

INTERNATIONAL STANDARD

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**Electrical safety in low voltage distribution systems up to 1 000 V AC and
1 500 V DC – Equipment for testing, measuring or monitoring of protective
measures –**

Part 7: Phase sequence

IEC 61557-7:2019

**Sécurité électrique dans les réseaux de distribution basse tension au plus égale
à 1 000 V en courant alternatif et 1 500 V en courant continu – Dispositifs de
contrôle, de mesure ou de surveillance de mesures de protection –**

Partie 7: Ordre de phases



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES –

Part 7: Phase sequence

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IEC 61557-7 edition 3.1 contains the third edition (201-07) [documents 85/683/FDIS and 85/698/RVD] and its amendment 1 (2023-08) [documents 85/872/FDIS and 85/882/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 61557-7 has been prepared by IEC technical committee 85: Measuring equipment for electrical and electromagnetic quantities.

This third edition constitutes a technical revision.

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

- a) alignment of the structure with that of the whole IEC 61557 series;
- b) updated requirements in 4.3 in accordance with new editions of IEC 61010-1 and IEC 61010-031;
- c) the information on markings was extended;
- d) the information on the operating instructions was extended;
- e) complement to the information on the testing of leads;
- f) test leads for insulated conductors were introduced;
- g) Annex B was added with information on phase sequence tests and indications.

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

This International Standard is to be used in conjunction with IEC 61557-1:2019.

A list of all parts of the IEC 61557 series, published under the general title *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures*, can be found on the IEC website

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ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES –

Part 7: Phase sequence

1 Scope

This part of IEC 61557 specifies the requirements applicable to measuring equipment for testing the phase sequence in three-phase distribution systems. Indication of the phase sequence can be mechanical, visual and/or audible.

This document does not apply to additional measurements for other quantities. It does not apply to monitoring relays.

NOTE Common ~~worldwide~~ three-phase distribution systems are depicted in IEC 61010-1:2010, Annex I and IEC 61010-1:2010/AMD1:2016, Annex I.

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 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*
IEC 61010-1:2010/AMD1:2016¹

IEC 61010-2-030:2017, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for equipment having testing or measuring circuits*

IEC 61010-031, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 031: Safety requirements for hand-held and hand-manipulated assemblies for electrical test and measurement*

IEC 61557-1:2019 *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61557-1 and the following apply.

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

¹ A consolidated version of this publication exists, comprising IEC 61010-1:2010 and IEC 61010-1:2010/AMD1:2016.

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

3.1

phase sequence indicator

instrument intended to indicate, in a polyphase system, the sequence in which the instantaneous voltages of the phase conductors reach their maximum values

[SOURCE: IEC 60050-313:2001, 313-01-21]

3.2

phase sequence indication

information displayed by a phase sequence indicator

3.3

phase sequence test

test taken to determine that the phase sequence of a polyphase winding is correct

[SOURCE: IEC 60050-411:1996, 411-53-45]

4 Requirements

4.1 General

In addition to the requirements of IEC 61557-1:2019, Clause 4, the requirements of Clause 4 of this document shall apply.

4.2 Indication

All indications shall be unambiguously displayed on the phase sequence indicator when the input to the phase indicator is between 85 % and 110 % of the nominal system voltage and between 95 % and 105 % of the nominal system frequency.

Indications shall also be unambiguously detectable in the presence of visual or audible interference.

The phase sequence indicator shall display a valid phase sequence indication, positive or negative, if the values of the voltage to earth of the three phases are within the voltage range specified above and the phase delay between two consecutive phases is 120° .

The phase sequence indicator shall not display a valid phase sequence indication, positive or negative, if the three-phase distribution system is heavily unbalanced.

NOTE An unbalanced system could be due to unbalanced loads on the three phases or due to cabling errors.

In particular the measuring equipment shall not display a valid phase sequence indication in the following cases:

- 1) one or more of the phase conductors are open-circuit;
- 2) one or more of the phase conductors are connected to neutral or protective earth;
- 3) two conductors are connected to the same phase.

The specific indications displayed in the above error cases shall be mentioned in the operating instructions of the phase sequence indicator.

The limits of unbalance in amplitude and in phase delay that the phase sequence indicator can handle reliably shall also be mentioned in the operating instructions.

4.3 Measuring equipment

4.3.1 General

The measuring equipment for the phase sequence test is intended for temporary operation, but shall withstand continuous operation.

Equipment intended to be used on the distribution system shall be rated at least for measurement category III according to IEC 61010-2-030.

Equipment intended to be used on socket outlets only can be rated for measurement category II according to IEC 61010-2-030.

The measuring equipment shall not be damaged nor shall the user be exposed to danger when the measuring equipment is connected to 120 % of the rated system voltage or to 120 % of the maximum voltage of its rated voltage range.

The phase sequence test (see Annex B) can be realised with test probes for direct contact with live parts, conductors or terminals, or with capacitive test-clamps clips for inductive non-contact phase detection on insulated or uninsulated conductors.

