IEC 60990

Edition 3.0 2016-05
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

BASIC SAFETY PUBLICATION

Methods of measurement of touch current and protective conductor current

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 17.220, 35.020

ISBN 978-2-8322-3449-5

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

METHODS OF MEASUREMENT OF TOUCH CURRENT AND PROTECTIVE CONDUCTOR CURRENT

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.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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.

It has the status of a basic safety publication in accordance with IEC Guide 104.

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;
– compliance statements and test specifications: *in italic type*;
– notes/explanatory matter: in smaller roman type;
– normative conditions within tables: in smaller roman type;
– terms defined in Clause 3: SMALL CAPITALS.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC website 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 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 ~~pilot~~ 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

_____

* ~~Terms in small capitals are defined in clause 3.~~

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, ~~one~~ small, finger contact), a different model may be appropriate but is not covered here.

Of the four responses, ~~perception~~ 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 ~~perception~~ startle-reaction and ~~let-go currents~~ 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 ~~required~~ 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,

– ~~compliance with 471.3.3 of IEC 60364-7-707.~~

– 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.

~~A bibliography of related documents is given in annex M.~~

~~This second edition has been prepared on the basis of comments provided by users of the first edition.~~

~~Principal changes include the following:~~

– ~~provision of an earthing alternative for testing, in order to accommodate some test situations;~~

– ~~provision of a more detailed description of the design and calibration of the measurement network, thus allowing deletion of component tolerances from the network diagrams;~~

– a minor inaccuracy in one measurement method has been corrected by the inclusion of an additional calculation;

– the discussion of the physiological effects has been clarified.

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~~-1~~ 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~~ 60536~~ 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

~~– a.c. in combination with d.c. The use of a single network for a composite indication of the effects of combined a.c. and d.c. has not been investigated,~~

– 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~~ will not~~ only apply~~, unless~~ 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.

~~Members of IEC and ISO maintain registers of currently valid International Standards.~~

~~IEC 60050(195): *International Electrotechnical Vocabulary (IEV) – Chapter 195: Earthing and protection against electric shock*~~

~~IEC 60050(604): *International Electrotechnical Vocabulary (IEV) – Chapter 604: Generation, transmission and distribution of electricity – Operation*~~

~~IEC 60309-1:1997, *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements*~~

~~IEC 60364-4-41:1992, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electric shock*~~

~~IEC 60364-7-707:1984, *Electrical installations of buildings – Part 7: Requirements for special installations or locations – Section 707: Earthing requirements for the installation of data processing equipment*~~

IEC TS 60479-1:~~1994~~ 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*

~~IEC 60536:1976, *Classification of electrical and electronic equipment with regard to protection against electric shock*~~

~~IEC 60536-2:1992, *Classification of electrical and electronic equipment with regard to protection against electric shock – Part 2: Guidelines to requirements for protection against electric shock*~~

IEC 61140~~:1997~~, *Protection against electric shock – Common aspects for installation and equipment*

ISO/IEC Guide 51:~~1990~~ 2014, *Safety aspects – Guidelines for their inclusion in standards*

~~IEC Guide 104:1997, *Guide to the drafting of safety standards and the role of committees with safety pilot functions and safety group functions*~~

IEC Guide 104:2010, *The preparation of safety publications and the use of basic safety publications and group safety publications*

IEC 60990

Edition 3.0 2016-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

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

IEC 60990:2016-05(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

METHODS OF MEASUREMENT OF TOUCH CURRENT AND PROTECTIVE CONDUCTOR CURRENT

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 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.

It has the status of a basic safety publication in accordance with IEC Guide 104.

