

INTERNATIONAL STANDARD

NORME INTERNATIONALE



GROUP SAFETY PUBLICATION
PUBLICATION GROUPEE DE SÉCURITÉ

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

**Règles de sécurité pour appareils électriques de mesure, de régulation et de laboratoire –
Partie 031: Exigences de sécurité pour sondes équipées tenues à la main pour mesurage et essais électriques**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2015 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 60 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

Plus de 60 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



GROUP SAFETY PUBLICATION
PUBLICATION GROUPEE DE SÉCURITÉ

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

**Règles de sécurité pour appareils électriques de mesure, de régulation et de laboratoire –
Partie 031: Exigences de sécurité pour sondes équipées tenues à la main pour mesure et essais électriques**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 19.080

ISBN 978-2-8322-2701-5

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

| | |
|---|----|
| FOREWORD..... | 7 |
| 1 Scope and object..... | 10 |
| 1.1 Scope..... | 10 |
| 1.1.1 Probe assemblies included in scope..... | 10 |
| 1.1.2 Probe assemblies excluded from scope..... | 13 |
| 1.2 Object..... | 13 |
| 1.2.1 Aspects included in scope..... | 13 |
| 1.2.2 Aspects excluded from scope..... | 13 |
| 1.3 Verification..... | 13 |
| 1.4 Environmental conditions..... | 13 |
| 1.4.1 Normal environmental conditions..... | 13 |
| 1.4.2 Extended environmental conditions..... | 13 |
| 2 Normative references..... | 14 |
| 3 Terms and definitions..... | 14 |
| 3.1 Parts and accessories..... | 14 |
| 3.2 Quantities..... | 15 |
| 3.3 Tests..... | 16 |
| 3.4 Safety terms..... | 16 |
| 3.5 Insulation..... | 17 |
| 4 Tests..... | 18 |
| 4.1 General..... | 18 |
| 4.2 Sequence of tests..... | 19 |
| 4.3 Reference test conditions..... | 19 |
| 4.3.1 Environmental conditions..... | 19 |
| 4.3.2 State of probe assemblies..... | 19 |
| 4.3.3 Position of the probe assembly..... | 19 |
| 4.3.4 Accessories..... | 20 |
| 4.3.5 Covers and removable parts..... | 20 |
| 4.3.6 Input and output voltages..... | 20 |
| 4.3.7 Controls..... | 20 |
| 4.3.8 Connections..... | 20 |
| 4.3.9 Duty cycle..... | 20 |
| 4.4 Testing in SINGLE FAULT CONDITION..... | 20 |
| 4.4.1 General..... | 20 |
| 4.4.2 Application of fault conditions..... | 20 |
| 4.4.3 Duration of tests..... | 21 |
| 4.4.4 Conformity after application of fault conditions..... | 21 |
| 4.5 Tests in REASONABLY FORESEEABLE MISUSE..... | 22 |
| 4.5.1 General..... | 22 |
| 4.5.2 Fuses..... | 22 |
| 5 Marking and documentation..... | 22 |
| 5.1 Marking..... | 22 |
| 5.1.1 General..... | 22 |
| 5.1.2 Identification..... | 22 |
| 5.1.3 Fuses..... | 23 |
| 5.1.4 CONNECTORS and operating devices..... | 24 |

