BRITISH STANDARD

BS EN 60947-5-4:1997
IEC 60947-5-4: 1996

Low-voltage switchgear and controlgear —

Part 5: Control circuit devices and switching elements —

Section 4: Methods of assessing the performance of low energy contacts — Special tests

The European Standard EN 60947-5-4:1997 has the status of a British Standard

ICS 29.120.60

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI Documents
Document Sharing Hub

Full document details: BS EN 60947-5-4:1997

National foreword

This British Standard is the English language version of EN 60947-5-4:1997. It is identical with IEC 60947-5-4:1996.

The UK participation in its preparation was entrusted by Technical Committee PEL/17, High-voltage switchgear, to Subcommittee PEL/17/2, Low-voltage switchgear, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

Attention is drawn to the fact that CEN and CENELEC Standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement these international or European publications may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 18 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Amendments issued since publication

Amd. No.	Date	Comments

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on
15 December 1997

© BSI 04-1999

ISBN 0 580 28823 4

Documents
Document Sharing Hub

Full document details: BS EN 60947-5-4:1997

Contents

	Page
National foreword	Inside front cover
Foreword	2
Text of EN 60947-5-4	3

Documents
Document Sharing Hub

© BSI 4-1999

Full document details: BS EN 60947-5-4:1997

blank

Documents
Document Sharing Hub

Full document details: BS EN 60947-5-4:1997

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60947-5-4

June 1997

ICS 29.120.60

Descriptors: Low-voltage switchgear and controlgear, electromechanical control circuit devices, low-energy contacts, tests

English version

Low-voltage switchgear and controlgear
Part 5: Control circuit devices and switching elements
Section 4: Methods of assessing the performance of low energy contacts
Special tests

(IEC 947-5-4:1996)

Appareillage à basse tension
Partie 5: Appareils et éléments
de commutation pour circuits de commande
Section 4: Méthode d'évaluation des
performances des contacts à basse
énergie — Essais spéciaux
(CEI 947-5-4:1996)

Niederspannungsschaltgeräte
Teil 5: Steuergeräte und Schaltelemente
Hauptabschnitt 4: Verfahren zur
Abschätzung der Leistungsfähigkeit
von Schwachstromkontakten
Besondere Prüfungen
(IEC 947-5-4:1996)

This European Standard was approved by CENELEC on 1995-02-15. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

© 1997 CENELEC — All rights of exploitation in any form and by any means reserved worldwide for CENELEC members.

Ref. No. EN 60947-5-4:1997 E

Documents
Document Sharing Hub

Full document details: BS EN 60947-5-4:1997

Foreword

A draft for an amendment to EN 60947-5-1:1991, prepared by the Technical Committee CENELEC TC 17B, Low-voltage switchgear and controlgear including dimensional standardization, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A11 to EN 60947-5-1 on 1995-02-15.

As the same document was approved and published by IEC as IEC 947-5-4:1996, the Technical Board of CENELEC has decided to redesignate it EN 60947-5-4 on 1997-03-11.

The following dates were fixed:

— latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-10-01

— latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1997-10-01

Annexes designated "normative" are part of the body of the standard. In this standard, Annex A and Annex ZA are normative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the Technical Report IEC 947-5-4:1996 was approved by CENELEC as a European Standard without any modification.

Contents

		Page
Foreword		2
Introduction		3
1	General	3
1.1	Scope and object	3
1.2	Normative references	3
2	Definitions and lists of symbols used	4
2.1	Definitions	4
2.2	List of symbols used	6
3	General principles	6
4	General test method	7
5	General characteristics	8
5.1	Measurement methods	8
5.1.1	Measurement on the contact (basic method)	8
5.1.2	Monitoring the load (alternative method)	8
5.2	Sequences of operations	9
5.3	Electrical characteristics	10
5.3.1	Characteristics of the supply for basic method	10
5.3.2	Supply for alternative method	10
5.3.3	Characteristics of active load	11
5.4	Characteristics of operation	11
6	Characterization of defects	11
6.1	For the basic method	11
6.1.1	Calibration of the detection threshold	11
6.1.2	Monitoring (during t_m)	11
6.2	Monitoring the load	11
6.2.1	Voltage drop measurement	11
6.2.2	Analysis of the state of the load	12
7	Ambient conditions	12
7.1	Normal conditions	12
7.1.1	Preconditioning	12
7.2	Particular conditions	12
8	Methods of reporting	12
8.1	Failure criterion	12
8.2	Reporting the failure rate	12
8.2.1	Estimation of λ_c when failed items are not replaced	12
8.2.2	Estimation of λ_c when failed items are replaced	13
9	Information to be provided in the test report	14
Annex A (normative) Information to be supplied by the manufacturer		16
Annex ZA (normative) Normative references to international publications with their corresponding European publications		18
Figure 1 — Functional diagram of the testing equipment		7
Figure 2 — Typical test circuit for the basic method		8
Figure 3 — Test circuit for monitoring a load		9
Figure 4 — Sequential diagram when the contact switches the load		9
Figure 5 — Sequential when the contact does not switch the load		10
Table 1 — Coefficient K_c for a time-terminated test		14

© BSI 04-1999

Documents Document Sharing Hub

Full document details: BS EN 60947-5-4:1997

Introduction

IEC 947-5-1 indicates (see note 2 of **4.3.1.1**) that control switches may not be suitable for use at very low voltages and therefore it is recommended to seek the advice of the manufacturer concerning any application with a low value of operational voltage, for example below 100 V a.c. or d.c.

