

Electromechanical elementary relays —

Part 7: Test and measurement procedures

The European Standard EN 61810-7:2006 has the status of a
British Standard

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee EPL/94, General purpose relays and reed contact units, which has the responsibility to:

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Part 7: Test and measurement procedures
(IEC 61810-7:2006)**

Relais élémentaires électromécaniques
Partie 7: Méthodes d'essai et de mesure
(CEI 61810-7:2006)

Elektromechanische Elementarrelais
Teil 7: Mess- und Prüfverfahren
(IEC 61810-7:2006)

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CENELEC

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Foreword

The text of document 94/226/FDIS, future edition 2 of IEC 61810-7, prepared by IEC TC 94, All-or-nothing electrical relays, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61810-7 on 2006-05-01.

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Endorsement notice

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ELECTROMECHANICAL ELEMENTARY RELAYS –

Part 7: Test and measurement procedures

1 Scope

This part of IEC 61810 states the test and measurement procedures for electromechanical elementary relays. It covers basic considerations which are, in general, common to all types of electromechanical elementary relays. Supplementary requirements may be necessitated by specific designs or application.

The test and measurement procedures of this standard are described as individual provisions covering a specific requirement. When combining them in a test programme, care must be taken (for example by suitable grouping of tested relays) to ensure that preceding tests do not devalue subsequent ones.

Where in this standard the term “specified” is used, this means a prescription in the appropriate documentation for the relay, for example manufacturer’s data sheet, test specification, customer detail specification. For application within the IECQ system such prescriptions are contained in the detail specification as defined in Clause A.7 of QC 001001.

NOTE 1 To improve the readability of this standard, the term “relay” is generally used in place of “electromechanical elementary relay”.

NOTE 2 Requirements and tests related to the type testing of electromechanical elementary relays are contained in IEC 61810-1. For that purpose, the generally described test and measurement procedures of this standard have been prescribed in a more restricted and stringent form in IEC 61810-1.

NOTE 3 Standards covering relays subjected to quality assessment in accordance with IECQ are compiled in the IEC 61811 series of publications.

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 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 60068-2-6:1995, *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 60068-2-10:2005, *Environmental testing – Part 2: Tests – Test J and guidance: Mould growth*

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, *Environmental testing – 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 60068-2-30:2005, *Environmental testing – Part 2: Tests – Test Db: Damp heat, cyclic (12 + 12-hour cycle)*

IEC 60068-2-42:2003, *Environmental testing – Part 2-42: Tests – Test Kc: Sulphur dioxide test for contacts and connections*

IEC 60068-2-43:2003, *Environmental testing – Part 2-43: Tests – Test Kd: Hydrogen sulphide test for contacts and connections*

IEC 60068-2-45:1980, *Environmental testing – Part 2: Tests – Test XA and guidance: Immersion in cleaning solvents*
Amendment 1 (1993)

IEC 60068-2-58:2004, *Environmental testing – Part 2-58: Tests – Test Td – Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60068-2-64:1993, *Environmental testing – Part 2: Test methods – Test Fh: Vibration, broad-band random (digital control) and guidance*

IEC 60068-2-68:1994, *Environmental testing – Part 2: Tests – Test L: Dust and sand*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60512-7: 1993, *Electromechanical components for electronic equipment; basic testing procedures and measuring methods – Part 7: Mechanical operating tests and sealing tests*

IEC 60695-2 (all parts), *Fire hazard testing – Part 2: Test methods*

IEC 60695-2-10:2000, *Fire hazard testing – Part 2-10: Glowing/hot wire based test methods – Glow-wire apparatus and common test procedure*

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

IEC 60695-2-12:2000, *Fire hazard testing – Part 2-12: Glowing/hot wire based test methods – Glow-wire flammability test method for materials*

IEC 60695-2-13:2000, *Fire hazard testing – Part 2-13: Glowing/hot wire based test methods – Glow-wire ignitability test method for materials*

IEC 60695-11-5:2004, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

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

IEC 61210:1993, *Connecting devices – Flat quick-connect terminations for electric copper conductors – Safety requirements*

IEC 61180-1:1992, *High-voltage test techniques for low-voltage equipment – Part 1: Definitions, test and procedure requirements*

IEC 61180-2:1994, *High-voltage test techniques for low-voltage equipment – Part 2: Test equipment*

IEC 61672-1:2002, *Electroacoustics – Sound level meters – Part 1: Specifications*

IEC 61810-1:2004, *Electromechanical elementary relays – Part 1: General and safety requirements*

IECQ QC 001001:2000, *IEC Quality Assessment System for Electronic Components (IECQ) – Basic Rules*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Types of relays

3.1.1

electromechanical relay

electrical relay in which the intended response results mainly from the movement of mechanical elements

[IEV 444-01-04]

3.1.2

all-or-nothing relay

electrical relay, which is intended to be energized by a quantity, the value of which is either within its operative range or effectively zero

