INTERNATIONAL STANDARD

IEC 61811-50

QC 160500

Second edition
2002-03

Electromechanical all-or-nothing relays –

Part 50:
Sectional specification –
Electromechanical all-or-nothing telecom relays of assessed quality

Relais électromécaniques de tout-ou-rien –

Partie 50:
Spécification intermédiaire –
Relais électromécaniques de tout-ou-rien télécom soumis au régime d'assurance de la qualité

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMECHANICAL ALL-OR-NOTHING RELAYS –

Part 50: Sectional specification – Electromechanical all-or-nothing telecom relays of assessed quality

FOREWORD

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International Standard IEC 61811-50 has been prepared by IEC technical committee 94: All-or-nothing electrical relays.

This second edition of IEC 61811-50 cancels and replaces the first edition published in 1997 and constitutes a technical revision.

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

FDIS	Report on voting
94/144/FDIS	94/158/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.

The QC number that appears on the front cover of this publication is the specification number in the IEC Quality Assessment System for Electronic Components (IECQ).

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

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- withdrawn;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

ELECTROMECHANICAL ALL-OR-NOTHING RELAYS –

Part 50: Sectional specification – Electromechanical all-or-nothing telecom relays of assessed quality

1 General

1.1 Scope

This part of IEC 61811 is a sectional specification and applies to electromechanical all-or-nothing telecom relays of assessed quality. Relays according to this standard are provided for operation in telecommunication applications. However, as electromechanical all-or-nothing relays, they are also suitable for particular industrial and other applications.

This standard selects from IEC 61810-7 and other sources the appropriate methods of test to be used in detail specifications derived from this specification, and contains basic test schedules to be used in the preparation of such specifications. Detailed test schedules are contained in the blank detail specifications supplementary to this specification.

1.2 Normative references

The following referenced documents are indispensable for the application 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 60062:1992, *Marking codes for resistors and capacitors*

IEC 60255-23:1994, *Electrical relays – Part 23: Contact performance*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 60695-2-2:1991, *Fire hazard testing – Part 2: Test methods – Section 2: Needle-flame test*

IEC 61709:1996, *Electronic components – Reliability – Reference conditions for failure rates and stress models for conversion*

IEC 61810-1:1998, *Electromechanical non-specified time all-or-nothing relays – Part 1: General requirements*

IEC 61810-5:1998, *Electromechanical non-specified time all-or-nothing relays – Part 5: Insulation co-ordination*

IEC 61810-7:1997, *Electromechanical all-or-nothing relays – Part 7: Test and measurement procedures*

IEC 61811-1:1999, *Electromechanical non-specified time all-or-nothing relays of assessed quality – Part 1: Generic specification*

QC 001002-3:1998, *Rules of Procedure of the IEC Quality Assessment System for Electronic Components (IECQ) – Part 3: Approval Procedures*

ISO 8601:2000, *Data elements and interchange formats – Information interchange – Representation of dates and times*

ISO 9001:2000, *Quality systems – Model for quality assurance in design, development, production, installation and servicing*

CECC 00016:1990, *Basic requirements for the use of statistical process control (SPC) in the CECC system*

CECC 00800:1986, *Code of practice on the use of the ppm approach in association with the CECC system*

1.3 Terms and definitions

For the purpose of this part of IEC 61811, the terms and definitions given in IEC 61810-7, as well as the following apply:

1.3.1
types of relays
types of relays as defined in IEC 61810-7

NOTE The most frequent types of electromechanical all-or-nothing telecom relays are the following ones:

– monostable: non-polarized;

– monostable: polarized;

– bistable: polarized.

