

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2014 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 14 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 55 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 14 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

Plus de 55 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.



IEC 61481-2

Edition 1.0 2014-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

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

Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references	9
3 Terms and definitions	10
4 Requirements	14
4.1 Indication	14
4.2 Functional requirements.....	14
4.2.1 Clear indication	14
4.2.2 Clear perceptibility.....	16
4.2.3 Temperature and humidity dependence of the indication.....	16
4.2.4 Frequency dependence	16
4.2.5 Response time.....	17
4.2.6 Power source dependability	17
4.2.7 Testing element.....	17
4.2.8 Time rating	17
4.3 Electrical requirements	17
4.3.1 Insulating material.....	17
4.3.2 Protection against bridging	17
4.3.3 Resistance against sparking	17
4.3.4 Resistive element	18
4.3.5 Insulating element of phase comparator as a complete device.....	18
4.3.6 Circuit current.....	18
4.3.7 Indicator casing	18
4.3.8 Insulation of the connecting lead	18
4.4 Mechanical requirements	18
4.4.1 General	18
4.4.2 Design	18
4.4.3 Dimensions, construction.....	20
4.4.4 Grip force and deflection	21
4.4.5 Vibration resistance	22
4.4.6 Drop resistance	22
4.4.7 Shock resistance	22
4.5 Marking.....	22
4.6 Instructions for use	22
4.7 Requirements in the case of reasonably foreseeable misuse during live working.....	23
4.7.1 Voltage selection	23
4.7.2 Frequency selection	23
5 Tests	23
5.1 General.....	23
5.1.1 Testing provisions	23
5.1.2 Atmospheric conditions.....	23
5.1.3 Tests under wet conditions	23
5.1.4 Type test	24
5.1.5 Test methods.....	25

5.2	Function tests	25
5.2.1	Description of the test set-up and general pass criteria.....	25
5.2.2	Clear indication	31
5.2.3	Electromagnetic compatibility (EMC)	33
5.2.4	Influence of electric interference fields.....	33
5.2.5	Clear perceptibility.....	36
5.2.6	Frequency dependence	40
5.2.7	Response time.....	40
5.2.8	Power source dependability	40
5.2.9	Check of testing element	41
5.2.10	Time rating	41
5.3	Dielectric tests	42
5.3.1	Insulating material for tubes and rods	42
5.3.2	Protection against bridging for indoor/outdoor type phase comparator	42
5.3.3	Protection against bridging for outdoor type phase comparator	47
5.3.4	Spark resistance.....	48
5.3.5	Leakage current for phase comparator as a complete device	49
5.3.6	Dielectric strength of connecting lead	52
5.3.7	Maximum current in case of misuse	53
5.4	Mechanical tests	53
5.4.1	Visual and dimensional inspection	53
5.4.2	Grip force and deflection for phase comparator as a complete device	54
5.4.3	Robustness of connecting lead and connections	54
5.4.4	Vibration resistance	56
5.4.5	Drop resistance	56
5.4.6	Shock resistance	57
5.4.7	Climatic resistance	58
5.4.8	Durability of markings	59
5.5	Test for reasonably foreseeable misuse during live working	59
5.5.1	Voltage selection (where relevant).....	59
5.5.2	Frequency selection (where relevant)	59
6	Conformity assessment of phase comparators having completed the production phase	60
7	Modifications	60
	Annex A (normative) Instructions for use	61
	Annex B (normative) Suitable for live working; double triangle (IEC 60417 – 5216 (2002-10)).....	63
	Annex C (normative) Chronology of type tests	64
	Annex D (normative) Classification of defects and tests to be allocated	66
	Annex E (informative) Information and guidelines on the use of the limit mark and of a contact electrode extension	68
	E.1 General.....	68
	E.2 Situation when using a phase comparator as a complete device	68
	E.3 Situation when using a phase comparator as a separate device.....	71
	Annex F (informative) Rationale for the classification of defects.....	74
	Annex G (informative) In-service care	76
	Bibliography.....	77

Figure 1 – Illustration of different elements of a phase comparator	20
Figure 2 – Location of allowed conductive parts within the minimum length of the insulating element of a pole of a phase comparator as a complete device.....	21
Figure 3 – Test set-up for clear indication with the ball electrode in front of its ring electrode	27
Figure 4 – Test set-up for clear indication with the ball electrode behind its ring electrode	28
Figure 5 – Example of positioning of a pole of the phase comparator in relation to a ball and ring test arrangement	30
Figure 6 – Examples of suitable means for ensuring appropriate contact between a contact electrode and the ball electrode.....	30
Figure 7 – Test set-up for clear perceptibility of visual indication	37
Figure 8 – Test set-up for clear perceptibility of audible indication	39
Figure 9 – Test arrangements and dimensions of the bars for protection against bridging	43
Figure 10 – Electrical connection of the bars	44
Figure 11 – Surface stress test	44
Figure 12 – Radial and surface stress test	45
Figure 13 – Bridging test on the connecting lead.....	46
Figure 14 – Test arrangement for testing bridging protection of outdoor type phase comparator	48
Figure 15 – Arrangement for leakage current test under dry conditions for phase comparator as a complete device.....	50
Figure 16 – Arrangement for leakage current tests under wet conditions for phase comparator as a complete device.....	51
Figure 17 – Test set up for pressure load application.....	52
Figure 18 – Test for grip force.....	54
Figure 19 – Test set-up for the robustness of connecting lead and connections	55
Figure 20 – Drop resistance test – Diagonal position	57
Figure 21 – Curve of test cycle for climatic resistance.....	58
Figure E.1 – Insulation element of a pole of a phase comparator as a complete device	68
Figure E.2 – Example of positioning of a pole of a phase comparator in contact with a live part without obstacles from other live parts.....	69
Figure E.3 – Example of incorrect positioning of a pole of a phase comparator with the limit mark between two live parts	70
Figure E.4 – Usual ways of managing the selection or the use of the phase comparator for maintaining the insulation distance between the limit mark and the hand guard	71
Figure E.5 – Usual ways of managing the use of the phase comparator as a separate device for assuring the appropriate insulation for the worker.....	73
Table 1 – Climatic condition ranges	16
Table 2 – Minimum length of the insulating element (L_i) of a phase comparator as a complete device.....	20
Table 3 – Dimensioning of the ball and ring test set-up	29
Table 4 – Test series and conditions for clear indication	32
Table 5 – Test series and conditions for influence of electric interference fields.....	35
Table 6 – Distance d_1 for the bridging test set-up	43

Table 7 – Dimensions for the concentric rings and band electrodes	47
Table C.1 – Sequential order for performing type tests ^a	64
Table C.2 – Type tests out of sequence	65
Table D.1 – Classification of defects and associated requirements and tests	66
Table E.1 – Recommended minimum lengths from the limit mark to the contact electrode (A_i)	71
Table F.1 – Rationale for the classification of defects	74
Table G.1 – In-service testing	76

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

IEC 61481-2:2014

<https://standards.iteh.ai/catalog/standards/sist/04270c61-5d50-478a-9c08-2c57a33a2818/iec-61481-2-2014>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**LIVE WORKING –
PHASE COMPARATORS –**
Part 2: Resistive type to be used for voltages from 1 kV to 36 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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 ($\pm 110^\circ$);
- 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

<https://standards.iteh.ai/catalog/standards/sist/04270c61-5d50-478a-9c08-2c57a33a2818/iec-61481-2-2014>

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.

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

Taking into consideration the functioning principle of portable *phase comparators 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 comparators* 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 60050-601:1985, 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.