

Specification for

Electrical relays of assessed quality: Generic data and methods of test

UDC 621.318.5:681.584.7

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Document Sharing Hub

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Electronic Components Standards Committee (ECL/-) to Technical Committee ECL/1 upon which the following bodies were represented:

- Association of Control Manufacturers (Tacma) (BEAMA)
- British Telecom
- Electronic Components Industry Federation
- Electronic Engineering Association
- Ministry of Defence
- National Supervising Inspectorate
- Telecommunication Engineering and Manufacturing Association (TEMA)

This British Standard, having been prepared under the direction of the Electronic Components Standards Committee, was published under the authority of the Board of BSI and comes into effect on 30 September 1983

© BSI 12-1999

The following BSI references relate to the work on this standard:
Committee reference ECL/1
Draft for comment 81/25027 DC

ISBN 0 580 13346 X

Amendments issued since publication

Amd. No.	Date of issue	Comments
4688	December 1984	Indicated by a sideline in the margin

Contents

	Page
Committees responsible	Inside front cover
Foreword	iii
Section 1. Principles and mandatory procedures	
1.1 General matters	1
1.1.1 Scope	1
1.1.2 Related documents	1
1.1.3 Terminology	1
1.1.4 Letters, symbols, signs and abbreviations	4
1.1.5 Graphical symbols	4
1.1.6 Marking of the component and package	4
1.1.7 Eligibility for qualification approval	4
1.1.8 Structurally similar components	4
1.1.9 Delayed delivery	5
1.1.10 Supplementary procedure for qualification approval	5
1.1.11 Certified test records (CTRs)	5
1.1.12 Preferred ratings and characteristics	5
1.1.13 Unchecked parameters	6
1.1.14 Procedure to be followed in the event of failures at Group C or Group D inspection	6
1.1.15 Instructions for ordering relays	6
1.1.16 Release prior to completion of Group B tests	6
1.2 Test procedures	6
1.2.1 Test and measurement conditions	6
1.2.2 Visual inspection	6
1.2.3 Dimensioning and gauging procedures	7
1.2.4 Electrical test procedures	7
1.2.5 Mechanical test procedures	21
1.2.6 Environmental test procedures	22
1.2.7 Endurance test procedures	31
1.2.8 Thermal test procedures	35
Section 2. General rules for the preparation of detail specifications	
2.1 General	35
2.2 Basic information	35
2.2.1 Originator of the specification	36
2.2.2 Specification number	36
2.2.3 Description of the component and intended application	36
2.2.4 Outline drawing	36
2.2.5 Ratings (including limiting conditions of use)	36
2.2.6 Characteristics	37
2.2.7 Related documents	37
2.2.8 Additional information (not for inspection purposes)	37
2.2.9 Instructions for ordering components	37
2.3 Inspection requirements	37
2.4 Certified test records	38
Appendix A List of rules documents	40
Appendix B Principles to be observed in the preparation of detail specifications when calling up related specifications	40
Appendix C Example of a certified test record	40

	Page
Figure 1006/1 — Typical circuit for the measurement of operate time and release time with typical voltage waveforms	12
Figure 1007/1 — Test circuit for the measurement of contact bounce	13
Figure 1007/2 — Typical recording of contact bounce	14
Figure 1010 — Mounting array for adjacent similar relays	15
Figure 1013 — Coil transient suppression test circuit	17
Figure 1014/1 — Typical voltage spike test arrangement	18
Figure 1014/2 — Unloaded spike generator waveform	19
Table 1 — Standard agents for fluid contamination tests	31
Table 2 — Major contaminant fluid groups and test temperatures	31

Foreword

This British Standard has been prepared under the direction of the Electronic Components Standards Committee. It supersedes BS 9150:1971, which is withdrawn. This revision incorporates technical changes to the previous text as well as new material, including new tests, in order to accommodate detail specifications covering a wider range of components.

This standard calls for the use of substances and/or test procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and in no way absolves anyone responsible for testing from statutory obligations relating to health or safety at any stage of manufacture or use.

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

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 43 and a back cover.

