

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – 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

Sécurité électrique dans les réseaux de distribution basse tension de 1 000 V c.a. et 1 500 V c.c. – 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 a.c. AND 1 500 V d.c. –  
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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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.

This part is to be used in conjunction with IEC 61557-1:2007.

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 a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures*, can be found on the IEC website.

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## INTRODUCTION

During periodical inspections of electrical installations, it is increasingly difficult to carry out measurements of insulation resistances with devices according to 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 standard 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.

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# **ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V a.c. AND 1 500 V d.c. – 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 a.c. and 1 500 V d.c., taking into account the influence of high external low-frequency magnetic fields and other influencing quantities. This standard does not apply to current clamps or sensors which are used in combination with devices for insulation fault location according to IEC 61557-9, unless it is specified by the manufacturer.

### **2 Normative references**

The following referenced documents are indispensable for the application 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 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*  
IEC 61557-13-2011  
 35d0d37f1fd0/iec-61557-13-2011

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

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

IEC 61010-2-032:2002, *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, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

IEC 61326-2-2, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-2: Particular requirements – Test configurations, operational conditions and performance criteria for portable test, measuring and monitoring equipment used in low-voltage distribution systems*

IEC 61557-1:2007, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements*

### **3 Terms and definitions**

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

### 3.1

#### **hand-held and hand-manipulated current clamps and sensors**

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

NOTE In the following text, only the expression “current sensors” is used.

### 3.2

#### **fixing device**

device to fix the position of a conductor in relation to the current sensors

### 3.3

#### **measurement category**

coordination of maximum transients to the working voltage according to IEC 61010-2-030

### 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 (see Annex A, Figure A.2)

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### 3.6

#### **variation $E_{13}$**

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

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### 3.7

#### **variation $E_{14}$**

variation due to frequency

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### 3.8

#### **variation $E_{15}$**

repeatability of the measurement readings due to at least 10 open / close cycles

### 3.9

#### **operating class**

performance class defining the influence of external low frequency magnetic fields on the current sensors (see 4.2)

### 3.10

#### **leakage current**

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

[IEC 60050-195:1998, 195-05-15, modified]

### 3.11

#### **load current**

current flowing through the line conductor/s

### 3.12

#### **rated burden**

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

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

## 4 Requirements

### 4.1 General

The following requirements as well as those given in IEC 61557-1 shall apply.

Current sensors according to this standard shall comply with IEC 61010-2-032.

Current sensors according to this standard shall have the ability to measure leakage currents from 1 mA to 10 A a.c. and/or d.c. as a minimum and shall be designed for a load current of at least 60 A. Multiple ranges are allowed.

The resolution shall be 0,1 mA a.c. and/or d.c or better.

The indicated current values shall be r.m.s. values.

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

NOTE 1 For railway applications a frequency range beginning at 15 Hz is recommended.

NOTE 2 For industrial applications a frequency range up to 1 kHz is recommended.

NOTE 3 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

According to their sensitivity for low frequency magnetic fields according to IEC 61000-4-8 within the range of 15 Hz up to 400 Hz, current sensors are classified into 3 operating classes.

#### 4.2.2 Operating class 1

Current sensors of operating class 1 shall be applicable to 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 on the pictogram according to 5.1.

#### 4.2.3 Operating class 2

Current sensors of operating class 2 shall be applicable to 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 on the pictogram according to 5.1.

#### 4.2.4 Operating class 3

Current sensors of operating class 3 shall be applicable to 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 on the pictogram according to 5.1.

### 4.3 Measuring range / percentage operating uncertainty of reading

#### 4.3.1 General

Percentage operating uncertainty of current sensors of operating class 1, operating class 2 and operating class 3 shall be determined according to the equation of Table 2 within the operating conditions of 4.4. 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 Measuring range of an operating class 1 current sensor

The measuring range of an operating class 1 current sensor is the range of indicated values between stated lower and upper measurements for which the percentage 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 Measuring range of an operating class 2 current sensor

The measuring range of an operating class 2 current sensor is the range of indicated values between stated lower and upper measurements for which the percentage 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.

