IEC 61481-2

Edition 1.0 2014-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Live working – Phase comparators –
Part 2: Resistive type to be used for voltages from 1 kV to 36 kV a.c.

Travaux sous tension – Comparateurs de phase –
Partie 2: Type résistif pour usage sur des tensions alternatives de 1 kV à 36 kV

IEC 61481-2:2014-10(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX XC

ICS 13.260; 29.240.20; 29.260.99

ISBN 978-2-8322-1878-5

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 61481-2 has been prepared by IEC technical committee 78: Live working.

This first edition, together with the first edition of IEC 61481-1, cancels and replaces the first edition of IEC 61481 published in 2001, Amendment 1:2002 and Amendment 2:2004. This edition constitutes a technical revision.

The major changes are:

- split of the standard in two parts;
- review of the requirements for indication;
- elimination of class C (±110°);
- introduction of a requirement for a new marking "LU" for limited use;
- increase of the specified range of voltage fluctuation in a network for clear indication;

- clarification of the design requirements by specifying a resistive element in each pole of the device;
- clarification of the test procedures in the case of additional contact electrodes, accessories and combination of accessories, as well as in the case of family of phase comparators;
- addition of requirements and tests for electromagnetic compatibility (EMC);
- clarification of the test provisions for the function tests;
- clarification of the test procedure for clear perceptibility of audible indication;
- preparation of the elements of evaluation of defects, and general application of IEC 61318:2007;
- revision of existing annexes;
- change of existing normative Annex C in two new Annexes D and F giving the classification of defects (normative) and the rationale for the classification of defects (informative);
- deletion of existing Annex D, not needed anymore following the specification of IEC 60068-2-75;
- deletion of existing Annex F, not applicable according to IEC 61318:2007;
- addition of a new informative Annex E giving additional information on the use of the limit mark and of a contact electrode extension.

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

FDIS	Report on voting
78/1052/FDIS	78/1088/RVD

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

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

In this standard terms defined in Clause 3 appear in *italics*.

A list of all parts of the IEC 61481 series, published under the general title *Live working – Phase comparators,* can be found on the IEC website.

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

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

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INTRODUCTION

This International Standard has been prepared in accordance with the requirements of IEC 61477.

Taking into consideration the functioning principle of portable *phase comparator*s *of resistive type* available on the market, the associated maximum a.c. *nominal voltage* is 36 kV.

The rationale for this maximum *nominal voltage* is:

- design of the *phase comparator* for operation by one person (see 4.4.2) – ergonomic consideration.

  With higher *nominal voltages*, the distance between phases of the installation increases and the positioning of the two poles of the *phase comparator* by one person becomes a limitation;
- correct performance of each component (including the connecting lead) under normal working conditions – performance consideration;
- possible contact of the connecting lead between the two poles of the *phase comparator* with a part of the installation at a phase or earth potential under normal working conditions.

The product covered by this standard may have an impact on the environment during some or all stages of its life cycle. These impacts can range from slight to significant, be short-term or long-term, and occur at the global, regional or local level.

In terms of environmental improvement, this standard includes neither requirements nor test provisions for the manufacturers of the product nor recommendations to the users of the product. However, all parties intervening in its design, manufacture, packaging, distribution, use, maintenance, repair, reuse, recovery and disposal are invited to take account of environmental considerations.

LIVE WORKING – PHASE COMPARATORS –

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

1 Scope

This part of IEC 61481 is applicable to portable *phase comparator*s of resistive type to be used on electrical systems for voltages from 1 kV a.c. to 36 kV a.c. and frequencies of 50 Hz and/or 60 Hz.

This standard is applicable to *phase comparators of resistive type* used in contact with the bare conductive parts to be compared:

- 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.

NOTE Some parts such as the *contact electrode* or the *insulating element* of a *phase comparator* as a complete device may be dismantled.

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

A device that is designed to provide other functions than phase comparison is a different device and is not covered by this standard. For example a device designed to be also used as a voltage detector is not covered by this standard (see Annex A).

Products designed and manufactured according to this standard contribute to the safety of the 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 when otherwise specified, all the voltages defined in this standard refer to 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 documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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 60417, *Graphical symbols for use on equipment.* Available from: http://www.graphical-symbols.info/equipment

IEC 60942, *Electroacoustics – Sound calibrators*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61260, *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*

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*

CIE 15, *Colorimetry*

3 Terms and definitions

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

3.1
accessory
supplementary item not necessary for the functioning of the *phase comparator* and provided by the manufacturer to facilitate its use under certain operating conditions

Note 1 to entry: An *accessory* is not considered as a part of a device. Without the *accessory*, the device is still functional. An item that is required each time a device is used is not an *accessory* but a part of the device which may be disassembled.

Note 2 to entry: For example an *accessory* is used to lengthen the handle, to improve the efficiency of the *contact electrode*, to enable the *contact electrode* to reach the parts to be compared, etc.