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

Section 1. Principles and mandatory procedures

1.1 General matters

1.1.1 Scope

This British Standard specifies the quality conformance and test procedures for electromechanical relays for control and switching circuits whose rated coil voltages do not exceed 500 V a.c. or 440 V d.c., and whose contact ratings do not exceed 20 A a.c. or d.c., 500 V a.c. or 440 V d.c. It is a generic specification in accordance with BS 9000 in conjunction with which it should be read. It also contains the general rules for the preparation of detail specifications, other requirements such as for marking, and lists relevant terminology.

NOTE More specific rules for the preparation of detail specifications are given in BS 9151, BS 9152 and BS 9153. (See Appendix A.)

1.1.2 Related documents

BS 308, *Engineering drawing practice*.

BS 2011, *Basic environmental testing procedures*.

BS 2045, *Preferred numbers*.

BS 3763, *The International System of units (SI)*.

BS 3939, *Graphical symbols for electrical power, telecommunications and electronics diagrams*.

BS 4000, *Sizes of papers and boards*.

BS 4727, *Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms*.

BS 5775, *Specification for quantities, units and symbols*.

BS 6001, *Sampling procedures and tables for inspection by attributes*.

BS 9000, *General requirements for electronic components of assessed quality*¹⁾.

BS 2G 100, *General requirements for electrical equipment and indicating instruments for aircraft*.

BS 3G 100, *General requirements for equipment in aircraft*.

BS CECC 16000:1980, *Generic specification: Electromechanical all-or-nothing relays*.

1.1.3 Terminology

For the purposes of this standard, the following terms and definitions apply in addition to the terms in BS 4727. Terms which are similar to terms contained in BS 4727-1:Group 03: Relay terminology are indicated by the corresponding term number.

1.1.3.1

type

relays having one of the following constructions

- a) unenclosed
- b) enclosed or dust protected
- c) hermetically sealed

1.1.3.2

pattern

relays of one type having one of the following contact duty categories:

- a) low-level duty: suitable for use in a low-level circuit;
- b) light duty: from a declared minimum up to and including 3 A;
- c) medium duty: above 3 A up to and including 10 A;
- d) heavy duty: above 10 A.

¹⁾ References to Part 1 of BS 9000 are to the 1981 edition.

1.1.3.3

style

relays of one type and one pattern having one of the following terminations

- a) solderable
- b) wrapped
- c) plug-in
- d) screw
- e) crimped
- f) push-on

1.1.3.4

range of style

relays having differing rated ranges within a style

1.1.3.5

pull-in (or operate) value (See 103 5501.)

the minimum value of coil voltage or current which will cause the relay to pull in or operate when this voltage or current is applied at a stated coil temperature

1.1.3.6

drop-out (or release) value (See 103 5502.)

the maximum value of coil voltage or current at which the relay will drop out (or release) when the voltage or current is reduced from a specified value, at a stated coil temperature

1.1.3.7

hold value

the minimum value of coil voltage or current which will hold the relay pulled in (or operated) when the value of coil voltage or current is reduced from a stated value at a stated coil temperature

1.1.3.8

non-operate value

the maximum value of coil current or voltage at a stated temperature which will not cause the contact circuit to be changed from the unenergized condition

1.1.3.9

release factor

the ratio expressed as a percentage of the drop-out (or release) value to the pull-in (or operate) value

1.1.3.10

contact force (See 103 1320.)

the force between contact points

1.1.3.11

contact chatter

a sustained rapid physical opening and closing of contact points caused by variation in the coil current or mechanical vibration or both

1.1.3.12

contact gap

the distance between specified contact points of a contact unit when the contact circuit is open under specified conditions

1.1.3.13

low-level circuit

a closed circuit that is completed through contact units, any one of which has a maximum open-circuit voltage of 10 mV and a maximum closed-circuit current of 10 mA, either a.c. or d.c.

