

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Methods of measurement of touch current and protective conductor current

Méthodes de mesure du courant de contact et du courant dans le conducteur de protection



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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

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Methods of measurement of touch current and protective conductor current

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INTERNATIONAL
ELECTROTECHNICAL
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CONTENTS

FOREWORD	6
INTRODUCTION	8
1 Scope	10
2 Normative references	10
3 Terms and definitions	11
4 Test site	11
4.1 Test site environment	11
4.2 Test transformer	12
4.3 Earthed neutral conductor	12
5 Measuring equipment	13
5.1 Selection of measuring network	13
5.1.1 General	13
5.1.2 Perception and startle-reaction	14
5.1.3 Letgo-immobilization	14
5.1.4 Electric burn (a.c.)	14
5.1.5 Ripple-free d.c.	14
5.2 Test electrodes	15
5.2.1 Construction	15
5.2.2 Connection	15
5.3 Configuration	15
5.4 Power connections during test	15
5.4.1 General	15
5.4.2 Equipment for use only on TN or TT star power distribution systems	19
5.4.3 Equipment for use on IT power distribution systems including unearthed delta systems	19
5.4.4 Equipment for use on single-phase centre-earthed power supply systems or on centre-earthed delta power supply systems	20
5.5 Supply voltage and frequency	20
5.5.1 Supply voltage	20
5.5.2 Supply frequency	20
6 Test procedure	20
6.1 General	20
6.1.1 Touch current measurements	20
6.1.2 Control switches, equipment and supply conditions	21
6.1.3 Use of measuring networks	21
6.2 Normal and fault conditions of equipment	21
6.2.1 Normal operation of equipment	21
6.2.2 Equipment and supply fault conditions	21
7 Evaluation of results	23
7.1 Perception, startle-reaction and letgo-immobilization	23
7.2 Electric burn	23
8 Measurement of protective conductor current	23
8.1 General	23
8.2 Multiple equipment	24
8.3 Measuring method	24

Annex A (normative) Equipment.....	25
Annex B (normative) Use of a conductive plane	26
Annex C (normative) Incidentally connected parts	27
Annex D (informative) Choice of current limits.....	28
D.1 General	28
D.2 Limit examples.....	28
D.2.1 Ventricular fibrillation	28
D.2.2 Inability to letgo-immobilization	28
D.2.3 Startle-reaction	28
D.2.4 Perception threshold.....	28
D.2.5 Special applications	28
D.3 Choice of limits	29
D.4 Electric burn effects of touch current.....	30
Annex E (informative) Networks for use in measurement of touch current.....	31
E.1 General	31
E.2 Body impedance network – Figure 3.....	31
E.3 Startle-reaction (and body impedance) network – Figure 4.....	31
E.4 Letgo-immobilization (and body impedance) network – Figure 5.....	32
Annex F (informative) Measuring network limitations and construction.....	33
Annex G (informative) Construction and application of touch current measuring instruments	35
G.1 Considerations for selection of components.....	35
G.1.1 General	35
G.1.2 Power rating and inductance for R_S and R_B	35
G.1.3 Capacitor C_S	35
G.1.4 Resistors R1, R2 and R3.....	36
G.1.5 Capacitors C1, C2 and C3.....	36
G.2 Voltmeter	36
G.3 Accuracy.....	36
G.4 Calibration and application of measuring instruments	37
G.5 Records.....	37
G.6 Confirmation systems.....	37
Annex H (informative) Analysis of frequency filtered touch current circuit measurements.....	39
Annex I (informative) AC power distribution systems (see 5.4).....	47
I.1 General	47
I.2 TN power systems	48
I.3 TT power systems.....	50
I.4 IT power systems.....	51
Annex J (informative) Routine and periodic touch current tests, and tests after repair or modification of mains operated equipment	53
Annex K (normative) Network performance and calibration.....	54
K.1 Network or instrument performance and initial calibration	54
K.2 Calibration in a confirmation system.....	56
K.2.1 General	56
K.2.2 Measurement of input resistance.....	56
K.2.3 Measurement of instrument performance.....	56
Bibliography	59