[IEV 444-01-02]

3.1.3

elementary relay

all-or-nothing relay which operates and releases without any intentional time delay

[IEV 444-01-03]

3.1.4

monostable relay

electrical relay which, having responded to an energizing quantity and having changed its condition, returns to its previous condition when that quantity is removed

[IEV 444-01-07]

3.1.5

bistable relay

electrical relay which, having responded to an energizing quantity and having changed its condition, remains in that condition after the quantity has been removed; a further appropriate energization is required to make it change its condition

[IEV 444-01-08]

3.1.6

polarized relay

electrical relay, the change of condition of which depends upon the polarity of its DC energizing quantity

[IEV 444-01-09]

3.1.7

non-polarized relay

electrical relay, the change of condition of which does not depend upon the polarity of its energizing quantity

[IEV 444-01-10]

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

3.2.1

RT 0 unenclosed relay

relay not provided with a protective case

3.2.2

RT I dust protected relay

relay provided with a case which protects its mechanism from dust

3.2.3

RT II flux proof relay

relay capable of being automatically soldered without allowing the migration of solder fluxes beyond the intended areas

NOTE Where an enclosed construction is used, venting to the outside atmosphere is permissible.

3.2.4

RT III wash tight relay

relay capable of being automatically soldered and subsequently undergoing a washing process to remove flux residues without allowing the ingress of flux or washing solvents

NOTE In service, this type of relay is sometimes vented to the atmosphere after the soldering or washing process.

3.2.5

RT IV sealed relay

relay provided with a case which has no venting to the outside atmosphere, and having a time constant better than 2×10^4 s (see IEC 60068-2-17)

3.2.6**RT V hermetically sealed relay**

sealed relay having an enhanced level of sealing, assuring a time constant better than 2×10^6 s (see IEC 60068-2-17)

3.3 Functions of a relay**3.3.1****release condition**

for a monostable relay, specified condition of the relay when it is not energized; for a bistable relay, one of the conditions, as declared by the manufacturer

[IEV 444-02-01]

3.3.2**operate condition**

for a monostable relay, specified condition of the relay when it is energized by the specified energizing quantity and has responded to that quantity; for a bistable relay, the condition other than the release condition as declared by the manufacturer

[IEV 444-02-02]

3.3.3**operate** (verb)

change from the release condition to the operate condition

[IEV 444-02-04]

3.3.4**release** (verb)

for a monostable relay, change from the operate condition to the release condition

[IEV 444-02-05]

3.3.5**reset** (verb)

for a bistable relay, change from the operate condition to the release condition

[IEV 444-02-06]

3.3.6**change over** (verb)

for a monostable relay, operate or release; for a bistable relay, operate or reset

[IEV 444-02-07]

3.3.7**cycle** (verb)

for a monostable relay, operate and then release or vice versa; for a bistable relay, operate and then reset or vice-versa

[IEV 444-02-08]

3.3.8**revert** (verb)

for a specific type of polarized relay, release/reset again, or remain in the release condition, when supplied with a coil voltage in excess of that required for operation and of the same polarity as required for operation

[IEV 444-02-09, modified]

3.3.9

revert reverse (verb)

for a specific type of polarized bistable relay, operate again, or remain in the operate condition, when supplied with a coil voltage in excess of that required for resetting and of the same polarity as required for resetting

[IEV 444-02-10, modified]

3.4 Types of contacts

3.4.1

make contact

contact which is closed when the relay is in its operate condition and which is open when the relay is in its release condition

[IEV 444-04-17]

3.4.2

break contact

contact which is open when the relay is in its operate condition and which is closed when the relay is in its release condition

[IEV 444-04-18]

3.4.3

change-over contact

combination of two contact circuits with three contact members, one of which is common to the two contact circuits; such that when one of these contact circuits is open, the other is closed

[IEV 444-04-19]

3.4.4

change-over make-before-break contact

change-over contact in which the make contact circuit closes before the break contact circuit opens

[IEV 444-04-20]

3.4.5

change-over break-before-make contact

change-over contact in which the break contact circuit opens before the make contact circuit closes

[IEV 444-04-21]

3.5 Prefixes for the values applicable to relays

Values may be defined as rated, actual ("just"), test ("must") or characteristic value and identified as such by using one of these words as a prefix. The prefixes are also applicable to timing values.

