

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Electromechanical elementary relays –
Part 1: General and safety requirements**

**Relais électromécaniques élémentaires –
Partie 1: Exigences générales et de sécurité**



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 It also gives information on projects, replaced and withdrawn publications.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



**Electromechanical elementary relays –
Part 1: General and safety requirements**

**Relais électromécaniques élémentaires –
Partie 1: Exigences générales et de sécurité**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.120.70

ISBN 978-2-8322-2322-2

**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.....	9
2 Normative references	9
3 Terms and definitions	11
3.1 Terms and definitions related to general terms.....	11
3.2 Terms and definitions of relay types.....	12
3.3 Terms and definitions related to conditions and operations	13
3.4 Terms and definitions of operating values	15
3.5 Terms and definitions related to contacts	16
3.6 Terms and definitions related to accessories.....	19
3.7 Terms and definitions related to insulation	19
4 Influence quantities	21
5 Rated values	22
5.1 General.....	22
5.2 Rated coil voltage/rated coil voltage range.....	22
5.3 Operative range	22
5.4 Release	23
5.5 Reset.....	23
5.6 Electrical endurance	23
5.7 Frequency of operation	23
5.8 Contact loads.....	23
5.9 Ambient temperature	24
5.10 Categories of environmental protection	24
5.11 Duty factor	24
6 General provisions for testing	24
7 Documentation and marking	27
7.1 Data.....	27
7.2 Additional data.....	28
7.3 Marking.....	28
7.4 Symbols.....	29
8 Heating.....	29
8.1 Requirements	29
8.2 Test set-up	30
8.3 Test procedure.....	31
8.4 Terminals.....	31
8.4.1 General	31
8.4.2 Solder terminals	32
8.4.3 Flat quick-connect terminations	32
8.4.4 Screw and screwless type terminals	33
8.4.5 Alternative termination types	33
8.4.6 Sockets	33
9 Basic operating function	33
9.1 General test conditions	33
9.2 Operate (monostable relays).....	33
9.2.1 Operate with (constant) coil voltage.....	34

9.2.2	Operate with PWM and/or other operating methods	35
9.3	Operate/reset (bistable relays).....	35
10	Dielectric strength	35
10.1	Preconditioning.....	35
10.2	Dielectric strength.....	36
10.3	Special cases for test procedure B.....	37
11	Electrical endurance.....	38
11.1	General.....	38
11.2	Overload and endurance test.....	39
11.3	Failure and malfunction criteria	39
11.4	Final dielectric test.....	39
12	Mechanical endurance.....	41
13	Clearances, creepage distances and solid insulation	42
13.1	General provisions.....	42
13.2	Clearances and creepage distances.....	43
13.3	Solid insulation	47
13.4	Accessible surfaces	47
13.5	Solid insulation in the coil assembly as part of the insulation coordination	48
14	Terminations	48
14.1	General.....	48
14.2	Screw terminals and screwless terminals.....	48
14.3	Flat quick-connect terminations.....	48
14.4	Solder terminals.....	48
14.4.1	Resistance to soldering heat.....	48
14.4.2	Solder pins	49
14.4.3	Terminals for surface mounting (SMD).....	49
14.4.4	Other solder terminations (e.g. soldering lugs).....	49
14.5	Sockets.....	49
14.6	Alternative termination types.....	49
15	Sealing.....	50
16	Heat and fire resistance.....	50
Annex A (normative)	Explanations regarding relays	51
Annex B (informative)	Inductive contact loads.....	54
Annex C (normative)	Test set-up	58
C.1	Test circuit.....	58
C.2	Description and requirements	60
C.2.1	Power source for coil energization	60
C.2.2	Switching (coil control) device	60
C.2.3	Power source for contact loads.....	60
C.2.4	Control device	60
C.2.5	Measuring and indicating device.....	61
C.3	Test schematic.....	61
C.4	Contact load categories (CC).....	61
C.5	Special loads	61
Annex D (informative)	Special loads	62
D.1	Dedicated device application tests and test sequences	62
D.2	Special loads for telecom and signal relays.....	68

