

INTERNATIONAL STANDARD

IEC
62246-1

First edition
2002-04

Reed contact units –

Part 1: Generic specification

Contacts à lames souples en enceinte scellée –

*Partie 1:
Spécification générique*



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

REED CONTACT UNITS –

Part 1: Generic specification

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 62246-1 has been prepared by IEC technical committee 94: All-or-nothing electrical relays.

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

FDIS	Report on voting
94/156/FDIS	94/164/RVD

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

This standard cancels and replaces IEC 60255-9 (1979).

The detail specifications (DS), the sectional specifications (SS) and the blank detail specifications (BDS) are not yet available and will be developed as the need arises.

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

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

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- withdrawn;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

REED CONTACT UNITS –

Part 1: Generic specification**1 General****1.1 Scope**

This part of IEC 62246 which is the generic specification applies to dry and mercury wetted reed contact units of assessed quality. It lists the tests and measurement procedures which may be selected for use in detail specifications for such units. This standard also specifies the quality assessment procedures to be followed.

This standard applies to those reed contact units which are operated by an applied magnetic field; it is not restricted to any particular type of contact load.

NOTE 1 Since tests using a standard coil and standard resistive loads are the easiest to specify and to define, this standard is currently restricted to tests of this type.

NOTE 2 For elementary relays with reed contact units, this standard is recommended to be used together with the standards IEC 61810-1 and IEC 61811-1 as applicable.

Where in this part of IEC 62246 the term “detail specification” is used, this either has the meaning defined in A.7 of QC 001001 for application within the IECQ system, or it means any appropriate document, for example manufacturer's data sheet, test specification, customer detail 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 60027, *Letter symbols to be used in electrical terminology*

IEC 60050, *International Electrotechnical Vocabulary (IEV)*

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*
Amendment 1(1992)

IEC 60068-2-1:1990, *Environmental testing – Part 2: Tests – Tests A: Cold*
Amendment 1(1993)
Amendment 2(1994)

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*
Amendment 1(1993)
Amendment 2(1994)

IEC 60068-2-3:1969, *Environmental testing – Part 2: Tests – Test Ca: Damp heat, steady state*

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-7:1983, *Environmental testing – Part 2: Tests – Test Ga: Acceleration, steady state*
Amendment 1(1986)

IEC 60068-2-11:1981, *Environmental testing – Part 2: Tests – Test Ka: Salt mist*

IEC 60068-2-13:1983, *Environmental testing – Part 2: Tests – Test M: Low air pressure*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*
Amendment 1(1986)

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

IEC 60068-2-20:1979, *Environmental testing – Part 2: Tests – Test T: Soldering*
Amendment 2(1987)

IEC 60068-2-21:1999, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27:1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

IEC 60068-2-29:1987, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*

IEC 60068-2-30:1980, *Environmental testing – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle)*
Amendment 1(1985)

IEC 60096 (series), *Radio-frequency cables*

IEC 60317-1:1990, *Specifications for particular types of winding wires – Part 1: Polyvinyl acetal enamelled round copper wire, class 105*
Amendment 1(1997)
Amendment 2(1997)

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

IEC 60617, *Graphical symbols for diagrams*

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

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

ISO 1000, *SI units and recommendation for the use of their multiples and of certain other units*

ITU-T Recommendation K.17:1988, *Tests on power-fed repeaters using solid-state devices in order to check the arrangements for protection from external interference*

QC 001002, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure*

1.3 Units, symbols and terminology

Units, graphical symbols, letter symbols and terminology shall, whenever possible, be taken from the following documents:

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units*

IEC 60027, *Letter symbols to be used in electrical technology*

IEC 60050, *International electrotechnical vocabulary*

IEC 60617, *Graphical symbols for diagrams*

Any other units, symbols and terminology specific to one of the components covered by the generic specification, shall be taken from the relevant IEC or ISO documents listed under 1.2.

The following additional terminology is also applicable.

1.3.1

reed contact unit

assembly containing contact blades, some or all of magnetic material, hermetically sealed in an envelope and controlled by means of externally generated magnetic field (e.g. an energizing quantity applied to a coil)

1.3.2

mercury wetted contact unit

assembly containing contact blades, some or all of magnetic material, some or all mercury wetted, hermetically sealed in an envelope and controlled by means of an externally generated magnetic field (e.g. an energizing quantity applied to a coil)

1.3.3

contact blade

metal blade providing either the functions of the electric or magnetic circuit or both functions combined as in the case of dry and wetted reed contact units.

For mercury wetted contact units: metal blade providing either the functions of the electric circuit through mercury or the magnetic circuit, or both functions combined

1.3.4

biasing magnetic field

continuous magnetic field intended to determine the operate and the release position of the contact, which can be adjusted to form a monostable or bistable contact unit

NOTE For bistable contact units, operate and release conditions have to be defined by the manufacturer in the detail specification with reference to applied magnetic field polarity.

1.3.5

applied magnetic field

externally generated field (for example by a test coil) intended to change the position of the contact

1.3.6

contact unit, mechanically biased

contact unit where the biasing, to determine the operate and release positions, is achieved mechanically

1.3.7

magnetically biased contact unit

contact unit to which a biasing magnetic field is applied, determining the functional characteristics and the operate and release position

1.3.8

make contact (Form A contact)

means that a reed contact unit is open when there is no applied magnetic field. This is a normally open contact

1.3.9

break contact (Form B contact)

means that a reed contact unit is closed when there is no applied magnetic field. This is a normally closed contact

1.3.10

change-over reed contact unit

contains a make contact and a break contact within its envelope, one contact blade being common

- a) change-over break-before-make reed contact unit (Form C contact)
Change-over reed contact unit, one contact circuit of which breaks before the other makes.
- b) change-over make-before-break reed contact unit (Form D contact)
Change-over reed contact unit, one contact circuit of which makes before the other breaks.
- c) change-over reed contact unit with unspecified switching sequence (Form A and Form B contacts)
Change-over reed contact unit where the switching sequence can be either make-before-break or break-before-make.

1.3.11

type

type comprises products having similar design features manufactured by the same techniques and falling within the manufacturer's usual range of ratings for these products

NOTE Mounting accessories are ignored, provided they have no significant effect on the test results.

1.3.12

variant

variation within a type having specific nominal dimensions and characteristics

1.3.13

rated value

value assigned by the manufacturer to a given characteristic of the reed contact unit

1.3.14

operate position

position where the make contact is closed and the break contact is open.

1.3.15

release position

position where the make contact is open and the break contact is closed

1.3.16

to operate

reed contact unit operates when it changes from the release position to the operate position

1.3.17

to release

reed contact unit releases when it changes from the operate position to the release position

1.3.18**just-operate value**

value of the magnetic field at which the released reed contact unit just operates (see figure 1)

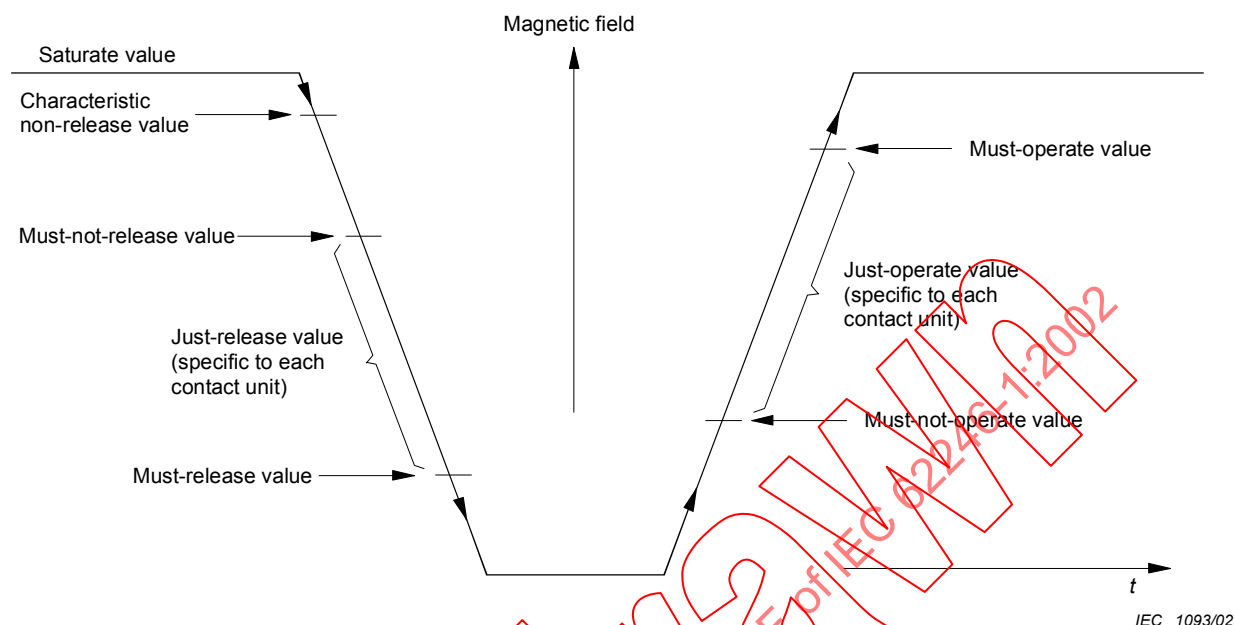


Figure 1 – Functional characteristics

1.3.19**must-operate value**

stated limit of the applied magnetic field at which the reed contact unit operates (see figure 1)

1.3.20**just-release value**

value of the applied magnetic field at which the operated reed contact unit just releases (see figure 1)

1.3.21**must-release value**

stated limit of the applied magnetic field at which the operated reed contact unit releases (see figure 1)

1.3.22**must-not-operate value**

stated limit of the applied magnetic field at which the reed contact unit does not operate (see figure 1)

1.3.23**must-not-release value**

stated limit of the applied magnetic field at which the operated reed contact unit remains operated (see figure 1)

1.3.24**characteristic non-release value**

stated value of the applied magnetic field above which the operated reed contact unit fulfils specified qualities, for example contact resistance, noise characteristics, etc. (see figure 1)

1.3.25

saturate value

arbitrarily defined value of the applied magnetic field at which the reed contact unit is unaffected by further increase of the applied magnetic field (see figure 1)

1.3.26

bounce

momentary re-opening of a contact after initial closing, or a momentary closing after initial opening

1.3.27

magnetic dwell (only for change-over contact units)

difference in the values of applied magnetic field when the break contact just opens and the make contact just closes, or vice versa

NOTE For time definitions, see figure 2, for test conditions, see 3.10.