However, the development of electronic systems and programmable controllers in industrial processes increases the use of switching elements in low-voltage circuit control.

So it is necessary to define how predictional behaviour of contacts in this area should be established (with an acceptable confidence level), by using precise conventional testing methods, down to specified values (such as 24 V, 1 mA; 5 V, 10 mA).

1 General

1.1 Scope and object

This report applies to separable contacts used in the utilisation area considered such as switching element for control circuits.

This report takes into consideration two rated voltage areas:

a) above (and including) 10 V (typically 24 V) where contacts are used for switching loads with possible electrical erosion, such as programmable controller inputs.

b) below 10 V (typically 5 V) with negligible electrical erosion, such as electronic circuits.

This report does not apply to contacts used in the very low energy area of measurement, for example sensor or thermocouple systems.

The object of this report is to propose a method of assessing the performances of low energy contacts giving:

— useful definitions;

— general principles of test methods which are to monitor and record the behaviour of contacts at each operation;

— functional bases for the definition of a general testing equipment;

— preferred test values;

— particular conditions for testing contacts intended for specific applications (such as switching of PC inputs);

— information to be given in the test reports;

— interpretation and presentation of the rest results.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this report. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this report are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 68-1:1988, *Environmental testing — Part 1: General and guidance.*

IEC 68-2, *Environmental testing — Part 2: Tests.*

IEC 605-6:1986, *Equipment reliability testing — Part 6: Tests for the validity of a constant failure rate assumption.*

IEC 947-1:1996, *Low-voltage switchgear and controlgear — Part 1: General rules.*

IEC 947-5-1:1990, *Low-voltage switchgear and controlgear — Part 5: Control circuit devices and switching elements — Section 1: Electromechanical control-circuit devices.*

IEC 1131-2:1992, *Programmable controllers — Part 2: Equipment requirements and tests.*

ISO 8402:1994, *Quality management and quality assurance — Vocabulary.*

Documents
Document Sharing Hub

© BSI 04-1999

Full document details: BS EN 60947-5-4:1997

2 Definitions and lists of symbols used

2.1 Definitions

For the purpose of this technical report the following definitions apply.

In this report "time interval" is expressed as the "number of switching cycles", as appropriate in definitions.

2.1.1
reliability

the probability that an item can perform a required function, under given conditions, for a given time interval (t_1, t_2) [IEV 191-12-01, modified]

NOTE 1 It is generally assumed that the item is in a state to perform this required function at the beginning of the time interval.
NOTE 2 The term "reliability" is also used to denote the reliability performance quantified by this probability (see IEV 191-02-06).

2.1.2
contact reliability

the probability that a contact can perform a required function, under given conditions, for a given number of operating cycles

2.1.3
failure

the termination of the ability of an item to perform a required function [IEV 191-04-01]

NOTE 1 After a failure the item has a fault.
NOTE 2 "Failure" is an event, as distinguished from "fault", which is a state.
NOTE 3 This concept as defined does not apply to items consisting of software only.

2.1.4
defect

the non-fulfillment of an intended requirement or an expectation for an entity, including one concerned with safety [ISO 8402:1994, 2-11 modified]

NOTE The requirement or expectation should be reasonable under the existing circumstances.

2.1.5
observed failure rate λ_{ob}

for a stated period in the life of an item, the ratio of the total number of failures in a sample to cumulated observed number of cycles on that sample. The observed failure rate is to be associated with particular and stated number of switching cycles (or summation of switching cycles) in the life of the item, and with stated conditions

2.1.6
assessed failure rate λ_c

the failure rate of an item determined by a limiting value or values of the confidence interval associated with a stated confidence level, based on the same data as the observed failure rate of nominally identical items

NOTE 1 The source of the data shall be stated.
NOTE 2 Results can be accumulated (combined) only when all conditions are similar.
NOTE 3 The assumed underlaying distribution of failures against time shall be stated.
NOTE 4 It should be stated whether a one-side or a two-side interval is being used.
NOTE 5 Where only one limiting value is given, this is usually the upper limit.

2.1.7
constant failure rate period

that period, if any, in the life of a non-repaired item during which the failure rate is approximately constant [IEV 191-10-09]

NOTE In reliability engineering, it is often assumed that the failure rate λ is constant that is that the times to failure are distributed exponentially.

2.1.8
entity; item

any element that can be individually considered

NOTE 1 An entity may be, for example:
— a physical item;

© BSI 04-1999
Documents Document Sharing Hub
Full document details: BS EN 60947-5-4:1997