1.3.2
types of contacts
a) **change-over break-before-make contact**

change-over contact, one contact circuit of which breaks before the other makes

b) **change-over make-before-break contact**

change-over contact, one contact circuit of which makes before the other breaks

1.3.3
contact fault and contact failure
a) **contact fault due to contact-circuit resistance**

the occurrence is assumed when the contact-circuit resistance of a closed contact exceeds the maximum value stated in the detail specification

b) **contact fault due to non-opening of the contact circuit (e.g. contact sticking)**

the occurrence due to the fact that the contact does not open is assumed when the resistance of an open contact assembly falls below the specified minimum value stated in the detail specification

c) **contact failure**

the occurrence is assumed when the number of faults due to contact-circuit resistance or/and of faults due to non-opening of the contact circuit exceeds the number of faults stated in the detail specification, with reference to a single tested contact

1.3.4
relay fault, relay failure and relay defect
a) **relay fault**

the state of a relay characterized by the inability to perform a required function. A fault persists for a limited time after which the relay recovers the ability to perform a required function without being subjected to any corrective maintenance

b) **relay failure**

failure occurs when the relay is unable to carry out its required function

c) **relay defect**

any deviation of a characteristic of a relay from the requirements

NOTE 1 The requirements may or may not be expressed in the form of a specification.

NOTE 2 A defect may or may not affect the ability of a relay to perform a required function.

d) **defective relay**

relay containing one or more defects

1.4 Preferred values

The following Subclauses contain preferred values applicable to electromechanical all-or-nothing telecom relays.

1.4.1 Rated coil voltages

Preferred values d.c.: 1,5; 3; 4,5; 5; 6; 9; 12; 24; 48 or 60 V.

1.4.2 Contact-circuit resistance

a) Preferred values in initial condition: maximum 50; 100 or 200 mΩ.

b) Preferred values during/after tests: maximum 0,5; 1; 5; 10; 20 or 100 Ω.

c) Preferred value for detecting faults due to non-opening of the contact circuit during tests: minimum 100 kΩ.

d) Voltage for detecting faults due to non-opening of the contact circuit during tests; preferred maximum values: 0,03; 5; 6; 12; 24; 48 or 60 V d.c.

e) Difference of contact-circuit resistance between different contact circuits in the same relay, preferred value: maximum 100 mΩ (initial condition).

1.4.3 Dielectric test

Preferred values in initial condition between opened contact circuits, between separate contact circuits, between contact circuits and coil(s), between all conductive parts and mass (if applicable) in accordance with IEC 61810-5.

a) Preferred voltages: 0,5; 0,8; 1,5; 2,5 kV a.c.

b) Preferred duration: 1 s or 60 s

1.4.4 Impulse voltage test

a) Preferred voltages: 0,5; 1,0; 1,5; 2 or 2,5 kV.

b) Preferred waveform: 0,5 μs/700 μs, 1,2 μs/50 μs or 10 μs/700 μs.

c) Preferred number of pulses (alternate positive and negative pulses): 10.

d) Preferred frequency of pulses: 2 or 4 pulses/min.

1.4.5 Insulation resistance

Preferred value: 1 000 MΩ at 500 V d.c. initial value.

1.4.6 Number of operations determining electrical endurance

Preferred values: 10 000; 20 000; 50 000; 100 000; 200 000; 500 000; 700 000; 1 000 000; 1 600 000; 2 000 000; 5 000 000; 10 000 000; 20 000 000 or 30 000 000.

1.4.7 Contact failure rate for test evaluation purposes

Preferred values: maximum 10^{-5}, 10^{-6}, 10^{-7}, 10^{-8}/contact/cycle.

1.5 Marking and documentation

Relays and their package supplied in accordance with detail specifications covered by this sectional specification shall be marked as follows:

1.5.1 Marking of the relay

a) Manufacturer's name, logo or trade mark.
b) Relay type and variant code.
c) Coded date of manufacture, in terms of year/week according to 1.5.3.
d) IECQ in letters or IECQ mark of conformity.
e) Identification of terminal No. 1.

1.5.2 Marking of the package

a) Manufacturer's name, logo or trade mark.
b) Relay type and variant code.
c) Manufacturer's batch identification code.
d) IECQ in letters or IECQ mark of conformity.
e) Detail specification reference if not marked on the relay.
f) Quantity.

1.5.3 Coded date of manufacture

The marking system shall use four figures as specified in 5.2 of IEC 60062. The first two figures shall be the last two figures of the year and the last two figures the numbering of the week (5.2.3.3 b) of ISO 8601, year and week in the current century, modified).

Example: Fifth week of 1994 = 9405.