1.1.3.14

conducting part

a part which is capable of conducting current although it may not necessarily be used for carrying circuit current

1.1.3.15**insulation voltage**

the specified voltage which the insulation of the relay will safely withstand continuously

1.1.3.16**pull-in or operate time** (See 103 3410.)

the interval of time between the application of a specified voltage and the first closing (or opening) of a specified contact circuit

1.1.3.17**drop-out or release time** (See 103 3411.)

the interval of time between the removal of a specified voltage or current within the rated range and the first opening (or closing) of a specified contact circuit

1.1.3.18**transit time** (See 103 1506.)

the interval of time during which both contact circuits of a break-before-make changeover contact unit are open

1.1.3.19**bridging (bunching) time**

the interval of time during which both contact circuits of a make-before-break changeover contact unit are closed

1.1.3.20**bounce time**

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

1.1.3.21**pull-in plus bounce time**

the total of pull-in time plus bounce time

1.1.3.22**drop-out plus bounce time**

the total of drop-out time plus bounce time

1.1.3.23**relay mounting arrangements**

the specified method of fixing or installing the relay

1.1.3.24**duty cycle**

the ratio of energization to the total period of intermittent duty. The duty cycle is often expressed as a percentage

1.1.3.25**continuous duty**

the duty in which the relay remains energized for a period long enough for the relay to reach thermal equilibrium

1.1.3.26**intermittent duty**

the duty in which the relay does not remain energized for a period long enough for the relay to reach thermal equilibrium. After switching cycles, a quasi-equilibrium may be reached

intermittent duty is specified in terms of the number of cycles per hour, and of the duty cycle

1.1.3.27**temporary duty**

the duty in which the relay remains energized for a period of insufficient length to reach thermal equilibrium, the energized periods being separated by unenergized periods of sufficient duration to restore the relay to ambient temperature

1.1.3.28**coil power (d.c.)**

the power which, when divided by the declared resistance of any coil variant and then square rooted gives the exact value of coil current, or which, when multiplied by the declared resistance of any coil variant and then square rooted gives the exact value of coil voltage

1.1.3.29**coil burden (a.c.)**

the burden which, when divided by the declared impedance of any coil variant and then square rooted gives the exact value of coil current, or which, when multiplied by the declared impedance of any coil variant and then square rooted gives the exact value of coil voltage

1.1.4 Letter symbols, signs and abbreviations

Letter symbols, signs and abbreviations shall, wherever possible, comply with BS 5775

1.1.5 Graphical symbols

Graphical symbols shall, wherever possible, comply with BS 3939.

1.1.6 Marking of the component and package

Each relay shall be clearly and indelibly marked with the following information, as space permits:

- a) number of the detail specification and code number;
- b) the manufacturer's factory code and date code;
- c) the rated value of coil voltage, or current, or resistance of coils, or relay type, or variants code;
- d) any special marking required by the detail specification;
- e) a terminal or circuit diagram;

The package shall be marked with the quantity in the package and the information listed above at a), b), c) and d).

1.1.7 Eligibility for qualification approval

The first stage of processing in accordance with 14.2 of BS 9000-1:1981 is the assembly of the mechanism to the contact units.

Where any relay contains components of a kind covered by another detail specification in the BS 9000 series (e.g. reed contact units) it is desirable (but not mandatory) that these should be released in accordance with BS 9000. Where any contained component is not so released the final manufacturer's chief inspector shall be satisfied that its quality is adequate by use of:

- a) a procurement specification, and
- b) approval tests, and
- c) incoming inspection procedure.

1.1.8 Structurally similar components

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

- a) coil, wire diameter and number of windings;
- b) types, numbers and material of contacts;
- c) rated coil and/or contact voltage(s);
- d) mounting and terminal variants;

altogether up to the limits prescribed in the detail specification.

If a detail specification covers variants a) to d), then the purchaser shall specify which variants he requires.

NOTE 1 Relays of the same style are regarded as structurally similar irrespective of whether they are designed for a.c. or d.c. operation.

NOTE 2 Samples for inspection purposes should be chosen so as to be representative of the relevant production lot. In the case of production lots covering structurally similar components the samples to be chosen should be representative of the extremes of the ranges in production during the sampling period.