4.3.2 Portable phase sequence indicator

Portable phase sequence indicators shall be housed in an enclosure of insulating material and comply with the requirements for double insulation or reinforced insulation (protection class II).

Portable phase sequence indicators shall be designed in such a manner that when either one or two measuring leads are connected to earth and the remaining measuring leads are connected to their corresponding phase conductors, the resulting total current to earth should not exceed 3,5 mA RMS. The phase conductors shall be at 110 % of the maximum rated voltage for which the equipment is designed.

4.3.3 Test leads for direct contact with live parts and accessories

Phase sequence indicators designed for direct contact to live parts shall be provided with permanently connected test leads or with terminals for removable test leads complying with IEC 61010-031.

The following applies to leads.

Test probes, test leads, clips and other accessories used with phase sequence indicators shall be in accordance with the requirements of IEC 61010-031.

A test lead cable that has a wear indicator shall, at the minimum, provide double insulation or reinforced insulation when new and, at the minimum, basic insulation when the wear indicator is reached (see IEC 61010-031).

Portable measuring equipment, together with its test leads, shall comply with the requirements for mechanical strength according to in accordance with IEC 61010-1 and in addition shall be tested in accordance with 6.4 6.3.1.

These requirements do not apply when the phase sequence indicator forms part of a multi-purpose instrument with provisions for carrying.

4.3.4 Test clips for non-contact phase detection

Phase sequence indicators designed for operation without direct contact to live parts shall be provided with leads and capacitive test clips for phase detection on insulated or uninsulated conductors complying with the requirements for spring-loaded clips of IEC 61010-031.

5 Marking and operating instructions

5.1 Marking

In addition to IEC 61557-1:2019, 5.1 and 5.2, the following information shall be provided on the measuring equipment:

- symbol for double insulation in accordance with IEC 61010-1:2010, Table 1, symbol 11;
- designation of leads L1, L2 and L3 on the equipment and on the leads;
- the measurement category shall be printed on the equipment close to the test lead connection.

5.2 Operating instructions

~~IEC 61557-1:2019, 5.3 applies.~~

In addition to IEC 61557-1:2019, 5.3, the following information shall be provided in the operating instructions:

- specific indications for the error cases of 4.2,
- limits of unbalance in amplitude and phase delay handled reliably by the phase sequence indicator.

6 Tests

6.1 General

6.1.1 Tests – General

In addition to the tests of IEC 61557-1:2019, Clause 6, the following tests shall be performed.

6.1.2 Visual display

Tests of the visual display are performed under the following conditions.

The display shall be unambiguously discernible by ~~a person~~ an observer with ~~6/6 vision~~ average sight from a distance of ~~500 mm~~ 0,5 m at ambient lighting levels from 30 lx to 1 000 lx. During the measurement, the measuring equipment shall be placed on a matt grey surface (type test).

A visual comparison under reference conditions with equipment that has successfully passed the type test is adequate for a routine test with respect to the visual display. The display on the item under test shall produce a similar or better readability (routine tests).

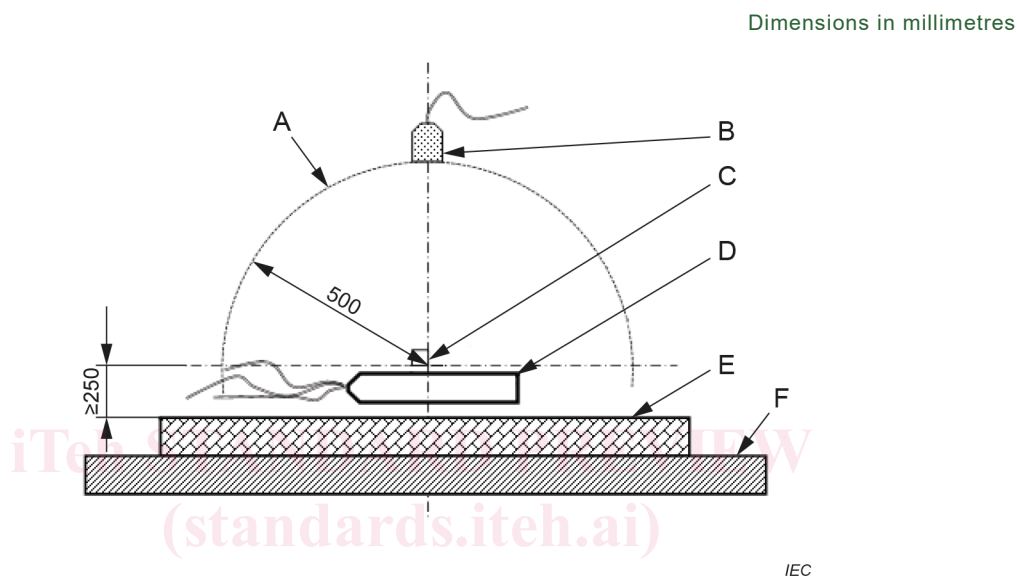
6.1.3 Audible indication (if applicable)

~~The test for the audible indication is performed at a sound level of $L_{AF} = 75$ dB (white noise). The indication shall generate a sound between 1 kHz and 4 kHz and be unambiguously discernible by a person with a hearing loss of less than 15 dB HL under these conditions (routine test).~~

The audible indication shall generate a sound level equal to or greater than 58,5 dB if continuous or 55,5 dB if intermittent in the frequency range between 1 kHz and 4 kHz.