3.5.1

rated value

value of a quantity used for specification purposes, established for a specified set of operating conditions of a relay

[IEV 444-02-18, modified]

3.5.2**actual (“just”) value**

value of a quantity determined by measurement on a specific relay, during performance of a specified function

[IEV 444-02-21]

3.5.3**test (“must”) value**

value of a quantity for which the relay shall comply with a specified action during a test

[IEV 444-02-20]

3.5.4**characteristic value**

value of a quantity with which, in the initial condition of a relay or for a specified number of cycles as specified, the relay shall comply with a specified requirement

[IEV 444-02-19, modified]

3.6 Energization values**3.6.1****energizing quantity**

electrical quantity which, when applied to the coil(s) of a relay under specified conditions, enables it to fulfil its purpose

[IEV 444-03-01, modified]

NOTE 1 For elementary relays, the energizing quantity is usually a voltage. Therefore, the input voltage as energizing quantity is used in the definitions given below. When a relay is energized by a given current instead, the respective terms and definitions apply with “current” used instead of “voltage”.

NOTE 2 The general term “input voltage” used in IEC Chapter 444 applies to all types of elementary relays (e.g. including solid-state relays). For electromechanical elementary relays the more specific term “coil voltage” has been chosen for the terms of 3.6, as in IEC 61810-1.

3.6.2**coil voltage**

voltage applied as an energizing quantity

[IEV 444-03-03]

3.6.3**operative range**

range of values of coil voltage for which a relay is able to perform its specified function

[IEV 444-03-05, modified]

NOTE For the following terms, refer also to Figures 3 to 7 which show the sequential functions of relays covered by the definitions.

3.6.4**magnetic preconditioning value**

value of the coil voltage at which the relay attains a defined magnetic condition

[IEV 444-03-19]

NOTE 1 For polarized relays, distinction is made between preconditioning in forward (operate) direction, and preconditioning in reverse direction.

NOTE 2 For bistable relays, preconditioning may also be used to set the relay to a defined position.

3.6.5

non-operate voltage

value of the coil voltage at which a relay does not operate

[IEV 444-03-07, modified]

3.6.6

operate voltage, set voltage (for bistable relays only)

value of the coil voltage at which a relay operates

[IEV 444-03-06, modified]

3.6.7

non-release voltage

value of the coil voltage at which a monostable relay does not release

[IEV 444-03-09, modified]

3.6.8

release voltage

value of the coil voltage at which a monostable relay releases

[IEV 444-03-08, modified]

3.6.9

non-reset voltage

value of the coil voltage at which a bistable relay does not reset

[IEV 444-03-11, modified]

3.6.10

reset voltage

value of the coil voltage at which a bistable relay resets

[IEV 444-03-10, modified]

3.6.11

revert voltage

for a specific type of polarized relay, value of the coil voltage greater than and with the same polarity as the operate voltage, at which the relay reverts

[IEV 444-03-12, modified]

3.6.12

non-revert voltage

for a specific type of polarized relay, value of the coil voltage greater than and with the same polarity as the operate voltage, at which the relay does not revert

[IEV 444-03-13, modified]

3.6.13

revert reverse voltage

for a specific type of polarized bistable relay, value of the coil voltage greater than and with the same polarity as the reset voltage, at which the relay reverts reverse

[IEV 444-03-14, modified]

3.6.14**non-revert reverse voltage**

for a specific type of polarized bistable relay, value of the coil voltage greater than and with the same polarity as the reset voltage, at which the relay does not revert reverse

[IEV 444-03-15, modified]

3.6.15**reverse polarity voltage**

for a polarized monostable relay, value of the coil voltage of reverse polarity at which the relay does not operate

[IEV 444-03-16, modified]

3.6.16**active power**

under periodic conditions, mean value, taken over one period T , of the instantaneous power p :

$$P = 1/T \int_0^T p \, dt$$

NOTE 1 Under sinusoidal conditions, the active power is the real part of the complex power.

NOTE 2 The SI unit for active power is the watt.

[IEV 131-11-42]

3.6.17**apparent power**

product of the r.m.s. voltage U between the terminals of a two-terminal element or two-terminal circuit and the r.m.s. electric current I in the element or circuit:

$$S = UI$$

NOTE 1 Under sinusoidal conditions, the apparent power is the modulus of the complex power.

NOTE 2 The SI unit for apparent power is the voltampere.

[IEV 131-11-41]

3.7 Electrical properties of contacts**3.7.1****contact current**

electric current which a relay contact carries before opening or after closing

[IEV 444-04-26]

3.7.2**switching current**

electric current which a relay contact makes and/or breaks

[IEV 444-04-27]

3.7.3**switching voltage**

voltage between the contact members before closing or after opening of a relay contact

[IEV 444-04-25, modified]

3.7.4

limiting continuous current

greatest value of electric current which a closed contact is capable of carrying continuously under specified conditions

[IEV 444-04-28, modified]

3.7.5

contact noise

spurious voltage which appears across the terminals of a closed contact

[IEV 444-04-33]

3.8 Contact load categories

3.8.1

contact load category 0

CC 0

load characterized by a maximum switching voltage of 30 mV and a maximum switching current of 10 mA

3.8.2

contact load category 1

CC 1

low load without contact arcing

NOTE Arcing with a duration of up to 1 ms is disregarded.