If stated in the detail specification only, the basic format for a specific date in accordance with 5.2.1.3 a) of ISO 8601 shall be used. The first two figures shall be the last two figures of the year, the month is represented by the next two figures and the day of the month is represented by the last two figures.

Example: 20th June 1994 = 940620.

2 Quality assessment procedures

2.1 Primary stage of manufacture

The primary stage of manufacture is the first process subsequent to the manufacture of finished parts and subassemblies of the relay.

NOTE 1 A subassembly is understood to mean here the permanent assembly of two or more piece parts.

NOTE 2 Important manufacturing steps are as follows:

a) fabrication, heat treatment and plating of the component parts of the relay;

b) coil winding;

c) assembling of the electrical and electromechanical parts;

d) adjustment of the relay contacts, if applicable;

e) high-temperature drying, gas backfilling and sealing of the relay, if applicable;

f) final measurements and periodic inspection of test groups A to C.

2.2 Structurally similar relays

Relays are considered structurally similar if they have no differences in design other than:

a) coil wire diameter and number of windings;

b) types, numbers and material of contacts;

c) rated coil and/or contact voltage(s);

d) mounting and terminal variants within the limits prescribed in the detail specification;

e) biasing of the input circuit parts.

2.3 Subcontracting

For subcontracting, see annex B to Clause 2 of QC 001002-3.

2.4 Qualification approval procedures

Qualification approval tests shall include all the tests prescribed in the detail specification and shall be performed by a schedule specifically prescribed in the detail specification.

The number of specimens for each subgroup is specified in the blank detail specification. As a general rule, a minimum of five specimens are required for each group of tests.

2.5 Quality conformance inspection

2.5.1 Formation of inspection lots

Inspection lots submitted to groups A and B acceptance tests shall be formed in accordance with 3.2.3 of QC 001002-3 and with the sampling plans and procedures given in IEC 60410, except where production is too infrequent or too small for sampling plans to apply; in these cases inspection shall be 100 %.

When sampling is carried out in accordance with IEC 60410, the percent defective concept only shall be used. Stratified or representative sampling shall always be used to include all production lines and structurally similar relays in proportion to their respective quantities in the lot. Exceptions from proportionality may become necessary and shall be stated in the detail specification. Specimens shall be as representative as possible of the production.

The determination basis for the sample sizes from continuous production lines shall be stated in the blank detail specification.

2.5.2 Periodic inspection

Fixed sample sizes for group C inspection shall be taken from a lot (or lots) which has (have) passed groups A and B inspection during or at the end of the specified reference period.

2.6 Test schedule

2.6.1 Test sequence

A test sequence shall consist of all tests listed in the detail specification. Where appropriate, the reference number of the tests are those of the IEC 61810-7. Additional testing may be called for by the detail specification.

2.6.2 Groups A and B

The inspection level (IL) notation applies to all tests in one subgroup. A corresponding value/range of values of the acceptable quality level (AQL) shall be given in the blank detail specification, and the authority preparing detail specifications shall choose the appropriate value, which then applies to all tests in one subgroup.

Any given IL-AQL notations shall be interpreted so that the number of defectives allowable for acceptance is applicable separately to each test within a subgroup. However, the blank detail specification may prescribe this same IL for relays submitted to cumulative tests of the same subgroup.

2.6.3 Group C

The blank detail specification shall prescribe for each subgroup:

a) periodicity of each subgroup. If the same periodicity is applicable to all subgroups, it shall be given at the beginning of the group test details;
b) the minimum sample size for each test (or group of tests) performed with the same relays and the acceptable number of defectives.

2.7 Order of tests

Quality conformance inspection is divided into two parts: that carried out lot-by-lot, on which the release of the individual lots is based, and that carried out on a periodic basis, which contains the time-consuming and more expensive tests.

When several tests are subsequently to be carried out on any one specimen or number of specimens, the following order shall apply, unless otherwise prescribed in the detail specification:

a) a 100 % test with a screening or sorting function shall always precede any other non-destructive (ND) or destructive (D) test;
b) tests in groups other than a 100 % test shall be performed in the sequence given in the blank detail specification. It shall be ensured that the effects of earlier tests are not liable to invalidate the results of the later tests (see 4.1).

