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*[Incorporating Amendment No. 1]*

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British Standard

# Harmonized system of quality assessment for electronic components. Fixed resistors for use in electronic equipment

## Part 0. Generic specification

[IEC title. Fixed resistors for use in electronic equipment.

Part 1: Generic specification]

Système harmonisé d'assurance de la qualité des composants électroniques.

Résistances fixes utilisés dans les équipements électroniques

Partie 0. Spécification générique

Harmonisiertes Gütebestätigungssystem für Bauelemente der Elektronik.

Spezifikation für Festwiderstände für die Anwendung in elektronischen Geräten

Teil 0. Fachgrundspezifikation

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## National foreword

This Part of this British Standard has been prepared under the direction of the Electronic Components Standards Committee. It is identical with IEC Publication 115-1 [QC 400000] 'Fixed resistors for use in electronic equipment. Part 1 : Generic specification', published in 1982 by the International Electrotechnical Commission (IEC) and incorporates Amendment No. 1 published in 1983.

This standard is a harmonized specification within the IECQ system of quality assessment for electronic components.

**Terminology and conventions.** The text of the international standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards.

NOTE. Page numbers referred to in the text are IEC page numbers.

## Cross references

The British Standard harmonized with QC 001001 and QC 001002 is BS 9000 'General requirements for a system for electronic components of assessed quality' Part 1 : 1981 'Specification for basic rules and procedures'.

| International standard | Corresponding British Standard                                                                                                                                             |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ISO 3-1973             | BS 2045 : 1965 Preferred numbers<br>(Technically equivalent)                                                                                                               |
| ISO 497-1973           |                                                                                                                                                                            |
| ISO 1000-1981          | BS 5555 : 1981 Specification for SI units and recommendations for the use of their multiples and of certain other units<br>(Identical)                                     |
| IEC 62 : 1974          | BS 1852 : 1975 Marking codes for resistors and capacitors<br>(Identical)                                                                                                   |
| IEC 63 : 1963          | BS 2488 : 1966 Schedule of preferred numbers for the resistance of resistors and the capacitance of capacitors for telecommunication equipment<br>(Technically equivalent) |
| IEC 68                 | BS 2011 Basic environmental testing procedures                                                                                                                             |
| IEC 68-1 : 1978*       | Part 1.1 : 1980 General<br>(Identical)                                                                                                                                     |
| IEC 68-2-1 : 1974      | Part 2.1A : 1977 Test A. Cold<br>(Identical)                                                                                                                               |
| IEC 68-2-2 : 1974      | Part 2.1B : 1977 Test B. Dry heat<br>(Identical)                                                                                                                           |
| IEC 68-2-3 : 1969      | Part 2.1Ca : 1977 Test Ca. Damp heat, steady state<br>(Identical)                                                                                                          |
| IEC 68-2-6 : 1982      | Part 2.1Fc : 1983 Test Fc. Vibration (sinusoidal)<br>(Identical)                                                                                                           |
| IEC 68-2-13 : 1966     | Part 2.1M : 1977 Test M. Low air pressure<br>(Identical)                                                                                                                   |
| IEC 68-2-14 : 1974     | Part 2.1N : 1977 Test N. Change of temperature<br>(Identical)                                                                                                              |
| IEC 68-2-20 : 1979     | Part 2.1T : 1981 Test T. Soldering<br>(Identical)                                                                                                                          |
| IEC 68-2-21 : 1975     | Part 2.1U : 1977 Test U. Robustness of terminations and integral mounting devices                                                                                          |
| IEC 68-2-27 : 1972     | Part 2.1Ea : 1977 Test Ea. Shock<br>(Identical)                                                                                                                            |
| IEC 68-2-29 : 1968     | Part 2.1Eb : 1977 Test Eb. Bump<br>(Identical)                                                                                                                             |
| IEC 68-2-30 : 1980     | Part 2.1Db : 1981 Tests Db and guidance. Damp heat cyclic (12+12 hour cycle)<br>(Identical)                                                                                |
| IEC 195 : 1965         | BS 4119 : 1967 Method of measurement of current noise generated in fixed resistors<br>(Technically equivalent)                                                             |
| IEC 294 : 1969         | BS 5692 : 1979 Method for measurement of the dimensions of a cylindrical electronic component having two axial terminations<br>(Identical)                                 |
| IEC 410 : 1973         | BS 6001 : 1972 Sampling procedures and tables for inspection by attributes<br>(Technically equivalent)                                                                     |
| IEC 440 : 1973         | BS 5694 : 1979 Method of measurement of non-linearity in resistors<br>(Identical)                                                                                          |