1.1.9 Delayed delivery

Following manufacturer's acceptance inspection, components held for a period exceeding twelve months, unless a lesser period is specified in the detail specification, shall be re-inspected prior to release for the Group A inspection.

1.1.10 Supplementary procedure for qualification approval

The standard Qualification Approval procedure as given in clause 14 of BS 9000-1:1981 shall apply unless otherwise specified in the relevant rules document.

1.1.11 Certified test records (CTRs)

1.1.11.1 A summary of the results of the appropriate tests listed in Groups A, B, C and D tests shall be presented in a certified test record (CTR). The CTR is a requirement for relays of all assessment levels other than basic assessment.

1.1.11.2 Where the appropriate detail specification requires that attributes information is to be recorded in the CTR, the following procedures shall be used.

- a) When a subgroup comprises only one conditioning test the total number of rejections shall be recorded without referring to the parameter against which the rejection was made.
- b) When a subgroup comprises two or more conditioning tests the appropriate detail specification shall indicate whether the results are to be recorded for the individual tests or for the number of tests as a group.

An example of a CTR is given in Appendix B.

1.1.12 Preferred ratings and characteristics

1.1.12.1 Values characterizing duty (see 1.1.3.23). There are no specified values characterizing duty.

The following are the preferred values:

- a) number of operations per hour:
6, 30, 150, 1 200, 3 600, 7 200, 9 000, 18 000, 36 000, 180 000, 360 000.
- b) duty cycle:
15 %, 25 %, 33 %, 40 %, 50 %, 60 % and 100 %.

1.1.12.2 Rated voltages. The preferred rated voltages are:

- a) For alternating current relays:
0.01, 0.03, 0.1, 1.5, 12, 24, 48, 57, 60, 63, 100, 115, 127, 200, 220, 240, 380 and 415 V r.m.s.
The frequency of the supply shall be as stated in the detail specifications.
- b) For direct current relays:
0.01, 0.1, 6, 12, 18, 24, 26.5, 28, 48, 60, 80, 110, 125, 200, 220, 250 and 440 V.

1.1.12.3 Climatic category. For the purposes of both steady state and cyclic climatic tests, selection should be made wherever possible from the following preferred values of upper and lower ambient temperatures.

- a) The preferred values of upper ambient temperatures are:
+ 200, + 155, + 125, + 100, + 85, + 70, + 55, + 40 and + 30 °C.
- b) The preferred values of lower ambient temperatures are:
– 65, – 55, – 40, – 25, – 10 and – 5 °C.

The preferred values of time of exposure to damp heat, steady state, together with the number of cycles of exposure to damp heat, cyclic tests, are in accordance with the values given in BS 2011-2.1Ca:1977 and BS 2011-2.1Da:1977. The climatic classification of relays shall be expressed in accordance with BS 2011 by indicating the two extremes of temperature together with the damp heat class for which they are suitable. The lower extreme of temperature (lower category temperature) shall be indicated first, followed by the upper extreme of temperature (upper category temperature) and then the time of damp heat, steady state, in that order. For example, a relay that satisfactorily meets dry cold tests at – 65 °C, dry heat at + 125 °C and six cycles of damp heat cyclic, and 56 days of damp heat, steady state, will be classed as 65/125/56. (See Appendix A to BS 2011-1.1:1983.)

Preferred environmental categories are as follows:

65/155/56, 65/125/56, 40/100/56, 40/085/56, 40/070/21 and 25/070/04.

1.1.13 Unchecked parameters

The manufacturer may quote additional parameters to those given in the relevant rules for the preparation of detail specifications in the series of BS 9151 to BS 9199. If quoted, these parameters shall not be used for inspection purposes; therefore their accuracy cannot be guaranteed.

1.1.14 Procedure to be followed in the event of failures at Group C or Group D inspection

The procedures listed in 20.1 b) of BS 9000-1:1981 shall apply.

1.1.15 Instructions for ordering relays

When ordering relays, the following information shall be given:

- a) quantity;
- b) the BS number of the detail specification, and its issue status;
- c) the coding allocated for contact variant, coil variant, mounting variant including earthed or unearthed, and termination variant including finish as applicable.