1.3.28

bounce time

interval of time between the instant of the first closing (or opening) and the instant of the final closing (or opening) of the reed contact unit

1.3.29

operate time

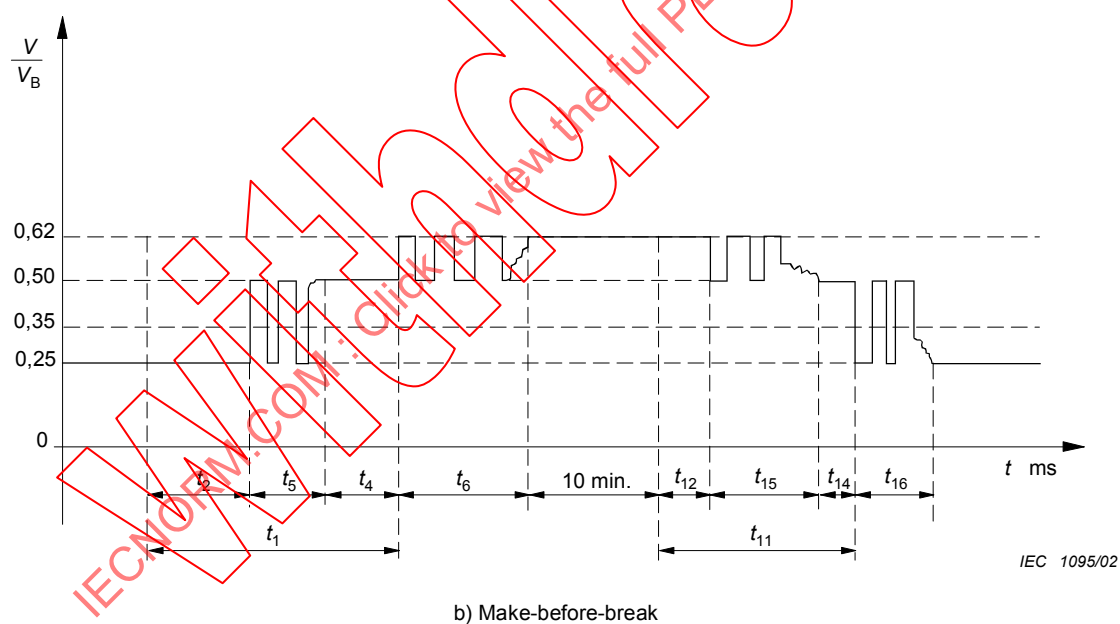
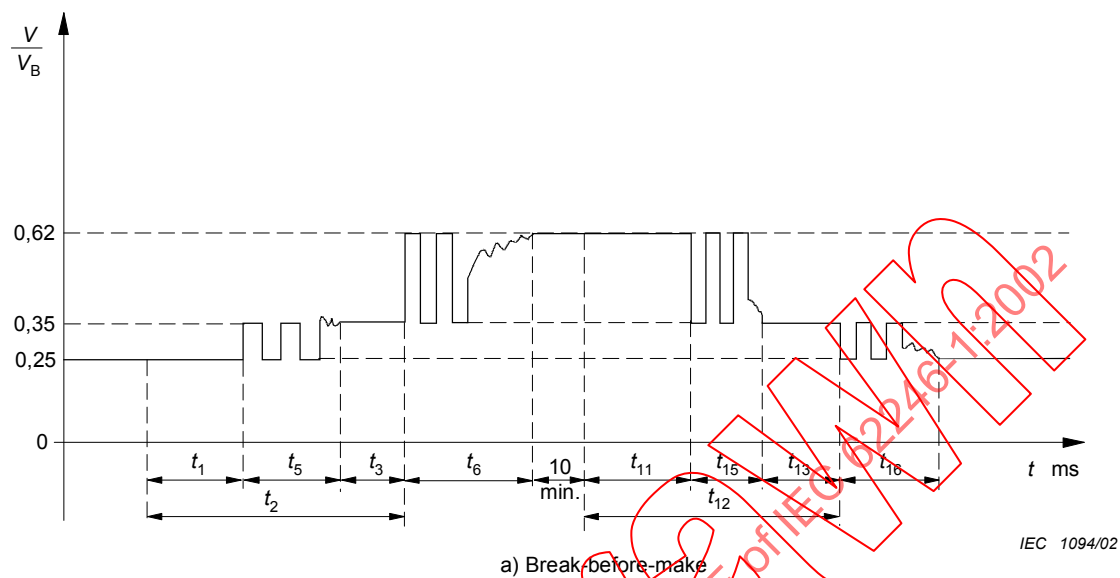
time between the instant of the application of a magnetic field to a reed contact unit and the instant the contact is in the operate position. It does not include bounce time

1.3.30

release time

time between the instant of the removal of the applied magnetic field to a reed contact unit, and the instant the contact is in the release position. It does not include bounce time

Oscilloscope diagram



Energization of the test coil

t_1 : operate break time

t_2 : operate make time

t_3 : operate transfer time

t_4 : operate bridging time

t_5 and t_6 : bounce times

Refer to figures 5 and 6 for key to V_B .

De-energization of the test coil

t_{11} : release break time

t_{12} : release make time

t_{13} : release transfer time

t_{14} : release bridging time

t_{15} and t_{16} : bounce times

Figure 2 – Time definitions

1.3.31

transfer time (Form C contact)

time interval during which both contact circuits are open (not including bounce time)

1.3.32

bridging time (Form D contact)

time interval during which both contact circuits are closed (not including bounce time)

1.3.33

operate make time

time interval between the instant of the application of a magnetic field to the contact unit and the instant of the first closing of the make contact

1.3.34

operate break time

time interval between the instant of the application of a magnetic field to the contact unit and the instant of the first opening of the break contact

1.3.35

release make time

time interval between the instant of the removal of an applied magnetic field from the reed contact unit and the instant of the first closing of the break contact

1.3.36

release break time

time interval between the instant of the removal of an applied magnetic field from the reed contact unit and the instant of the first opening of the make contact

1.3.37

operate transfer time (Form C contact)

transfer time measured when the break-before-make reed contact unit moves from the release position to the operate position

1.3.38

release transfer time (Form C contact)

transfer time measured when the break-before-make reed contact unit moves from the operate position to the release position

1.3.39

operate bridging time (Form D contact)

bridging time during which the make-before-break reed contact unit moves from the release to the operate position

1.3.40

release bridging time (Form D contact)

bridging time during which the make-before-break reed contact unit moves from the operate to the release position

1.3.41

minimum time of operate energization

minimum time between the instant of the first application of a magnetic field (at a stated value), and the instant of reduction of that field to the characteristic non release value to ensure that the reed contact unit is maintained in the operate condition

1.3.42**time to stable closed position**

time between the instant of application of a specified magnetic field to the instant at which the reed contact unit fulfils specified qualities, for example contact resistance, noise characteristics, etc.

1.3.43**maximum cycling frequency**

maximum number of cycles per second, at and below which, the contact unit still meets the specifications

1.3.44**failure-to-make**

fault condition of the contacts, indicated by the contact circuit resistance of the unit exceeding a specified value, for a specified applied magnetic field, within a specified period

1.3.45**failure-to-break**

fault condition of the contacts, indicated by the contact circuit resistance of the unit failing to exceed a specified value, for a specified applied magnetic field, within a specified period

1.3.46**contact sticking**

failure-to-break of a reed contact unit due to residual magnetic, physical or chemical effects

1.3.47**maximum contact current**

maximum allowed switched d.c. or peak current in correlation to a given number and frequency of operations and load, under specified conditions

1.3.48**limiting continuous current**

highest value of the current (r.m.s. if a.c.) which a previously closed contact is capable of carrying continuously, in specified conditions

1.3.49**maximum contact voltage**

maximum allowed switched d.c. or peak voltage, in correlation to a given number of operations and load, under specified conditions

1.3.50**contact noise**

spurious peak-to-peak voltage which is generated across the reed contact unit terminations, in specified conditions

1.3.51**thermal e.m.f.**

e.m.f. generated by the reed contact unit, when connected to an external circuit in an operate position and subjected to a temperature differential

1.3.52**duty cycle**

ratio, expressed as a percentage, of the duration of energization to the interval between commencements of successive energizations

1.3.53

drain-time

time taken for the contacts to become electrically open after they have been flooded with mercury by inversion and then returned to the preferred position

NOTE In the case of change-over mercury wetted contact units there are two drain-times; one for each position of the contact.

1.3.54

preferred position

position recommended for use and in which tests are normally performed, unless otherwise specified

1.3.55

mounting position restriction

maximum angle from the preferred position at which the device may be mounted and still meet the specifications

1.4 Preferred values

The following preferred values shall be used, unless otherwise stated in the detail specification.

1.4.1 Frequency of operation

1; 2; 5; 8; 10; 12,5; 16; 20; 25; 30; 50; 60; 100; 500 operations per second.

