested on the live part or external tester, or tested with built-in self-test and gives the ready to operate indication

3.27**response time**

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

3.28

selector

mechanical or electronic switch or means to change the range of the *nominal voltage* and/or the nominal frequency

3.29

stand-by state

permanent state in which the *voltage detector* will indicate "voltage present" automatically when put in contact with operational voltage

3.30

testing element

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

[SOURCE: IEC 60743:2013, 11.3.7, modified – The terms "element" and "diagnostic device" have been deleted.]

3.31

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 1 to entry: As defined in this document, *threshold voltage* is related to specific test conditions. It is important that users are aware that their requirements for *threshold voltage* for field operation need to be related to the test conditions in this document.

3.32

voltage detector

diagnostic device used to provide clear evidence of the presence or absence of an *operating voltage*

Note 1 to entry: These diagnostic devices are generally described as either capacitive type or resistive type.

Note 2 to entry: Clear evidence is a YES or NO indication with no interpretation needed.

Note 3 to entry: According to the performance, in some parts of the world a capacitive type is named unipolar and resistive type is named bipolar.

[SOURCE: IEC 60050-651:2014, 651-24-02, modified – In Note 2 to entry, the second sentence has been deleted. Note 3 to entry has been replaced.]

3.33

voltage detector of capacitive type

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

Note 1 to entry: The term *voltage detector* is used in this document for *voltage detector of capacitive type*.

Note 2 to entry: 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.

4 Requirements

4.1 General requirements

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

4.2.1.1 General

If *voltage detectors* have more than one *nominal voltage* or a *nominal voltage* range, the limiting values are named $U_{n \min}$ and $U_{n \max}$.

The *voltage detector* shall give an unambiguous indication of the presence and/or the absence of any *operating voltages* related to the *nominal voltage* or *nominal voltage* range of the *voltage detector*, and its nominal frequency or nominal frequencies only or almost when in contact with the bare part to be tested.

NOTE 1 A *voltage detector* can indicate the presence of voltage just before touching a bare part to be tested. The distance for which a *voltage detector* is able to indicate the presence of voltage depends, among various parameters, on the *operating voltage* and on the configuration of the installation.

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 (grounded) part shall not affect its indication of in-phase or phase opposition situation.

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

NOTE 2 Annex H presents some information for the next maintenance of this document.

4.2.1.2 Continuous indication

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

4.2.1.3 Threshold voltage

4.2.1.3.1 General

The indication "voltage present" shall appear if the voltage to earth (ground) on the part to be tested is greater than 45 % of the *nominal voltage*.

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

The indication "voltage present" shall not appear if the voltage to earth (ground) 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 $0,17U_n / \sqrt{3}$ and is the maximum phase to earth (ground) induced voltage normally encountered in the field.

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

$$0,10 U_{n \max} < U_t \leq 0,45 U_{n \min}$$

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 In some cases 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. In this case, a special marking is the result of an agreement between the manufacturer and the client to identify the compatible devices

In some cases the variations of the nominal voltage network are such that $0,45 U_n$ or $0,45 U_{n \min}$ 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), customers can agree with the manufacturer on a low value of the *threshold voltage*.

In all these cases, an agreement is necessary between manufacturer and customer to set the appropriate value for the *threshold voltage*, while keeping the ratio of $U_{n \max}$ and $U_{n \min}$ below or equal to 4,5. The setting of the *threshold voltage* is further limited by the requirements and tests for *clear indication* which shorten the range of possible values.

4.2.1.3.2 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 $0,10 U_{n \max}$.

This particular case allows the application of the *voltage detector* in the vicinity of large conductive parts. Changing the *threshold voltage* to a lower value, the theoretical limit of 4,5 for the ratio between $U_{n \max}$ and adapted $U_{n \min}$ still remains valid, and the relevant tests (*clear indication*) shall be passed, with adapted lower value of the *threshold voltage* for the *interference voltage* test.

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*.

4.2.1.3.3 Indication on overhead lines

Voltage detectors of category L (see 4.4.2.2) shall give a *clear indication* on overhead lines and fulfil the requirement of 4.2.1.3.1.