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;
– compliance statements and test specifications: *in italic type*;
– notes/explanatory matter: in smaller roman type;
– normative conditions within tables: in smaller roman type;
– terms defined in Clause 3: SMALL CAPITALS.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC website 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 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*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

ISO/IEC Guide 51:2014, *Safety aspects – Guidelines for their inclusion in standards*

IEC Guide 104:2010, *The preparation of safety publications and the use of basic safety publications and group safety publications*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

_____

MÉTHODES DE MESURE DU COURANT DE CONTACT ET DU COURANT DANS LE CONDUCTEUR DE PROTECTION

AVANT-PROPOS

1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. À cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets et de ne pas avoir signalé leur existence.

La Norme internationale IEC 60990 a été établie par le comité d'études 108: Sécurité des appareils électroniques dans le domaine de l'audio, de la vidéo, du traitement de l'information et des technologies de la communication.

Cette troisième édition annule et remplace la deuxième édition, parue en 1999. Cette édition constitue une révision technique.

Cette édition inclut les modifications majeures suivantes par rapport à la deuxième édition:

– les désignations des effets ont été mises à jour pour refléter la meilleure compréhension de la plage des effets et s'accorder avec l'utilisation actuelle;
– les conditions d'utilisation impliquant une PARTIE PREHENSIBLE ont été réduites pour l'application des exigences fondées sur la compréhension actuelle de cet effet;

– les références à l'ISO 10012-1, qui a été remplacée par une norme de management portant le même numéro, ont été remplacées par un texte explicatif, le cas échéant, afin de conserver le sens du document;
– l'ancienne Annexe H informative (PARTIE PREHENSIBLE) a été supprimée de cette mise à jour car elle ne représente pas de manière adéquate l'intégralité des conditions dans lesquelles une immobilisation est susceptible de se produire. Une nouvelle Annexe H informative (Analyse du mesurage de circuits de courant de contact avec filtre de fréquence) a été ajoutée;
– la Bibliographie (anciennement dénommée Annexe M) a été mise à jour avec des références supplémentaires par souci d'exhaustivité.

Elle a le statut d'une publication fondamentale de sécurité conformément au Guide IEC 104.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
108/630/FDIS	108/640/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Dans la présente norme, les caractères d'imprimerie ou formats suivants sont utilisés:

– exigences et annexes normatives: caractères romains;
– déclarations de conformité et spécifications d'essai: *caractères italiques*;
– notes/explications: petits caractères romains;
– conditions normatives dans les tableaux: petits caractères romains;
– termes définis à l'Article 3: PETITES CAPITALES.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives à la publication recherchée. À cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

IMPORTANT – Le logo *"colour inside"* qui se trouve sur la page de couverture de cette publication indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.

INTRODUCTION

La présente Norme internationale a été élaborée pour répondre à des préoccupations provenant de l'arrivée de nouvelles techniques de découpage à haute fréquence largement appliquées dans les systèmes d'alimentation et dans les MATERIELS, et qui provoquent des courants et tensions harmoniques à haute fréquence.

La présente norme est destinée à servir de guide aux comités traitant de MATERIELS lors de la préparation ou de la modification des spécifications d'essai dans leurs normes de mesure du courant de fuite. Toutefois, le terme «courant de fuite» n'est pas utilisé pour les raisons indiquées ci-après.

La présente norme a été initialement établie dans le cadre de la fonction fondamentale de sécurité assignée au comité d'études 74 (désormais comité d'études 108), comme suit.

Méthodes de mesure du courant de fuite

Ces méthodes incluent, pour divers types de MATERIELS, tous les aspects qui se rapportent à ce qui est désigné par le terme «courant de fuite», y compris les méthodes de mesure du courant en ce qui concerne les effets physiologiques et les questions d'installation, dans les conditions normales et dans certaines conditions de défaut.

Les méthodes de mesure du courant de fuite décrites ci-après proviennent de l'étude de l'IEC TS 60479-1 et d'autres publications, y compris les descriptions de méthodes de mesure précédentes.

