

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Electromechanical elementary relays –
Part 2-1: Reliability – Procedure for the verification of B_{10} values**

**Relais électromécaniques élémentaires –
Partie 2-1: Fiabilité – Procédure de vérification des valeurs de B_{10}**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2017 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 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 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 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 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 2-1: Reliability – Procedure for the verification of B_{10} values**

**Relais électromécaniques élémentaires –
Partie 2-1: Fiabilité – Procédure de vérification des valeurs de B_{10}**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.120.70

ISBN 978-2-8322-4389-3

**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.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	6
3.2 Definitions related to tests	7
4 Verification of B_{10}	7
4.1 General.....	7
4.2 Requirements	7
4.2.1 Test specimens	7
4.2.2 Test circuit.....	8
4.2.3 Contact loads	8
4.2.4 Environmental conditions.....	8
4.2.5 Operating conditions.....	8
4.2.6 Failure criteria	8
4.3 Performance of the tests	9
4.3.1 Type test	9
4.3.2 Routine test.....	9
5 Evaluation and verification of B_{10D}	9
5.1 General.....	9
5.2 Requirements	10
5.2.1 Test specimens	10
5.2.2 Test circuit.....	10
5.2.3 Contact loads	11
5.2.4 Environmental conditions.....	11
5.2.5 Operating conditions.....	11
5.2.6 Failure criteria	11
5.3 Performance of the tests	12
5.3.1 Type test	12
5.3.2 Routine test.....	12
Annex A (informative), Example illustrating the assessment of malfunctions for B_{10D} evaluation.....	15
A.1 Purpose.....	15
A.2 Basic assumptions	15
A.3 Example.....	15
A.4 Evaluation.....	16
Bibliography.....	17
Figure 1 – Schematic flowchart.....	13
Figure 2 – Schematic flowchart for relays where dangerous failures have to be assessed.....	14
Table A.1 – Example with number of cycles at which malfunctions have been recorded	15

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMECHANICAL ELEMENTARY RELAYS –**Part 2-1: Reliability – Procedure for the verification of B_{10} values**

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 61810-2-1 has been prepared by IEC technical committee 94: All-or-nothing electrical relays.

This second edition cancels and replaces the first edition published in 2011. This edition constitutes a technical revision.

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

- a) limitation of tests to 10 M cycles in Clause 5;
- b) reduction of required number of test samples to 5 in specified cases;
- c) introduction of WeiBayes analysis for routine test under Clause 4.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
94/416/FDIS	94/419/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

This International Standard is to be used in conjunction with IEC 61810-2:2017.

A list of all parts in the 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 document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

Based on the general provisions of IEC 61810-2, this part of IEC 61810 specifies reliability test procedures for electromechanical elementary relays where enhanced requirements for the verification of reliability apply. A type test is passed and then confirmed by routine tests with specified periodicity. This document describes how figures for B_{10} (the mean number of cycles until 10 % of the relays have failed) are derived from these life tests performed with representative relay samples.

In particular when electromechanical elementary relays are intended to be incorporated in safety-related control systems of machinery in accordance with IEC 62061 and ISO 13849-1, the mean time to dangerous failure ($MTTF_d$) is a measure that can be taken into account when assessing the probability of dangerous failure of the safety function concerned. Although a component failure cannot be defined as "dangerous" unless the detailed application is known, it is common to consider a failure mode that is likely to result in danger in a typical application of the component, and to refer to this failure mode as a "dangerous failure". The $MTTF_d$ then becomes the expectation of the mean time to failure in this "dangerous" mode. For the calculation of $MTTF_d$ for electromechanical relays, the data provided by the manufacturer for B_{10D} can be used (see Clause C.4 of ISO 13849-1:2015).

Electromechanical elementary relays with forcibly guided (mechanically linked) contacts offer the possibility of a high diagnostic coverage according to 4.5.3 of ISO 13849-1:2015.

NOTE Requirements for such relays are given in IEC 61810-3.

ELECTROMECHANICAL ELEMENTARY RELAYS –

Part 2-1: Reliability – Procedure for the verification of B_{10} values

1 Scope

This part of IEC 61810 specifies reliability test procedures for electromechanical elementary relays when enhanced requirements for the verification of reliability apply.

Particular provisions are given for relays incorporated in safety-related control systems of machinery in accordance with IEC 62061 and ISO 13849-1. For such relays, P_{10} values for dangerous failures (B_{10D} values) are derived from the tests specified in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61810-1:2015, *Electromechanical elementary relays – Part 1: General and safety requirements*

IEC 61810-2:2017, *Electromechanical elementary relays – Part 2: Reliability*

IEC 61810-3, *Electromechanical elementary relays – Part 3: Relays with forcibly guided (mechanically linked) contacts*

IEC 62061, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*

ISO 13849-1:2015 *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61810-2 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

• IEC Electropedia: available at <http://www.electropedia.org/>

• ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

dangerous failure

failure which has the potential to put the safety-related part of a control system in a hazardous or fail-to-function state

[SOURCE: ISO 13849-1:2015, 3.1.5, modified – In the definition, the abbreviated term "SRP/CS" has been replaced by "safety-related part of a control system".]