This information shall be in accordance with the data given in the detail specification.

1.1.16 Release prior to completion of group B tests

When the conditions of BS 6001 for reduced inspection (see 17.4.4 of BS 9000-1:1981) have been satisfied for all group B tests, the manufacturer is permitted to release components before the completion of such tests.

1.2 Test procedures

NOTE Health and safety. Test procedures call for the use of substances and test procedures that may be injurious to health if adequate precautions are not taken. They refer only to technical suitability and in no way absolve anyone responsible for testing from statutory obligations to health and safety at any stage of the testing. Particular attention is drawn to the following hazards, the list of which is not exhaustive:

- a) electrical shock;
- b) high and low surface temperatures;
- c) security of mounting during vibration, centrifuge, shock and bump testing;
- d) inflammable and toxic materials specified in fluid contamination tests.

1.2.1 Test and measurement conditions

1.2.1.1 Unless otherwise required by the appropriate rules document (or blank detail specification), all tests shall either be carried out in the standard atmospheric conditions for testing as specified in BS 2011-1.1:1980 or their results be corrected to correspond to those conditions.

1.2.1.2 Unless explicitly permitted by the detail specification, contacts and/or other parts shall not be cleaned or adjusted prior to submission to a test.

1.2.1.3 Where mounting is required for a particular test, the relay shall be mounted by fixing arrangements provided on the relay housing unless otherwise specified by the detail specification. In the case of plug-in relays, such relays shall be tested with the specified sockets as a combined device and any specified retainers shall be used.

1.2.1.4 Unless otherwise specified in the detail specification, where a series of tests in a given subgroup is followed by "final measurements", which consist of at least an aggregate of the post-test end-points from the individual tests in that subgroup, it is not necessary to carry out these post-test end-points after the individual tests.

1.2.2 Visual inspection

Unless otherwise specified in the detail specification, inspection shall be performed under approved factory lighting and normal visual conditions.

Inspection shall be made to detect the following faults:

- a) incorrectness of marking;
- b) incorrectness of terminal identification
- c) incorrect housing;

d) physical defects, as specified in the detail specification, for example:

- 1) incorrect assemblies or sub-assemblies such that the relay does not function;
- 2) unsoldered connections;
- 3) hazardous loose particle;
- 4) missing finish or flaking plating;
- 5) illegibility of relay code number;
- 6) missing contact (one of any twin contact in the relay);
- 7) taut winding wire at the coil termination;
- 8) hazardous loose turns;
- 9) corrosion;
- 10) contact not set (only one contact of a pair of twin contacts making in either the fully operated on rated current or released condition);
- 11) contact misaligned by greater than one-third of the contact width, as judged by the eye.

1.2.3 Dimensioning and gauging procedures

1.2.3.1 Outline dimensions. The relays shall be measured for compliance with the outline drawings given in the appropriate detail specification.

1.2.3.2 Dimensions and material of associated piece parts. Where the detail specification requires accessories or piece parts such as mounting brackets to be supplied, these shall be supplied with the relay for release in accordance with the detail specification. Such parts shall be inspected in accordance with the detail specification.

NOTE Replacement parts may be available separately from the supplier.

1.2.3.3 Mass. Where specified in the detail specification, the component shall be weighed. The mass shall not be greater than the maximum specified in the detail specification.

1.2.4 Electrical test procedures

1.2.4.1 The following electrical test procedures are given on separate pages to facilitate revision.

- 1001 D.C. coil resistance
- 1002 Voltage proof
- 1003 Insulation resistance
- 1004 Contact-circuit resistance (or voltage drop)
- 1005 Performance characteristics
- 1006 Timing tests: d.c. relays only
- 1007 Contact bounce time: d.c. relays only
- 1008 Contact sticking
- 1009 Capacitance (low capacitance relays only)
- 1010 Magnetic interference (adjacent similar relays)
- 1011 Radio interference
- 1012 Magnetic influence (compass safe distance)
- 1013 Exported spikes (transient voltage)
- 1014 Imported spikes (transient voltage)
- 1015 Combined contact timing and bounce time tests: d.c. relays only
- 1016 Contact dynamic sequencing
- 1017 Clamp diode test