NOTE This additional test assures, that *voltage detectors* of category L will give a *clear indication* on overhead lines except when they are used in equipotential zones. *Voltage detectors* of category S (see 4.4.2.2) do not have these problems due to the *contact electrode extension*.

4.2.1.3.4 Settings

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

A *selector* (possible for voltage and frequency, see 3.28) is allowed, but for each position of the *selector* the user shall not have access to any *threshold voltage* settings.

If the *voltage detector* has a *selector*, the theoretical limit of 4,5 for the ratio between $U_{n \max}$ and $U_{n \min}$ is valid for each position of the *selector*.

4.2.2 Clear perceptibility

4.2.2.1 General

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 (see also Table 1).

- Group I: Indication with at least two distinct *active signals*, which give an indication of the condition "voltage present" and "voltage not present". The ready to operate indication is given by the *active signal* "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* or *contact probe* 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". A ready to operate indication shall be available and shall have a *stand-by state*.

The *ready to operate state* is the situation in which the detector will be able to pass all the tests of the functional requirements.

"Passive" *voltage detectors* without a built-in energy source are included in group III, because the "ready to operate indication" is the performed test on operational voltage with an *active signal* before and after the voltage detection.

Table 1 – Indication group

Group	Active indication of "voltage present"	Active indication of "voltage not present"	"Ready to operate" indication
I	X	X	
II	–	X	
III	X	–	X

4.2.2.2 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.

4.2.2.3 Audible indication

The indication shall be clearly audible to the user 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 2.

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

In these cases, the *threshold voltage* shall satisfy 4.2.1.3.1.

Table 2 – 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 device, 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 to operate", if the self-test was successfully passed. Any indication of a failure shall be described in the instructions for use.

4.2.8 Non-response to DC voltage

The *voltage detector* shall not respond to a DC voltage.

The AC detector shall reject DC voltage in order to be able to apply portable earthing equipment on the remaining capacitive load.

4.2.9 Time rating

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

4.2.10 Electromagnetic compatibility (EMC)

Voltage detectors shall comply with the requirements according to IEC 61000-6-2.

NOTE In some countries additional requirements are mandatory to fulfil EMC regulations.

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 1 When tubes of insulating material with circular cross section are used in the design of *voltage detectors*, this requirement is fulfilled by meeting the requirements of IEC 60855-1 or IEC 61235 or the requirements of 5.1 for voltage detectors as a complete device.

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

NOTE 2 For a *voltage detector* as a separate device, the user is 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 (ground).

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

4.4.1 General

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 is provided with adequate distance by means of an adaptable *insulating stick*.

4.4.2 Design

4.4.2.1 General design

- a) 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).

For 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, dismantling is allowed.

- b) The *voltage detector* as a separate device shall include at least the following elements: *adaptor*, *indicator*, and *contact electrode* or *contact probe* (see Figure 1b).

The *insulating stick* used in conjunction with the *voltage detector* as a separate device shall fulfil the requirements of 4.3.1 and 4.4.3 even if not provided with the *voltage detector*.

Voltage detectors are designed for indoor use (see 3.14), for outdoor use (see 3.23) or exclusively outdoor use (see 3.10).