| | | |
|-------|---|----|
| 5.1.5 | RATING | 24 |
| 5.2 | Warning markings | 24 |
| 5.3 | Durability of markings | 24 |
| 5.4 | Documentation | 25 |
| 5.4.1 | General | 25 |
| 5.4.2 | Probe assembly RATING | 25 |
| 5.4.3 | Probe assembly operation | 25 |
| 5.4.4 | Probe assembly maintenance and service | 26 |
| 6 | Protection against electric shock | 26 |
| 6.1 | General | 26 |
| 6.2 | Determination of ACCESSIBLE parts | 27 |
| 6.2.1 | General | 27 |
| 6.2.2 | Examination | 27 |
| 6.2.3 | Openings for pre-set controls | 28 |
| 6.3 | Limit values for ACCESSIBLE parts | 28 |
| 6.3.1 | General | 28 |
| 6.3.2 | Levels in NORMAL CONDITION | 29 |
| 6.3.3 | Levels in SINGLE FAULT CONDITION | 29 |
| 6.3.4 | Measurement of voltage and touch current | 31 |
| 6.4 | Means of protection against electric shock | 34 |
| 6.4.1 | General | 34 |
| 6.4.2 | CONNECTORS | 35 |
| 6.4.3 | PROBE TIPS | 36 |
| 6.4.4 | Impedance | 38 |
| 6.4.5 | PROTECTIVE IMPEDANCE | 38 |
| 6.4.6 | BASIC INSULATION, SUPPLEMENTARY INSULATION, DOUBLE INSULATION and REINFORCED INSULATION | 39 |
| 6.5 | Insulation requirements | 39 |
| 6.5.1 | The nature of insulation | 39 |
| 6.5.2 | Insulation requirements for probe assemblies | 44 |
| 6.6 | Procedure for voltage tests | 50 |
| 6.6.1 | General | 50 |
| 6.6.2 | Humidity preconditioning | 50 |
| 6.6.3 | Conduct of tests | 50 |
| 6.6.4 | Test voltages | 51 |
| 6.6.5 | Test procedures | 53 |
| 6.7 | Constructional requirements for protection against electric shock | 54 |
| 6.7.1 | General | 54 |
| 6.7.2 | Insulating materials | 54 |
| 6.7.3 | ENCLOSURES of probe assemblies with DOUBLE INSULATION or REINFORCED INSULATION | 54 |
| 6.7.4 | PROBE WIRE attachment | 54 |
| 7 | Protection against mechanical HAZARDS | 58 |
| 8 | Resistance to mechanical stresses | 58 |
| 8.1 | General | 58 |
| 8.2 | Rigidity test | 59 |
| 8.3 | Drop test | 59 |
| 8.4 | Impact swing test | 59 |
| 9 | Temperature limits and protection against the spread of fire | 60 |

| | | |
|--------------|---|----|
| 9.1 | General..... | 60 |
| 9.2 | Temperature tests..... | 61 |
| 10 | Resistance to heat..... | 61 |
| 10.1 | Integrity of SPACINGS..... | 61 |
| 10.2 | Resistance to heat..... | 61 |
| 11 | Protection against HAZARDS from fluids..... | 61 |
| 11.1 | General..... | 61 |
| 11.2 | Cleaning..... | 61 |
| 11.3 | Specially protected probe assemblies..... | 62 |
| 12 | Components..... | 62 |
| 12.1 | General..... | 62 |
| 12.2 | Fuses..... | 62 |
| 12.3 | PROBE WIRE..... | 63 |
| 12.3.1 | General..... | 63 |
| 12.3.2 | RATING of PROBE WIRE..... | 63 |
| 12.3.3 | Pressure test at high temperature for insulations..... | 63 |
| 12.3.4 | Tests for resistance of insulation to cracking..... | 65 |
| 12.3.5 | Voltage test..... | 65 |
| 12.3.6 | Tensile test..... | 66 |
| 13 | Prevention of HAZARD from arc flash and short-circuits..... | 68 |
| 13.1 | General..... | 68 |
| 13.2 | Exposed conductive parts..... | 68 |
| Annex A | (normative) Measuring circuits for touch current (see 6.3)..... | 69 |
| A.1 | Measuring circuits for a.c. with frequencies up to 1 MHz and for d.c..... | 69 |
| A.2 | Measuring circuits for a.c. with sinusoidal frequencies up to 100 Hz and for d.c..... | 69 |
| A.3 | Current measuring circuit for electrical burns at frequencies above 100 kHz..... | 70 |
| A.4 | Current measuring circuit for WET LOCATIONS..... | 71 |
| Annex B | (normative) Standard test fingers..... | 73 |
| Annex C | (normative) Measurement of CLEARANCES and CREEPAGE DISTANCES..... | 76 |
| Annex D | (normative) Routine spark tests on PROBE WIRE..... | 78 |
| D.1 | General..... | 78 |
| D.2 | Spark test procedure..... | 78 |
| D.3 | Routine spark test method for PROBE WIRE..... | 80 |
| Annex E | (informative) 4 mm CONNECTORS..... | 82 |
| E.1 | General..... | 82 |
| E.2 | Dimensions..... | 82 |
| Annex F | (normative) MEASUREMENT CATEGORIES..... | 84 |
| F.1 | General..... | 84 |
| F.2 | MEASUREMENT CATEGORIES..... | 84 |
| F.2.1 | MEASUREMENT CATEGORY II..... | 84 |
| F.2.2 | MEASUREMENT CATEGORY III..... | 84 |
| F.2.3 | MEASUREMENT CATEGORY IV..... | 84 |
| F.2.4 | Probe assemblies without a MEASUREMENT CATEGORY RATING..... | 85 |
| Annex G | Index of defined terms..... | 86 |
| Bibliography | | 87 |