The test shall be performed in accordance with Figure 1.

The alternative test consisting in comparing the perceptibility of the audible indication under reference conditions with a phase sequence indicator that has successfully passed the type test is adequate for the routine test. The sound on the item under test shall produce a similar or better indication (routine test).



Key

- A hemisphere measurement distance
- B microphone
- C sound emitter
- D phase sequence indicator
- E sound absorbing material
- F mounting surface

Figure 1 – Test set-up for measurement of perceptibility of the audible indication

6.2 Leakage current

The requirements under 4.3.2 shall be tested as follows.

The phase sequence indicator shall be connected in series with a current measuring instrument that has one lead connected with earth, and with the other interconnected leads connected with a phase conductor at a voltage of 110 % of its rated voltage or a voltage at the upper limit of its rated voltage range. The magnitude of the current shall not exceed the value specified under 4.3.2.

This test shall be executed on each conductor (routine test).

6.3 Test of mechanical requirements (type tests)

6.3.1 Mechanical shock test

For the purpose of a mechanical shock test, the item under test shall be suspended as shown in Annex A, Figure A.1, using a pendulum length of 2 m. The item under test shall be dropped

in a pendulum movement with a deflection of 1 m in height to hit a hard wooden plate 50 mm thick. The test shall be carried out so that each of the sides of the enclosure parallel to the suspension hits the wood once.

6.3.2 Test of leads for direct contact with live parts

The strain relief of permanently attached leads shall be tested by a drop test in accordance with Annex A, Figure A.2, in the following manner:

- the item under test shall be suspended so that it is caught with the extended lead after a free drop of 2 m;
- the item under test shall be dropped three times from the suspension point for each of the leads;
- the enclosure of the measuring equipment shall be free from damage;
- permanently attached leads shall not have become detached from the measuring equipment;
- live parts of the leads connected by means of plugs shall remain inaccessible when they have become unplugged from the measuring equipment;
- no parts inside the measuring equipment shall have become loose.

6.3.3 Test of clips for non-contact phase detection

Tests clips and leads for non-contact detection on insulated or uninsulated conductors shall comply with the conformity tests for spring-loaded clips of IEC 61010-031.

6.4 Overvoltage

The applicable requirement of 4.3.1 shall be tested as follows:

Compliance with the requirements given in 4.3.1 shall be tested by connecting, for a duration of at least 10 min, the item under test to a three-phase system at 120 % of the rated system voltage or, in the case of multi-range measuring equipment, at 120 % of all rated voltages (type test).

The surface temperature of EUT shall be measured and checked ~~according to~~ in accordance with IEC 61010-1:2010, Clause 10 and IEC 61010-1:2010/AMD:2016, Clause 10.

Compliance with the requirements given in 4.3 shall be tested by operating the item under test for a duration of at least 1 h at the rated voltage or, in the case of multi-range measuring equipment, at all rated voltage values (type test).

6.5 Test of markings

The markings shall be checked in respect of legibility by a visual inspection (type test).

Annex A (normative)

Illustrations for mechanical tests

Mechanical shock tests shall be performed according to Figure A.1.

Dimensions in metres

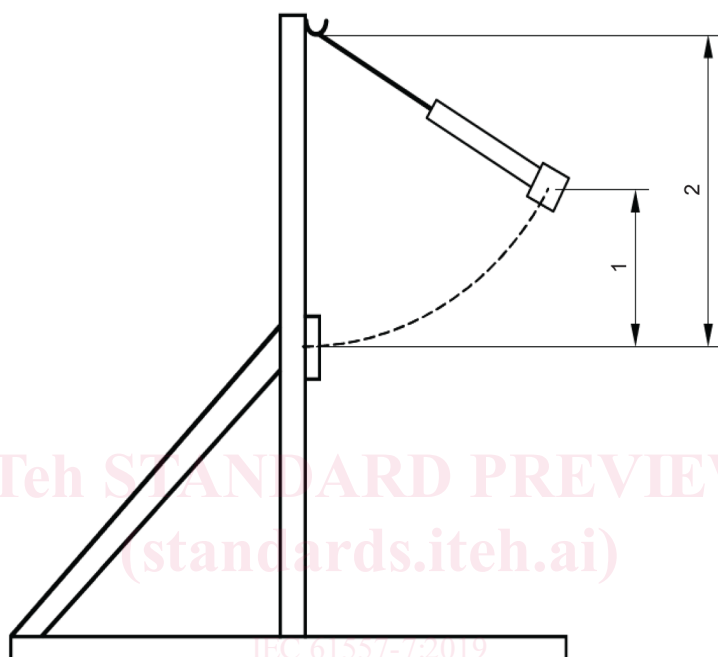


Figure A.1 – Mechanical shock test