1.4.2 Duty cycle

50 %.

1.4.3 Open-circuit voltage across contacts

a) 0,01; 0,1; 5; 12; 24; 50; 100; 110; 127; 150; 220; 250; 380; 500; 1 000; 1 500; 2 000 V a.c. (r.m.s.).

b) 0,01; 0,03; 0,05; 0,1; 1; 1,5; 4,5; 5; 6; 6,3; 10; 12; 15; 17; 20; 24; 30; 36; 48; 50; 60; 80; 100; 110; 150; 175; 200; 250; 440; 500; 600; 800; 1 200; 1 500 V d.c.

1.4.4 Current rating

1; 1,25; 1,6; 2; 2,5; 3; 3,15; 4; 5; 6,3; 8 A or the decimal multiples or submultiples of these figures in amps; 1, 2 and 5 are preferred.

1.4.5 Load ratings

1; 2; 5; 10; 15; 30; 50; 100; 150; 250; 500 VA.

1.4.6 Number of operations

5 000, 10 000, 20 000, 50 000

$1 \cdot 10^5$, $2 \cdot 10^5$, $1 \cdot 10^6$, $2 \cdot 10^6$, $5 \cdot 10^6$, $1 \cdot 10^7$, $2 \cdot 10^7$, $5 \cdot 10^7$, $1 \cdot 10^8$, $2 \cdot 10^8$, $5 \cdot 10^8$, $1 \cdot 10^9$, $1 \cdot 10^{10}$.

1.4.7 Climatic category

The climatic category (see appendix A of IEC 60068-1) of a reed contact unit, both steady state and cyclic shall be established by a selection from the following preferred standard values of lower and upper ambient temperatures and damp heat values.

- a) The preferred values of lower ambient temperature are:
– 65, – 50, – 40, – 25, – 10 °C
- b) The preferred values of upper ambient temperature are:
40, 55, 70, 85, 100, 125, 200 °C
- c) The preferred times of exposure to damp heat, steady state are:
4, 10, 21, 56 days
- d) The preferred climatic categories are:
65 / 125 / 56
40 / 100 / 56
40 / 100 / 21
40 / 85 / 56
40 / 70 / 21
25 / 70 / 21
25 / 55 / 04
10 / 40 / 04
10 / 55 / 04

1.4.8 Preferred environmental severities

- a) Vibration (IEC 60068-2-6, Test Fc)

Frequency	Vibration amplitude or acceleration	No. of sweep cycles
10-500 Hz	0,35 mm or 49 m/s ² (5 g)	10
10-500 Hz	0,75 mm or 98 m/s ² (10 g)	10
10-2000 Hz	0,75 mm or 98 m/s ² (10 g)	8
10-2000 Hz	1,5 mm or 196 m/s ² (20 g)	8

Duration of the sweep endurance in each of the three axes is given by a specified number of sweep cycles. Sweep rate: 1 octave per minute $\pm$ 10 %.

Cross-over frequency between 57 Hz and 62 Hz.

- b) Bump (IEC 60068-2-29, Test Eb): 1 000 + 10 bumps at 390 m/s², duration 6 ms.

- c) Shock (IEC 60068-2-27, Test Ea)

11 ms, 490 m/s², 50 g

11 ms, 294 m/s², 30 g

- d) Acceleration (IEC 60068-2-7, Test Ga)

m/s ²	g
98	10
196	20
490	50
19 600	2 000
49 000	5 000
98 000	10 000
196 000	20 000
294 000	30 000

Duration of 1 min in each direction prescribed in the specification.

- e) Low air pressure (IEC 60068-2-13, Test M): 80 mbar

1.5 Marking

The sectional or detail specifications shall indicate the identification criteria and other information to be shown on the unit and/or package. The letter or colour code shall be described in full or reference made to the appropriate specifications. The order of priority for marking small units shall be specified.

The marking shall, as a minimum, consist of:

- the trade mark or the manufacturer's name;
- the unit type and variants' code;
- the coded date of manufacture, quantified by months or less.

Each package of reed contact unit shall be marked with the following information:

- date code;
- number of the detail specification;
- manufacturer's factory identification code;
- additional marking as required by the detail specification.

1.6 Order of precedence

Where any discrepancies occur for any reasons, documents shall rank in the following order of authority:

- a) the detail specification,
- b) the sectional specification,
- c) the generic specification,
- d) any other international documents (for example, of the IEC) to which reference is made.

The same order of precedence shall apply to equivalent national documents.

1.7 Precautions regarding mercury (for mercury wetted contact units)

1.7.1 General

As mercury is a toxicologically and environmentally hazardous substance, all applicable international and local laws and regulations have to be complied with.

1.7.2 Information sheet

A sheet containing relevant general information about mercury on

- a) physical properties,
- b) important characteristics,
- c) hazards/symptoms,
- d) preventive measures,
- e) fire extinguishing/first aid,
- f) spillage,
- g) storage,
- h) labelling,

should be given to the user.

1.7.3 Recommendations for control and disposal

a) Control of mercury wetted contact units:

- the contact units shall be stored in the manufacturer's packaging until required for assembly;
- sufficient number of contact units should be released from stock to cover the immediate assembly programme; unused contact units should be returned to stock;
- contact units rejected either due to damage or failure should be stored in a suitable container until disposal;
- contact units should be regularly monitored to ensure that no units are lost or mislaid.

b) Disposal of mercury wetted contact units:

- it is illegal to put mercury wetted reed contact units in any quantity in domestic or industrial general waste, unless local laws allow exceptions for the maximum amount of mercury used per total weight of disposal (percentage or ppm). Local laws and regulations have to be followed;
- contact units in any condition (intact or damaged) which are ready for disposal should be stored separately in an impervious container until there is sufficient quantity to be taken or sent to a licensed disposal or recycling site,
- the licensed site may be for instance an incinerator, an adequate land-fill or a metal-recovery dealer; licensing is the prerogative of the local authorities.

2 Quality assessment procedures

2.1 General

The basic concept of the IECQ system for quality assessment is to provide assurance to the purchaser that the components which are released conform to the requirements in the relevant specifications.

Before a manufacturer is permitted to produce, test and deliver components under the IECQ quality assessment system, it is necessary that his production organization, facilities, storage and delivery systems organization, facilities for inspection and tests of components, and arrangements for calibration meet the requirements of the IECQ system. In particular, it shall be demonstrated that all appropriate parts of the organization and its facilities are under the direct control or surveillance of the person appointed as chief inspector. This approval of manufacturers is granted in accordance with IEC QC 001002.

The procedures for the qualification approval of electronic components as stipulated in IEC QC 001002 comprise the following consecutive basic steps:

- a) qualification approval;
- b) quality conformance inspection.

2.1.1 Primary stage of manufacture

The primary stage of manufacture is defined as the plating and related processing of the contact blades.

2.1.2 Structurally similar components

The blank detail specification(s) shall define those reed contact units within its scope which may be considered as structurally similar.

2.1.3 Subcontracting

Subcontracting is permitted for any stages preceding the primary stage of manufacture (see 2.1.1). Subcontracting shall be in accordance with requirements of annex B to clause 2 of QC 001002-3. Subcontracting the primary stage of manufacture and/or subsequent stages to an unapproved manufacturer is forbidden.

2.2 Qualification approval procedures

These procedures shall be in accordance with the requirements of QC 001002-3.

The manufacturer shall comply with the requirements for the primary stage of manufacture (see 2.1.1) as well as with the requirements given in the sectional and detail specifications.

In addition, the manufacturer shall produce test evidence of conformance to the specification requirements either on three consecutive lots for lot-by-lot inspection and on one lot for periodic inspection, or on a fixed sample subjected to the prescribed sequences of tests.

Samples shall be taken from the lots in accordance with IEC 60410. Normal inspection shall be used, but where the sample size is less than that which would give acceptance on zero defectives, additional specimens shall be taken to meet the sample size required to give acceptance on one defective.

2.3 Quality conformance inspection requirements

The quality conformance inspection shall be in accordance with the requirements of QC 001002-3.

The blank detail specification shall prescribe the minimum test schedule which shall be included in each detail specification for those reed contact units covered by the scope of the specification.

This test schedule shall also specify the division into groups and subgroups (see 3.2.3 of IEC QC 001002-3) for the purpose of lot-by-lot and periodic inspection.

The blank detail specification shall show the order in which the tests or conditions in the subgroup shall be carried out where this order may affect the test results. The blank detail specification shall also indicate wherever any particular order of testing in any subgroup is to be observed.

Where a subgroup contains a destructive test, this shall either be stated in full or the symbol "D" shall be placed alongside of the title of the subgroup in the schedule of inspection requirements in the blank detail specification.

2.3.1 Delivery of units subjected to destructive tests or non-destructive tests

Units subjected to destructive tests shall not be included in the lot for delivery. Units subjected to non-destructive tests may be delivered provided they are re-tested to Group A (see 3.2.3 of IEC QC 001002-3) requirements and satisfy them.

2.3.2 Delayed delivery

Units which have been held by the manufacturer for a period exceeding 12 months following acceptance inspection, shall be re-inspected as prescribed in the detail specification, unless another period is specified therein.

If this has been done for the complete lot, no further retesting before delivery is needed for another period of one year or as otherwise specified in the detail specification.

2.3.3 Supplementary procedure for deliveries

When this has been nationally recognized, manufacturers may, at their discretion, supply units that have met a higher assessment level against orders for a lower assessment level.

2.3.4 Unchecked parameters

When, in detail specifications, supplementary information is given, this shall not be the subject of inspection.

2.3.5 Release for delivery before the completion of Group B tests

When the conditions of IEC 60410 for reduced inspection have been satisfied for all Group B (see 3.2.3 of IEC QC 001002-3) tests, the manufacturer is permitted to release the units before the completion of such tests.