\*Now superseded by IEC 68-1 : 1982, the corresponding identical British Standard for which is BS 2011 : Part 1.1 : 1980 'General and guidance'.

There are no corresponding British Standards for IEC 27-1 : 1971, IEC 50 and IEC 117, which are all referred in in clause 2. As the standards are referred to for information only, the validity of this British Standard is not affected.

British Standards related to IEC 27-1 : 1971, IEC 50 and IEC 117 are, respectively, BS 1991 'Letter symbols, signs and abbreviations' Part 6 : 1975 'Electrical science and engineering'; BS 4727 'Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms; and BS 3939 'Graphical symbols for electrical power, telecommunications and electronics diagrams'.

**Textual error.** When adopting the text of the international standard, the textual error given below was discovered. It has been marked in the text and has been reported to the International Electrotechnical Commission in a proposal to amend the text of the international standard.

In 4.26 the figure number should be FIG. 4 not FIG. 1.

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

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British Standard

# Harmonized system of quality assessment for electronic components. Fixed resistors for use in electronic equipment

## Part 0. Generic specification

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### SECTION ONE — SCOPE

#### 1. Scope

This standard is applicable to fixed resistors for use in electronic equipment.

It establishes standard terms, inspection procedures and methods of test for use in sectional and detail specifications for qualification approval and for quality assessment systems for electronic components.

### SECTION TWO — GENERAL

#### 2. General

##### 2.1 *Related documents*

###### *IEC Publications*

|                                |                                                                      |
|--------------------------------|----------------------------------------------------------------------|
| Publication 27-1:<br>(1971)    | Letter Symbols to be Used in Electrical Technology. Part 1: General. |
| Publication 50:                | International Electrotechnical Vocabulary (I.E.V.).                  |
| Publication 62:<br>(1974)      | Marking Codes for Resistors and Capacitors.                          |
| Publication 63:<br>(1963)      | Preferred Number Series for Resistors and Capacitors.                |
|                                | Amendment No. 1: (1967)                                              |
|                                | Amendment No. 2: (1977)                                              |
| Publication 68:                | Basic Environmental Testing Procedures.                              |
| Publication 68-1:<br>(1978)    | Part 1: General.                                                     |
| Publication 68-2-1:<br>(1974)  | Tests A: Cold.                                                       |
| Publication 68-2-1A:<br>(1976) | First supplement.                                                    |
| Publication 68-2-2:<br>(1974)  | Tests B: Dry Heat.                                                   |
| Publication 68-2-2A:<br>(1976) | First supplement.                                                    |
| Publication 68-2-3:<br>(1969)  | Test Ca: Damp Heat, Steady State.                                    |

|                                 |                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------|
| Publication 68-2-6:<br>(1970)   | Test Fc: Vibration (Sinusoidal).<br><br>Amendment No. 1: (1972)                              |
| Publication 68-2-13:<br>(1966)  | Test M: Low Air Pressure.                                                                    |
| Publication 68-2-14:<br>(1974)  | Test N: Change of Temperature.                                                               |
| Publication 68-2-20:<br>(1968)  | Test T: Soldering.                                                                           |
| Publication 68-2-20A:<br>(1970) | First Supplement: Test Tb: Resistance to Soldering Heat, Method 1.                           |
| Publication 68-2-21:<br>(1975)  | Test U: Robustness of Terminations and Integral Mounting Devices.<br>Amendment No. 1: (1979) |
| Publication 68-2-27:<br>(1972)  | Test Ea: Shock.                                                                              |
| Publication 68-2-29:<br>(1968)  | Test Eb: Bump.                                                                               |
| Publication 68-2-30:<br>(1969)  | Test Db: Damp Heat, Cyclic (12+12-hour Cycle).                                               |
| Publication 117:                | Recommended Graphical Symbols.                                                               |
| Publication 195:<br>(1965)      | Method of Measurement of Current Noise Generated in Fixed Resistors.                         |
| Publication 294:<br>(1969)      | Measurement of the Dimensions of a Cylindrical Component having Two Axial Terminations.      |
| Publication 410:<br>(1973)      | Sampling Plans and Procedures for Inspection by Attributes.                                  |
| Publication 440:<br>(1973)      | Method of Measurement of Non-linearity in Resistors.                                         |