3 Preparation of blank detail and detail specifications

3.1 Blank detail specifications shall conform to the test schedules given in Table 1 of this specification and the related explanations.

3.2 Blank detail specifications shall give the following information or call for its inclusion in the detail specification:

a) Identification of the detail specification.

b) Identification of the relay and information on its applications; identification shall be provided by such properties as size, sealing, whether monostable or bistable, polarized or not, or other characteristics required for identification, contact operating range and temperature range.

c) Outline drawing of the relay and key dimensions; variants, such as for terminals, may be given in an annex to the detail specification.

   Customer packaging requirements for automatic handling.

d) Reference data of the relay.

   1) A limited number of values is required on the front page to describe the overall performance of the relay.

   2) Full information in conformance with 1.4 and IEC 61810-1 shall be added on one of the subsequent pages. Rated values preferably should be those listed therein. Where tests refer to rated values, this shall be indicated with each test. Where tests are to be performed at other than rated values, the test values shall be indicated and clearly distinguished from the rated values.

e) Normative references.

   Reference shall be made to IEC 61810-7 and this sectional specification. When reference to further documents is necessary, such documents shall be listed with their full titles, year of edition and, unless common knowledge, the source from which they can be obtained.

f) Assessment level.

   Table 1 of this specification contains one test schedule. If additional tests not listed there have been added, this shall be stated.

g) Periodicity of tests.

h) Formation of inspection lots, if predictable in the sense of 2.6.1.

i) Order of tests, if deviating from 2.7.

j) General test conditions, if deviating from 3.5 of IEC 61810-7.

k) Qualification approval test schedule.

l) Quality conformance test schedule.

   For each group of tests, the final measurements and post-test requirements specified in each of them may be summarized and stated at the end of the subgroup.

   It shall be stated that samples subjected to destructive tests (D) shall not be released for delivery.

   NOTE If application of SPC or ppm approach is required, this should be provided between the manufacturer and user of a relay in accordance with CECC 00800, CECC 00016 or ISO 9001.

m) Specification of IL numbers (groups A and B) and sample sizes (group C).

n) Specification of AQL numbers (groups A and B) and acceptable numbers of defectives (group C).

o) Marking of package and/or relays beyond those listed in this specification, if necessary.

p) Ordering information.

3.3 Additional information such as curves and drawings may be given in an annex to the detail specification. Such information is not required to be verified for test purposes.

3.4 When preparing blank detail or detail specifications, the following procedures should be followed:

– select the tests to be performed from Table 1 of this sectional specification;

– if necessary, add any other necessary tests, required or not specified in IEC 61810-7.

4 Test schedule

4.1 Test sequence

The order of tests in each subgroup of Table 1, and in the derived schedule in any corresponding blank detail specification, is mandatory unless a specific statement to the contrary is given. The sealing test shall always be the final test.

4.2 Types of relays, based upon environmental protection (relay technology RT)

RT 0 unenclosed relay

RT I dust-protected relay

RT II flux-proof relay

RT III wash-tight relay

RT IV sealed relay

RT V hermetically sealed relay

The definitions of protection and sealing are defined in 2.2 of IEC 61810-7.

4.3 Categories of application of contacts

CA 0 30 mV max./10 mA max.

CA 1 30 mV to 60 V/10 mA to 0,1 A

CA 2 5 V to 250 V/0,1 A to 1 A

CA 3 5 V to 600 V/0,1 A to 100 A.

The definitions of contact application are defined in 2.8 of IEC 61810-7.

The actual power rating of the contacts at minimum and maximum loads and the required number of switched cycles shall be defined in the detail specification (see 4.4, note 3).

4.4 Notes relative to Table 1

NOTE 1 Test groups are as defined in IEC 61811-1.

NOTE 2 For the 100 % test subgroup, a relay shall be rejected when it fails any test. For detection purposes, a contact can be considered closed when the voltage drop across it is less than one half of its open-circuit value. Conditions of test shall be specified in the detail specification. All contact loads shall be at a level that does not cause significant change to the contact surfaces.

NOTE 3 Electrical endurance testing shall be for a minimum number of operations as defined in the blank detail or detail specification. If required, these tests can be continued to failure in order to acquire reliability data. Failure criteria and rules shall be specified in the blank detail specification.