2.3.6 Screening procedures

When screening is specified in the detail specification or the purchase order, it is to be applied to all devices in the production lot prior to the formation of samples for quality conformance testing (lot-by-lot and periodic).

The test shall be performed in the given order; when, however, part of screening sequence is already performed during production and in the same sequence, it need not be repeated.

Any device found defective during any of the tests shall be removed and not considered as part of the production lot for subsequent sampling purposes.

3 Test and measurement procedures

3.1 General

The blank detail specifications shall contain tables showing the tests to be made, which measurements are to be made before and after each test or subgroup of tests, and the sequence in which they shall be carried out.

3.2 Alternative procedures

The test and measurement methods given in the relevant specification are not necessarily the only methods which can be used. However, the manufacturer shall satisfy the National Supervising Inspectorate that any alternative methods which he may use will give results equivalent to those obtained by the methods specified.

Alternative methods shall not be used where methods are specifically designated as referee or reference methods.

3.3 Standard conditions for testing

Unless otherwise prescribed, all tests shall be carried out under standard atmospheric conditions for testing, as specified in IEC 60068-1. The stages of each test shall be carried out in the order written.

For those measurements that require the reed contact unit to be energized, the reed contact unit shall be positioned in its test coil, as prescribed in the detail specification.

Test coils and test systems shall, wherever possible, be selected from the list of standard test coils in annex A and from the test systems in annex B.

The test shall be carried out in an environment in such a way that no external field or body shall influence the test results by an amount equivalent to $0,5 \text{ A} \times \text{turns}$ or 2 %, whichever is the greater.

The voltage of the test supply as measured at the test specimen shall remain within 0,5 % of the nominal value at all test conditions other than the voltage test, unless otherwise prescribed.

In case of mercury wetted contact units the tests shall be made with the unit in the preferred position, unless otherwise prescribed in the detail specification. The preferred position shall be described in the detail specification.

3.4 Visual inspection and check of dimensions

3.4.1 Visual inspection

Unless otherwise prescribed in the detail specification, inspection shall be performed under normal visual conditions. The workmanship, seals, finish, mercury wetting and marking shall be as prescribed in the detail specification.

If prescribed in the detail specification, more detailed visual inspection under specified magnification shall be made for failures such as:

- glass defects: cracks, bubbles, crystallisation, devitrification chips, cold-seals, short-seals, unwetted parts, etc.
- geometrical defects: contact alignment, overlapping failures, burrs, parallelism, etc.
- mechanical defects: blistering, unplated areas, staining, rusting, magnetic and unmagnetic dirt, whisker growth, etc.
- mercury defects: insufficient wetting, unwanted wetting, mercury level, mercury outside envelope, mercury surface condition, etc.

3.4.2 Outline dimensions

The outline dimensions shall be checked and shall comply with those prescribed in the detail specification.

3.4.3 Mass

The nominal mass shall be prescribed in the detail specification.

3.4.4 Information to be stated in the detail specification

- a) For visual inspection typically: conditions of light and magnification, limits of defect.
- b) Outline dimensions.
- c) Nominal mass.

3.5 Functional tests

3.5.1 Procedures

- a) Functional tests shall be applied, in the order given, to the reed contact unit mounted in a test coil. Unless otherwise prescribed, the increase and decrease of the energization of the coil shall be performed at a rate not greater than:

5 A $\times$ turns/ms for saturate value and zero energization;

1 A $\times$ turns/ms for must-not-release, must-release, must-not-operate, must-operate, just-release and just-operate values.

Either of the following monitoring procedures may be used:

Procedure 1: Contact circuits shall be monitored, throughout the tests, for failure-to-make and failure-to-break at the appropriate values of test coil energization.

Procedure 2a: Physical opening and closing of the contact shall be monitored throughout the tests by magnetic induction or other equivalent methods.

- 1) Saturate: The test coil shall be energized for a specified period to the saturate value. The contact is then in the operate position.
- 2) Must-not-release: When prescribed, the energization of the coil shall be reduced to the must-not-release value (see notes 1 and 2).
- 3) Must-release: The energization of the coil shall be reduced from the must-not-release value (or in its absence, the saturate value) to the must-release value. Unless otherwise prescribed, the release energization attained shall then be reduced to zero for a minimum period of 20 ms.
- 4) Must-not-operate: When prescribed, the energization of the coil shall be increased from zero to the must-not-operate value (see note 1).
- 5) Must-operate: The energization of the coil shall be increased from zero (or from the must-not-operate value, when specified) to the must-operate value.

Procedure 2b: Physical opening and closing of the contact shall be monitored throughout the tests by magnetic induction or other equivalent methods.

- 1) Saturate: The test coil shall be energized for a specified period to the saturate value. The contact is then in the operate condition.
- 2) Zero energization: The energization shall be reduced to zero for a period of 20 ms.
- 3) Must-not-operate: When prescribed, the energization of the coil shall be increased from zero to the must-not-operate value (see note 1).
- 4) Must-operate: The energization of the coil shall be increased from zero (or from the must-not-operate value, when specified) to the must-operate value.
- 5) Must-not-release: When prescribed, the energization of the coil shall be reduced to the must-not-release value (see notes 1 and 2).
- 6) Must-release: The energization of the coil shall be reduced from the must-not-release value (or in its absence, the saturate value) to the must-release value.

NOTE 1 Must-not-release and must-not-operate tests are optional and should be performed only when prescribed in the detail specification.

NOTE 2 When prescribed, the functional test for the must-not-release may be replaced by a similar test performed at the characteristic non-release value.

b) Special procedures for magnetically biased contact units:

The procedures of a) above apply with a rate of $0,1 \text{ A} \times \text{turns/ms}$ for must-not-release, must release, must-not-operate, must-operate, just-release, and just-operate values.

Either of the following test systems may be used (see annex B):

Procedure for test system 1

- 1) The central coil M energization shall be zero.
- 2) The L coil energization shall be increased to the saturate value of the release position and afterwards decreased to zero.
- 3) The R coil energization shall be increased from zero to the must-operate value.
- 4) The R coil energization shall further be increased to the saturate value of the operate position and afterwards decreased to zero.
- 5) The L coil energization shall be increased to the must-release value.

Procedure for test system 2

- 1) The central coil M energization shall be brought to the saturate value of the operate position and shall afterwards be decreased to zero.
- 2) The energization of the coil shall then be increased to the opposite polarity to the release value and further increased to the saturate value of the release position and afterwards brought back to zero.
- 3) The energization of the coil shall be increased in the opposite polarity to the operate position.

3.5.2 Requirements

Procedure 1: The contact circuit resistance limits for failure-to-make and failure-to-break shall be complied with.

Procedure 2: Physical opening and closing of the contact shall be within the limits of must-release, must-not-release, must-operate and must-not-operate.

3.5.3 Information to be stated in the detail specification

- a) Test coil (and test system, if applicable)
- b) Method of monitoring opening and closing of the contact
- c) Saturate value and period of application
- d) Must-not-release value (if applicable)
- e) Must-release value
- f) Must-not-operate value (if applicable)
- g) Must-operate value
- h) Characteristic non-release value (if applicable)
- i) Failure-to-make (for Procedure 1): contact circuit resistance limit
- j) Failure-to-break (for Procedure 1): contact circuit resistance limit
- k) Time at zero energization if other than 20 ms
- l) Rate of increase and decrease of energization (if applicable).

3.6 Remanence test (see figure 3)

3.6.1 Procedure

Functional tests shall be applied, in the order given, to the reed contact unit mounted in a test coil. The position of the reed contact unit in the test coil and the influence of the external fields must remain constant during the test. Contact circuits shall be monitored throughout the tests for failure to make, and failure to break at the appropriate values of test coil energization.

a) Saturate:

The test coil shall be energized to the saturate value for a minimum period of 20 ms, unless otherwise prescribed. The contact is then in the operate position. The saturate energization shall be reduced to zero and shall remain at zero for a minimum period of 20 ms.

b) Just-operate (1):

The energization of the coil shall be increased from zero, in the same polarity to the just-operate value.

c) Saturate (reverse polarity):

The energization shall be reduced from the just-operate value through zero to the saturate value in the reverse polarity, for a minimum period of 20 ms, unless otherwise prescribed.

d) Just-operate (2):

The energization shall then revert from the saturate value (reverse polarity) through zero to the original polarity, to the just-operate (2) value.

3.6.2 Requirements

The remanence value shall be the difference between the just-operate (2) and just-operate (1) value divided by the just-operate (1) value. The contact circuit resistance limit for failure-to-make shall be complied with, for procedure 1 according to 3.5.2.

3.6.3 Information to be stated in the detail specification

a) Test coil.

b) Saturate value.

c) Remanence value in %: $100 \times \frac{\text{just-operate (2)} - \text{just-operate (1)}}{\text{just-operate (1)}} \%$

d) Failure-to-make contact circuit resistance limit for procedure 1 of 3.5.2.

e) Time at zero energization if other than 20 ms.



Figure 3 – Remanence test sequence

3.7 Contact circuit resistance

3.7.1 Procedure

The contact circuit resistance shall be measured by the Kelvin method (4 points method) at a point 6 mm from the point of emergence of the termination from the seal, or to the point prescribed in the detail specification.

The voltage and current applied to the contact circuit shall be not more than 100 mV and 10 mA a.c. r.m.s. or d.c. unless otherwise prescribed. Preferred values for the voltage applied are: 30 mV and 100 mV (a.c. r.m.s. or d.c.).

The frequency of the alternating current shall be in the audio frequency range.

When d.c. is used, the direction of this current shall be reversed, and the measurement repeated.

The value of contact resistance shall be the mean of the two values.