Les conclusions suivantes sont déduites de l'étude des effets du courant de fuite:

– le principal intérêt pour la sécurité concerne le passage possible d'un courant nuisible à travers le corps humain (ce courant n'est pas nécessairement égal au courant traversant le conducteur de protection);
– l'effet du courant électrique traversant un corps humain s'est révélé être sensiblement plus complexe que dans les hypothèses retenues lors de l'élaboration des normes antérieures, dans la mesure où il convient de prendre en compte plusieurs réponses du corps. Les réponses les plus significatives pour établir les limites de sécurité pour des formes d'onde permanentes sont
    - la perception,
    - la réaction de tressaillement,
    - le non-lâcher/l'immobilisation, et
    - la BRÛLURE ÉLECTRIQUE.

Chacune de ces quatre réponses du corps a un niveau de seuil unique. D'importantes différences existent aussi dans la manière dont certains de ces seuils varient en fonction de la fréquence.

Deux types de courants ont été identifiés comme nécessitant des méthodes de mesure différentes: le COURANT DE CONTACT et le COURANT DANS LE CONDUCTEUR DE PROTECTION.

Le COURANT DE CONTACT existe uniquement lorsque le corps ou un modèle de corps humain est un chemin de passage du courant.

Il a été également noté que le terme «courant de fuite» a déjà été appliqué à plusieurs concepts différents: COURANT DE CONTACT, COURANT DANS LE CONDUCTEUR DE PROTECTION, propriétés d'isolement, etc. En conséquence, dans la présente norme, le terme «courant de fuite» n'est pas utilisé.

Mesurage du COURANT DE CONTACT

Dans le passé, les normes de MATERIELs ont traditionnellement utilisé deux techniques pour mesurer le courant de fuite. Soit le courant réel circulant dans le conducteur de protection était mesuré, soit un simple réseau résistance/condensateur (représentant un modèle simple du corps humain) était utilisé, le courant de fuite étant défini comme le courant traversant la résistance.

La présente norme fournit des méthodes de mesure pour les quatre réponses du corps au courant électrique indiqué ci-dessus, utilisant un modèle du corps humain plus représentatif.

Ce modèle du corps humain a été choisi pour les cas les plus courants de chocs électriques au sens général. En ce qui concerne le cheminement du courant et les conditions de contact, un modèle du corps humain est utilisé, représentant approximativement le contact complet main à main ou main à pied en situation normale. Pour de petites surfaces de contact (par exemple un petit contact de doigt), un modèle différent peut être approprié, mais ce modèle n'est pas abordé ici.

Parmi les quatre réponses, la réaction de tressaillement et le non-lâcher/l'immobilisation sont liés à la valeur de crête du COURANT DE CONTACT et varient avec la fréquence. Traditionnellement, les questions concernant les chocs électriques ont traité des formes d'onde sinusoïdales, pour lesquelles les mesurages de valeurs efficaces conviennent le mieux. Les mesurages de valeurs de crête sont plus appropriés pour les formes d'onde non sinusoïdales, pour lesquelles il est prévu des valeurs significatives du COURANT DE CONTACT, mais sont également utilisables pour les formes d'onde sinusoïdales. Les réseaux spécifiés pour le mesurage de la réaction de tressaillement et du non-lâcher/de l'immobilisation ont une réponse en fréquence et sont pondérés de telle façon que des valeurs limites uniques puissance-fréquence puissent être spécifiées et référencées.

Toutefois, les BRULURES ELECTRIQUES sont liées à la valeur efficace du COURANT DE CONTACT et sont relativement indépendantes de la fréquence. Pour les MATERIELs pour lesquels les BRULURES ELECTRIQUES peuvent être significatives (voir 7.2), deux mesurages séparés sont effectués, un en valeur de crête pour les chocs électriques et un second en valeur efficace pour les BRULURES ELECTRIQUES, chacun utilisant le circuit d'essai approprié.