NOTE 4 For electromechanical all-or-nothing telecom relays, the majority contact action is break-before-make change-over. To ensure that the contact sequencing occurs in this order, the transfer time measurement refers to the time interval during which all contact circuits of a relay are open.

Analogously, to ensure that the make-before-break change-over contact sequencing occurs in the right order, the bridging time measurement refers to the time interval during which all contact circuits of a relay are closed.

Specifying of time to stable closing in the detail specification is optional.

NOTE 5 Abbreviations:

M: mandatory test to be included in the blank detail or detail specification;

R: recommended test to be included in the blank detail or detail specification;

(D): destructive test;

(ND): non-destructive test.

5 Relay reliability – Failure rate data

The evaluation and indication of reliability data is not mandatory.

However, if required in a detail specification, the failure rate data for the reliability prediction of telecom relays in electronic equipment (telecommunication systems, data processing, etc.) shall be stated in an appropriate way. It is strongly recommended to give such data in accordance with IEC 61709. Therefore, the preferred (blank) data base for failure rates, the stress model and the particular stress factors for conversion of the failure rate data at reference conditions to the actual operating conditions are given in informative annex A. In the relevant detail specification, reference shall be made to this annex A and further details shall be given.

The reference failure rate shall be determined by the manufacturer for his particular relay type. The relay manufacturer is required to log cumulatively all endurance test data and all other relevant data including those derived from field experience, which would demonstrate/ indicate achieved reliability. The endurance tests specified in the detail specification are intended, amongst other things, to provide a measure of the failure rate under prescribed conditions.

If another stress model, or other stress factors respectively, are known to be more suitable for a particular relay type, such deviations shall be clearly described in an annex of the relevant detail specification and used instead (all necessary details which allow the conversion of the failure rate data to the actual operating conditions and the source(s) of these data shall be described). However, the statements in Clause A.8 shall be kept in this case.

All the activities listed above shall be performed under the supervision of the National Supervising Inspectorate (NSI).

NOTE Relay manufacturers are not required to demonstrate the achievement of the failure rate data before delivery of a specific lot.

Table 1 – Test schedule

Group A
Subgroup A0

For all tests in this subgroup: 100 % test. The lot shall be rejected in case of failure rate of more than ... % cumulative.

Test from IEC 61810-7 Subclause	Options and particular requirements
Visual inspection – relay marking (ND) 3.6.4 a) and 3.6.4 b)	R
Coil resistance (ND) 3.8.1	M
Dielectric test (ND) 3.9	M
Contact-circuit resistance, static (ND) 3.12	M Test voltage and current as for CA 0
Functional tests (ND) 3.13	M Checking the relay function by monitoring the contacts
Timing tests (ND) 3.14.2	M See also 4.4, note 4
Sealing (ND) 3.20.2	R Procedure 1 (test Qc, method 2), procedure 2 (test Qk, method 1 or 2) or procedure 4 (test Qy) for RT III and RT IV
Acoustic noise (ND) 3.44	R Method 1, if stated in the detail specification only

Table 1 *(continued)*

Subgroup A4

For all tests in this subgroup IL: S4
AQL: 0,25...1,0...4

Lot-by-lot

Test from IEC 61810-7 Subclause	Options and particular requirements
Visual inspection – relay marking (ND) 3.6.4, items a) and b)	M
Coil resistance (ND) 3.8.1	M
Contact-circuit resistance, static (ND) 3.12	M Test voltage and current as for CA 0
Functional tests (ND) 3.13	M Checking the relay function by monitoring the contacts
Timing tests (ND) 3.14.2	M See also 4.4, note 4
Sealing (ND) 3.20.2	M Procedure 1 (test Qc, method 2), procedure 2 (test Qk, method 1 or 2) or procedure 4 (test Qy) for RT III and RT IV
Acoustic noise (ND) 3.44	R Method 1, if stated in detail specification only