3.8.3

contact load category 2

CC 2

high load where contact arcing can occur

3.9 Mechanical properties of contacts

3.9.1

contact tip

contact point

part of a contact member at which the contact circuit opens or closes

[IEV 444-04-06]

3.9.2

contact gap

gap between the contact tips (points) when the contact circuit is open

[IEV 444-04-09, modified]

3.9.3

contact force

force which two contact members exert against each other at their contact tips (points) in the closed position

[IEV 444-04-10, modified]

3.9.4

contact member

conductive part designed to co-act with another to close or open the contact

[IEV 444-04-05, modified]

3.10 Terms relating to times

3.10.1

operate time

time interval between the application of the specified coil voltage to a relay in the release condition and the change of state of the last contact circuit, bounce time not included

[IEV 444-05-01, modified]

NOTE The operate time covers the closing time of a make contact, and the opening time of a break contact.

3.10.2

release time

time interval between the removal of the specified coil voltage from a monostable relay in the operate condition and the change of state of the last contact circuit, bounce time not included

[IEV 444-05-02, modified]

NOTE The release time covers the opening time of a make contact and the closing time of a break contact.

3.10.3

reset time

time interval between the application of the specified coil voltage to a bistable relay in the operate condition and the change of state of the last contact circuit, bounce time not included

[IEV 444-05-03, modified]

NOTE The reset time covers the opening time of a make contact and the closing time of a break contact.

3.10.4

bounce time

for a contact which is closing/opening its circuit, time interval between the instant when the contact circuit first closes/opens and the instant when the circuit is finally closed/opened

[IEV 444-05-04]

3.10.5

transfer time; transit time

for a change-over break-before-make contact, time interval during which both contact circuits are open

[IEV 444-05-06]

3.10.6

bridging time

for a change-over make-before-break contact, the time interval during which both contact circuits are closed

[IEV 444-05-05]

3.10.7

stabilization time

time interval between the instant when a specified coil voltage is applied and the instant when the last contact circuit is closed/opened and fulfils the specified requirements, bounce time included

[IEV 444-05-07, modified]

3.10.8

minimum time of energization

minimum duration of application of the coil voltage to ensure that the relay operates or resets

[IEV 444-05-08, modified]

3.10.9

contact time difference

for a relay having several contacts of the same type, difference between the maximum value of the operate (release/reset) time and the minimum value of the operate (release/reset) time

3.11 Miscellaneous terms

3.11.1

coil transient suppression device

device connected to the relay coil to limit its back electromotive force (e.m.f.) to a prescribed value

3.11.2

thermal equilibrium

variation of less than 1 K between any two out of three consecutive measurements made at an interval of 5 min

4 Test and measurement procedures

4.1 General

The test and measurement procedures specified in this part of IEC 61810 are recommended to be used for the testing of parameters given for a relay.

4.2 Deviations

Any test and measurement procedures deviating from those given in this standard may be applied but shall be indicated in the documentation of the relay.

4.3 Precision of measurement

Measurement inaccuracies shall be taken into account when evaluating the results. If not otherwise specified, all measurements shall be taken with an accuracy of $\pm 2\%$ for electrical, of $\pm 5\%$ for mechanical parameters and with $\pm 2\text{ K}$ for temperatures.

4.4 Power supplies

Unless otherwise specified, the following shall apply to power supplies and their connections:

Voltage or current shall be maintained within a tolerance range of $\pm 5\%$ of the specified value.

The alternating component (ripple content) of the output of a d.c. supply shall not exceed 6 %.

NOTE 1 The alternating component in d.c., expressed as a percentage, is defined as:

$$(\text{maximum value} - \text{minimum value}) \times 10 / (\text{d.c. component})$$

The frequency of an a.c. supply shall be maintained within a tolerance range of $\pm 2\%$ of the specified value, and the distortion factor shall not exceed 5 %.

NOTE 2 The distortion factor is defined as the ratio of the harmonic content obtained by subtracting the fundamental wave from a non-sinusoidal harmonic quantity and the r.m.s. value of the non-sinusoidal quantity. It is usually expressed as a percentage.

The following shall be earthed as applicable: one side of the d.c. power supply, one side of the single-phase a.c. power supply, or the neutral of the three-phase a.c. power supply. The

earthed side of the power supply shall be connected to: one terminal of each of one or more coils of the relay under test and one terminal of each of the loads connected to the relay under test.

4.5 Reference conditions for testing

4.5.1 General conditions

Unless otherwise specified, all tests shall be carried out under the standard atmospheric conditions for testing as follows:

- temperature 23 °C ± 5 °C
- relative humidity 25 % to 75 %
- air pressure 86 kPa to 106 kPa (860 mbar to 1 060 mbar)

Before testing, the relays shall be subjected to the standard atmospheric conditions for a time sufficient to allow them to reach thermal equilibrium.