Figure 1 – Example of earthed neutral, direct supply	12
Figure 2 – Example of earthed neutral, with transformer for isolation	13
Figure 3 – Measuring network, unweighted touch current	13
Figure 4 – Measuring network, touch current weighted for perception or startle-reaction	14
Figure 5 – Measuring network, touch current weighted for letgo-immobilization	14
Figure 6 – Single-phase equipment on star TN or TT system	16
Figure 7 – Single-phase equipment on centre-earthed TN or TT system	16
Figure 8 – Single-phase equipment connected line-to-line on star TN or TT system	17
Figure 9 – Single-phase equipment connected line-to-neutral on star IT system	17
Figure 10 – Single-phase equipment connected line-to-line on star IT system.....	17
Figure 11 – Three-phase equipment on star TN or TT system.....	18
Figure 12 – Three-phase equipment on star IT system	18
Figure 13 – Unearthed delta system.....	19
Figure 14 – Three-phase equipment on centre-earthed delta system	19
Figure A.1 – Equipment	25
Figure B.1 – Equipment platform	26
Figure F.1 – Frequency factor for electric burn	33
Figure F.2 – Frequency factor for perception or startle-reaction.....	33
Figure F.3 – Frequency factor for letgo-immobilization	34
Figure H.1 – Triangular waveform touch current, startle-reaction	40
Figure H.3 – 1 ms rise time pulse response, startle-reaction.....	41
Figure H.4 – 1 ms rise time pulse response, letgo-immobilization	41
Figure H.5 – Touch current vs. rise time plot, 20 ms square wave	42
Figure H.6 – PFC SMPS touch current waveform	42
Figure H.7 – 50 Hz square wave, 0,1 ms rise time, startle-reaction.....	43
Figure H.8 – 50 Hz square wave, 0,1 ms rise time, letgo-immobilization	43
Figure H.9 – IEC TS 60479-2 let-go threshold for AC and DC combinations augmented by additional data, mA each axis.....	44
Figure H.10 – Ex1 case: showing r.m.s. window	45
Figure H.11 – Waveform ex2 case: showing r.m.s. window	45
Figure I.1 – Examples of TN-S power system	48
Figure I.2 – Example of TN-C-S power system	49
Figure I.3 – Example of TN-C power system.....	49
Figure I.4 – Example of single-phase, 3-wire TN-C power system.....	50
Figure I.5 – Example of 3-line and neutral TT power system	50
Figure I.6 – Example of 3-line TT power system	51
Figure I.7 – Example of 3-line (and neutral) IT power system	51
Figure I.8 – Example of 3-line IT power system	52
Table H.1 – Triangular waveform response comparison.....	40
Table H.2 – Square wave touch current response	41

Table H.3 – Square wave monopolar touch current response43

Table H.4 – Mixed ACnDC waveform evaluation, ex145

Table H.5 – Mixed ACnDC waveform evaluation, ex246

Table K.1 – Calculated input impedance and transfer impedance for unweighted touch current measuring network (Figure 3).....54

Table K.2 – Calculated input impedance and transfer impedance for startle-reaction touch current measuring network (Figure 4)55

Table K.3 – Calculated input impedance and transfer impedance for letgo-immobilization current measuring network (Figure 5).....55

Table K.4 – Output voltage to input voltage ratios for unweighted touch current measuring network (Figure 3)57

Table K.5 – Output voltage to input voltage ratios for startle-reaction measuring network (Figure 4)57

Table K.6 – Output voltage to input voltage ratios for letgo-immobilization measuring network (Figure 5)58

INTERNATIONAL ELECTROTECHNICAL COMMISSION

METHODS OF MEASUREMENT OF TOUCH CURRENT AND PROTECTIVE CONDUCTOR CURRENT

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International Standard IEC 60990 has been prepared by TC 108: Safety of electronic equipment within the field of audio/video, information technology and communication technology.

This third edition cancels and replaces the second edition published in 1999. It constitutes a technical revision.

The principal changes in this edition as compared with the second edition are as follows:

- the effects names have been updated to reflect increased understanding of the range of effects and is in concert with present usage;
- the conditions of use invoking a GRIPPABLE PART have been reduced in the application of the requirements based upon the current understanding of this effect;
- the references to ISO 10012-1, which has been replaced by management standard of the same number, have been replaced with explanatory text, where needed to maintain the sense of the document;

- former informative Annex H (GRIPPABLE PART) has been deleted from this update as it does not properly represent the full set of conditions under which immobilization can occur. A new informative Annex H (Analysis of frequency filtered touch current circuits measurement) has been added;
- the Bibliography (formerly Annex M) has been updated with additional references for completeness.

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

FDIS	Report on voting
108/630/FDIS	108/640/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, the following print types or formats are used:

- requirements proper and normative annexes: in roman type;
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- notes/explanatory matter: in smaller roman type;
- normative conditions within tables: in smaller roman type;
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INTRODUCTION

This International Standard was developed as a response to concerns arising from the advent of electronic switching techniques being broadly applied to power systems and within EQUIPMENT, giving rise to high-frequency harmonic voltages and currents.

This standard is intended for the guidance of EQUIPMENT committees in preparing or amending the test specifications in their standards for measurement of leakage current. However the term "leakage current" is not used for reasons explained below.

This standard was initially prepared under the basic safety function assigned to TC 74 (now TC 108), as follows:

Methods of measuring leakage current

This includes, for various types of EQUIPMENT, all aspects of what is referred to as "leakage current", including methods of measurement of current with regard to physiological effects and for installation purposes, under normal conditions and under certain fault conditions.

The methods of measurement of leakage current described herein result from the review of IEC TS 60479-1 and other publications, including descriptions of earlier methods of measurement.