3.2
active signal
visual phenomenon, and optionally audible phenomenon, whose presence, absence or variation is considered as representing information on the condition “correct phase relationship” or “incorrect phase relationship”

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

[SOURCE: IEC 60050-101:1998, 101-12-02, modified – the definition of “signal” has been modified to fit the specific context of diagnostic of phase relationship and Note 1 to entry has been added.]

3.3
adaptor
part of a *phase comparator* as a separate device which permits attachment of an *insulating stick*

3.4
clear indication
unambiguous detection and indication of “incorrect phase relationship” and/or “correct phase relationship” between the parts to be compared

3.5
clear perceptibility
case when the indication is unmistakably discernible by the user under specific environmental conditions when the *phase comparator* is in its operating position

3.6
connecting lead
flexible cable electrically connecting the two poles of a *phase comparator of resistive type*

3.7
contact electrode
bare conductive part of the *phase comparator* which establishes the electric connection to the part to be compared

3.8
contact electrode extension
externally insulated conductive part to enable the *contact electrode* to reach the parts of the installation to be compared

Note 1 to entry: For a certain installation configuration, the *contact electrode extension* is used to increase the *insertion depth* (see Figure 1).

Note 2 to entry: The *contact electrode extension* is an *accessory* of the *phase comparator*.

3.9
end fittings
part of an *insulating stick* permanently fitted to the end of an insulating tube or rod

3.10
family of phase comparators
for testing purposes, a group of *phase comparators*, delimited by a minimum and a maximum *rated voltage* and/or by the two frequencies (50 Hz and 60 Hz), that are identical in design (including dimensions) and only differ by their *nominal voltages* or *nominal voltage* ranges and/or their nominal frequency

3.11
hand guard
distinctive physical guard separating the handle of a *phase comparator* as a complete device from its *insulating element*

Note 1 to entry: The purpose of a *hand guard* is to prevent the hands from slipping and passing into contact with the *insulating element*.

3.12
indicator
part of the *phase comparator* that indicates the status of the phase relationship between two parts to be compared

3.13
indoor type
phase comparator designed for use in dry conditions, normally indoors

3.14
insertion depth
A_i
distance between the *limit mark* and the top of the *contact electrode* for a *phase comparator* as a complete device

3.15
insulating element
part of a *phase comparator* as a complete device that provides adequate safety distance and insulation to the user

3.16
insulating stick
insulating tool made essentially of an insulating tube and/or rod with *end fittings*

Note 1 to entry: For phase comparison, an *insulating stick* is intended to be attached to a *phase comparator* 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.

[SOURCE: IEC 60050-651:2014, 651-22-01, modified – the Note 1 to entry has been added.]

3.17
interference field
superposed electric field which may affect the indication

Note 1 to entry: The *interference field* may result from the parts to be compared or other adjacent parts, and may have any phase relationship.

Note 2 to entry: The extreme cases for the tests are:

– an in-phase *interference field*. This occurs as a result of the dimensions and/or configuration of the parts of the installation to be compared or of adjacent parts of the installation having voltages in the same phase as the parts to be compared;

– an *interference field* in phase opposition. This occurs as a result of the adjacent parts of the installation having voltages in phase opposition to the parts to be compared.

3.18
limit mark
distinctive location or mark to indicate to the user the physical limit to which the *phase comparator* may be inserted between live parts or may touch them

3.19
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

[SOURCE: IEC 60050-151:2001, 151-16-25, modified – the definition has been modified to fit the specific context of maintenance of device or equipment.]

3.20
nominal voltage
U_n
suitable approximate value of voltage used to identify a system or device

Note 1 to entry: The *nominal voltage* of the *phase comparator* is a parameter associated with its *clear indication*. When a *phase comparator* has more than one *nominal voltage*, or a *nominal voltage* range the limit values of the *nominal voltage* range are named $U_{n\ min}$ and $U_{n\ max}$.

[SOURCE: IEC 600500-601:1985, 601-01-21, modified – the definition has been modified to fit the specific context of device or equipment and Note 1 to entry has been added.]

3.21
outdoor type
phase comparator designed for use in wet conditions, either indoors or outdoors

3.22
phase comparator
portable device used to provide clear evidence of the presence or the absence of the correct phase relationship between two energized parts at the same *nominal voltage* and frequency

[SOURCE: IEC 60050-651:2014, 651-24-03, modified – the definition has been modified to specify that the device herein defined is a portable device.]

3.23
phase comparator of resistive type
resistive phase comparator
device whose operation is based on the current passing through a resistor located in the *resistive element*

Note 1 to entry: *Phase comparators* of resistive type are always two-pole *phase comparators* and have a *connecting lead*.

Note 2 to entry: *Phase comparators* of resistive type mainly work on the basis of voltage measurement (voltage-based).

3.24
protection against bridging
protection against flashover or breakdown, when the insulation between the parts of the installation, at different potentials, is reduced by the presence of the *phase comparator*

3.25
rated voltage
U_r
value of voltage to which certain operating specifications are referred

Note 1 to entry: The *rated voltage* of the *phase comparator* is the voltage selected from IEC 60071-1:2006, Table 2, 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 that table.