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

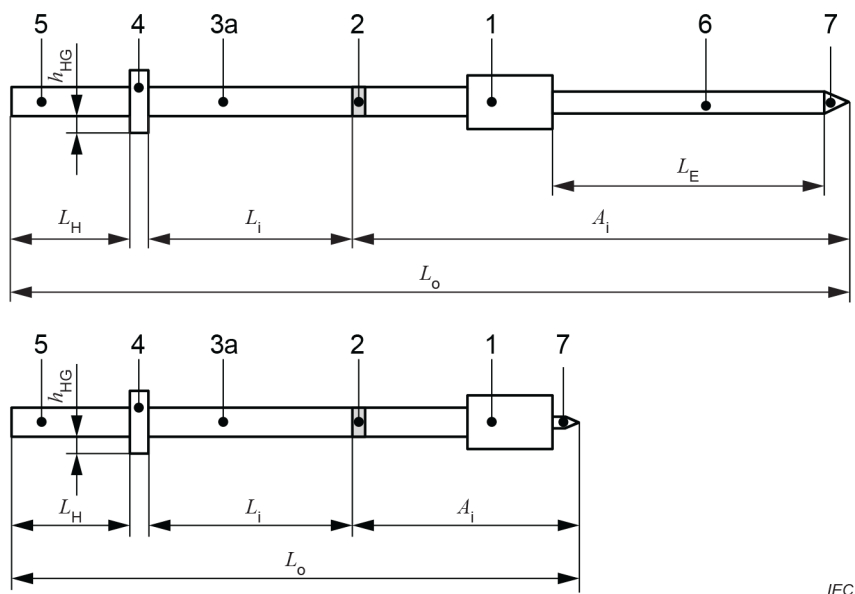
4.4.2.2 Category

- The *voltage detector* without *contact electrode extension* shall have category marking L.
- The *voltage detector* with *contact electrode extension* shall have category marking S. The length of the *contact electrode extension* shall be at least a_e according to Figure 3a.

NOTE *Voltage detectors* of category S can also be applied for category L use.

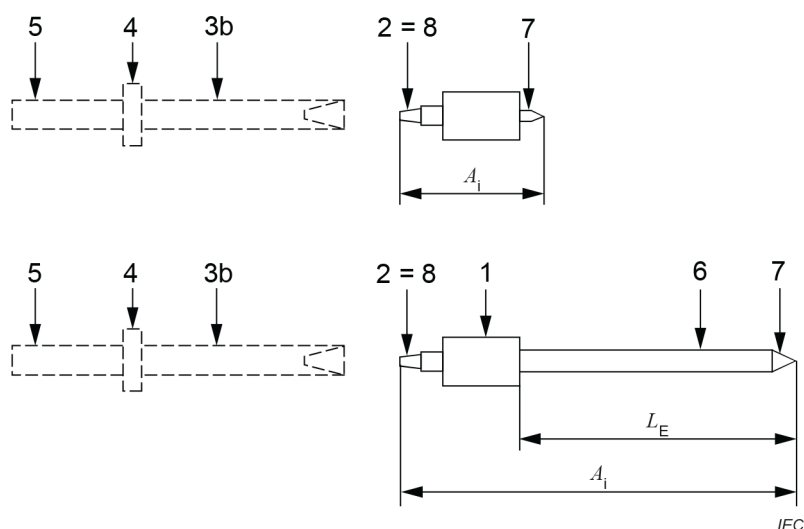
4.4.3 Dimensions, construction

The minimum length of the *insulating element* of a *voltage detector* as a complete device shall be in accordance with Table 3.



IEC

Figure 1a – Voltage detector as a complete device (including its insulating element)



IEC

Figure 1b – Voltage detector as a separate device (with an adaptable insulating stick)

Key

1	Indicator	h_{HG}	Height of <i>hand guard</i>
2	Limit mark	L_H	Length of <i>handle</i>
3a	Insulating element	L_i	Length of <i>insulating element</i>
3b	Adaptable insulating stick	L_E	Length of <i>contact electrode extension</i>
4	Hand guard	L_o	Overall length of <i>voltage detector</i>
5	Handle	A_i	Insertion depth (length)
6	Contact electrode extension		
7	Contact electrode or contact probe		
8	Adaptor		

Figure 1 – Examples of designs of voltage detectors of capacitive type

Table 3 – 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
$420 < U_r \leq 550$	4 300
$550 < U_r \leq 800$	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 3 correspond to the minimum distance in air (obtained from Tables 1 and 2 of IEC 61936-1:2010 and IEC 61936-1:2010/AMD1:2014) plus an additional safety distance.

NOTE 3 The L_i values of Table 3 are 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.

In the case of a *voltage detector* as a complete device and for L_i equal to or greater than 520 mm, conductive parts are allowed within the minimum length of the *insulating element*, if they are completely externally insulated and are located immediately adjacent to the *limit mark*, in one section of the *insulating element* not exceeding 200 mm.

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* to be fixed to the adaptable stick 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 4 It is possible to make the handle 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* may be readily interchangeable or supplemented with other types of *contact electrodes* depending on the type of installation and instructions for use.