Unless otherwise specified, the terms a.c. voltage and current indicate r.m.s. values throughout this standard.

4.5.2 Use of sockets

4.5.2.1 General considerations

Relays with the option of connection via an appropriate socket may be tested using a specified socket or via direct electrical connections. In either case, the wiring to the relay or socket should follow any requirements specified in the test clause. Where this is not possible, any deviation shall be recorded in the test report.

Where a socket is used, the test report must identify the related test clause(s) and the socket type/part number.

NOTE Reference to "terminal" or "relay terminal" within a test clause of this standard must be taken to mean "socket terminal", where a socket is used.

4.5.2.2 Precautions

The use of a socket can artificially improve some (relay) test results. As a consequence, the checks under 4.5.2.4 must be performed prior to conducting any tests using a socket.

The use of a socket can affect some test results to the detriment of the relay test results. As a consequence, the option remains for the test to be conducted without a socket, where it is practically possible to do so.

4.5.2.3 Socket mounting

Where a socket is employed for the shock, bump, vibration and acceleration tests (see 4.26 through 4.29), the method and conditions of mounting and the use of any retaining devices as recommended by the manufacturer must be specified.

4.5.2.4 Preliminary socket checks

Prior to conducting any tests via a socket, it shall be established that the resistance introduced at the relay terminal/socket receptacle interface does not exceed 10 % of the declared contact resistance for the relay.

Prior to conducting any tests via a socket, it shall be established that the insulation resistance (see 4.11) and the dielectric strength (see 4.9), between all electrically separate terminations, exhibited by the socket is no less than the values declared for the relay.

4.6 Visual inspection and check of dimensions

4.6.1 Purpose

To ensure that the relay marking and the key dimensions are in compliance with the requirements specified for the relay, and that there are no visible mechanical defects.

4.6.2 Procedure

Unless otherwise specified, visual inspection shall be performed under normal factory lighting and visual conditions. External inspection and check of key dimensions shall be carried out as non-destructive tests.

Visual inspection shall include:

- a) correctness of marking (complete and legible);
- b) correctness of terminal identification;
- c) correct housing;
- d) absence of mechanical defects.

The relays (and their accessories, if applicable) shall be checked for conformity to the outline drawings, including creepage distances and clearances as specified.

4.6.3 Conditions to be specified

The conditions to be specified are the following:

- a) dimensions and tolerances, marking and terminals to be checked;
- b) minimum values of outside creepage distances and clearances to be checked;
- c) particular lighting and/or optical devices, if required;
- d) mechanical properties to be checked, and required results.

4.7 Mechanical tests and weighing

4.7.1 Purpose

To ensure that particular mechanical properties are within specified limits.

4.7.2 Procedure

The relay shall be weighed. Mechanical test procedures, if required (for example contact force, armature travel, contact gaps) shall be as specified for the relay.

4.7.3 Conditions to be specified

The conditions to be specified are the following:

- a) mechanical properties to be tested, methods of tests and required results;
- b) mass of the relay and tolerances.

4.8 Relay coil properties

4.8.1 Coil resistance

4.8.1.1 Purpose

To ensure that the d.c. resistance of the relay coil(s) is within the specified limits.

4.8.1.2 Procedure

The resistance shall be measured between the terminals of the relay. The method shall involve negligible temperature rise. The reference temperature shall be 23 °C unless otherwise specified.

4.8.1.3 Conditions to be specified

The conditions to be specified are the following:

- a) coil resistance limits;
- b) reference temperature, if other than 23 °C;
- c) temperature coefficient of the wire material, if other than electrolytic copper;
- d) any special precautions due to the presence of resistors, diodes, etc., in the coil circuit.

4.8.2 Coil inductance

4.8.2.1 Purpose

To ensure that the inductance of the relay coil(s) is within the specified limits.

4.8.2.2 Procedure

The coil inductance shall be measured with the armature both in open and closed position (for this purpose mechanical means will be adopted, when necessary, in order to keep the armature in a fixed position). The relay shall be mounted with no adjacent metal parts. Unless required, no preconditioning is applied to the relay coil.

Method 1 (a.c.): The coil inductance shall be measured in the rated energized condition of the relay. Unless otherwise prescribed, the a.c. voltage U applied for measurement shall be sinusoidal at a frequency f equal to the nominal frequency of the energizing quantity or, for d.c. relays, as specified. Coil resistance R (see 4.8.1) and current I are measured; then the coil inductance L is calculated applying the following formulas:

$$Z = UI; \quad Z^2 = R^2 + (2 \pi f L)^2$$

Method 2 (d.c.): The inductance shall be measured by determining the time constant t . The value of t is determined as the time necessary for reaching 63,21 % of the rated current I when the rated voltage U is applied to the coil. Then, the value L of the inductance is calculated applying the following formula:

$$L = R t$$

Method 3: Direct measurement with LCR meter at a frequency of 1 kHz and rated coil voltage, unless otherwise specified.

