

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Measuring relays and protection equipment –  
Part 27: Product safety requirements**

**Relais de mesure et dispositifs de protection –  
Partie 27: Exigences de sécurité**



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2013 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 la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI 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](mailto:info@iec.ch)  
[www.iec.ch](http://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.

#### Useful links:

IEC publications search - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

The advanced search enables you 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It also gives information on projects, replaced and withdrawn publications.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](http://webstore.iec.ch/justpublished)

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

Electropedia - [www.electropedia.org](http://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 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

Customer Service Centre - [webstore.iec.ch/csc](http://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](mailto:csc@iec.ch).

### A propos de la CEI

La Commission Electrotechnique Internationale (CEI) 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 CEI

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

#### Liens utiles:

Recherche de publications CEI - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

La recherche avancée vous permet de trouver des publications CEI 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.

Just Published CEI - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

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

Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire en ligne au monde 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 les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

Service Clients - [webstore.iec.ch/csc](http://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](mailto:csc@iec.ch).

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

**Measuring relays and protection equipment –  
Part 27: Product safety requirements**

**Relais de mesure et dispositifs de protection –  
Partie 27: Exigences de sécurité**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

PRICE CODE **XD**  
CODE PRIX

ICS 29.120.70

ISBN 978-2-8322-1161-8

**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.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references .....	10
3 Terms and definitions .....	11
4 General safety requirements.....	19
4.1 General.....	19
4.2 Earthing requirements .....	20
5 Protection against electric shock .....	20
5.1 General.....	20
5.1.1 Introductory remark .....	20
5.1.2 Protection from contact with hazardous live parts.....	20
5.1.3 Discharge of capacitors .....	21
5.1.4 Protective impedance .....	22
5.1.5 Accessible parts .....	22
5.1.6 Bonding to the protective conductor.....	25
5.1.7 Protective conductor connection.....	26
5.1.8 High leakage current .....	26
5.1.9 Solid insulation.....	26
5.1.10 Clearances and creepage distances .....	27
5.1.11 Functional earthing.....	29
5.2 Single-fault conditions .....	29
5.2.1 Testing in single-fault condition .....	29
5.2.2 Application of single-fault condition .....	30
5.2.3 Duration of tests.....	31
5.2.4 Compliance .....	32
6 Mechanical aspects .....	33
6.1 Protection against mechanical hazards.....	33
6.1.1 Stability .....	33
6.1.2 Moving parts.....	33
6.1.3 Edges and corners .....	33
6.2 Mechanical requirements.....	33
6.3 Mechanical security of terminations.....	33
7 Flammability and resistance to fire .....	33
7.1 General.....	33
7.2 Rationale.....	34
7.3 General hazards from overheating and fire .....	36
7.3.1 Equipment temperature limits .....	36
7.3.2 Hazardous gases and chemicals.....	36
7.4 Minimization of fire risk.....	37
7.4.1 General .....	37
7.4.2 Eliminating or reducing the sources of ignition within the equipment.....	37
7.5 Cabling and fusing.....	37
7.6 Flammability of materials and components .....	38
7.6.1 General .....	38
7.6.2 Materials for components and other parts inside fire enclosures .....	38

7.6.3	Materials for fire enclosures .....	39
7.6.4	Materials for components and other parts outside fire enclosures .....	39
7.7	Fire ignition sources .....	40
7.8	Conditions for a fire enclosure .....	40
7.8.1	General .....	40
7.8.2	Parts requiring a fire enclosure .....	40
7.8.3	Parts not requiring a fire enclosure .....	40
7.9	Requirements for primary circuits and circuits exceeding ELV limits .....	41
7.10	Fire enclosures and flame barriers .....	41
7.11	Assessment of the fire risk due to a single-fault condition .....	43
7.11.1	Guidelines for maximum acceptable temperatures when subjecting a circuit or component to a single-fault condition .....	43
7.11.2	Temperature of windings under a normal condition or a single-fault condition .....	43
7.11.3	Compliance of equipment with requirements for protection against the spread of fire .....	43
7.12	Limited-energy circuit .....	44
8	General and fundamental design requirements for safety .....	45
8.1	Climatic conditions for safety .....	45
8.2	Electrical connections .....	45
8.3	Components .....	45
8.3.1	General .....	45
8.3.2	High-integrity part or component .....	45
8.4	Connection to telecommunication networks .....	46
8.5	Connection to other equipment .....	46
8.6	Laser sources .....	46
8.7	Explosion .....	46
8.7.1	General .....	46
8.7.2	Components at risk of explosion .....	46
9	Marking, documentation and packaging .....	47
9.1	Marking .....	47
9.1.1	General .....	47
9.1.2	Identification .....	48
9.1.3	Auxiliary supplies, VT, CT, I/O (Input/Output) .....	48
9.1.4	Fuses .....	49
9.1.5	Measuring circuit terminals .....	50
9.1.6	Terminals and operating devices .....	50
9.1.7	Equipment protected by double or reinforced insulation .....	51
9.1.8	Batteries .....	51
9.1.9	Test voltage marking .....	53
9.1.10	Warning markings .....	53
9.1.11	Marking durability .....	54
9.2	Documentation .....	54
9.2.1	General .....	54
9.2.2	Equipment ratings .....	54
9.2.3	Equipment installation .....	55
9.2.4	Equipment commissioning and maintenance .....	55
9.2.5	Equipment operation .....	56
9.3	Packaging .....	56