The reed contact unit shall be saturated magnetically unless otherwise prescribed and the test coil energization reduced to a value prescribed in the detail specification.

The break contact circuit resistance shall be measured without energization of the test coil unless otherwise specified.

The measurement circuit may be connected to the reed contact unit at instants 0 or t_2 (see figure 4) as prescribed in the detail specification.

The measurement circuit shall be disconnected from the reed contact unit at the instant t_3 as prescribed in the detail specification.

The measurement of the contact resistance shall be made between instant t_2 and t_3 for the make contact and between t_5 and t_6 for the break contact, see figure 4.

3.7.2 Requirements

The contact circuit resistance shall not exceed the value prescribed in the detail specification.

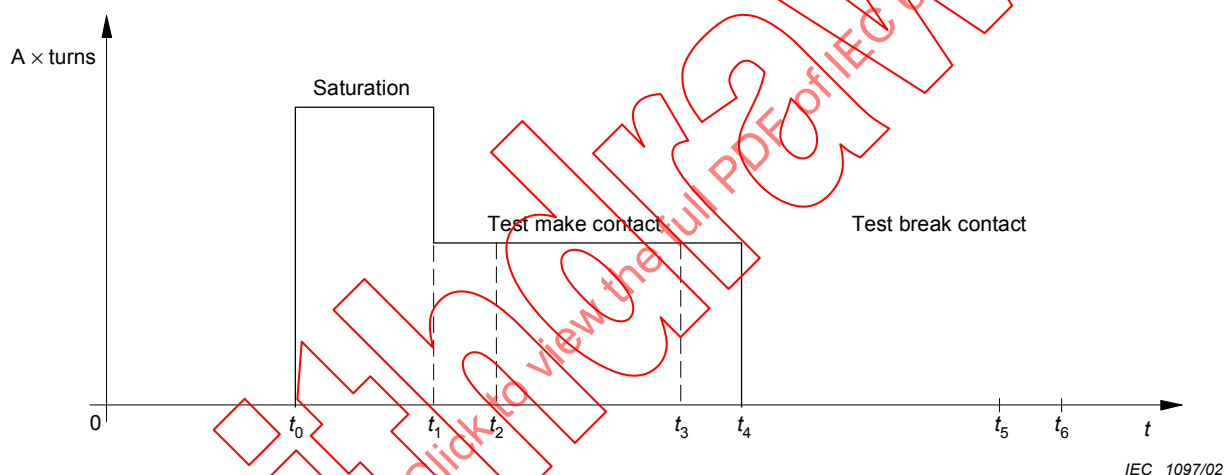


Figure 4 – Sequence of contact circuit resistance measurement

3.7.3 Information to be stated in the detail specification

- Test coil.
- Point of measurement, if other than 6 mm.
- Contact circuit resistance.
- Value of saturation and the reduced value.
- t_1 , t_2 , t_3 , t_4 , t_5 and t_6 .
- Applied measurement voltage and current (if applicable).
- The frequency of the applied qualities used for contact circuit resistance test, where applicable.

3.8 Dielectric test

3.8.1 Procedures

When the terminals of the test equipment are short-circuited, the current shall be between 0,1 mA and 1 mA.

a) Procedure 1

The test voltage, as prescribed in the detail specification shall be applied:

- between the terminals of a normally open contact unit in the release position,
- between the terminals of the make and break contact for both the operate and the release positions of the contact unit, unless otherwise prescribed in the detail specifications (Form C and Form D contacts),
- between all specified conductive parts of the reed contact unit.

The test voltage (d.c. or a.c.) (45 Hz – 65 Hz) shall be applied between the terminals for one of the following durations:

- for (60 ± 5) s,
- for 1 s (at 1,1 times the specified voltage).

b) Procedure 2

The method prescribed in 3.8.1 (a)) can be applied with an appropriate preconditioning ionization method.

Unless otherwise prescribed in the detail specification, a test duration of procedure 1 shall be applied.

3.8.2 Requirements

The leakage current through the reed contact unit shall not exceed a specified value for a specified duration as prescribed in the detail specification.

3.8.3 Information to be stated in the detail specification

- a) Procedure 1 or 2.
- b) Preconditioning, if applicable.
- c) Voltage between the terminals of the make contact (and break contact, for both the operate and the release positions of the contact unit; Form C and Form D contacts) unless otherwise prescribed in detail specifications.
- d) Conductive parts.
- e) Duration of application of the test voltage.
- f) Maximum value of leakage current.
- g) Maximum duration of leakage current.
- h) Time that elapses between preconditioning ionization and monitoring for a leakage current, if applicable.

3.9 Insulation resistance

3.9.1 Procedure

The test voltage, as prescribed in the detail specification, shall be applied:

- between the terminals of the make contact (and break contact, in both the release and the operate positions of the contact unit; Form C and Form D contacts), unless otherwise prescribed in the detail specification;
- between specified metallic parts of the reed contact unit.

The insulation resistance of the reed contact unit shall be measured at the d.c. voltage level prescribed in the detail specification, which shall preferably be one of the following:

- 100 V
- 500 V

The voltage shall be applied for at least 0,5 s, or for a longer period as is necessary to obtain a stable reading, after which the insulation resistance shall be measured.

3.9.2 Requirements

The insulation resistance value obtained shall be not less than that prescribed in the detail specification.

3.9.3 Information to be stated in the detail specification

- a) Insulation test voltage.
- b) Minimum value of insulation resistance.
- c) Conductive parts.

3.10 Operate, release, transfer or bridging, and bounce times (see figure 2)

3.10.1 Procedure

NOTE The result of the time measurements upon reed contact units made in a test coil depend not only upon the reed contact unit itself but also upon the test coil, and the impedances of the total circuit in the open and closed positions.

Suitable test circuits shall be used.

The test coil shall be energized from an adjustable d.c. supply via a bounce-free (e.g. mercury-wetted) switch with a high open-circuit impedance and without any damping circuit.

Operate make, break and transfer or bridging time

The zero energization shall be maintained for a minimum period of 10 ms. The d.c. supply voltage shall be set to provide a steady current equivalent to 150 % of the must-operate value. This shall be applied to the test coil and the times t_1 (t_2 , t_3 , t_4 if applicable) of the reed contact unit shall be measured.

Bounce time (operate) (t_5 , t_6)

The bounce time (operate) shall be measured, under the same condition as the operate time. Discontinuities of less than 10 μ s shall be ignored, unless otherwise prescribed.

Release make, break, bridging or transfer time

The d.c. supply shall be set to 150 % of the must-operate value and maintained for a minimum period of 10 ms prior to disconnection of the coil energization, and the times t_{11} (t_{12} , t_{13} , t_{14} if applicable) of the reed contact unit shall be measured.

Bounce time (release) (t_{15} , t_{16})

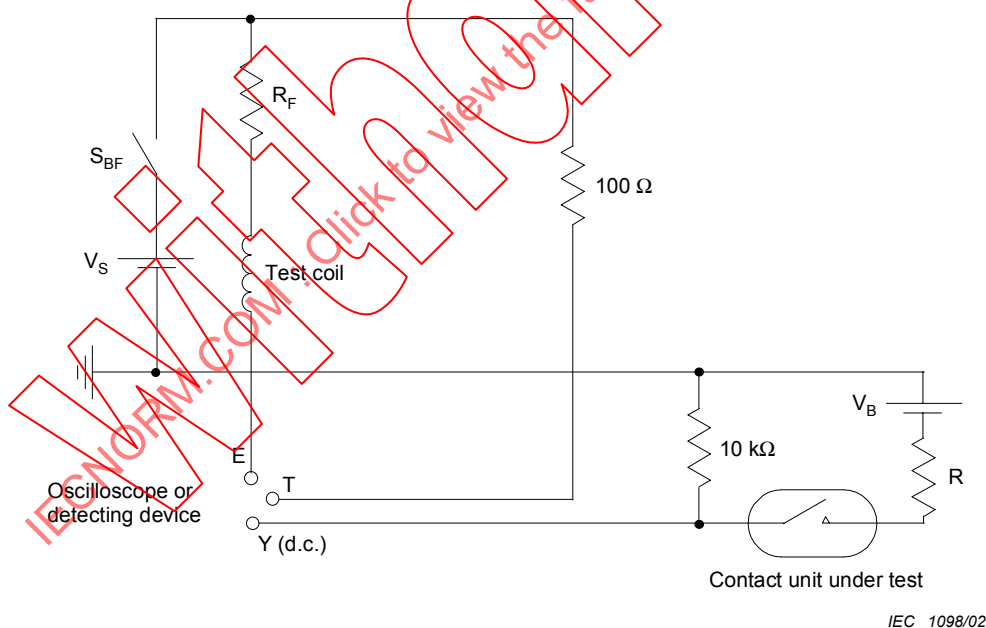
The bounce time (release) shall be measured, under the same conditions as the release time. Discontinuities of less than 10 μ s shall be ignored, unless otherwise prescribed.

3.10.2 Requirements

The time(s) shall not exceed that (those) prescribed in the detail specification.