4.8.2.3 Conditions to be specified

The conditions to be specified are the following:

- a) method 1, 2 or 3;

- b) coil inductance limits;
- c) voltage of the applied a.c. or d.c. supply;
- d) frequency of the applied a.c. supply;
- e) rated energization value;
- f) any alternative procedure, if the above is not applicable.

4.8.3 Coil impedance and power consumption

4.8.3.1 Purpose

To ensure that the impedance of the relay coil(s) or the power consumption is within the specified limits.

4.8.3.2 Procedure

The relay shall be mounted with no adjacent metal parts.

Method 1: The coil impedance shall be measured in the non-energized and the rated energized condition of the relay. Unless otherwise prescribed, the a.c. voltage applied for measurement shall be sinusoidal at a frequency equal to the nominal frequency of the coil voltage or, for d.c. relays, as prescribed by the manufacturer.

When d.c. energization is to be superimposed in the winding during measurement, adequate means for isolation of the a.c. and d.c. circuits shall be provided.

Method 2: The power consumption (active power for d.c. or apparent power for a.c.) shall be measured in the rated energized condition of the relay or, for a relay the power consumption of which varies with the position of its moving parts, in the energized conditions as prescribed by the manufacturer.

4.8.3.3 Conditions to be specified

The conditions to be specified are the following:

- a) method 1 or 2;
- b) coil impedance or power consumption limits;
- c) rated value of the coil voltage or, with method 2, the values of the coil voltage;
- d) method 1: voltage of the applied a.c. supply and its frequency;
- e) any alternative procedures, if the above is not applicable.

4.8.4 Coil transient suppression test

4.8.4.1 Purpose

To verify that the back-e.m.f. (electromotive force) generated by the relay coil is not greater than the maximum specified induced transient voltage.

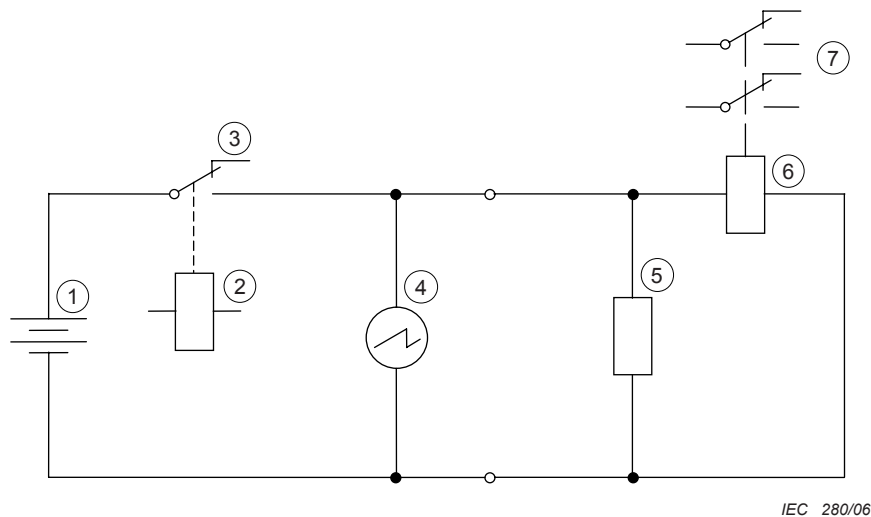
4.8.4.2 Procedure

The relay shall be connected to a test circuit (a typical example is shown in Figure 1) and energized at rated coil voltage. The switching relay is operated from a source voltage independent of the relay energizing source.

It is important that the energizing source is a low impedance source with no limiting resistor or potentiometer used to regulate the line voltage.

The switching relay shall be closed for a minimum of 10 times the operate time of the relay under test to allow the monitoring device (for example oscilloscope) and circuit-network to stabilize and then opened to obtain the induced voltage deflection trace. The cycling rate and duty factor of the relay shall be as specified by the manufacturer .