Il convient que les comités de MATERIELS décident des effets physiologiques qui sont acceptables et des effets qui ne le sont pas et, à partir de là, qu'ils décident des valeurs limites de courant. Des comités concernés par certains types de MATERIELs peuvent adopter des procédures simplifiées, fondées sur la présente norme. Une discussion des valeurs limites, issue de travaux antérieurs de différents comités de MATERIEL de l'IEC, est donnée à l'Annexe D.

Mesurage du COURANT DANS LE CONDUCTEUR DE PROTECTION

Dans certains cas, il est exigé de mesurer le COURANT DANS LE CONDUCTEUR DE PROTECTION des MATERIELs dans les conditions normales d'utilisation, notamment:

– pour le choix d'un dispositif de protection à courant résiduel,
– pour la détermination du moment auquel un circuit de terre de protection de haute intégrité de protection est exigé,
– pour prévenir toute surcharge excessive de COURANT DANS LE CONDUCTEUR DE PROTECTION dans l'installation électrique.

Le COURANT DANS LE CONDUCTEUR DE PROTECTION est mesuré par insertion d'un ampèremètre d'impédance négligeable en série avec le conducteur de mise à la terre de protection du MATERIEL.

MÉTHODES DE MESURE DU COURANT DE CONTACT ET DU COURANT DANS LE CONDUCTEUR DE PROTECTION

1 Domaine d'application

La présente Norme internationale définit des méthodes de mesure pour

– les courants continus ou les courants alternatifs de forme d'onde sinusoïdale ou non sinusoïdale qui peuvent traverser le corps humain, et

– les courants qui peuvent circuler dans un conducteur de protection.

Les méthodes de mesure recommandées pour le COURANT DE CONTACT sont basées sur les effets possibles provoqués par le passage du courant dans le corps humain. Dans la présente norme, les mesurages de courant à travers des réseaux représentant l'impédance du corps humain sont appelés mesurages du COURANT DE CONTACT. Les réseaux utilisés ne sont pas nécessairement valables pour des animaux.

La spécification ou l'implication de valeurs limites spécifiques ne fait pas partie du domaine d'application de la présente norme. La série IEC TS 60479 fournit des informations concernant les effets du courant traversant le corps humain, à partir desquelles des valeurs limites peuvent être déduites.

La présente norme est applicable à toutes les classes de MATERIELS, conformément à l'IEC 61140.

Les méthodes de mesure indiquées dans la présente norme ne sont pas destinées à être utilisées pour

– les COURANTS DE CONTACT de durée inférieure à 1 s,

– les courants patients tels qu'ils sont définis dans l'IEC 60601-1,

– les courants alternatifs de fréquence inférieure à 15 Hz, et

– les courants supérieurs aux courants choisis pour les limites de BRULURE ELECTRIQUE.

La présente publication fondamentale de sécurité est destinée principalement à être utilisée par les comités d'études lors de la préparation de normes conformément aux principes figurant dans le Guide IEC 104 et le Guide ISO/IEC 51. Elle n'est pas destinée à être utilisée par les fabricants ou les organismes de certification indépendants de normes de produit.

L'une des responsabilités d'un comité d'études est d'utiliser, pour la préparation de ses publications, les publications fondamentales de sécurité, lorsque celles-ci sont applicables. Les exigences, méthodes d'essai ou conditions d'essai de la présente publication fondamentale de sécurité s'appliquent uniquement lorsqu'elles sont incorporées ou spécifiquement mentionnées dans les publications appropriées.

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC TS 60479-1:2005, *Effets du courant sur l'homme et les animaux domestiques – Partie 1: Aspects généraux*

IEC TS 60479-2:2007*, Effets du courant sur l'homme et les animaux domestiques – Partie 2: Aspects particuliers*

IEC 61140*, Protection contre les chocs électriques – Aspects communs aux installations et aux matériels*

Guide ISO/IEC 51:2014*, Aspects liés à la sécurité – Principes directeurs pour les inclure dans les normes*

Guide IEC 104:2010, *The preparation of safety publications and the use of basic safety publications and group safety publications* (disponible en anglais seulement)