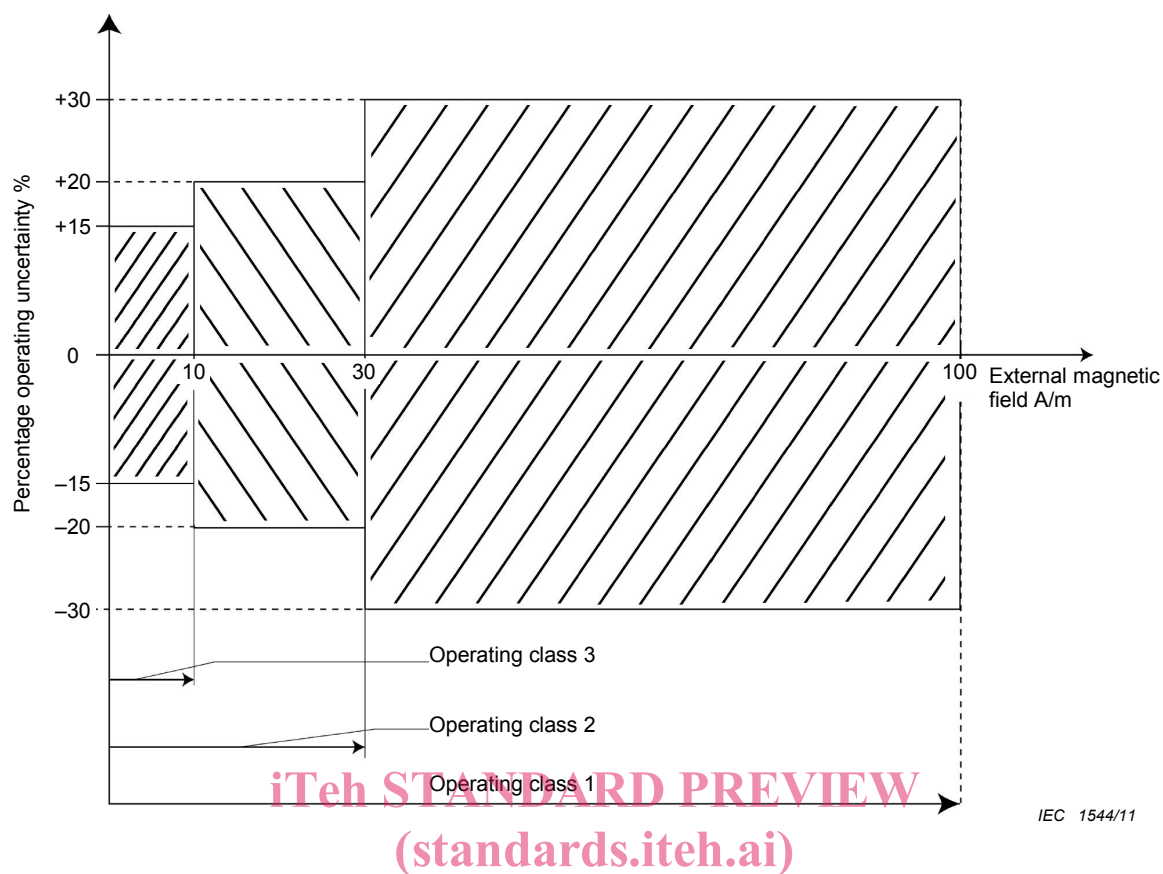
#### 4.3.4 Measuring range of an operating class 3 current sensor

The measuring range of an operating class 3 instrument is the range of indicated values between stated lower and upper measurements for which the percentage 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 of external field and operating class**

External field strength	10 A/m	30A/m	100A/m
Percentage operating uncertainty of reading ≤10 mA	15%	20%	30%
Percentage 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	✓	-	-



**Figure 1 – Percentage operating uncertainty in relation to operating class and external magnetic field for measuring ranges less than or equal to 10 mA**