D.3	Special loads with inrush current	69
Annex E (normative)	Heating test arrangement	72
Annex F (normative)	Measurement of clearances and creepage distances	73
Annex G (normative)	Relation between rated impulse voltage, nominal voltage and overvoltage category	78
Annex H (normative)	Pollution degrees	80
Annex I (normative)	Proof tracking test	81
Annex J (informative)	Schematic diagram of families of terminations	82
Annex K (normative)	Glow-wire test	83
Annex L (normative)	Ball pressure test	84
Annex M (informative)	Needle flame test	86
Annex N (informative)	Resistance for standard soldering processes	87
N.1	General	87
N.2	Double wave soldering process	87
N.2.1	Profile	87
N.2.2	Conditions	87
N.3	SMT and through hole reflow (THR) soldering process	88
N.3.1	Profile	88
N.3.2	Conditions	88
N.4	Evaluation	88
Annex O (informative)	Risk assessment	89
O.1	General	89
O.2	Risk assessment procedure	89
O.3	Achieving tolerable risk	90
O.4	An application of risk assessment procedures (proposal for the user)	91
	Alphabetical list of terms	93
	Bibliography	94
Figure A.1	– Diagram explaining terms related to monostable relays	51
Figure A.2	– Example explaining terms relating to contacts	52
Figure A.3	– Explanations regarding the operative range of the coil voltage	52
Figure A.4	– Explanation regarding the preconditioning and testing of the operate voltage according to 5.3.1 (Class 1) and 9.2	53
Figure A.5	– Explanation regarding the preconditioning and testing of the operate voltage according to 5.3.2 and 9.2	53
Figure C.1	– Standard test circuit	58
Figure C.2	– Functional block diagram	59
Figure C.3	– Contact load categories	61
Figure D.1	– Typical test circuit diagram	67
Figure D.2	– Waveform per synthetic measurement of pulse width and peak current	68
Figure D.3	– Circuit for cable load	68
Figure D.4	– Test circuit for inrush current loads (e.g. capacitive loads and simulated tungsten filament lamp loads) – AC circuits	69
Figure D.5	– Example for a tungsten filament lamp test for relays rated 10/100 A/250 V~/2,5 ms	70

Figure D.6 – Test circuit for inrush current loads (e.g. capacitive loads and simulated lamp loads) – DC circuits	70
Figure D.7 – Test circuit for inrush current loads (e.g. simulated fluorescent lamp loads) with power-factor correction	71
Figure E.1 – Test arrangement	72
Figure F.1 – Example 1	73
Figure F.2 – Example 2	73
Figure F.3 – Example 3	74
Figure F.4 – Example 4	74
Figure F.5 – Example 5a and 5b	74
Figure F.6 – Example 6a and 6b	75
Figure F.7 – Example 7a and 7b	75
Figure F.8 – Example 8a and 8b	76
Figure F.9 – Example 9	76
Figure F.10 – Example 10	77
Figure F.11 – Example 11	77
Figure J.1 – Schematic diagram of families of terminations	82
Figure L.1 – Ball pressure test apparatus	85
Figure N.1 – Double wave soldering profile	87
Figure N.2 – SMT and through hole soldering profile	88
Figure O.1 – Iterative process of risk assessment and risk reduction	89
Figure O.2 – Risk reduction	90
Table 1 – Reference values of influence quantities	22
Table 2 – Categories of protection	24
Table 3 – Type testing	26
Table 4 – Routine tests	26
Table 5 – Number of test samples	26
Table 6 – Required relay data (1 of 2)	27
Table 7 – Symbols	29
Table 8 – Examples for indication of rated values	29
Table 9 – Thermal classification	30
Table 10 – Cross-sectional areas and lengths of conductors dependent on the current carried by the terminal	32
Table 11 – Operate and release with constant coil voltages	34
Table 12 – Operate and release with PWM and/or other operating methods	35
Table 13 – Dielectric strength – AC	36
Table 14 – Dielectric strength – DC	37
Table 15 – Electrical endurance test procedures	39
Table 16 – Schematics for contact loading	40
Table 17 – Provisions for the dimensioning of clearances and creepage distances	43
Table 18 – Minimum clearances in air for insulation coordination	45
Table 19 – Material groups	45
Table 20 – Minimum creepage distances for equipment subject to long-term stresses	46

Table 21 – Rated insulation voltage according to supply system voltage	47
Table 22 – Test conditions for test Tb	49
Table B.1 – Verification of the making and breaking capacity (abnormal conditions)	55
Table B.2 – Verification of the making and breaking capacity (normal conditions)	56
Table B.3 – Electrical endurance test.....	56
Table B.4 – Contact rating designations and equivalency to utilization categories	57
Table C.1 – Characteristics of power sources for contact loads	59
Table C.2 – Standard contact load characteristics	60
Table D.1 – Overload test values	62
Table D.2 – Endurance test values	63
Table D.3 – Horsepower-rated equipment full-load currents (AC).....	64
Table D.4 – Horsepower-rated equipment currents (DC)	64
Table D.5 – Overload and endurance test voltages	64
Table D.6 – Bulk energy capacitances	66
Table D.7 – Peak current requirements	66
Table G.1 – Correspondence between the nominal voltage of the supply system and the equipment rated impulse withstand voltage, in case of overvoltage protection by surge-arresters according to IEC 60099-1.....	78
Table O.1 – Examples for the relation between failure mode, consequences and hazard	91
Table O.2 – Severity of harm	92
Table O.3 – Probability of harm	92
Table O.4 – Risk category.....	92

Preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMECHANICAL ELEMENTARY RELAYS –**Part 1: General and 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 61810-1 has been prepared by IEC technical committee 94: All-or-nothing electrical relays.