Table 1 *(continued)*

Group B
Subgroup B1

For all tests in this subgroup IL: S3
AQL: 0,4...1,0...4

Lot-by-lot

Test from IEC 61810-7 Subclause	Options and particular requirements
Visual inspection – check of dimensions of stick magazines (ND) 3.6.1 and 3.6.4 a)	M If applicable
Visual inspection – other than marking, check of relay outside key dimensions (ND) 3.6.1 and 3.6.4 c) and 3.6.4 d)	M
Electrical endurance, miss-free acceptance (ND) 3.30.5	R
Contact dynamic dielectric test (ND) 3.50	R

Subgroup B2

For all tests in this subgroup IL: S3
AQL: 0,4...1,0...4

Lot-by-lot

Test from IEC 61810-7 Subclause	Options and particular requirements
Solderability (D) 3.25	M If not tested in sub-group C1

Table 1 *(continued)*

Group C
Subgroup C1

For all tests in this subgroup fixed sample size.

Period shall not exceed 1 year.

Test from IEC 61810-7 Subclause	Options and particular requirements
Magnetic interference (ND) 3.37	R If stated in the detail specification only
Solderability (D) 3.25	M For relays manufactured with automatic facilities only, if not tested in subgroup B2
Electrical endurance (D) 3.30.3 and 3.30.4	M Method 1, definition of contact fault and contact failure in accordance with 1.3.3 of this specification

Subgroup C2

For all tests in this subgroup fixed sample size.

Period shall not exceed 1 year.

Test from IEC 61810-7 Subclause	Options and particular requirements
Acoustic noise (ND) 3.44	R Method 1, only if not tested in A0 or A4 respectively
Dielectric test (ND) 3.9	M
Impulse voltage test (ND) 3.10	M
Insulation resistance (ND) 3.11	M
Sealing (ND) 3.20.2	R Procedure 1 (test Qc, method 2)

Table 1 *(continued)*

Subgroup C4

For all tests in this subgroup fixed sample size in accordance with Clause C.3 of IEC 60255-23.

Period shall not exceed 2 years.

Test from IEC 61810-7 Subclause	Options and particular requirements
Electrical endurance, extended assessment (D) 3.30.6 or 3.30.3 and 3.30.4	M Method 1; prolongation of test from subgroup C1 possible, definition of contact fault and contact failure in accordance with 1.3.3 of this specification

Subgroup C5

For all tests in this subgroup fixed sample size.

Period shall not exceed 2 years.

Test from IEC 61810-7 Subclause	Options and particular requirements
Climatic sequence (D) 3.15	M Dry heat, 3.15.2 Damp heat cyclic, 3.15.3 Cold, 3.15.4 Damp heat cyclic, 3.15.6
Damp heat, steady state (D) 3.16	M
Robustness of terminals (D) 3.24	M
Shock (D) 3.26	M Method 1, functional Method 2, survival
Vibration (D) 3.28	M Method 1, functional
Mechanical endurance (D) 3.31.3	M Method 2
Thermal endurance (D) 3.32	M
Overload (contact circuit) (D) 3.34	M
Magnetic interference (ND) 3.37	R Only if not tested in C1
Resistance to cleaning solvents (D) 3.47.2	M
Fire hazard (D) 3.48.2	M Procedure according to IEC 60695-2-2

Table 1 *(concluded)*

Subgroup C6

For all tests in this subgroup fixed sample size.

Period shall not exceed 2 years.

Test from IEC 61810-7 Subclause	Options and particular requirements
Weighing (ND) 3.7.2	M
Thermal resistance (ND) 3.17	M
Rapid change of temperature (D) 3.19	M Method 1
Resistance to soldering heat (D) 3.25	M

Annex A
(informative)

Data base for failure rates

A.1 Scope

This annex details the data base for failure rates of telecom relays based on IEC 61709. If required in the relevant detail specification, the information given below and any further details necessary should be given in a respective annex in that specification.

A.2 Description of the relay

A.2.1 Identification

The XY relay is (details to be given in the detail specification). For further details, see boxes (5) and (6) under 1.3 of the relevant blank detail specification.

A.2.2 Ratings

Coil data and contact data see boxes (9), (10) and (11) under 1.3 of the relevant blank detail specification.

A.3 Quality level

Form of qualification: IECQ qualification approval and quality conformance inspections according to clauses 3 and 4 of this specification.