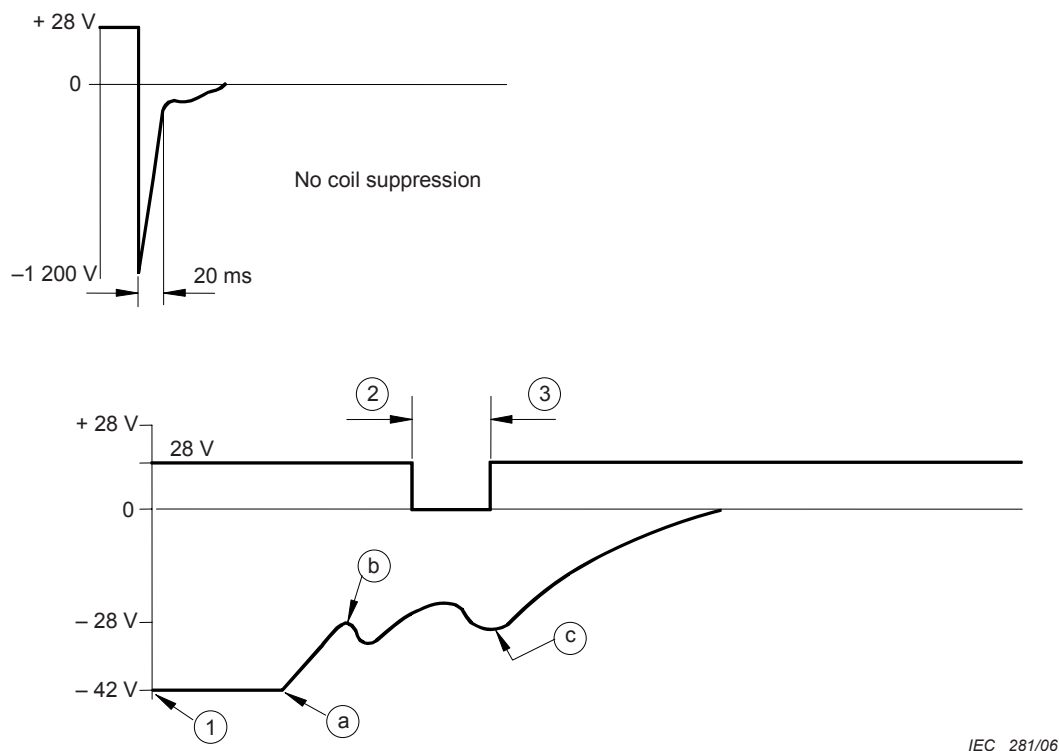
The reading shall be observed on the monitoring device. The magnitude of the induced transient voltage shall be noted. A typical oscilloscope trace is presented in Figure 2.



Key

- ① energization supply (low impedance)
- ② coil of the switching relay
- ③ contact of the switching relay (bounce free)
- ④ monitoring device (oscilloscope)
- ⑤ suppression circuit
- ⑥ coil of the relay under test
- ⑦ contacts of the relay under test

Figure 1 – Typical circuit for the measurement of coil transient suppression



Key

- ① switching relay contact opens
- ② test relay contact opens (break contact)
- ③ test relay contact closes (make contact)
- a cut off due to suppression component use
- b start armature movement
- c end armature movement

Figure 2 – Typical traces on an oscilloscope screen during transient voltage measurement

4.8.4.3 Conditions to be specified

The conditions to be specified are the following:

- a) rated coil voltage;
- b) cycling rate;
- c) duty factor;
- d) number of consecutive readings, if different from three;
- e) ambient temperature, if different from $(23 \pm 5) ^\circ\text{C}$;
- f) limits for back-e.m.f.

4.9 Dielectric strength test

4.9.1 Purpose

To ensure that the withstand capability of the insulation between specific circuits of the relay or across open contact(s) is sufficient.

4.9.2 Procedure

The test voltage specified for a circuit shall be applied to the respective relay terminals. The a.c. test voltage shall be of sinusoidal waveform having a frequency of 50 Hz or 60 Hz and may be substituted by a d.c. test voltage of a value equal to the peak value of the a.c. test voltage. Unless otherwise specified, the test voltage is applied for 1 min across the insulation or disconnection. An application time of 1 s is permissible, provided the test voltage value is increased to 110 % of the rated value. For even shorter periods, the manufacturer shall evaluate an appropriate value ensuring the same level of dielectric withstand capability. No flashover or breakdown shall occur. A current of not more than 3 mA is permitted.

NOTE 1 For relays, the following types of insulation are applicable: functional, basic and reinforced insulation. Micro-disconnection (covers also micro-interruption) and full-disconnection apply to relay contacts. See also 10.3 of IEC 61810-1.

NOTE 2 Values for a.c. and d.c. test voltages depending on the rated voltage of a circuit and the insulation or disconnection to be tested are given in Table 9 and Table 10 of IEC 61810-1.

The high-voltage transformer used for the test shall be designed so that, when the output terminals are short-circuited after the output voltage has been adjusted to the test voltage, the output current is at least 200 mA unless otherwise prescribed by the manufacturer. Care shall be taken that the r.m.s. value of the test voltage is measured within ± 3 %.

Special components which might render the test impractical such as light emitting diodes, free-wheeling diodes, varistors are disconnected at one pole, or bridged, or removed, as appropriate to the insulation being tested.

If prescribed, a relay in the new condition shall be subjected to the following preconditioning, unless other procedures and values are specified:

The preconditioning comprises the tests “dry heat” and “damp heat”.

The test dry heat is carried out in a heat chamber. The air temperature is maintained at 55 °C with an accuracy of ± 2 K in the area where the specimens are mounted. The specimens are kept in the chamber for 48 h.