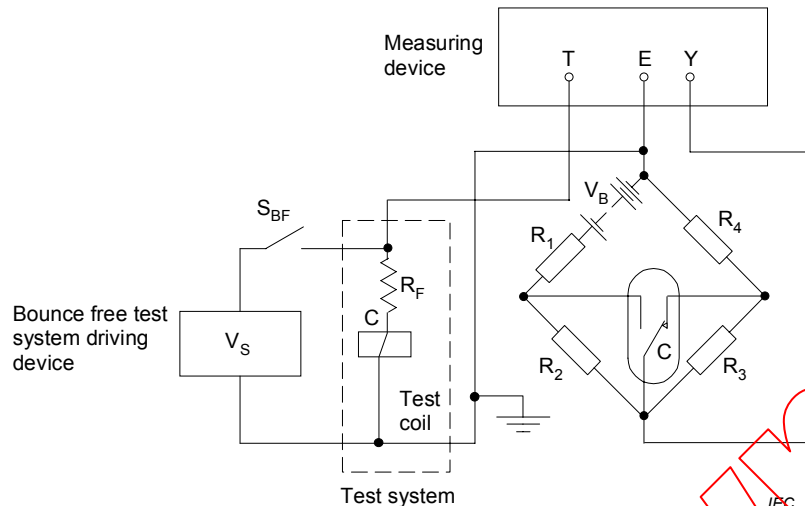
3.10.3 Information to be stated in the detail specification

- a) Test coil number (see annex A).
 - b) Test system description.
 - c) Must-operate value.
 - d) Operate time, maximum.
 - e) Release time, maximum.
 - f) Operate bounce time, maximum (where specified).
 - g) Release bounce time, maximum (where specified).
 - h) Test circuit potentials and resistances.
 - i) Repetition rate and duty cycle.
 - j) Transfer time, maximum and minimum
 - k) Bridging time, maximum and minimum
- } Form C and Form D contacts.



E: Earth/Ground
T: Trigger
Y: Amplifier

Figure 5 – Test circuit for the measurement of release and bounce time of a make contact unit



- | | | | |
|-------------------|-----------------------------|------------------------------------|------------------|
| C: | Test coil | R ₁ to R ₄ : | Resistors |
| c: | Contact unit under test | R _F : | Fixed resistor |
| V _S : | Energization voltage supply | T: | Trigger input |
| S _{BF} : | Switch, bounce-free | Y and E: | Measuring inputs |
| V _B : | Test supply voltage | | |

NOTE In order to distinguish between bridging and transfer time it is recommended to take the following ratios for the resistors: R₁ = 1, R₂ = 2, R₃ = 2/3, R₄ = 1

Figure 6 – Test circuit for the measurement of time parameters of a change-over contact unit

3.11 Contact sticking

3.11.1 Thermal sticking

Procedure 1: Change of release time and operate time

The test circuit of 3.10 shall be used.

a) Make contact

The reed contact unit under test shall be mounted in a test coil and the coil energized at 150 % of the must-operate values, and then while at room ambient temperature, the release break time shall be measured.

With the coil energization maintained, the ambient temperature shall be raised to the upper limit according to the given climatic category over 1 h approximately.

The reed contact unit shall be held operated at 150 % of the must-operate value at this temperature for not less than 24 h. The coil energization shall then be disconnected without any physical disturbance to the contact unit under test and the release break time shall be measured while still at this temperature (see 3.10.1).

The difference between the first and the second measurements indicates the degree of contact sticking.

The heating from the coil shall be taken into consideration.

b) Break contact

The reed contact unit under test shall be mounted in a test coil with no coil energization and then while at room ambient temperature, the operate break time shall be measured by applying 150 % of the must-operate value of energization.

The ambient temperature shall be raised to the upper limit according to the given climatic category over 1 h approximately without coil energization.

The reed contact unit shall be held at this temperature for not less than 24 h without coil energization.

Without any physical disturbance to the contact unit under test, the operate break time shall be measured while still at this temperature by applying 150 % of the must-operate value of energization.

The difference between the first and the second measurements indicates the degree of contact sticking.

The heating from the coil shall be taken into consideration.

c) Requirements

The difference between the two time measurements shall not exceed the value prescribed in the detail specification.

d) Information to be stated in the detail specification

- 1) Test coil.
- 2) Upper category temperature.
- 3) The maximum permitted value of the difference between the first and the second measurement.
- 4) Test circuit description.
- 5) Test period if over 24 h.

Procedure 2: Change of just-release value and just-operate value

a) Make contact

The just-release value shall be measured according to 3.5, except that the saturate value shall not be applied.

The reed contact unit under test shall be mounted in a test coil and the coil energized at 150 % of the must-operate values, and then while at room ambient temperature, the just-release value shall be measured.

With the coil energization maintained, the ambient temperature shall be raised to the upper limit according to the given climatic category within 1 h.

The reed contact unit shall be held operated at 150 % of the must-operate value at this temperature for not less than 24 h.

Without any physical disturbance to the contact unit under test the just-release value shall be measured while still at this temperature.

The difference between these two measurements indicates the degree of contact sticking.

The heating from the coil shall be taken into consideration.

b) Break contact

The just-operate values shall be measured according to 3.5, except that the saturate value shall not be applied.

The reed contact unit under test shall be mounted in a test coil and the coil energization shall be increased from zero, and then while at room ambient temperature, the just-operate value shall be measured.

The ambient temperature shall be raised to the upper limit according to the given climatic category within 1 h, without coil energization.

The reed contact unit shall be held at this temperature for not less than 24 h without coil energization.

Without any physical disturbance to the contact unit under test the just-operate value shall be measured while still at this temperature.

The difference between these two measurements indicates the degree of contact sticking.

The heating from the coil shall be taken into consideration.

c) Requirements

The difference between the two measurements shall not exceed the value prescribed in the detail specification.

d) Information to be stated in the detail specification

- 1) Test coil.
- 2) Upper category temperature
- 3) The maximum permitted value of the difference between the two measurements.
- 4) Rate of change of energization if other than 1 A × turns/ms.
- 5) Method of monitoring.
- 6) Failure-to-break contact circuit resistance limit, when using procedure 1 of 3.5.1.

3.11.2 Magnetostrictive sticking (for dry reed contact units only)

a) Procedure

1) Make contact

The reed contact unit under test shall be mounted in a coil energized with 2 000 square wave pulses at a specified pulse rate. The peak-to-peak value of the pulses shall extend between the values prescribed in the detail specification.

The upper value of energization shall be above the must-operate value and the lower value of energization shall be above the must-not-release value.

The coil energization shall then be disconnected at the higher value without any physical disturbance of the reed contact unit under test and the unit shall be checked for failure-to-break (see 3.5).

The checking voltage for failure-to-break shall be removed before the test coil is re-energized.

The above cycle of tests shall be repeated at least five times.

A failure shall be any occasion on which the contact fails to break, measured within a specified period after the interruption of the energization of the test coil.

NOTE A tendency to stick can also be estimated by comparing release value and release break time during the test as under 3.11.1.

2) Break contact

The reed contact unit under test shall be mounted in a test coil energized with 2 000 square wave pulses at a specified pulse rate. The peak-to-peak value of the pulses shall extend between the value prescribed in the detail specification.

The upper value of energization shall be lower than the must-not-operate value and the lower value of energization shall be lower than the must-release value.

The coil energization shall then be increased to 150 % of the must-operate value without any physical disturbance of the reed contact unit under test and the unit shall be checked for failure-to-break (see 3.5). The checking voltage for failure-to-break shall be removed before the test coil energization is disconnected.

The above cycle of tests shall be repeated at least five times.

A failure shall be any occasion on which the contact fails to break, measured within a specified period after the energization of the test coil.

NOTE A tendency to stick can also be estimated by comparing operate value and operate break time during the test as under 3.11.1.

b) Requirements

The total number of failures-to-break shall not exceed that prescribed in the detail specification.

c) Information to be stated in the detail specification

- 1) Test coil.
- 2) Pulsing rate.
- 3) Limits for the peak-to-peak value of the pulses.
- 4) Number of test cycles if exceeding five.
- 5) Acceptable number of failures-to-break.
- 6) Minimum contact circuit resistance defining failure-to-break.
- 7) Specified period of measurement.

3.12 Robustness of terminals**3.12.1 Procedure**

The reed contact unit shall be subjected to the procedure of Tests U of IEC 60068-2-21.

3.12.2 Requirements

The terminals and seals shall not show any visible damage, unless degradation is permitted to the extent explicitly prescribed in the detail specification. The changes in the functional characteristics shall not exceed the values prescribed in the detail specification.

3.12.3 Information to be stated in the detail specification

- a) Applicable Tests U of IEC 60068-2-21.
- b) Information required by the tests chosen from IEC 60068-2-21.
- c) Permissible changes of functional characteristics.
- d) Test method Qk or Ql of IEC 60068-2-17 and leakage rate.

3.13 Soldering (solderability and resistance to soldering heat)**3.13.1 Procedure**

a) Solderability

Prior to the test, the reed contact unit shall be subjected to an accelerated ageing procedure either by exposing it to steam for 1 h or to dry heat at 155 °C for 16 h, if so required by the detail specification.

The reed contact unit shall be subjected to one of the methods for solderability of Test Ta of IEC 60068-2-20.

b) Resistance to soldering heat

The reed contact unit shall be subjected to one of the methods for resistance to soldering heat of Test Tb of IEC 60068-2-20.

3.13.2 Requirements

The requirements for solderability and resistance to soldering heat shall be prescribed in the detail specification.

3.13.3 Information to be stated in the detail specification

- a) Method.
- b) Information required by the methods chosen from IEC 60068-2-20.

3.14 Climatic sequence

In the climatic sequence, an interval of not more than three days is permitted between any of these tests, except between damp heat, cyclic, first cycle and dry cold.

In such a case, the cold test shall follow immediately after the recovery period specified for the damp heat test.

The tests and measurements shall be performed in the following order:

3.14.1 Procedure

a) Dry heat

The reed contact unit shall be subjected to Test Ba of IEC 60068-2-2, at the upper limit according to the given climatic category.

b) Damp heat, cyclic, first cycle

- This shall be carried out in accordance with Test Db of IEC 60068-2-30, for one cycle of 24 h, with the exception that the periodic variation in temperature shall be omitted.
- After recovery, the reed contact unit shall be immediately subjected to the cold test.

c) Cold

The reed contact unit shall be subjected to Test Aa of IEC 60068-2-1, at the lower limit according to the given climatic category.

d) Low air pressure

The reed contact unit shall be subjected to Test M of IEC 60068-2-13, using the degree of severity prescribed in the detail specification. The preferred severity is stated in 1.4.8.

e) Damp heat, cyclic, remaining cycles

The reed contact unit shall be subjected to Test Db of IEC 60068-2-30, with the exception that the periodic variation of temperature shall be omitted.