A.4 Fault and failure data

A.4.1 Fault definition

According to 1.3.3 and 1.3.4 of this specification – see also A.4.3.

A.4.2 Fault application

Useful life time period. Beginning of useful life time: relay in new condition; end of useful life time: number of switching cycles stated in Table 3 of the relevant blank detail specification.

A.4.3 Failure definition

According to 1.3.3 and 1.3.4 of this specification.

Contact failure: contact-circuit resistance of a closed contact higher than 1 Ω, or resistance of an open contact circuit lower than 100 kΩ, both more than once per 10^5 cycles (or for the minimum number of switching cycles stated), calculated for each single contact; or a contact fault due to non-opening with a short circuit between break and make contact (resistance value lower than 100 Ω). This means that one contact fault is permissible for 100 000 switching cycles and seven contact faults are permissible for 700 000 switching cycles.

A.4.4 Failure application

Wear-out failure time period.

NOTE For conversion of the cycle-related to the time-related failure rate see E.2.2 through E.2.4 of IEC 60255-23.

A.5 Source of data

A.5.1 Failure rate under reference conditions λ_{ref} specified in A.7

Manufacturer's laboratory tests in accordance with 5.2.1.2 of IEC 60255-23.

A.5.2 Stress factors π_{ES}, π_S and π_T

According to 7.7 of IEC 61709 – see A.10.

A.5.3 Data level

Single relay

A.6 Conditions for which failure rates apply

The application of the failure rates described in this annex is limited by the following values:

– ratings – see boxes (9) and (10) under 1.3 of the relevant blank detail specification,
– component climatic category according to IEC 60068 – see box (11) under 1.3 of the relevant blank detail specification,
– operating range – see box (11) under 1.3 of the relevant blank detail specification,
– environmental data – see 2.6 of the relevant blank detail specification.

A.7 Reference failure rate λ_{ref}

A.7.1 The failure rate under reference conditions specified in A.7.2:

$$\lambda_{ref} = \text{.... per operating cycle}$$

A.7.2 Factors for failure rate under reference conditions

A.7.2.1 Time period

Mean failure rate related to wear-out time period according to C.3 of IEC 60255-23 (μ value) with confidence level of 90 %.

A.7.2.2 Failure criterion

Fault and failure definitions according to A.4.

A.7.2.3 Operating mode

Accelerated conditions in accordance with E.1 of IEC 60255-23 simulating one operating cycle per hour.

A.7.2.4 Climatic and mechanical stresses

Ambient temperature: 40 °C
Climatic conditions: 3K3 of IEC 60721-3-3
Mechanical stresses: 3K3 of IEC 60721-3-3

A.7.2.5 Electrical stresses

Stress region 2 according to figure 9 of IEC 61709: 0,5 V < $U \leq U_{rat}$, 0 A < $I \leq$ 0,1 A.

A.7.2.6 Supplementary statements

No supplementary statements required.

A.8 Methods for combining and adding new data

The relay manufacturer shall cumulatively log all endurance test data and all other relevant data including the ones derived from field experience which would demonstrate/indicate achieved reliability. All endurance tests specified in this specification (particularly test numbers 15 and 18 with extended assessment given in Table 4 under subgroup C4 of the relevant blank detail specification) are intended, amongst other things, to provide a measure of the failure rate under prescribed conditions.

The relay manufacturer shall systematically check the validity of the failure rate data by a particular communication/cooperation with the relevant relay user(s). The relay manufacturer shall keep the necessary records on this matter and suggest amendments (particularly of Clause A.10) if necessary.

All these activities shall be performed under the supervision of the National Supervising Inspectorate (NSI).

A.9 Stress model

The following stress model and stress factors should be used for conversion of the failure rate at reference conditions (λ_{ref}) to the failure rate under actual operating conditions (λ). This conversion is only permissible within the functional limits specified in this detail specification and in connection with the statements in IEC 61709.

The failure rate under operating conditions is calculated as follows:

$$\lambda = \lambda_{ref} \cdot \pi_{ES} \cdot \pi_S \cdot \pi_T$$

where

λ is the failure rate under operating conditions;

λ_{ref} is the failure rate under reference conditions – see Clause A.7;

π_{ES} is the electrical stress dependence factor – see Table A.1;

π_S is the switching rate dependence factor – see A.10.2;

π_T is the temperature dependence factor – see A.10.3.