1.2.4.2 The following electrical tests, whose procedures are given in BS CECC 16000:1980, are also relevant:

Test	BS CECC 16000:1980 clause No.
1) Coil inductance	5.8.2
2) Coil impedance	5.8.3
3) Impulse voltage test	5.10 (see note 1)
4) Extended assessment (of contact performance)	5.30.6 (see note 2)
5) Limiting continuous current	5.33
6) Load transfer (3-phase)	5.35
7) Electrical contact noise	5.39
8) Thermo-electric e.m.f.	5.40
9) Magnetic remanence	5.43
10) Continuity of protective earth connection	5.45

NOTE 1 Reference is made to IEC Publication 255-5, with which BS 5992-3:1980 is identical.

NOTE 2 Reference is made to IEC Publication 255-0-20, with which BS 5992-1 is identical.

1001

D.C. resistance of coil assembly

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

Procedure. The resistance shall be measured between the terminations of the relay coil. The method shall involve negligible temperature rise. The reference temperature shall be 20 °C unless otherwise specified in the detail specification.

Conditions to be specified in the detail specification

- Coil resistance limits.
- Reference temperature, if other than 20 °C.
- The suffix “s” to be added to the coil variants with internal suppression.

1002

Voltage proof

Procedure. The test voltage specified in the detail specification, which should normally be taken from the values given in the table below, shall be applied to the following test points as specified in the detail specification.

- Terminations of each contact circuit. Break contacts shall be open for this test.
- All terminations connected together and any exposed metal parts not intended to be electrically connected.
- Terminations of separate windings.
- All coil terminations connected together and all contact unit terminations connected together.
- Terminations of separate contact units.
- Terminations of bifilar windings.
- All terminations of each contact circuit connected together and any exposed metal parts not intended to be electrically connected.
- All coil terminations connected together and any exposed metal parts not intended to be electrically connected.

Test points	Rated voltage	Test voltage	
		a.c. r.m.s.	d.c.
	V	V	V
b), c), d), e), g) or h)	{ 115 or less Above 115, up to 250 Above 250, up to 500	500 1 000 2 000	700 1 400 2 840
a) or f)	To be specified in the detail specification		

During the test, the test voltage shall be increased by 10 % if a period of 1 s is selected.

The tests shall be made with alternating voltage having effectively sinusoidal waveform and at the rated frequency (50 Hz or 60 Hz), or with direct voltage at the manufacturer's discretion for the duration specified in the detail specification.

- 1) Each group shall be tested at the specified test voltage in relation to all the other groups connected together.
- 2) Each circuit shall be tested at the specified test voltage in relation to all other circuits (of any group) connected together.

During the tests 1) or 2) there shall be no breakdown or flashover and the leakage current shall not exceed the value specified in the detail specification, where applicable.

Conditions to be specified in the detail specification

- a) Test duration: preferred values 1 s and 1 min.
- b) Test voltage.
- c) Maximum leakage current, if applicable.
- d) Terminations to which the test voltage is to be applied.

1003

Insulation resistance

Procedure. The insulation test voltage shall be applied between:

- a) Terminations of each contact circuit. Break contacts shall be opened for this test.
- b) All terminations connected together and any exposed metal part not intended to be electrically connected.
- c) Terminations of separate windings.
- d) All coil terminations connected together and all contact unit terminations connected together.
- e) Terminations of separate contact units.

The voltage shall be applied for 1 min, or for such time as is necessary to obtain a stable reading, the insulation resistance being read at the end of that period.

Conditions to be specified in the detail specification

- a) D.C. voltage level.
- b) Minimum value of insulation resistance.

1004

Contact-circuit resistance (or voltage drop)

Procedure. The resistance shall be measured using a 4-terminal bridge or by the voltmeter-ammeter method or, particularly for dynamic tests, using automatic monitoring equipment, and shall not exceed the value specified in the detail specification.