This fourth edition cancels and replaces the third edition published in 2008. This edition constitutes a technical revision.

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

- two main test procedures were introduced: procedure A, reflecting the procedure known from Edition 3 of this standard and procedure B, reflecting the assessment according to North American requirements;
- inclusion of dedicated device application tests especially relevant for applications in the North American Market (see Clause D.1);
- introduction of testing under single mounting condition;
- clarification of insulation requirements after endurance testing;

- inclusion of provisions for basic safety requirements;
- update of references.

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

FDIS	Report on voting
94/380/FDIS	94/384RVD

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 IEC 61810 series, published under the general title *Electromechanical elementary relays* 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.

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.

ELECTROMECHANICAL ELEMENTARY RELAYS –

Part 1: General and safety requirements

1 Scope

This part of IEC 61810 applies to electromechanical elementary relays (non-specified time all-or-nothing relays) for incorporation into low voltage equipment (circuits up to 1 000 V alternate current or 1 500 V direct current). It defines the basic functional and safety requirements and safety-related aspects for applications in all areas of electrical engineering or electronics, such as:

- general industrial equipment,
- electrical facilities,
- electrical machines,
- electrical appliances for household and similar use,
- information technology and business equipment,
- building automation equipment,
- automation equipment,
- electrical installation equipment,
- medical equipment,
- control equipment,
- telecommunications,
- vehicles,
- transportation (e.g. railways).

Compliance with the requirements of this standard is verified by the type tests indicated.

In case the application of a relay determines additional requirements exceeding those specified in this standard, the relay should be assessed in line with this application in accordance with the relevant IEC standard(s) (e.g. IEC 60730-1, IEC 60335-1, IEC 60950-1).

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 60038:2009, *IEC standard voltages*

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org>)

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-17:1994, *Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-20:2008, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60079-15:2010, *Explosive atmospheres – Part 15: Equipment protection by type of protection "n"*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60099-1, *Surge arresters – Part 1: Non-linear resistor type gapped surge arresters for a.c. systems*¹

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60364-4-44:2007, *Low voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

IEC 60417, *Graphical symbols for use on equipment* (available at <http://www.graphical-symbols.info/equipment>)

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-3:2003, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60664-4:2005, *Insulation coordination for equipment within low-voltage systems – Part 4: Consideration of high-frequency voltage stress*

IEC 60664-5:2007, *Insulation coordination for equipment within low-voltage systems – Part 5: Comprehensive method for determining clearances and creepage distances equal to or less than 2 mm*

IEC 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*²

IEC 60695-2-12:2010, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

IEC 60695-2-13:2010, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*

IEC 60695-10-2:2003, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test*

¹ Withdrawn.

² This first edition has been replaced in 2014 by a second edition IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60721-3-3:1994, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weatherprotected locations*

IEC 60721-3-3:1994/AMD 1:1995

IEC 60721-3-3:1994/AMD 2:1996

IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

IEC 61210:2010, *Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements*

IEC 61760-1:2006, *Surface mounting technology – Part 1: Standard method for the specification of surface mounting components (SMDs)*

IEC 61984:2008, *Connectors – Safety requirements and tests*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-444 and the following apply.

An alphabetical list of terms can be found at the end of this standard.

NOTE In the text of this standard, the term *relay* is used instead of *elementary relay* to improve the readability.

3.1 Terms and definitions related to general terms

3.1.1 marking

identification of a relay which, when completely given to the manufacturer of this relay, allows the unambiguous indication of its electrical, mechanical, dimensional and functional parameters

EXAMPLE Through the indication of the trade mark and the type designation on the relay, all relay-specific data can be derived from the type code.

3.1.2 intended use

use of a relay for the purpose for which it was made, and in the manner intended by the manufacturer

3.1.3 relay technology categories

categories of relays, based upon environmental protection

Note 1 to entry: Six categories are in use (RT 0 to RT V).

[SOURCE: IEC 60050-444:2002, 444-01-11]