The test damp heat is carried out in a climatic test cabinet at a relative humidity between 91 % and 95 %. The air temperature shall be maintained at 25 °C with an accuracy of ± 5 K in the area where the specimens are mounted. The specimens are kept in the chamber for 48 h. There shall be no condensation.

4.9.3 Conditions to be specified

The conditions to be specified are the following:

- a) terminals to which the test voltage shall be applied, selected from the following:
 - terminals of each contact circuit; break contacts shall be opened for this test,
 - all terminals requiring the same test voltage connected together and any exposed conductive part not intended to be electrically connected, the latter being simulated by a foil wrapped around relays having an insulating enclosure,
 - terminals of separate windings (bifilar or not),

- all coil terminals requiring the same test voltage connected together and all contact circuit terminals connected together,
 - terminals of separate contact circuits;
- b) test voltage or voltages;
- c) duration of the test: 1 s or 1 min;
- d) reductions for repetition tests, for example for final measurement after an endurance test. Reductions shall be specified together with such tests;
- e) details of the preconditioning, if prescribed.

4.10 Impulse voltage test

4.10.1 Purpose

To ensure that the relay withstands specified transient overvoltages.

4.10.2 Procedure

The impulse test voltage of peak value and waveform as specified shall be applied to the relevant parts of the relay as prescribed by the manufacturer. The standard waveform for the simulation of lightning overvoltages is characterized by a front time of 1,2 μ s and a time to half-value of 50 μ s. The test details are given in IEC 61180-1 and IEC 61180-2. Other waveforms and test setups may be specified.

NOTE The 10/700 μ s test impulse described in ITU-T Recommendation K.44 may be also relevant for telecom applications.

In any case, the output impedance of the impulse generator shall not be higher than 500 Ω .

The test shall be conducted for a minimum of three impulses of each polarity with an interval of at least 1 s between pulses.

A breakdown through solid insulation or a flashover is not permitted.

There shall be no flashover across an open contact, unless otherwise specified by the manufacturer. In this case the flashover shall not cause any permanent damage, and the output energy of the generator shall be specified.

If prescribed, a relay in the new condition shall be subjected to the following preconditioning, unless other procedures and values are specified:

The preconditioning comprises the tests “dry heat” and “damp heat”.

The test dry heat is carried out in a heat chamber. The air temperature is maintained at 55 °C with an accuracy of ± 2 K in the area where the specimens are mounted. The specimens are kept in the chamber for 48 h.

The test damp heat is carried out in a climatic test cabinet at a relative humidity between 91 % and 95 %. The air temperature shall be maintained at 25 °C with an accuracy of ± 5 K in the area where the specimens are mounted. The specimens are kept in the chamber for 48 h. There shall be no condensation.

4.10.3 Conditions to be specified

The conditions to be specified are the following:

- a) number of impulses, if other than three positive and three negative impulses;
- b) terminals to which the impulse test voltage is applied;
- c) waveform and generator characteristics (including output energy);

- d) peak value of the impulse voltage;
- e) details of preconditioning, if required;
- f) required test results and final measurements to verify compliance.

4.11 Insulation resistance

4.11.1 Purpose

To ensure that a sufficient electrical resistance is maintained between specified circuits of a relay.

4.11.2 Procedure

The d.c. measurement voltage shall be applied to the relevant parts of the relay as specified by the manufacturer. The value of that measurement voltage shall be 500 V unless otherwise prescribed. The resistance measurement shall be made at least 5 s after applying the voltage.

If prescribed, a relay in the new condition shall be subjected to the following preconditioning, unless other procedures and values are specified:

The preconditioning comprises the tests “dry heat” and “damp heat”.

The test dry heat is carried out in a heat chamber. The air temperature is maintained at 55 °C with an accuracy of ± 2 K in the area where the specimens are mounted. The specimens are kept in the chamber for 48 h.

The test damp heat is carried out in a climatic test cabinet at a relative humidity between 91 % and 95 %. The air temperature shall be maintained at 25 °C with an accuracy of ± 5 K in the area where the specimens are mounted. The specimens are kept in the chamber for 48 h. There shall be no condensation.

4.11.3 Conditions to be specified

The conditions to be specified are the following:

- a) terminals to which the test voltage shall be applied, selected from the following:
 - terminals of each contact circuit; break contacts shall be opened for this test,
 - all terminals requiring the same test voltage connected together and any exposed conductive part not intended to be electrically connected, the latter being simulated by a foil wrapped around relays having an insulating enclosure,
 - terminals of separate windings (bifilar or not),
 - all coil terminals requiring the same test voltage connected together and all contact circuit terminals connected together,
 - terminals of separate contact circuits;
- b) measurement voltage, if other than 500 V;
- c) time to steady-state reading;
- d) details of preconditioning, if required;
- e) minimum value(s) of insulation resistance(s).