

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

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 13: Hand-held and hand-manipulated current clamps and sensors for measurement of leakage currents in electrical distribution systems**

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**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 13: Pinces et capteurs de courant portatifs et manipulés à la main pour la mesure des courants de fuite dans les réseaux de distribution électriques**



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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 13: Hand-held and hand-manipulated current clamps and sensors for measurement of leakage currents in electrical distribution systems**

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IEC 61557-13 has been prepared by IEC technical committee 85: Measuring equipment for electrical and electromagnetic quantities. It is an International Standard.

This second edition cancels and replaces the first edition published in 2011. This edition constitutes a technical revision.

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

- a) the term "fixing device" has been removed;

- b) the measuring range was changed to a display range, the indication of DC or peak values has been added in 4.1;
- c) the frequency for the test of sensitivity for low-frequency magnetic fields has been defined in 4.2;
- d) the specified measuring range is now defined as the range of indicated values based on the operating uncertainty in 4.3;
- e) alignment of the structure with that of the whole IEC 61557 series;
- f) the variation  $E_{12}$  (maximum load current), may be specified according to the manufacturer's specification.

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

Draft	Report on voting
85/877/FDIS	85/883/RVD

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

The language used for the development of this International Standard is English.

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

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

[IEC 61557-13:2023](#)

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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](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.

## INTRODUCTION

During periodical inspections of electrical installations, it is increasingly difficult to carry out measurements of insulation resistances with devices in accordance with IEC 61557-2 when the installations cannot be switched off for long periods and when there are sensitive appliances connected. Therefore, the measurement of leakage currents can provide additional information about the safe or unsafe situation of an installation.

Furthermore, the user has the opportunity to place current clamps and sensors on different points of the distribution system for troubleshooting nuisance tripping of RCDs, alarms of RCMs and other problems caused by low-frequency leakage currents.

Unfortunately, the presence of high external magnetic fields has a big impact on the performance of commonly used current clamps and sensors. High uncertainty and non-repeatability of readings can lead to unsafe interpretations.

This document defines performance classes for current clamps and sensors in relationship to ranges of high external magnetic fields and gives guidance to the user to choose the appropriate measuring device for a given situation.

The hand-held and hand-manipulated current clamps and sensors can be stand-alone instruments or accessories of instruments.

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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 13: Hand-held and hand-manipulated current clamps and sensors for measurement of leakage currents in electrical distribution systems

### 1 Scope

This part of IEC 61557 defines special performance requirements for hand-held and hand-manipulated current clamps and sensors for measurement of leakage currents in electrical distribution systems up to 1 000 V AC and 1 500 V DC taking into account the influence of high external low-frequency magnetic fields and other influencing quantities. See Annex A for examples of measurement applications.

This document does not apply to current clamps or sensors that are used in combination with devices for insulation fault location in accordance with IEC 61557-9, unless it is specified by the manufacturer.

### 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.

<https://standards.iteh.ai/catalog/standards/sist/a2261e98-ea79-479d-861c-8c4a296b0a46/iec-61000-4-8>, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

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

IEC 61010-2-032:2019, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement*

IEC 61326-1:2020, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

IEC 61557-1:2019, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – 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 terminology databases for use in standardization at the following addresses:

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

### 3.1 hand-held current clamp and sensor

portable or hand-held device for measurement, display or for indication of types of leakage currents in distribution systems without interruption of circuits

Note 1 to entry: For simplification, this term is replaced with the term "current sensors" throughout the document.

### 3.2 hand-manipulated current clamp and sensor

portable or hand-manipulated device for measurement, display or for indication of types of leakage currents in distribution systems without interruption of circuits

Note 1 to entry: For simplification, this term is replaced with the term "current sensors" throughout the document.

### 3.3 measurement category

classification of testing and measuring circuits according to the type of mains to which they are intended to be connected

[SOURCE: IEC 61010-2-030:2017, 3.5.101, modified – Note 1 removed.]

### 3.4 variation $E_{11}$

variation due to external low-frequency magnetic fields

### 3.5 variation $E_{12}$

variation due to load current during measurement using the differential method

Note 1 to entry: For the differential method, see Figure A.2. <https://standards.iteh.ai/catalog/standards/sist/a2261e98-ea79-479d-861c-8c4a296b0a46/iec-61557-13-2023>

### 3.6 variation $E_{13}$

variation due to touch current to earth caused by common mode voltage during hand-manipulation

### 3.7 variation $E_{14}$

variation due to frequency

### 3.8 variation $E_{15}$

repeatability of the measurement readings

Note 1 to entry: The variation repeatability means that at least 10 (or maybe more) open/closed cycles are made before taking a measurement reading.