Publication QC 001001 (1981): Basic Rules of the IEC Quality Assessment System for Components (IECQ).

Publication QC 001002 (1981): Rules of Procedure of the IEC Quality Assessment System for Electronic Components (IECQ).

#### *ISO publications*

|                              |                                                                                                                       |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| ISO Standard 3:<br>(1973)    | Preferred Numbers — Series of Preferred Numbers.                                                                      |
| ISO Standard 497:<br>(1973)  | Guide to the Choice of Series of Preferred Numbers and of Series Containing more Rounded Values of Preferred Numbers. |
| ISO Standard 1000:<br>(1973) | SI Units and Recommendations for the Use of their Multiples and of Certain Other Units.                               |

*Note.* — The above references apply to the current editions, except for IEC Publication 68 for which the referenced edition must be used.

## 2.2 *Units, symbols and terminology*

### 2.2.1 *General*

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

IEC Publication 27  
IEC Publication 117  
IEC Publication 50  
ISO Standard 1000

When further items are required they shall be derived in accordance with the principles of the documents listed above.

### 2.2.2 *Type*

A group of components having similar design features and the similarity of whose manufacturing techniques enables them to be grouped together either for qualification approval or for quality conformance inspection.

They are generally covered by a single detail specification.

*Note.* — Components described in several detail specifications may, in some cases, be considered as belonging to the same type and may therefore be grouped together for qualification approval and quality conformance inspection.

### 2.2.3 *Style*

A sub-division of a type, generally based on dimensional factors.

A style may include several variants, generally of a mechanical order.

### 2.2.4 *Grade*

A term to indicate additional general characteristics concerning the intended application e.g. long life applications.

The term “grade” may be used only in combination with one or more words (e.g. long life grade) and not by a single letter or number.

Figures to be added after the term “grade” should be arabic numerals.

### 2.2.5 *Family (of electronic components)*

A group of electronic components which predominantly displays a particular physical attribute and/or fulfils a defined function.

### 2.2.6 *Sub-family (of electronic components)*

A group of components within a family manufactured by similar technological methods.

### 2.2.7 *Rated resistance*

The resistance value for which the resistor has been designed, and which is generally indicated upon the resistor.

### 2.2.8 *Critical resistance*

The resistance value at which the rated voltage is equal to the limiting element voltage (see Sub-clauses 2.2.15 and 2.2.16).

At an ambient temperature of 70 °C, the maximum voltage which may be applied across the terminations of a resistor is either the calculated rated voltage, if the resistance is less than the critical resistance, or the limiting element voltage if the resistance is equal to or greater than the critical resistance. At temperatures other than 70 °C, account shall be taken of the derating curve and the limiting element voltage in the calculation of any voltage to be applied.

### 2.2.9 *Category temperature range*

The range of ambient temperatures for which the resistor is designed to operate continuously; this is defined by the temperature limits of its appropriate category.

### 2.2.10 *Upper category temperature*

The maximum ambient temperatures for which a resistor has been designed to operate continuously at that portion of the rated dissipation which is indicated in the category dissipation.

### 2.2.11 *Lower category temperature*

The minimum ambient temperature at which a resistor has been designed to operate continuously.

### 2.2.12 *Maximum surface temperature*

The maximum temperature permitted on the surface for any resistor of that type when operated continuously at rated dissipation at an ambient temperature of 70 °C.

### 2.2.13 *Rated dissipation*

The maximum allowable dissipation at an ambient temperature of 70 °C under the conditions of the endurance test at 70 °C and for which the permitted change in resistance for this endurance test is not exceeded.