The number of cycles shall be prescribed in the detail specification.

Upon completion, the reed contact unit shall be exposed to the recovery conditions appropriate to the chosen severity.

3.14.2 Requirements

At the end of this climatic sequence the reed contact units shall meet the requirements of the following tests as prescribed in the detail specification:

- a) visual inspection (3.4);
- b) functional tests (3.5);
- c) contact-circuit resistance (3.7);
- d) voltage proof (3.8);
- e) insulation resistance test (3.9);
- f) sealing (3.22).

3.14.3 Information to be stated in the detail specification

- a) Degree of severity for Test M.
- b) Duration for Tests Aa and Ba.
- c) Number of cycles for Test Db.
- d) Permissible changes of functional characteristics.
- e) Contact-circuit resistance.

- f) Maximum value of leakage current permissible.
- g) Insulation resistance.
- h) Method Qk or Ql of IEC 60068-2-17, and leakage rate.

3.15 Damp heat, steady state

3.15.1 Procedure

The reed contact unit shall be subjected to Test Ca of IEC 60068-2-3, using the appropriate degree of severity prescribed in the detail specification.

3.15.2 Requirements

At the end of this test the reed contact unit shall meet the requirements of the following tests as prescribed in the detail specification:

- a) visual inspection (3.4);
- b) functional tests (3.5);
- c) contact-circuit resistance (3.7);
- d) voltage proof (3.8);
- e) insulation resistance test (3.9);
- f) sealing (3.22);
- g) solderability (3.13.1).

3.15.3 Information to be stated in the detail specification

- a) Degree of severity for Test Ca of IEC 60068-2-3.
- b) Permissible changes of functional characteristics.
- c) Contact-circuit resistance.
- d) Maximum value of leakage current permissible.
- e) Insulation resistance.
- f) Test method Qk or Ql of IEC 60068-2-17, and leakage rate.

3.16 Rapid change of temperature

3.16.1 Procedure

The reed contact unit shall be subjected to Test Na or Nc of IEC 60068-2-14.

3.16.2 Requirements

The reed contact unit shall be visually examined. There shall be no visible damage, unless degradation is permitted to the extent explicitly prescribed in the detail specification, and the marking shall be legible as prescribed in the detail specification. The reed contact unit shall meet the requirements of the sealing test (3.22).

3.16.3 Information to be stated in the detail specification

- a) Test Na or Test Nc of IEC 60068-2-14.
- b) Information required by the test selected (in particular test conditions and severities).
- c) Test method Qk or Ql of IEC 60068-2-17, and leakage rate.

3.17 Salt mist

3.17.1 Procedure

The reed contact unit shall be subjected to Test Ka of IEC 60068-2-11.

3.17.2 Requirements

The reed contact unit shall be visually examined. There shall be no visible damage and the marking shall be legible as prescribed in the detail specification.

3.17.3 Information to be stated in the detail specification

As stated in Test Ka of IEC 60068-2-11.

3.18 Bump

3.18.1 Procedure

The reed contact unit shall be subjected to Test Eb of IEC 60068-2-29.

The preferred severity is stated in 1.4.8.

The severity shall be as prescribed in the detail specification.

a) Method 1 – Functional

For the purpose of this test, the reed contact unit shall be rigidly mounted in a test coil. The sample shall then be submitted to one half of the number of bumps with the test coil energized at 150 % of the must-operate value; and the other half of the number of bumps while de-energized. The sample shall be continuously monitored to detect false opening or closing.

b) Method 2 – Survival

During this test the reed contact unit shall be rigidly mounted and subjected to the required number of bumps, in the jig prescribed in the detail specification.

3.18.2 Requirements

Method 1

During the test, no failure-to-make or failure-to-break shall exceed 10 μ s.

Immediately following the bump test, the reed contact unit shall meet the requirements of the following tests, as prescribed in the detail specification:

- a) visual inspection (3.4);
- b) functional tests (3.5);
- c) sealing (3.22).

Method 2

Immediately following the bump test, the reed contact units shall meet the requirements of the following tests, as prescribed in the detail specification:

- a) visual inspection (3.4);
- b) functional tests (3.5);
- c) sealing (3.22).

3.18.3 Information to be stated in the detail specification

- a) Information required by Test Eb of IEC 60068-2-29.
- b) Method 1 or 2.
- c) Identification of the plane of movement of the contacts (if appropriate).
- d) Mounting jig.
- e) Permissible changes of functional characteristics.
- f) Test method Qk or Ql of IEC 60068-2-17, and leakage rate.

3.19 Vibration

3.19.1 Vibration 1 – Functional

a) Procedure

The reed contact unit shall be subjected to Test Fc of IEC 60068-2-6. Subclauses 8.1 (vibration response investigation) followed by 8.2.1 (endurance by sweeping) and finally 8.1 (vibration response investigation) of IEC 60068-2-6 shall apply. The preferred severity is stated in 1.4.8.

Unless otherwise prescribed in the detail specification, vibration shall be applied

- in case of dry reed contact units only normal to the longitudinal axis with the direction of acceleration in the same direction as the movement of the contacts during make and break;
- in case of mercury wetted contact units in each of the following two directions:
 - vertical with the contact unit in the preferred position,
 - horizontal, in the direction of the movement of the blades, with the contact in the preferred position.

For the purpose of this test, the sample shall be rigidly mounted in the test coil.

During this test, the test coil shall be alternately energized at 150 % of the must-operate value and de-energized, the change in condition to synchronize with the completion of each vibration sweep, ignoring the defects in the resonance frequency band.

The reed contact unit under test shall be continuously monitored to detect false contact opening or closing.

Adequate precautions shall be taken to shield the reed contact unit from the magnetic field of the vibration table.

b) Requirements

During the test, no failure-to-make (or failure-to-break) shall exceed 10 μ s.

Immediately following the tests, the reed contact units shall meet the requirements of the following tests as prescribed in the detail specification:

- 1) visual inspection (3.4);
- 2) functional tests (3.5);
- 3) sealing (3.22).

c) Information to be stated in the detail specification

- 1) Axis of mounting if different from above.
- 2) Identification of the direction of movement of the contacts (if appropriate).
- 3) Severity.
- 4) Permissible changes of functional characteristics.
- 5) Mounting jig.
- 6) Test method Qk or Ql of IEC 60068-2-17 and leakage rate.

3.19.2 Vibration 2 – Survival

a) Procedure

The reed contact unit shall be mounted in the jig prescribed in the detail specification.

The vibration test shall be carried out at 50 Hz for 6 h with a vibration amplitude of 0,35 mm unless otherwise prescribed in the detail specification.

Unless otherwise prescribed in the detail specification, vibration shall only be applied normal to the longitudinal axis with the direction of acceleration in the same direction as the movement of the contacts during make and break.

NOTE Where the direction of movement of contacts is not identifiable, this test is not applicable.

b) Requirements

Immediately following the test, the reed contact units shall meet the requirements of the following tests as prescribed in the detail specification:

- 1) visual inspection (3.4);
- 2) functional tests (3.5);
- 3) sealing (3.22).

c) Information to be stated in the detail specification

- 1) Axis of mounting, if different from above.
- 2) Identification of the direction of movement of the contacts (if appropriate).
- 3) Permissible changes of functional characteristics.
- 4) Mounting jig.
- 5) Test method Qk or Ql of IEC 60068-2-17 and leakage rate.

3.20 Shock

3.20.1 Procedure

The reed contact unit shall be subjected to Test Ea of IEC 60068-2-27.

The preferred severities are stated in 1.4.8.

The severity shall be prescribed in the detail specification.

a) Method 1 – Functional

For the purpose of this test, the reed contact unit shall be rigidly mounted in a test coil. The sample shall then be submitted to one half of the number of shocks with the test coil energized at 150 % of the must-operate value; and the other half of the number of shocks while de-energized.

The reed contact unit under test shall be continuously monitored to detect false opening or closing.

b) Method 2 – Survival

During this test, the reed contact unit shall be rigidly mounted in the jig prescribed in the detail specification and subjected to the required number of shocks.

3.20.2 Requirements

Method 1

During the test, no failure-to-make or failure-to-break shall exceed 10 μ s. Immediately following the test, the reed contact unit shall meet the requirements of the following tests as prescribed in the detail specification:

- a) visual inspection (3.4);
- b) functional tests (3.5);
- c) sealing (3.22).

Method 2

Immediately following the shock test, the reed contact unit shall meet the requirements of the following tests as prescribed in the detail specification:

- a) visual inspection (3.4);
- b) functional tests (3.5);
- c) sealing (3.22).

3.20.3 Information to be stated in the detail specification

- a) Information required by Test Ea.
- b) Method 1 or 2.
- c) Mounting jig.
- d) Identification of the plane of movement of the contacts (if appropriate).
- e) Permissible changes of functional characteristics.
- f) Test method Qk or Ql of IEC 60068-2-17 and leakage rate.

3.21 Acceleration test – Functional test only (applicable to dry reed contact units only)

3.21.1 Procedure

The reed contact units shall be subjected to Test Ga of IEC 60068-2-7.

The preferred severities are stated in 1.4.8.

Unless otherwise prescribed in the detail specification, the acceleration shall only be applied normal to the longitudinal axis with the direction of acceleration in the same direction as the movement of the contacts during make and break.