| | |
|---|----|
| Figure 1 – Examples of type A probe assemblies | 11 |
| Figure 2 – Examples of type B probe assemblies | 11 |
| Figure 3 – Examples of type C probe assemblies | 12 |
| Figure 4 – Examples of type D probe assemblies | 12 |
| Figure 5 – Example of a STACKABLE CONNECTOR with a male CONNECTOR and a female TERMINAL | 15 |
| Figure 6 – Methods for determination of ACCESSIBLE parts (see 6.2) and for voltage tests of (see 6.4.2) | 28 |
| Figure 7 – Capacitance level versus voltage in NORMAL CONDITION and SINGLE-FAULT CONDITION (see 6.3.2 c) and 6.3.3 c) | 30 |
| Figure 8 – Voltage and touch current measurement | 31 |
| Figure 9 – Voltage and touch current measurement for the reference CONNECTOR | 32 |
| Figure 10 – Voltage and touch current measurement with shielded test probe | 33 |
| Figure 11 – Maximum test probe input voltage for 70 mA touch current | 34 |
| Figure 12 – Protection by a PROTECTIVE FINGERGUARD | 37 |
| Figure 13 – Protection by distance | 37 |
| Figure 14 – Protection by tactile indicator | 38 |
| Figure 15 – Distance between conductors on an interface between two layers | 42 |
| Figure 16 – Distance between adjacent conductors along an interface of two layers | 42 |
| Figure 17 – Distance between adjacent conductors located between the same two layers | 44 |
| Figure 18 – Example of recurring peak voltage | 47 |
| Figure 19 – Flexing test | 56 |
| Figure 20 – Rotational flexing test | 58 |
| Figure 21 – Impact swing test | 60 |
| Figure 22 – Indentation device | 64 |
| Figure A.1 – Measuring circuit for a.c. with frequencies up to 1 MHz and for d.c. | 69 |
| Figure A.2 – Measuring circuits for a.c. with sinusoidal frequencies up to 100 Hz and for d.c. | 70 |
| Figure A.3 – Current measuring circuit for electrical burns | 71 |
| Figure A.4 – Current measuring circuit for high frequency test probes | 71 |
| Figure A.5 – Current measuring circuit for WET LOCATIONS | 72 |
| Figure B.1 – Rigid test finger | 73 |
| Figure B.2 – Jointed test finger | 74 |
| Figure D.1 – Bead Chain Configuration (if applicable) | 79 |
| Figure E.1 – Recommended dimensions of 4 mm CONNECTORS | 82 |
| Figure F.1 – Example to identify the locations of MEASUREMENT CATEGORIES | 85 |
| | |
| Table 1 – Symbols | 23 |
| Table 2 – SPACINGS for unmated CONNECTORS RATED up to 1 000 V a.c. or 1 500 V d.c. with HAZARDOUS LIVE conductive parts | 36 |
| Table 3 – Multiplication factors for CLEARANCES of probe assembly RATED for operation at altitudes up to 5 000 m | 40 |
| Table 4 – Test voltages for testing solid insulation | 41 |
| Table 5 – Minimum values for distance or thickness | 43 |