The following conclusions were derived from a review of the effects of leakage current:

- the primary concern for safety involves possible flow of harmful current through the human body (this current is not necessarily equal to the current flowing through a protective conductor);
- the effect of electric current on a human body is found to be somewhat more complex than was assumed during the development of earlier standards in that there are several body responses which should be considered. The most significant responses for setting limits for continuous waveforms are
 - perception,
 - startle-reaction,
 - letgo-immobilization, and
 - ELECTRIC BURN.

Each of these four body responses has a unique threshold level. There are also significant differences in the manner in which some of these thresholds vary with frequency.

Two types of current have been identified as needing separate measuring methods: TOUCH CURRENT and PROTECTIVE CONDUCTOR CURRENT.

TOUCH CURRENT only exists when a human body or a body model is a current pathway.

It was also noted that the term "leakage current" has already been applied to several different concerns: TOUCH CURRENT, PROTECTIVE CONDUCTOR CURRENT, insulation properties, etc. Therefore, in this standard, the term "leakage current" is not used.

Measurement of TOUCH CURRENT

In the past, EQUIPMENT standards have used two traditional techniques for measurement of leakage current. Either the actual current in the protective conductor was measured, or a simple resistor-capacitor network (representing a simple body model) was used, the leakage current being defined as the current through the resistor.

This standard provides measuring methods for the four body responses to the electric current noted above, using a more representative body model.

This body model was chosen for most common cases of electric shock in the general sense. With respect to the path of current flow and conditions of contact, a body model approximating full hand-to-hand or hand-to-foot contact in normal conditions is used. For small areas of contact (for example, small, finger contact), a different model may be appropriate but is not covered here.

Of the four responses, startle-reaction and letgo-immobilization are related to the peak value of TOUCH CURRENT and vary with frequency. Traditionally, concerns for electric shock have dealt with sinusoidal waveforms, for which r.m.s. measurements are most convenient. Peak measurements are more appropriate for non-sinusoidal waveforms where significant values of TOUCH CURRENT are expected, but are equally suitable for sinusoidal waveforms. The networks specified for the measurement of startle-reaction and letgo-immobilization are frequency-responsive and are so weighted that single limit power-frequency values can be specified and referenced.

ELECTRIC BURNS, however, are related to the r.m.s. value of TOUCH CURRENT, and are relatively independent of frequency. For EQUIPMENT where ELECTRIC BURNS may be of concern (see 7.2), two separate measurements are made, one in peak value for electric shock and a second in r.m.s. value for ELECTRIC BURNS each using the appropriate test circuit.

EQUIPMENT committees should decide which physiological effects are acceptable and which are not, and then decide on limit values of current. Committees for certain types of EQUIPMENT may adopt simplified procedures based upon this standard. A discussion of limit values, based upon earlier work by various IEC EQUIPMENT committees, is provided in Annex D.

Measurement of PROTECTIVE CONDUCTOR CURRENT

In certain cases, measurement of the PROTECTIVE CONDUCTOR CURRENT of EQUIPMENT under normal operating conditions is required. Such cases include:

- selection of a residual current protection device,
- determination when a high integrity protective earth circuit is required,
- prevent excessive PROTECTIVE CONDUCTOR CURRENT overload in the electrical installation.

The PROTECTIVE CONDUCTOR CURRENT is measured by inserting an ammeter of negligible impedance in series with the EQUIPMENT protective earthing conductor.

METHODS OF MEASUREMENT OF TOUCH CURRENT AND PROTECTIVE CONDUCTOR CURRENT

1 Scope

This International Standard defines measurement methods for

- d.c. or a.c. current of sinusoidal or non-sinusoidal waveform, which could flow through the human body, and
- current flowing through a protective conductor.

The measuring methods recommended for TOUCH CURRENT are based upon the possible effects of current flowing through a human body. In this standard, measurements of current through networks representing the impedance of the human body are referred to as measurements of TOUCH CURRENT. These networks are not necessarily valid for the bodies of animals.

The specification or implication of specific limit values is not within the scope of this standard. IEC TS 60479 series provides information regarding the effects of current passing through the human body from which limit values may be derived.

This standard is applicable to all classes of EQUIPMENT, according to IEC 61140.

The methods of measurement in this standard are not intended to be used for

- TOUCH CURRENTS having less than 1 s duration,
- patient currents as defined in IEC 60601-1,
- a.c. at frequencies below 15 Hz, and
- currents above those chosen for ELECTRIC BURN limits.

This basic safety publication is primarily intended for use by technical committees in the preparation of standards in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51. It is not intended for use by manufacturers or certification bodies independent of product standards.

One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications in the preparation of its publications. The requirements, test methods or test conditions of this basic safety publication only apply when specifically referred to or included in the relevant publications.

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.

IEC TS 60479-1:2005, *Effects of current on human beings and livestock – Part 1: General aspects*

IEC TS 60479-2:2007, *Effects of current on human beings and livestock – Part 2: Special aspects*