For the purpose of this test, the sample shall be rigidly mounted in the test coil.

During this test, the test coil shall be alternately energized at 150 % of the must-operate value and de-energized, for at least 10 times, unless otherwise prescribed in the detail specification.

The reed contact unit under test shall be continuously monitored to detect opening or closing.

3.21.2 Requirements

Immediately following the acceleration test, the reed contact unit shall meet the requirements of the following tests as prescribed in the detail specification:

- a) visual inspection (3.4);
- b) functional tests (3.5);
- c) sealing (3.22).

3.21.3 Information to be stated in the detail specification

- a) Information required by Test Ga of IEC 60068-2-7.
- b) Mounting jig.
- c) Identification of the plane of movement of the contacts.
- d) Permissible changes of functional characteristics.
- e) Test method Qk or Ql of IEC 60068-2-17 and leakage rate.

3.22 Sealing

3.22.1 Procedure

The reed contact units shall be subjected to Test Qk or Ql of IEC 60068-2-17.

For pressurized mercury wetted contact units hermeticity of the seal shall be checked by means of an arc time duration test, while switching a load, as prescribed in the detail specification.

3.22.2 Requirements

- a) The leakage rate shall not exceed the rate prescribed in the detail specification.
- b) The specimens shall be visually inspected and electrically and mechanically checked as required by the relevant specification (Test Ql).
- c) The arcing time shall not exceed a value prescribed in the detail specification (arc time duration test).

3.22.3 Information to be stated in the detail specification

- a) Test Qk or Ql or arc time duration test.
- b) Pressure and duration for Test Ql or severity for Test Qk or switching load and frequency for arc time duration test.
- c) – For Test Qk: leakage rate;
 – For Test Ql: information on how the specimens shall be visually inspected and electrically and mechanically checked;
 – For arc duration test: maximum arcing time.

3.23 Electrical endurance

3.23.1 Types of electrical endurance test

- a) Standard electrical endurance test
- b) Application simulation endurance test

Application simulation tests are electrical endurance tests performed under specified conditions related to a well-defined application. Due to the diversity and numerous possible applications, these endurance tests cannot be specified in a harmonized specification.

3.23.2 Standard electrical endurance tests

These tests are standardized as far as possible to allow comparison of several products and give information on reliability and assessed quality under standardized conditions.

3.23.3 General test arrangements

Most of the endurance testing equipments are built corresponding to the block diagram given in figure 7:

The input energization source incorporates a power supply unit complete with the stabilization circuitry consistent with the given energization and impedance limits, and the corresponding over-current protection. The switching device provides a pulse pattern of the desired frequency, duty cycle and waveform to operate the reed contact via the test coil.

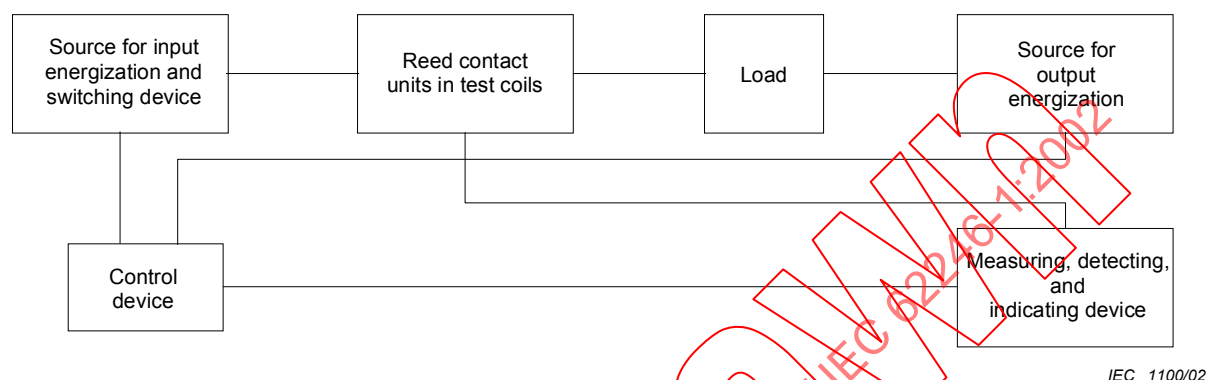


Figure 7 – Electrical endurance test arrangement

The control device provides signals for operating the switching device and controls, starts, measurement stops, etc.

The reed contact units shall be mounted in test coils according to annex A.

The load shall be a component, a cable or a combination of several components and / or cables. The source for output energization shall supply the voltages or currents for energizing the load and may provide voltages or currents necessary for the measurements. Together the load and the source for output energization define the load conditions. The load conditions shall be selected from the standard loads as prescribed in the blank detail specification or in the detail specification.

The measuring and indication device shall be capable of performing the specified measurements. It shall also indicate which type of failure was detected in which reed contact and indicate when this occurred. Other functions which this device may provide are the indication of data and time, limiting and mean values of measurements and tests, failures of the test equipment; and the provision of commands to the control device to de-energize reed contact units which have failed.

The electrical endurance testing equipment shall be capable of performing standard electrical endurance tests as specified in this subclause or application simulation endurance tests as specified in a detail specification. Application simulation tests shall be so written that the test equipment capable of performing the standard electrical endurance tests will be equally suitable for the simulation tests.

3.23.4 Procedure

The test shall be performed under standard atmospheric conditions.

The operate energization of the test coils shall be 150 % of the must-operate value of the reed contacts to be tested. The release energization shall be zero, unless otherwise prescribed in the detail specification. The frequency of operation shall be selected from: 10; 12,5; 16; 20; 25; 50 and 60 operations per second.

The pulse pattern shall be of a rectangular waveform with a duty cycle of 50 % unless otherwise prescribed in the detail specification.

The source for input energization should be a voltage source with low internal impedance.

The test coils in with the reed contact units are mounted shall be energized individually or in parallel, with precautions against interactions. When coil suppression (electrical components to suppress or reduce unwanted transients) is used it shall be prescribed in the detail specification.

Each contact of the contact unit shall be connected to a separate load with or without additional contact protection, as prescribed in the detail specification.

NOTE A relay may be considered as a test system for the purposes of endurance testing.

Each contact unit shall be tested for failure to make and failure to break at each operation, unless otherwise prescribed. This test may be done by measuring the voltage drop across the contact under normal load conditions.

The measuring period τ_1 for failure to make, starts at a time t_1 after the start of the coil energization.

The measuring period τ_2 for failure to break, starts at a time t_2 after the end of the coil energization.

The times t_1 , t_2 , τ_1 and τ_2 shall be given in the detail specification.

At intervals prescribed in the detail specification, the contact circuit resistance of each reed contact unit shall be measured according to the method in 3.7, excepting that the measuring period shall start at time t_3 and shall last τ_3 , as given in the detail specification and the energization shall be 150 % of the must-operate energization value.

The integration times of the measuring device shall be shorter than τ_1 , τ_2 , and τ_3 respectively.

The integration time is the time required by the monitoring device to register the mean value of a signal. In the case of an input step voltage at the failure criteria level, it is the time required to register a failure.

The load shall be switched on and off by the reed contact unit under test. The wiring to the loads shall be as short as possible.

The wiring of the control, the measuring and indicating devices shall not effectively influence the current through and the voltage across the reed contact unit during operation. For example, the test point may be switchable for this purpose.

If the source for output energization is a voltage source it shall be connected with one terminal to earth. The voltage source shall have an internal resistance R_i and surge impedance Z_s so that the following conditions are met $R_i < 0,02 \times$ resistance of d.c. load and $Z_s < 0,02 Z$ of the load up to 1 MHz (see 3.3).

If several loads are connected in parallel via the respective reed contact unit under test to the same voltage source, the combined load shall be taken into account.

The tolerance on the voltage source shall be a maximum of $\pm 10\%$ on 30 mV and a maximum of $\pm 2\%$ for the other values.

If the reed contact unit is an unsymmetrical type having a preferred switching polarity, this should be stated in the detail specification.

NOTE This procedure describes only tests for the make contact. If the break contact is tested, similar test conditions should be described in the detail specification. If both contacts are to be tested, when two separate loads will be needed, the two circuits shall be independent of each other.

Standard load conditions

The standard electrical endurance test load conditions shall be selected from the following loads:

a) Resistive loads (see table 1)

The load, including the connection wires, shall have a maximum rise time of 0,1 μ s, an inductance $< 10^{-4}$ Henry and a capacitance < 50 pF. (Overshoot under consideration)

If more stringent test conditions are required, these shall be prescribed in the blank detail specification.

The test point of the measuring and indicating device should be connected to the reed contact unit under test via a resistor ≥ 50 k Ω .

Table 1 – Resistive loads

Type of voltage	Voltage of output source V	Current through closed contacts mA
Dry reed contact units		
d.c.	<u>0,03</u>	<u>1</u>
	0,03	10
	0,10	1
	5	5
	5	10
	10	100
	<u>12</u>	<u>2</u>
	<u>12</u>	<u>10</u>
	<u>24</u>	<u>50</u>
	<u>50</u>	<u>10</u>
	<u>50</u>	<u>100</u>
	60	10
	60	100
	<u>100</u>	<u>50</u>
	120	50
	<u>200</u>	<u>100</u>
a.c.	0,03	10
	<u>0,1</u>	<u>1</u>
	<u>230</u>	<u>100</u>
	230	500
	230	1000
Mercury wetted contact units		
d.c.	<u>0,03</u>	<u>1</u>
	<u>30</u>	<u>100</u>
	30	1000
	<u>50</u>	<u>100</u>
	50	1000
	50	2000
	50	5000
	100	50
	500	100
	500	200
	500	500
a.c.	<u>230</u>	<u>100</u>
	230	200

NOTE Preferred loads are underlined.