Relay manufacturers are not required to demonstrate the achievement of the failure rate data before delivery of a specific lot.

A.10 Stress factors

A.10.1 Electrical stress dependence factor π_{ES}

See Table A.1.

Table A.1 – Factor π_{ES}

Stress region (see figure 9 of IEC 61709)	Factor π_{ES} for		
	Resistive load	Capacitive* and incandescent lamp load	Inductive load
1	2	2	–
2	1	8	8
3	2	20	40
4	8	40	–
* The maximum current peak stated in the relevant blank detail specification is not to be exceeded.			

A.10.2 Switching rate dependence factor π_S

This factor considers the number of operating cycles per hour *(S)*.

a) $\pi_S = 1$ for $0{,}01 < S \leq 1$

b) $\pi_S = S/S_{ref}$ for $S > 1$

where

S is the number of operating cycles per hour;

S_{ref} is the reference operating cycles per hour, where $S_{ref} = 1$.

The factor π_S is shown in Figure A.1.

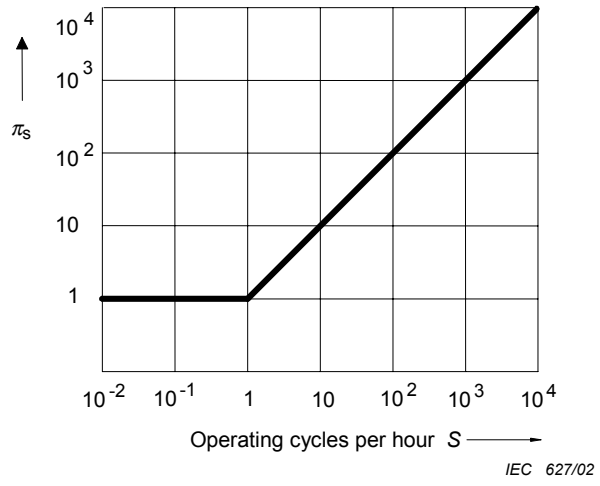

Figure A.1 – Factor π_S depending on the operating cycles

A.10.3 Temperature dependence factor π_T

See Table A.2.

Table A.2 – Factor π_T

Factor for the average ambient temperature θ_{amb}*		
≤40 °C	**70 °C**	**85 °C**
1	1,8	2,3
* Valid only up to the maximum permissible ambient temperature according to box (11) under 1.3 of the relevant blank detail specification.		

A.11 Example of calculation of the failure rate under actual operating conditions

A relay certified according to this detail specification switches a contact load of stress region 1 (see figure 9 of IEC 61709) at an ambient temperature of 70 °C:

$\lambda = 10^{-7}$; $U \leq 0{,}5$ V; $I \leq 0{,}1$ A; ambient temperature $\theta_{amb} = 70$ °C

What is the value of the failure rate under those conditions?

Step (1) from equation under A.9: $\lambda = \lambda_{ref} \cdot \pi_{ES} \cdot \pi_S \cdot \pi_T$

Step (2) from A.10.1, Table A.1, stress region 1: $\pi_{ES} = 2$

Step (3) from A.10.2, Figure A.1, one cycle per hour: $\pi_S = 1$

Step (4) from A.10.3, Table A.2, $\theta_{amb} = 70$ °C: $\pi_T = 1{,}8$

Step (5) perform the calculation; thus the failure rate, under the conditions stated above, is obtained as:

$$\lambda = \lambda_{ref} \cdot \pi_{ES} \cdot \pi_S \cdot \pi_T = 10^{-7} \cdot 2 \cdot 1 \cdot 1{,}8 = 3{,}6 \cdot 10^{-7} \text{ per operating cycle} = 360 \text{ fit}$$

Step (6) perform the calculation according to E.2.4 of IEC 60255-23:

$$\text{MTBF} = \frac{1}{\lambda} = \frac{1}{3{,}6 \cdot 10^{-7}} = 2{,}8 \cdot 10^{6} \text{ h} = 317 \text{ years}$$

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