### 3.9 operating class

performance class defining the influence of external low-frequency magnetic fields on the current sensors

### 3.10 leakage current

current driven by active conductors of a distribution system and/or loads to earth and/or protective conductors

**3.11****load current**

current flowing through the line conductor(s)

**3.12****rated burden**

value of the burden on which the accuracy requirements of a specification are based

[SOURCE: IEC 60050-321:1986, 321-01-26]

**3.13****resolution**

smallest change in the measurand, or quantity supplied, which causes a perceptible change in the indication

[SOURCE: IEC 60050-311:2001, 311-03-10]

**3.14****fiducial value**

fiducial value used for reference is the measured value of the leakage current

**4 Requirements****4.1 General requirements**

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

Current sensors according to this document shall be in accordance with IEC 61010-2-032.

Current sensors according to this document shall have the ability to indicate leakage currents for a minimum range of either 1 mA to 10 A AC or 1 mA to 10 A DC (or both) and shall be designed for a load current of at least 60 A. Multiple ranges are allowed.

The resolution shall be 0,1 mA AC or 0,1 mA DC, or higher.

The current values shall be indicated as RMS values. Additional indication of DC or peak values are allowed.

The frequency range of the current sensors shall include a range from a minimum of 40 Hz up to the third harmonic of the rated mains frequency.

For railway applications, a frequency range starting at 15 Hz is recommended.

For industrial applications, a frequency range up to 1 kHz is recommended.

For testing the leakage current of appliances, a measuring range starting at 0,1 mA with a resolution of 0,01 mA is recommended.

**4.2 Operating classes****4.2.1 General**

Current sensors are classified into three operating classes according to their sensitivity for low-frequency magnetic fields in accordance with IEC 61000-4-8 at 50 Hz and 60 Hz.

For optional frequency ranges between 16,7 Hz and 400 Hz, the test configuration in accordance with IEC 61000-4-8 shall be used.

#### 4.2.2 Operating class 1

Current sensors of operating class 1 shall operate within external low-frequency magnetic fields according to 4.2.1 up to a field strength of 100 A/m.

The upper limit of field strength shall be marked in accordance with Figure 5.

#### 4.2.3 Operating class 2

Current sensors of operating class 2 shall operate within external low-frequency magnetic fields according to 4.2.1 up to a field strength of 30 A/m.

The upper limit of field strength shall be marked in accordance with Figure 5.

#### 4.2.4 Operating class 3

Current sensors of operating class 3 shall operate within external low-frequency magnetic fields according to 4.2.1 up to a field strength of 10 A/m.

The upper limit of field strength shall be marked in accordance with Figure 5.

### 4.3 Operating uncertainty of the specified measuring range

#### 4.3.1 General

The operating uncertainty of the specified measuring range for current sensors of operating class 1, operating class 2 and operating class 3 shall be determined according to the operating uncertainty equation (1) of Table 3 within the reference conditions or specified operating range. The relation between operating class and external magnetic field is shown in Figure 1, Figure 2 and Table 1.

The fiducial value is the measured value of the leakage current.

#### 4.3.2 Specified measuring range of an operating class 1 current sensor

The specified measuring range of an operating class 1 current sensor is the range of indicated values between stated lower and upper measurements for which the operating uncertainty of reading is:

- less than 15 % for values less than or equal to 10 mA, and is less than 10 % for values greater than 10 mA for external low-frequency magnetic fields of up to 10 A/m;

and

- less than 20 % for values less than or equal to 10 mA and is less than 12,5 % for values greater than 10 mA for external low-frequency magnetic fields of up to 30 A/m;

and

- less than 30 % for values less than or equal to 10 mA, and is less than 15 % for values greater than 10 mA for external low-frequency magnetic fields of up to 100 A/m.

#### 4.3.3 Specified measuring range of an operating class 2 current sensor

The specified measuring range of an operating class 2 current sensor is the range of indicated values between stated lower and upper measurements for which the operating uncertainty of reading is:

- less than 15 % for values less than or equal to 10 mA and is less than 10 % for values greater than 10 mA for external low-frequency magnetic fields of up to 10 A/m;

and

- less than 20 % for values less than or equal to 10 mA and is less than 12,5 % for values greater than 10 mA for external low-frequency magnetic fields of up to 30 A/m.

#### 4.3.4 Specified measuring range of an operating class 3 current sensor

The specified measuring range of an operating class 3 instrument is the range of indicated values between stated lower and upper measurements for which the operating uncertainty of reading is:

- less than 15 % for values less than or equal to 10 mA and is less than 10 % for values greater than 10 mA for external low-frequency magnetic fields of up to 10 A/m.

**Table 1 – Relation between external magnetic field and operating class**

External magnetic field strength	10 A/m	30 A/m	100 A/m
Operating uncertainty of reading $\leq$ 10 mA	15 %	20 %	30 %
Operating uncertainty of reading $>$ 10 mA	10 %	12,5 %	15 %
Operating class 1 current sensor	✓	✓	✓
Operating class 2 current sensor	✓	✓	-
Operating class 3 current sensor	✓	✓	-