| | |
|---|----|
| Table 6 – CLEARANCES for probe assemblies of MEASUREMENT CATEGORIES II, III and IV | 44 |
| Table 7 – CLEARANCE values for the calculation of 6.5.2.3.2..... | 46 |
| Table 8 – CLEARANCES for BASIC INSULATION in probe assemblies subjected to recurring peak voltages or WORKING VOLTAGES with frequencies above 30 kHz..... | 48 |
| Table 9 – CREEPAGE DISTANCES for BASIC INSULATION or SUPPLEMENTARY INSULATION | 49 |
| Table 10 – Test voltages based on CLEARANCES..... | 52 |
| Table 11 – Correction factors according to test site altitude for test voltages for CLEARANCES | 53 |
| Table 12 – Pull forces for PROBE WIRE attachment tests..... | 57 |
| Table 13 – Diameter of mandrel and numbers of turns | 65 |
| Table C.1 – Dimension of X | 76 |
| Table D.1 – Maximum centre-to-centre spacings of bead chains | 78 |
| Table D.2 – Formula for maximum speed of wire in terms of electrode length L of link- or bead-chain electrode | 80 |
| Table F.1 – Characteristics of MEASUREMENT CATEGORIES..... | 85 |

Withdrawing

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT
FOR MEASUREMENT, CONTROL AND LABORATORY USE –****Part 031: Safety requirements for hand-held
probe assemblies for electrical measurement and test**

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 61010-031 has been prepared by IEC technical committee 66: Safety of measuring, control and laboratory equipment.

It has the status of a group safety publication in accordance with IEC GUIDE 104.

IEC 61010-031 is a stand-alone standard. This second edition cancels and replaces the first edition published in 2002 and Amendment 1:2008. This edition constitutes a technical revision.

This edition includes the following significant changes from the first edition, as well as numerous other changes:

- a) Voltages above the levels of 30 V r.m.s., 42,4 V peak, or 60 V d.c. are deemed to be HAZARDOUS LIVE instead of 33 V r.m.s., 46,7 V peak, or 70 V d.c.

- b) Servicing is now included within the scope.
- c) Extended environmental conditions are included within the scope.
- d) New terms have been defined.
- e) Tests for REASONABLY FORESEEABLE MISUSE have been added, in particular for fuses.
- f) Additional instruction requirements for probe assembly operation have been specified.
- g) Limit values for ACCESSIBLE parts and for measurement of voltage and touch current have been modified.
- h) SPACINGS requirements for mating of CONNECTORS have been modified.
- i) PROBE TIPS and SPRING-LOADED CLIPS requirements have been modified. The PROTECTIVE FINGERGUARD replace the BARRIER with new requirements.
- j) Insulation requirements (6.5) and test procedures (6.6.5) have been rewritten and aligned when relevant with Part 1. Specific requirements have been added for solid insulation and thin-film insulation.
- k) The terminology for MEASUREMENT CATEGORY I has been replaced with the designation “not RATED for measurements within MEASUREMENT CATEGORIES II, III, or IV”.
- l) The flexing/pull test (6.7.4.3) has been partially rewritten.
- m) Surface temperature limits (Clause 10) have been modified to conform to the limits of IEC Guide 117.
- n) Requirements for resistance of PROBE WIRES to mechanical stresses have been added in Clause 12 and a new Annex D.
- o) Requirements have been added regarding the prevention of HAZARD from arc flash and short-circuits for SPRING-LOADED CLIPS.
- p) A new informative Annex E defines the dimension of the 4 mm banana CONNECTORS.

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

| FDIS | Report on voting |
|-------------|------------------|
| 66/569/FDIS | 66/571/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.

A list of all parts of the IEC 61010 series, under the general title, *Safety requirements for electrical equipment for measurement, control, and laboratory use*, may be found on the IEC website.

In this standard, the following print types are used:

- requirements and definitions: in roman type;
- NOTES and EXAMPLES: in smaller roman type;
- *conformity and tests: in italic type;*
- terms used throughout this standard which have been defined in Clause 3: SMALL ROMAN CAPITALS.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site 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.

Withdrawn