10	Type tests and routine tests.....	56
10.1	General.....	56
10.2	Safety type tests.....	58
10.3	Routine testing or sample testing.....	58
10.4	Conditions for testing.....	58
10.5	Verification procedure.....	58
10.6	Tests.....	59
10.6.1	Climatic environmental tests.....	59
10.6.2	Mechanical tests.....	59
10.6.3	Clearances and creepage distances.....	60
10.6.4	Safety-related electrical tests.....	60
10.6.5	Electrical environment and flammability.....	66
10.6.6	Reverse polarity and slow ramp test.....	67
Annex A	(normative) Isolation class requirements and example diagrams.....	69
Annex B	(normative) Rated impulse voltages.....	77
Annex C	(normative) Guidance for the determination of clearance, creepage distance and withstand voltages.....	78
Annex D	(informative) Components.....	88
Annex E	(normative) External wiring terminations.....	92
Annex F	(informative) Examples of battery protection.....	94
	Bibliography.....	95
	Figure 1 – Flow chart showing requirements for protection against the spread of fire.....	35
	Figure 2 – Baffle.....	42
	Figure 3 – Location and extent of a flame barrier.....	42
	Figure 4 – Voltage ramp test.....	68
	Figure A.1 – Equipment with SELV input/output (I/O).....	73
	Figure A.2 – Equipment with PELV input/output (I/O).....	74
	Figure A.3 – Equipment with PEB input/output (I/O).....	75
	Figure A.4 – Equipment with ELV input/output (I/O).....	76
	Figure C.1 – Guidance for determination of clearances, creepage distances and withstand voltages.....	81
	Figure F.1 – Non-rechargeable battery protection.....	94
	Figure F.2 – Rechargeable battery protection.....	94
	Table 1 – Current levels under normal conditions.....	24
	Table 2 – Charge or energy of capacitance levels under normal conditions.....	24
	Table 3 – Altitude multiplication factor.....	28
	Table 4 – Current levels in single-fault condition.....	32
	Table 5 – Maximum temperature under normal conditions and at an ambient temperature of 40 °C.....	36
	Table 6 – Acceptable perforation in the bottom of an equipment case.....	42
	Table 7 – Insulation material of windings.....	43
	Table 8 – Limits of maximum available current.....	44
	Table 9 – Overcurrent protective device.....	44

Table 10 – Symbols .....	52
Table 11 – Symbols for marking of test voltage(s).....	53
Table 12 – Overview of tests.....	57
Table 13 – Guidance for routine and sample dielectric voltage testing for safety – Informative.....	63
Table 14 – AC test voltages .....	64
Table A.1 – Circuit isolation class for product circuits/groups.....	69
Table A.2 – Insulation requirement between any two circuits .....	71
Table B.1 – Rated impulse voltages (waveform: 1,2/50 $\mu$ s).....	77
Table C.1 – Functional insulation, pollution degree 1, overvoltage category I.....	82
Table C.2 – Functional insulation, pollution degree 2, overvoltage category I.....	83
Table C.3 – Functional, basic or supplementary insulation, pollution degree 1, overvoltage category II .....	83
Table C.4 – Functional, basic or supplementary insulation, pollution degree 2, overvoltage category II .....	84
Table C.5 – Functional, basic or supplementary insulation, pollution degree 1, overvoltage category III .....	84
Table C.6 – Functional, basic or supplementary insulation, pollution degree 2, overvoltage category III .....	85
Table C.7 – Double or reinforced insulation, pollution degree 1, overvoltage category II.....	85
Table C.8 – Double or reinforced insulation, pollution degree 2, overvoltage category II.....	86
Table C.9 – Double or reinforced insulation, pollution degree 1, overvoltage category III.....	86
Table C.10 – Double or reinforced insulation, pollution degree 2, overvoltage category III.....	87
Table C.11 – Test voltage multiplication factor for proving the clearance in air.....	87
Table C.12 – Reduction of the pollution degree of internal environment through the use of additional protection within the equipment.....	87
Table E.1 – Range of conductor sizes to be accepted by terminals .....	93
Table E.2 – Sizes of terminal studs or screws directly securing supply conductors.....	93

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MEASURING RELAYS AND PROTECTION EQUIPMENT –****Part 27: Product safety requirements**

## 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 60255-27 has been prepared by IEC technical committee 95: Measuring relays and protection equipment.

This second edition cancels and replaces the first edition published in 2005. This edition constitutes a technical revision.

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

- a) The removal of tables and diagrams which are from other standards and referring instead directly to the source standard.
- b) All aspects of IEC 60255-5 have been covered and this standard can be withdrawn.
- c) Ambiguity within the standard has been removed.

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

FDIS	Report on voting
95/316/FDIS	95/318/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 in the IEC 60255 series, published under the general title *Measuring relays and protection equipment*, can be found on the IEC website.

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.

Withdrawn

## INTRODUCTION

In order to demonstrate that the equipment is safe, it was previously necessary to refer to general safety standards such as IEC 61010-1 in addition to IEC 60664-1.

These general safety standards specify requirements for general product types or product families in order to reduce the risk of fire, electric shock or injury to the user. The product types do not include measuring relays and protection equipment. These standards also take into account single-fault conditions.

Reference to all these various standards created confusion due to conflicting requirements, for example, different clearances, creepage distances and test voltages etc., for the same rated voltages.

The aim of this standard is:

- to remove confusion due to conflicting requirements between existing standards;
- to achieve a uniform approach throughout the international industry for measuring relays and protection equipment.

This product safety standard for measuring relays and protection equipment takes the general product safety standards and IEC 60664-1 as the base, defining those issues specific to measuring relays and protection equipment.

Withdrawing