### 2.2.14 *Category dissipation*

A fraction of the rated dissipation exactly defined in the detail specification, applicable at the upper category temperature, taking account of the derating curve prescribed in the detail specification.

*Note.* — The category dissipation may be zero.

### 2.2.15 *Rated voltage ( $U_N$ or $U_R$ )*

The d.c. or a.c. r.m.s. voltage calculated from the square root of the product of the rated resistance and the rated dissipation.

*Note.* — At high values of resistance the rated voltage may not be applicable because of the size and the construction of the resistor (see Sub-clause 2.2.16).

### 2.2.16 Limiting element voltage

The maximum d.c. or a.c. r.m.s. voltage that may be continuously applied to the terminations of a resistor (it is generally dependent upon size and manufacturing technology of the resistor).

Where the term "a.c. r.m.s. voltage" is used in this standard, the peak voltage shall not exceed 1.42 times the r.m.s. value.

*Note.* — This voltage shall only be applied to resistors when the resistance value is equal to or higher than the critical resistance value.

### 2.2.17 Isolation voltage (applicable only to insulated resistors)

The maximum peak voltage which may be applied under continuous operating conditions between the resistor terminations and any conducting mounting surface.

### 2.2.18 Insulated resistor

A resistor which fulfils the voltage proof and insulation resistance test requirements and the damp heat, steady-state test with a polarizing voltage applied when mounted on a metal plate.

### 2.2.19 Insulation resistance

Under consideration.

### 2.2.20 Variation of resistance with temperature

Variation of resistance with temperature can be expressed either as temperature characteristic or as temperature coefficient as defined below:

#### 2.2.20.1 Temperature characteristic of resistance

The maximum reversible variation of resistance produced over a given temperature range within the category temperatures. It is normally expressed as a percentage of the resistance related to a reference temperature of 20 °C.

Temperature characteristic of resistance =  $\frac{\Delta R}{R}$ , where:

$\Delta R$  is the change in resistance between the two specified ambient temperatures.

$R$  is the resistance value at the reference temperature.

#### 2.2.20.2 Temperature coefficient of resistance ( $\alpha$ )

The relative variation of resistance between two given temperatures (mean coefficient), divided by the difference in temperature producing it. It is normally expressed in parts per million per degree Celsius ( $10^{-6}/^{\circ}\text{C}$ ).

$$\alpha = \frac{R_2 - R_1}{R_1 \cdot \Delta\theta}$$

where:

$\Delta\theta$  is the algebraic difference, in degrees Celsius, between the specified ambient temperature and the reference temperature (for calculation see Sub-clause 4.8.4).

*Note.* — It should be noted that use of the term does not imply any degree of linearity for this function, nor should any be assumed.

### 2.2.21 *Visible damage*

Visible damage which reduces the usability of the resistor for its intended purpose.

## 2.3 *Preferred values*

### 2.3.1 *General*

Each sectional specification shall prescribe the preferred values appropriate to the sub-family; for rated resistance see also Sub-clause 2.3.2.

### 2.3.2 *Preferred values of rated resistance*

The preferred values of rated resistance shall be taken from the series specified in IEC Publication 63.

## 2.4 *Marking*

### 2.4.1 *General*

2.4.1.1 The information given in the marking is normally selected from the following list; the relative importance of each item is indicated by its position in the list:

- a) rated resistance.
- b) tolerance on rated resistance.
- c) year and month (or week) of manufacture.
- d) number of the detail specification and style reference.
- e) manufacturer's name or trade mark.

2.4.1.2 The resistor shall be clearly marked with *a)* and *b)* above and with as many of the remaining items as is practicable. Any duplication of information in the marking on the resistor should be avoided.

2.4.1.3 The package containing the resistor(s) shall be clearly marked with all the information listed above.

2.4.1.4 Any additional marking shall be so applied that no confusion can arise.

### 2.4.2 *Coding*

When coding is used for resistance value, tolerance or date of manufacture, the method shall be selected from those given in IEC Publication 62.

## SECTION THREE — QUALITY ASSESSMENT PROCEDURES

## 3. Quality assessment procedures

3.1 *Qualification Approval/Quality Assessment Systems*

3.1.1 For a full Quality Assessment System the procedures of Sub-clauses 3.4 and 3.5 shall be followed.

3.1.2 For Qualification Approval without Quality Conformance Inspection (type testing only), the procedures and requirements of Sub-clauses 3.4.1 and 3.4.2b) may be used as appropriate, but in any case tests and parts of tests shall be applied in the order given in the test schedules.

3.2 *Primary Stage of Manufacture*

For fixed resistor specifications, the primary stage of manufacture is:

- For film types: the deposition of the resistive film on the substrate.
- For carbon composition types: the process which produces the greatest change in polymerization of the binder.
- For wirewound types: the winding of the resistance wire (or ribbon) on the former.
- For metal foil resistors: the fixing of the resistive foil on the substrate.

3.3 *Structurally Similar Components*

Resistors considered as being structurally similar are resistors produced with similar processes and materials, though they may be of different sizes and values. The grouping of structurally similar components for the purpose of qualification approval and quality conformance inspection shall be prescribed in the sectional specification.

3.4 *Qualification Approval Procedures*

3.4.1 The manufacturer shall comply with:

- the general requirements of the rules of procedure governing qualification approval;
- the requirements for the primary stage of manufacture which is defined in Sub-clause 3.2 of this standard.

3.4.2 In addition to the requirements of Sub-clause 3.4.1 procedures *a)* or *b)* below shall apply:

- a)* The manufacturer shall produce test evidence of conformance to the specification requirements on three inspection lots for lot-by-lot inspection taken in as short a time as possible and one lot for periodic inspection. No major changes in the manufacturing process shall be made in the period during which the inspection lots are taken.

Samples shall be taken from the lots in accordance with IEC Publication 410 (see Appendix A). The sample shall contain the highest and lowest resistance values represented in the lot and a critical value when this value falls between such high and low values. The highest and lowest resistance values so selected shall define the resistance range for which qualification approval is granted.

Normal inspection shall be used, but when the sample size would give acceptance on zero defectives, additional specimens shall be taken to meet the sample size required to give acceptance on one defective.

- b) The manufacturer shall produce test evidence to show conformance to the specification requirements on the fixed sample size test schedule given in the sectional specification.

The specimens taken from the sample shall be selected at random from current production or as agreed with the National Supervising Inspectorate.

- 3.4.3 Qualification Approval obtained as part of a Quality Assessment System shall be maintained by regular demonstration of compliance with the requirements for Quality Conformance (see Sub-clause 3.5). Otherwise this qualification approval must be verified by the rules for the maintenance of Qualification Approval given in the Rules of Procedure for the IEC Quality Assessment System for Electronic Components (IECQ) (IEC Publication QC 001002, Sub-clauses 11.5.2 and 11.5.3).

### 3.5 *Quality Conformance Inspection*

The blank detail specification(s) associated with a sectional specification shall prescribe the test schedule for Quality Conformance Inspection.

This schedule shall also specify the grouping, sampling and periodicity for the lot-by-lot and periodic inspection.

Inspection Levels and AQL's shall be selected from those given in IEC Publication 410.

If required, more than one schedule may be specified.

#### 3.5.1 *Certified Records of Released Lots*

When certified records of released lots are prescribed in the relevant specification and are requested by a purchaser, the following information shall be given as a minimum:

- attributes information (i.e. number of components tested and numbers of defective components) for tests in the sub-groups covered by periodic inspection without reference to the parameter(s) for which rejection was made.
- variables information for the change in resistance after the 1000 h endurance test.

##### 3.5.1.1 *Attributes information*

When the relevant detail specification requires that attributes information shall be recorded, the following procedures shall be used:

- 1) When a sub-group comprises a single conditioning test, the total number of rejected resistors shall be recorded together with the test in which the failures occurred but without reference to the parameters for which the rejection was made.
- 2) When a sub-group comprises a number of conditioning tests, the relevant detail specification shall state whether the results shall be recorded for the individual conditioning tests or for a number of them as a group. For the purposes of this specification, the climatic sequence shall be deemed to form a single conditioning test.